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Research Article

Potentially Inappropriate Medication-Related Adverse Drug Reaction among Hospitalized Geriatric Patients: A Combined Interventional Study

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Abstract

Purpose: Prescribing appropriate medications for geriatric patients is still a challenge for health care professionals. Potentially Inappropriate Medications (PIMs) should be discontinued because of the high risk of Drug-Drug Interactions (DDIs), drug-disease interaction and Adverse Drug Reactions (ADRs). The aim of this study was to assess the effectiveness of a combined intervention program: educational and clinical pharmacist interventions on the incidence of ADRs among hospitalized geriatric patients who received PIMs as defined by Screening Tool of Older Persons' Prescriptions (STOPP) and American Geriatric Society Beers criteria.

Methods: The study was a prospective before-and-after interventional design. A combined intervention program involving educational and clinical pharmacist-initiated intervention was conducted in the medical wards at King Abdulaziz Medical City in Riyadh, Saudi Arabia.

Results: Among 400 geriatric patients enrolled in the study, 200 in a pre-intervention group (control) and 200 in the intervention group. The incidence rate of PIMs was 61% in the pre-intervention phase which decreased to 29.5% in the intervention phase with a statistically significant difference between the two groups. After the combined intervention, the incidence rate of ADRs decreased significantly from 90 (45 %) to 56 (28%). Using multivariate analysis, Activities of Daily Living (ADL), haemodialysis, hospital readmission, polypharmacy, DDIs and PIMs were the potential predictors which predispose the geriatric patients to ADRs.

Conclusion: Using a combined educational and clinical pharmacist intervention program would add a significant value to improve prescribing patterns in hospitalized geriatric patients. PIMs should be discontinued because of the high risk of ADRs.

Keywords: Clinical pharmacist; Education; Inappropriate; Intervention; Knowledge; Prescribing

Introduction

With advancing age, medical diseases become more common and tend to occur concurrently [1]. Accordingly, multiple medications are a logical result of the concurrent occurrence of multiple diseases among geriatric patients [2]. However, concurrent administration of several medications is problematic, because of their possible Drug-Drug Interactions (DDIs), polypharmacy, Potentially Inappropriate Medications (PIMs) and Adverse Drug Reactions (ADRs) [3]. PIMs usage poses a significant dilemma among geriatric patients, which may contribute to increased morbidity and mortality [4]. Therefore, multiple lists were designed to identify drugs inappropriate for use by geriatric populations [5]. The best-known explicit screening tool is the Beers criteria, but there are several medications have a high risk of ADRs in geriatric patients and not included in the Beers criteria. Therefore, Screening Tool of Older Persons' Prescriptions (STOPP) criteria were developed to address some of the limitations of Beers criteria. Many previous studies recommended STOPP and Beers criteria, in order to optimize prescribing for geriatric population with multiple diseases [6]. Beers and STOPP criteria are valid and reliable which is useful in geriatric patients as an important intervention method to assess and assist in minimizing the incidence of polypharmacy, DDIs and ADRs [7]. Prescribing PIMs can be attributed to the fact that many physicians are unaware of PIMs usage. The awareness of PIMs by physicians and clinical pharmacists is important, especially for patients with a high number of medications [8]. Educational intervention has been recommended to improve prescribing pattern in the geriatric population. Educational interventions targeting physicians can be passively by printing material alone, or by interactive educational outreach (e.g., Academic detailing). Previous studies found that educational interventions designed to improve appropriate prescribing knowledge of physicians had a significant effect in reducing PIMs [8,9]. In a recent study conducted in Germany, the physician-related reasons of PIMs prescribing were; lack of knowledge, lack of applicability of PIMs criteria in practice, lack of time and lack of alternatives in medication for specific diagnoses [10].

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Clinician geriatricians play leading roles in educating healthcare professionals, training non-geriatrician physicians, research and development applied to clinical quality and safety improvement. Potentially inappropriate medications among geriatric inpatients are often related to the lack of knowledge and training in geriatric medicine and geriatric pharmacotherapy education. Educational sessions, seminars and workshops are the effective way to improve the awareness of physicians and pharmacists towards using PIMs among geriatric patients [9,10].

