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Incidence Rates of Adverse Drug Events and Analysis of Contributing Trigger Factors: A Retrospective Study at Alnoor Specialist Hospital

Ahmed Abdul-aziz Hawsawi [1], Abdullah Mousa Alzahrani [2], Mohammed Mousa Alzahrani [3], Ibrahim Mohammed Alnami [4], Osamah Mohammed Alshreef [5], Abdulelah Abdulrazaq Alghamdi [6], Albaraa Musa Almahzari [7], Nawaf Saed Alqurashi [8], Ziyad Hassan Mousa Abu Dabbaj[9], Abdurahman Ali Ahmad Mehdaly[10], Amal Mohamad Adnan [11], Mazen Saleh Alshehri [12]

1. General Surgery Consultant - Al-Noor Specialist Hospital (Ministry of Health, Saudi Arabia), AHAHAWSAWI@mog.gov.sa
2. Pharmacist – Al-Noor Specialist Hospital (Ministry of Health, Saudi Arabia), aalzahrani616@moh.gov.sa
3. Medical Student – Faculty of Medicine, Al-Baha University, dr.m.almousa@outlook.sa
4. Pharmacist – Al-Noor Specialist Hospital (Ministry of Health, Saudi Arabia), ibalnami@moh.gov.sa
5. Pharmacist – Al-Noor Specialist Hospital (Ministry of Health, Saudi Arabia), ph.o@hotmail.com
6. Pharmacy Student – Faculty of Clinical Pharmacy, Al-Baha University, abody123321.at@gmail.com
7. Pharmacist – Ahejla PHC (Ministry of Health, Saudi Arabia), aalmahzari@moh.gov.sa
8. Pharmacy Director - Al-Noor Specialist Hospital (Ministry of Health, Saudi Arabia), nasalqurashi@mog.gov.sa
9. Baish general hospital- Jazan health cluster
10. Baish General Hospital - Jazan Health Cluster
11. Research & AHA Coordinator- Academic Affairs & Training – Al-Noor Specialist Hospital (Ministry of Health, Saudi Arabia), ammsaad@moh.gov.sa
12. Medication Safety Officer -Al-Noor Scpicalist Hospital (Ministry of Health, Saudi Arabia), MazenAlshehri9@gmail.com

Abstract

Background: Patient safety, particularly medication safety, is a critical aspect of healthcare quality. Adverse drug events (ADEs), including medication errors, allergic reactions, and overdoses, pose significant risks to patients, especially the elderly, leading to extended hospital stays, morbidity, and mortality. Studies indicate that older populations are more susceptible to ADEs due to co-morbid conditions, polypharmacy, and age-related changes in pharmacokinetics and pharmacodynamics.

Objective: To determine the incidence rates and contributing factors of ADEs among patients at Alnoor Specialist Hospital and provide recommendations to improve medication safety, particularly for older adults.

Methods: A retrospective study was conducted at Alnoor Specialist Hospital from April 2019 to April 2024. The study included 173 patients who experienced ADEs during their hospital stay. Data were collected from patient records using a standardized form, which included demographic details, medication profiles, and the Naranjo scale to assess the likelihood of ADEs. Descriptive statistics were used to summarize the data, and statistical analyses were performed using SPSS version 28.

Results: The majority of participants were male (61.3%), with a mean age of 47.06 years and a mean BMI of 27.62. Antibiotics were the most commonly implicated drug class, accounting for 44.50% of ADEs, followed by blood thinners (12.13%). The Naranjo scale classified 45.1% of ADEs as probable, with only 4.6% classified as definite. Ceftriaxone was the most frequently associated drug with ADEs (12.1%).

Conclusion: ADEs at Alnoor Specialist Hospital, particularly involving antibiotics and anticoagulants, highlight the need for stricter medication safety protocols. The findings emphasize the vulnerability of elderly patients and those on multiple medications to ADEs. Implementing trigger tools and enhanced pharmacovigilance can improve ADE detection and reduce preventable events, ultimately improving patient outcomes and reducing healthcare costs.

Keywords: Adverse drug events, medication safety, antibiotics, anticoagulants, Naranjo scale, patient safety, Alnoor Specialist Hospital.

