



# Impact of Implementing the Lean Management on Internal Errors at an Outpatient Hospital Pharmacy in China

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**Purpose:** The purpose of this study was to explore the lean management strategies used by an outpatient hospital pharmacy in China to reduce internal errors in prescription dispense and to describe their impact on patient satisfaction.

**Methods:** The type and number of internal errors in prescription dispense from January 1, 2022, to December 31, 2022, were collected. The causes of these errors were analyzed based on a series of lean management concepts and methods, and Lean Management was implemented from January 1, 2023, to December 31, 2023, in this outpatient hospital pharmacy. The number of internal errors, the proportion of dispense errors and the change of patient satisfaction before and after Lean Management were compared.

**Results:** Before the implementation of Lean Management, 2978 cases of internal errors were reported. It includes 1286 cases (43.18%) of delivering wrong numbers, 612 cases (20.55%) of medication in close proximity, 434 cases (14.57%) of forget to dispense medication, 221 cases (7.42%) of sound-alike medication, 203 cases (6.82%) of multiple sizes of a medication, 125 cases (4.20%) of look-alike medication, and 97 cases (3.26%) of others. The proportion of dispense errors was 3.46%. After the implementation of Lean Management, the total number of internal errors in prescription dispense decreased to 219 cases, the proportion of internal errors in prescription dispense decreased to 0.27%, which has a significant difference, and the satisfaction of patients increased from 52.94% to 72.97%.

**Conclusion:** The implementation of Lean Management can be an efficient approach to reduce the internal errors in prescription dispense.

**Keywords:** lean management, internal errors in prescription dispense, outpatient hospital pharmacy

## Introduction

The quality of the dispensing work carried out by pharmacists in the hospital outpatient pharmacy holds paramount importance in ensuring top-quality pharmaceutical care for patients. The internal errors in prescription dispense are made, worldwide, on a daily basis, resulting in a high burden of morbidity and mortality.<sup>1</sup> Internal errors refer to the error that arise during the process of drug dispense and are corrected in a timely manner upon discovery by the dispense pharmacist and other pharmacists, with no irremediable consequences. Once an error occurs, it will not only damage the reputation of the hospital but also may bring a bad experience to the patient, causing dissatisfaction of the patient, thus increasing the contradiction between the hospital and the patient. In addition, it takes time to record and correct these errors, which can impact workflow and slow down service delivery.<sup>2</sup> According to an online survey by Maria Barsky et al,<sup>3</sup> the fact that the most obvious and painful consequence of medical errors and injuries is the harm experienced by patients and their families, in the real world. In another study from Yousefi N in Iranian,<sup>4</sup> some of the consequences of drug dispense errors include reduced treatment effectiveness, decreased patient satisfaction, increased adverse drug reactions, and increased treatment costs, ultimately leading to significant increases in patient comorbidities and mortality.

Lean management is a relatively scientific approach that has been systematically used in healthcare.<sup>5</sup> Continuous improvement is an important part of this approach.<sup>6,7</sup> The goal of Lean in the healthcare field is to maximize the value of

patients by reducing waste and wait times.<sup>8</sup> A lean culture includes ongoing training and development, encouraging employee participation, and maintaining consistent standards. However, to our knowledge, no studies in China have been reported on Lean Management reducing the internal errors in prescription dispense on outpatient hospital pharmacy.<sup>9,10</sup> Factors contributing to internal errors in prescription dispense were myriad and included those that are related to pharmacists (eg, forgot to dispense), medical environment (eg, cluttered stacks of medicines), process (eg, dispense multiple prescriptions at the same time) and the technology (eg, missed printing of prescription). Therefore, there is an urgent need to find a right way to improve the internal errors in prescription dispense.

The purpose of this study is to describe the Lean Management strategies that have been used to reduce internal errors in prescription dispense at an outpatient hospital pharmacy in China and to elaborate its impact on patients' satisfaction.

## Methods

### Study Design

This study was designed as a pre-post interventional trial in Tongde Hospital of Zhejiang Province, which is a teaching hospital situated in Hangzhou of Zhejiang province in southeast China. There are 12 pickup Windows at the hospital's outpatient pharmacy, which handles about 3,000 prescriptions a day. The primary outcomes were the number of internal errors, the proportion of dispenses errors and the change in patient satisfaction before and after Lean Management. Because this study only focuses on the methodological study of lean management, it did not include any privacy of patients, and the exemption from informed consent would not have any adverse impact on the rights and health of patients, the Ethics Committee of Tongde Hospital in Zhejiang Province exempted our study from ethical approval.