Clinical pharmacist responsible for medication reviews of patients' prescriptions to optimize medication treatment and outcomes through the improvement of prescribing patterns of physicians. Clinical pharmacists can play an important role to create changes in prescribing practices in accordance with guidelines from the literature and utilize the effective tools and interventions in prescribing practice [9]. Clinical pharmacist is responsible for detecting PIMs and recommending appropriate use of alternative medications among geriatric patients. This task is the core of the clinical pharmacist's role in which remarkable knowledge exists regarding the efficacy and safety of drug therapies [11]. The persistent lack of geriatric physicians and geriatric pharmacists is the most concern not only in Saudi Arabia, but also in the most of developing and developed countries [12]. Hence, the current study conducted to determine the impact of combined intervention program: an educational and clinical pharmacist's interventions to reduce the incidence of PIMs-related ADRs among hospitalized geriatric patients.

Methodology

The study was a prospective before-and-after interventional design, investigating the impact of combined intervention program; an educational and a clinical pharmacist intervention to minimize PIMs and ADR among hospitalized geriatric patients. The pre-intervention (Phase I) and the intervention (phase II) were conducted by three clinical pharmacists in the Department of Medicine from March 2015 to July 2016. The study population consisted of all geriatric patients (≥65 years old) admitted to one ward of the Department of Medicine at King Abdulaziz Medical City (KAMC) for at least three days were enrolled in the study. The primary outcome of this study was the incidence rate of PIMs, as measured in the pre-intervention and the intervention group. Based on the literature, the reduction in the incidence rate of PIMs from 50% to 25%, using an alpha of 0.05, the power of 80% and a two-sided McNemar's test for paired proportions, the estimated number of geriatric inpatients to be included is 384 patients [13]. A random sample of 400 hospitalized geriatric patients who met the inclusion criteria was enrolled using the BEST Care® which is the Computerized Physician Order Entry (CPOE) and Hospital Information System (HIS). The educational program was consisting of one-hour of weekly educational lectures for one month in the Department of Medicine. In addition, collaboration between the clinical pharmacists and the prescribers who aimed to utilize the STOPP and Beers criteria to optimize prescribing among hospitalized geriatric patients. The clinical pharmacists offered all possible interventions that might prevent PIM prescribing; the interventions included audit of the physicians' orders and providing feedback and recommendations during medical rounds, reminders, and discussions with physicians. The interventions and recommendations were carried-out by three clinical pharmacists working in the medical wards in KAMC Hospital. The clinical pharmacists were trained before starting the current phase using 2015 AGS Beers and 2014 STOPP criteria [6,14]. To facilitate the clinical pharmacists' interventions, the authors of the study developed the pocket-sized "Handbook of PIMs Use Among Geriatric Patients®" as an interventional tool based on the guidelines on prescribing appropriate medications in hospitalized geriatric patients. This tool was tailored to the drugs available in the formulary of KAMC Hospital. The purpose of the Handbook was to save physicians' time during clinical ward rounds and to improve their prescribing decisions. The study's investigator compiled the data of PIMs based on STOPP and Beers criteria only. Statistical Package for Social Sciences (SPSS) software program version 22 for Windows was applied in this study. The difference in the incidence rate of PIMs between the two phases was detected by two-sided McNemar's test for paired proportions. In addition, several predictors of ADRs were identified using multivariate regression analysis.

