

Original Article

Perceptions of hospital pharmacists regarding roles in preventing and minimizing prescribing cascades: a mixed-method study

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Abstract

Introduction: A prescribing cascade occurs when new medications are prescribed to address an adverse drug reaction (ADR) associated with the preceding use of a medication, which may be mistaken as the onset of a novel disease or condition. The aim of this study was to evaluate the perceptions of hospital pharmacists regarding roles in preventing and minimizing prescribing cascades.

Methodology: A qualitative, semi-structured interview, followed by a quantitative, questionnaire-based study, was carried out at the Shifa International Hospital (SIH; Islamabad, Pakistan). Discharge summaries of patients aged ≥ 60 years were collected to assess the prevalence of polypharmacy at SIH.

Results: Discharge summaries of $n = 350$ patients were collected; 60.2% ($n = 211$) had comorbid conditions, and the co-occurrence of diabetes and hypertension were the most common. 37.8% ($n = 132$) were taking 8 or more medications. Eight ($n = 8$) hospital pharmacists participated in the qualitative study, and 4 major themes were identified in their perceptions regarding prescribing cascades. Fifty-two ($n = 52$) pharmacists were recruited in the quantitative phase. 86.5% ($n = 45$) of the participants reported long standing illness/chronic conditions; 67.3% ($n = 35$) noted the presence of comorbidities as a high risk, while 90.3% ($n = 47$) noted multiple prescribers, and 75.0% ($n = 39$) identified the ageing population as important risks factors for polypharmacy.

Conclusions: The current research may inform the role and responsibilities of hospital pharmacists in outpatient and inpatient departments, and in interprofessional care teams, in preventing and minimizing prescribing cascades.

Key words: prescribing cascade; polypharmacy; adverse drug reaction; hospital pharmacists; healthcare professional; mixed-methods.

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Introduction

Adverse events (AEs) due to inappropriate medication usage are common, and are a major burden on the healthcare system [1]. In many cases, adverse drug reactions (ADRs) may be explained by the innate pharmacological properties of medications, whether administered alone or in conjunction with another type of treatment [2]. Failure to recognize the issues caused by the administration of medicines may lead to many health-related issues. Thus, it is a priority to identify and preclude all types of AEs and to prevent further risks to the patients' health [3]. Polypharmacy, is the regular use of at least five medications, and is common among the geriatric population. It is explained by their multimorbidity, especially associated with chronic, non-communicable diseases, where prescribing

guidelines promote use of many medicines to alleviate symptoms, improve the quality of life (QoL), and increase the life expectancy of the patients [4]. In recent years, there has been a significant increase in the incidence of chronic conditions such as hypertension, diabetes, musculo-skeletal diseases, and neurological conditions; resulting in an increase in the use of medications by the elderly population [5]. Inappropriate polypharmacy and use of unnecessary and excessive medicines increases the danger of ADRs, including drug-drug and drug-disease interactions, in which medication prescribed for one condition may worsen the clinical presentation of another, or produce symptoms resembling a new condition [6]. Additionally, polypharmacy makes consistency with prescriptions more cumbersome, as it may lead to

suboptimal treatment results, and diminished patient adherence, which could have serious clinical repercussions [7]. According to a study reported from the United States, 57% of women aged ≥ 65 years take ≥ 5 medications, while 12% take ≥ 9 medications regularly [8]. In older individuals, the number of commonly used drugs is the single most important predictor of inappropriate prescribing, which reliably predicts the incidence of drug-related AEs [9]. Moreover, a dose-dependent relationship between polypharmacy and mortality has been described [10].

