Development and Application of Robots in Hysteroscopic Surgery Instrument Management and Surgical Cooperation Atlas

Fuli An

Operating Room, Sun Yat-Sen Memorial Hospital, Sun Yat-Sen University, Guangzhou, China

814635261@qq.com

Keywords: Robot Technology, Hysteroscopic Surgery, Instrument Management, Surgical Cooperation, Intelligent Development

Abstract: This study aims to explore how robot technology can improve the efficiency and safety of hysteroscopic surgery. This study first analyzes the existing instrument management system of hysteroscopic surgery, determines the areas that may need to be improved, and introduces a robot assistance system to realize the precise management and distribution of instruments. A surgical cooperation atlas based on robotics has been developed. By integrating surgical data and real-time feedback system, the surgical process can be optimized, the surgical burden of doctors can be reduced, and the surgical success rate and safety can be improved. This article also discusses the synergy of robots in surgery, and analyzes the impact of robots on surgery time, bleeding amount and postoperative recovery. The results show that the application of robotic technology not only improves the accuracy of instrument management, but also significantly improves the overall surgical efficiency, providing a new direction for the intelligent development of hysteroscopic surgery in the future.

1. Introduction

1.1. Research Background

As a minimally invasive gynecological treatment, hysteroscopic surgery has received more and more attention in recent years. With its technical advantages it can be quite efficient in diagnosing and treating a number of different diseases. However, the control and coordination of surgical instruments still face many challenges. Traditional surgery often causes confusion and inconvenience in the handling of instruments, which increases the workload of doctors and affects the efficiency and safety of surgery. The rapid development of robot technology and its growing maturity in the medical field show unique advantages in minimally invasive surgery. The introduction of a robot-assisted system can achieve intelligent management of instruments [1]. It has the ability to enhance the coordination, correctness and efficiency of items utilized in the course of surgery, reduce the span of operations and limit the risks of complications. At present, the application of robot technology in hysteroscopic surgery is still at the exploratory stage. The related system development and improvement are urgently needed. Exploring the application of robot technology in hysteroscopic surgery can help realize efficient management and cooperation of surgical instruments. It also provides theoretical and practical guidance for improving the overall quality of gynecological surgery and ensuring patient safety.

1.2. Research Significance

The implementation of robotic technology in the management of hysteroscopic surgical instruments and surgical collaboration has had three values, namely enhancement of medical safety, enhancement of surgical efficiency, and medical innovation. Diagnosis and treatment in the field of gynecology are increasingly becoming hysteroscopic. Nonetheless, the traditional device management models tend to be ineffectiveness and near-certain to create an error in the operations, which is directly converted into success rates and patient safety. With the implementation of robotic technology, it will be possible to have intelligent management of surgical tools. It enhances the

  DOI: 10.25236/ieesasm.2025.012

precision of the measurement, it saves man-man hours of employees in the healthcare center and it decreases the number of complications. The creation of surgery cooperation programs enables to standardise surgical operations and effective and precise work of the staff. The robotics use provides the surgeons with the best technology and creates treatment procedures that are less harmful to the patients. Potential consideration is immense. Furthermore, the application of robotics in other medical fields provides a reference model for promoting technological advances across the healthcare industry.

2. Current Situation and Challenges of Hysteroscopic Surgery Instrument Management and Surgical Cooperation

2.1. Main Problems in Traditional Instrument Management

2.1.1. Difficulty in Instrument Counting and Tracking

There are many instruments with complex structures. It is easy for medical staff to ignore items when counting before and after surgery. Time pressure in this situation creates the problem of incomplete counts and this further increases the risk of post operational equipment retention in the circumstances of high intensity working conditions. Traditional controls do not have an effective tracking system. Hospitals are very paper-based and don't track their equipment usage in real-time and constantly, so there can be manual records there. In the event of complications such as postoperative infection, it is difficult to quickly determine which equipment is involved and to investigate who is responsible. This issue concerns the quality of medical services and patient safety. This also increases the legal and financial risks for hospitals. There is an urgent need to establish an informed and intelligent instrument counting and tracking system. Increase the accuracy and efficiency of surgery, ensure smooth progression of surgery, and ensure patient safety.