### Cause Analysis by Lean Management

The number of internal errors in prescription dispense registered from January 1, 2022, to December 31, 2022, was collected as a pre-Lean Management, recorded in an excel spreadsheet and counted to analyze the types of internal errors. According to the concept of Lean management, the "Gantt chart" method was used to schedule activities, as shown in Figure 1.

A Pareto chart enables a quality improvement specialist to make informed decisions and prioritize the appropriate interventions to achieve the desired goal.<sup>11</sup> The Pareto principle, which is also known as the rule of 20/80, has become an

Task	2022											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Establish the theme												
Set up quality improvement team												
Situation analysis and data collection												
Cause analysis												
Response formulation												

**Figure 1** Gantt chart of Pre-implementation in 2022.

important quality tool, recognized by the American Society for Quality (ASQ) as one of the seven basic quality tools for process improvement.<sup>12</sup> In this present study, Pareto charts were applied to analyze the causes of internal errors in prescription dispense. According to the type of internal error in prescription dispense, it can be divided into delivering the wrong number of medication (A), medication in close proximity (B), forgetting to dispense medication (C), sound-alike medication (D), multiple sizes of a medication (E), look-alike medication (F), and others (G), as shown in Figure 2.

The line that reflects the cumulative percentage of the factors is a key component of the Pareto chart; when the line reaches  $\geq 80\%$ , this means that all of the previously added up factors represent 20% of the causes. If we focus on these causes, then we will be able to reach the desired outcome most efficiently.<sup>13</sup>

The dispense mode of outpatient hospital pharmacy in our hospital is mainly conveyor belt mode, in which a pharmacist receives prescriptions on the computer in the background and dispenses drugs manually. The dispensed drug is then placed on a conveyor belt, which finally delivers the drug to the window, where the window pharmacist distributes the drug to the patient. This is a process that requires careful cooperation of all pharmacists, and any error at any stage of the process can result in dispense errors.

Based on the root cause analysis method, we found that forgetting to fill prescriptions, lack of training, unfamiliar process, misprinting prescriptions, dispensing multiple prescriptions at the same time, and paper jam (as detailed in Table 1) were the main causes of internal errors in prescription dispensing, so it was necessary to make corresponding improvements to these root causes.

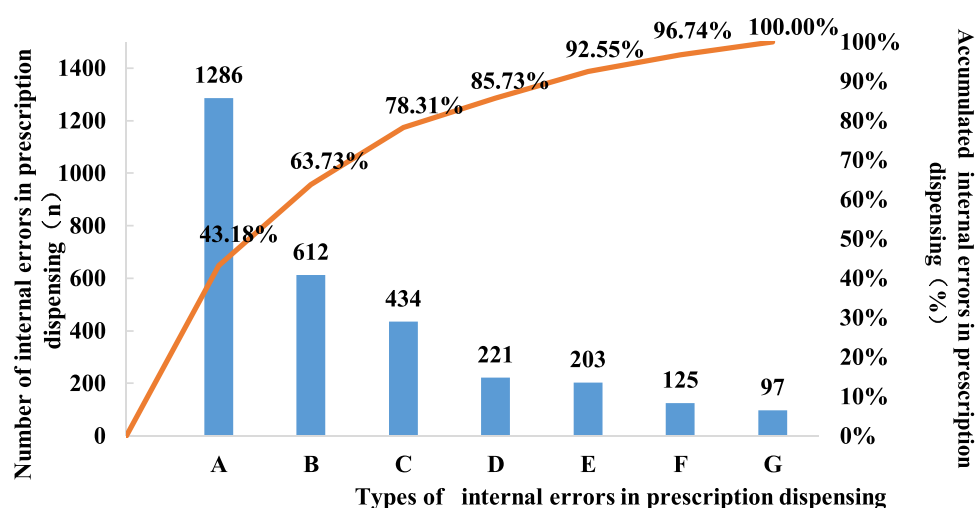
Finally, countermeasures were selected and integrated based on key factors, including: (I) Optimizing the process of dispensed medication. (II) Enhancing the training to the staff. (III) Updating computer information software and replacing computer hardware.

