Patient Preference and Adherence

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ORIGINAL RESEARCH

Impact of Pharmacist-Led PDCA Cycle in Reducing Prescription Abandonment: An Action Research from China

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Purpose: Taking medicine as prescribed in time plays an important role in the treatment of diseases. However, some prescriptions have not picked up in time for various reasons. To analyze the influencing factors in patients with prescription abandonment and the role of pharmacists in Plan–Do–-Check–Act (PDCA) cycle, we conducted a study in our hospital of Hangzhou, China.

Methods: Based on the prescription abandonment from October 1, 2021 to March 31 2022, we collected and analyzed the possible causes. According to the PDCA management method, we conducted improvement measures and supervised the implementation of measures from April 1, 2022 to September 30, 2022. The number, the proportion and the amount of prescription abandonment before and after establishment of the PDCA cycle were analyzed.

Results: Three measures were proposed and applied to improve the prescription abandonment:(I) Enhancing the education and training to the staff. (II) Improving the medical environment for patients, especially the environment for taking medicine. (III) Updating the computer information software. After the implementation of PDCA, the number of prescription abandonment decreased from 2030 to 775, there was significant reduction in the proportion of prescription abandonment (4.75‰ vs 1.77‰, $P<0.05$), and the amount of prescription abandonment decreased from $36,161.11 to $17,041.59. The target compliance rate was 108.36%.

Conclusion: The implementation of pharmacist-led PDCA can effectively reduce the number, the proportion and the amount of prescription abandonment, Moreover, Pharmacists play an important role in improving the management quality of outpatient pharmacy, and PDCA is a feasible and effective management tool for reducing prescription abandonment.

Keywords: prescription abandonment, plan–do–check–act cycle, medical environment, pharmacist-led, patients

Introduction

Nonadherence to prescription medications has been shown to result in upward of $290 billion each year in total healthcare expenditures, with $100 billion of that amount in hospital bills alone.[1] Prescription abandonment is one form of medication nonadherence, which occurs when a prescription has been electronically delivered, faxed, telephoned, or hand-delivered to a pharmacy, and the patient never picks up the prescription regardless of whether the prescription is a new medication or refill medication.[2] This behavior of patients not only leads to unnecessary waste of drugs, but also affects the management quality of outpatient pharmacy.[3] According to an online survey in Wales,[4] 89.1% held strong concerns about medicinal waste of the 5584 respondents. In another study from Vogler S in Vienna,[5] the medicines wasted had a total value of € 1965, € 2987 and € 4207, while there might be different reasons for medicines being wasted, the findings suggest possible adherence challenges as one issue to be addressed. Factors contributing to this were myriad and included those that are related to patients (eg, forgot to take their medicine or suboptimal health literacy), medical environment (eg, window for taking medicine was not clearly prompted), physicians (eg, communication barriers with patients) and the computer information software (eg, lack of patient calling system and office visit time

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limitations). Therefore, measures are critically needed to improve this phenomenon of prescription abandonment and to reduce unnecessary waste of medicine.

The "Plan–Do–Check–Act" (PDCA cycle) was proposed by Dr Edwards Demingin the 1950s, this method divides the process of management into four parts, refers to the process of finding and solving problems in various areas of quality management.[6] It has been widely used for continuous improvement of medical quality,[7] As pharmacists have an important role in reducing medication waste throughout the pharmaceutical supply chain,[8] however, to our knowledge, no studies in China have been reported on PDCA reducing prescription abandonment. Therefore, we conducted a pharmacist-led PDCA at Tongde hospital of Zhejiang province, the main purpose was to analyze the influence factors in patients with prescription abandonment and the impact of pharmacist-led PDCA cycle.

