# Influences of information management path coordination with dynamic monitoring on the quality of hospital drug management

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**Background:** To explore the impact of information management path coordination with dynamic monitoring on the quality of hospital drug management.

**Methods:** Based on the management mode of the information management path coupled with dynamic monitoring for hospital drug management, the overall structure of drug management was designed according to the drug management needs, and the management process was dynamically monitored by computer. The incidence of drug management errors was analyzed before and after implementation, including errors in drug placement, unreasonable actions, and vague labeling of high-risk drugs. The near-term and overdue statuses of various drugs were analyzed before and after implementation. Based on the "Hospital Pharmaceutical Management Regulations", a questionnaire about drug management quality was designed to address issues such as the pharmacy area, pharmacy management, drug management, pharmacy equipment management, and management efficiency; a drug management quality score was given before and after implementation.

**Results:** The incidence rates of drug placement errors, unreasonable actions, and vague labeling of high-risk drugs were 1.67%, 2.50%, and 1.67%, respectively, which were significantly lower than the pre-implementation rates of 8.33%, 10.00%, and 8.33% ($P<0.05$), respectively. The expiration rates of emergency medicines and general medicines after the implementation of information management path coordination with dynamic monitoring were 0.00% and 3.41%, respectively, which were significantly lower than the rates of 30.00% and 11.36% before implementation ($P<0.05$). The total score and the scores for the pharmacy area, pharmacy management, drug management, pharmacy equipment management, and management efficiency after the implementation of the information management path combined with dynamic monitoring were significantly higher than those before implementation ($P<0.05$).

**Conclusions:** Using information management path coordination with dynamic monitoring can reduce the incidence of errors in the drug management process, improve the drug utilization rate in the near-term, and improve the management quality.

**Keywords:** Dynamic monitoring; information management path; hospital drug management; management quality; management efficiency

## Introduction

The quality of drug management in hospitals is closely related to the safety of drug use. However, in various hospitals, there are many drug management problems, which need to be carefully treated and managed closely (1). With the development of network information technology, the mode of drug management in Chinese hospitals has gradually changed toward microcomputer networking (2,3). Information technology provides a tool to solve current problems in the drug management process. It is conducive to the dynamic monitoring of the use of various drugs, the discovery of unreasonable activities in a timely fashion and the proposal of solutions to improve the quality of management (4,5). The information management path is a new type of management model supported by information technology. By constructing a series of management paths and optimizing the management process, dynamic monitoring of the management process can be accomplished (6,7). This study mainly analyzes the impact of information management path coordination with dynamic monitoring on the quality of hospital drug management. It is committed to the creation of a more comprehensive and accurate management model to improve the level and quality of management, which is described below.

## Methods

### General information

From February 2018 to February 2019, this hospital adopted the model of an information management path combined with dynamic monitoring for drug management. Participants included 25 management personnel, comprising 15 males and 10 females aged 23–46 years, with an average age of 36.53±8.39 years. The members consisted of 4 operation managers, 4 warehouse managers, 8 pharmacy managers, 5 purchasers and 4 system managers. Regarding the highest degree obtained, 6 participants had a college degree, 14 had a bachelor's degree, and 5 had a master's degree. During the study period, drug management comprised 120 batches, which included 8 batches of high-risk drugs, 4 batches of toxic and anesthetic drugs, 20 batches of emergency drugs, and 88 batches of general drugs. To analyze the drug utilization before the implementation of the information management path combined with dynamic monitoring, this study used the traditional management of 8 batches of high-risk drugs, 4 batches of toxic and anesthetic drugs, 20 batches of emergency drugs and 88 batches of

general drugs from December 2017 to December 2018 for comparison. Drug management was conducted by the same group of personnel during both periods.

### Inclusion and exclusion criteria

**Inclusion criteria**

Drug management personnel who (I) were working in the pharmacy of the hospital during the study period; (II) had more than 3 years' work experience; (III) had a college education or higher; (IV) were in good physical health.

**Exclusion criteria**

(I) Management personnel who were on leave due to illness or pregnancy; (II) pharmacy management interns; (III) trainees.

