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Application of intelligent management mode for drugs and consumables in anesthesiology department

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Abstract. – OBJECTIVE: To explore whether anesthesiologists' efficiency can be increased *via* the use of intelligent equipment, thereby improving the quality of surgical anesthesia.

SUBJECTS AND METHODS: This paper first introduces the intelligent management system and work flow of drugs and consumables in the department of anesthesiology in our hospital, and then compares the time before and after the use of intelligent equipment, the time for anesthesiologists and nurses to manage drugs and consumables, the misdistribution rate of drugs distributed by anesthetic nurses, and the inventory time and accuracy of narcotic drugs.

RESULTS: For the intelligent management with intelligent drug cabinets and logistics robots as the terminal, compared with traditional management, the anesthesiologist saves an average of 24±1 (min) per day in acquisition of drugs and consumables, and the total error rate in drugs and consumables distribution by anesthesia nurses is reduced from 4% to 1%, the inventory time of anesthetic drugs is 12±5 (min) earlier than before, and inventory accuracy has been increased from 94.6% to 98.6%. The anesthesia nurses save an average of 53.1±10 (min) per day from taking medicines to operating anesthesia billing than before.

CONCLUSIONS: The intelligent management of drugs and consumables in the Anesthesiology Department improves management efficiency, ensures medication safety for surgical patients, increases anesthesia management time for anesthesiologists, and improves the quality of surgical anesthesia.

Key Words:
Intelligent drug cabinet, Drug management, Intelligence, Anesthesiology.

Introduction

Our hospital is a grade III-A hospital integrating medicine, education, scientific research, prevention and rehabilitation. At the beginning of 2017, the digital operating room was put into use, including one digital hybrid operating room and one Da Vinci operating room. Information integration and centralized control of various equipment are the foundation of the digital operating room. With the expansion of the operating room and the reform of the medical system, the number of surgical patients is increasing. According to the surgery statistics of our hospital, 15% anesthesiologists complete 1-2 surgeries per day on average, 63% anesthesiologists complete 3-4 surgeries, 19% complete more than 5 surgeries, and about 3% anesthesiologists complete more than 6 surgeries per day. The increase in surgery times has led to an increase in the workload of anesthesiologists and the difficulty in drugs and consumables management, which will definitely affect the anesthesia quality. As one of the important factors affecting anesthesia quality, drugs and consumables management is an important part of anesthesia management. Therefore, sufficient use of intelligent equipment and information systems to quickly and accurately complete the management of pharmaceutical consumables plays an important role in improving anesthesiologists' work efficiency and surgical anesthesia quality.

With the launch of digital operating room and online application of intelligent drug cabinets and logistics robots in the Department of Anesthesia and Perioperative Medicine, the Information Department, the Pharmacy Department and the Department of Anesthesia and Perioperative Medicine jointly sort out the drug management process, thus realizing intelligent closed-loop management model of drugs and consumables with information tech-

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nology as the basis and computers, intelligent drug cabinets, logistics robots and printers as terminals.

Traditional Drug and Consumables Management Model

Traditional drug management in the Department of Anesthesia and Perioperative Medicine belongs to three-level management model, namely, the Pharmacy Department (first-level library)-inpatient Pharmacy (secondary library)-Anesthesia and Perioperative Medicine (cardinal library). According to the surgery number, the department reserves a certain number of drugs involving more than 70 varieties. The management of anesthetics is directly in the charge of the anesthesia nurse in the anesthesia preparation room. As the number of surgeries and consecutive surgeries increases, the traditional manual entry-based drug management method cannot achieve effective drug monitoring and management in real time. Intelligent equipment application is a prerequisite for the information management of department drugs and consumables (Figure 1).

Intelligent Closed-Loop Drugs and Consumables Management Mode

The new management mode is a two-level drug management mode in which the pharmacist bears direct responsibility while the anesthesia nurse assists in the management. By combining modern information technology, data collection, data verification, and process information recording and utilization in the drug dispensing process are implemented. The anesthesia preparation room, as the second-level warehouse of hospital drugs, facilitates real-time and effective management and control of drug inventory and use in the Anesthesiology Department, enables electronic entry and electronic registration, and effectively reduces the uncertainty of various human factors, so that anesthetics management is more accurate, scientific and efficient[1,2].

