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Original Research

Characterization of children's prospective prescription review and exploration of factors influencing the success of interventions

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Abstract

Background: Medication safety is crucial in clinical care. Although many hospitals have implemented prospective prescription review systems to manage medication use, the impact of these systems on pediatric patients is not yet fully understood.

Objectives: We explore the characteristics and economic impacts of pediatric prospective prescription review and identify factors influencing intervention success rates.

Design: This study adopted a cross-sectional design.

Methods: Prospective prescription review tasks were compared in the outpatient of our hospital between 2021 and 2023 to assess medication rationalization rates and cost variability. Data were collected using the PASS PharmReview system, including patient information, medication indications, prescribing physicians, intervention pharmacists, prescription rationality rate, and medication costs. SPSS 26.0 software was used to compare changes in medication rationality and medication costs between the initial (2021) and stable (2023) periods and to analyze factors affecting intervention success during the stable period by the logistic regression model.

Results: The study included 11,533,807 prospective prescription review tasks. The medication rationalization rate increased from 92.0% to 95.7% ($p < 0.05$) between the initial ($n = 5,392,551$) and stabilization periods ($n = 6,141,256$). Outpatient medication costs per capita decreased by 3.2%, from ¥320.7 to ¥310.5. Factors influencing intervention success included the following: the greater age is negatively associated with success($p < 0.001$, odds ratio (OR) = 0.98); internal medicine demonstrates a superior intervention success rate compared to the surgical department ($p < 0.001$, OR = 1.37); higher physician titles were associated with lower success rates ($p < 0.001$, OR = 0.59); and success increased with pharmacists of higher educational levels ($p < 0.001$, OR = 1.18).

Conclusion: Implementing a prospective prescription review system in pediatric outpatient settings improves medication rationality and reduces errors and costs, with intervention success influenced by patient age, department, physician titles, and the educational level of pharmacists.

Plain language summary

Pediatric prescription reviews: success factors and safety improvements *Why was the study done?* Children's medication safety is crucial in healthcare. Many hospitals now check prescriptions by prospective review model to make sure they're safe for children, but we still need to understand how effective this process is and what makes

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it work better. This study looked into these questions. ***What did the researchers do?*** The researchers studied how prescriptions were reviewed in the outpatient department of a pediatric hospital between 2021 and 2023. They collected data on patients, medications, doctors, and costs. Their study compared prescription rationality and medication costs, employing statistical methods to identify factors contributing to more successful intervene prospective review outcomes. ***What did the researchers find?*** Out of 11.5 million reviews, appropriate prescriptions increased from 92.0% in 2021 to 95.7% in 2023. Medication costs per patient dropped by 3.2%. Some factors affected review success: Older children's prescriptions were reviewed less successfully. Internal medicine prescriptions were more successful than surgical ones. Doctors with higher titles had lower success rates, whereas pharmacists with more education were more successful. ***What do the findings mean?*** Prospective prescription review can enhance safety and reduce costs for children. Factors like a child's age, the doctor's department, doctor's title, and pharmacist's education level affect review success. This information can help improve the way medications are managed for children in outpatient settings.

Keywords: characterization, children, impact factors, intervention, prospective prescription review

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Introduction

Pediatric medication safety is fraught with challenges due to the persistent lack of tailored formulations and appropriate dosages.[1,2] The dynamic nature of children's growth and development leads to significant pharmacokinetic and pharmacodynamic variations compared to adults,[3] elevating the risk of adverse drug reactions and errors. A multicenter prospective study identified dosage errors and inappropriate medications as the most prevalent issues in pediatric emergencies,[4] which can notably impact treatment outcomes, including the misuse of antibiotics contributing to bacterial resistance.[5] Thus, maintaining pediatric medication safety remains a paramount concern in clinical practice due to the unique characteristics of Children.