## Implementation

The Lean Management was implemented from January 1, 2023, to December 31, 2023, at our outpatient hospital pharmacy (Figure 3). Continuous data monitoring and tracking of internal, department generated, data was undertaken.<sup>14</sup>

## Optimizing the Process of Dispense Medication

First of all, pharmacists are advised to segregate look-alike and sound-alike medications on pharmacy shelves, using partitions to ensure that the medication corresponds to the correct labels. Pharmacists routinely organize medication shelves and refills to prevent mix-ups. Second, responsible pharmacists are stationed at the outpatient hospital pharmacy to handle phone calls and provide medication counseling, alleviating pressure at the pick-up window and ensuring smooth coordination between counseling and dispense work. Thirdly, answering bells are installed in Area C for communication between pharmacists in different areas regarding medication dispense. Reminder cards are placed by



**Figure 2** Types of internal errors in prescription dispense before Lean Management.

**Table 1** Reasons of Prescription Dispense Internal Errors

Reasons of internal errors in prescription dispense	Quantity	Proportions
Forgetting to fill prescriptions	611	20.52%
Lack of training	588	19.74%
Unfamiliar process	431	14.47%
Misprinting prescriptions,	372	12.49%
Dispensing multiple prescriptions at the same time	299	10.04%
Paper jam	287	9.64%
Busy work	117	3.93%
Medication in close proximity	99	3.32%
Cluttered stacks of medicines	90	3.02%
Too noisy	84	2.82%
Total	2978	100%

pharmacists in Area A for medications needing to dispense in Area C, with a bell signal prompting action from pharmacists in Area C. Finally, a standardized process is implemented for diverting medications: prescriptions are entered into the computer system immediately by pharmacists before placing the medications on appropriate shelves.

### Enhancing the Training to the Staff

We have conducted a series of training for our employees. First of all, pharmacists are required to allocate drugs in strict accordance with the Prescription Management Measures. In addition, all internal errors in the dispense process will be recorded and analyzed, and the information will be communicated to all pharmacists in the outpatient hospital pharmacy in a timely manner. On the one hand, the pharmacist who made the mistake can be educated, and on the other hand, it can also serve as a warning to other pharmacists to avoid the occurrence of similar situations. Finally, we set the specific position of the daily pharmacist, who is responsible for the arrangement of the drug shelves in the corresponding area, to ensure that the drugs on the shelves are neatly placed, so as to facilitate drug dispense.

Task	2023											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Countermeasure implementation												
Confirmation of countermeasure												
Standardization												
Discussion												

**Figure 3** Gantt chart of Post-implementation in 2023.

## Updating Computer Information Software and Replacing Computer Hardware

First and foremost, we updated the rational drug use information system in outpatient hospital pharmacy. When a doctor prescribes the wrong prescription, the information system immediately intervenes by popping up a dialog box on the computer interface alerting the doctor that this is the wrong prescription and preventing these prescriptions from going to the next step. In addition, some frequently malfunctioning machines were eliminated, and new equipment was purchased to ensure the convenience and smooth dispense of drugs in outpatient hospital pharmacy of our hospital.

### Data Analysis

All data were analyzed using the SPSS 22.0 software (IBM Corp, USA). All variables will be described as frequency and percentage and the mean  $\pm$  standard deviation. The chi-square and *T* test will be used to identify variations and  $P < 0.05$  meant that the difference was statistically significant.

## Results

### Impact on the Number and Different Types of Internal Errors in Prescription Dispense

Before the implementation of Lean Management, 2978 cases of internal errors were reported. It includes 1286 cases (43.18%) of delivering wrong numbers (A), 612 cases (20.55%) of medication in close proximity (B), 434 cases (14.57%) of forget to dispense medication (C), 221 cases (7.42%) of sound-alike medication (D), 203 cases (6.82%) of multiple sizes of a medication (E), 125 cases (4.20%) of look-alike medication (F), and 97 cases (3.26%) of others (G). After the implementation of Lean Management, the total number of internal errors in prescription dispense decreased to 219 cases, and A, B, and C have been significantly reduced, with a *p*-value of 0.048, as illustrated in Table 2.

### Impact on the Proportion of Internal Errors in Prescription Dispense

Before the implementation of lean management, the total number of prescriptions was 861205, the number prescriptions with internal errors was 2978, and the proportion of internal errors in prescription dispense was 3.46%. After the implementation of lean management, the total number of prescriptions was 812748, the number prescriptions with internal errors was 219, and the proportion of internal errors in prescription dispense was 0.27%. When compared with the implementation of lean management, there are significant differences, as it was shown in Table 3.

