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Emergency Department Visits Due to Drug-Related Problems: A Cross-Sectional Study at King Salman Armed Forces Hospital, Saudi Arabia

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Abstract: **Background:** This study aimed to measure the incidence of drug-related problems (DRPs) among patients visiting the emergency department (ED) at King Salman Armed Forces Hospital (KSAFH). **Methods:** This cross-sectional study enrolled 300 patients who visited the ED between January and April 2015. Collected data included demographics, chief complaint, and medication history. DRPs were identified through structured patient/caregiver interviews and verification of electronic medication records. **Results:** The incidence of DRPs was 24.7% (95%CI: 20%, 30%). Among the DRPs, 48.6% were considered definitely preventable, 41.9% were possibly preventable, and only 9.5% were non-preventable. The most common DRPs were non-compliance (54.1%) and adverse drug reactions (ADRs, 22.9%). There was a significant association between DRPs and the adult age group ($p = 0.001$). The elderly age group was significantly associated with the occurrence of ADRs ($P = 0.030$). All the non-preventable DRPs were caused by ADRs ($p<0.001$). The mean number of medications was significantly higher in the elderly age group (5.81±1.71) compared to the pediatric (3.00±1.58, $p = 0.002$) and adult age groups (4.14±2.13, $p = 0.002$). **Conclusion:** Non-compliance and ADRs are major contributors to ED visits due to DRPs. Appropriate measures should be considered to improve patient adherence to the treatment regimen. Close monitoring and follow-up of patients' drug therapy is crucial to avoid preventable ADRs, particularly in at-risk elderly patients. Physicians should instruct their patients about the importance of adhering to treatment, and provide the necessary information related to drug dosage and regimen, the expected adverse effects, and any early signaling manifestations of ADRs that warrant seeking medical care.

Key Words: Drug Interactions, Drug-Related Side Effects and Adverse Reactions, Emergency Medical Services, Patient Compliance

INTRODUCTION

Drug-related problems (DRPs) are defined by the Pharmaceutical Care Network Europe (PCNE) as "an event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes." [1].

Estimates showed that DRPs account for 1.3% to 41.3% of hospital admissions, with an average rate of 15.4% [2]. The incidence of DRPs in hospitalized patients ranges between 5.7 and 14.2% [3]. Previous studies reported that DRPs are associated with prolonged hospital stays, increased rates of outpatient encounters, emergency department (ED) visits, and healthcare expenditure [2, 4]. A systematic review has reported that 2.7% of hospitalized patients die due to DRPs [2].

Previous research suggests that the diagnosis of DRPs is commonly missed in patients visiting the ED [5-7], and thus, the true incidence of DRPs requiring emergency care is underestimated, and physicians end up treating symptoms rather than the actual cause. In recent years, research has increasingly focused on assessing the incidence of emergency department visits related to drug use, but the studies reported widely varying rates from 2.3 and up to 28.6% [5,6,8-11]. This variability is likely attributed to the heterogeneity across studies in terms of populations, inclusion criteria, and the definition of what constitutes a DRP. Moreover, previous studies found that 68 to 70% of DRPs encountered in the ED were preventable [8,10]. In Saudi Arabia, a prospective study at Riyadh Military Hospital

reported DRPs in 18.7% of ED visits, with adverse drug reactions and non-compliance among the most frequently identified problems [12]. Moreover, a recent systematic review synthesized evidence from studies in Saudi Arabia and estimated that 1 out of every 16 ED visits is attributed to DRPs, and that up to 80% of the reported DRPs were preventable [13].

Considering the relatively high incidence of DRPs among ED visits, the potential morbidity and mortality associated with such incidents, and the potential for misdiagnosing them by ED physicians, DRPs represent a serious health problem in acute care settings. The magnitude of this problem highlights the importance of investigating the true incidence and the causes of DRPs, as well as improving early recognition of DRPs in the ED, so that early recognition of acutely presenting DRPs can be facilitated. The present study was conducted to assess the incidence of DRPs among patients visiting the Emergency Department at King Salman Armed Forces Hospital (KSAFH) and to classify them according to type, contributing factors, and preventability.

