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An Analytical Model for Clinical Pharmacist Interventions in Identifying and Resolving Drug-Related Problems at Pediatric Hospital Patients

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ABSTRACT

Clinical pharmacists offer valuable services to people of all ages, but their advantages for pediatric (PD) hospitalized individuals are less established. Five libraries were queried utilizing the keywords 'clinical pharmacy,' 'PD,' 'hospital,' and 'interventions' to identify studies involving PD children in hospital environments that detailed pharmacist-initiated actions. Following the full-text review, the searching technique discovered many articles that met the requirements. The analytical model was utilized to evaluate the eligible publications. Medical pharmacist treatments significantly enhanced PD Patient (PDP) care. Physicians detected prescription errors that encompassed overdosing, under-dosing, missing doses, deficiencies in drug history, asthma, and near-misses. Treatments aimed at rectifying these mistakes were favorably accepted and adopted by physicians, achieving an average approval rate of over 96%. Education began by clinical pharmacists led to enhanced comprehension of medications, increased adherence, greater satisfaction with patients, and better management of long-term medical diseases. The analytical model determined that pharmacy technicians in PD wards mitigate drug-related issues and enhance patient results. The advantages of pharmacist participation are most evident during ward visits, as they swiftly detect drug problems in the prescription phase and offer immediate counsel and suggestions to prescribers.

Keywords: *Pharmacist interventions, Pediatric hospital, drug-related problems, analytical model*

1. INTRODUCTION

Pediatric (PD) patients face different healthcare providers' obstacles [1]. This is partly attributable to a restricted ability to speak, especially when experiencing a stressful illness, and variations in pharmacokinetic characteristics relative to adults. Children constitute roughly one-quarter of the world's inhabitants [9]. While the majority enjoy a healthy youth, a recent well-being survey indicated that nearly half had experienced at least one chronic well-being circumstance, and around sixty percent were given prescription drugs in the past year. The incidence of intricate PD diseases is increasing, encompassing diabetes, allergies, hypertension, inattentive deficient hyperactivity illness, and sadness [3]. These illnesses typically necessitate pharmaceutical treatments, with medical pharmacists tasked with delivering direct, individualized medication for individuals to guarantee the optimal utilization of drugs.[2].

Medical pharmacists in a heterogeneous care team inside adult medical units are essential for assuring the quality use of medications, minimizing medication mistakes, and improving patient results that save cost [14]. Mitigating pharmaceutical errors in the susceptible PD demographic is paramount, as prior studies have indicated that PD Patients (PDPs) are at a heightened risk of errors relative to adults, with a threefold increased likelihood of such errors resulting in injury.[10]. These mistakes, which encompass medication omissions, overdosing, under-dosing, and administering mistakes, underscore the necessity of clinical chemists' participation in PD disease management for optimal patient care.[4].

Drug-Related Problems (DRPs) can be characterized as any occurrences or situations connected to drug therapy that either really or possibly hinder a patient from achieving optimal health results [5].[15]. The detection, prevention, and resolution of DRPs, often referred to as medication-related issues, are fundamental components of pharmaceutical treatment. Any care activity to enhance medication utilization is intended to rectify or avert actual and anticipated DRPs, such as side effects or interactions. DRP is an essential term that encompasses medication mistakes and adverse drug reactions. Medication mistakes frequently occur in clinics. Pharmaceutical errors are categorized as prescribing, transcribing, dispensing, and administration errors [11]. Medication errors include incorrect medication, dosage, strength, formulation, and expired medication.[6].

A severe drug reaction is described as an unanticipated response to a drug when administered at a therapeutic dose. Intervention is characterized as an action undertaken by pharmacists to maximize treatment, hence improving patient care. The pharmacist is crucial in reducing DRPs by ensuring the appropriate use of medications, as many errors arise from a lack of drug information [7].

Pharmacists have demonstrated the ability to enhance medication adherence, understanding, and suitability of prescribed drugs and decrease hospital length of stay amongst adult inpatients [16]. Not all hospitals utilize PD pharmacy technicians, as financial oversight and alterations in healthcare financing need physicians to delineate and substantiate their medical and economic rationale for their participation in caring for patients.[18].[8].

