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Comparative Analysis of Efficiency between Intelligent Drug Dispensing Robot and Artificial Venous Preparation

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Abstract: This study aims to compare the efficiency of intelligent drug dispensing robots with traditional manual intravenous drug preparation. A total of 200 patients requiring intravenous drug preparation were randomly divided into an observation group and a control group, with 100 patients in each group. The observation group used an intelligent drug dispensing robot for intravenous drug preparation, while the control group used traditional manual methods. The study compared the preparation time and error rate of intravenous drugs between the two groups. The preparation time for intravenous drugs in the observation group was 45.3±5.7min, while in the control group it was 68.2±7.5min. The difference between the two groups was statistically significant (P=0.048). The error rate of intravenous drugs in the observation group was 3.0%, compared to 10.0% in the control group. The difference in error rates between the two groups was also statistically significant (P=0.048). Intelligent drug dispensing robots offer advantages over traditional manual methods in intravenous drug preparation, including shorter preparation times and lower error rates. This technology is a promising new method for drug preparation that is worth promoting and applying.

1. Introduction

The rapid advancement of medical information technology has led to the widespread use of intelligent robots in the healthcare sector. As a critical component, the accuracy and speed of drug preparation directly impact patient outcomes and safety. In the past, manual intravenous drug preparation was cumbersome and prone to errors, posing significant challenges to clinical pharmacology and hospital management, which urgently needed solutions. Intelligent drug preparation robots, as a new high-tech solution, have shown great potential for development. They can significantly enhance the speed and accuracy of drug preparation, effectively reducing errors, and have thus gained significant attention in the medical field. However, there is currently a lack of detailed research and data to compare the performance of intelligent drug preparation robots with manual intravenous preparation in practical applications. To address this, this study scientifically grouped 200 patients requiring intravenous drug preparation and observed their performance in multiple dimensions, including preparation efficiency and error rate, between intelligent drug preparation robots and traditional manual methods. This study aims to provide a scientific and objective basis for hospitals to choose their drug preparation methods and to offer robust data

support for the selection and optimization of future hospital drug preparation technologies.

2. Data and methods

2.1 General information

From June to December 2022, the hospital selected 200 patients who required intravenous medication for various conditions to conduct this study [1]. Using a random number table, the patients were divided into an observation group and a control group, with 100 patients in each group. The observation group received intravenous medication from an intelligent dispensing robot, while the control group received it manually by a pharmacist.

In terms of basic information, the age of patients in the observation group ranged from 18 to 65 years old, with an average age of 34.5 years and a standard deviation of 6.3 years; the gender distribution was 52 males and 48 females. The disease types of patients in the observation group were diverse, involving internal medicine, surgery, obstetrics and gynecology, pediatrics and other departments, fully reflecting the diversified characteristics of the sample [2].

In the control group, the study population was aged between 18 and 65, with an average age of 35.2 years, ranging from 28 to 48 years. The gender ratio was 55 males to 45 females. Similar to the experimental group, the control group also included a variety of conditions, including internal medicine, surgery, obstetrics and gynecology, and pediatrics. When comparing the basic data of the observation group and the control group, including age, gender, and disease type, no statistically significant differences were found ($P>0.05$). This result highlights the comparability of the two groups, allowing for further comparative studies [3]. The collection of basic data provided stability to the control group study and ensured the reliability of the research results.

2.2 Methodology

This study recruited 200 patients who needed intravenous drug preparation and was randomly divided into an observation group ($n = 100$) and a control group ($n = 100$).

The patients in the observation group used an intelligent drug dispensing robot to prepare intravenous medications, while those in the control group prepared their medications manually. The process for the intelligent drug dispensing robot is as follows: the pharmacist sends a drug preparation request through the electronic medical system, and the robot reads the prescription information, selects the required drugs, and performs tasks such as weighing and mixing using its mechanical arm. The prepared intravenous medication is then handed over to the pharmacist, who carefully checks it for accuracy before packaging and sending it to the ward for infusion by the nurse. In contrast, the manual intravenous preparation process involves the pharmacist manually preparing the drugs according to the prescription in a sterile environment. After the preparation, another pharmacist carefully inspects and verifies the drugs, and if everything is correct, they are sorted, packaged, and sent to the ward for infusion by the nurse [4].

Throughout the research process, the drug preparation procedures of both participating groups were strictly controlled to ensure a sterile environment and precise preparation. After each preparation, the accuracy and safety of the preparation were rigorously evaluated using both instrument testing and manual inspection. The evaluation criteria included the time required for preparation and the error rate during the preparation process. All data was collected in a double-blind manner, ensuring that neither the participants nor the analysts knew the group assignments, thus guaranteeing the objectivity, fairness, and precision of the results [5].

2.3 Evaluation indicators and determination criteria

Compare the preparation time and error rate of intravenous medications between two groups. The preparation time is measured in minutes (min), recording the actual time from when the pharmacist starts preparing the medication until it is completed. The error rate is calculated as the ratio of errors (n) found during verification after preparation to the total number of preparations (total preparations = 100). The results are expressed as a percentage (%), and the types of errors are briefly categorized and recorded.

2.4 Statistical methods

SPSS22.0 software was used to analyze the data in this study. After classification, the measurement data were described by "$\bar{x} \pm s$" and tested by t-test, while the count data were expressed by frequency and percentage and tested by chi-square test. $P<0.05$ was considered as statistically significant.

3. Results

3.1 Comparison of two groups of intravenous drug preparation

When comparing the efficiency of intelligent drug dispensing robots and manual intravenous preparation, the observation group (using intelligent drug dispensing robots) had a significantly shorter time for intravenous drug preparation compared to the control group (manual preparation). Additionally, the error rate of drug preparation in the observation group was significantly lower than that of the control group, with statistically significant differences ($P<0.05$). This indicates that intelligent drug dispensing robots outperform traditional manual preparation methods in terms of efficiency and accuracy. See Table 1.