METHODS

Study Design, Settings, and Time

This descriptive cross-sectional study was conducted on ED visits and admissions at KSAFH, Tabuk City, Saudi Arabia, during the period from April to May 2015. The Tabuk area is located in the northwestern part of Saudi Arabia and covers an area of approximately 154.12 thousand square kilometers, accounting for 8.1% of the total kingdom's area. The population of Tabuk is around 950,000. The KSAFH is a 500-bed tertiary hospital in Tabuk, providing emergency services to Ministry of Defense personnel and their dependents, and serves as a teaching hospital for Tabuk medical college students. An average of 400 patients visit the emergency department every day. The department operates 24 hours a day, 7 days a week. The patients are initially assessed in triage. The department has three shifts, each staffed with at least four doctors and twenty-five nurses. The hospital drug formulary follows the national treatment guidelines and regulatory requirements. The prescription practices follow standardized protocols comparable to those used in civilian tertiary hospitals. Physicians prescribed medications using an electronic prescribing system with embedded dosing and drug–drug interaction alerts. Hospital pharmacists revised all prescriptions before dispensing to ensure appropriateness of the dose, indication, and formulary compliance.

Inclusion Criteria

Patients visiting the emergency department of any age or sex during the study period were eligible.

Exclusion Criteria

Patients refusing to participate in the study were excluded.

Sample Size

Data were collected from 300 patients who visited the emergency department between April and May 2015, using a computerized randomization program. A random list of 10 occupied ED bed numbers (across areas/shifts) was generated, and the patient assigned to each selected bed at the time of sampling was included to ensure 10 beds were selected each day across different areas and times.

Data Collection Tool

Data were collected using a structured form (Appendix 1), which was filled out by the researcher during interviews with patients and their relatives and verified using patients' files and medication charts. The collected data included the patient's age, weight, height, sex, chief complaint, history of the present illness, past medical history, allergy status, and drug-related problems. Each drug-related problem was categorized by type, and for each instance, details such as the medication name, dosage, route of administration, frequency, and duration were recorded. Positive findings on physical examination were recorded if present. Additional information was obtained when necessary from family members or other healthcare providers.

Definition of Drug-Related Problems

An emergency department visit was considered to be related to medication use if the presentation was directly related to the presenting chief complaint and could be classified into 1 of 8 predefined drug-related categories: adverse drug reaction, drug interaction, improper drug selection, untreated indication, sub-therapeutic dosage, supra-therapeutic dosage, non-adherence, and drug use without indication [14,15]. If the patient had other symptoms related to drug use, and the chief presenting complaint was not related to these, the ED visit was considered not drug-related. The assessment of DRPs was only for medications taken before ED presentation. Medications initiated in the ED were not evaluated for DRPs.

An adverse drug reaction was defined as any response that is noxious and unintended that occurs at doses normally used in man for prophylaxis, diagnosis, or treatment, excluding a failure to accomplish the intended purpose [16]. Drug compliance was defined as the extent to which the patient's drug-taking behavior in terms of taking medication coincides with the prescription [17]. An untreated indication refers to a medical problem that requires drug therapy, but the patient is not receiving a drug for that indication. Improper drug selection was the taking of the wrong drug other than one prescribed by the physician. Sub-therapeutic dosage is when the patient has a medical problem for which he receives too little of the correct medication. Drug overdose is a medical problem treated with too much of the correct drug toxicity. Drug use without indication is when an individual is taking a drug in the absence of a medically valid reason [14].

Drug-related visits were considered preventable if prescribed therapy deviated from current best practice. Such inconsistencies included inappropriate drug, dosage, route, or frequency for the patient's clinical condition, age, weight, or renal function; known drug allergy or previous reaction to drug; known drug interaction; non-adherence; lack of

laboratory monitoring; and prescribing, dispensing, or administration errors. Non-preventable drug events could not have been avoided by any reasonable means, or it was an unpredictable event in the course of a treatment fully following good medical practice. Events were described as possibly preventable if "the prescription was not erroneous, but the drug event could have been avoided by an effort exceeding the obligatory demands" [18].

