ORIGINAL RESEARCH

Application of Visual Management in Enhancing Work Quality within the Central Sterile Supply Department

Caixin Yuan, MD; Xiaoxue Yang, MD

ABSTRACT

Objective • This study aims to investigate the implementation of visual management in the central sterile supply department, focusing on enhancing work efficiency, improving work quality, reducing errors and accidents, and elevating the satisfaction levels of clinical departments.

Methods • Visual flow diagrams were carefully developed and classified by a dedicated team from July to August 2021, led by an established visual management team. Subsequently, department staff underwent organized training sessions to understand the concepts, requirements, and contents of these visual management flow diagrams through a related examination. The application of visual flow diagrams extended to instruments and equipment, infection control, and instrument package management. To assess the impact, a control group comprising 400 pieces of instruments used in the operating room and clinical practice in June 2021 and an observation group with 400 pieces for surgical instruments and clinical use in October 2021 were selected using a convenience sampling method. The study analyzed and compared the qualified rate of instrument cleaning, the qualified rate of instrument packaging, and clinical satisfaction between the two groups.

Results • The device qualified rates for instrument cleaning in the observation and control groups were 99% and 95%, respectively; for instrument packaging, they were 96% and 92%. Clinical satisfaction rates were 99% and 90%, respectively. These findings indicate an improved qualified rate for instrument cleaning, instrument packaging, and clinical satisfaction in the observation group compared to the control group before the implementation of visual management, with statistically significant differences ($P = .000$).

Conclusions • The application of visual flow diagrams has a significant positive impact on the work quality in the central sterile supply department and enhances clinical work satisfaction. This approach is deemed suitable for broader promotion. (*Altern Ther Health Med.* [E-pub ahead of print.])

Caixin Yuan, MD; **Xiaoxue Yang**, MD, Department of Hematology; Fourth Hospital of Hebei Medical University; Shijiazhuang City, Hebei Province; China.

Corresponding author: Xiaoxue Yang, MD
E-mail: sjzycx_1997@163.com

INTRODUCTION

Visual management is the practice of presenting information through intuitive and colorful visual cues to enhance understanding and facilitate efficient work processes, promoting clarity and effectiveness in various tasks.[1] In the context of healthcare, it involves utilizing visual techniques to streamline processes, such as the cleaning and sterilization of medical instruments in the central sterile supply department. The central sterile supply department is responsible for the cleaning, disinfection, and sterilization of all reusable medical instruments, apparatus, and items in each department, along with supplying sterile items throughout the hospital.[2]

Modern hospitals are typically equipped with a wide variety of supplies and experience fast turnovers involving multiple departments, each playing a crucial role in the quality of medical treatment, teaching, and research. Incomplete disinfection and sterilization can lead to imperfections in hospital-wide infection control, subsequently affecting the accuracy of diagnosis and treatment. Therefore, effective sterilization supply management is critically important for hospital infection control.[2,3]

The implementation of visual management has the potential to enhance the management quality of the supply room. This approach involves utilizing methods such as the positioning method, incorporating various colors, signboards, and pictures to differentiate management objectives. In this manner, staff can promptly share information and grasp the main points of their work, facilitating the swift resolution of identified problems immediately. This technique, in turn, gradually reduces issues and enhances the work capability of the staff.[1-3]

Therefore, this study implemented visual management with the aim of providing guidance through easily visible and prompt messages, fostering improved management through effective visual communication. The purpose of this study was to enhance work quality, efficiency, and staff capabilities, contributing to improved hospital-wide infection control and, consequently, enhanced patient care outcomes.

MATERIALS AND METHODS

Study Design

The convenience sampling method was utilized to select 400 pieces of reused medical devices in the operating room and clinical departments during June 2021 as the control group. The qualified rates of instrument cleaning, instrument packaging, and clinical satisfaction were recorded to analyze influencing factors. Visual management implementation commenced in July 2021. After the intervention, 400 pieces of reused medical devices used in the operating room and clinical departments during October 2021 were collected as the observation group to observe and analyze variations in the qualified rates of instrument quality and clinical satisfaction.