In China, the labeling rate of pediatric usage information in commonly used drug instructions is relatively low,[6] which heightens the risk of medication errors (MEs) and adverse drug reactions (ADRs) among children. Similarly, in many European countries, there is a shortage of pediatric-specific medications, indicating a disconnect between pediatric drug research and clinical practice.[7] To address these issues, new legislation has been enacted to encourage the pharmaceutical industry to conduct high-quality, transparent pediatric research.[8]

In the era of rapid information technology development, prospective prescription review systems play an indispensable role in managing extensive pharmaceutical information, enhancing the efficiency of prescription reviews, controlling MEs and accidents, and reducing medication costs.[9,10] A prospective prescription review system is a real-time prescription monitoring system that requires pharmacists to intercept prescriptions with potential drug-related problems based on clinical guidelines, medical insurance policies, and drug instructions. In July 2018, the Chinese National Health Commission mandated that medical institutions promote the informatization of prescriptions review and provide necessary information via systems.[11] Since then, approximately 42.7% of public hospitals in China have implemented prospective prescription review systems, achieving significant results.[12]

As the National Children's Regional Medical Center in Southwest China, our hospital recognized the urgent need to establish a stable and

well-functioning prescription review system tailored to the unique needs of pediatric patients. In June 2019, we introduced a proactive prescription intervention system that integrates the "real-time rational medication review" function into the clinical physician workstation. This system evaluates and verifies drug therapy before a physician issues a prescription, thereby enhancing both medication safety and appropriateness.

The system is designed not only for ex ante alerts and real-time control but also for ex post analysis. Liu et al. conducted a descriptive analysis of the frequency and proportion of potentially inappropriate prescriptions identified through a prospective review.[13] A previous study also demonstrated that prospective prescription review helps reduce inappropriate antibiotic use and minimizes associated risks.[14] However, these analyses of the effectiveness of prospective review in rational medication use primarily rely on comparative metrics, such as the qualified rate of prescriptions before and after system implementation and the proportion of major irrational medication issues,[15] which tend to be limited in scope. Moreover, previous studies have predominantly focused on adults, leaving the effectiveness of prospective prescription review systems in pediatric hospitals largely unknown.[16] Therefore, this study aims to conduct a retrospective analysis to compare the medication rationalization rate and the variability in medication costs before and after the implementation of the prospective prescription review system. The focus is on exploring the factors that influence the success of prospective prescription review intervention, thereby expanding the dimensions of the analysis.

Materials and methods

Study design and setting

The pilot testing of our hospital's prospective prescription review system commenced in June 2019. However, it was not until the end of 2020 that the system achieved comprehensive coverage across outpatient departments. After 2 years of continuous maintenance, the system reached a level of maturity and stability, enabling reliable operation by 2023. To ensure the quality of the data, this study adopts a cross-sectional design, selecting all prospective prescription review tasks executed in our outpatient department from January 2021 to December 2021 (initial operational period) and January 2023 to December 2023 (fully stabilized period) as the research subjects.

Our hospital is a tertiary public pediatric specialty institution primarily dedicated to serving children aged 0–18 years, equipped with 2480 beds and comprising 42 fully specialized departments to ensure comprehensive pediatric care. To further standardize pediatric medication use, our hospital's outpatient pharmacy employs five pharmacists specializing in prospective prescription review, with their team size determined by the number of pediatric patients in our outpatient department. All five pharmacists are certified following rigorous training. They developed a prescription review rule database tailored for rational pediatric drug use. The "rule database" refers to structured sets of guidelines or criteria established to ensure medication safety and efficacy. It is constructed based on high-quality evidence, including drug labels from China, the United States, and other countries, the National Prescription Collection of China, and major international clinical practice guidelines. After undergoing evidence-based evaluation by the pharmacist team, the preliminary medication rules are submitted to an expert committee on rational medication use for review. This expert group holds regular meetings and employs a voting mechanism to achieve consensus, ensuring the scientific validity and clinical applicability of the rules in pediatric care. Finally, the consensus is translated into structured and logical language by our team of five pharmacists and integrated into the system, resulting in a comprehensive set of rational medication rules, referred to as the rule base. For instance, our rule base specifies that mometasone furoate nasal spray is appropriate for allergic rhinitis in children aged 2 years and above. When a physician prescribes this medication for a 1-year-old child, our review system will automatically trigger an alert, signaling potential medication misuse.

