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Refined management in risk control of extrahepatic laparoscopic instrument handover

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ABSTRACT: Objective The present study intends to analyze and explore the application effect of the refined management in risk control of extrahepatic laparoscopic instrument handover. **Methods** A retrospective analysis of 1,973 adverse events during extrahepatic laparoscopic instrument handover in 2022 was conducted. Refined management measures were formulated and applied to 1,973 cases of extrahepatic laparoscopic instrument handover in 2023. The types, incidence rates of adverse events, and instrument handover duration were compared before and after the intervention. **Results** Under the fine management, the types and incidence of adverse events decreased significantly. The incidence rate dropped from 35.68% to 2.84%, and the average handover duration per instrument decreased from 291.36±43.855 seconds to 113.41±11.497 seconds (P<0.05 for all). **Conclusion** The risk of adverse events in extrahepatic laparoscopic instrument handover is high. The application of the fine management significantly reduces both the risk of adverse events and the handover duration.

KEY WORDS: Refined management; Laparoscopic instruments; Sterile supply; Instrument handover

Introduction

With the continuous advancement of minimally invasive surgical techniques, laparoscopic surgery has gained widespread development and application due to its advantages such as rapid postoperative recovery, minimal trauma, few complications, and low costs. It has gradually become the most widely used surgical approach in clinical practice[1-3]. The Central Sterile Supply Department (CSSD) undertakes the handover, cleaning, disinfection, and sterilization of laparoscopic instruments[4]. However, challenges such as the increasing of laparoscopic instrument brands, types, and components, coupled with insufficient instrument inventory, have introduced various risks in the centralized management of laparoscopic instruments between operating rooms and CSSD[5-7]. In alignment with China's national initiative, the *Comprehensive Healthcare Quality Improvement Campaign (2023—2025)*, to enhance the centralized management of laparoscopic instruments, mitigate adverse handover risks, and improve overall healthcare standards, this study implemented a refined management model in the handover process of extrahepatic laparoscopic instruments. A retrospective analysis of historical handover incidents and a comprehensive literature review[8-13] were conducted, achieving notable outcomes as follows.

1 Materials and methods

1.1 Materials

Extrahepatic laparoscopic instruments consist

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of over 20 types, such as lens systems, fiber optic cables, various dissecting forceps, grasping forceps, laparoscopic scissors, electrosurgical hooks, electrosurgical probes, electrosurgical forceps, laparoscopic needle holders, titanium clip appliers, insufflation tubing, electrosurgical wires, and suction devices. This study analyzed 1,973 cases of extrahepatic laparoscopic surgeries conducted in 2022 with documented adverse events related to instrument handover as the control group, and 1, 973 cases from 2023 applying the refined management for handover as the experimental group.

1.2 Methods

1.2.1 Control group

1.2.1.1 Retrospective analysis

Adverse events during the extrahepatic laparoscopic instrument handover from January to December 2022 were analyzed for types, incidence rates, and causes.

1.2.1.2 Routine operation procedure

Staff in the decontamination area performed the recovery and handover of extrahepatic laparoscopic instruments using conventional methods. Specifically, the scrub nurse disassembled instruments based on personal experience, followed by a quantity verification with decontamination staff using a conventional checklist. This checklist only included instrument names and quantities, such as:"Small right-angle dissecting forceps: 1; Gastric grasping forceps: 1; Suction device: 1; Needle holder: 1; and Electrosurgical hook: 1".

1.2.2 Experimental group

1.2.2.1 Establishment of a Refined Management Team

A quality improvement program for extrahepatic laparoscopic instrument handover was implemented across all staff under the leadership of a team leader (Director of CSSD) and deputy leaders (Head nurses of CSSD and the operating room). The program was executed under the coordinated management of quality control team leaders from both the CSSD and the operating room.