### Management methods

Information management path: the hospital invited professional information technology teams to provide technical support and designed the overall structure according to drug management needs. (I) Analysis of drug management needs: (i) patients' needs: patients could search doctors' information and office hours online and schedule a visit. In addition, an online queuing system was adopted to improve the efficiency of doctors' office visits and drug pick-ups. (ii) Doctors' needs: through access to patients' personal files, doctors could learn the patient's medical history and medication use history and write prescriptions according to the actual condition. Searches for various drugs could also be performed, with the system automatically displaying drug information such as brand name, price, dosing, inventory, adverse reactions and so on, which is conducive to a timely understanding of the storage and use of the drugs. (iii) Drug purchasing needs: the drug management system had its own reminder function, and management personnel could set the upper and lower limits for various drugs. Once the inventory was insufficient to meet the lower limit, the system issued a reminder function, which helped the managers know which drugs needed to be purchased. (iv) Pharmacy management needs: managers could inquire about the classification of drugs through information technology; understand drug placement, usage, base, dosage, type and other conditions in a timely fashion; and determine the problems in the management process and correct them. In addition, the system could update the drug information in real time and understand drug usage and

surplus. (v) System security management needs: hospitals are required to be equipped with professional information management teams to maintain system security and daily monitoring of the equipment operation conditions, especially in terms of hardware facilities, to avoid the disclosure of patients' privacy. (II) Design principles: (i) practical principles: the information system must take the needs of patients, doctors, and management personnel into full consideration, maximally improving work efficiency and considering the management of business and user needs as the most important service elements. (ii) Security and reliability needs: the design of the information system must be secure and reliable to prevent illegal intrusion. The system could improve security through multilevel authentication and make full use of encryption technology. The information in the database should be backed up to prevent information loss caused by natural disasters. (iii) Principle of flexibility: the system design should be componentized and modularized as much as possible while ensuring the flexibility of its configuration to cope with different situations. (iv) Standardization principle: the system design should conform to China's healthcare industry standards and criteria and should be equipped with detailed development documents and prepared for secondary developments. (v) The principle of innovation: mature technology of the industry should be actively introduced to the system design, using advanced network technology as the basis of the system's design to improve system configuration. (vi) The principle of easy operation: the system must be easy to operate, avoid cumbersome operation processes, be easy to use by managers, and must maximally improve work quality and efficiency. (III) Overall structure design: there are four modules: physician information query, inventory drug management, prescription drug dispensing, and user management. Users can query and access relevant information by logging into the system. (IV) Specific plans: (i) the physician information query should only contain the physician information query module, which mainly makes it convenient for patients to access doctors' information to learn their qualifications, work experience and so on. (ii) Warehouse drug management should include system settings (making it easy for users to change the login password and set up the user role and management), drug stockroom management (such as tracking drugs entering the stockroom, purchasing, returning drugs to the stockroom, reporting loss, making donations, returning goods, noting expiration dates, taking inventory, making price adjustments, tracking allocations

and deliveries, etc.), drug inquiry (inquiring about the purchase, storage and expiration dates of drugs according to the conditions and taking inventory of the drugs), financial statements (automatically generating quarterly and annual financial statements according to drug prices), system help (setting up menus according to operational needs for online help), equipment management (checking the conditions of pharmacy equipment regularly and uploading the equipment condition to the system). (iii) Prescription drug dispensation: 5 modules: system login, outpatient registration, pharmacy management, pricing management, and doctors' prescriptions. (iv) Back office management: 4 modules: setting of login authority, physician information management, drug recovery and drug receipts.

Dynamic monitoring: the drug management sampling inspection module is set up in the drug management system to simplify complex work as much as possible and comprehensively evaluate the drug management process. This module includes audit status, outpatient service, physician, units, physician levels, prescription number, prescription type, drug type and other information. The quantitative sampling mode is adopted for inspection to analyze unreasonable drug management situations, summarizing experiences and adjust and improve the information management path.

### Observation indices

(I) Error occurrence: 120 samples of drugs were randomly selected for analysis, and the incidence rate of drug management errors, including drug misplacement, unreasonable base, and vague labeling of high-risk drugs, was analyzed before and after the implementation of information management path combined with dynamic monitoring. (II) The near-term and expiration dates of various drugs before and after the implementation of this model were analyzed. (III) The drug management quality questionnaire was designed by referencing the "Hospital Pharmaceutical Management Standards" (8) and included five items: pharmacy area, pharmacy management, drug management, pharmacy equipment management, and management efficiency. The drug management quality scores before and after implementation were evaluated. Each item was marked with 0–10 points, with higher scores indicating better management quality. The questionnaire survey was filled out independently by the management personnel, and 25 questionnaires were distributed twice, with a recovery rate of 100%.