The study aimed to assess whether PD pharmacy technicians deliver comparable advantages to PDPs as they do to adults, how much their actions enhance medical results for PDPs, and the monetary savings they generate for their employers. The fundamental study question for this meta-analysis was 'What is the impact of clinical pharmacists' job responsibilities on the care of PD hospital sufferers?' [12].

2. MATERIALS AND METHOD

This research adheres to the Preferred Reporting Items for Systematic and Meta-Analyses (PRISMA) criteria for reporting systematic examinations.

1.1 Research Methodology

This research employed a cross-sectional approach by the declaration, which is required in published cross-sectional research, to assess the capacity of community pharmacy technicians in the location to identify DRPs in PD prescriptions and their interventions to address these issues. This investigation utilized the patient strategy, a well-validated and internationally recognized tool for assessing the achievement of neighborhood pharmacies. This method employs trained persons as test purchasers to simulate a specific scenario that mirrors a real-world event, allowing for the evaluation of the level of service. The primary justification for employing this method is to mitigate the Hawthorne operation, wherein individuals alter their actions upon realizing they are being observed.

1.2 Criteria for Selection

The research was chosen according to the specified inclusion requirements: Accepted research methods encompassed qualitative epidemiological investigations and interventional research; studies detailing the epidemiology of DRPs in PDs (including prevalence, type, related variables, severity, avoidance, causes, and actions); as well as individuals aged 0 to 18 years. The criteria for removal were outlined below: (1) Research released solely in abstracts or consisting of unoriginal content (letters or articles) and (2) research that concentrated exclusively on a singular principal domain of DRPs, such as those reporting solely on Adverse Drug Reactions (ADRs) or prescribing mistakes.

1.3 Search Methodology

Original studies in English were deemed suitable for insertion and determined through methodical examination libraries. The terms included clinical pharmacy technician, PD, hospital, and treatment. Titles were reviewed to identify possibly pertinent papers, and the research initially accepted any study that seemed to contain hospitalized individuals of any age and any treatment by health professionals. Papers were examined, and articles about PD children and pharmacist participation were selected for comprehensive evaluation. Publications were considered eligible for consideration if they enrolled PDPs in a medical facility, included pharmacist-initiated actions, and discussed the impact of these actions on patients' health. For this evaluation, "PDs" encompassed individuals from birth to 19 years of age. Removed papers included those detailing interventions solely partially overseen by pharmacists, routine pharmacist interventions not associated with client outcomes, those exclusively addressing older age demographics, or studies involving PD and older patients without age-specific result differentiation.

1.4 Selection of Studies, Information Extraction, and Quality Evaluation

The study chose a study, gathered data, and evaluated quality. All disputes were settled through agreement and, when required, consultation with a third assessor. Data obtained from qualifying papers encompassed author information, publication year, country of respondent source, participant measure, research design, regularity and technique of treatments utilized, as well as primary and secondary results provided. The principal results of interest were the kinds of pharmacist interventions used and their consequent health and other results about the care of PDPs. The information was categorized by the type of reported result, with medical results further divided into decreased DRPs, enhanced disease/condition management, and reduction of medication-related mistakes and/or seriousness.

The quality of the research was evaluated utilizing standardized standards from the Joanna Briggs Institute (JBI). The checklists assess the clarity of the study, the suitability of the approach and design, the analysis, the delivery of outcomes, and the correspondence between the results and the discussion with the research goals. The study separately employed three JBI critical evaluation criteria for each publication to evaluate the quality of eligible investigations: analyzing cross-sectional research, cohort research, and randomized controlled studies. Score discrepancies were deliberated until an agreement was

reached, categorizing publications as high grade if they received a 'yes' for no less than 70% of the standards, medium if 50% or above, and lower if below 50%.

1.5 Managing Data and Interpretation

Data was examined using the Statistical Package for Social Sciences (SPSS) program. At first, any information was gathered using an organizing sheet and encoded into parameters. The frequencies were employed to illustrate the results through statistical analysis. The correlation between factors was assessed using the Chi-square examination, with a p-value of 0.05 or lower deemed significant.