Methods

The study includes four consecutive steps of the PDCA cycle, divided into four aspects of improvement measures (Figure 1). The study data were obtained from the outpatient pharmacy management system (OPMS) of Tongde hospital of Zhejiang province. All of the prescription abandonment were included during the study period, and we summarized the number and amount of all prescription abandonment before and after the establishment of the PDCA cycle, as well as the department where the prescribing doctor was located. The Ethics Committee of Tongde hospital of Zhejiang province waived the need for ethics approval for the following reasons: this study focuses only on the methodological study of the management and does not involve any privacy of the patients or any privacy to be disclosed, the exemption from informed consent will not adversely affect the rights and health of the subject.

Plan

Data Collection and Statistical Analysis

We investigated the prescription abandonment from October 1, 2021 to March 31, 2022 as the pre-intervention period. During this time, there was only the measure of short message notification once a week for patients to pick up their prescription. According to the PDCA management method, we conducted a PDCA cycle and supervised the

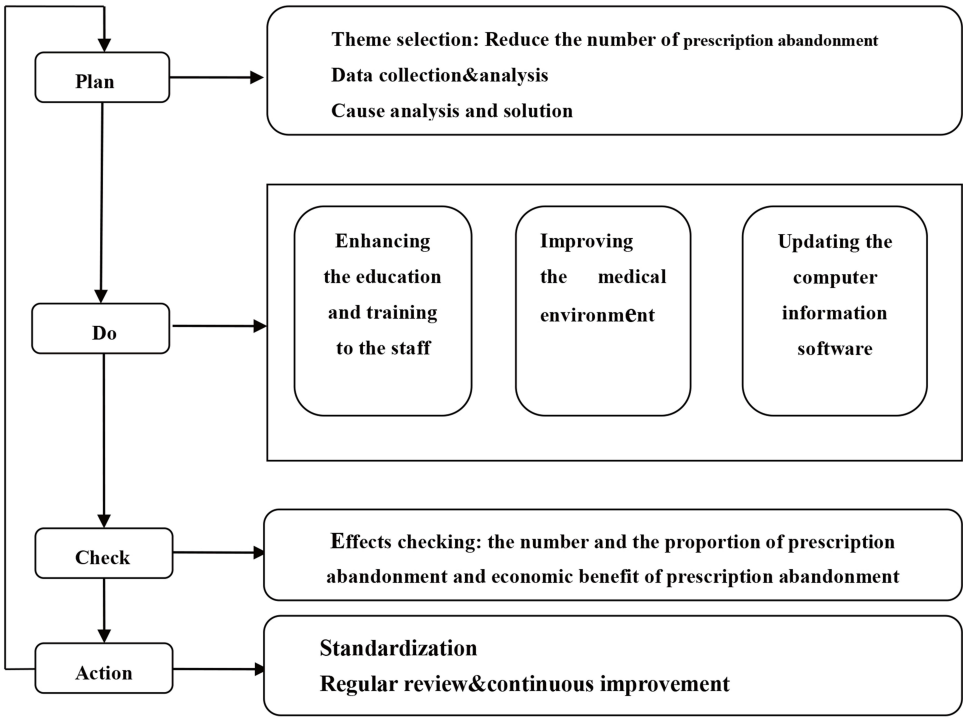

Figure 1 Process of pharmacist-Led PDCA cycle in patients with prescription abandonment.

implementation of measures from April 1, 2022 to September 30, 2022. The Chinese currency (Renminbi, CNY) was used to determine expenditure for every prescription during this period (7.0 CNY equals 1 USD). And we did not adjust for currency inflation or deflation in computing the actual changes.