A prescribing cascade occurs when a new medication is prescribed to address an AE or ADR associated with the preceding use of a medication [11]. The definition of a prescribing cascade may be broadened to include both unrecognized and recognized AEs or ADRs, as both can contribute to controversial prescribing practices. For example, an AE associated with the use of a medication may be mistaken as the onset of a novel disease or condition, and additional medicines are inappropriately prescribed to address this new perceived ailment [12]. The steps of the cascade may vary in complication and severity, depending on the prescribed drugs and individual patient characteristics. With the aging of the population worldwide, prescribing cascades as a clinical problem will become more frequent in medical practice, and lead to polypharmacy [13]. Reliable data on the prevalence of prescribing cascades is still scarce. Several studies regarding the prevalence of prescribing cascades among older adults were conducted in developed countries, such as the United Kingdom, Canada, Germany, Italy, and the United States [14–20]. In these studies, it was demonstrated that elderly patients were at considerably higher risk of prescribing cascades than younger adults, which may be explained by a complex web of causes. The prevalence and severity of AEs and ADRs, such as falls, fatigue, confusion, or constipation is worse in elderly patients; resulting in a higher risk of misinterpreting the event as the development of a new medical condition [21]. Recently published research from Ireland on problematic polypharmacy and prescribing cascade reported that at a particular intensity of polypharmacy, the probability that an additional new symptom will emerge due to an existing medication becomes indeterminable. Consequently, in cases where there are no adverse consequences, medication changes should be avoided; but one cannot deny that medication reconciliation post hospital discharge influences prescribing choices and can be visualized as a highly risky activity by stakeholders [22]. Furthermore, another study explored community

pharmacists' awareness, identification, and management of prescribing cascades and reported that only half of the respondents expressed their awareness about the prescribing cascade, but nearly three-fourth of the respondents reported that they personally identified a potentially inappropriate prescribing cascade in clinical practice [23]. Patient and prescriber resistance were identified as factors responsible for the non-resolution of identified prescribing cascades [23]. The study also advocated for the provision of additional resources to community pharmacists so that they can better handle prescribing cascades [23]. Likewise, the findings from the recently published systematic review by Adrien *et al.* reported that suggestions to reverse or prevent prescribing cascades were not stated in more than 90 studies that were assessed in the review [24]. Nevertheless, despite these potential harmful effects of polypharmacy related to prescribing cascade, and its potential impact on patients' health and QoL, prescribing cascades receive little attention from clinicians and pharmacists. This — at least in part — might be due to the intricacy and contextual nature of prescribing cascades, which has posed difficulties for the relevant stakeholders engaged in their detection [25].

A critical step in presenting clinically relevant cascades is the higher pharmaceutical costs and the effects of avoidable adverse drug events. This will enable safe prescribing practices to provide fresh insights into the scope and application of the concept of prescription cascade [26]. It is important to assess the efficacy of prescribing cascade prevention, detection, and reversal strategies in clinical settings; especially when dealing with older patients with multimorbidity and related polypharmacy [27]. Polypharmacy may be avoided by appropriate patient education and shared decision-making about the treatment plan and the main objectives. Clinical and hospital pharmacists may play a crucial role in limiting the development of prescribing cascades during appropriate medication review, and thereby promote judicious use of quality medicines and identify drug related problems [28]. Patients' medication regimens may be enhanced by eliminating duplicate medicine, reducing dose recurrences, and conducting regular medication audits [29]. Hospital pharmacists may be able to increase patient awareness and medication adherence by frequent patient contact, as patients may be more likely to go to their pharmacist as compared to physicians [30]. Educational tools may promote awareness of the patients and caregivers to request for a session with the doctor, who can then tailor the discussion of the possible cascade to the patient and

caregiver's specific needs [31]. Practical suggestions based on the available evidence are also welcome to assist prescribers in limiting the spread of dangerous prescribing cascades within their medical practice [32,33].

With this background, the aim of the present study was to assess the nature, causes, and related factors leading to polypharmacy and prescribing cascades in older adults with non-communicable diseases; in addition to appraising the role of the hospital pharmacists in minimizing and preventing the prescribing cascade in a developing country.