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List of abbreviation

ADEs: Adverse drug events

WHO: World Health Organisation

GTT: The Global Trigger Tool

PPV: positive predictive value

ADR: Adverse drug reaction

Introduction

Patient safety, including the safety of medication usage, is widely recognized as a crucial aspect of ensuring quality within healthcare facilities. [1] Several studies have reported significant issues in medication safety. Worldwide, adverse drug events (ADEs) and medication errors have been widely studied from the point of view of how often they take place in practice and how technology can be used to avoid them. So, investigating the types of contributing factors to and causes of ADEs is essential. [2, 3]

ADEs are any undesired effects of a drug that may occur during treatment with medicine. [4] This includes medication errors, allergic reactions, and overdoses. [5] Hospital adverse events are an essential source of morbidity and mortality in various countries and settings and represent a necessary item of expenditure for health care systems. [6] Hospital adverse events are the leading causes of morbidity and hospitalization. [7] In a study done across low- and middle-income countries, the rate of ADEs was around 8%, of which 83% could have been avoided, and 30% resulted in death. [8]

In addition, the Harvard Medical Practice Study reported that medication-related injuries were the most common cause of adverse events. It was correlated with disabling injury in about 1% of all hospitalized patients. [9] Studies reported that medication-related adverse events lead to prolonged hospital stays, cause 100,000 deaths annually, and cost about $10 to $150 billion in the US per year. [10] So, the World Health Organization (WHO) is concerned with the global patient safety challenge to promote and implement actions to improve medication safety and decrease preventable ADEs. [11]

Regarding the contributing factors to ADEs, older populations were reported to be more likely to experience drug-related events and have higher ADEs prevalence rates than other age populations due to several co-morbid diseases, polypharmacy, difficulty monitoring prescribed medicines, and age-related changes in pharmacokinetics and pharmacodynamics. In addition, older adults in the US account for about 35% of all hospitalizations and 53.1% of hospital ADEs. Therefore, decreasing ADEs in these patients has become an important safety goal in many medical centers. [9, 12]

In a series of studies focusing on Adverse Drug Events (ADEs), several key findings emerged. Tola et al. (2023) examined 73 participants, detecting 466 ADEs with an incidence rate of 638.36 per 100 participants, 38.35 per 100 participants' days, and 2.34 per chemotherapy cycle. The prevalent ADEs included

hematologic toxicities such as anemia (11.8%), neutropenia (11.16%), and thrombocytopenia (6.65%), along with gastrointestinal symptoms like nausea (9.87%), vomiting (9.87%), and anorexia (8.8%) [13]. Furthermore, Qiaozhi Hu et al. (2020) conducted a retrospective review involving 234 participants, identifying 1646 positive triggers and 296 ADEs. They found that older individuals taking more medications, experiencing extended hospital stays or multiple admissions, and avoiding surgical procedures were at higher risk of ADEs. Their refined Chinese geriatric trigger tool, comprising 20 triggers with a positive predictive value (PPV) of 28.50%, captured 99.66% of all ADEs detected [9].

Additionally, Sahilu et al. (2020) investigated ADEs among hospital patients in Ethiopia, enrolling 319 participants with a mean age of 43 years and a follow-up period of 5667 days. They recorded 116 ADEs, translating to an incidence rate of 36.4 per 100 admissions and 20.5 per 1000 person-days. About half of the participants were females [8]. Also, Varallo et al. (2017) analyzed 3318 hospital admissions and identified 837 ADEs using trigger tools, contributing to a 10.5% increase in detection. Their overall positive predictive value (PPV) was 0.43, with a reported underreporting rate where only one out of 356 potential ADEs was documented by healthcare professionals [14].

The rationale behind this research lies in the crucial need to enhance medication safety and reduce the occurrence of preventable ADEs, especially in healthcare settings serving older adult populations. Therefore, in our research, we **aimed** to analyze the incidence rates of adverse drug events (ADEs) and identify the contributing trigger factors through a retrospective study conducted at Alnoor Specialist Hospital. By comprehensively examining ADE incidence rates and delving into the specific factors that contribute to these events, this study seeks to provide valuable insights that can inform targeted interventions and strategies aimed at improving patient care outcomes and overall medication safety within the hospital setting.

Methods:

- **Study objectives**

The study aims to determine the incidence rates of adverse drug events (ADEs) among the patient population at Alnoor Specialist Hospital over a specified period. Additionally, it seeks to identify and categorize the types of ADEs encountered in the hospital setting, the actions taken to address these events, and whether any medications were administered to counteract the adverse drug reactions. Furthermore, the study examines the demographic and clinical characteristics of patients who experienced ADEs, including factors such as age, gender, BMI, and medication profiles. Ultimately, the research provides recommendations for targeted interventions and strategies to reduce ADEs and improve medication safety within the hospital, with a particular focus on older adult populations who may be more vulnerable to such events.

- **Study Design and Area:** A retrospective study design was conducted at Al-Noor Specialist Hospital from April 2019 to April 2024.
- **Study Population**

Consisted of patients who were admitted to Alnoor Specialist Hospital during the specified study period.

- **Inclusion end Exclusion criteria**

The study included patients who met the following inclusion criteria: those who were admitted to Alnoor Specialist Hospital during the specified study period and experienced adverse drug events (ADEs) during their hospital stay. However, certain patients were excluded based on the following criteria: those with incomplete medical records or missing key information necessary for the analysis, and those who had ADEs due to non-medication-related causes (e.g., falls).

