

Analysis of Advantages and Disadvantages of Automatic Medicine Dispensing Machine in Hospital Pharmacies: An analytical study to help pharmacies decide whether to install automatic dispensers.

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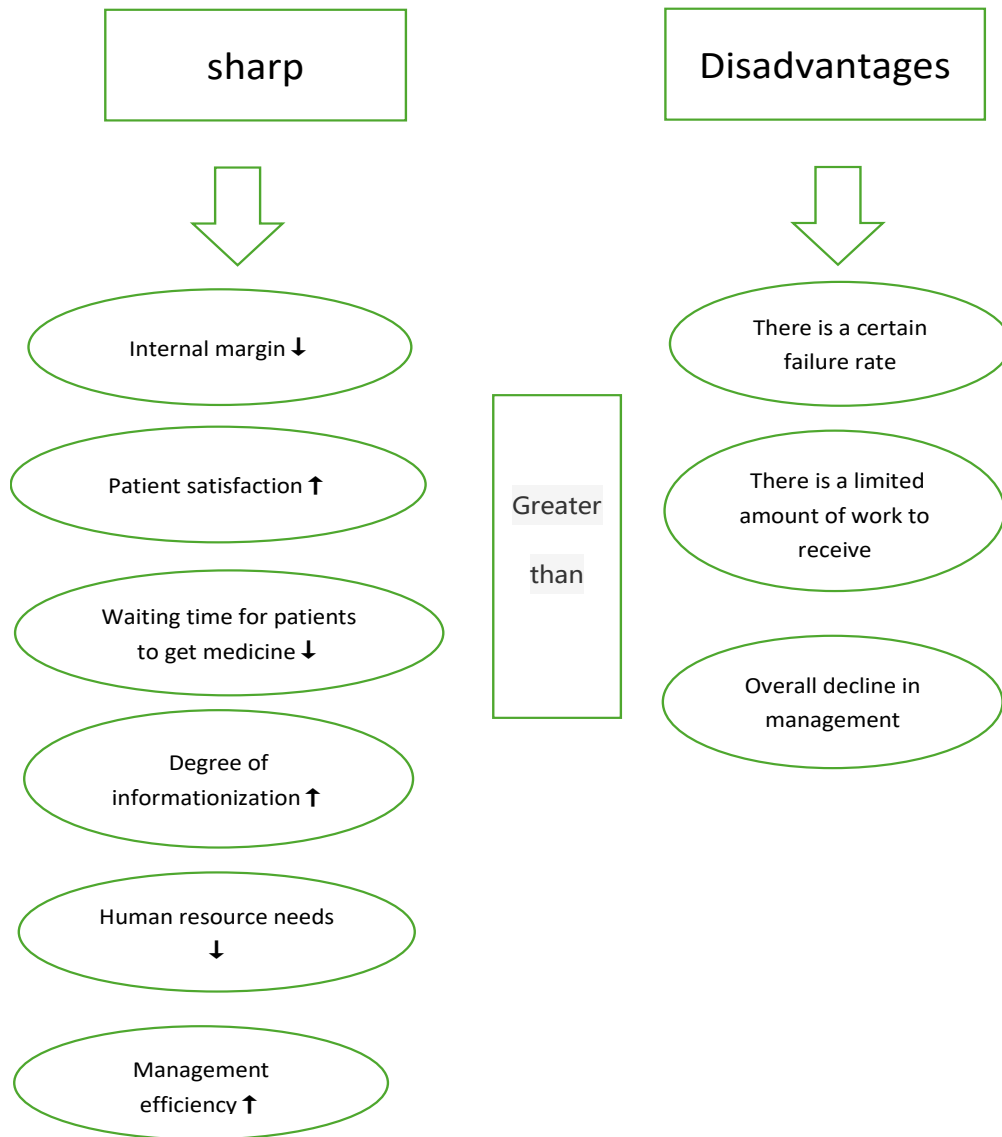
Abstract: Objective: To understand the advantages, disadvantages, and user experiences brought by the installation and use of automatic medicine dispensing machines in hospital pharmacies, as their adoption is gradually increasing.

Methods: Through practical application, this study compares the changes in pharmacy processes, patient waiting times for medication pick-up, and dispensing error rates before and after installing automatic medicine dispensing machines in hospital pharmacies.