Intelligent Drug Cabinet

The intelligent drug cabinet (Beijing Ruihua Kangyuan Technology Co., Ltd., China) is composed of storage equipment and control equipment. According to the requirements of drug storage management, the storage equipment is set up as a layered drug rack cabinet door and drawer, in which refrigerated cabinet, light-proof drug cabinet and drawer with separate electronic locks and authorization functions are set. Control equipment includes computer touch screen, keyboard, fingerprint scanning system, temperature and humidity monitoring alarm system, electronic lock, thermal printer, monitoring equipment, etc.

Logistics Robot

The logistics robot (Beijing Ruihua Kangyuan Technology Co., Ltd., China) is responsible for delivering surgical anesthetics and consumables to the operating rooms. It is composed of a robot and a drug cabinet. There are layered partitions in the drug cabinet, and multiple drug boxes can be placed. Through the hospital Internet technology, engineer implants the walking route of the operating room in the robot management system, locates the stopping point, and equips robot alarm

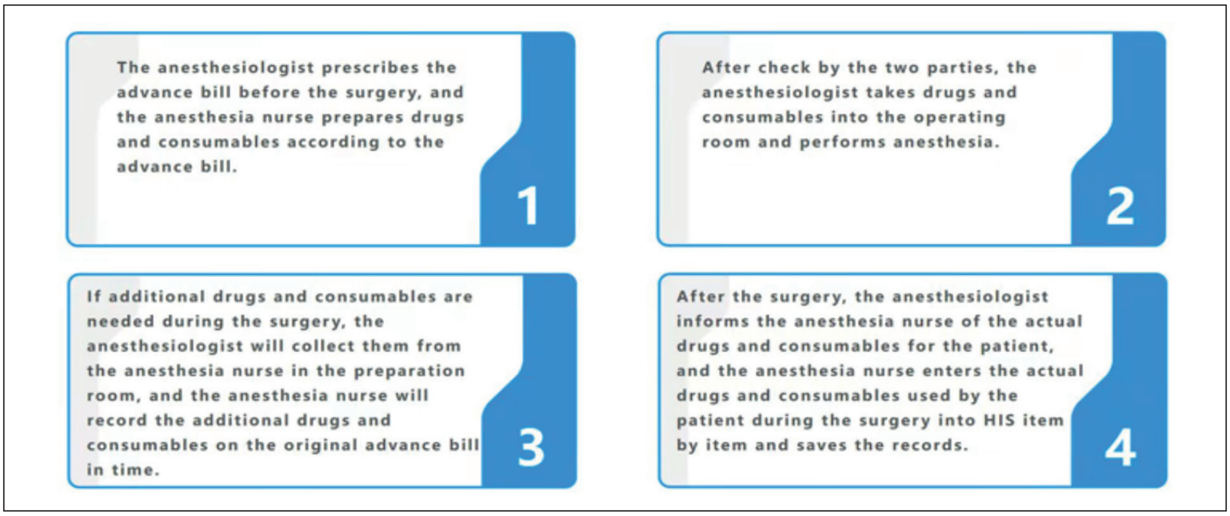

Figure 1. Traditional anesthetics and disposable consumables management process.

buzzer in each operating room. The anesthesia nurse puts the drug box with the operating room number plate in the drug cabinet of the robot. The robot then automatically plans the walking route according to the instructions. The sensor automatically senses the surrounding environment and stops at the designated operating room stop. The buzzer receives the information and sends it to the anesthesiologist. Through the robot information query system, it is possible to query and count the drugs and consumables delivery time and frequency.