**Table 2** Comparison of the Number of Different Types of Internal Errors in Prescription Dispense Before and After Lean Management

Internal errors in prescription dispense	Pre-implementation (%)	Post-implementation (%)
Delivering wrong numbers	1286 (43.18%)	42 (19.18%)
Medication in close proximity	612 (20.55%)	39 (17.81%)
Forget to dispense medication	434 (14.57%)	38 (17.35%)
Sound-alike medication	221 (7.42%)	33 (15.07%)
Multiple sizes of a medication	203 (6.82%)	27 (12.33%)
Look-alike medication	125 (4.20%)	23 (10.50%)
others	97 (3.26%)	17 (7.76%)
Total	2978	219
<i>T</i>	2.475	
<i>P</i>	0.048	

**Table 3** Comparison of Internal Errors in Prescription Dispense Before and After Lean Management

Prescription	Pre-implementation	Post-implementation	$\chi^2$	P
Total number of prescriptions	861205	812,748		
Number of internal errors in prescription dispense	2978	219		
The proportion of internal errors in prescription dispense	3.46‰	0.27‰	2195.973	0.000

## Standardized Workflows

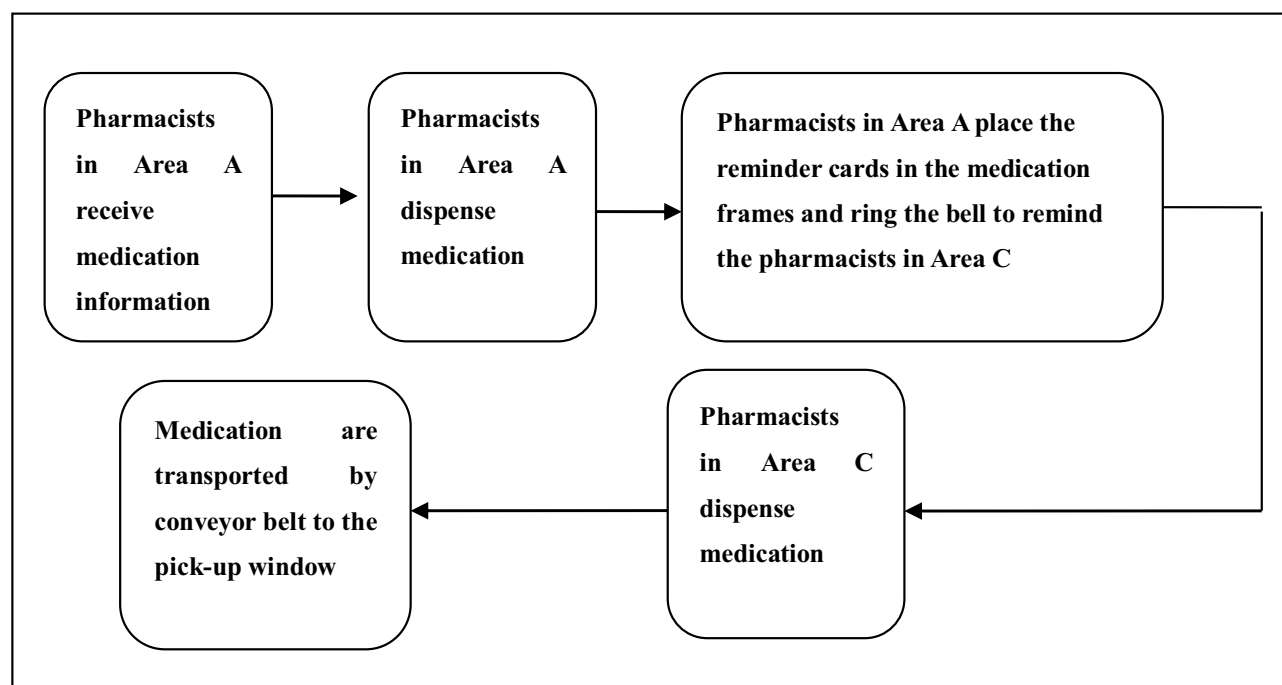
Following Lean Management and practical work tests, two standardized process flow was established, as depicted in Figures 4 and 5.