Data Entry and Analysis

Statistical analysis was undertaken using the SPSS (Statistical Package for Social Science) version 21 program [19]. Categorical data were summarized as frequencies, and associations of drug-related problems with age and sex were performed using Pearson's Chi-square test. Numerical data were represented using the mean and standard deviation (SD), and comparisons were carried out using one-way analysis of variance (ANOVA) followed by post hoc Scheffe test. An alpha level of 0.05 was selected to interpret the significance of statistical tests.

Ethical Considerations

This study protocol was approved by the Institutional Review Board of KSAFH in Tabuk City, Saudi Arabia. Verbal consent was obtained from the patients who participated or their guardians. The collected data were strictly kept confidential by keeping the data spreadsheets anonymous and devoid of any personally identifiable information. Each participant was assigned a specific code known only to the investigators. All interviews were conducted privately. If any clinically significant DRP was identified during data collection, the ED treating team was informed to ensure timely patient management.

RESULTS

A total of 300 patients presented to the ED who fulfilled the pre-established eligibility criteria and were randomly selected and included in the study. The age of the selected patients ranged from below one year to 106 years old, and the mean age was 33.7 ± 26.6 years. Almost 50% (n = 147) of patients were aged between 14 and 64 years. Among the included patients, 158 (52.7%) were males and 142 (47.3%) were females. About two-thirds (65%) of the patients were treated and discharged in the ED, while the remaining 35% (n = 105) were referred for hospital admission. DRPs were identified as the reason for visiting the ED in 74 patients (24.7% of the entire sample, 95% CI: 20%, 30%; Table 1). There was a statistically significant association between age and DRPs, as 67.6% of DRPs were identified in adults compared to 33.3% of DRPs in children and 21.6% in the elderly (p = 0.001). Moreover, DRPs were slightly more encountered in female than in male patients, although the difference did not reach statistical significance (p = 0.286). The rate of hospital admission was nearly similar in patients presenting with NDRPs and DRPs (p = 0.978; Table 1).

As regards the disease conditions in patients presenting with DRPs, the most common was diabetes mellitus (31.1%), followed by hypertension (10.8%), hyperkalemia (5.4%), sickle cell crisis (5.4%), bronchial asthma, shortness of breath, epilepsy, and schizoaffective disorder (4.1% each).

The results showed that non-compliance was the most frequent cause of DRPs (n = 40, 54.1% of all the identified DRPs). The second most frequent cause was adverse drug reaction (n = 18, 23%).

The most common causes of non-compliance included forgetfulness (45%), followed by regimen complexity (20%), unbearable side effects (17.5%), and disliking taking medicines (12.5%). As for ADR, the most commonly encountered was hyperkalemia in 4 patients (23.5%) with cardiovascular disease taking an angiotensin-converting enzyme inhibitor and a potassium-sparing diuretic simultaneously. The patients' ages ranged between 76 and 89 years. The event was serious and life-threatening if it went unnoticed and was not appropriately treated. Nevertheless, it is definitely preventable by close monitoring as well as appropriate education and patient counseling. Hypokalemia was documented in one 87-year-old patient (5.9%). Hyponatremia was detected in two patients (11.8%); one 48-year-old patient and the other was an elderly patient of 88 years old. Epistaxis was observed in 2 patients (11.8%) aged 66 and 79 years. Edema was detected in 2 patients (11.8%), aged 68 and 79 years. Infections were recorded in 3 patients (17.6%), aged 23 and 64 years. Rash occurred in 2 patients (11.8%) aged 28 and 56 years. Chemical ingestion occurred in 2 patients (11.8%), aged 24 and 51 years. The drug categories most