1.2.2.2 Formulation of fine management measures

(1) Development of customized inventory and training tools This includes creating an improved checklist for extrahepatic laparoscopic instruments, color visual guides, and disassembly instructional videos.

a. Improved checklist for extrahepatic laparoscopic instruments Based on statistical analysis of adverse events and feedback from operating room staff, surgeons, and manufacturers, an enhanced checklist was designed. The updated checklist template is as follows[5].

b. Production of color visual guides for extrahepatic laparoscopic instruments High-resolution photographs were taken to create visual references, containing full set overview (image of the complete instrument set), Individual instrument views (isolated shots of each instrument), disassembly close-ups (detailed photos of detached components), key area magnifications (zoomed-in images

Figure 1 Updated checklist template

Header: Name of the instrument set

(with labels for urgent sterilization or special infection alerts)

No.	Instrument	Quantity	Components	Remarks
1	Suction device	1	Four components: Flush switch ×1, Flush cap ×1, Handle ×1, Shaft ×1.	Inspect the sealing ring at the shaft-handle junction.

Signatures for CSSD cleaning/verification:

Time of the fourth intraoperative inventory check:

Signature of circulating nurse:

Area for barcode attachment.

of complex, fragile, or small parts), and multi-angle shots (additional perspectives for structurally intricate instruments). All images were categorized by serial number, annotated with explanatory text, and integrated into the information traceability system[14-16].

c. Production of disassembly instructional videos Two-part instructional videos were recorded, the instrument overview including names, functions, and clinical applications, as well as the operational protocols covering preprocessing, handover, disassembly and reassembly, and inventory verification.

(2) Standardization of handover procedures

a. On-site pre-processing The scrub nurse immediately removes contaminants (e. g., tissue residues, bloodstains, bile, residual medical adhesive) and non-reusable items (e.g., ligation clips) from the surfaces of used laparoscopic instruments.

b. Transportation The scrub nurse transfers the pre-processed laparoscopic instruments to the decontamination area of CSSD.

c. Disassembly The scrub nurse fully disassembles all detachable components of the instruments.

d. Joint inventory verification After disassembly, the scrub nurse and CSSD decontamination staff verify the instrument names, quantities, and component integrity against the checklist. Any discrepancies identified during verification prompt immediate investigation to locate missing items. Unfamiliar components are cross-referenced using the color visual guides.

e. Verification of checklist completion Confirm that the checklist is fully completed, including circulating nurse's signature and attachment of the recovery barcode. Any omissions shall be reported to the scrub nurse for immediate rectification.

f. Sign-off Upon successful verification, the CSSD decontamination staff signs the checklist in the designated cleaning verification section.

g. Quality supervision via traceability system After handover completion,scan the recovery barcode on the checklist using a barcode scanner to access the instrument set's color visual guides for on-demand reference. Scan the cleaning basket and the staff responsible for recovery. The barcode links traceable data, including patient information, operating room number, surgical case sequence, and CSSD instrument receiver details.

h. Continuous quality improvement Implement the Plan-Do-Check-Act (PDCA cycle) to continuously identify, analyze, and resolve issues in the handover process, driving sustained quality enhancement[17]. Establish yearly improvement objectives. Decontamination staff conduct routine inspections and documentation. Quality control team leaders monthly compile data, analyze root causes, and propose corrective actions during team meetings. The leaders track the implementation and effectiveness of improvements in subsequent months.

1.3 Evaluation metrics

The two groups were compared in terms of types, frequencies, incidence rates, and handover duration of adverse events in extrahepatic laparoscopic instrument handover.

The incidence rate of adverse events is calculated as:

$$\text{Incidence rate} = \frac{\text{Number of cases with adverse events during handover within the statistical period}}{\text{Total number of extrahepatic laparoscopic surgeries within the statistical period}} \times 100\%$$

The instrument handover duration is defined as the time from the moment instruments are delivered to the decontamination area of CSSD to the completion of inventory verification and inspection. This duration is recorded using a stopwatch.

1.4 Statistical analysis

The data were analyzed using SPSS 22.0 statistical software. Measurement information was expressed as mean ± standard deviation (x±s) and a *t*-test was used. Count information was described as rate (%) and an χ^2 test was used. The difference was considered to be statistically significant at $P<0.05$.