Surgical Anesthesia Management System and Intelligent Drug Cabinet Management System

The surgical anesthesia management system (referred to as the anesthesia system) is a business process with the patient as the core. It operates based on the time axis and runs through the entire surgical process. The system is seamlessly integrated with information systems such as hospital HIS, laboratory information system (LIS), imaging system (PACS), electronic medical record information system (EMRS), performance appraisal system, operating room scheduling system, and intelligent drug cabinet system. Meanwhile, it is connected to the anesthesia machine, anesthesia monitor, infusion pump, blood gas analyzer, anesthesia preparation room printer, intelligent drug cabinet in the operating room. The intelligent drug cabinet is a set of intelligent drug storage cabinets controlled by an information system. It enables seamless data connection between computer technology, hospital HIS and anesthesia system, which reduces the error rate in drug distribution, and achieves plasticity in drug circulation[3,4]. The Console server is placed in the pharmacy, which supports basic information maintenance, parameter setting of the terminal intelligent drug cabinet, drug acquisition and withdrawal data information, and generation of drug supplementation report information. The anesthesiologist prescribes an advance bill for surgical anesthesia drugs and consumables through the drug cabinet program of the anesthesia system. The intelligent drug cabinet system synchronously receives the doctor's medical advice information. The anesthesia nurse receives the advance bill, enters the intelligent drug cabinet system and takes the drug according to the medical advice information on the touch screen. By automatic data collection and automatic generation of anesthesia documents, it effectively avoids possible errors in the manual entry process, increases accuracy of surgical anesthesia data, effectively reduces the labor intensity of anesthesiologists and anesthesia nurses, and improves the surgical anesthesia quality[5-7].

Intelligent Management of Anesthetic Drugs

Anesthetic drugs have sedative and pain-relieving effects, and their continuous use is prone to physical dependence and addiction[8]. The Department of Anesthesia and Perioperative Medicine is a department with more frequent anesthetics usage. According to the "Administrative Regulations on Anesthetic Drugs and Class I Psychotropic Drugs in Medical Institutions", hospital implements three-level management and five-specialized management for anesthetic drugs and Class I psychotropic drugs.

The use of intelligent drug cabinets provides a direction for the information management of anesthetic drugs. The "drawers" of the intelligent drug cabinet are equipped with separate electronic lock structure to replace the turnover safe in storage of anesthetic drugs. The system is designed with anti-theft function. The anesthesiologist or nurse enters the intelligent drug cabinet system through fingerprint scanning or job number/password entry. When taking anesthetic drugs, the display screen will prompt that there are drugs in the drawer that need to be double-signed. Then, another anesthetist nurse scans the fingerprint and enters the system, so that the drawer storing the anesthetic drug can be unlocked and automatically pops up. The two persons take out the anesthetic drug after verification, thus achieving double-lock management. The intelligent drug cabinet is equipped with a monitoring system, which can perform multi-directional video recording and monitoring. The inpatient pharmacy pharmacist conducts base management of anesthetic drugs through information such as the use and storage of anesthetic drugs uploaded by the intelligent drug cabinet information system. Authorized anesthesia nurses are solely responsible for the distribution, recovery, and supplementation of anesthetic drugs in the intelligent drug cabinet (Figure 2). With the intelligent drug cabinet as the terminal, the intelligent anesthetic drug management mode based on information technology guarantees the safety and accurate distribution of anesthetic drugs, truly achieves full-range anesthetic drug management informatization, and realizes fine management of anesthetic drugs[9,10].