- **Sampling Frame**

The sample frame was determined based on the availability of medical records. A comprehensive analysis of medical records from the past five years, from April 2019 to April 2024, was anticipated. The study included 173 patients from the medical health records during that period.

- **Data Collection Techniques and Study Tools:** The data was collected using a standardized data collection form from the patient files, which included patient information such as age, gender, BMI, the drug

that caused the adverse drug reaction, the Naranjo scale, route of administration (ROA) (Oral, Injected, Both), allergic reactions, and action taken. The Naranjo scale inquired about previous conclusive reports on the reaction, the timing of the adverse event in relation to drug administration, improvement upon drug discontinuation or antagonist administration, recurrence upon drug readministration, alternative causes, placebo reactions, drug concentrations in fluids, dose-dependent reactions, previous exposure to similar drugs, and confirmation by objective evidence [8].

- **Data Analysis**

Descriptive statistics, such as counts, proportions (%), and mean values with standard deviations, were utilized in the research study to summarize the data. The Statistical Package for Social Sciences (SPSS), version 28, was used for all statistical analyses.

- **Ethical Considerations:**

This research study adhered to rigorous ethical guidelines to safeguard the rights, privacy, and well-being of the participants. Informed consent was obtained, ensuring that participants had a clear understanding of the study's purpose and their right to withdraw. Confidentiality and privacy were strictly maintained through the anonymization of data and secure storage. To ensure participant anonymity, all collected data were assigned unique identifiers and stored separately from personally identifiable information. Access to the data was restricted to authorized members of the research team, and appropriate security password protection were implemented to prevent unauthorized access. The research protocol underwent thorough review and approval by the Institutional Review Board (IRB) at Al-Noor Specialist Hospital and Health Cluster in Makkah Al-Mukarramah. The study carried minimal risk to the participants. The study complied with ethical guidelines, including the Declaration of Helsinki, and the research team remained vigilant in upholding ethical standards throughout the study, addressing any concerns promptly.

Result:

Sociodemographic and pharmacological data

The demographics of the study participants reveal year distribution, the majority of participants were from 2022, with 77 individuals (44.5%), followed by 2023 with 47 participants (27.2%). The mean age of participants was 47.06 years (+/- 17.99). Gender distribution revealed that 106 participants (61.3%) were male. The mean body mass index (BMI) was 27.62 (+/- 6.25).

Regarding Adverse Drug Events (ADEs) were categorized according to different pharmacological categories. The most commonly implicated drugs included ceftriaxone, reported by 21 participants (12.1%), followed by warfarin and vancomycin, each reported by 12 participants (6.9%). The most commonly reported category was **Antibiotics**, which accounted for 77 cases (44.50%). Following this, **Blood Thinners** (including anti-platelets and anti-coagulants) were reported in 21 cases (12.13%). Other notable categories included **Vitamins and Minerals** and **Analgesics**, each with 9 cases (5.20%). The Naranjo scale ratings indicated that 11 cases (6.3%) were classified as doubtful (0), while 35 cases each were rated as possible (3 and 4). Additionally, 78 cases were classified as probable (5 to 8), and only (9 and 10) 8 cases were classified as definite—**table 1.**

Table 1: Demographics of Study Participants

Items		**n**	**%**
Year	*2019.00*	3	1.7%
	2020.00	12	6.9%
	2021.00	15	8.7%
	2022.00	77	44.5%
	2023.00	47	27.2%

	2024.00	19	11.0%
Age	*Mean*	47.06	
	Median	47	
	Std. Deviation	17.99	
Gender	*Male*	106	61.3%
	Female	67	38.7%
BMI	*Mean*	27.62	
	Median	25.71	
	Std. Deviation	6.25	
Drug that causes Adverse Drug Reaction	*Amoxicillin*	4	2.3%
	Cinacalcet	4	2.3%
	Gemcitabine Hydrochloride	4	2.3%
	Sulfamethoxazole trimethoprim	4	2.3%
	Warfarin	4	2.3%
	Azithromycin	5	2.9%
	Enoxaparin	5	2.9%
	Morphine	5	2.9%
	Cefuroxime	7	4.0%
	Piperacillin / Tazobactam	9	5.2%
	Heparin	12	6.9%
	Vancomycin	12	6.9%
	Ceftriaxone	21	12.1%
	The rest were ranging from (0.6- 1.7%)		
Naranjo scale	*1 (possible)*	4	2.3%
	10 (definite)	4	2.3%
	2 (possible)	4	2.3%
	9 (definite)	4	2.3%
	0 (doubtful)	11	6.3%
	6 (probable)	14	8.0%
	7 (probable)	14	8.0%
	5 (probable)	25	14.3%
	8 (probable)	25	14.3%
	3 (possible)	35	20.0%
	4 (possible)	35	20.0%