Results

The sample of geriatric patients which screened from the Computerized Physician Order Entry (CPOE) and Hospital Information System (HIS) was 400 geriatric patients who were admitted to the Department of Medicine wards of King Abdulaziz Medical City (KAMC) in pre-interventions and intervention phase. The data of the final sample enrolled in the study were collected from the time of patients' admission till they discharged, transferred to other than Department of Medicine wards or died. There was no significant difference between pre-intervention and intervention groups in all socio-demographic characteristics of the study geriatric patients admitted to KAMC Hospital (Table 1). The incidence rate of PIMs was 61% in the pre-intervention phase and decreased to 29.5% in the intervention phase with a statistically significant difference between the two groups (p-value <0.001). About half of geriatric patients (54%) were on ≥2 Beers criteria drugs during hospitalization in the pre-intervention phase, which decreased significantly to 10.5% in the intervention phase (p-value <0.05). Several medications which were considered potentially inappropriate by STOPP and Beers criteria were found to be prescribed in high rate among hospitalized geriatric patients (Tables 2 and 3). The intervention phase was conducted by three clinical pharmacists in the Department of Medicine. Out of 317 recommendations given by the clinical pharmacist, the prescribers accepted a total of 196 (61.83%) recommendations. The most commonly accepted interventions were 96 (48.9%) to change PIMs among geriatric inpatients to safe alternatives. The other accepted recommendations were to stop PIMs as listed in Beers criteria (31; 15.8%), followed by to decrease dose (25; 12.7%), to stop STOPP criteria (21; 10.7%), to stop drug duplications (14; 7.1%) and stop DDIs9 (4.6%). As the incidence of ADRs is the outcome of this study, of the 200 geriatric patients in the pre-intervention group, 90 (45 %) patients had suspected ADRs. The incidence rate significantly decreased in the intervention group to 56 (28%), (OR: 0.475, 95% CI, 0.314-0.720); (p-value <0.001). Moreover, the incidence rate of PIMs-related ADRs was 82 (20.5%) and the non-PIMs-related ADRs were 67 (16.8%). The difference was significance (p-value <0.001). Diuretics, anticoagulants, insulin sliding scale, beta-blocker, benzodiazepines, glyburide, antidepressants, antihistamines, NSAIDs, digoxin and metformin were the most common medications or medication classes related to ADRs (Table 4). Both lists of PIMs were associated with ADRs in geriatric patients who were received Tricyclic Antidepressants (TCA), anticholinergic drugs, and non Cyclooxygenase 2-selective (COX-2) Nonsteroidal Anti-Inflammatory Drugs (NSAIDs) and long-acting benzodiazepines (Table 4). In our findings, there was no significant difference in the

incidence rate of mortality between the pre-intervention and interventional group of the hospitalized geriatric patients (p=0.338). A total of 44 deaths (11%) were found among hospitalized geriatric patients in the present study. Only 14 (3.5%) associated with ADRs. Backward stepwise logistic regression test was carried out for each independent variable with PIMs as the dependent variable to determine predictors of ADRs among hospitalized geriatric patients. The main predictors were Activities of Daily Living (ADL), Charlson-Age Comorbidity Index (CACI), Length of Hospital Stay (LOHS), haemodialysis, re-admission, polypharmacy at admission and PIMs. The odds of ADRs were doubled by PIMs use (OR: 1.98, 95% CI, 1.16-14.31) (Table 5).

Characteristics	Group	Pre-intervention N=200 n.(%)	Intervention N=200 n.(%)	P-value*
Age (years) (mean± SD)		76.47 ± 9.43	77.10 ± 10.20	0.524
BMI (kg/m2) (mean± SD)		27.81 ± 6.41	27.48 ± 6.32	0.612
Gender	Male	88 (44.0)	95 (47.5)	0.482
Ethnicity	Arab	187 (93.5)	175 (87.5)	0.122
	Others	13 (06.50)	25 (12.50)	
Smoking status	Smoker	53 (26.5)	46 (23.0)	0.417
Alcohol consumption	Drinker	04 (2.0)	07 (3.5)	0.359
Family care Giver	Spouse	124 (62.0)	126 (63.0)	0.631
	Children	65 (32.5)	59 (29.5)	
	Others	11 (5.5)	15 (7.5)	
Functional level	Dependent	41 (20.5)	36 (18.0)	0.060
ADL	Partially dependent	26 (13.0)	44 (22.0)	
	Independent	133 (66.5)	120 (60.0)	
CACI	≤5	41 (20.5)	54 (27.0)	0.127
	>5	159 (79.5)	146 (73.0)	
Frailty	Yes	61 (30.5)	67 (33.5)	0.52
	No	139 (69.5)	133 (66.5)	
Malnutrition	Yes	54 (27.0)	74 (37.0)	0.032
	No	146 (73.0)	126 (63.0)	
History of falls	Yes	05 (2.5)	02 (1.0)	0.253¥
	No	195 (97.5)	198 (99.0)	
Polymorbidity	≥4 diseases	109 (54.5)	95 (47.5)	0.161
	<4 diseases	91 (45.5)	105 (52.5)	
Polypharmacy	≥5 drugs	77 (85.6)	48 (85.7)	0.979
LOHS (days)(mean± SD)		12.88 ± 10.87	10.64 ± 6.80	0.014