In summary, the prescription issued by the physician undergoes an initial review by the system before reaching the patient. Any potential medication issues identified during this process are referred to a pharmacist for further evaluation. Within 60 s, the pharmacists must decide whether to approve, execute with dual signatures, review with double signatures, or reject the medication, while also documenting their review comments. This time limit is designed to avoid interfering with doctors' normal

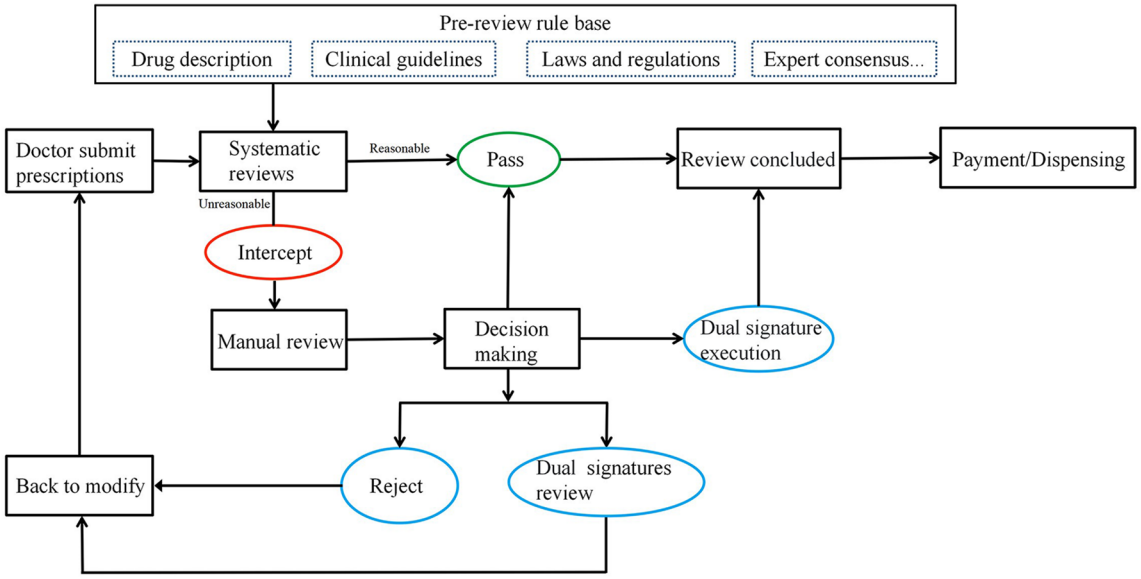

Figure 1. Flowchart for prospective prescription review system.

consultations while enabling pharmacists to promptly address unreasonable prescription issues, tailored to our hospital's prospective prescription review system environment. The specific review process is illustrated in Figure 1.

Inclusion and exclusion criteria

Through the PASS pharmReview system (MEDICOM, Version 1.2), eligible prospective prescription review tasks for outpatient departments were screened. Inclusion criteria were prospective prescription review tasks for patients aged 0–18 years who received services at our hospital during the study period. Exclusion criteria were prospective prescription review tasks lacking complete medical records and those for patients over 18 years of age.

Data collection

Patient demographics (age, gender, diagnosis, and department visited), number of visits, physicians' titles and pharmacists' education levels, basic information about the prospective prescription review interventions, and the classification of issues related to the irrational use of medications were collected. In addition, differences in the rational use of medications between 2021 and 2023, as well as medication costs, were recorded. The data collection process conforms to a standardized process to reduce information bias and measurement bias.