2 Results

2.1 Comparison of adverse events

The control group had 704 adverse events

(35.68%), while the experimental group had 56 (2.84%). There are more than ten primary types of adverse events, including unrecognized instruments, disassembly errors, quantity mismatches, tubular blockages, instrument damage, failure to perform necessary pre-treatment, disposables not removed, etc. Both groups show statistically significant differences in the incidence rate of adverse events and the frequency of occurrence by type (P<0.05) (Table 1).

2.2 Comparison of handover duration

The average handover duration for extrahepatic laparoscopic instruments was 291.36±43.855 seconds before the intervention and 113.41±11.497 seconds after the intervention. The difference between the two groups was statistically significant (P<0.05) (Table 2).

3 Results

The widespread application of minimally invasive surgery in clinical practice has increased the demand for minimally invasive laparoscopic instruments. These instruments feature complex and diverse structures with multiple detachable components, and some tools (e. g., electrosurgical hooks) are highly prone to damage. During instrument handover, issues such as incomplete inventory checks, lost components, and surgical delays frequently arise, creating challenges in laparoscopic instrument management and handover[18]. Based on literature review[19] and experience from use of extrahepatic laparoscopic instruments, the causes of adverse handover events include as follows.

a. Insufficient nursing expertise: Lack of knowledge about laparoscopic instrument structures and standardized processing protocols, leading to unclear component handovers and instrument channels clogged by residual adhesive.

b. Inadequate responsibility and care awareness: High handover demands for laparoscopic instruments prompt nurses to prioritize speed over thorough handover checks, while rough handling by surgeons exacerbates instrument damage.

c. Material limitations: Specialized internal

Table 1 Comparison of adverse event types and incidence rates

Group	Qty. (n)	Type and quantity of adverse events (n)									Incidence rate of adverse events (%)
		Unrecognized instruments	Disassembly errors	Quantity mismatches	Tubular bockages	Disposables not removed	No pre-treatment	Black rod broken	Line broken	Electrosurgical hook cephalic end defect	Electrosurgical hook head end defect	
Control group	1 973	200	100	138	19	100	300	57	100	85	79	35. 68 (704*)
Experimental group	1 973	0	0	3	2	0	0	12	16	24	18	2. 84 (56*)
χ^2 value		210. 678	102. 6	134. 045	29. 87	102. 6	324. 685	13. 836	62. 67	35. 107	34. 328	684. 302
P value		0	0	0	0	0	0	0	0	0	0	0

Note: *refers to quantity of adverse events.

Table 2 Comparison of handover duration

Group	Qty. (n)	Time consumption of handover (s)
Control group	1 973	291. 36±43. 855
Experimental group	1 973	113. 41±11. 497
t value		174. 346
P value		<0. 001

materials in fiber optic cables and electrosurgical wires make them susceptible to damage when bent. Frequent reuse of these instruments accelerates wear, causing defects, screw loosening, fractures, or detachment.

d. Incomplete checks: Missing identifiers in inventory lists result in overlooked component verification.

Postoperative instrument handover is the critical first step for CSSD to process instrument, and its quality control directly impacts subsequent opeartion steps, underscoring the necessity for standardized laparoscopic instrument handover management[20].

In China, research on instrument handover management has focused on visual guides, checklists, Quality Control Circles (QCC), and PDCA cycles. DU, WEI, and YANG[21-23] developed instrument catalogs to guide classification, disassembly, cleaning, sterilization, and packaging during instrument recovery, effectively reducing handover errors between operating rooms and CSSD while shortening packaging and handover time. LI and PAN[24-25] designed and refined instrument checklists, optimizing handover workflows and mitigating risks. XU, LYU, and BAO[26-28] demonstrated that QCC interventions reduced handover error rates and ensured smooth surgical procedures. LI ZJ and LI JL[29-30] applied PDCA cycles to decrease irregular handover practices in urological laparoscopic procedures, achieving optimized workflows and reduced non-compliance rates between operating rooms and CSSD.