3. STUDY ANALYSIS

1.6 Searching Outcomes and Study Attributes

A total of 4.2k possibly suitable records emerged from the search. Thirty-five papers were reviewed, resulting in eighteen studies satisfying the inclusion requirements. Figure 1 illustrates the screening procedure and its outcomes. All selected research has been released in English; 7 were cohort investigations, and 13 were cross-sectional investigations. The duration of the study varied from three weeks to 12 years, and the sample size comprised 50 to 8.7k people.

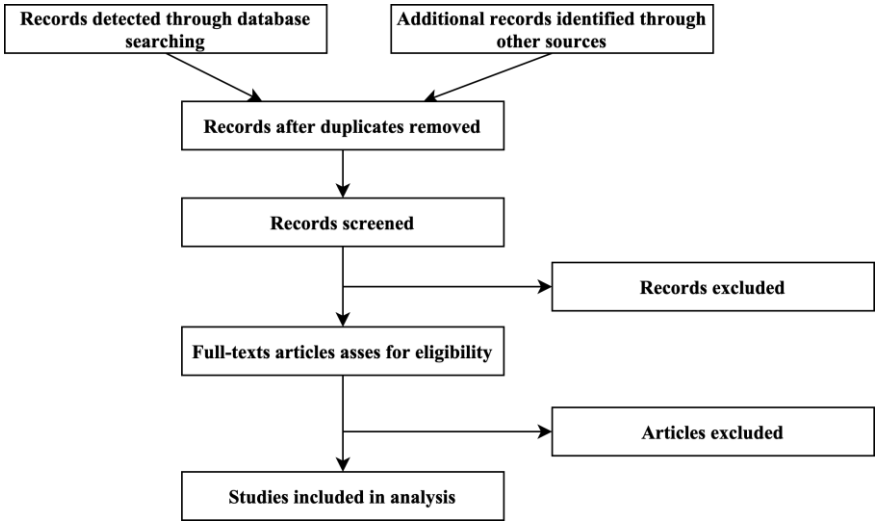

Figure 1: Workflow of the study

1.7 Potential Bias in Research

All included cohort investigations were assessed as having a low risk of bias across every element, with a score of ≥7 stars signifying excellent quality. In almost half of the 13 cross-sectional investigations, Study ID 7, "explain the evaluations performed for safeguarding objectives," and Study ID 9, "an assessment and/or methods to control variables," were classified as ambiguous. However, the overall assessment outcomes of the other items were deemed satisfactory.

1.8 Epidemiological Attributes of DRPs in PDPs

Eighteen research examined the prevalence of DRPs in PDPs across various nations and regions, utilizing the DRP categorization method to detail problem type, prevalence, severity, avoidance, triggers, contributing variables, and treatments.

- Taxonomy Framework

Seventeen studies employed six distinct types of DRP categorization methods, with one failing to disclose the categorization utilized. The categorization methods were used the most frequently, accounting for 72% of the instances. There exist distinctions among several DRP categorization schemes.

- Prevalence of DRPs in PDPs

Twelve research investigated the prevalence of DRPs. The study evaluated DRPs in a PD ward in Ethiopia through a prospective longitudinal study; 80 patients participated, with 70 experiencing at least one DRP, suggesting that the actual frequency of DRPs is far more than documented. The incidence of DRPs in PD renal residents was 18.3% higher than in PD renal outpatient clinics (50.5% vs. 30%). The median rate of DRPs among PD patients transferred to a clinical ward, PD Intensive Care Unit (ICU), or neonatal ICU (NICU) across seven medical facilities was 22.5%.

- Severity of DRPs in PDPs

Seven investigations documented the severity of DRPs in PDPs. Five studies utilized a confirmed scale for medication mistakes to assess the degree of DRPs; investigators evaluated the validated DRPs based on potential patient results using a scale from 0 to 10, where 0 indicates no potential negative impact on the patient, and 10 signifies a case that could lead to death. The research employed varying definitions, categorizing DRP that necessitated no therapy as "mild," DRP that required intervention for symptom alleviation as "moderate," and DRP that mandated hospitalizations as "severe." Seven investigations indicated that the extent of DRPs in PDPs was predominantly classified as low and medium. Figure 2 illustrates the severity of DRPs.