Results: The integration of automatic medicine dispensing machines with the hospital's information network system has led to significant improvements in pharmacy workflow efficiency and dispensing quality, markedly reducing patient waiting times and saving human resources. With continuous advancements in medical technology, the popularity of automatic medicine dispensing machines has emerged as a trend in hospital pharmacies. Compared to the traditional manual dispensing mode, the incorporation of robotic automatic medicine dispensing machines into outpatient pharmacy operations highlights notable application advantages. This article primarily examines the pros and cons of robotic automatic medicine dispensing machines^[1] in hospital outpatient pharmacies.

Keywords: Automatic Medicine Dispensing Machine; Outpatient Pharmacy; Process; Efficiency; Quality

Our hospital, a tertiary grade A specialized hospital, processes approximately 1,700 outpatient prescriptions daily. The traditional manual dispensing model has resulted in high workload for pharmacists, prone to errors, and long waiting times for patients, with limited time for medication consultation. To alleviate these issues and align with the development of pharmaceutical information and automation in hospitals, our outpatient pharmacy has introduced mechanical arm-based automated drug dispensing machines, refining patient-centered pharmaceutical services^[2].



1. Research Objects and Methods

1.1 Basic Operation of Robotic Automated Drug Dispensing Machines^[3]

Most drug boxes in hospital pharmacies have QR codes containing identification information (for drugs without QR codes, their information can be entered into the system). The automated drug dispensing machine can recognize and record the QR codes on the drug packages, and in conjunction with prescription information from the hospital's HIS system, it uses two mechanical arms to pick up the relevant drugs and deliver them to the appropriate window via a sliding track, completing the dispensing process.

1.2 Drug Loading in Automated Drug Dispensing Machines

The machine automatically recognizes the QR codes on the drug boxes on the loading track and, based on the initially set outer packaging specifications, completes the drug loading process. Pharmacists only need to enter the expiration date of the first drug box with a QR code on their computers, and then pour the remaining drugs in their smallest packaging units into the automatic loading track to complete the loading process.

1.3 Window Settings for Automated Drug Dispensing Machines

The outpatient pharmacy is equipped with five dispensing windows, including three direct dispensing windows and two mixed dispensing windows^[4]. Direct dispensing windows receive prescriptions with all drugs within the machine's inventory. By scanning the patient's medical insurance card, the machine dispenses all drugs directly to the window, requiring only one pharmacist per window. Mixed dispensing windows handle prescriptions with drugs not stored in the machine, such as split-dose drugs or refrigerated drugs, requiring manual dispensing by pharmacists in conjunction with the automated machine.

1.4 Medication Pickup Process after the Introduction of Automated Drug Dispensing Machines

The medication pickup process for patients: (1) The patient presents their card to the doctor for consultation, and the doctor enters the prescription into the card; (2) The patient settles the bill through their mobile electronic health card, self-service machine, or cashier. Upon settlement, they receive an electronic message with the pickup location and window. Simultaneously, the automated drug dispensing machine receives the prescription information; (3) The dispensing system sorts prescriptions into direct or mixed dispensing windows and displays patient names on LED screens. Patients with mixed prescriptions wait for the pharmacist to complete manual dispensing before their names appear^[5]; (4) Patients present their cards at the designated window to collect their medication. After collection, their names disappear from the screen, and the system records the completed dispensing.

1.5 Methods

We compared traditional manual dispensing processes with those after installing automated drug dispensing machines, focusing on changes in processes, patient waiting times, and dispensing error rates.

2. Discussion

2.1 The advantages brought by the installation of automatic drug dispenser for the work of the pharmacy are obvious, as follows:

2.1.1 Optimize the drug collection process in outpatient pharmacy

In the traditional drug collection mode, after the patient swipes the card to settle the bill, he still needs to go to the pharmacy self-service machine to click to confirm the drug collection, the information is pushed to the pharmacy, and the pharmacist begins to dispense the medicine after dispensing. Due to the uncertainty of the dispensing personnel, the dispensing speed of the dispensing pharmacist is different, in the case of multiple Windows at the same time, it is not clear the window number, nor is it clear that they need to wait about the time to take medicine, and patients can only wait blindly. After the automatic drug dispensing machine is online, combined with the application of the hospital network, patients only need to settle this step, they can know their own drug taking window, and through the on-site drug taking personnel can know their own waiting time in line to take medicine, compared with the previous drug taking procedure is more concise, patients are more clear about their drug taking information and steps. At the same time, for the prescription of patients who take medicine at the straight hair window, the dispensing operation will be performed only when the patient goes to the front of the window to take medicine, avoiding the phenomenon of a large amount of traditional predispensing mode prescriptions in the dispensing window, so that the dispensing environment becomes more concise and orderly.