Personnel and Team Structure

The study was conducted in a third-grade, first-class hospital involving 37 staff members in the Central Sterile Supply Department. Of these, 18 individuals participated in visual management, comprising 5 supervisor nurses, 8 senior nurses, and 5 nurses.

Development of Visual Flow Diagrams

Guided by the supply room matron, the department's leadership, including team leaders from various areas and seasoned nurses, formed a dedicated visual management team. They analyzed and determined the fixed location for each significant instrument and equipment, utilizing the positioning method with lines representing the four corners of each location.[3]

Organization and Familiarization. Signboards were strategically placed at the entrance of key areas focused on inspection and packaging sterilization, sterile storage, and decontamination. This facilitated a swift orientation for department newcomers and visitors, allowing them to familiarize themselves with the environment quickly.

Visual Flow Diagrams and Mapping. Comprehensive visual flow diagrams were carefully created and categorized into instruments and equipment, hospital infection control, and instrument packages. These were documented as individual pictures, developing vibrant loose-leaf maps.

Training and Implementation. After training in management-related concepts, tools, and implementation methods, a specific plan was formulated. This plan was then executed, and the effects of the implementation were systematically summarized and analyzed.

Application of Visual Flow Diagrams in Instrument and Equipment

Implementation by Area Members. In this phase, members from each designated area affixed the names and color-coded positioning diagrams of various items, including large cleaning machines, ultrasound machines, and sterilizers, within their assigned areas. They carefully organized the instruments and equipment in accordance with the diagram contents, ensuring a seamless and user-friendly application.[4]

Development and Implementation of Standardized Equipment Operation Processes. Aligned with equipment specifications and industry standards, this phase involved crafting Standard Operating Procedures (SOPs) for the standardized operation process of equipment. The subsequent step entailed documenting the operation processes of large instruments and equipment in each region through step-by-step images, capturing their service sequence. Notably, attention-worthy details, detection methods, observation points, and standard parameters were clearly marked and recorded. As a result of this process, vibrant encapsulated loose-leaf guides were produced and attached to the equipment for clear and accessible guidance. This user-friendly approach ensured safe operations during use.

Formulation of Area-Specific Regulations and Work Requirements. In this phase, regulations and work requirements tailored to the needs of each area were developed.[5] Simultaneously, in accordance with WS310-2016 central sterile supply department specification,[6] the technical operation process in the supply room, common emergency plans, and treatment processes were established. These were presented in a flowchart style and compiled into a booklet. The booklet included a table of contents with serial numbers for easy reference by department members. This visual representation enables members to intuitively find solutions to problems, enhancing their workflow and overall efficiency.

Structured Emergency Protocols for Efficient Response and Operations

We developed structured emergency protocols for efficient response and operations pressure check with the following components: (1) Pressure check: steam, water, and air pressure were promptly assessed to ensure adequacy; (2) Sterilizer failure: in the event of a sterilizer malfunction, the equipment maintenance department was immediately alerted for swift identification and repair; (3) B-D test results: usage was ceased if the B-D test revealed unsatisfactory results. The cause was identified, and repairs were initiated; (4) Side leakage test: if the side leakage test indicated issues, usage was discontinued, the cause was identified, and repairs were initiated; (5) Failed sterilization: if normal sterilization failed within a short duration, alternative sterilizers or methods were promptly employed; (6) Priority sterilization: precedence was given to urgent and important instruments in the sterilization process; (7) Notification and adjustments: relevant departments and sections were notified, and timely adjustments for materials and work were made.