### Improved Patients' Satisfaction

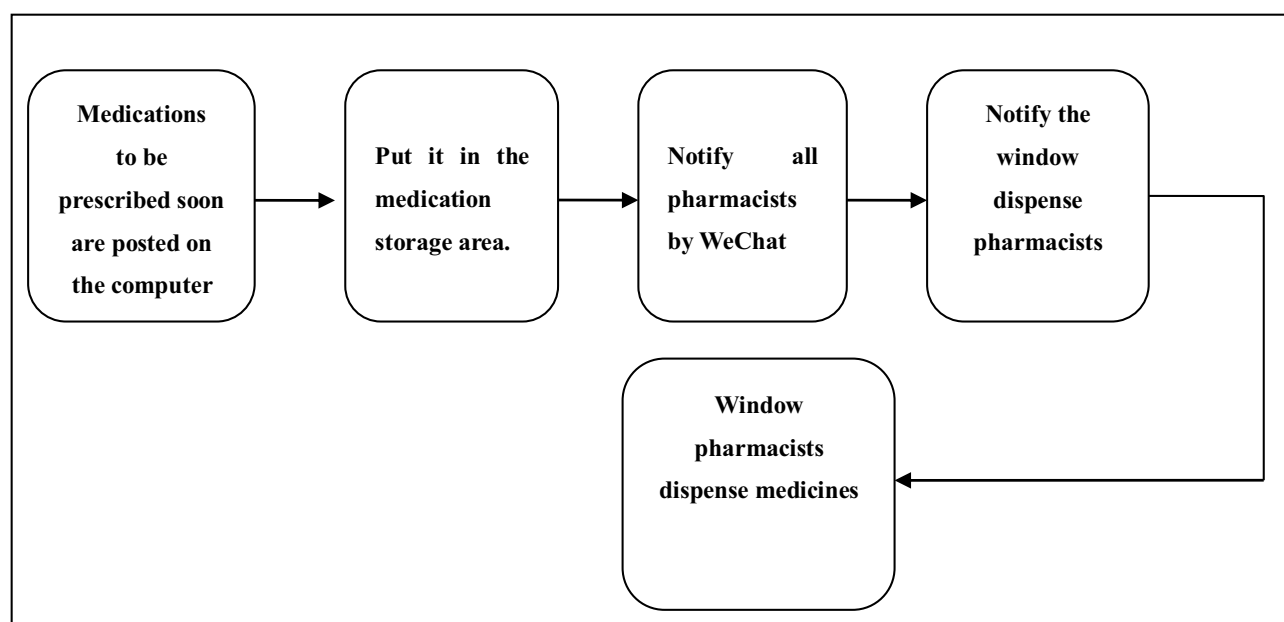
Before the implementation of lean management, according to the data provided by the outpatient management office of our hospital, 24,898 patients completed the satisfaction survey through WeChat QR code scanning in 2022, of which 13,180 (52.94%) were satisfied with the pharmaceutical care of outpatient pharmacies. After the full implementation of lean management in 2023, 42,989 patients completed the satisfaction survey, and 31,371 patients (72.97%) were satisfied with the pharmaceutical care of outpatient pharmacies ( $P=0.000 < 0.05$ ), indicating that patient satisfaction increased by 20.03%.

## Discussion

Tongde Hospital of Zhejiang Province is a national class-3 Grade-A hospital located in Hangzhou, integrating traditional Chinese and Western medicine. Since the opening of the new outpatient hospital pharmacy in October 2021, the average daily prescription can reach around 3,000. In this hospital environment, optimizing workflows to minimize interruptions in medication dispense is critical to preventing patient medication errors. Based on a “patient-centered” philosophy,<sup>15</sup> the method of lean management was implemented to improve internal errors during prescription dispense. We apply many lean management tools to improve patient satisfaction, such as brainstorming method in the stage of analyzing the causes of



**Figure 4** Standard process flow for dispense response. A area: Medications for common chronic diseases; B area: Commonly used medications for non-chronic diseases; C area: Medications be prescribed rarely.