2.1.2 Promote the realization of informationization of drug dispensing process^[6]

The on-line of automatic dispensing machine has directly promoted the informationization of drug dispensing process, abandoned the paper prescription printing process of the traditional process, and the electronic prescription is directly received by the system. When the pharmacist formulates the prescription of the mixed hair window, he can complete the adjustment only by looking at the electronic device in his hand. In the hair straightening window, it is directly abandoned the background dispensing process, and the dispensing is directly completed by the automatic dispensing machine, and there is no need to print paper prescriptions. This link not only saves a lot of paper prescription printing costs for the adjustment of work, so as to achieve energy saving and environmental protection, but also avoids the drawbacks of unclear writing, paper jam, prescription loss, multiple prescription paging, etc., and eliminates the tedious work of traditional preservation of paper prescriptions and destruction of paper prescriptions, saving a large amount of labor for pharmacists.

2.1.3 The waiting time for patients to obtain medicine has been greatly reduced^[7]

Reducing the waiting time for patients to take medicine is one of the outstanding advantages of the automatic dispensing machine. In the improved drug collection process combined with the work of the automatic dispensing machine, the outpatient pharmacy can receive the drug collection information of the patient as soon as the patient pays the bill. Whether it is the prescription of the straight window or the mixed window, the pharmacy has prepared the drug of the patient before the patient arrives at the pharmacy to pick up the drug^[8]. Taking medicine personnel only need to queue up at their respective Windows in order to take medicine. Compared with the traditional mode, this mode saves more waiting time for patients to take medicine.

The following is the drug collection waiting time of patients before and after the automatic drug dispensing machine. Among them, the intermediate period from October 2020 to March 2021 is the preparation time of the automatic drug dispensing machine line.

	Time period	Average waiting time for drug collection
Automatic dispensing machine line before	April - September 2020	6.5min
Automatic dispensing machine line behind	April - September 2021	4.5min

From the data point of view, the waiting time for patients to get medicine has been significantly shortened.

2.1.4 Reduce drug dispensing error rate in outpatient pharmacy^[9]

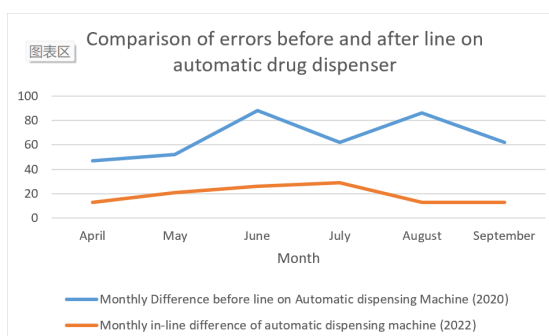
In the traditional drug taking mode, the prescription drugs are all manually dispensed by the pharmacist, and there is a risk of dispensing errors when the number of prescriptions is large and the work intensity is large. The on-line of the automatic drug dispensing machine greatly reduces the dispensing internal error rate of outpatient pharmacies, especially to avoid the variety errors that may be caused by similar drugs, similar packaging or similar locations, greatly reducing the safety risks of patients, and further ensuring the safety of patients.

At the same time, through practice, with the automatic dispensing machine to take appropriate measures, can also further reduce the allocation error rate. The measures that can be taken to reduce dispensing errors include: (1) formulating standard dispensing process and training pharmacists to operate according to standard dispensing process; (2) The mixing interface of the mixing window sets prefixes for drug names with similar drug names, such as trade names, packaging colors and other unique special words, so that the pharmacist can identify the drug to be adjusted at a glance when dispensing; (3) For easily miscible drugs without special words, the storage space can be set in the dispensing interface to increase drug discrimination; (4) When dispensing in the mixing window, dif-

ferent background colors can be set for drugs that are prone to dispensing errors, such as orange and green for easily miscible drugs, which can be easily identified by pharmacists; (5) Third-party equipment such as intelligent storage dispensing machine can be introduced to complete the mixing window with the automatic dispensing machine.