Variable classification and encoding

In our study, several variables were employed to characterize patient demographics, departmental settings, physician titles, and pharmacist education levels. Each variable was meticulously coded to ensure consistency and clarity in data analysis. The details are as follows: Patient's Gender: Female: Coded as 0; Male: Coded as 1. Department: Surgical Department: Coded as 1; Remaining Specialties: Coded as 2; Dermatology: Coded as 3; Emergency Department: Coded as 4; Internal Medicine: Coded as 5. Physician title: Physician: Coded as 1; Attending Physician: Coded as 2; Associate Chief Physician: Coded as 3; Chief Physician: Coded as 4. Pharmacist education levels: Undergraduate: Coded as 0; Postgraduate: Coded as 1. Intervention Success: No: Coded as 0; Yes: Coded as 1. Within each category, the variable exhibiting the lowest value serves as the reference group. For example, an attending physician is defined as a higher physician title when compared to a physician. We have also categorized the issues related to the irrational use of medications collected into six categories: usage and dosage, drug interactions, off-label use,

prescription normativity errors, drug duplication, and others. "Prescription normativity errors" refer to practices that contravene relevant regulations or medical protocols in medication prescribing. This encompasses, but is not limited to, incomplete prescription information, prescriptions issued for duration that exceed the stipulated maximum, and non-compliant prescription formats. "Usage and dosage" primarily refers to issues related to medication administration, including but not limited to incorrect dosage, inappropriate frequency, formulation problems, and suboptimal timing of drug administration.

Key variable description

In 2023, the status of prospective prescription review intervention tasks was categorized as follows: ① After the doctor indicated the reasons for the medication, direct approval by the pharmacist; ② Automatic approval after dual signatures by the physician; ③ System approval after physician modification; ④ Pharmacist approval after physician modification; ⑤ Manual review approval by pharmacist after dual signatures by the physician; ⑥ Legacy tasks; ⑦ Automatic approval after physician modification—did not meet pharmacist monitoring standards; ⑧ Timed-out approval—pharmacist has not reviewed; ⑨ Timed-out approval after physician modification, pharmacist has not reviewed; ⑩ Automatic approval after physician modification—duplicate issues filtered out; ⑪ Timed-out approval after dual signatures by the physician, pharmacist has not re-evaluated. ⑫ Automatic approval—pharmacist has left after physician modification. The pre-review pharmacist team, through brainstorming, has ultimately determined that any prescription issued by a doctor, after undergoing the complete pre-review process, will be considered a successful intervention if the prescription is appropriately adjusted by the physician and approved by both the system and the pharmacist. Therefore, categories ①, ③, ④, ⑦, and ⑩ were deemed successful interventions, while the remaining categories were considered unsuccessful interventions. Furthermore, the presence of remaining tasks or task timeouts that the pharmacist has not yet reviewed may be attributed to reasons such as the physician voiding inappropriate prescribing tasks without resubmitting them for review, or the pharmacist's inability to manage multiple tasks in a timely manner.

Statistical analysis

Data analysis was performed using SPSS software (version 26.0). The rationality rates of medication use between the initial and stable operation periods of the prospective prescription review were compared using the Chi-square test. The medication rationalization rate was calculated using the following formula: Medication rationalization rate = 1 − (number of inappropriate prescription tasks reviewed by the system as unreasonable − number of tasks revised by physicians − number of tasks passed directly by pharmacists)/total number of tasks × 100%. In this study, outpatient medication costs per capita were used to represent outpatient medication costs. Outpatient medication costs per capita = total income of outpatient medication costs/outpatient visit counts. For the factors influencing intervention success, these candidate variables were identified for inclusion in the model through brainstorming sessions and expert consultations. The two categorical logistic regression analyses were employed to investigate the factors influencing the success of prospective prescription review interventions, with odds ratios (ORs) calculated. A p-value of less than 0.05 was considered statistical significance.

Ethical and STROBE statement

This study's data neither involve any critical private information about patients nor does it include potential risks to humans or animals. Consequently, ethical approval is not required. However, this study rigorously adheres to the principles of confidentiality and anonymity to ensure the security of the collected information. The reporting of this study conforms to the STROBE statement.[17] See Supplemental Table 2 for details.