Table 1: Cross-Tabulation of Participant Characteristics by Presence of Drug-Related Problems (DRPs) (n = 300)

Characteristics	NDRPs # N = 226 (75.3%)	DRPs # N = 74 (24.7%)	All patients N = 300 (100%)	p-value
Age Group				0.001*
Pediatric (≤ 13)	92 (40.7%)	8 (10.8%)	100 (33.3%)	
Adult (>13-64)	97 (42.9%)	50 (67.6%)	147 (49.0%)	
Elderly (≥ 65)	37 (16.4%)	16 (21.6%)	53 (17.7%)	
Gender				0.286
Female	103 (45.6%)	39 (52.7%)	142 (47.3%)	
Male	123 (54.4%)	35 (47.3%)	158 (52.7%)	
Patient disposition				0.978
ER Visit	147 (65.0%)	48 (64.9%)	195 (65.0%)	
Admission	79 (35.0%)	26 (35.1%)	105 (35.0%)	

Table 2: Distribution of identified DRP types according to gender (n = 74)

Types of DRPs	Female N = 39	Male N = 35	p-value
Adverse Drug Reaction	12 (30.7%) (95% CI: 18.6 - 46.4%)	5 (14.2%) (95% CI: 6.3 - 29.4%)	0.636
Improper Drug Selection	1 (2.6%) (95% CI: 0.5 - 13.2%)	0 (0.0%) (95% CI: 0.0 - 9.9%)	1.000
Untreated Indication	1 (2.6%) (95% CI: 0.5 - 13.2%)	4 (11.4%) (95% CI: 4.5 - 26.0%)	0.915
Subtherapeutic Dosage	2 (5.1%) (95% CI: 1.4 - 16.9%)	1 (2.9%) (95% CI: 0.5 - 14.5%)	1.000
Supratherapeutic Dosage	4 (10.3%) (95% CI: 4.1 - 23.6%)	1 (2.9%) (95% CI: 0.5 - 14.5%)	1.000
Non-compliance	17 (43.6%) (95% CI: 29.3 - 59.0%)	23 (65.7%) (95% CI: 49.2 - 79.2%)	0.461
Drug Use Without Indication	2 (5.1%) (95% CI: 1.4 - 16.9%)	1 (2.9%) (95% CI: 0.5 - 14.5%)	1.000

Row-wise Fisher's exact test with adjustment for p-value with the Holm-Bonferroni method, Significant at p≤0.05, # All percentages were calculated from column totals

Table 3: Distribution of Identified DRP Types According to Age Groups (n = 74)

Types of DRPs	Pediatric N = 8	Adult N = 50	Elderly N = 16	p-value
All categories of DRPs				0.030*
Adverse Drug Reaction	1	6	10a	
Improper Drug Selection	0	0	1	
Untreated Indication	0	5	0	
Subtherapeutic Dosage	0	3	0	
Supratherapeutic Dosage	1	4	0	
Non-compliance	5	27	8	
Drug Use Without Indication	1	1	1	

Fisher's exact test, *Significant at p≤0.05, a Significant on examining standardized residuals

Table 4: Distribution of Identified DRP Types According to Preventability (n = 74)

Types of DRPs #	Possibly preventable N = 31	Definitely preventable N = 36	Not preventable N = 7	p-value
All categories of DRPs				<0.001*
Adverse Drug Reaction	3 (17.6%) (95% CI: 6.2 - 41.0%)	7 (41.2%) (95% CI: 21.6 - 64.0%)	7 (41.2%) a (95% CI: 21.6 - 64.0%)	
Improper Drug Selection	0 (0.0%)	1 (100.0%)	0 (0.0%)	
Untreated Indication	1 (20.0%) (95% CI: 3.6 - 62.4%)	4 (80.0%) (95% CI: 37.6 - 96.4%)	0 (0.0%) (95% CI: 0.0 - 43.4%)	
Subtherapeutic Dosage	0 (0.0%) (95% CI: 0.0 - 56.1%)	3 (100.0%) (95% CI: 43.9 - 100.0%)	0 (0.0%) (95% CI: 0.0 - 56.1%)	
Supratherapeutic Dosage	3 (60.0%) (95% CI: 23.1 - 88.2%)	2 (40.0%) (95% CI: 11.8 - 76.9%)	0 (0.0%) (95% CI: 0.0 - 43.4%)	
Non-compliance	21 (52.5%) (95% CI: 37.5 - 67.1%)	19 (47.5%) (95% CI: 32.9 - 62.5%)	0 (0.0%) a (95% CI: 0.0 - 8.8%)	
Drug Use Without Indication	1 (100.0%)	0 (0.0%)	0 (0.0%)	