2.1.2. Nonstandard Instrument Maintenance and Care

Many medical institutions lack perfect instrument maintenance mechanisms. Therefore, cleaning, disinfection and regular maintenance are not carried out properly, leading to bacterial growth and higher risk of infection. Some medical personnel have not received systematic repair training, which causes damage or wear during operation, affecting accuracy and stability. The service life of the instrument has been shortened, which has increased the medical expenses. If the equipment fails, it may cause the operation to be interrupted or delayed, affecting the treatment process. Conventional management methods often lack appropriate records and tracking measures, making it difficult to monitor the maintenance situation [2]. It is necessary to establish a standardized and systematic maintenance management framework to ensure the safety, cleanliness, and effectiveness of instruments. This helps improve surgical efficiency and guarantee patient safety.

2.1.3. Confusion in Instrument Wear and Disposal Management

In the process of using equipment, many medical institutions lack systematic records and analysis of equipment wear and tear, and often only rely on the subjective judgment of medical staff, which leads to the reuse or unnecessary loss of similar equipment [3]. When the equipment is worn, deformed and otherwise damaged, if it is not eliminated in time, it will directly endanger the safety of the operation and the effect is that the elimination management of equipment lacks a standardized process, which is easy to cause some devices that do not meet safety standards to be continuously used, increasing the risk of postoperative symptoms for patients. The lack of efficient monitoring and management system leads to the weak performance of medical institutions in terms of device loss accounting data, forecasting and procurement planning. As a result of the low efficiency of equipment management, need to build a technically appropriate instrument consumption and elimination management system, and strive to ensure the safe use and efficient flow of instruments, which is conducive to reducing medical costs, improving the quality of surgery and patient safety, and achieving a reasonable allocation of medical resources.

2.2. Core Difficulties in Traditional Surgical Cooperation

2.2.1. Low Degree of Standardization in Surgical Procedures

Many medical institutions rely too much on the personal experience and habits of employees during surgery. They usually do not have clear and unified standard operating procedures. Therefore, similar operations performed by different doctors or teams may be very different. The arrangement, handling and management of postoperative instruments usually depend on personal preferences. This will increase the complexity of the operation and increase the risk of patients. Different teams deal with unexpected situations in different ways, and there is no systematic guidance [4]. This may lead to delays or errors in decision-making. At the same time, the inefficiency of recording and analyzing information hinders the continuous improvement of the surgical process. Non-standard operations also make it more difficult to train new employees. They will weaken the coordination of the whole team. Hospitals can improve consistency by strengthening the standardization of surgery and introducing an intelligent management platform. This also helps to reduce human errors and improve the quality of surgery and the safety of patients.

2.2.2. Team Coordination Depends on Experience

The professional background and experience levels of the team members are different, so the effectiveness of collaboration is different, which affects the smooth implementation of the operation. Especially in high-pressure situations, senior medical personnel can quickly respond to emergencies and communicate efficiently with team partners. Inexperienced people lack corresponding execution and response skills, and the overall synergy weakening, the degree of medical and nursing cooperation is closely related to the completeness of preoperative preparation. If there is an omission in the preparation link, it may cause insufficient equipment or improper operation, which will hinder the surgical process. If the team training system is not perfect and there is a lack of systematic guidance, it will be difficult for new medical personnel to quickly integrate into the collective. Building a standardized training framework and strengthening cooperation and communication among members will help improve the level of medical and nursing cooperation, thereby improving the overall quality of surgery and patient safety and security.

2.2.3. Lack of Surgical Teaching and Training Resources

A large number of medical institutions lack systematic training plans and standardized teaching materials, resulting in the face of complex situations in clinical operations for first-time medical personnel. In actual operations, senior doctors are usually busy with clinical affairs and find it difficult to spare time for efficient experience transfer, resulting in interruptions in the inheritance of knowledge and skills. Simulation training and practice There are insufficient opportunities, and most medical institutions can only rely on real patients for operation. This move increases the risk of postoperative symptoms, and the learning process lacks systematic and safety guarantee, and the distribution of training resources is uneven, which makes young doctors lack confidence in dealing with complex surgeries and hinders professional growth. Building a perfect classroom teaching system, introducing diversified training resources and methods, such as simulation training, online courses and internship arrangements, etc., is conducive to improving the overall level of the medical team, ensuring the success rate of surgery and patient safety, and laying the foundation for the popularization of hysteroscopic surgery.