All data were analyzed using Microsoft excel and SPSS 22.0. Categorical variables are expressed as number and percentage, Continuous variables were expressed as means ± standard deviations, and $P<0.05$ was considered statistically significant. The target compliance rate was calculated using the following equation:[9]

$$\text{Target compliance rate} = (\text{Improved value} - \text{Current value})/(\text{Target value} - \text{Current value}).$$

Cause Analysis and Solution Formulation

Based on the results of prescription abandonment before PDCA and the 80/20 rule, we drew a fishbone diagram to analyze the causes of each factor and find out the main reasons for improvement,[10] as it was shown in Figure 2. In our hospital, doctors usually used a combination of traditional Chinese medicine and conventional Western medicine, but sometimes, doctors did not verbally explain to patients that they had prescribed both traditional Chinese medicine and conventional western medicine because of the large workload and the number of consultations.[11] The factors of medical environment mainly include the large number of patients in the doctor's office and the noisy environment, resulting in patients not hearing the doctor's prompt. In addition, there were many windows for taking medicine in pharmacies and many people in the lobby, so patients often cannot find their own window for taking medicine and hear the tips of volunteers. The main factors of computer information system software were that the font of the specific window prompting to take medicine on the invoice of patients was too small, or the printing is fuzzy, leading to some patients cannot see clearly. Finally, countermeasures were selected and integrated based on the main reasons, including:(I) Enhancing the education and training to the staff. (II) Improving the medical environment for patients, especially the environment for taking medicine. (III) Updating the computer information software.

Do

Enhancing the Education and Training to the Staff

We have carried out a series of education and training for our staff. First of all, the doctor should remind the patient clearly which pharmacy to go to when issuing the prescription. If the patient has both traditional Chinese medicine prescription and conventional western medicine prescription, the patient should not forget to go to the two pharmacies to get the medicine, and make sure that the patient knows the process of getting the medicine.[12] In addition, pharmacists should carefully check patients' electronic prescription information and observe whether patients have medicines in other

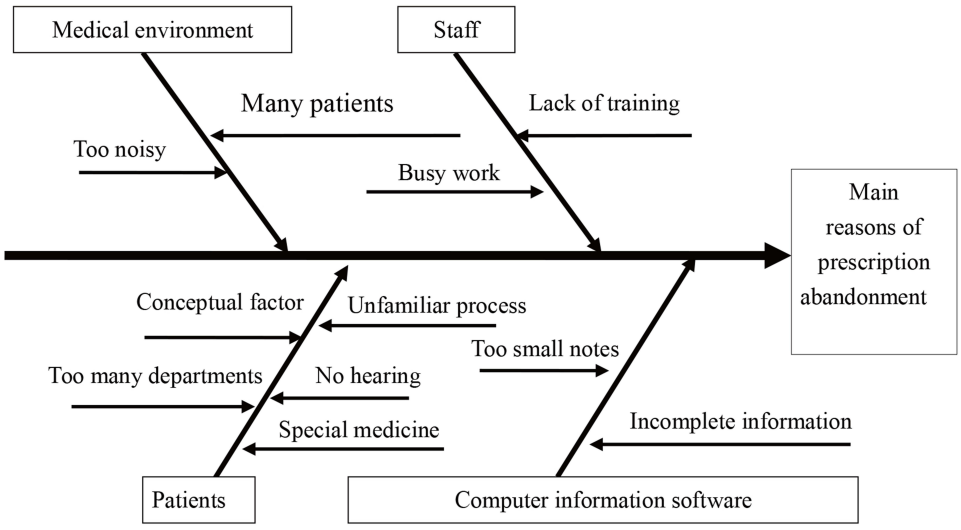

Figure 2 Main reasons of prescription abandonment using fishbone diagram.

windows. Finally, we set up the position of responsible pharmacists in the outpatient pharmacy, registered the information of prescription abandonment, called these patients or sent short message daily and tell them to pick up their prescriptions in time to ensure the timeliness and effectiveness of medication treatment.

Improve the Medical Environment

In order to improve the medical environment, we have made the following improvements. Firstly, nurses and volunteers were assigned in each clinical department to maintain medical order.[13] Therefore, the communication between doctors and patients can be clearer after noise was eliminated. Secondly, we set up "one meter line" in front of the pharmacy window to ensure that patients who come to take medicine are smooth and orderly.[14] In addition, we have also posted warm reminders in the outpatient hall, doctor's consulting room, and in front of the prescription window of the pharmacy to inform patients of the complete prescription process and remind them to check the invoice and prescription in time to reduce the occurrence of prescription abandonment.