Table 1: Clinical characteristics of the geriatric patients (n=400) admitted to KAMC at pre-intervention and intervention group.

*Chi square test, ¥Fischer's Exact test, KAMC: King Abdulaziz Medical City; BMI: Body Mass Index; ADL: Activities of Daily Living; CACI: Charlson-Age Comorbidity Index; BMI: Body Mass Index; LOHS: Length of Hospital Stay

PIMs categories Beers criteria		Pre-intervention N=200 n.(%)	Intervention N=200 n.(%)	P-value*
Drugs to be avoided				
Antihistamines	Chlorpheniramine, Hydroxyzine	32 (16.0)	9 (4.5)	< 0.001
Antispasmodics	Atropine, Scopolamine	18 (9.0)	7 (3.5)	0.023
Antipsychotics	Conventional, Atypical	13 (6.5)	7 (3.5)	0.169
Antiparkinson agents	Benztropine, Trihexyphenidyl	7 (3.5)	3 (1.5)	0.338
Antiarrhythmic drugs	Amiodarone, Procainamide	30 (15.0)	12 (6.0)	0.003
Alpha1 blockers	Prazosin, Terazosin	14 (7.0)	4 (2.0)	0.016
Alpha agonists	Clonidine, Methyldopa	11 (5.5)	5 (205)	0.201
Benzodiazepines	Lorazepam, Diazepam	19 (9.5)	6 (3.0)	0.007
Tertiary TCAs	Amitriptyline, Clomipramine	13 (6.5)	4 (2.0)	0.026
Gastrointestinal medications	Metoclopramide	29 (14.5)	11 (5.5)	0.003
Endocrine medications	Androgens, Estrogens, Insulin	37 (18.5)	13 (6.5)	< 0.001
Sulfonylureas, long-duration	Glyburide	31 (15.5)	14 (7.0)	0.007

Pain Medications	Meperidine, NSAIDs	18 (9.0)	7 (3.5)	0.023
Drug-Disease interaction				
Heart failure	NSAIDs, COX-2 inhibitors, CCBs	13 (6.5)	3 (1.5)	0.011
Chronic seizures	Olanzapine, Chlorpromazine	7 (3.5)	1 (0.5)	0.006
Delirium	Benzodiazepines, Corticosteroids	9 (4.5)	0 (0.0)	0.004
Dementia	Anticholinergics, Benzodiazepines	9 (4.5)	2 (1.0)	0.031
	Antipsychotics			
History of falls or fractures	Antipsychotics, Benzodiazepines, Antidepressants, Opioids	5 (2.5)	2 (1.0)	0.449
Insomnia	Pseudoephedrine, Phenylephrine	7 (3.5)	1 (0.5)	0.068
Parkinson's disease	Anticholinergics (antispasmodics)	6 (3.0)	4 (2.0)	0.751
Chronic constipation	CCB, Antipsychotics	13 (6.5)	5 (2.5)	0.044
History of GIT ulcer	Aspirin (>325 mg/day)	11 (5.5)	3 (1.5)	0.053
	Non–COX-2 selective NSAIDs			
Chronic kidney disease	NSAIDs	9 (4.5)	3 (1.5)	0.140
Benign Prostatic Hyperplasia	Strongly anticholinergic drugs	8 (4.0)	1 (0.5)	0.037
Lower urinary tract symptoms	Alpha-blockers	6 (3.0)	3 (1.5)	0.503
Drugs to be used with caution	Aspirin	35 (17.5)	18 (9.0)	0.012
	Antipsychotics	13 (6.5)	7 (3.5)	0.169
	TCAs	13 (6.5)	4 (2.0)	0.026
	Vasodilators	25 (12.5)	9 (4.5)	0.004
	Mirtazapine	5 (2.5)	3 (1.5)	0.724
Drugs to be avoided or reduced with Kidney disease	Spironolactone	8 (4.0)	2 (1.0)	0.105
	Amiloride	4 (2.0)	2 (1.0)	0.685
	Dabigatran	5 (2.5)	2 (1.0)	0.449
	Triamterene	3 (1.5)	1 (0.5)	0.623
	Pregabalin	2 (1.0)	2 (1.0)	1.000
	Levetiracetam	3 (1.5)	2 (1.0)	1.000