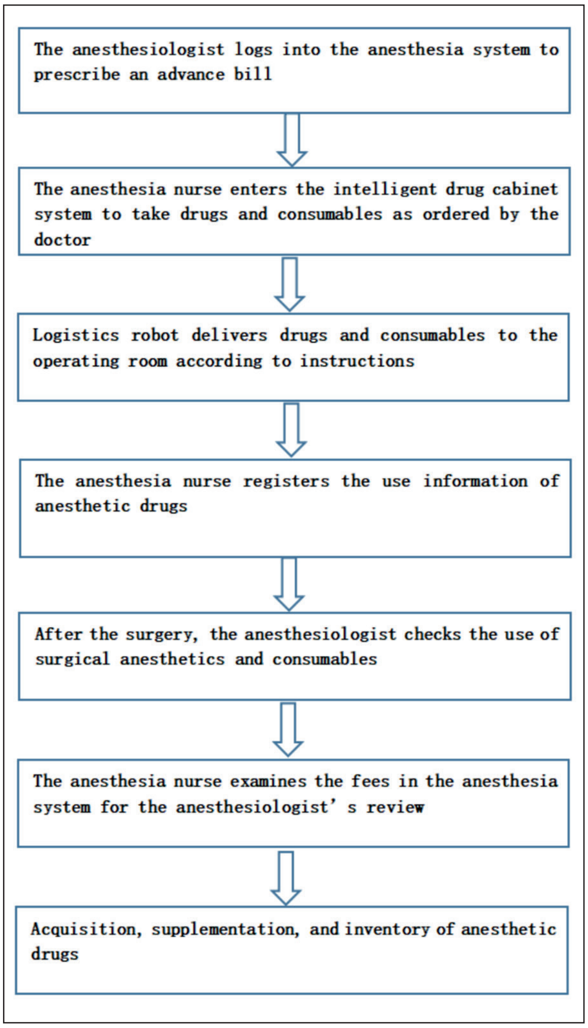

Figure 2. Flow chart of intelligent management of drugs and consumables.

Subjects and Methods

With the traditional drug and consumable management data before 2017 as the control group, 100 surgical patients were randomly selected, including 35 cases of general anesthesia by tracheal intubation, 15 cases of intravenous general anesthesia, 29 cases of intraspinal anesthesia, 13 cases of basic anesthesia, and 8 cases of nerve block anesthesia. There were 57 males and 43 females. The oldest patient was 92 years old, the youngest was 1 year old, with an average age of 46±4 years. The traditional model was directly managed by the anesthesia nurse. After the intelligent drug cabinet and logistics robot were launched in 2017, 100 surgical patients were also randomly selected as the experimental group, including 42 cases of general anesthesia by tracheal intubation, 16 cases of intravenous general anesthesia, 27 cases of intraspinal anesthesia, 8 cases of basic anesthesia, and 7 cases of nerve block anesthesia. There were 53 males and 47 females. The oldest patient was 89 years old, the youngest was 1 year old, with an average age of 45±6 years. The intelligent mode has the pharmacist's direct participation and auxiliary management by the anesthesia nurse.

Statistical Analysis

Statistical analysis was performed on the collected data using statistical software SPSS 20.0 (IBM, Armonk, NY, USA). Measurement data were expressed as mean±standard deviation ($\bar{x}\pm s$). *t*-test and one-way analysis of variance (ANOVA) were used for comparison. The count data were expressed by frequency (%) and $p<0.05$ indicates statistically significant difference.

Results

Comparison of the number of drugs and consumables collected by the anesthesiologist and the average time of each group under different anesthesia methods. The control group refers to the average time from the anesthesiologist to the anesthesia preparation room to wait for the anesthesia nurse to complete the anesthesia medication and consumables. The experimental group is the time cost when the anesthesiologist prescribes an advance bill in the operating room, the anesthesia nurse receives the doctor's medical advice information and collects drugs and consumables from the intelligent drug cabinet. According to the different methods of anesthesia, we will observe the comparison of the number of cases and the average time between the control group and the experimental group when the anesthesiologist collects drugs and consumables (Table I).

Randomly select the surgery in the last six days of 2017 (except holidays) and count the number of cases and the proportions of different anesthesia ways per day as shown. Calculate the average daily surgery time and the proportion of different anesthesia ways in the total surgeries. There were 123 daily average surgeries, of which, general anesthesia by tracheal intubation accounted for 60.5%, intravenous anesthesia accounted for 7.3%, intraspinal anesthesia accounted for 25.1%, basic anesthesia accounted for 4.5%, and nerve block anesthesia accounted for 2.6%. Combined with Table II, the average time of receiving dru-

Table I. Comparison of the number of cases (n) and average time (s) when anesthesiologist collects drugs and consumables.

Anesthesia way											
		General anesthesia by tracheal intubation		Intravenous general anesthesia		Intraspinal anesthesia		Basic anesthesia		Nerve block anesthesia	
Group	Number of cases	Number of cases	Average time	Number of cases	Average time	Number of cases	Average time	Number of cases	Average time	Number of cases	Average time
Control group	100	35	110 ± 10	15	35 ± 3	29	40 ± 5	13	12 ± 2	8	40 ± 5
Experimental group	100	42	115 ± 5	16	50 ± 5	27	60 ± 3	8	45 ± 3	7	60 ± 6

gs and consumables by each anesthetic method was calculated. The average time for anaesthesia nurses to take out drugs and consumables in each operation was 80.7 ±6 (s) in the control group and 91.8 ±4 (s) in the experimental group. The control group is 80.7±6 (s) and the experimental group is 91.8±4 (s).