Updating the Computer Information Software

There have been major updates to the computer information software system. First and foremost, we have installed a patient number calling system in the doctor's room. Patients will be treated according to the doctor's number calling order. Furthermore, we updated the information of the patient's invoice to make the prescription information more clearly displayed, and bolded and enlarged the font of the specific window for taking medicine. Additionally, we have added a prescription prompt sheet to every patient who needs to take medicine, so that patients can clearly know which window to take medicine.

Check

According to the developed plan, the total of prescription abandonment was compared before and after the establishment of the PDCA cycle. The economic benefit was calculated with the data provided by the finance department. The number of prescription abandonment, the proportion of prescription abandonment in all prescriptions, the distribution of departments involved in prescription abandonment, and the amount of prescription abandonment were evaluated.

Act

At each stage, inspection criteria and statistical results were submitted to the hospital administration, and a reward and punishment system was developed. In addition, regular meetings were held to discuss and solve the problems that was found in the phase of Check. The flow chart was standardized and updated every 1 month.

Results

Distribution of Departments with Prescription Abandonment Before PDCA Implementation

Based on the prescription abandonment from October 1, 2021 to March 31, 2022 before the PDCA cycle, there were 27 departments involved in this period, and the total number of prescription abandonment was 2030, as it was shown in Table 1. However, no statistics were kept for individual doctors, because PDCA method focuses on the improvement of the whole system rather than on the condemnation of individual.

Types of Prescription Abandonment Before PDCA Implementation

The types of prescription abandonment were determined by telephone call backs, which can be broadly classified as: did not know they have conventional western medicine (A), knew but forgot to pick it up (B), medicine used for testing at the day (C), refuse to use medicine for personal reasons (D), as shown in Figure 3. The total number of prescriptions before the implementation of PDCA was 426,956, so the proportion of prescriptions abandoned was 4.75‰. Based on various complex individual factors of the patient, the target value of this project was set as a rate of prescription abandonment of 2‰.

Table 1 The Number and Amount Distribution of Departments with Prescription Abandonment Before PDCA Implementation

Department	Number (n)	Proportion (%)	Amount ($)	Department	Number (n)	Proportion (%)	Amount ($)
Otorhinolaryngology	194	9.55%	3053.85	**Cardiovascular**	47	2.32%	1000.13
Gastroenterology	187	9.21%	2849.87	**Oncology**	44	2.17%	959.22
Orthopedics	174	8.57%	2599.98	**Nephrology**	39	1.92%	920.19
General surgery	159	7.83%	2388.77	**Internal Medicine**	38	1.87%	833.25
Neurology	157	7.74%	2287.66	**Infection**	33	1.63%	899.21
Colorectal surgery	133	6.56%	1954.33	**Emergency Medicine**	33	1.63%	753.42
Dermatology	112	5.52%	1845.63	**Endocrinology**	25	1.23%	783.37
Gynecology	109	5.37%	1788.33	**Vascular surgery**	23	1.13%	799.23
Pediatric	107	5.28%	1643.77	**Metal health**	22	1.08%	773.12
Ophthalmology	94	4.63%	1544.44	**Reproductive Immunology**	21	1.03%	682.98
Urology surgery	62	3.05%	1253.55	**Hematology**	21	1.03%	512.36
Respiratory	59	2.91%	1155.43	**Forensic Laboratory**	20	0.99%	512.18
Obstetrics	50	2.46%	934.77	**Clinical psychology**	20	0.99%	406.19
Stomatology	47	2.32%	1025.88	**Total**	2030	100%	36,161.11

Impact on the Proportion and the Amount of Prescription Abandonment

After implementing PDCA countermeasures, the total of prescription abandonment from April 1, 2022 to September 30, 2022 were 775, the number of clinical departments with prescription abandonment decreased from 27 to 9, as it was shown in Table 2. The total number of prescriptions after the implementation of PDCA was 437,481, when compared with the pre-PDCA implementation, the total number of prescription abandonment decreased by 61.82%, and