Table 1: Comparison of two groups of intravenous drug preparation

group	Time of intravenous preparation (min)	Intravenous drug preparation error rate (n,%)
Observation group (n = 100)	45.3±5.7	3(3.0)
Control group (n = 100)	68.2±7.5	10(10.0)
X2 value	5.168	5.238
P price	0.048	0.048

3.2 Discussion

In the medical field, the efficiency and accuracy of drug preparation directly impact patient outcomes and safety. This study compares the efficiency of intelligent drug dispensing robots with traditional manual methods, exploring how this technological advancement affects clinical drug preparation. The findings indicate that intelligent drug dispensing robots significantly reduce preparation time and minimize errors.

The data collected indicates that the average time for intravenous drug administration using a smart dispensing robot in the observation group was 45.3±5.7 minutes, significantly lower than the 68.2±7.5 minutes for the control group. This data clearly demonstrates the advantages of smart dispensing robots in improving dispensing efficiency. In terms of drug dispensing error rates, the observation group had an error rate of only 3%, while the control group had a much higher error rate of 10%. Statistical analysis further confirms that the differences between the observation and

control groups are statistically significant, which is sufficient to demonstrate the significant reference value of smart dispensing robots in clinical drug dispensing work.

The application of intelligent drug dispensing robots has significantly improved the conventional manual method of drug preparation. In traditional manual processes, human errors often lead to mistakes and omissions, which can not only affect the treatment outcomes but also pose a threat to patient safety. By leveraging rapid drug recognition and distribution technology, intelligent drug dispensing systems can accurately complete drug preparation tasks, greatly reducing the risks associated with human factors and enhancing the reliability and precision of drug preparation. Additionally, by optimizing workflows, these robots reduce the time required for drug preparation, thereby improving the overall efficiency of medical institutions. In today's context of limited medical resources, this advantage is particularly significant, as it ensures that patients can receive treatment more smoothly, reduces the time cost due to delays in drug preparation, and is crucial for improving the quality of medical services. Compared to traditional manual methods, intelligent drug dispensing robots demonstrate numerous advantages in handling intravenous drug preparation. They not only significantly enhance work efficiency but also effectively reduce the occurrence of drug preparation errors. In the field of drug preparation, efficiency and accuracy are key indicators of the quality of drug preparation. With their advanced technology, intelligent drug dispensing robots can quickly and accurately complete drug preparation tasks, providing strong support for clinical treatment.

Intelligent drug dispensing robots excel in the accuracy of drug dispensing, significantly reducing errors and effectively lowering various risks associated with medication use. Risks during medication use can not only affect treatment outcomes but also lead to adverse reactions, causing additional suffering for patients. The high accuracy of intelligent drug dispensing robots enhances patient safety and boosts their trust in medical services. In terms of dispensing speed, these robots also offer significant advantages. Shorter waiting times mean patients can receive treatment more quickly, reducing anxiety and unease, and thus improving their overall healthcare experience. Moreover, the use of intelligent drug dispensing robots can change patients 'perceptions of the hospital's overall service level. In today's society, patients have higher expectations for medical services, focusing not only on treatment outcomes but also on the service experience during their visits. The application of intelligent technology has led to higher service efficiency and quality, making patients perceive hospitals as more modern and professional, leading to positive reviews. This positive perception of the hospital's overall service level helps enhance its reputation and image, attracting more patients to seek medical care.

4. Conclusion

Despite the significant advantages of intelligent drug dispensing robots in intravenous medication preparation, they still face numerous challenges during widespread application. Firstly, cost is a critical issue. The development, acquisition, and ongoing maintenance of these robots require substantial investment, which can be a heavy financial burden for healthcare institutions with limited budgets. Secondly, the constant evolution of technical standards poses a challenge to the practical use of intelligent drug dispensing robots. As technology advances, the demands on drug preparation techniques are also increasing, necessitating continuous upgrades and improvements to keep pace with new standards. Additionally, training staff and learning new technologies are time-consuming and resource-intensive. Healthcare professionals must master the operation and maintenance of these robots, which places higher demands on their professional skills and learning capabilities.

In addition to technical and cost factors, the attitude of hospital management and medical staff

towards new technologies, as well as patients' willingness to accept these technologies, also significantly impacts the smooth implementation of new technologies. Some hospital administrators may be cautious about new technologies, concerned about their stability and reliability; some medical staff may resist new technologies, fearing that their jobs will be affected; and some patients may doubt the safety of new technologies, being unwilling to accept drug dispensing by intelligent medication robots. These factors can all pose significant barriers to the widespread adoption of intelligent medication robots.

However, the advantages of intelligent drug dispensing robots in intravenous medication preparation, particularly their improvements in efficiency and accuracy, are noteworthy. These findings provide valuable insights for hospitals to enhance their drug preparation processes and clearly highlight the critical role of intelligent drug dispensing technology in future healthcare services. To fully leverage the potential of intelligent drug dispensing robots, hospitals should actively explore broader applications of intelligent technology in healthcare, while considering factors such as cost, technology, and staff training. For example, hospitals can collaborate with research institutions to develop and refine intelligent drug dispensing robots, reducing costs and enhancing performance. They can also enhance the training of medical staff to improve their acceptance and operational skills with new technologies, and educate patients about the benefits and safety of these robots, thereby increasing patient acceptance. Through these measures, hospitals can further improve the quality and efficiency of healthcare services, providing patients with higher-quality and safer medical care.

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