**Table 1** Comparison of the incidence rate of errors before and after the implementation of the information management path combined with dynamic monitoring [n (%)]

| Variable | Time | | χ² | P |
|---|---|---|---|---|
| | Before implementation | After implementation | | |
| Sample size | 120 | 120 | – | – |
| Drug misplacement | 10 (8.33) | 2 (1.67) | 5.614 | 0.018 |
| Unreasonable action | 12 (10.00) | 3 (2.50) | 5.76 | 0.016 |
| Vague identification of high-risk drugs | 10 (8.33) | 2 (1.67) | 5.614 | 0.018 |

### Statistical methods

SPSS 22.0 software was used to analyze the data. The $\chi^2$ test was used to test the qualitative data (results are expressed as %). The *t* test was used to test the quantitative data (expressed as $\bar{\chi}\pm s$). Comparisons between groups were tested by the *t* test, with P<0.05 indicating statistical significance.

### Results

#### Comparison of the incidence of errors before and after the implementation of the information management path combined with dynamic monitoring

After the implementation of the information management path combined with dynamic monitoring, the incidence rates of drug placement errors, unreasonable actions and vague identification of high-risk drugs were significantly lower than the rates before the implementation, and the difference was statistically significant (P<0.05, *Table 1*).

#### Comparison of drug expiration status before and after the implementation of the information management path combined with dynamic monitoring.

After the implementation of the information management path combined with dynamic monitoring, the expiration rates of emergency drugs and general drugs were 0.00% and 3.41%, respectively, which were significantly lower than the rates before implementation (30.00%, 11.36%, P<0.05) (*Table 2*).

#### Comparison of management scores before and after the implementation of the information management path combined with dynamic monitoring

After the implementation of the information management

path combined with dynamic monitoring, the pharmacy area, pharmacy management, drug management, pharmacy equipment management, and management efficiency scores and the total score were significantly higher than the scores before the implementation (P<0.05, *Table 3*).

### Discussion

Hospital information management is an important indicator for the construction of hospital information. By means of hardware support such as computers, network communication equipment and servers, hospital information management can meet the work needs of each healthcare department and administrative unit (9,10). Hospital information management is a comprehensive management system that involves complex management contents, such as doctor stations, nurse stations, registration, fees, drugs, and medical insurance and so on (11,12). Hospital drug management, which is concerned with the normal use of drugs in all units of the hospital, is an important part of hospital information management. It is mainly divided into two parts: pharmacy management and drug stockroom management. Pharmacy management includes outpatient and inpatient aspects. The pharmacy fulfills drug delivery and storage through drug stockroom management, and it dispenses and returns drugs through the pharmacy (13). Information management paths and dynamic monitoring are based on the HIS system. The authors believe that this model can effectively improve the work efficiency and quality of drug management through technical support.

Aimed at hospital drug management, this study developed a management model based on information management paths combined with dynamic monitoring. The results showed that compared to the pre-implementation period, the incidence rates of drug misplacement, unreasonable actions, and vague identification of high-risk drugs were

**Table 2** Comparison of drug expiration status before and after the implementation of the information management path combined with dynamic monitoring [n (%)]

| Drug expiration status | Time | | $\chi^2$ | P |
|---|---|---|---|---|
| | Before implementation | After implementation | | |
| High-risk drugs (n=8 batches) | | | 1.641* | 0.2 |
|   Expiration date | 3 (37.50) | 0 (0.00) | | |
|   Near-term date | 5 (62.50) | 8 (100.00) | | |
| Toxic and anesthetics drugs (n=4 batches) | | | 0.667 | 0.414 |
|   Expiration date | 2 (50.00) | 0 (0.00) | | |
|   Near-term date | 2 (50.00) | 4 (100.00) | | |
| Emergency drugs (n=20 batches) | | | 4.902* | 0.027 |
|   Expiration date | 6 (30.00) | 0 (0.00) | | |
|   Near-term date | 14 (70.00) | 20 (100.00) | | |
| General drugs (n=88 batches) | | | 4.07 | 0.044 |
|   Expiration date | 10 (11.36) | 3 (3.41) | | |
|   Near-term date | 78 (88.64) | 85 (96.59) | | |

*, using the $\chi^2$ test with correction for continuity.