Table 2: Potentially Inappropriate Medication (PIMs) categories among geriatric patients (n=400) at pre-intervention and intervention group based on Beers Criteria.

Fischer's Exact test; TCAs: Tricyclic Antidepressant; NSAIDs: Non-Steroidal Anti-Inflammatory Drugs; COX-2: Cyclooxygenase-2; GIT: Gastrointestinal Tract

Drug or Drug Class STOPP criteria		Pre-intervention N=200 n.(%)	Intervention N=200 n.(%)	P-value*
ACE inhibitors or ARB	With hyperkalemia	25 (12.5)	9 (4.5)	0.004
Amiodarone	First-line antiarrhythmic therapy	17 (8.5)	9 (4.5)	0.105
Beta-blocker	Bradycardia, or with verapamil, in DM or Asthma patients	27 (13.5)	10 (5.0)	0.003
Calcium channel blockers	Heart failure or with beta-blocker	18 (9.0)	7 (3.5)	0.023
Digoxin	Long-term dose greater than 125µg/day	11 (5.5)	9 (4.5)	0.646
Loop diuretic	Initial monotherapy for hypertension	36 (18.0)	18 (9.0)	0.008
Spironolactone	With concurrent potassium-conserving drugs	15 (7.5)	6 (3.0)	0.044
Thiazide	Hypokalaemia, Hyponatraemia	7 (3.5)	3 (1.5)	0.338¥
Vasodilators	With orthostatic hypotension	25 (12.5)	9 (4.5)	0.004
Anticoagulants Clopidogrel, Enoxaparin, Heparin Na, Warfarin	With bleeding risk, with aspirin, For first deep venous, thrombosis, For first pulmonary embolus, with NSAID	24 (12.0)	13 (6.5)	0.083
	If eGFR < 15 ml/min/1.73m²			
Aspirin	Dose over 160 mg, History of peptic ulcer disease, with clopidogrel, warfarin, NSAID	19 (9.5)	7 (3.5)	0.026
Acetylcholinesterase inhibitors	History of persistent bradycardia, heart block, syncope or with beta-blockers, digoxin, diltiazem, verapamil	4 (2.0)	1 (0.5)	0.372¥
Anticholinergics	To treat neuroleptic extrapyramidal side effects, or with dementia, chronic constipation, BPH, or with glaucoma	82 (41.0)	50 (25.0)	0.001
	Concomitant use of two or more drugs			
Antihistamines	Use for more than one week	32 (16.0)	9 (4.5)	< 0.001
Benzodiazepines	Use of long-acting agent, with one or more falls in past three months	19 (9.5)	6 (3.0)	0.007