Results

Basic information about the study subjects

The study included a total of 11,533,807 pre-review tasks that met the inclusion criteria (initial operational period (2021): $n = 5{,}392{,}551$; fully stabilized period (2023): $n = 6{,}141{,}256$). According to the investigation, in 2021, the pre-review system predicted 563,865 inappropriate prescribing tasks. Of these, physicians modified 129,676 tasks, and pharmacists directly approved

Table 1. The baseline characteristics of the patients.

Variables	Subgroups	Value	Total, *N* (%)
Patient's age, M (IQR)	—	4.0 (4.3)	59,342 (100%)
Patient's gender, *N* (%)	Female	26,431(44.5)	59,342 (100%)
	Male	32,911 (55.5)	
Department, *N* (%)	Surgical department	1929 (3.3)	59,342 (100%)
	Remaining Specialties	4043 (6.8)	
	Dermatology	4142(7.0)	
	Emergency Department	13,744(23.2)	
	Internal Medicine	35,484(59.8)	

IQR, interquartile range; M, median; *N*, number.

Table 2. Comparison of pediatric prescription pre-review tasks between 2021 and 2023.

Time	Systematic review of inappropriate prescribing tasks (*N*)	Physician modification tasks (*N*)	Pharmacist review tasks (*N*)	Tasks passed directly by pharmacists (*N*)	Tasks performed by physicians with dual signatures (*N*)	Tasks that pharmacists refused to pass (*N*)
2021	563,865	129,676	30,426	4669	18,286	15
2023	547,112	255,647	59,342	29,995	24,289	11
2021 vs 2023, *N* (%)	−16,753 (−3.0)	125,971 (97.1)	28,916 (95.0)	25,326 (542.4)	6003 (32.8)	−4 (−26.7)

N, number; %, percentage.

4669 tasks. In 2023, doctors proactively modified 255,647 tasks following the pre-review system's judgment. Among the remaining inappropriate prescription tasks, 59,342 prescriptions were flagged by the system as requiring pharmacist review. Some inappropriate prescription tasks were voluntarily voided and reissued by doctors. Refer to Table 1 for the baseline characteristics of the patients included in the study; the comparison of pediatric prescription pre-review tasks between 2021 and 2023 is detailed in Table 2; and the classification of intervention tasks for the prospective prescription review system is detailed in Supplemental Table 1.

The changes in medication rationalization rate and medication costs

Figure 2 shows a comparison of the operational effects of prospective prescription review in 2021 versus 2023. The medication rationalization rate increased from 92.0% to 95.7%, with the difference being statistically significant ($p < 0.05$). In addition, the average medication costs per outpatient decreased from 320.7 Chinese Yuan (CNY) to 310.5 CNY, demonstrating a saving of approximately 3.2% in medical resources.

The classification of issues related to the irrational use of medications in children

Figure 3 clearly shows that in 2023, the main issues of irrational drug use at this pediatric regional medical center were concentrated in improper usage and dosage ($n = 115,977$), drug interactions ($n = 45,473$), and off-label use ($n = 44,096$). These three categories accounted for 78.6% of all reported issues, with off-label use alone comprising 16.9% of the total.

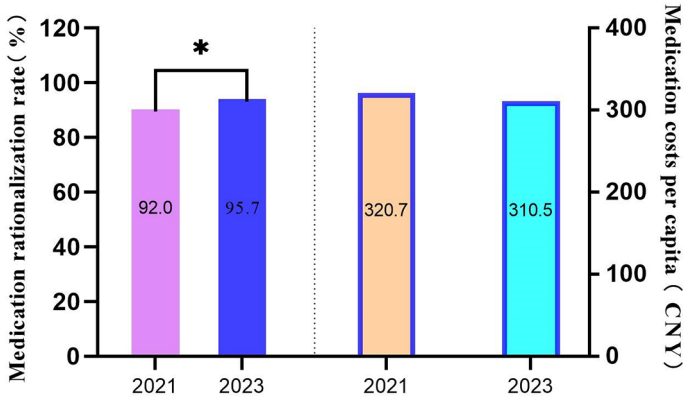

Figure 2. The changes in medication rationalization rate and medication costs.
*$\chi^2 = 70{,}075.1$, $p < 0.001$.