4 Conclusion

Refined management, a modern management approach, has been widely applied in hospital administration[31-36]. This model involves establishing standardized handover procedures based on refined management requirements to ensure evidence-based operations, developing personalized inventory checklists and training tools to facilitate staff competency, incorporating information traceability barcodes to enhance management efficiency, and implementing continuous quality improvement to optimize handover processes and methods. It has effectively reduced the incidence rate of adverse events and improved handover efficiency, demonstrating comparable effectiveness to previous studies[37-38]. However, further validation is required to determine its applicability to other types of medical devices.

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References

[1] Li ZY, Ma Y. Advances in vascular reconstruction techniques in laparo-s copic hepatectomy [J]. Chinese Journal of Practical Surgery, 2022,42(9):1051-1053.

[2] Lu HY. Advances in laparoscopic surgery for gastrointestinal surgery [J]. Journal of Minimally Invasive Medicine, 2023,18(5):611-614,637.

[3] Xu G, Tao YZ, Liu WC, et al. Development and prospects of laparoscopic surgery in Jilin Province [J]. Jilin Medical Journal, 2024,45(11):2783-2785.

[4] Central sterile supply department (CSSD)-Part1: Management standard [J]. Chinese Journal of Infection Control, 2017,16(9):887-892.

[5] ZHU X, YUAN L, LI T, et al. Errors in packaging surgical instruments based on a surgical instrument tracking system: an observational study [J]. BMC Health Serv Res, 2019,19(1):176.

[6] Li HY, LYU WT, Wang J. Discussion on the Role of Quality Nursing in Surgical Instrument Management of Disinfection Supply Center [J]. Chongqing Medicine, 2020,49(1):441-442.

[7] Wang X, Zhang Q, Zhou YQ. Competence investigation on insulation testing on electrosurgical instruments and needs analysis of training for Central Sterile Supply Department staff [J]. Journal of Integrative Nursing, 2020,2(3):134.

[8] Fu ZH, Lu XY, Qin BW. Publication of *Nursing Man-*

agement: Practical application of refined management in nursing management [J]. Journal of Interventional Radiology, 2023,32(10):I0001.

[9] Junjun MO, Huang F, Bei L, et al. Reuse process of positive pressure powered air-filter protective hoods [J]. Journal of Zhejiang University (Medical Sciences), 2021,49(5):603-60.

[10] Ni LJ, Song XY, Wang L, et al. Effect Analysis of CSSD Centralized Management Based on 5M1 E Analysis Method [J]. Chinese Hospital Management, 2020,40(12):42-45.

[11] Fan ML, Qian SP, Xi YH. Observation on the effect of pictorial checklists in managing external instruments [J]. Chinese Journal of Disinfection, 2023, 40 (4):319-320.

[12] He L, Tang GJ, Xu M, et al. Information management practice of operating room instruments based on whole process traceability [J]. Journal of Nursing Science, 2023,38(24):52-55.

[13] Xu YY, Yuan Y, Wen GJ, et al. Application of refined management in CSSD and its role in infection prevention [J]. Practical Preventive Medicine, 2023, 30(7): 889-893.

[14] Chen WW, Liu X, Huang DL, et al. Effect of Information-based Detachable Atlas Library of Endoscopic Instruments in CSSD [J]. Journal of Nursing, 2022,29(15):33-35.

[15] Shao J. Application of innovative electronic pictorials in the management of cleaning and disinfection of endoscopic instruments [J]. Tianjin Journal of Nursing, 2023,31(3):314-316.

[16] Lin S, Lin W, Liu XY, et al. Study on the advantages of electronic atlas of surgical instruments in the informatization management of disinfection supply center [J]. China Medicine and Pharmacy, 2022, 12(15): 151-154.

[17] Li JL, Cen SY, Li JM, et al. Impact of PDCA cycle on reducing irregular operations in urological instrument handover between operating room and supply room [J]. Nursing Practice and Research, 2023,20(3): 468-472.

[18] Yang YL. Standardized management and effect analysis of endoscopic instruments in CSSD [J]. Medicine and Hygiene, 2023(11):11-13.