We compared the time of sending drugs and consumables to the operating room between the two groups when receiving or adding drugs or consumables during the operation (Table II). The control group is the time required for the anesthesiologist to take drugs and consumables in the preparation room and then return to the operating room. The experimental group is the time required for the logistics robot to send the drugs and consumables to the operating room. Calculated based on the distance between the operating room and the anesthesia preparation room, the average time spent by the anesthesiologists in the control group was 160±6 (s), while the logistics robots in the experimental group took 125±11 (s) on average for delivery. The average daily surgery number was 123. There were 34 operating rooms open. On average, each anesthesiologist completed 3.6 surgeries in the operating room. According to changes in the patient's condition during the surgery, drugs or consumables need to be supplemented once during each surgery. Statistics show that the anesthesiologists in the control group take 1442.5±64 (s) to take drugs and consumables every day on average, i.e., 24±1 (min). The anesthesiologists in the experimental group take 1230.5±27 (s) to take drugs and consumables every day on average, i.e., 20.5±0.5 (min). The anesthesia nurses in the control group had to go to the safe to take the anesthetic drugs in the traditional way. Due to limited space, they could only take the drugs for one operating room at a time. When the surgeries have relatively concentrated start time, the waiting time of the anesthesiologist will be relatively extended. The anesthesia nurses in the experimental group adopted intelligent method. Four intelligent drug cabinets support simultaneous withdrawal of drugs and consumables for different operating rooms. The logistics robot receives instructions and automatically plans the route to send drugs and consumables to multiple operating rooms in turn. According to intelligent management approach, the anesthesiologist saves 1442.5±64(s) in walking between the anesthesia preparation room and the operating room every day, and the time to get drugs and consumables is advanced by 58.9±15(s) on average in every surgery. The application of information technology and the use of terminal intelligent drug cabinets and logistics robots save the anesthesiologist's preoperative preparation time, reduce the anesthesiologist's physical consumption, increase the surgical anesthesia preparation time, and improve the anesthesiologist's surgical anesthesia quality.

We compared the misuse of drugs and consumables distributed by anesthetic nurses in two groups and the proportion to the total number of cases (total error rate) (Table III). In the control group, the anesthesia nurses took the drugs from the drug cabinet manually, and it was easy to make mistakes in look-alike, sound-alike drugs of different specifications. The average error rate was 4%. In the experimental group, the anesthesia nurses took the drug according to the indicator of the intelligent drug cabinet, and the average error rate was 1%. Here, negligence of the anesthesia nurse and the wrong number of drugs taken are the main reasons for the error. The experiment showed that strengthening the sense of responsibility among the medical staff could avoid or reduce the error. $p<0.05$ indicates statistical significance.

We compared the average time and accuracy of charging in different anesthetic methods between the two groups (Table IV). The average billing accuracy rate is 97% in the control group and 99%

Table II. Comparison of the time required for distributing anesthetic drugs and consumables to the operating room (s).

Group	Distribution way: Operating room farthest from the anesthesia preparation room	Operating room nearest from the anesthesia preparation room	Five consecutive operating rooms
Control group	(65 ± 5) × 2	(15 ± 3) × 2	
Experi-mental group	200 ± 20	30 ± 2	650 ± 100

Table III. Comparison of the number of wrongly distributed cases (n) and the total error rate (%) when anesthesia nurses distribute anesthetics according to the advance bill.

		Anesthesia way														
		General anesthesia by tracheal intubation			Intravenous general anesthesia			Intraspinal anesthesia			Basic anesthesia			Nerve block anesthesia		
	Number of cases	Number of wrongly distributed cases	Total error rate	Number of cases	Number of wrongly distributed cases	Total error rate	Number of cases	Number of wrongly distributed cases	Total error rate	Number of Cases	Number of wrongly distributed cases	Total error rate	Number of cases	Number of wrongly distributed cases	Total error rate	Number of cases
Control group	100	35	2	2	15	0	0	29	1	1	13	0	0	8	1	1
Experimental group	100	42	1	1	16	0	0	27	0	0	8	0	0	7	0	0

Table IV. Comparison of the average billing time (s) and billing accuracy (%) of anesthesia.