Fisher's exact test, *Significant at p≤0.05, a: Significant on examining standardized residuals, CI: Confidence interval, # All percentages were calculated from row totals

frequently implicated in ADRs were ACE inhibitors (10%), antiplatelet (2%), calcium channel blockers and diuretics (4%), antibiotics (10%), ARBS (10.5%), and antidiabetics (5%).

Comparison of causes of DRPs between male and female patients showed that the incidence of ADR among females was nearly two times that in male patients (30.7% vs. 14.2%). However, there was no significant association between the patient's gender and the cause of DRPs (all p-values >0.05; Table 2).

Adverse drug reaction was significantly associated with the elderly age group compared to other age groups (P = 0.030). Untreated indication was recorded in five adult patients (one female and four males), while no such incidents were reported in pediatric or elderly patients. The untreated medical problems included a case of hyperthyroidism, a case of heart failure, and 3 cases of epilepsy. Three patients took medications without a specific medical indication (two females and a male patient, all were adults). The medications involved were glargine insulin, sodium valproate, and a hypnotic (Table 3).

The results also showed that 36 (48.6%) of the 74 DRPs were considered definitely preventable, whereas 31 (41.9%) were possibly preventable, and only 7 (9.5%) were considered not preventable. All of the 7 non-preventable DRPs were caused by ADRs, while the remaining DRPs were either preventable or possibly preventable (p<0.001; Table 4).

The number of medications per DRP patient ranged from 1 to 8, with an average of 4.38 ± 2.18 for the whole

Table 5: Number of Medications in Patients with Drps According to Patients' Gender and Age (n = 74)

Parameters	Number of Patients	Number of medications			p-value
		Total	Mean	Standard deviation	
Gender					0.128 t
Male	35	139	3.97	2.04	
Female	39	185	4.74	2.26	
Age groups					0.007* F
Pediatric (≤13)	8	24	3.00 a	1.58	
Adult (>13 - 65)	50	207	4.14 b	2.13	
Elderly (≥65)	16	93	5.81 a,b	1.71	
Total	74	324	4.38	2.18	

t: Independent samples T-test; F: one-way ANOVA, *Significant at P≤0.05, a,b: Significant difference on post hoc Scheffe test between age groups with the same symbol

group of DRPs. The average number of medications due to DRPs in male patients was 3.97 ± 2.04, while in female patients it was 4.74 ± 2.26, with no significant difference between the two genders (t (df = 73) = 1.54, p = 0.128; Table 5). The mean number of medications showed an increase with age, and statistical testing showed a significantly (p = 0.007) higher mean number of medications in the elderly group compared to adults and pediatric groups (Scheffe test: p = 0.002 for both; Table 5).

DISCUSSION

Drug-related problems represent a serious health problem that is associated with increased morbidity and mortality and places a burden on the resources of health systems [2,4]. This descriptive cross-sectional study was carried out with the aim of assessing the incidence of DRPs among patients visiting the Emergency Department at KSAFH and to classify them according to their potential cause and preventability. While the hospital is administered under the Ministry of Defense, the ED serves not only armed forces personnel but also their families and dependents, resulting in a patient population that encompasses all age groups and a wide range of clinical conditions. In addition, being a high-volume tertiary unit, the DRP-related patterns and patients' characteristics are broadly comparable to those of other tertiary EDs.