Structured Processing Flow for Efficient Sterilization Operations

The processing flow was as follows: (1) Pressure sterilizer failure; (2) Immediate alarm check: the alarm prompt was checked promptly to ensure that steam pressure, water pressure, and air pressure were sufficient; (3) Sterilizer failure; (4) Unqualified B-D test; (5) Unqualified side leakage test; (6) Professional maintenance personnel were immediately notified; (7) Cessation of use: the sterilizer was stopped from being used. (8) Cause identification: the failure reason was identified, and repairs were initiated as soon as possible; (9) Reason summarization and record maintenance: reasons were summarized, and records were maintained; (10) Alternative sterilization methods: when normal sterilization failed within a short time, alternative sterilizers or other sterilization methods were immediately chosen; (11) Priority sterilization: urgent and important instruments were prioritized for sterilization; (12) Relevant departments and sections were notified, and timely adjustments for material and work were made.

Optimizing Visual Communication: Hospital Sense Through Visual Flow Diagrams

In addition to incorporating names and vibrant diagrams, visual management encompasses the categorization of items and the delineation of areas. This comprehensive approach involves a combination of positioning, labeling, zoning, graphics, color, direction, and map methods.[7]

Warning Clarity. Within supply room management, colored signs were strategically employed to convey essential messages, such as "*Please take protective measures when entering the decontamination area,*" presented in a bright color. A high-contrast red color was introduced to maximize the display's effectiveness and ensure a clear warning, replacing the original identification system.

Training on Dressing Protocols for Protective Equipment. Dressing requirements, steps for putting on and taking off protective equipment, and crucial considerations in each area were comprehensively demonstrated by a designated expert. This crucial information was presented through visual aids, utilizing picture illustrations with accompanying text descriptions. This approach facilitates more intuitive and accurate understanding among staff, ensuring not only the quality of their work but also significantly enhancing self-protection awareness.[8]

Enhanced Sterile Package Management. Change diagrams depicting chemical indicators before and after sterilization in various sterilization methods were prominently displayed in the sterile articles' distribution hall. This visual aid ensures that the correct color change is readily available for personnel, facilitating the inspection of sterile package quality.[9]

Additionally, adherence to the provisions of WS310.1 dictates specific validity periods based on the temperature and humidity of the aseptic storage area. Ordinary cotton material-packed aseptic items have a 14-day validity, while those with disposable paper-plastic bags extend to 180 days. Effective management of the validity period was important for the overall management and safe utilization of aseptic packages.[10]

To prevent the expiration of sterile packages and potential risks to patients, the principle of first-in, first-out was strictly followed during issuance. Color markings, with eye-catching green for new expiration dates and yellow for critical periods, were introduced to delineate areas. This systematic approach further enhanced the scientific and standardized management of sterilized items in the supply room, ensuring medical safety and protecting patients' health.

Efficient Medical Waste Management. In this initiative, medical waste within the department underwent visual documentation and classification into five distinct categories: infectious waste, injury medical waste, chemical waste, pathological waste, and pharmaceutical waste, aligning with the guidelines set by the Ministry of Health. To ensure clarity and understanding, visual aids representing regional divisions of medical waste, accompanied by pictures, were affixed beside waste classification bins. This strategic placement aimed to facilitate personnel in accurately classifying and treating medical waste, ultimately reducing waste output and preventing the spread of infectious diseases.

Visual Flow Diagrams for Instrument Packages

The continuous introduction of diverse and intricate surgical instruments poses challenges in their identification and configuration.[11] The quality of instrument packages significantly impacts the safety and quality of sterile items, emphasizing the importance of developing visual flow diagrams for optimal equipment configuration.[12]

Surgical instruments were categorized into packages personalized for specific surgeries, such as thoracic, general surgery, laparoscopic, and appendix packages. Taking the appendix package as an illustration, instruments were systematically classified based on the fundamental instrument configuration down to the smallest unit. They were arranged in the order of use with standardized quantities, uniformly placed on disposable blue non-woven fabric.[13]

A comprehensive visual representation was created, starting with an overview and progressing to detailed photographs of each instrument. Each instrument's name, quantity, and verification points were carefully described, with serial numbers marked using a combination of diagrams and text. The finalized diagrams were typeset by a computer, printed in color, and tied in plastic loose-leaf pages for easy reference.