3. Theoretical Basis of Robot Technology Empowering Instrument Management and Surgical Cooperation

3.1. Core Technical Features of Robots

3.1.1. High-Precision Positioning and Operation

These characteristics enable the robot to accurately and quickly identify and confirm the position of various surgical instruments, and try their best to ensure that the instruments are placed in the

preset position during the operation. This can greatly reduce the risk caused by human operating errors. The robot makes use of high-precision sensors as well as the latest control algorithms. It can immediately calculate the display position and working mode of each device, and even in complex environments, it can achieve the accuracy level required for surgery. This technology also supports microsurgery. This machine allows the robot to carry out very detailed movements in a very small space. This feature will greatly reduce surgical wounds and greatly shorten the recovery time required by patients. Robots have the ability to find their place in space. This ability enables them to adapt to different environments around them and respond to changes in real time [5]. This real-time adaptation increases the flexibility of the surgical process and makes the whole process safer. This advantage is especially important for laparoscopic surgery. Hysteroscopic surgery must have high accuracy and strict safety. High-precision identification technology and control technology can improve the surgical process. They also improve the patient's experience in surgery and the overall safety of the operation.

3.1.2. Automated Identification and Sorting

With the help of high-precision detection devices and image recognition means, the robot can quickly identify various surgical tools and follow the established rules to carry out classification and sorting [6]. This technology optimizes the efficiency of instrument management, reduces the probability of errors in manual detection, and tries to ensure the rapid identification and accurate use of the required tools. Robot systems can learn with the help of machine algorithms to further improve their own skills. Even achieve effective operating levels for different categories and specifications. Efficient automatic detection reduces the burden on medical personnel and makes the operation more concentrated. Enhance the safety and efficiency of comprehensive operations by improving the effectiveness of instrument management through technical applications.

3.1.3. Data Recording and Analysis

The robot is capable of gathering numerous types of data during the working process within a short time, thus the instrument operation details, operation time, staff involvement, and patient feedback. The data collection will enable the determination of possible issues and challenges in the surgery procedure and contribute to the maximization of the surgery operations and the conceptual framework [7]. With the help of the analysis tools, the team will be able to identify major trends and strategies that can be used by referencing to the past trends to enhance efficiency and security. The consideration of the outcomes of the various cases helps physicians to create more precise and individualized operative strategies so that they can enhance the recovery of the patient. Digital files are significant in training medical personnel. They also facilitate the life-long learning of these professionals. These digital records can be utilized by new doctors. This assistance enables them to learn easily on operating skills necessary in the job. The current digitalization has enhanced technical and normative standards of logo and cadastral surgery, and facilitated digitalization of health care.

3.1.4. Visualization Guidance and Interaction

High-resolution display technology is combined with virtual reality technology. They can easily check the layout of surgical instruments through this technology, thus improving the accuracy of the operation. At the same time, it also improves the overall safety of the operation. Visualization tools can help doctors quickly identify the location of the required instruments in complex fields and adjust their operation in real time, reducing errors in tool replacement [8]. Doctors can also adjust their behavior in real time to reduce errors when using or replacing tools. The interactive interface allows medical staff to work with robots using touch or voice commands. This allows intelligent and customized control. During the operation, the team can quickly correct any deviation, improve teamwork ability, and keep the operation smooth. By using visualization and interaction functions, robotics improve the adaptability of surgery. It also promotes the intelligent and digital development of medical work. In this way, the overall treatment experience of the patient is improved.

3.2. Compatibility Analysis between Robot Technology and Management Needs

3.2.1. Realizing Automated Management of the Full Life Cycle of Instruments

Through automation, tools can be managed in an intelligent way throughout their life cycle. In the procurement stage, automated equipment can make procurement plans through demand forecasting and simple data analysis. In this way, it helps to ensure that the inventory level is suitable for the needs of the hospital. In terms of storage management, with automatic identification technology, the system can quickly identify and classify tools to ensure the accuracy and efficiency of retrieval. During the use stage, the automation system monitors the status of the tool in real time and records the usage to ensure safety and efficiency. For cleaning and maintenance, automated equipment can carry out cleaning and maintenance according to pre-set schedules and standards to reduce the risk of human error. In the process of disposal management, the automated system can evaluate the use of data, recommend appropriate replacement, and optimize resource allocation [9]. Automation runs through the whole life cycle, improving the standardization and technical level of instrument management, and providing solid support for the efficient operation of medical institutions.