The incidence of DRPs in the present study was 24.7% (95% CI: 20, 30%), indicating that approximately 1 out of every 4 cases involved a DRP. This rate agrees with similar previous studies. One prospective study in France reported a rate of 22.5% (95% CI: 18.6, 26.7%) [7]. Another prospective study in New Zealand reported that adverse drug events were responsible for 28.6% of acute admissions [11]. A retrospective study from Norway reported that 19.7% of ED visits were drug-related (20), while another prospective study in Minnesota, the United States, found that DRPs constituted 29.6% of all ED visits (95% CI: 26.8, 32.4%) [4]. On the other hand, some studies reported much lower incidence rates. One prospective study in British Columbia, Canada, investigated the rate of DRPs in 944 ED visits and reported a rate of 12.3% [5]. A much lower incidence was reported by one prospective study on 18,646 patients admitted to the ED in four general hospitals in Italy, where adverse drug events were detected in 3.4% (95% CI: 3.1, 3.7%) [10]. Differences in the inclusion criteria and definition of the outcome may partially explain the lower incidence rate, as these two studies included younger patients.

In the current study, non-compliance was the most frequent cause of DRPs (54.1% of DRPs), followed by adverse drug reaction (23%). This finding differs from the results of previous studies. Hohl *et al.* [5] found that the most frequent causes of drug-related ED visits comprised adverse drug reactions (37.9%), non-compliance (29.3%), wrong drug (12.1%), need for additional medications (8.6%), supratherapeutic doses (7.8%), and subtherapeutic doses (4.3%). In addition, Haag *et al.* [4] reported that the most common types of DRPs were adverse drug reaction (43.6%), ineffective medication (15.6%), subtherapeutic dosage (15.3%), non-adherence (11.5%), untreated indication (5.2%), improper drug selection (4.7%), supratherapeutic dosage (3.4%), and drug interaction (0.7%). Similarly, Nymoen *et al.* [20] found that most DRPs in the ED were due to adverse drug effects (72.2%), while non-adherence and suboptimal dosing accounted for 16.5% and 7.6% of cases. Need for additional drug treatment, inappropriate drug choice, and suboptimal formulation were responsible for 1.3% of cases.

The DRPs were significantly more common in adults compared to the pediatric age group (p = 0.001). Among the different types of DRPs, adverse drug reactions were significantly more common in the elderly age group (p = 0.030). Our findings are consistent with those of previous studies [8, 11, 20], which reported that the risk of having a drug-related ED visit increased with increasing age. Notably, the elderly group had a higher mean number of medications compared to both the adult and pediatric groups (p = 0.002), suggesting the contribution of polypharmacy to ADR-related ED visits in this population. In addition to higher medication exposure observed in this study, age-related pharmacokinetic and pharmacodynamic changes may contribute to the increased susceptibility of the elderly to ADRs. These changes cause considerable alterations in drug absorption, distribution, metabolism, and excretion [21], resulting in decreased drug elimination from the body and accumulation of high drug or metabolite levels. Furthermore, elderly patients generally suffer from multiple chronic diseases and thus are taking multiple prescription and non-prescription medications, which exposes them to the risks of drug interactions [22].

We did not find a significant association between sex and DRPs, though their rate was slightly higher in female patients compared to males (p = 0.286). Likewise, there was no significant association between the patient's gender and the cause of DRPs, despite the higher incidence of ADR among females compared to male patients (30.7% vs. 14.2%). Similarly, Roulet *et al.* [7] and McLachlan *et al.* [11] found a lack of significant association between gender and DRPs. Also, Nymoen [20] found no significant association between female sex and drug-related ED visits (OR: 1.42 (95% CI: 0.87, 2.33, p = 0.16).