Methodology

Study design, study site

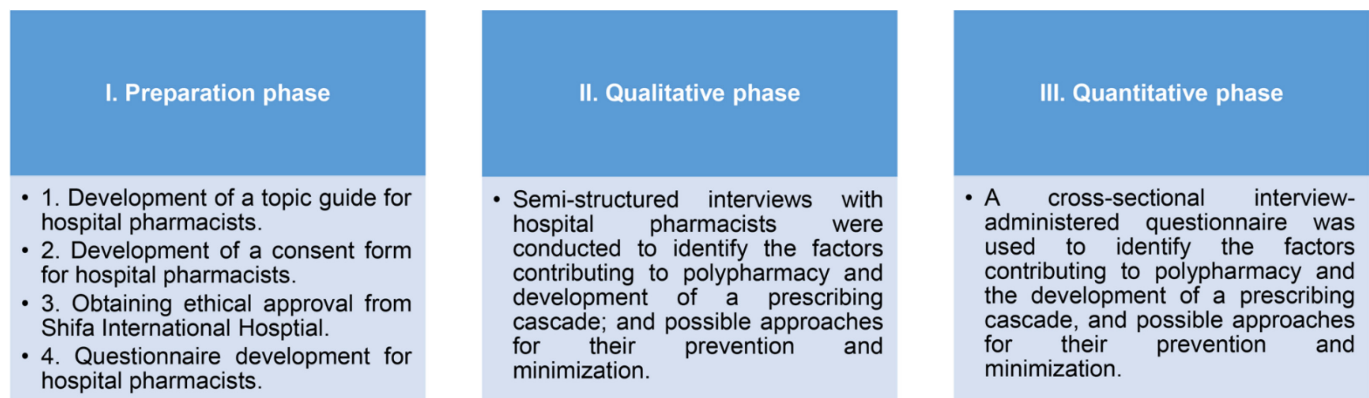
The study employed a two-armed approach, involving two data sources: (i) discharge summaries of patients aged ≥ 60 years with existing non-communicable diseases were collected at the Shifa International Hospital (SIH; Islamabad, Pakistan), to assess the prevalence of polypharmacy; (ii) a sequential exploratory mixed-method study was used to assess and evaluate the role of hospital pharmacists working at SIH in preventing and minimizing prescribing cascades in older adults with non-communicable diseases. The SIH was established in 1993, and is a well-equipped private hospital with a 550-bed capacity and is a quaternary healthcare facility. The study was approved by the Institutional Review Board and Ethics Committee of SIH (approval number: 064-22). Retrospective data was collected from discharge summaries corresponding to patients of interest (age: ≥ 60 years, with existing non-communicable diseases and/or comorbidities) and corresponding to the time period between 1 January 2021 and 1 January 2023.

Mixed-methods study involving hospital pharmacists: qualitative approach

The study involving hospital pharmacists consisted of two parts: (i) a qualitative, semi-structured interview with a phenomenological approach was carried out, which was followed by (ii) a quantitative, questionnaire-based study, to explore their role in preventing and minimizing prescribing cascades. Figure 1 summarizes the steps in the research methodology. The phenomenological approach was chosen to allow for the researchers to comprehensively delve into the understanding of the participants' perspectives, experiences, attitudes, behavior, and interactions regarding the research topic [34,35]. Streubert's procedural steps for carrying out phenomenological research were applied [36]; hospital pharmacists working in the outpatient department, inpatient department, and emergency departments of SIH were recruited by means of purposive and snowball sampling approaches to allow for the comprehensive interpretation of the phenomenon. Phenomenological research usually entails a sample of 1–10 individuals; therefore, the study sample used was $n = 6$ hospital pharmacists, followed by $n = 2$ more interviews for the confirmation of the point of saturation. The timing, date, and venue of interview was based on joint agreement of the participants and the researcher.

Semi-structured interviews were chosen above other qualitative approaches for gathering extensive information regarding the unexplored role of hospital pharmacists who were well positioned in preventing and minimizing the prescribing cascade. In addition, this interview format is unique among interview techniques in terms of the amount of topic relevance it provides while remaining responsive to the participant [37]. A semi-structured interview guide (topic guide) was formulated as per Kvale's recommendations [38]. The structured interview questions comprised of a

Figure 1. Research methodology.



central question along with numerous supplementary questions related to the primary question, which were then refined further through an interview guide pilot survey. Interviews were conducted in the native language (Urdu) or in English. Each interview was recorded with the informed consent of the participants. The durations of the interviews were within the range of 20–30 minutes. Reflective journals were used throughout the interview process, encouraging the researchers to talk about the presumptions, capabilities, and activities and justifications during the research process [39]. A thematic content analysis was adopted for the purpose of the analysis of interview transcripts. Analysis of the transcripts were done by two more qualitative research experts and codes were derived on the basis of consensus. The data was studied to uncover recurring themes, and identify the contradictory and conflicting observations. Following that, overview statements for each subject were created, which included sub-themes and categories. Both a priori themes and emergent themes were generated. The participants were contacted again to provide feedback on the findings based on the interview transcripts that were sent to them for input and review. Finally, the comments were reviewed again to confirm that no important concern or worry had been overlooked and that the arrangement of categorical items was appropriate. Data collection and analysis was carried out between 1 June 2021 and 1 January 2022.