The following is the data of the internal difference of the automatic dispensing machine within half a year before and after the line, and the intermediate time of the preparation time of the automatic dispensing machine from October 2020 to March 2022 and the implementation, investigation and final decision of various measures to reduce the internal difference of the automatic dispensing machine.

	April	May	June	July	August	September
Monthly Difference before line on Automatic dispensing Machine (2020)	47cases	52cases	88cases	62cases	86cases	62cases
Monthly in-line difference of automatic dispensing machine (2022)	13cases	21cases	26cases	29cases	13cases	13cases



Through data comparison, after the automatic dispensing machine was set up, the dispensing error in outpatient pharmacy was significantly reduced, and dispensing safety was further guaranteed.

2.1.5 Reduce the work intensity of pharmacists and save manpower

There are more than 1700 prescriptions per day in the outpatient pharmacy of our hospital. Before the automatic dispensing machine is online, 7-8 dispensing pharmacists per day are needed to cope with the daily basic work including applying medicine, dispensing and issuing, etc., and the work intensity is high, and the pharmacist has a strong sense of fatigue. After the automatic dispenser, because the dispenser undertakes a lot of work of drug preparation and dispensing, it only needs 5-6 dispensing pharmacists on average to deal with the same amount of prescription, and the job responsibilities are clear, the pharmacist's position is clear, and the workload is easy to count. Compared with the automatic dispenser, the work intensity is significantly reduced, and the pharmacists all report that the work is significantly easier than that before the dispenser. Pharmacists can devote more energy to communication with patients and medication consultation.

2.1.6 Improve drug management efficiency^[10]

The storage system of the automatic drug dispenser records the effective date and drug preparation date of all the drugs in the drug dispenser, and can also query the drugs with zero and few transactions in the near future through the system, prompting the drug administrator to make timely drug maintenance and adjustment, ensuring the quality and safety of the drugs. At the same time, it can also scientifically and reasonably supplement according to the drug transaction situation, ensure the supply of drugs in time, and strictly achieve the near-effect first-out, first-in-first-out, reduce the risk of drug expiration and other quality problems, which is conducive to the daily management and maintenance of drugs, and ensure the quality of drugs.

2.1.7 Conducive to the management of the daily work of the pharmacy^[11]

Compared with the traditional paper prescription dispensing mode, the automatic drug dispensing machine and its supporting queuing and calling system can clearly and accurately calculate the number of prescriptions dispensed by each pharmacy staff, the number of drugs issued and the specific waiting time of each drug receiving patient. The department can use the above data as a key reference for assessing the work performance of outpatient pharmacy staff. At the same time, it will also provide corresponding data for hospital management, facilitate the scientific and reasonable management of outpatient pharmacy, and make the management of outpatient pharmacy more comprehensive, scientific and standardized.

2.1.8 Improve patients' satisfaction of taking medicine^[12]

By reducing the waiting time for patients to get medicine and increasing the communication time with patients, the satisfaction of patients can be improved, the adverse experience of patients' difficulty in seeking medical treatment can be reduced, and the patient-centered service purpose can be better reflected. The process of taking medicine for most patients is the last step in the medical treatment process, which means that they have already gone through the process of waiting for treatment and examination. Therefore, in the process of taking medicine, it is particularly important to reduce the waiting time of taking medicine for patients, which can greatly improve the satisfaction of patients. At the same time, pharmacists have more time to communicate with patients, so that patients can feel humanistic care, and get better medication guidance to ensure medication compliance. In addition, the smooth automatic dispensing operation of the automatic dispensing machine often makes patients sigh and praise the advanced nature, science and technology and The Times of the hospital's medical equipment, which improves patients' trust in the hospital on the other hand.

Patient Satisfaction Survey

	April	May	June	July	August	September
Patient satisfaction rate (2020)	88%	79%	85%	83%	85%	81%
Patient satisfaction rate (2022)	96%	93%	88%	91%	90%	92%

NOTE: 100 patients were randomly selected from the hospital to investigate the satisfaction of the drug-taking process. The survey options were divided into satisfaction and dissatisfaction, and the satisfaction rate was the number of people/The total number of people surveyed.