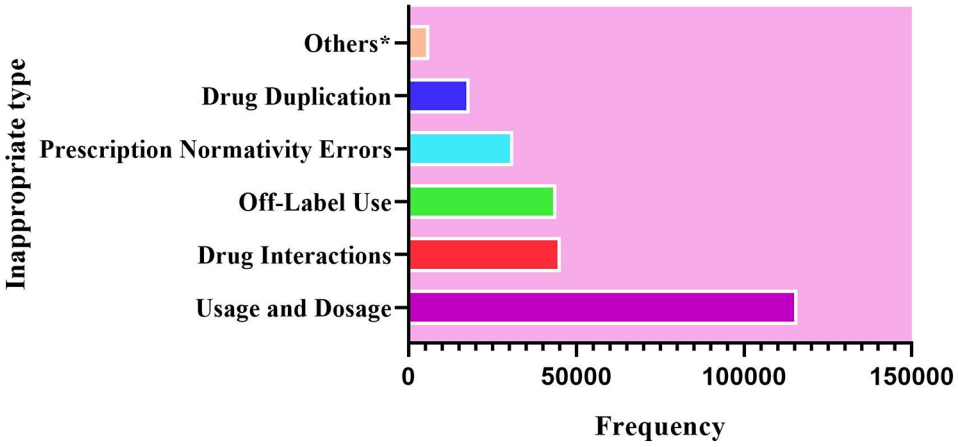

Figure 3. The classification of issues related to the irrational use of medications in children.

Factors affecting the success of prospective prescription review system interventions

Before conducting the SPSS analysis, all data were assigned classifications, as detailed in Table 2. The analysis results indicated a significant negative correlation between age and the success rate of prospective prescription review interventions, meaning that the older the patients, the lower the success rate of interventions ($p < 0.001$, OR = 0.98, 95% CI (0.98–0.99)). Furthermore, the analysis revealed that the internal medicine department demonstrates a superior intervention success rate compared to the surgical department ($p < 0.001$, OR = 1.37, 95% CI (1.24–1.50)). In addition, the findings showed that higher physician titles were associated with a relatively lower success rate of pre-review interventions ($p < 0.001$, OR = 0.59, 95% CI (0.58–0.60)). On the other hand, a higher educational level among pharmacists was significantly positively correlated with the success rate of pre-review interventions ($p < 0.001$, OR = 1.18, 95% CI (1.14–1.22)). For more detailed information, please refer to Table 3.

Discussion

This study retrospectively analyzed data from the prospective prescription review system for outpatient children aged 0–18 receiving treatment at a pediatric regional medical center in Southwest China. Our findings primarily apply to pediatric specialty institutions that have implemented prospective prescription review systems, particularly those in similar regional centers and resource-rich medical environments. The results demonstrate that the system effectively intervenes in physicians'

Table 3. Factors affecting the success of prospective prescription review interventions.

Variables	Subgroups	β	S.E	Wald	*p*	OR	OR 95%CI	
							Lower bound	Upper bound
Patient's gender		−0.018	0.018	1.02	0.312	0.982	0.949	1.017
Patient's age		−0.016	0.002	43.51	<0.001*	0.984	0.980	0.989
Department[a]		—	—	548.58	<0.001*	—	—	—
	Remaining Specialties;	−0.096	0.057	2.86	0.091	0.908	0.812	1.015
	Dermatology;	−0.323	0.057	31.86	<0.001*	0.724	0.647	0.810
	Emergency Department;	0.421	0.051	68.69	<0.001*	1.524	1.379	1.683
	Internal Medicine	0.312	0.048	41.88	<0.001*	1.366	1.243	1.501
Physician titles		−0.525	0.009	3488.49	<0.001*	0.591	0.581	0.602
Pharmacists' educational levels		0.161	0.018	83.61	<0.001*	1.175	1.135	1.216