Team members, adorned with protective caps, individually photographed plasticized precision instruments, such as ophthalmic precision instruments under a magnifier. Special attention was given to noting important considerations when packing in paper and plastic packages.[14] The completion and prompt updates of flow diagrams for commonly used instrument packages in each department were designed to the specific requirements of each department, aiming to enhance efficiency.

These visual process diagrams served as invaluable tools for new nurses and department visitors, providing preliminary knowledge and understanding of the instruments. This approach alleviates unfamiliarity with the new department, initiates learning interest and motivation, facilitates the integration of theory and practice, and accelerates the adjustment to regular work, ultimately improving work efficiency.[15]

Organizational Training Through Visual Process Diagrams

During the morning shift change, department staff underwent comprehensive training on the concept, requirements, and contents of visual process diagrams. The significance of improving work quality and efficiency was emphasized during this session. The training was personalized for each post and area, aligning with the classification of visual process diagrams. This approach aimed to enhance familiarity with relevant work contents and standards, encompassing the utilization of instruments and equipment, hospital sensory control, and instrument packages. The training strategy contributed to seamless staff rotation, ensuring consistent work quality and minimizing the occurrence of errors.

Operation Check

Office staff underwent a monthly operation check, overseen by members of the visual management team, with scoring and accurate record-keeping being integral parts of the process.

Evaluation Indicators

Qualified Rate of Instrument Cleaning. The evaluation of the qualified rate of instrument cleaning involved a careful process. Cleaned instruments underwent visual inspection using a 10-times magnifier with a light source to assess the cleaning and disinfection quality of robotic surgical instruments. Instruments were examined for both cleanliness and functional integrity before packaging, determining the overall qualification of instrument cleaning.

The qualified rate of instrument cleaning was calculated using the formula: Qualified Rate of Instrument Cleaning=(1−Number of Re-washing Instruments / Total Number of Cleaned Instruments)×100%

Qualified Rate of Instrument Packaging. In adherence to the specifications outlined in the second part of the WS 310.2—2016 central sterile supply department specification, the instrument packaging quality checklist[6] was initially developed. This checklist served as the first tool for assessing the quality of instrument packaging. Specialized personnel utilized this checklist to determine the qualification of instrument packaging.

The qualified rate of instrument packaging was calculated using the formula: Qualified Rate of Instrument Packaging = (1−Number of Unqualified Packaging Instruments / Total Number of Instrument Packaging)×100%.

Clinical Satisfaction. To determine clinical satisfaction, a custom-made satisfaction questionnaire was developed within the department. The questionnaire consisted of four key entries: sterilization mark management, quality of plastic encapsulated items, quantity and performance of items in the package, and qualified discoloration of chemical indicators. Each entry featured two rating options: qualified and unqualified. This questionnaire served as the tool for collecting feedback from all clinical departments within the hospital regarding their satisfaction with the central sterile supply department.

For each instrument, a satisfaction questionnaire was attached, enabling the evaluation of each department's satisfaction when utilizing the instrument. The instrument was considered qualified (equivalent to the department's satisfaction with the used instrument) only when all four entries were assessed as qualified.

Statistical Analysis

The data was analyzed using SPSS 21.0 statistical software (IBM, Armonk, NY, USA). Frequency and percentage were utilized for the statistical description of counted data. Additionally, the chi-square test (χ^2) was implemented for group comparisons, with statistical significance set at $P < .05$.

RESULTS

Enhanced Rates and Satisfaction with Visual Management Implementation

As illustrated in Table 1, the implementation of visual management led to significant improvements in the qualified rate of instrument cleaning, instrument packaging, and clinical satisfaction. These positive changes signify the effectiveness of visual management in enhancing various aspects.