	Control group				Experimental group			
Anesthesia way	Number of cases	Billing time	Accurate number of cases	Accuracy rate	Number of cases	Billing time	Accurate number of cases	Accuracy rate
General anesthesia by tracheal intubation	35	120 ± 30	33	94.2	42	70 ± 30	41	97.6
Intravenous anesthesia	15	52 ± 8	15	100	16	30 ± 10	16	100
Intraspinal anesthesia	29	58 ± 12	28	96.5	27	35 ± 20	27	100
Basic anesthesia	13	40 ± 5	13	100	8	20 ± 3	8	100
Nerve block anesthesia	8	55 ± 10	8	100	7	35 ± 20	7	100
Total	100	105 ± 15	97	97	100	68 ± 16	99	99

in the experimental group. Calculated according to the daily average proportion of surgical anesthesia, the average billing time for anesthesia per surgery is 105 ± 15 (s) in the control group and 68 ± 10 (s) in the experimental group. According to Table II, the anesthesia nurses spent more time [11.1±4(s)] in drug acquisition in the experimental group than in the control group. That is to say, the anesthesia nurses spend less time [25.9±5(s) on average] than the control group in each surgery from drug acquisition to surgical anesthesia billing. Calculated on the basis of 123 surgeries per day, the anesthesia nurses in the experimental group save 3185±615 (s), or 53.1±10 (min) compared with the control group. In the experimental group, the process of collecting and sorting out doctor's medical advice information is reduced before surgical anesthesia billing. By automatic recording of the anesthesia system, it reduces interconnection links, avoids human errors, shortens the billing time, and improves the accuracy in surgical anesthesia billing. $p<0.05$ indicates statistical significance.

We set the inventory time and accuracy rate of commonly used anesthetic drugs within 1 month before 2017 as the control group, and set that within 1 month after 2017 as the experimental group. The inventory time and accuracy rate of anesthetic drugs are compared between the two groups. The accuracy rate of anesthetic drugs refers to the base rate of anesthetic drugs after counting. If the statistical quantity does not match the base, it is necessary to contact the anesthesiologist in time and find out the cause of the error. According to the usage of anesthetic drugs, the average inventory accuracy rate of anesthetic drugs is 94.6% in the control group and 98.6% in the experimental group. The inventory time is 12±5 (min) less in the experimental group than in the control group. The intelligent drug cabinet system automatically counts the anesthetic drugs accounting information to provide effective data for the inventory of anesthetic drugs. Compared with the manual statistics in the control group, it shortens the inventory time for anesthetic drugs and increases the account-item matching rate in inventory of anesthetic drugs. $p<0.05$ indicates statistical significance.

Discussion

Intelligent drug cabinets and logistics robots have been used in our department for three years, which optimizes and perfects the management process of drugs and consumables in the Department of Anesthesia and Perioperative Medicine. Based on information technology, intelligent management of drugs and consumables with intelligent drug cabinets and logistics robots as terminals ensures medication safety for surgical patients, shortens the management time of drugs and consumables for anesthesiologists and nurses, increases management efficiency, so that anesthesiologists and anesthesia nurses can devote more time to the patients' surgical anesthesia[11-13]. The intelligent drug cabinet provides round-the-clock service. The anesthesiologist can take drug by himself when the anesthesia nurse is absent. The intelligent drug cabinet system, anesthesia system, and HIS are seamlessly connected to build a powerful database for the management of drugs and consumables in the department of anesthesia and perioperative medicine, thus achieving full-process, intelligent, and information-based closed-loop management of department drugs and consumables[13]. Each intelligent drug cabinet is equipped with a backup positive opening key, which is kept by the nurse in the anesthesia preparation room. In case of power failure, network paralysis or other failures, the lock can be forcibly opened to meet anesthesia medication needs of emergency surgery. After the intelligent drug cabinet returns to normal, remedial measures can be taken to make the account-item matching rate reach 100%.