[19] Tang LQ, Huang J, Wang GR. Analysis and prevention of the causes of adverse events of endoscopic instruments in operating room [J]. Journal of North Sichuan Medical College, 2018,33(6):954-956.

[20] Wei YE. Research progress on nursing-related methods for cleaning and sterilizing laparoscopic surgical instruments [J]. Medicine and Hygiene, 2023(4):123-125.

[21] Du J. The Effect of Equipment Atlas Management on Work Efficiency and Quality in the Management of Equipment Handover in the Disinfection Supply Room [J]. China Medical Device Information, 2024, 30(1): 164-167.

[22] Wei QF, Li HY, Zeng MZ, et al. Application effect of instrument pictorials in reducing handover defect rates between operating room and sterile supply room [J]. Medical Equipment, 2021,34(6):36-37.

[23] Yang H, Zhang N. Application value of instrument atlas management in the management of instrument handover in disinfection supply room and its influences on work efficiency and quality [J]. Clinical Research and Practice, 2023,8(16):183-186.

[24] Li YL. Design and application of instrument checklists in integrated operating room-supply room instrument management [J]. The Medical Forum, 2013, 17 (21):2829-2830.

[25] Pan JR, Zhang XH. Application of small instrument checklists in surgical safety management [J]. Nursing Practice and Research, 2017,14(6):92-93.

[26] XU BW, LUO WL, Zheng XL. Quality control circle activity in decreasing postoperative error rate of surgical instrument handover [J]. International Medicine and Health Guidance News, 2019,25(5):829-831.

[27] LYU Y, FU ML, ZHOU RJ, et al. Application of quality control circles in reducing instrument handover errors in operating rooms [J]. Medicine and Hygiene, 2021, 9.393-395.

[28] BAO WL. Application of quality control circle activities in improving the completeness rate of reusable instrument window handover in supply room [J]. Continuing Medical Education, 2019,33(4):77-79.

[29] LI ZJ, LI P, SUN LL. Application of PDCA cycle management in nursing management of disinfection supply center [J]. Chinese Nursing Research, 2024,38 (3):522-525.

[30] LI JL, LI JM, LI Y, et al. Impact of PDCA cycle on reducing irregular operations in urological instrument handover between operating room and supply room [J]. Nursing Practice and Research, 2023,20(3):468-472.

[31] REN LJ, XIE YL, WU QL, et al. Refined management practice based on ORTCC model of myasthenia syndrome in maintenance hemodialysis [J]. Journal of Nursing Science, 2023,38(10):26-30.

[32] WU XF, CHEN LR, SHENG X. Refined management of high-value medical consumables in urology operating room [J]. Journal of Nursing Science, 2020, 35(16):57-58.

[33] LIU YJ. Refining management practices in national key clinical specialties to enhance administrative efficiency:Practices and considerations [J]. Chinese Hospitals, 2024,28(6):91-93.

[34] FANG MW, JIN MY, ZHANG BR, et al. Exploration of the Multi-Disciplinary Treatment Practical Mode in Severe Patients under Infectious Public Health Emergency Based on Refined Management [J]. Chinese Health Service Management, 2024,41(9):1062-1065.

[35] XIE Q, WANG FZ, ZHANG LY, et al. Health Economic Evaluation of Hepatocellular Carcinoma Screening and Optimal Delicacy Management Strategies in China [J]. Chinese Health Economics, 2024,43(2):16-20.

[36] JIANG L, ZHOU Y, ZHANG ZT, et al. Thoughts and practice of refined management of medical consumables in a Grade III Level A hospital in Beijing [J]. Chinese Hospitals, 2021,25(12):92-93.

[37] NIE RJ, LI J, LI XD. The Application and Practice of "Artificial Intelligence + Big Data" in Hospital Service Process Management [J]. Chinese Hospital Management, 2024,44(7):94-96.

[38] ZHAO QQ. The refined management method and practice of a Grade III hospital in Beijing [J]. Chinese Hospitals, 2022,26(6):88-90.

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