	Antibiotics	77	44.50%
	Blood Thinners (Anti-Platelets and Anti-Coagulants)	21	12.13%
	Antihypertensive Agents	4	2.31%
	Anticonvulsants	5	2.89%
	Analgesics	9	5.20%
	Sedatives/Anxiolytics	3	1.73%
	Antidepressants	1	0.57%
	Combinations	8	4.62%
ADE according to Different Pharmacological Categories	*Anti-Cancer Agents*	6	3.46%
	Anti-Dot Agents	2	1.15%
	Anti-Fungal Agents	1	0.57%
	Calcimimetic Agent	4	2.31%
	Anti-Viral Agents	1	0.57%
	Diuretics	3	1.73%
	Gastrointestinal Medications.	3	1.73%
	Hypoglycemic Agents	6	3.46%
	Anti-Malarial Agents	2	1.15%
	Monoclonal Antibodies	4	2.31%
	Anti- Tuberculosis	4	2.31%
	Vitamins And Minerals	9	5.20%

Adverse Drug Events in Antibiotics: An Overview of Occurrence.

Table 2 presents an overview of adverse drug events (ADEs) associated antibiotics. Azithromycin was linked to five cases, primarily in females aged 27 to 78, with reactions such as diarrhea, erythema, pruritus, and prolonged QT prompting drug withdrawal in all patients. Ceftriaxone, the most frequently reported with 21 cases, affected both genders and included a range of reactions from pruritus, skin rash, redness, and generalized itchiness to anaphylactic shock, all resulting in drug withdrawal. Cefuroxime was associated with seven cases, predominantly involving males, where allergic reactions like anaphylactic shock and pruritus necessitated cessation of the drug, often accompanied by hydrocortisone treatment. Piperacillin/Tazobactam accounted for nine cases, with reactions including pruritus, skin rash, and thrombocytopenia leading to drug withdrawal or a switch to meropenem. Lastly, Vancomycin, reported in 12 cases, displayed a variety of reactions, including skin rash, redness, palpitations, severe dryness, and swelling on the lips, with most cases requiring withdrawal, though one was switched to daptomycin.

Table 2: Adverse Drug Events in Antibiotics: An Overview of Occurrence.

Age	Gender	BMI	ROA	Allergic Reactions	Action Taken
Amoxicillin (4)					
46	Male	29.38	Oral	Pruritus, Redness	Drug withdrawn

46	Male	22.03	INJ	Shortness of breath	Drug withdrawn
62	Female	31.25	INJ	Shortness of breath	Drug withdrawn
14	Male	24.22	Oral	Pruritus, Redness	Drug withdrawn
Augmentin (3)					
42	Male	18.36	INJ	Anaphylactic shock	Drug withdrawn
42	Male	26.23	INJ	Generalized numbness, Chocking sensation	Drug withdrawn
29	Male	28.36	INJ	Sweating, hypotension	Drug withdrawn
Azithromycin (5)					
27	Female	28.36	INJ	Diarrhea	Drug withdrawn
29	Female	34.76	INJ	Diarrhea	Drug withdrawn
78	Female	34.60	INJ	Rash, erythema, and Pruritus	Drug withdrawn
66	Male	23.87	INJ	Erythema of the face, Pruritus, and shortness of breath	Drug withdrawn
60	Male	30.10	INJ	Prolonged QT	Drug withdrawn
Ceftriaxone (21)					
33	Female	28.04	INJ	Pruritus, Skin Rash	Drug withdrawn
83	Female	23.87	INJ	Skin Rash	Drug withdrawn
50	Male	27.34	INJ	Pruritus, Skin Rash	Drug withdrawn
38	Female	24.85	INJ	Pruritus, Redness	Drug withdrawn
14	Male	24.85	INJ	Pruritus, Redness	Drug withdrawn
29	Male	19.92	INJ	Pruritus, Redness	Drug withdrawn
31	Male	25.71	INJ	Shortness of breath and rash	Drug withdrawn
31	Female	20.56	INJ	Shortness of breath and rash	Drug withdrawn

27	Male	24.22	INJ	Anaphylactic shock	Drug withdrawn
27	Male	25.39	INJ	Anaphylactic reaction	Drug withdrawn
24	Female	25.39	INJ	Skin rash and redness	Drug withdrawn
26	Female	29.06	INJ	Skin rash and redness	Drug withdrawn
62	Female	19.36	INJ	Skin rash and redness	Drug withdrawn
63	Female	23.43	INJ	Generalized itchiness and redness	Drug withdrawn
41	Male	24.03	INJ	Generalized redness	Drug withdrawn
54	Male	24.22	INJ	Skin rash and redness	Drug withdrawn
27	Male	27.34	INJ	Shortness of breath	Drug withdrawn
35	Female	20.76	INJ	Pruritus, fever, tachycardia, and nausea	Drug withdrawn
63	Female	23.66	INJ	Shortness of breath, skin redness, and puffiness of face	Drug withdrawn
50	Male	24.22	INJ	Generalized itchiness and redness	Drug withdrawn
85	Female	35.11	INJ	Shortness of breath	Drug withdrawn
Cefuroxime (7)					
25	Male	24.22	INJ	Anaphylactic shock	Drug withdrawn
60	Male	46.87	INJ	Anaphylactic shock	Drug withdrawn
47	Male	24.48	INJ	Anaphylactic shock	Drug withdrawn
60	Male	31.96	INJ	Anaphylactic shock	Drug withdrawn
62	Male	26.12	INJ	Anaphylactic shock	Drug withdrawn
44	Female	23.66	INJ	Pruritus and redness all over the body	Stopped the antibiotic, and hydrocortisone was given