DISCUSSION

The Impact of Visual Management in the Central Sterile Supply Department

This study presents compelling evidence that the implementation of visual management significantly improved the qualified rate of instrument cleaning from 95% to 99% and instrument packaging from 92% to 96%. These findings highlight the effectiveness of visual management in elevating the quality of instrument cleaning and packaging within the

Table 1. Comparison of the qualified rate of instrument quality before and after visual management [n (%)]

Grouping	Instrument Cleaning		Instrument Packaging		Clinical Satisfaction	
	Qualified	Unqualified	Qualified	Unqualified	Qualified	Unqualified
Control Group	380 (95)	20(5)	368(92)	32(8)	360(90)	40(10)
Observation Group	396 (99)	4(1)	384(96)	16(4)	396(99)	4(1)
χ^2 value	44.463		800.00		128.256	
P value	.000		.000		.000	

Note: The data presented in the table represent the number and percentage (%) of qualified and unqualified cases for instrument cleaning, instrument packaging, and clinical satisfaction in both the control and observation groups before and after the implementation of visual management. The χ^2 values and associated *P*-values demonstrate the statistical significance of the observed differences.

central sterile supply department, aligning with the results of a previous study by Yuhua, et al.[16]

The concise, swift, and accurate attributes of visual management empowered office staff to efficiently master the cleaning, packaging, and sterilization processes of instruments, along with gaining a better understanding of hospital sense-related knowledge. This heightened efficiency was observed to lead to a reduction in errors. Therefore, the full-scale application of visual management in the clinical work of the central sterile supply department is recommended. This comprehensive approach showed the potential to enhance the quality of instrument cleaning, ensure patient safety and improve the overall satisfaction of clinical departments.

Enhanced Clinical Satisfaction

The outcomes of this study revealed a notable increase in clinical satisfaction from 90% to 99% after the implementation of visual management. It highlights the effectiveness of visual management in enhancing clinical satisfaction. By relying on visual cues, department staff effectively prevented errors, such as instrument mixing and underloading, that could arise from dependence on subjective memory. Concurrently, the quick and intuitive training of various precise and valuable instruments through visual methods contributed to waste reduction and cost savings. These improvements resulted in a positive shift in clinicians' satisfaction when utilizing instrument packages, thereby minimizing departmental conflicts.

In the current era of technological advancements and the continuous evolution of national medical reform, society has a growing demand for elevated standards in both medical services and quality.[17] The central sterile supply department plays an important role as the primary entity responsible for cleaning medical instruments and packaging sterile dressings and items within the hospital. The sterilization quality maintained by this department is intricately linked to hospital infection rates, directly impacting patient safety and the overall quality of hospital services. Considering its crucial role in medical services, the central sterile supply department needs continuous development to meet evolving standards.[18]

The implementation of a standardized visualization process in the central sterile supply department enhanced its management practices and significantly improved the qualified rates of instrument cleaning, instrument packaging, and clinical satisfaction. The approach led to a considerable improvement in work efficiency and quality, ultimately propelling the overall development of the entire department.

Study Limitations

It is important to acknowledge certain limitations in this study. The sample size might affect the generalizability of the findings, and the study's focus on a specific department within a hospital may limit broader applicability. Additionally, the observational nature of the study design could introduce potential biases, and external factors not accounted for in the research might influence the outcomes. These limitations emphasize the need for cautious interpretation and suggest avenues for future research to address these limitations and broaden the understanding of visual management in healthcare settings.

CONCLUSION

In conclusion, the implementation of visual management in the central sterile supply department has proven to be a transformative strategy, significantly improving the qualified rates of instrument cleaning, packaging, and overall clinical satisfaction. These improvements not only highlight the department's commitment to quality but also contribute to heightened work efficiency. The study encourages the continued adoption of visual management practices in healthcare settings, fostering a safer and more efficient environment for both staff and patients alike.