[a]The surgical department is the reference group.
*Statistically significant ($p < 0.05$).

inappropriate prescriptions, significantly enhancing the efficiency and quality of prescription reviews. The intervention model, which integrates system and manual review, continuously optimizes outpatient prescriptions and offers economic benefits, aligning with the findings of Bao et al.[18] Further analysis of factors influencing the success of prospective prescription review interventions reveals that patient age, department of visit, physician's professional title, and the educational level of the pharmacist handling the task are key factors significantly impacting the success of the pre-review intervention.

Our study fills a gap in pediatric research by demonstrating that implementing a prospective prescription review system in a tertiary children's hospital significantly enhances medication rationality. Previous studies have indicated that such systems reduce MEs before they reach patients, with a 69.9% reduction in inpatient settings.[19] In addition, a prospective review of discharge medications at a large tertiary medical center led to a 22% reduction in medication-related issues.[20] Even in the context of primary care settings in Malaysia, the system effectively reduces prescription irrational rates.[21] Beyond improving medication safety, these systems also contribute to medication cost savings. For example, a study from a Japanese children's hospital reported a reduction in the annual per capita cost of oral antibiotics from $7.2 to $1.2.[22] Our findings support these outcomes, emphasizing the economic benefits of prospective prescription review. However, a study from Korea found that while the system improved patient outcomes, it did not significantly reduce ADE-related costs.[23] This discrepancy may be due to the limitations of the economic cost models used. Future work should aim to refine these models for a more comprehensive evaluation of all associated costs.

The establishment and refinement of rule databases for the prospective prescription review system are essential for ensuring rational medication use.[24,25] Pharmacists play a significant role in the formulation of the prescription review rule database, and multidisciplinary collaboration is also essential in establishing consensus standards for pediatric medication safety. However, the current pharmacist training system in China is inadequate, with the majority of Chinese pharmacists unable to meet the high demands for pharmaceutical service capabilities and standards—a situation similar to that in other developing countries.[26] Compared to undergraduate education, graduate

education provides pharmacists with more comprehensive knowledge, organizational skills, and practical application abilities, which enhances their capacity to make informed medication therapy decisions.[27] As a result, their professionalism is more credible to physicians, leading to higher intervention success rates.

Physicians with advanced titles often have superior educational backgrounds and extensive clinical experience. They are typically more informed about current evidence and the latest developments in their specialized fields, making them more inclined to explore innovative treatments in complex cases. This is consistent with research findings that indicate a higher incidence of off-label drug use among senior physicians in pediatrics. While physicians with lower-level titles tend to adhere to label-based medication practices.[28,29] This difference in clinical practice may present greater challenges for pharmacists when intervening with senior physicians, contributing to lower intervention success rates.

Previous studies have demonstrated the significant impact of a pharmacist-led informatics prescription review system in medication management, effectively intercepting inappropriate prescriptions, preventing serious MEs, and reducing pharmaceutical costs. However, to date, there has been a lack of studies on the types and characteristics of inappropriate prescriptions in the pediatric outpatient setting.[30,31] However, to date, there has been a lack of studies on the types and characteristics of inappropriate prescriptions in the pediatric outpatient setting.[32] Off-label drug use was also prevalent in the United States,[33] and our study further demonstrates that similar issues exist in pediatrics. Due to delays in drug label updates and the difficulties associated with conducting clinical trials in children, off-label drug use is relatively common in this particular population.[34] The alert system for potential drug interactions in pre-prescription reviews may induce alert fatigue among clinicians, resulting in the dismissal of critical warnings and consequently increasing the risk of inappropriate drug interactions.[35] This phenomenon could explain why our study identified drug interactions as the second most common type of inappropriate medication use in pediatrics.