40	Female	31.02	INJ	Pruritus and redness all over the body	Stopped the antibiotic, and hydrocortisone was given
Ciprofloxacin (3)					
24	Female	23.87	INJ	Skin rash, dizziness	Drug withdrawn
26	Female	23.87	INJ	Skin rash, dizziness	Drug withdrawn
14	Female	34.25	INJ	Red patches on her left arm, Pruritus	Discontinue antibiotics, hydrocortisone 100mg iv given
Clistimethate Sodium (1)					
65	Female	36.98	INJ	Swelling, redness, and shortness of breath	Drug withdrawn
Colistin (1)					
67	Male	35.25	INJ	Swelling, redness, and shortness of breath	Drug withdrawn
Linezolid (1)					
60	Female	19.60	INJ	Thrombocytopenia	Drug withdrawn
Metronidazole (1)					
21	Female	25.35	Oral	Oral Redness and Swelling	Drug withdrawn
Moxifloxacin (2)					
71	Male	34.60	INJ	Thrombocytopenia	Drug withdrawn
40	Female	33.73	INJ	Rash	Given Cetirizine and Augmentin
Penicillin-G (1)					
54	Male	27.68	INJ	Skin rashes	Drug withdrawn
Piperacillin / Tazobactam (9)					
54	Female	27.68	INJ	Pruritus, Nausea	Drug withdrawn
44	Male	29.98	INJ	Pruritus, Skin Rash	Drug withdrawn
62	Female	22.89	INJ	Pruritus	Drug withdrawn

64	Female	19.53	INJ	Severe Pruritus	Drug withdrawn
26	Male	22.22	INJ	Pruritus, shortness of breath, palpitation and dizziness	Drug withdrawn
48	Male	25.39	INJ	Rash	Drug withdrawn
46	Male	31.25	INJ	Thrombocytopenia	Drug withdrawn
87	Male	31.25	INJ	Thrombocytopenia	Drug withdrawn
54	Female	28.30	INJ	Tenderness and itchiness	Switch to meropenem
Sulfamethoxazole trimethoprim (4)					
21	Male	22.03	INJ	Prolonged QT	Drug withdrawn
23	Male	27.04	INJ	Tachycardia	Drug withdrawn
45	Male	28.44	INJ	Prolonged QT	Drug withdrawn
47	Male	22.32	INJ	Prolonged QT	Drug withdrawn
Tigecycline (2)					
39	Male	21.60	INJ	GIT upset	Drug withdrawn
42	Male	24.22	INJ	nausea and vomiting	Drug withdrawn
Vancomycin (12)					
34	Female	50.78	INJ	Skin rash, Palpitation	Drug withdrawn
81	Female	22.03	INJ	Redman Syndrome	Drug withdrawn
34	Male	23.87	INJ	Pruritus	Drug withdrawn
33	Male	30.07	INJ	Pruritus	Drug withdrawn
26	Male	35.59	INJ	Pruritus	Drug withdrawn
42	Male	27.54	INJ	Skin rash, redness, and fever	Drug withdrawn
78	Male	23.87	INJ	Skin rash, redness, and fever	Drug withdrawn

18	Female	27.62	INJ	Skin rash and redness	Drug withdrawn
36	Female	27.34	INJ	Skin rash	Drug withdrawn
71	Male	41.15	INJ	Severe Dryness	Change to daptomycin
15	Female	37.46	INJ	Swelling on the lips and redness on the neck	Drug withdrawn
33	Female	26.12	INJ	Redness, skin rash, and shortness of breath	Drug withdrawn
ROA: Route of Administration, INJ: Injected.					

Adverse Drug Events in Blood Thinners: An Overview of Occurrence.

Table 3 presents an overview of adverse drug events (ADEs) associated with blood thinners, **Enoxaparin** was involved in five cases, primarily affecting males aged 17 to 63, with reactions including increased prothrombin time (PTT) and thrombocytopenia, all leading to drug withdrawal. In comparison, **Unfractionated Heparin** was associated with several cases, predominantly in males aged 41 to 80. Common reactions included increased PTT (with levels exceeding 120 seconds) and bleeding. Most patients had their drugs withdrawn, although one case required Protamine Sulphate administration, and another showed no action taken despite increased PTT. **Warfarin** accounted for four cases, with reactions such as increased international normalized ratio (INR) and bleeding prompting drug withdrawal in three instances. In one case, when INR was elevated, Warfarin was held, and Vitamin K was initiated.