3.2.2. Improving the Standardization and Safety of Surgical Procedures

Apply automated management tools, and the intervention measures are kept in the standardized process. It complies with the established procedures from machine preparation to operation. Standardized procedures help improve the efficiency of collaboration among team members and avoid the potential risk of communication barriers or operational conflicts. Robot technology The operation is equipped with real-time monitoring and feedback functions, which can identify and correct potential defects in real time, and make every effort to ensure the safety of the surgical environment. When an emergency occurs during the operation, the robot system can quickly provide relevant information support, and the doctor's decision-making basis can be provided to reduce the probability of medical errors. With the help of information recording and analysis, we can summarize past surgical data, draw efficient lessons from them, and continuously optimize the surgical process. The application of robotics technology can achieve the accuracy and intelligence of surgery, significantly improve the safety and success rate of surgery, and provide reliable medical services for patients [10].

3.2.3. Building a Standardized Surgical Cooperation Knowledge Atlas

The visualization means of the knowledge atlas present the operation procedures and the use of equipment in each link of the operation. Medical staff provides intuitive references to reduce the dependence on personal experience. With the help of systematic knowledge architecture, the training efficiency of new medical staff can be significantly improved, which is conducive to accelerating the process of team integration. The knowledge atlas can be in real time [11]. Update feedback information, collect data through postoperative evaluation, adjust and optimize according to practical experience, and strive to ensure that the knowledge of the operation keeps pace with the times, the knowledge atlas supports intelligent retrieval function, and medical staff can consult relevant information at any time during the operation. Respond to emergencies and enhance the level of collaborative flexibility and response. By building a standardized surgical and knowledge atlas, robot technology can efficiently realize surgical standardization and intelligence, and ensure patient safety and medical quality.

3.2.4. Optimizing Surgical Teaching and Training Models

With the help of the simulated training platform, medical staff can practice in a risk-free environment. They can conduct exercises that are close to reality, and this way allows them to learn in a safer way. Doctors and medical students can get an immersive learning experience. With this kind of learning experience, they can master professional skills faster. At the same time, they can also build stronger confidence in their operational ability. With the support of virtual reality technology, the teaching plan can show the trainees a clear demonstration of the surgical process and provide step-by-step operation guidelines. These intuitive contents help learners have a deeper understanding of

complex surgical steps, and also help them become familiar with how to use various instruments.

Teaching methods can make use of digital records. They can also rely on effective feedback mechanisms to support the learning process. With the support of these two elements, the teaching process can be more personalized to meet personalized needs. In this way, the training tries its best to ensure that every medical staff can master the required skills. The training will also combine regular assessment with practical operation. This strategy enables the system to continuously monitor the training effect and carry out continuous and dynamic optimization. With the introduction of robotics technology, the whole surgical teaching system and training mode have been newly improved. This helps to improve the overall ability of the medical team. In the end, medical staff can provide high-quality diagnosis and treatment services for patients with a more professional level and more reliable safety and security.

4. Application Paths and Practical Challenges of Robotic Technology in Instrument Management and Surgical Collaboration

4.1. Analysis of Application Paths Empowered by Robotics

4.1.1. Application of Automated Instrument Counting and Inventory Management

In this application, the robot system uses barcode or RFID technology to automatically identify surgical instruments and monitor the inventory status in real time [12]. Before the operation begins, the system automatically generates a list of equipment requirements to check whether the inventory is sufficient. This can prevent the shortage of tools. During the operation, through real-time counting, the robot tracks the use status of the instrument to ensure the accurate positioning and rapid use of each instrument. This effectively reduces human operating errors. In the postoperative counting stage, the robot automatically records the use of each instrument, updates inventory data, and provides analytical information to assist managers in reasonable procurement and inventory adjustment. Automated counting and management improve the accuracy of inventory data, greatly reduce labor costs, improve the efficiency of the operating room, and ensure the safety of patients and the smooth operation.

4.1.2. Application of Intelligent Instrument Cleaning and Disinfection Processes

Adopt an automated device to carry out efficient cleaning and sterilization of surgical instruments, and strive to ensure the safety and sterility of surgical instruments. The automated cleaning system is set according to the program. According to the materials and forms of different instruments, the appropriate cleaning agent, sterilization method and cleaning time are selected to achieve targeted cleaning and disinfection. The system is equipped with high-precision sensor can monitor the cleaning effect in real time, and strive to ensure that each instrument meets the strict clean standards. Through information recording and analysis, system managers provide detailed reports on cleaning and disinfection, assist in optimizing the process and improving work efficiency, and use robotic technology to clean and disinfect the instrument. Reduce the risk of infection caused by manual operation, reduce the workload of medical personnel, improve the work efficiency and safety of the whole operating room, use intelligent cleaning and disinfection procedures, improve the management level of medical devices, and provide strong support for the safety of patients' surgery.