Neuroleptics (Antipsychotics)	As a hypnotic, with parkinsonism over one month, with fall in past three months	13 (6.5)	7 (3.5)	0.169¥
Tricyclic Antidepressants	As first-line antidepressant treatment	13 (6.5)	4 (2.0)	0.026¥
	With dementia, glaucoma, arrhythmias, constipation, opioids, CCB, BH or with urinary retention			
Iron (oral)	Use in patients with chronic constipation, or >200 mg daily	21 (10.5)	6 (3.0)	0.003¥
Corticosteroids, systemic	COPD maintenance	20 (10.0)	13 (6.5)	0.203
NSAIDs	With history of ulcer or GI bleed, unless with concurrent PPI or H2 antagonist, with blood pressure 160/100 mmHg or higher, with heart failure, Long-term use of NSAID, with GFR<50 mL/min/1.73m^2, with warfarin, or with corticosteroids without PPI prophylaxis	18 (9.0)	7 (3.5)	0.023¥
Opioids	Long-term use of strong opioids (e.g., morphine), or as 1st line for mild to moderate pain, use in patients with chronic constipation, or using of regular opioids without concomitant laxative	11 (5.5)	8 (4.0)	0.638
Alpha-blockers	With urinary catheter for over two months	14 (7.0)	4 (2.0)	0.016
Sulphonylureas (Glyburide)	With symptomatic orthostatic hypotension with a long duration of action with type 2 diabetes mellitus	31 (15.5)	14 (7.0)	0.007

Table 3: Potentially Inappropriate Medication (PIMs) categories among geriatric patients (n=400) at pre-intervention and intervention group based on STOPP Criteria.

Chi square test, ¥Fischer's Exact test; NSAID: Non-Steroidal Anti-Inflammatory Drugs; ACEI: Angiotensin-Converting-Enzyme Inhibitor; ARB: Angiotensin II Receptor Blockers; PPI: Proton-Pump Inhibitors; COPD: Chronic Obstructive Pulmonary Disease; DM: Diabetes Mellitus; CCB: Calcium Channel Blockers; BPH: Benign Prostatic Hyperplasia

Medication class	ADR	Pre-intervention N=90 n. (%)	Intervention group N=56 n. (%)
Diuretics	Electrolyte disturbance, dehydration	12 (6.0)	7 (3.5)
Anticoagulants	Haemorrhage	11 (5.5)	4 (2.0)
Insulin SS	Hypoglycemia	8 (4.0)	3 (2.0)
Beta-blocker	Hypotension, bradycardia	8 (4.0)	8 (4.0)
Benzodiazepines	Fall, drowsiness, dizziness	7 (4.5)	2 (2.0)
Glyburide	Hypoglycemic	5 (2.5)	3 (1.5)
Antidepressants	Insomnia, confusion, anxiety	5 (2.5)	3 (1.5)
Antihistamines	Fall, Dizziness	4 (2.0)	5 (2.5)
NSAIDs	Nephropathy, Haemorrhage	3 (1.5)	3 (1.5)
Digoxin	AV-block, Bradycardia,	3 (1.5)	2 (1.0)
Metformin	Gastric disturbances, Metabolic acidosis, Hypoglycemia	3 (1.5)	2 (1.0)
Opioids	Drowsiness, Constipation	3 (1.5)	2 (1.0)
Vasodilators	Fluid retention, Nausea or vomiting, Dizziness.	3 (1.5)	0 (0.0)
Amlodipine	Urinary incontinence, Water retention	2 (1.0)	1 (0.5)
Antibiotics	Allergy, Anaphylactic reactions	2 (1.0)	2(1.0)
Amiodarone	QT interval prolongation	2 (1.0)	3 (1.5)
ACEIs	Renal impairment, Electrolyte disturbance	2 (1.0)	2 (1.0)
Allopurinol	Stevens-Johnson syndrome	1 (0.5)	0 (0.0)
Quetiapine	Hepatotoxicity (hepatitis)	1 (0.5)	1 (0.5)
Candesartan	ARF with electrolyte imbalance	1 (0.5)	1 (0.5)
Colchicine	Electrolyte disturbance, Diarrhoea	1 (0.5)	0 (0.0)
Losartan	Hyperkalemia	1 (0.5)	1 (0.5)
Phenytoin	Hepatotoxicity	1 (0.5)	0 (0.0)
Risperidone	Dysphagia	1 (0.5)	1 (0.5)

Table 4: Medication or medication classes related to Adverse Drug Reactions (ADRs) among geriatric inpatients (n=400) in the pre-intervention and intervention group.