2.2. At the same time, the application of the robotic automatic drug dispenser also has the following defects.

2.2.1 There is an upper limit to the daily prescription quantity that can be accepted

At present, the average daily amount of prescriptions in the outpatient pharmacy of our hospital is about 1500-2000. The robotic automatic drug dispensing machine can cooperate with the dispensing pharmacists in a high efficiency to complete this workload, and patients can also get drugs in a short period of time, and prescriptions will not be overstocked. However, if the daily prescription volume is further increased to about 2500, there may be more cases of patients waiting in long lines to get medicine, and the time for patients to get medicine will be significantly increased. Therefore, combined with the use of experience, this automatic dispensing machine is not suitable for use in outpatient pharmacies with abnormally large prescriptions.

2.2.2 Only drugs in cuboid or cuboid pill boxes can be received

Because the robotic automatic drug dispenser adopts the working mode of the mechanical arm to grab the drug, only the cuboid or cuboid drug box can be stored in the automatic drug dispenser, and some bottled, bagged and packaged drugs can not use the automatic drug dispenser to work, which will affect the use efficiency of the automatic drug dispenser and reduce the straight hair rate. Although this problem can be solved by artificially increasing the setting of drug packaging, the manual packaging of such drugs that cannot enter the automatic drug dispensing machine into the cube or cuboid pill box set by themselves, and then by maintaining the two-dimensional code, such drawbacks can be solved, but at the same time, it will increase the consumption of certain human and material resources.

2.2.3 There is a certain failure rate^[13]

Due to the difference in the packaging quality of the drug box, the grasping error^[14] of the mechanical arm, etc., there will be a certain failure rate during the working process of the automatic drug dispensing machine, which is mostly

non-hardware failures, such failures can usually be solved in a short time, and the impact on the overall dispensing work will not be too great. In the case of normal maintenance in place, the incidence of hardware failure is also relatively low, almost will not appear, but if there is a hardware failure, the maintenance time is relatively slow, so the pharmacy needs a set of emergency deployment plan for the failure of the drug dispensing machine, in case of emergency processing when the machine fails.

Failure rate statistics of automatic dispenser

	April	May	June	July	August	September
Failure rate statistics of automatic dispenser (2022)	4 times	3 times	2 times	3 times	2 times	1 times

The above is the dispenser when the use of a small fault, the fault can be repaired in 1 minute.

2.2.4 Drug maintenance cannot be carried out comprehensively and intuitively^[15]

Since all drugs are stored in the automatic dispensing machine, if there is a manual misrecording of the expiration date when preparing drugs, it is less easy to be found than the drugs stored on the shelf before, which will lead to the possibility of drug storage expiration. At the same time, individual quality problems such as leakage and damaged drugs cannot be found visually, and can only be found when dispensing.

3.Results

according to the above analysis, the application of mechanical hand-type automatic drug dispenser in the daily operation of outpatient pharmacy has the following obvious advantages: 1. Promote the formation of electronic information process, the abolition of paper disposal, saving medical costs. 2. It reduces the waiting time for patients to get medicine. According to the statistics of the same period, the waiting time of patients to get medicine was reduced from 6.5 minutes to 4.5 minutes. 3. The dispensing error rate was reduced from 66 cases to 19 cases during the same period. Four. Reduced labor costs. The manpower required for the same workload at the same pharmacy during the same period has been reduced from 7-8 to 5-6. 5. To improve the satisfaction of patients. Compared with the same period, the satisfaction rate of patients increased from 83.5% to 91.7% . 6. Improve the management efficiency of daily work. At the same time, there are some drawbacks: 1. The applicable workload is limited and not suitable when the pharmacy workload exceeds 2,500 prescriptions per day. 2. Not applicable to all drug dispensing, including non-cubic and disassembled drugs. 3. There is a certain failure rate, the statistics of the automatic dispenser failure rate within 6 months, the average monthly occurrence of 2.5 small failures, such failures can be resolved in 1 minute.

4. Conclusion

To sum up, the application of mechanical hand-type automatic dispensing machine in the daily operation of outpatient pharmacy has more prominent advantages, which can be based on improving the environment of outpatient pharmacy, it has realized the informationization and automation of the hospital drug dispensing work, realized the shift of the focus of the pharmacist's work, and significantly reduced the waiting time for patients to take medicine, at the same time, it plays an active role in improving the service quality and level of the hospital, which can ensure the safety of taking medicine for patients and reduce the occurrence of medical disputes, recommended prescription volume in the automatic dispenser within the working range of the outpatient pharmacy application.

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