Mixed-methods study involving hospital pharmacists: quantitative method

Following the qualitative phase of the research, a questionnaire was designed based on the qualitative findings. The participants were given interview-administered questionnaires in order to explain ambiguous questions and to use open-ended questions with a variety of conceivable solutions [40]. Furthermore, the questionnaire was sent with the intention that all questions would be completed by the respondents. Before the main data collection, the questionnaire was pilot tested on a sample of $n = 30$ recruited hospital pharmacists. The data of the pilot sample was not included in the final data analysis. Hospital pharmacists working in the outpatient department, inpatient department and emergency departments of SIH were recruited by the means of purposive and snowball sampling approaches, as they were dealing with discharge summaries and discharge medications of patients.

Evaluation of face validity and content validity of the questionnaire was performed with the involvement

of experts in clinical pharmacy practice. Lawshe's content validity index (CVI) was calculated for each item, and the indices were > 0.8 for all items [41]. Internal consistency assessment was also performed by calculating Cronbach's α , which was found to be 0.82, indicating excellent internal consistency [42]. Data collection and analysis was carried out between 1 January 2022 and 1 January 2023. Overall, $n = 52$ pharmacists were sampled.

Statistical analysis

During data collection and database creation, all data were entered into the Statistical Software for Social Sciences (SPSS) version 22 (IBM Corp., Endicott, NY, USA). Descriptive statistical analyses (including means with ranges, standard deviations [SD], and percentages to characterize the data) were performed by SPSS 22.0.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki and national and institutional ethical standards. Ethical approval for the study protocol was obtained from the Institutional Review Board and Ethics Committee of SIH (approval number: 064-22). Written informed consent was obtained from the respondents before conducting the surveys. They were briefed about the research objectives, privacy, and confidentiality of their data. The respondents were made aware that their participation in the research is voluntary and they may withdraw from the study at any time.

Results

Analysis of discharge summaries of patients at SIH

Discharge summaries of 350 patients selected based on our inclusion and exclusion criteria were collected and analyzed. All patients (100.0%, $n = 350$) were between 60 and 65 years of age, and 177 (50.57%) were males. Almost half (48.0%, $n = 168$) of the patients were illiterate, 27.4% ($n = 96$) attended high school, 14.0% ($n = 49$) attended college, and 10.3% ($n = 36$) attended higher university education. Slightly less than half of the patients (156; 44.6%) were cigarette smokers, and only 9 (2.6%) were tobacco chewers. None of the patients consumed alcohol. Around one-fourth of the patients (87; 24.8%) were of normal body mass index (BMI), whereas more than 35.0% ($n = 123$) were overweight, and 20% ($n = 70$) were obese. Almost 75.0% of the patients had diabetes ($n = 261$; 74.5%) and over 80% had hypertension ($n = 288$; 82.2%). Around one-fourth of the patients had chronic kidney disease ($n = 81$; 23.1%) and 60.2% ($n = 211$) had comorbid

conditions. Among the comorbid conditions, the co-occurrence of diabetes and hypertension were the most common. On the other hand, 20.2% (n = 71) patients were suffering from diabetes and chronic kidney disease concurrently, 4.3% (n = 15) patients had diabetes and musculoskeletal disease concurrently, and 6.3% (n = 22) had diabetes and chronic respiratory disease, e.g. chronic obstructive pulmonary disease or asthma.

All 350 patients were eligible for the definition of polypharmacy, i.e. taking 5 or more medications regularly: 22.2% (n = 78) were taking 5 drugs on a daily basis, 24.2% (n = 85) were taking 6 drugs, 15.8% (n = 55) were prescribed 7 drugs for daily use, and 37.8% (n = 132) were taking 8 or more medications to treat their comorbid conditions. The frequency of prescribed drugs that caused the prescribing cascade are summarized in Table 1. The most prescribed medications were antiplatelet medications (74.0%; e.g., acetyl-salicylic acid, clopidogrel), followed by statins (72.0%; as patients with diabetes and hypertension have a chance to develop other cardiac issues), and proton pump-inhibitors (59.1%).