ADR: Adverse Drug Reaction; Insulin SS: Insulin Sliding Scale; NSAID: Non-Steroidal Anti-Inflammatory Drugs; ACEI: Angiotensin-Converting-Enzyme Inhibitor; ARF: Acute Renal Failure

Predictors	B	SE	OR	95% CI	P-value
Age (Years)	-0.12	0.04	0.88	0.82-0.95	0.001
ADL	-3.3	0.85	0.04	0.01-0.19	0.001
CACI	1.75	0.82	5.73	1.16-28.43	0.033
Malnutrition	1.26	0.63	3.53	1.03-12.08	0.044
Haemodialysis	-2.75	1.02	0.06	0.01-0.48	0.007
LOHS (days)	-0.04	0.04	0.96	0.88-1.05	0.401
Outpt visit	1.76	0.67	5.83	1.56-21.80	0.009
Polypharmacy	-0.26	0.13	0.77	0.59-0.98	0.036
DDIs	-0.51	0.85	0.6	0.11-1.04	0.270
PIMs	1.93	0.91	6.88	1.16 -14.31	0.005

Table 5: Predictors of ADRs use among geriatric patients (n=400) on PIMs in the pre-intervention and intervention groups during hospitalization at KAMC.

*Backward stepwise logistic regression test, [a]OR: Odds Ratio, CI: Confident Interval, B: regression coefficient value, ADL: Activities Of Daily Living; CACI: Charlson-Age Comorbidity Index; LOHS: Length Of Hospital Stay; DDIs: Drug-Drug Interactions, ADRs: Adverse Drug Reactions; DDI: Drug-Drug Interaction; PIM: Potentially Inappropriate Medication

Discussion

Geriatric patients at excessive danger of receiving high-risk medications. There is a lack of published interventional studies among geriatric population in Saudi Arabia; therefore, an educational and clinical pharmacists interventions were conducted for hospital physicians to reduce PIMs prescribing among hospitalized geriatric patients. The findings from the current study demonstrate that the combined intervention program reduced the incidence of ADRs among hospitalized geriatric patients who were exposed to PIMs. STOPP and Beers criteria have been used as two of the main interventional tools in the literature to assess and assist in minimizing the incidence of PIMs among geriatric patients [15]. There are several interventional tools were developed in every region in the world, but the most valid and reliable explicit criteria were the Screening Tool of Older Persons' Prescriptions (STOPP) and Beers criteria [16].

In the pre-intervention phase, we found a deviation between the evidence-based guidelines for geriatric patients as stated in STOPP and Beers criteria and the clinical practice of the study's physicians. The incidence rate of PIMs was 61% in the pre-intervention phase and decreased to 29.5% in the intervention phase with a statistically significant difference between the two groups (p-value <0.001). In many previous studies, the incidence rates of PIMs prescribing among hospitalized geriatric patients ranged from 12% to 40% [17,18]. In agreement with our analysis, a combined intervention involving educational and clinical pharmacists' interventions was significantly effective in reducing the incidence of PIMs [17]. This result was also reported in previous studies [19,20]. Therefore, an educational intervention program was needed to improve the knowledge of hospital physicians. In an extensive systematic review, the effectiveness of educational interventional for physicians and other healthcare professionals had little or no effect on clinical practice [21]. Hence, it is recommended in the literature to use a combined intervention instruments to reduce the PIMs incidence rate among geriatric inpatients instead of using single intervention [18]. In the present study, the combined intervention was consisted of the delivery of educational sessions on inappropriate prescribing of PIMs. Consistent with previous studies, we found a significant correlation between the educational program among our physicians and the knowledge level of the STOPP and Beers criteria [22]. As reported by Ramaswamy et al., we found the positive impact of educational intervention and the physicians' knowledge score of PIMs among geriatric patients [23]. Also, there was a significant difference in the median total score of knowledge of PIMs concept according to the qualification of the physicians of Medicine Department (p-value <0.001) [23]. An exception is a study conducted by Allard et al., who failed to demonstrate a significant association between the educational intervention and reducing the rate of PIMs [24].