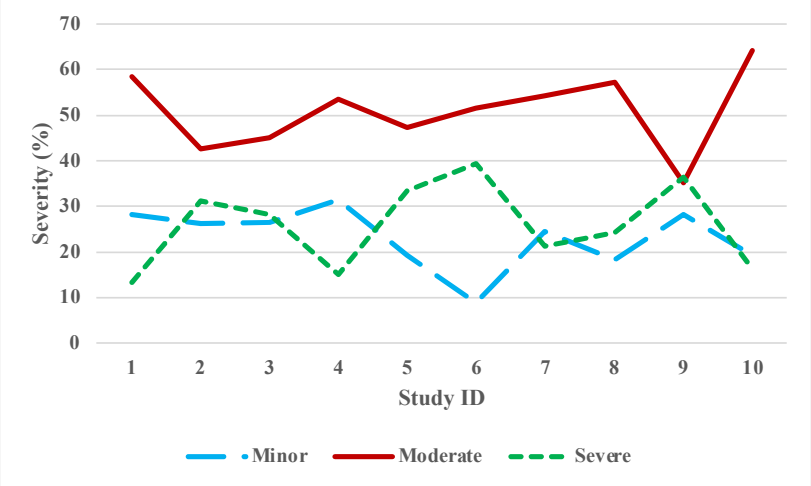

Figure 2: Severity analysis of DRPs

- Preventability of DRPs in PDPs

Seven investigations evaluated the preventability of DRPs in PDs. Six studies utilized the established criteria to assess the avoidance of DRPs. Seven investigations indicated that most identified DRPs in PDPs were avoidable, with preventability rates ranging from 45.2% to 85.5%. Figure 3 illustrates the avoidable nature of DRPs.

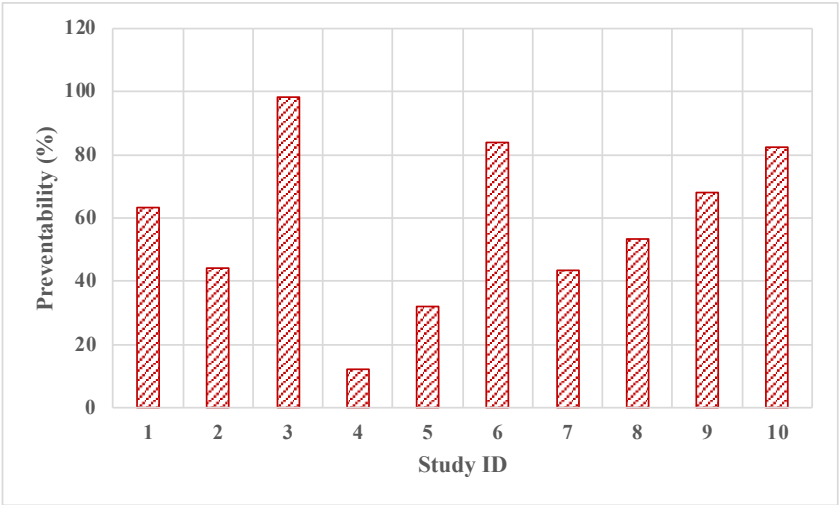

Figure 3: Preventability analysis of DRPs

1.9 Classification of DRPs in PDPs

Utilizing several categorization techniques on identical patient databases of difficulties has yielded disparate counts of DRPs, distinct category discoveries, and varied troubles. Thirty-six This review analyzed 18 papers employing six distinct DRP categorization techniques, yielding various types and quantities of DRPs in PDPs. The findings indicated that DRPs encompass drug choice, dosage, ADRs, and administering the medication. Dosing issues, characterized by insufficient or excessive dosages, are the predominant categories of DRPs reported in numerous research. ADR ranks as the second most commonly documented DRP in specific research.

1.10 Causative Factors

Eleven investigations documented the etiology of DRPs in PDPs. The vast majority pertained to the determination of the dose. Two of the most prevalent reasons are drug selection and medication administration procedures. The necessity for prophylactic treatment to mitigate the risk of new ailments is the primary reason for the demand for supplementary therapy. Investigations indicate that the lack of essential prescribing data and the administration of medication without an approved prescription are significant contributors to DRPs and mistakes in prescribing. At the same time, patients' medication-taking behaviors are also substantial variables in DRPs.