Mixed-methods study involving hospital pharmacists: results of the qualitative interviews

A total of 8 (n = 8) hospital pharmacists were involved in the qualitative phase; among them 6 were females and 2 were males. Their role as hospital pharmacists were to handle the discharge summaries of the patients, dispense medication, and discharge patients after medication review. The characteristics of the participating hospital pharmacists are summarized in Table 2. All pharmacists had Doctor of Pharmacy (PharmD) qualification, and 1 pharmacist was enrolled in postgraduate degree (MPhil). Two pharmacists were working as team leaders while the remaining 6 were working as subordinate pharmacists.

Four major themes were identified based on the responses provided by the pharmacists, including, (i) causes and factors related to polypharmacy, (ii) factors related to the prescribing cascade, (iii) prevention of the prescribing cascade, (iv) management of the

Table 1. Classification of prescribed medications involved in prescribing cascades.

Pharmacological group/drug prescribed	Frequency (n, %)
Anxiolytics	35 (10.0%)
Statins	252 (72.0%)
Proton pump inhibitors	207 (59.1%)
Beta-blockers	197 (56.2%)
Antiplatelet medications	259 (74.0%)
Diuretics	123 (35.1%)
Calcium-channel blockers	94 (26.8%)
Angiotensin-receptor blocker/hydrochlorothiazide combination	94 (26.8%)
Angiotensin-converting enzyme inhibitor	14 (4.0%)
Glyceryl-trinitrate	97 (27.7%)

prescribing cascade. The detailed findings of this thematic analysis are presented in Figure 2.

Mixed-methods study involving hospital pharmacists: results of the questionnaire-based study

A total of 52 (n = 52) hospital pharmacists working in the outpatient, inpatient, and emergency departments of SIH were recruited in the quantitative phase of our research. The majority of the respondents (57.7%; n = 30) were females; most of them (94.2%; n = 49) had a PharmD degree, and only a few of them had either a BPharm or MPharm degree (5.8%; n = 3). All participating pharmacists (100.0%; n = 52) were registered with the National Pharmacy Council. 53.8% (n = 28) were recruited from the outpatient department, while 23.1% (n = 12) and 23.1% (n = 12) were recruited from the hospital’s inpatient department and emergency department, respectively. The mean age of the participants was 29.31 ± 3.2 years, and their mean work experience as a hospital pharmacist was 3.97 ± 2.68 years.

When asked about the factors contributing to polypharmacy, the pharmacists identified the following: long standing illness or chronic conditions such as obesity (86.5%, n = 45), presence of comorbidities (67.3%, n = 35), multiple prescribers (90.3%, n = 47), ageing population (75.0%, n = 39), inadequate medication reconciliation (78.8%, n = 41), lack of deprescribing (59.6%, n = 31), dietary supplements (80.8%, n = 42), and psychosocial contributions (30.7%, n = 16).

Table 2. Demographic characteristics of hospital pharmacists (HP) who participated in the qualitative phase.

Study ID	Age (years)	Gender	Work experience (years)	Education	Position	Department
HP 1	32	Female	7	PharmD	Team leader	Outpatient
HP 2	28	Male	4	PharmD	Pharmacist	Outpatient
HP 3	29	Female	4.5	PharmD	Pharmacist	Outpatient
HP 4	27	Female	2.5	PharmD	Pharmacist	Outpatient
HP 5	29	Female	4	PharmD, MPhil (ongoing.)	Pharmacist	Outpatient
HP 6	27	Male	3	PharmD	Pharmacist	Outpatient
HP 7	26	Female	2	PharmD	Pharmacist	Outpatient
HP 8	32	Female	6	PharmD	Former team leader	Outpatient

When the pharmacists were asked to identify the factors leading a prescribing cascade, they identified the following: the misinterpretation of an AE/ADR as new condition (78.8%, n = 41); inappropriate assessment of signs and symptoms (57.7%, n = 30); users of high-risk medications (61.5%, n = 32); specific therapeutic categories such as antihypertensive drugs, sedatives, and opioids (36.5%, n = 19); and gender of patient (3.8%, n = 2).