4.1.3. Application of Real-Time Navigation and Prompting in Surgical Collaboration

With advanced navigation technology, the surgical team obtains accurate instrument positioning and real-time dynamic data during the procedure. This allows surgeons to better understand surgical progress. The real-time navigation system integrates high-definition cameras and sensor components to monitor the surgical scene and instrument status, providing intraoperative image feedback and assisting surgeons in precise manipulation. The system can issue operational guidance based on the surgical stage to ensure medical staff follow standard procedures and reduce the risk of errors. The real-time navigation system can also work together with the robotic surgical control system through a visual interface that displays surgical progress and instrument usage. This strengthens

communication and cooperation within the team. The application of this technology improves surgical standardization and safety, shortens surgical duration, and enhances medical efficiency. With real-time navigation and prompts, the surgical team can respond more confidently and quickly in complex medical situations, providing patients with better medical services.

4.1.4. Application of Surgical Data Collection and Atlas Construction

Of the operation, the robot system gathers data in real time. These data include the frequency of device use, the duration of surgery, the surgeon's habits and the patient's postoperative recovery. The data is intelligently analyzed. It shows the trend and common patterns of surgery. It provides a clear basis for improving the procedure. The medical team has a useful tool that is called surgical information atlas. They can use it to quickly master the key stages of surgery. They can identify potential risks. They can see which parts need to be improved. They can also get practical optimization methods. They can choose the right one. The vertebrae after surgery is also very useful. It is helpful for postoperative examination. It is used to educate young doctors. It provides them with a case reference. This will improve their skills. This strengthens their operational knowledge. These methods, which are based on data, make surgery more of a standard. They also make the operation more accurate. Hysteroscopic surgery is now more efficient with the introduction of robot technology. This also improves the safety level of the operation. It helps to provide higher-quality medical services. It also provides patients with a better treatment experience.

4.2. Practical Challenges in the Application Process

4.2.1. Technical Aspects: Recognition Accuracy, System Stability, Human-Computer Interaction

The success and safety of any surgery rests upon a very important foundation. This foundation is realizing the accurate identification of medical equipment and surgical areas. Without this accurate identification, it is difficult to ensure the safety of the operation and the successful completion of the operation. Robots need to accurately locate the location of surgical instruments. Detection errors or mistakes may lead to errors and affect the results. Improving the accuracy of system detection has become the core task of complex equipment technology. Also, see the stability and quality of the system. Robots must be efficient and stable when working. Systemic failure may cause interruptions or failures and harm the safety of patients. Make every effort to ensure that the robot works consistently in different operating scenarios. This is crucial to reducing the frequency of medical accidents. Friendly image design between humans and machines is also crucial to optimizing the doctor's experience. The interface should be simple and intuitive, and doctors can easily access it. Medical staff can gain valuable operational experience by working with other human professionals. This shared experience helps to greatly shorten their learning cycle. Due to the shorter cycle, they can work effectively even in an emergency. At the same time, it also helps them improve their teamwork ability with colleagues. In general, more energy and resources need to be invested in these three elements in the development phase, and continuous optimization and improvement.

4.2.2. Cost Aspects: Equipment Investment, Maintenance Costs, Upgrade Expenses

When hospitals introduce robotic systems, their first concern is the cost of equipment. It is usually very expensive to buy a robotic surgery system. This will put an economic burden on many medical institutions. This pressure will also affect their decision to use advanced technology. Maintenance costs also need special attention. Although these machines are highly efficient, regular inspection, maintenance and repair require a long service life. These costs are often ignored in families. With the aging of equipment, the maintenance cost is increasing year by year. Rapid development also requires hospitals to adopt new systems. However, the higher costs brought about by these changes may be very high. Hospitals need to update their robotic systems from time to time to improve their functions and keep pace with technology. This situation has increased the financial burden on the Authority. When hospitals recognize the possibility of using robots, they should consider all these factors. They must find funds within limited resources to make effective use of these systems and make them

continuously improved.