- Causes Contributing to the Incidence of DRPs

Several research assessed the parameters linked to the incidence of DRPs, revealing a substantial correlation between the quantity of prescribed medications and the frequency of DRPs. A patient is at a heightened risk of experiencing DRPs when identified with specific transmissible and parasitic illnesses. DRPs correlate with prolonged hospital stays, higher amounts of prescribed medications, and a higher frequency of clinical issues. Polypharmacy and care transitions between various medical facilities or wards are interesting causes for DRPs.

- Interventions

Eight studies evaluated therapies for DRPs. Clinical pharmacists constitute the primary workforce executing interventions, with dosage adjustment being the most commonly employed intervention. Medical professionals embrace most pharmacists' suggestions, resulting in substantial medical and favorable economic outcomes.

1.11 Pharmacists' error identification and corrective measures

The identification of mistakes and the commencement of treatments by chemists were the most often documented outcomes; however, the amount of reporting per individual exhibited considerable variability across research, influenced by the size of the amenities, the number of chemists, and their workload. Antibiotics were the predominant pharmaceuticals implicated in DRPs, as noted in six qualifying papers, followed by prescriptions for alimentary system and metabolic conditions. Pharmacists frequently recommended alterations in medication therapy in several studies, addressing off-label prescribing, medical disorders inadequately treated per established guidelines, and the prescription of drug formulations inappropriate for adolescents. Inaccurate dosing, including under-dosing and overdosing, emerged as an essential problem in this research, with overdoses ranging from 1.8 to 12 times the suggested maximum dose, posing considerable danger for younger individuals, hence heightening the likelihood of severe problems.

Research that monitored pre- and post-pharmacist engagement in prescription and medical ward rounds revealed substantial decreases in mistake rates, ranging from one-fifth to one-third ($p < 0.01$). The clinical importance of these actions has been documented in numerous studies, indicating that errors committed by doctors and captured by pharmacists could be dangerous or fatal in 1.2-2.5% of cases, very or significant in 2.6-28.5% of instances, and slightly essential in 36.2-65.4% of cases. A study revealed that free-text submissions by doctors were almost five times more prone to errors ($p<.001$) than standardized templates and computerized entries. Additional advantages of pharmacist participation in PD care, as reported in multiple studies, encompassed a notable decrease in missed dosages of both critical and non-urgent drugs ($p = 0.25$ and $p < 0.01$, accordingly), a substantial reduction in hospitalization duration (from 8.5 to 7.5 days, $p = 0.01$), and an improvement in medication adherence rates (from 72.5% to 80.5%, $p < 0.02$).

1.12 Enhancement of medical condition

Two randomized controlled trials examined the effects of pharmacist treatments on certain illness conditions in PDPs. Both investigations identified non-compliance to therapy as a serious concern, treatments by medical pharmacists, primarily through patient education. In contrast to the other research mentioned, dosing complications in these tests, including overdose, were less prevalent, which is hypothesized to result from enhanced prescriber knowledge with a limited number of drugs required for these specific conditions. These investigations demonstrated substantial enhancements in markers (e.g., serum phosphates, parathyroid hormone, bone magnesium, and serum iron) for both diseases (all $p<0.02$), along with notable gains in quality of life scores relative to the control groupings.

1.13 Economic ramifications

Three of the four investigations addressing the financial implications of medical pharmacist interventions reported savings in funds attributable to a decline in the necessity for less or less costly treatments (decrease in overall drug expenditures) or the avoidance of unwanted drug reactions and their related expenses. A study revealed no substantial disparity in drug expenses or overall patient care expenses associated with the engagement of pharmacies. [13].

4. EXPERIMENTAL ANALYSIS

1.14 Socio-Demographic Profile of Regional Pharmacists

The analytical model completed 230 pharmacy trips, each involving prescriptions with three distinct types of DRPs, achieving a compliance rate of 100%. The pharmacists utilized the prescriptions to evaluate the proficiency of local

pharmacists in recognizing DRPs and monitored their subsequent treatment. Among the 230 local pharmacists, 25% were men, and 75% were women. These Clinical Professionals (CPs) possessed a bachelor's level as a prerequisite to perform their duties. The socio-demographic attributes of the CP are shown in Table 1.