The opinions of the hospital pharmacists regarding the prevention and management of prescribing cascades were assessed. The majority of respondents (82.7%; n = 43) agreed, while 17.3% (n = 9) were neutral about the importance of early detection of ADRs. Avoiding ADRs was another possible strategy, and this was selected by 63.5% (n = 33) pharmacists, while 36.5% (n = 19) were neutral on its relevance. 84.6% (n = 44) agreed on the importance of checking with the patients about the appearance of new symptoms. 75.0% (n = 39) were in agreement that initiation of treatment from a low dose, tailoring dosage to prevent ADRs, patient education regarding ADRs, establishing home medication reviews in high-risk patients, and

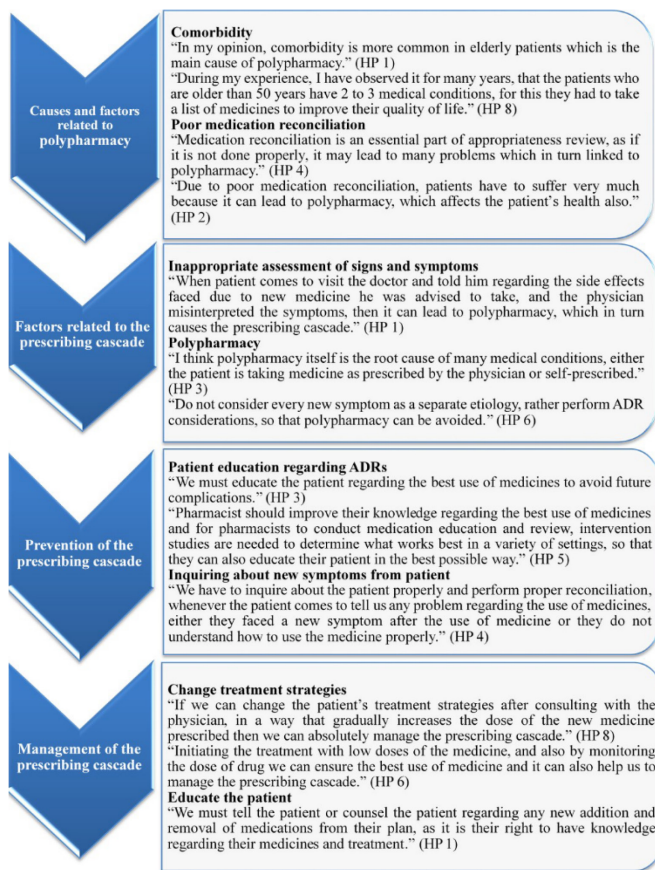
deprescribing and monitoring after the confirmation of a prescribing cascade, are all important and usable strategies. 80.8% (n = 42) of the pharmacists were in agreement with the proposal of strengthening their role in an interprofessional healthcare team for conducting medication review. Finally, the pharmacists were more split on the role of incorporating prescribing cascade education with tangible examples in healthcare education, and 44.2% (n = 23) were neutral in this regard.

Discussion

In the present study, the perceptions of hospital pharmacists regarding their roles in preventing and minimizing prescribing cascades was analyzed using both qualitative and quantitative methods, taken from a sample of healthcare professionals at the SIH, Islamabad. Additionally, we also established the prevalence of polypharmacy and the risk for prescribing cascades in a relevant patient sample using discharge summary analysis. To the best of our knowledge, this was the first qualitative exploration of hospital pharmacists’ perceptions regarding their roles in preventing and minimizing prescribing cascades. Numerous factors involved in initiating the prescribing cascade were identified based on the opinions of the hospital pharmacists; the most important among these were polypharmacy, patients with multiple diseases and comorbidities, and the aging process which in turn considerably affects the QoL of patients. In addition to exploring the hospital pharmacists’ perspectives, we sought to understand what sort of strategies would be helpful in minimizing the prescribing cascade. A similar study was conducted in Geriatric Day Hospital, Ottawa, Canada regarding the persistence of the prescribing cascade and strategies to manage them according to physician and patient perspectives [13].

In the first phase of the study (qualitative research), pharmacists who were directly involved in the management of patients’ discharge medication were interviewed. According to the participating pharmacists, the prescribing cascade could be prevented and/or managed by educating the patients regarding ADR, starting the therapy from a lower dose, and interpreting new signs and symptoms appropriately and continuously. The result of the current study unveiled that medication reconciliation performed by pharmacists is a crucial step to managing the prescribing cascade, and if it is not done adequately, it may cause further harm to patient health. However, awareness regarding this phenomenon is essential to identify and prevent a prescribing cascade in routine

Figure 2. Thematic analysis.