Hospital informatization and digital construction mark the modernization degree of a hospital[14]. According to the department's needs, intelligent drug cabinet combines information technology to successfully integrate patient information, medical advice information, cost information and drug information into one platform, so that medical advice, anesthesia drug and consumables, and cost data are processed intelligently, thus improving level of automation in drug management[6]. If possible, the hospital can equip the on-duty doctor with an intelligent drug cart. In case of duty at night and holidays, the on-duty doctor can push the intelligent drug cart to the operating room without running between the operating room and anesthesia preparation room and is thus able to complete acquisition of drugs and consumables at any time. It saves preparation time, and moreover, ensures life safety and surgical anesthesia quality of emergency surgery patients.

The results of this study showed that compared with traditional management, the intelligent management based on intelligent drug cabinets and logistics robots saved an average of 24±1 (min) per day in anesthesiologists' acquisition of drugs and consumables, and the total error rate in anesthesia nurses' distribution of drugs and consumables was reduced from 4% to 1%. The anesthetic drug inventory time was 12±5 (min) earlier than before, and the inventory accuracy rate was improved from 94.6% to 98.6%. The anesthesia nurse saved 53.1±10 (min) on average per day in drug acquisition and surgical anesthesia billing.

Conclusions

In summary, the intelligent management of drugs and consumables in the anesthesiology department improves management efficiency, which not only guarantees medication safety for surgical patients, but also increases anesthesia quality. Moreover, application of intelligence in management of drugs and consumables can greatly improve the medical management level and contribute more to the improvement of the modern hospital management system.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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Data Availability Statement

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

Authors' Contribution

Jing Liu: Methodology, data curation, and analysis. Writing-draft and editing.

References

1) Wang J, Yang W, Yang L. The construction and practice of information management of anesthetic drugs in our outpatient department. China Pharmacy 2017; 28: 95-98.
2) Shuai L, Luo X, Ma X. Application Effect and Experience of Hospital Narcotic Drug Information Management System. Chinese Journal of Health Informatics and Management 2019; 16: 618-622.
3) Liu H, Xiao F, Hong Q. Research on the construction of hospital digital operating room. Chinese Med-ical Equipment Journal 2017; 3: 67-69.
4) Ye P, Bian X. Using automated dispending cabinet to explore the decentralized drug distribution in our hospital. Journal of China Prescription Drug 2016; 14: 31-32.
5) Shi L, He J, Geng Z. Design and Application of Intelligent Drug Cabinet Management System[J]. Chi-nese Medical Equipment Journal 2016; 37: 67-69
6) He J, Shi L, Luan Y, Sun W, Liu B. Interface of HIS with automated cabinet system based on No.1 military medical project. Chinese Medical Equipment Journal 2016; 37: 60-63.
7) Mikolajczak A, Bellon B, Calmels V, Cestac P, Cool C, Duhalde V. OHP-009 How hospital pharma-cists can promote proper use of breath tests beyond buying medical devices? Eur J Hosp Pharm 2016; 23: A175-A176.
8) Li W, Xu J, Xu J, Peng X, Xu Z. Application of multifunctional special drug and consumables man-agement cabinet in anesthesiology department. Chinese Journal of Hospital Administration 2017; 033: 524-526.
9) Chen X, Zhang R, Chu Y, Du S. Application practice and experience of intelligent anesthetic drug management system in our anesthesiology department. China Pharmacy 2015; 26:2 247-2250.
10) Kumar S, Chakravarty A. ABC-VED analysis of expendable medical stores at a tertiary care hospital. Med J Armed Forces India 2015; 71: 24-27.
11) Shen G, Wang Y, Zhang Y, Shi X, Zeng Y, Wang W, Bao J, Miao L. Development and application of intelligent management system for anesthetic drugs in our central pharmacy. China Pharmacy 2018; 029: 1158-1161.
12) Ding H, Xiao P, Jiang Y, Gu M. Investigation and analysis of nursing status in the anesthesiology de-partment of tertiary hospitals in Guangdong Province. Chinese Journal of Anesthesiology 2018; 038: 516-520.
13) Zhu J, Huang L, Ma Z. Clinical Pathway and Alert Management of Intelligent Medical Consumables. Chinese Journal of Medical Instrumentation 2019; 43: 69-71.
14) Hu Q, Guo Z. Construction and application of risk warning in surgical anesthesia information man-agement system. Chinese Journal of Nursing 2018; 53: 48-52.