Table 1: Demographic analysis of responders

Category	Features	Frequency (%)
Age	20 to 25 years	12.5
	25 to 30 years	39.5
	30 to 35 years	27.4
	35 to 40 years	18.4
	Over 40 years	2.2
Gender	Men	25
	Women	75
Education	B. Pharm	20
	M. Sc.	80
Experience	< 2 years	24.5
	2 to 5 years	31.4
	5 to 10 years	29.4
	> 10 years	14.7

1.15 Detection of DRPs by Local Pharmacists

Among the 230 local pharmacists, 3.6% successfully identified at least one of the DRPs in the prescriptions, whereas 15.2% did not find any. The predominant type of DRP observed was incorrect treatment time, which was succeeded by incorrect dosage. No substantial correlation exists between the detection of DRPs by CPs and their sex, years of expertise, or daily time spent in the pharmacies. The recognition of DRPs is presented in Table 2.

Table 2: DRP detection analysis

DRP category	CPs detected by DRP (%)	CPs not detected by DRP (%)
Wrong dosage	3.6	15.2
Wrong period	4.3	13.4
Wrong indicator	6.2	16.4
Wrong dosage, wrong period	2.3	20.3
Wrong dosage, wrong indicator	1.6	7.4
Wrong dosage, wrong period, wrong indicator	1.2	8.1

1.16 Actions Executed by Pharmacists in Addressing DRPs

No neighborhood pharmacist referred the individual to the prescriber while addressing the DRPs given to them. Suitable measures were occasionally implemented; two declined to provide the superfluous drug with the incorrect diagnosis, and twelve recalibrated the dosage based on weight and rectified the erroneous dosage. The outcomes are presented in Table 3. The time allocated by the neighborhood pharmacist for distributing was under three minutes, with a mean time of 65.45 ± 35.2 seconds.

Table 3: DRP action execution analysis

DRPs	Pharmacist activity	Frequency (%)
Wrong dosage	Dispensing	2
	Correcting	95
	Referencing	3
Wrong period	Dispensing	1
	Correcting	87
	Referencing	12
Wrong indicator	Dispensing	5
	Correcting	88
	Referencing	7

5. CONCLUSION

Pharmacy technicians can substantially enhance health outcomes for PD hospital patients by identifying and managing drug mistakes. These mistakes frequently pertain to infections and arise while prescribing during medical ward rounds, benefiting from the engagement of a clinical pharmacist to guarantee the timely and precise delivery of DRPs to medical professionals.

This research possesses certain limitations. The research is a cross-sectional study conducted exclusively in regional neighborhood pharmacies. The findings do not apply to the practices across the nation. The absence of audio evidence, which reduces memory bias, in this research raises the chance that specific data may not have been recorded while filling out the list of questions. The present study did not evaluate the practices of neighborhood pharmacists concerning other categories of medication-related problems, such as interactions between drugs and severe drug responses. This study did not address several factors influencing the pharmacist's efficiency, including involvement in postgraduate education, training classes, and prior experience with medical and clinical environments. The data indicate a particular circumstance since only one simulated prescription with specified drugs was utilized. Extrapolating the findings of this analytical model to the comprehensive pharmacy work of neighborhood pharmacies proves challenging.

This research's conclusions advocate for the enhancement of neighborhood pharmacy profession guidelines. Ongoing education is essential for neighborhood pharmacists to enhance their understanding and skills. Stakeholders should approve the required educational initiatives. This training should examine prevalent PD medication, emphasizing verifying weight-based dosage precision and strategies for identifying and preventing DRPs in PD medicines. The results indicate that additional, comprehensive studies should seek to measure neighborhood pharmacists' proficiency in identifying and managing DRPs in PD prescriptions and other facets of their profession. Further research employing standardized reporting of the issues is necessary to facilitate easy comparison between investigations and enable a more accurate evaluation of the extensive benefits pharmacy technicians offer in clinical settings.

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