**Table 3** The comparison of management scores before and after the implementation of the information management path combined with dynamic monitoring (score, $\bar{\chi}\pm s$)

| Management scores | Time | | t | P |
|---|---|---|---|---|
| | Before implementation (n=25) | After implementation (n=25) | | |
| Pharmacy area | 6.23±1.12 | 8.07±0.75 | 6.825 | 0.000 |
| Pharmacy management | 6.81±1.53 | 9.11±0.19 | 7.459 | 0.000 |
| Drug management | 7.12±0.46 | 8.23±0.21 | 10.976 | 0.000 |
| Pharmacy equipment management | 6.78±0.56 | 7.84±0.36 | 7.961 | 0.000 |
| Management efficiency | 6.24±0.62 | 8.41±1.17 | 8.194 | 0.000 |
| Total score | 32.18±4.32 | 42.66±4.76 | 8.152 | 0.000 |

significantly decreased after implementation, suggesting that this management model can reduce the occurrence of errors in drug management. Studies have shown that the information management path enables management personnel to quickly obtain necessary information while effectively ensuring the accuracy of information, which is conducive to simplifying the tedious and complex work process, improving work efficiency, and reducing the error rate (14,15). This provides a theoretical basis for this study. In this study, the hospital invited professional teams to design the information system and the developed detailed management path. The overall design structure fully takes into account the needs of patients, doctors, drug procurement, pharmacy management and system safety management. A targeted management module was designed based on the actual situation of hospital drug management, including physician information query, drug storage management, prescription drug dispensation and user management. In addition, each large module had a different number of submodules, and the overall management path was rich and hierarchical. Furthermore, the system set up a sampling inspection module for drug

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management that could comprehensively analyze and evaluate the management process, facilitate the timely discovery of problems in the management process, and reduce the occurrence of errors. In contrast, the traditional management model mainly relies on manual operations and lacks the flexibility of intelligent management, leading to a relatively high incidence of errors. Therefore, the implementation of the information management path combined with dynamic monitoring management model can reduce the occurrence of errors.

This study suggests that the implementation of information management paths combined with dynamic monitoring can improve the utilization rate of near-term drugs and reduce the rate of expired batches. Jing Wang *et al.* (16) also adopted the information management model for anesthetic drugs. The results showed that this management mode could fully take advantage of the intelligence and flexibility of the information system, reduce various uncertainties caused by human factors, and improve the efficiency of and scientific approach to anesthetic drug management. Zuojun Wang *et al.* (17) believed that this management model could provide real-time monitoring of drug management and adjust unreasonable aspects in a timely manner. The above studies all fully reflect the advantages of an information system for drug management. This study combined the information management path with dynamic monitoring. On the one hand, through the automatic reminder function of the information system, the manager can quickly determine the status of drug delivery, allocation and use and promptly deal with expired drugs or purchase drugs with low supplies. On the other hand, the system can be used to conduct self-management reviews through dynamic monitoring to understand the deficiencies of each link, improve the information system, improve the sensitivity of the system, effectively remind managers of the use and storage status of drugs through the alarm mechanism, and reduce the rate of expired drugs. This study also found that the implementation of information management paths combined with dynamic monitoring can improve the quality of drug management. The possible reason for this improvement is that the application of this management model optimizes the management process, improves management efficiency, and reduces errors. This flexible and intelligent management model greatly makes up for the inadequacy of traditional manual management, thus enhancing management quality.

In conclusion, the management mode of information management paths combined with dynamic monitoring can be adopted for hospital drug management and is convenient for reducing the occurrence of errors and the drug expiration rate and improving management quality. Hospitals can use this management model as the main drug management model in the future. However, this study also has shortcomings. For example, the selected sample batch size was relatively small. Future studies will discuss this topic based on a larger sample batch size.

## Acknowledgments

## Footnote

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