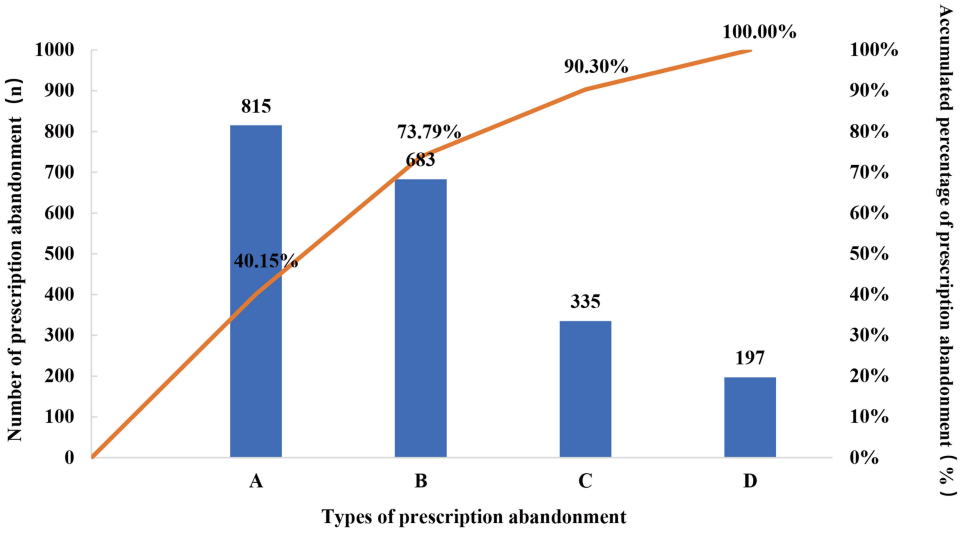

Figure 3 Types of prescription abandonment before PDCA implementation. (A) Did not know they have conventional western medicine; (B) Knew but forgot to pick it up; (C) Medicine used for testing at the day; (D) Refuse to use medicine for personal reasons.

Table 2 The Number and Amount Distribution of Departments with Prescription Abandonment After PDCA Implementation

Department	Number (n)	Proportion (%)	Amount ($)
Otorhinolaryngology	104	13.42%	2188.66
Gastroenterology	101	13.03%	2211.33
Orthopedics	97	12.52%	2014.45
Osteoporosis	85	10.97%	1976.77
Neurology	81	10.45%	1877.98
Colorectal surgery	80	10.32%	1825.22
Dermatology	79	10.19%	1727.35
Gynecology	75	9.68%	1647.77
Pediatric	73	9.42%	1572.06
Total	775	100%	17,041.59

Table 3 Comparison of Prescription Abandonment Before and After PDCA Cycle

Prescription	Before PDCA Implementation	After PDCA Implementation	χ^2	*P*
Number of prescription abandonment (n)	2030	775		
Amount of prescription abandonment ($)	36,161.11	17,041.59		
Total number of prescriptions (n)	426,956	437,481		
The proportion of prescription abandonment	4.75‰	1.77‰	590.634	<0.001

correspondingly, the proportion of prescription abandonment decreased from 4.75‰ to 1.77‰ of all prescriptions, reaching the target value of the project, and showing a significant difference. On the other hand, the total amount of prescription abandonment was $36,161.11 before PDCA implementation. However, the total amount of prescription abandonment was $17,041.59 after the PDCA cycle implementation, indicating that the implementation of PDCA resulted in a total reduction of $ 19,119.52 in drug waste, as it was shown in Table 3. The target compliance rate was 108.36%.