Table 3: Adverse Drug Events in Blood Thinners: An Overview of Occurrence.

Age	Gender	BMI	ROA	Allergic Reactions	Action Taken
Enoxaparin (5)					
56	Male	24.22	INJ	PTT Increased	Drug withdrawn
62	Male	24.80	INJ	Thrombocytopenia	Drug withdrawn
17	Male	23.43	INJ	PTT Increased	Drug withdrawn
18	Male	23.43	INJ	Increased PTT > 120 sec	Drug withdrawn
63	Female	25.71	INJ	Thrombocytopenia	Drug withdrawn
Unfractionated heparin (11)					
70	Male	36.33	INJ	Increased PTT > 120 sec	Drug withdrawn
70	Male	25.29	INJ	Increased PTT > 120 sec	Drug withdrawn

50	Male	37.10	INJ	Increased PTT > 120 sec	Drug withdrawn
41	Female	32.81	INJ	Increased PTT > 120 sec	Drug withdrawn
51	Male	38.06	INJ	Bleeding	Drug withdrawn
51	Male	38.06	INJ	Increased INR	Drug withdrawn
47	Male	24.48	INJ	Increased PTT > 120 sec	Drug withdrawn
69	Male	31.17	INJ	Increased PTT > 120 sec	Drug withdrawn
57	Male	31.88	INJ	Increased PTT > 120 sec	Drug withdrawn
70	Male	31.17	INJ	Increased PTT > 120 sec	No action
80	Male	22.98	INJ	Increased PTT > 120 sec	Protamine Sulphate given
35	Female	23.66	INJ	Thrombocytopenia	Drug withdrawn
Warfarin (4)					
65	Male	26.12	Oral	Increased INR	Drug withdrawn
67	Male	46.29	Oral	Bleeding	Drug withdrawn
45	Female	24.22	Oral	Bleeding	Drug withdrawn
24	Female	24.22	Oral	Increased INR	Hold Warfarin and Start Vit K
ROA: Route of Administration, INJ: Injected.					

Adverse Drug Events in Anti-hypertensive Agents: An Overview of Occurrence

Table 4 provides an overview of adverse drug events (ADEs) associated with anti-hypertensive agents, Amlodipine was linked to one case involving a 59-year-old male who experienced foot swelling, resulting in a change to Nifedipine. Perindopril was associated with one case of angioedema in a 45-year-old female, leading to drug withdrawal. Telmisartan accounted for two cases, both in females aged 61 and 63, who reported similar reactions of headache, cough, and dryness, prompting withdrawal of the medication in both instances.

Table 4: Adverse Drug Events in Anti-hypertensive Agents: An Overview of Occurrence.

Age	Gender	BMI	ROA	Allergic Reactions	Action Taken
Amlodipine (1)					
59	Male	23.72	Oral	Foot swelling	changed to Nifedipine

Perindopril (1)					
45	Female	24.22	Oral	Angioedema	Drug withdrawn
Telmisartan (2)					
61	Female	31.25	Oral	Headache, cough and dryness	Drug withdrawn
63	Female	48.88	Oral	Headache, cough and dryness	Drug withdrawn

Adverse Drug Events in Anticonvulsants, Analgesics Sedatives/Anxiolytics, Antidepressants Agents: An Overview of Occurrence.

Table 4 presents an overview of adverse drug events (ADEs) associated with anticonvulsants, analgesics, sedatives/anxiolytics, and antidepressants. In the anticonvulsant category, Carbamazepine was linked to a 33-year-old female who developed pancytopenia, requiring close monitoring. Lamotrigine accounted for two cases involving a 62-year-old male with uncontrolled severe seizures, leading to drug withdrawal, and a 27-year-old female with a pruritic rash and swelling, also prompting withdrawal. Levetiracetam was associated with a 19-year-old male experiencing loss of concentration and memory impairment, resulting in withdrawal, while Phenytoin was linked to a 44-year-old male who developed Stevens-Johnson syndrome, necessitating drug withdrawal. In the analgesic category, Diclofenac Sodium was involved in two cases of shortness of breath among males aged 32 and 34, leading to withdrawal, and Ibuprofen saw two cases of hypotension in males aged 19 and 21, resulting in similar action. Morphine accounted for four cases, including respiratory depression in two females aged 42 and 43, both requiring withdrawal, while a 37-year-old female faced sedation and respiratory depression, prompting naloxone administration, and a 16-year-old male also experienced shortness of breath, leading to drug withdrawal. In the sedative/anxiolytic category, Midazolam was associated with three cases: two males aged 49 and 50 experienced sedation and respiratory depression, resulting in withdrawal, while a 57-year-old male faced over-sedation, leading to a dose reduction. Lastly, Venlafaxine was linked to a 38-year-old male who reported anxiety, insomnia, nausea, and abdominal pain, resulting in drug withdrawal.