**Figure 5** Standardized process flow for diverting medication.

internal errors, Pareto charts in the stage of analyzing the types of internal errors, Gantt charts in the stage of researching the duration of the project, and root cause analysis in the stage of identifying the real causes of internal errors. The results showed that the number of prescriptions with internal errors decreased from 2978 to 219, and the proportion of prescriptions with internal errors also decreased significantly (3.46‰ vs 0.27‰,  $P = 0.000$ ). Moreover, the application of lean management in outpatient hospital pharmacy also improved patient satisfaction (52.94% vs 72.97%,  $P = 0.000$ ). In addition, as a result of lean management, we have developed two standardized flow charts for dispense prescriptions to reduce the number of internal errors during dispense and continuously improve dispense quality.<sup>16</sup> These enhancements align with initiatives to improve prescriber engagement, build trust with patients, decrease medication errors, and advance a patient-centered approach.

Medication errors are the most common and preventable cause of patient injury.<sup>17</sup> Reducing internal errors in prescription dispense is one effective solution. In this study, we use a lean management method to analyze the root cause of internal errors in the process of prescription dispense. We found that delivering wrong numbers, medication in close proximity, forgetting to dispense medication accounted for 43.18%, 20.55% and 14.57% of the total errors, respectively. Based on the lean management method, we proposed and implemented corresponding countermeasures to these problems, which significantly reduced the number of internal errors in prescription dispense. If the internal errors identified by the dispense pharmacist are confirmed by the compounding pharmacist, the department will reward the reporting pharmacist according to the number of prescriptions. This approach encourages pharmacists to proactively report errors, shifting management from a reactive “blocking” stance to a proactive “guiding” approach. By confining internal errors to occur only within the pharmacy, we can effectively reduce external errors and enhance management quality. Furthermore, regular data analysis contributes to improving subsequent management quality. Performance evaluation has also been instrumental in boosting employee motivation.

In the process of implementing Lean Management, we developed two standardized workflows based on some successful experiences.<sup>18</sup> For instance, one standardized workflow pertains to the dispense response: initially, pharmacists in Area A receive medication information that needs to be dispensed. Subsequently, they dispense some medications, while the remaining medications are designated for dispense by pharmacists in Area C. Pharmacists in Area A place reminder cards in the medication frames and ring the bell to alert pharmacists in Area C. Pharmacists in Area C then dispense the remaining medications. Finally, pharmacists in Area C place the dispensed medicine on the conveyor belt for transfer to the pick-up window. Our study is aligning with Sallam M findings<sup>19</sup> that Lean Management, as a management method, enhances the motivation of pharmacists. The application of Lean Management in the outpatient



hospital pharmacy also leads to improved patient satisfaction. Establishing a culture of lean, wherein all pharmacy staff are engaged at all stages, and developing a patient-centered process were crucial not only for the initial success of the interventions but also for sustaining the outcomes.

In addition to the 12-month intervention, the strengths of this study are outstanding. The implementation of Lean Management not only yielded tangible results such as reducing internal errors in prescription dispense but also generates intangible benefits, stimulating the creative thinking of pharmacists, allowing everyone to freely express their suggestions, and making each member of the project feel satisfied, accomplished, recognized, and respected in the realization of their own value. And with the reduction of internal errors after the implementation of lean management, the corresponding pharmacist's dedicated time to deal with errors is reduced, and pharmacists can have more time to serve patients, which is crucial to eliminate the waste of pharmacist manpower, this has ignited enthusiasm for work.

Based on the outcomes of this study, it is proposed that future research could concentrate on how to choose suitable management tools for outpatient pharmacies to enhance work efficiency, improve work quality, and prioritize both employee and patient satisfaction. Additionally, this study was merely carried out in one hospital outpatient pharmacy in China; thus, it is recommended that it be attempted in other hospital departments, other developing countries, etc.

## Study Limitations

The quality improvement project focused on the specific findings of Tongde hospital of Zhejiang province and did not address the pharmacy of other hospitals. Additionally, the 12-month short-term evaluation period of the study might not comprehensively reflect the long-term sustainability and effectiveness of the implemented changes.

## Conclusions

The implementation of Lean Management can be an effective approach to reduce the internal errors in prescription dispense and enhance patients' satisfaction. The process of implementing lean management also stimulated the creative thinking of participating pharmacists, enabling everyone to freely express their own suggestions. Thus, each member could feel satisfied, a sense of accomplishment, recognition and respect during the process of realizing their own value, and this cultural formation also laid a solid foundation for the future quality improvement of outpatient pharmacy work. Therefore, health managers and decision-makers can improve the quality of work in outpatient pharmacies through lean management, thereby increasing patient satisfaction.

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## Disclosure

The authors report no conflicts of interest in this work.

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