CONFLICTS OF INTEREST

The authors report no conflict of interest.

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AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

1. Zheng X. Managerial Effectiveness of Visual Labeling Management Combined with Health Education in Nosocomial Infection and Impact on Patient Satisfaction [J]. *Zhongguo Yaowu Yu Linchuang*. 2021;21(21):3536-3538.
2. Zhang K. Application of Visual Management and "4324" Digital Labeling in the Management of Disposable Items in Central Sterile Supply Department [J]. *Chinese Journal of Management in Chinese Medicine*. 2021;29(10):169-170.
3. Li F, Zhou H, Liu X. Study on Visual Management of Instruments and Equipment in Operating Room [J]. *Electronic Journal of Clinical Medical Literature*. 2020;7(40):184.
4. Minggui Huang, Qin Zeng, Yi Lin, et al. Application of Visual Management in Pediatric Nursing Safety Quality Control Management [J]. *Medical Diet and Health*,2020,18(20):197+199.
5. Zhang M, Zhang Y, Zhang L, et al. Application of Visual Management in Emergency Management of Hospital Response to Novel Coronavirus Pneumonia [J]. *Mod Hosp*. 2020;20(05):637-639.
6. WS 310.2—2016 Central Sterile Supply Department—Part Two: Standard for Operating Procedure of Cleaning, Disinfection, and Sterilization [J]. *Can J Infect Control*. 2017;16(10):986-992.
7. Xiao J. Study on Occupational Protection for Nursing Staff in Central Sterile Supply Department [J]. *J Med Res*. 2021;3(7).
8. Jiang C, Wu J, Kan X. Application of Information Traceability System in Central Sterile Supply Department [J]. *Chinese Community Doctors*. 2021;37(06):188-189.
9. Li H, Lu S, Xu H, et al. Application of "Zero Tolerance" Management Concept in Standardized Management of Sterile Package Expiration Date [J]. *Chinese Journal of Management in Chinese Medicine*. 2020;28(12):224-226.
10. Chen Y. Application of Visual Management in Foreign Instrument Management in Department of Plastic Surgery [J]. *Chinese Journal of Management in Chinese Medicine*. 2020;28(10):227-229.
11. Hong Y. Application of Visual Labeling in Operating Room Management [J]. *Chinese Journal of Management in Chinese Medicine*. 2019;27(16):56-57.
12. Zhao L, Dou X. Analysis of Application Effect of Surgical Instrument Map Query System in New Nurse Training [J]. *Guizhou Medical Journal*. 2021;45(11):1847-1848.
13. Chen Q, Wu L. Analysis of Application Effect of Dental Specialist Instrument Map in Central Sterile Supply Department [J]. *Famous Doctor*. 2020;(09):387-388.
14. Xue L. Analysis of Application Effect of Instrument Cleaning Realistic Map in the Teaching of Nursing Students in Central Sterile Supply Department [J]. *Heilongjiang Journal of Traditional Chinese Medicine*. 2021;50(01):153-154.
15. Zhao L. Reflections on Primary Care Teaching Arising from Evolution of the Healthcare Environment [J]. *Invention & Innovation*. 2021;(01):40-41.
16. Zhu Y, Shen B, Qian Y. Application of Visual Management in the Handling of Microscopic Precious Instruments in Ophthalmology Department [J]. *China Continuing Medical Baucation*. 2018;10(29):69-71.
17. Zhou H. Significance of Centralized Cleaning of Reused Medical Instruments in Central Sterile Supply Department [J]. *Chinese Journal of Medical Device*. 2022;35(01):92-94.
18. Zhen L, Luo L, He L. Effect Analysis of Visual Management on Reducing Hospital Infection in Central Sterile Supply Department [J]. *The Medical Journal of The Present Clinical*. 2021;34(04):108-109.