The drug most frequently associated with ADRs in the present study included ACE inhibitors (10%), antiplatelets (2%), calcium channel blockers and diuretics (4%), antibiotics (10%), ARBS (10.5%), and antidiabetics (5%). These findings highlight the need for closer monitoring and education at the primary care level for patients prescribed these drugs. Our results are comparable to a previous study, which showed that medications most frequently found related to ED visits were the anticoagulants (21.8%), antibiotics (17.6%), hypoglycemic agents (9.6%), and ACE inhibitors (4.7%) (23). Similarly, another study reported that the drug classes most frequently involved in ADEs were antibiotics (34.4%), anti-inflammatory/antirheumatic drugs (22.6%), and antithrombotic agents (9.4%) [10].

Our results showed no significant difference in the rate of hospital admission between NDRPs and DRPs (p = 0.978). Our results also showed that 48.6% of DRPs were definitely preventable and 41.9% were possibly preventable, whereas only 9.5% were deemed not preventable. All non-preventable DRPs in the present study were caused by ADRs (p<0.001). Previous studies have found that 57.3 to 70.7% of drug-related ED visits may be preventable [8,10,24], and were caused by non-compliance, suboptimal dosing, and need for additional drug treatment were most frequently found preventable [8,10].

The present was subject to a few limitations. Being a single-center study, our results may not be generalizable to other centers or regions. Also, the study's cross-sectional design allows only for association assessment and does not establish causality. While the diagnosis and classification of DRPs followed standardized definitions, formal assessment of inter-rater reliability was not conducted in the current study. Data collection in the present study was conducted in 2015; thus, changes in ED workflow, prescribing systems, and clinical pharmacy services may affect the current incidence of DRPs. However, the identified patterns remain clinically relevant and provide a useful baseline for guiding future interventions. In addition, we did not assess the percentage of DRPs identified by ED physicians, which may have shed light on the discrepancy between the actual incidence of DRPs and that reported by ED staff. Although participants were selected randomly, the bed-based computerized sampling approach may have preferentially included patients with longer ED stays. Therefore, some degree of selection bias cannot be excluded. While the study included patients of all age groups and both sexes, the sample size was relatively small in some subgroups. Therefore, subgroup results should be interpreted cautiously as exploratory analyses. Moreover, the present study did not include an assessment of DRP severity and economic evaluations; therefore, the full clinical and economic impact of DRP-related ED visits could not be quantified.

CONCLUSIONS

Medication-related problems are a significant cause of ED visits. In this study, non-compliance and adverse drug reactions were frequent contributors, suggesting that a substantial proportion of drug-related ED visits are potentially preventable. In order to reduce the rate of DRPs, several strategies should be implemented. Treating physicians should identify high-risk individuals among their patients, such as the elderly and those administering several medications. Appropriate patient education and counseling by physicians and then by pharmacists during the dispensing phase can also help prevent or reduce the incidence of non-compliance. A comprehensive pharmacy review of patient medication therapy should be established and maintained, along with the provision of written information about prescribed medication, expected effects, and side effects. Patients should be made aware of the expected adverse effects of their drug therapy and measures to address them upon occurrence. Future studies on ED presentations due to DRPs should include longer recruitment periods, longitudinal follow-up, age-stratified analyses, DRP severity grading, economic evaluation, and multivariable modelling to identify independent predictors of DRPs. In addition, future studies should assess interventions to reduce the occurrence of DRPs.

Author Contributions

NE, GA, OA, AA, IA, and BA have full access to all the data in the study and take responsibility for the integrity of the data. Study concept and design: NE; acquisition of data: GA, OA, AA, IA, and BA; analysis of data: NE and GA; drafting of the manuscript: GA, OA, AA, and IA; critical revision of the manuscript: NE and BA. All authors have read and approved the final manuscript.

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Institutional Review Board Statement

This study adheres to the Declaration of Helsinki guidelines, and it was approved by the Institutional Review Board of King Salman Armed Forces Hospital in Tabuk City, Saudi Arabia.

Informed Consent Statement

All participants provided informed consent, and their confidentiality was maintained.

Data Availability Statement

De-identified data are available from the corresponding author upon reasonable request and subject to institutional approval.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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