In tandem with the educational sessions, the clinical pharmacists screened the hospitalized geriatric patients who were admitted to the Medicine Department wards in the KAMC hospital. The physicians in the interventional group received the recommendations for geriatric patients at the ordering time during multidisciplinary round in the Department of Medicine. Similar to the literature findings, we found that the clinical pharmacist's audit and recommendations were effective in improving professional medical practice by reducing the incidence of PIMs prescribing among hospitalized geriatric patients [23]. We hypnotized that the clinical pharmacists' interventions will improve clinical outcomes of geriatric inpatients in term of decreasing the incidence rate of ADRs, DDIs and drug-disease interactions as listed in STOPP and Beers criteria. In agreement with previous studies, we found that the geriatric patients who received PIMs had a significantly higher risk of DDIs and ADRs [16]. Hence, the STOPP and Beers criteria are useful in geriatric patients to decrease DDIs and ADRs [7]. The combined interventions of educational and clinical pharmacist intervention of the current study led to a statistically and clinically significant decrease in the incidence rate of ADRs as STOPP and Beers criteria are stress more on the potentially inappropriate ADRs. In our geriatric sample, DDIs were widespread, especially in those receiving PIMs and 60% of the DDIs lead to ADRs. We found that the combined interventions targeted the prescribers was effective in reducing the incidence of ADRs among hospitalized geriatric patients. The findings from the current study demonstrate that the geriatric patients on PIMs experienced more ADRs than those without PIMs (p-value <0.001). Most of ADRs were non-serious and recovered during hospitalization (64%). Several previous studies reported that geriatric patients who received PIMs had a significantly higher risk of ADRs and DDIs [25]. The occurrence of ADRs during hospitalization of geriatric patients in this study increased with polypharmacy and PIMs. Similar to our findings, the comorbidity in the geriatric population is correlated to PIMs [26]. About 114 (57.0%) of geriatric patients with high comorbidity index were received PIMs as described by STOPP and/or Beers criteria. In the present study, it was found that there was no significant association between PIMs and mortality. In contrast to our result, the appropriate prescribing of medications among geriatric patients has reduced the rate of mortality [25]. Recent findings in Saudi Arabia found that PIMs prescribing is possibly related to mortality [27]. Although no significant relationship is proved, PIMs prescribing is an important preventable error of mortality in the geriatric patients, but there was no apparent association with mortality of geriatric patients and PIMs [26]. PIMs may increase the risk of ADR, which may lead to morbidity or mortality [28].

Conclusion

This study demonstrates that the combined intervention program which targeted the physicians at medical wards was effective in reducing the incidence of PIMs prescribing among hospitalized geriatric patients. Geriatric patients who received PIMs had a significantly

higher risk of ADRs. Moreover, reducing the incidence rate of PIMs by medical physicians after the educational and clinical pharmacist intervention program resulted in a significant decrease in the incidence of ADR.

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Disclosure

The authors report no conflicts of interest in this work.

Ethics Approval

This study was approved by the Institutional Review Board of the KAMC. Waiver of Informed Consent Form (ICF) did not adversely affect the rights of the patients. Data collected from the patients were fully anonymized and only used for the study purposes and future treatment planning of prescribing among geriatric patients. Hence, the investigators request the Institutional Review Board to approve an exemption from administering informed consent from the patients.

Author Contributions

Dr. Muath Najjar and Dr. Syed Azhar contributed to the design and concept of the manuscript and wrote the draft. Dr. Hashim and Dr. Majed review the data collection and results analysis. Mohamed Sallout, Mohammed Alessa and Numan Alabdan were the clinical pharmacists who perform the pharmaceutical care interventions. All authors contributed and commented to the manuscript and approved the final version.

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