Table 4: Adverse Drug Events in Anticonvulsants, Analgesics Sedatives/Anxiolytics, Antidepressants Agents: An Overview of Occurrence.

Age	**Gender**	**BMI**	**ROA**	**Allergic Reactions**	**Action Taken**
Anticonvulsants					
Carbamazepine (1)					
33	Female	31.25	INJ	Pancytopenia	Close monitor
Lamotrigine (2)					
62	Male	24.22	Oral	Uncontrolled severe seizure	Drug withdrawn
27	Female	23.87	Oral	Pruritic rash and swelling	Drug withdrawn
Levetiracetam (1)					

19	Male	28.04	INJ	Loss of concentration, memory impairment	Drug withdrawn
Phenytoin (1)					
44	Male	21.40	INJ	Steven Johnson Syndrome	Drug withdrawn
Analgesics					
Diclofenac Sodium (2)					
32	Male	31.25	INJ	Shortness of breath	Drug withdrawn
34	Male	27.62	INJ	shortness of breath	Drug withdrawn
Ibuprofen (2)					
19	Male	22.94	INJ	Hypotension	Drug withdrawn
21	Male	23.43	INJ	Hypotension	Drug withdrawn
Morphine (5)					
37	Female	20.02	INJ	Shortness of breath	Drug withdrawn
42	Female	24.22	INJ	Respiratory Depression	Drug withdrawn
43	Female	30.11	INJ	Respiratory Depression	Drug withdrawn
37	Female	27.54	INJ	Sedation and respiratory depression	Naloxone was given
16	Male	25.71	INJ	Shortness of breath	Drug withdrawn
Sedatives/Anxiolytics					
Midazolam (3)					
49	Male	21.25	INJ	Sedation and respiratory depression	Drug withdrawn
50	Male	24.16	INJ	Sedation and respiratory depression	Drug withdrawn
57	Male	29.41	INJ	Over sedation	Dose reduced
Antidepressants					
Venlafaxine (1)					
38	Male	33.20	Oral	Anxiety, insomnia, nausea and abdominal pain	Drug withdrawn
ROA: Route of Administration, INJ: Injected.					

Adverse Drug Events in Combinations of Agents: An Overview of Occurrence.

Table 5 provides an overview of adverse drug events (ADEs) associated with combinations of agents. A 68-year-old female taking Carbamazepine with anti-tuberculosis drugs experienced increasing liver enzymes, leading to drug withdrawal. An adverse reaction was noted in a 47-year-old male who used Augmentin with warfarin, resulting in increased INR and necessitating a dose reduction. In another case, an 82-year-old male on Carbidopa/levodopa combined with linezolid exhibited altered mental status and seizures, prompting drug withdrawal. A 54-year-old female using Metronidazole with lactulose reported watery diarrhea, which also resulted in drug withdrawal. For a 70-year-old male on Noradrenalin and spironolactone, tachycardia and hyperkalemia were managed by switching spironolactone to furosemide and decreasing the dose of Noradrenalin. A 55-year-old female taking Pertuzumab with Docetaxel experienced hypotension and tachypnea, leading to drug withdrawal. Additionally, a 31-year-old female on Warfarin and Enoxaparin had increased INR, resulting in drug withdrawal, while a 57-year-old male using Warfarin with Valproate required a hold on the medication until his INR was corrected.

Table 5: Adverse Drug Events in Combinations of Agents: An Overview of Occurrence.

Age	Gender	BMI	ROA	Allergic Reactions	Action Taken
Carbamazepine with Anti Tuberculosis drugs (1)					
68	Female	26.95	both	Increasing liver enzymes	Drug withdrawn
Augmentin with warfarin (1)					
47	Male	27.05	Oral	Increased INR	Dose reduced
Carbidopa/levodopa with linezolid (1)					
82	Male	44.98	both	Altered Mental Status and seizures	Drug withdrawn
Metronidazole with lactulose (1)					
54	Female	21.25	both	Watery diarrhea	Drug withdrawn
Noradrenalin, spironolactone (1)					
70	Male	21.64	both	Tachycardia and Hyperkalemia	Manage hyperkalemia, switch spironolactone to furosemide, and decrease the dose of Noradrenalin
Pertuzumab with Docetaxel (1)					
55	Female	27.34	both	Hypotension and Tachypnea	Drug withdrawn
Warfarin with Enoxaparin (1)					
31	Female	53.33	both	Increased INR	Drug withdrawn

Warfarin with Valproate (1)					
57	Male	20.93	Oral	Increased INR	Dose Hold until INR corrected

Adverse Drug Events in Other Different Pharmacological Agents: An Overview of Occurrence.