Discussion

Tongde hospital of Zhejiang province is a general hospital integrating traditional Chinese and western medication with 1500 beds, which located in Hangzhou of Zhejiang Province in China. In our hospital, we have a traditional Chinese medicine pharmacy and a conventional western medicine pharmacy. There were 12 windows for taking medicine, including 4 windows in the traditional Chinese medicine pharmacy and 8 Windows in the conventional western medicine pharmacy, the average daily prescriptions can reach about 5000. Except for Narcotic Drugs and Psychotropic Substances, our hospital has cancelled the traditional manual prescription and implemented the electronic prescription management mode. Patients can see a doctor, pay and get medicine by relying on the medical insurance card. While this model simplifies the patient's medical treatment process, we also found that some prescriptions were not picked up in time. In this study, we conducted a pharmacist-led PDCA cycle to improve the prescription abandonment, the number of prescription abandonment decreased from 2030 to 775, and the amount of prescription abandonment decreased from

$36,161.11 to $17,041.59 with PDCA implementation, and there was significant reduction in the proportion of prescription abandonment (4.75‰ vs 1.77‰, $P<0.001$).

In response to the call of the government of Zhejiang Province for "the most run once" reform, we take the initiative to provide high-quality pharmacy services to patients, optimize the patient access process, ensure patient access to medication, and further improve patient satisfaction.[15,16] In this study, we actively searched for the reasons why patients did not pick up their prescriptions through PDCA, and found that many patients did not know they have conventional western medicine or knew but forget to pick it up, accounting for 40.15% and 33.64%, respectively. According to the PDCA analysis method, corresponding countermeasures were proposed and implemented to solve the problem, the number and amount of prescription abandonment were significantly improved, indicating that the pharmacist-led management method was successfully adopted by hospital managers and well implemented in practice. Although many hospitals have carried out PDCA, to our knowledge, this is the first report in China to apply PCDA in prescription abandonment, which may serve as a basis for a feasible service mode for pharmacists at the outpatient pharmacy.

In the process of implementing PDCA, we developed standardized norms for some successful experiences.[17] For example, a responsible pharmacist was routinely set in outpatient pharmacy, who was responsible for registering the information of prescription abandonment on the day, and called these patients to tell them that they can bring valid identification to the corresponding pharmacy window to pick up their medicine. Of all the measures, we found this was the most effective. Our study is consistent with Li's findings[18] that PDCA, which as a management method, improved the enthusiasm of pharmacists. During the implementation of PDCA, pharmacists were willing to invest more time, energy and creativity to contribute to the solution of prescription abandonment. Furthermore, we revised and improved the dispensing process of window pharmacists. Every pharmacist should carefully check the electronic prescription information of patients, remind patients to take their medicine from Chinese and western pharmacies respectively, and explain and communicate with patients accordingly.

In addition to the six-month intervention, the study's stands out as a strength. Moreover, the implementation of PDCA not only can obtain tangible results such as reduction of prescription abandonment, but also produce intangible benefits, for example, since this PDCA involved many different departments in our hospital, the personnel involved in the PDCA cycle have enhanced their sense of responsibility and exercised their coordination skills. After all, relying only on one department to solve problems is no longer the best way in modern society. Although this preliminary study was carried out in only one hospital in China, we hope that our findings may inspire further research in other medical institutions on the role of PDCA in prescription abandonment.

Despite the success of the study, there are several limitations in our study. Firstly, this data was collected from only one hospital. Furthermore, although we also did an economic analysis, the sample size of the study was relatively small, and the observation time of PDCA was also relatively short. Therefore, future studies with larger sample sizes and pharmacoeconomic analyses are warranted to explore the effects of pharmacist-led PDCA cycles.

Conclusions

The implementation of pharmacist-led PDCA can effectively reduce the number, the proportion and the amount of prescription abandonment, Moreover, Pharmacists play an important role in improving the management quality of outpatient pharmacy, and PDCA is a feasible and effective management tool for reducing prescription abandonment.

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Disclosure

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The authors report no conflicts of interest in this work.

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