As early as 2005, there have been reports abroad on the use of computer information systems to assist with pre-prescription reviews, enhancing hospital pharmacy services.[36] This study provides significant insights for pediatric clinical practice and future research, particularly regarding the role of pharmacists in monitoring rational medication use in outpatient settings. However, pharmacists should prioritize improving physicians' acceptance of the alert information generated by the prospective prescription review system. Currently, physician reports indicate that the acceptance rate of prospective prescription reviews is around 80%, meaning 20% of physicians opt to sign a waiver to bypass system recommendations. Increasing physician acceptance is a gradual process, as many physicians believe that pharmacists need to further develop their professional skills.[37] Presently, the training system for high-level pharmaceutical talent is inadequate, with a noticeable lack of professionalism.[38] Therefore, we recommend enhancing the professional capabilities of pharmacists with lower academic qualifications through various channels to build a robust talent pool for pre-prescription review work. Given the shortage of pediatric medical resources in the country,[39,40] regional prospective prescription review centers, unrestricted by geography, represent the best solution to alleviate this issue, thereby improving healthcare services through enhanced accessibility.

Overall, this study has several strengths. First, our hospital, as a regional pediatric medical center, handles a large volume of outpatient pediatric prospective prescription reviews, ensuring a sufficient and representative sample size. Second, to the best of our knowledge, this is the first study to investigate the factors influencing the success of prospective prescription review interventions in children. Lastly, since the implementation of the national centralized drug procurement policy by the Chinese government in 2019, the average price of selected drugs has decreased by 52%. Importantly, the economic evaluation data for the time frame specified in this study are not affected by this policy.

Limitations

However, our study also has certain limitations. First, it is a single-center study focusing on children in the southwestern region of China. Future research should involve multicenter studies to obtain more comprehensive information. Second, as this study employed a retrospective analysis

design, there may be limitations in fully controlling for confounding variables (such as time-effect bias) in the historical data, which could affect the robustness of the results. Although our study included a large sample size, the sample was limited to pediatric outpatients from specific regions or healthcare institutions, which may not be representative on a national or international scale. Furthermore, the economic cost model used in this study was relatively simplistic, focusing only on certain economic indicators and failing to fully capture the overall economic burden on patients. Incorporating the usage of different types of medications (such as generic vs branded drugs, prescription vs over-the-counter drugs) could potentially influence the results of the economic cost model. These limitations suggest that caution should be exercised when interpreting the findings, and they highlight areas for further optimization and expansion in future research.

Future research

In the future, we can integrate the Diagnosis-Related Group rules into the prospective prescription review system, advancing healthcare structural optimization. We will explore how this integration can provide diagnosis and treatment references and decision-making basis from the perspectives of drug interactions,[41] ADRs,[42] and to achieve the quality control of medical prescriptions and risk assessment.[43] In addition, the properties of medications, such as dosage form and whether they are prescription drugs, can serve as candidate factors influencing the success of interventions in our future research, offering a more comprehensive insight to the academic community.

Conclusion

This study shows that implementing a prospective prescription review system in pediatric outpatient settings can significantly improve the rationality of medication use, reduce MEs, and lower medication costs. We found that patient age, department type, physician titles, and the educational level of pharmacists all significantly influence the success rates of interventions. Given these benefits, we recommend adopting prospective prescription review systems widely in pediatric clinical settings to enhance medication safety.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Author contributions

Qiang Wen: Conceptualization; Data curation; Visualization; Writing – original draft; Writing – review & editing.

Chuang Yang: Data curation; Formal analysis; Methodology.

Bangjian Deng: Data curation; Software.

Yi Zhang: Conceptualization; Supervision; Validation; Writing – review & editing.

Lin Song: Project administration; Supervision; Validation; Writing – review & editing.

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Competing interests

The authors declare that there is no conflict of interest.

Availability of data and materials

All data analyzed in this study can be obtained by a reasonable request to the corresponding author.

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Supplemental material

Supplemental material for this article is available online.

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