4.2.3. Promotion Aspects: Training of Medical Staff and Integration of Systems into Existing Procedures

The acceptance of new technologies by medical staff directly affects the promotion and application of robot systems. Not all medical staff members have expressed trust and dismissal of robot technology and fear that they might substitute manual operation and create troubles because of lack of technical proficiency. Thus, greater sensitization of medical staff and their confidence towards robotics technology is specific to be improvised. It is extremely significant to establish a training mechanism of trainings of operations. The contents of the training need to be focused on technical operation functionality, and they need to be coupled with the relevant safety expertise as well as emergency rescue techniques in a manner that healthcare personnel are confident and capable with regard to real operations. Another task is the integration of new technologies with the current processes. The use of new technologies can involve modifying the current procedures in the field of surgery and attempting to introduce robot work into the team patterns and procedures as seamlessly as possible. The hospitals are recommended to be flexible in management structures to ensure the creation of communication and collaboration among the team and adaptation to emerging technologies.

5. Conclusion

The hysteroscopic surgery becomes increasingly utilized through robot technology. The trend in the current-day medicine through this usage is too clear: the medical equipment required to direct and orchestrate surgery. Surgery can be made more standard with the help of the robots. Moreover, the robots also facilitate the optimization of the process of work performed by medical workers. Simultaneously the possibility of errors due to human factors is minimised. Such features are automatic devices control, smart disinfection cycle, alarm system (in time), gathering of data and generation of images. The major features of this technology are correct identification of devices. They also include the stability of the entire system and bring out easy interaction between humans and computers. Equipment and maintenance cost, medical personnel is another cost that needs to be looked at. All expenditures and systems of work are to be considered when launching robotics. They should as well increase collaboration and flexibility. The point is to generate the efficient operation of the new technologies and to attain the ongoing integration. As the technological system grows and the developing network is enhanced, the possibilities of robot systems in cabin operation will keep increasing. This will significantly enhance the standards and services of the medical care and patient safety.

References

[1] Shi Z X. Current Situation and Development Trend of Intelligent Medical Robots[C]//Chinese Academy of Engineering. Chinese Academy of Engineering, 2015.

[2] Yao J Y, Yao Y Y, Yao, et al. Survey on Cleaning, Disinfection and Sterilization Procedures of Medical Devices in Primary Healthcare Institutions[J]. Nursing Research (Late Edition), 2009, 23(7):3. DOI:CNKI:SUN:SXHZ.0.2009-21-015.

[3] Yao Y, Li B. Quality Control and Practice of Economic Management of Medical Devices and Medical Consumables[J]. China Medical Herald, 2010, 7(28):2. DOI:10.3969/j.issn.1673-7210.2010.28.002.

[4] Li Y N, Chang H C, Dai H X, et al. Analysis of Causes and Countermeasures of Surgical Delays[J]. Modern Clinical Nursing, 2010(10):3. DOI:10.3969/j.issn.1671-8283.2010.10.004.

[5] Xu S J. Surgical Robots Are Coming[J]. Innovation World Weekly, 2019(07):55-56. DOI:CNKI:SUN:CXZK.0.2019-07-023.

[6] He Q, Huang H, He X Y, et al. Application Analysis of Digital Imaging and Electronic Tags in the Recovery of Surgical Instruments[J]. West China Medical Journal, 2016, 31(11):3. DOI:10.7507/1002-0179.201600523.

[7] Xu L L. Research on Surgical Instrument Nurse Robot[D]. Harbin Engineering University, 2014. DOI:10.7666/d.D596321.

[8] Zhang H J. Research on Serial Minimally Invasive Surgical Instruments[D]. Jilin University, 2019.

[9] Wu C Y. Research on Equipment Operation Reliability Evaluation and Maintenance Optimization Methods[D]. Hunan University, 2011. DOI:10.7666/d.y1906755.

[10] Hu L, Zhang J L, Liu W Y. Medical Robots Benefiting Humanity[J]. China Manufacturing Informatization (Academic Edition), 2005, 34(11):1. DOI:CNKI:SUN:JXZZ.0.2005-11-006.

[11] Zhang S, Liu L, Wu Y. Research Hotspots and Trends of Artificial Intelligence in Nursing Education Based on Knowledge Graphs[J]. Chinese Journal of Practical Nursing, 2024, 40(30):2365-2371. DOI:10.3760/cma.j.cn211501-20231126-01124.

[12] Lu Y, Xu F, Xue X Y. Application of RFID Traceability System in the Management of High-Value Medical Consumables[C]//Proceedings of the 14th Annual Academic Conference of the Medical Engineering Branch, Chinese Medical Association. 2013.