ADR: adverse drug reaction.

medication review. A study conducted in 2018 showed that a prescribing cascade could be prevented by starting a new medication therapy at a lower starting dose, evaluating drug therapies with fewer side effects, and including patients and caregivers in determining if a new medicine is being used to treat a side effect from another drug they were previously taking [43]. Additionally, a study conducted in Australia in 2011 highlighted similar strategies for preventing and minimizing the prescribing cascades [44]. However, none of these previous reports had suggestions regarding the role of the hospital pharmacists in the management of prescribing cascades.

This study also identified how prescribing cascades may be converted from problematic to appropriate when interventions, such as dosage reduction are used. The inclusion of the patient in any assessment of the appropriateness of the cascade is critical, with particular attention given to whether the cascade's initiation matches with the patient's goals and their awareness of the cascade's possible long-term risks. According to previous research, prescribing cascades may be further classified as either appropriate, in which people may require multiple pharmacological agents to manage their complicated medical conditions (benefits outweigh harms); or problematic, in which people use multiple drug therapies in an inappropriate manner that do not offer an overall benefit (harms outweigh benefits) [21].

Pharmacists are competent in acting as mediators between patients with developmental disabilities and healthcare providers, caregivers, and family members. They can make considerable improvements in disease management of patients with disabilities and chronic conditions by providing cognitive services and expertise, as well as providing medication reconciliation and aiding care transitions. In addition, in collaboration with the patient's primary care physician, pharmacists can provide patient counselling about medication intake, medication storage, and medication dose adjustment, due to their expertise in pharmacotherapy, to limit AEs and a prescribing cascade [44].

The results of the current study, underscore the fact that no medicine should be added to the list of prescribed medicines until there is a demonstrable reason for its addition. Our findings have several implications, including highlighting the need for strategies that provide resources to patients and pharmacists to recognize prescribing cascades, social and environmental support that would assist in their identification of prescribing cascades, and the

recommendation that further improvement is needed in patient prescription management. With the ageing of the global population, the importance of prescribing cascades is expected to increase further, becoming a 'hot' topic in pharmacoepidemiology and drug safety. This will encourage the appropriate use of medicine and hence, unnecessary prescribing cascades can be prevented. In our study, the importance of hospital pharmacists was highlighted as they act as a barrier between physicians and patients to ensure the suitable use of medication regimen by dispensing the medication ordered by the physician and educating the patients regarding their best use.

Our study had several limitations. As the data was obtained from one specialized care hospital with non-randomized sampling methods, the generalizability of the findings may be limited; therefore, the inclusion of additional healthcare institutions is warranted. Survey bias and biased responses cannot be ruled out based on the data collection methods used in our research. The understanding and interpretation of the questions may have varied among the participants. Finally, there is a lack of previously published research regarding prescribing cascades in this region; therefore, drawing inferences for a conclusion may also be inadequate.

Conclusions

Hospital pharmacists may play crucial roles in minimizing and preventing prescribing cascades and have a direct role in increasing the QoL of their patients. Prescribing cascades have the potential to do considerable harm to people, leading to adverse therapeutic outcomes. Hospital pharmacists should be knowledgeable about medications with the potential for serious AEs, especially in the elderly or in patients using medications that are typically associated with adverse drug responses. It is necessary to raise awareness and recognize the possibility for medication responses leading to prescribing cascades. For those at risk of prescribing cascades, home medication reviews should be explored. The current research is expected to inform the role and responsibilities of hospital pharmacists in outpatient and inpatient departments, and in interprofessional care teams to perform medication education and medication review, and to address the prescribers to document the reasoning for prescribing additional medicines. Care coordination and patient-pharmacist communication are critical to providing safe and effective therapy.

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Authors' contributions

Conceptualization: MA, WU, SS; methodology: MA, WU, SS, MG; data analysis: MA, WU, SS; resources: MA, WU, SS, SV, SJ; writing-original draft: MA, WU, SS; writing-review and editing: MG, MM, SJ; project administration: SJ, SV; supervision: MM, MG, SJ. All authors have read and agreed to the published version of the manuscript. The authors alone are responsible for the content and writing of this article.

Data availability statement

All data generated during the study are presented in this paper.

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Conflict of interests

No conflict of interests is declared.

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