Table 6 presents an overview of adverse drug events (ADEs) associated with various pharmacological agents. In the category of anti-cancer agents, Gemcitapine Hydrochloride was linked to four cases of hallucination and delirium in patients aged 66, 67, and 82, all leading to drug withdrawal, while one case involving Octreotide resulted in a skin rash in a 48-year-old female, also requiring withdrawal. Oxaliplatin was associated with hypertension, dizziness, and redness in a 74-year-old male, prompting drug withdrawal. Anti-dot agents included Acetylcysteine, which caused a skin rash and redness in a 27-year-old female, leading to drug withdrawal, and Snake Antivenom, which resulted in anaphylactic shock in a 27-year-old male, also necessitating withdrawal. In the anti-fungal agents category, Fluconazole caused an erythematous scale and itchy skin lesion in a 40-year-old female, leading to withdrawal. The calcimimetic agent Cinacalcet was linked to four cases of vomiting and abdominal pain in patients aged 36, 53, 58, and 67, with some patients refusing to continue the drug. Anti-viral agents included Favipiravir, causing shortness of breath in a 30-year-old male, resulting in withdrawal. Regarding diuretics, Furosemide was associated with high chloride and sodium levels in three males, all leading to drug withdrawal. In gastrointestinal agents, Metoclopramide Hydrochloride caused extrapyramidal symptoms in two elderly males, leading to withdrawal, and Senna resulted in diarrhea in a 74-year-old female, requiring withdrawal. Hypoglycemic agents included Dulaglutide and Gliclazide, both causing skin rashes, with Dulaglutide leading to withdrawal and Gliclazide prompting a switch to a different formulation. Insulin also caused rashes and hypoglycemia in two males, leading to a shift to oral medications and a dose reduction, respectively. Anti-malarial agents such as Quinine resulted in thrombocytopenia in two males, necessitating drug withdrawal. In the monoclonal antibodies category, Infliximab and Omalizumab caused skin rashes and weight gain, respectively, leading to withdrawal, while Rituximab resulted in flushing and shortness of breath in a 33-year-old male, prompting withdrawal. Anti-tuberculosis agents like pyrazinamide and Rifampicin were linked to increased liver enzymes and altered mental status in a 57-year-old female, resulting in withdrawal, with additional cases of increased bilirubin and pruritus leading to withdrawal in males. In the vitamins and minerals category, various agents like Calcium Polystyrene, Ferric Carboxymaltose, and Potassium Chloride caused adverse effects ranging from constipation and nausea to hyperkalemia, leading to drug withdrawal or refusal to complete treatment.

Table 6: Adverse Drug Events in Other Different pharmacological Agents: An Overview of Occurrence.

Age	Gender	BMI	ROA	Allergic Reactions	Action Taken
Anti-cancer Agents					
				Gemcitapine Hydrochloride (4)	
82	Male	22.03	INJ	hallucination and delirium	Drug withdrawn
66	Male	18.36	INJ	Shortness of breath	Drug withdrawn
67	Male	23.43	INJ	Shortness of breath	Drug withdrawn

83	Male	26.98	INJ	hallucination and delirium	Drug withdrawn
				Octreotide (1)	
48	Female	31.25	INJ	Skin rash	Drug withdrawn
				Oxaliplatine (1)	
74	Male	24.22	INJ	Hypertension, dizziness and redness	Drug withdrawn
Anti-dot Agents					
Acetylcysteine (1)					
27	Female	21.48	INJ	Skin rash and redness	Drug withdrawn
Snake Antivenom (1)					
27	Male	27.34	INJ	Anaphylactic shock	Drug withdrawn
Anti-fungal Agents					
Fluconazole (1)					
40	Female	33.80	Oral	erythematous scale and itchy skin lesion	Drug withdrawn
Calcimimetic Agent					
Cinacalcet (4)					
67	Female	23.66	Oral	Vomiting and abdominal pain	Patient refused to complete using the drug
58	Male	22.49	Oral	Vomiting and abdominal pain	Drug withdrawn
53	Male	40.00	Oral	Nausea vomiting	Patient refused to complete using the drug
36	Male	24.76	Oral	Vomiting	Patient refused to complete using the drug
Anti-viral Agents					
Favipiravir (1)					
30	Male	33.95	Oral	Shortness of breath	Drug withdrawn
Diuretics					
Furosemide (3)					

57	Male	20.76	INJ	High chloride and sodium	Drug withdrawn
49	Male	21.09	INJ	Chloride Increased	Drug withdrawn
50	Male	23.87	INJ	Hyperchloremia > 118 mmol/ml	Drug withdrawn
Gastrointestinal Agents					
Metoclopramide Hydrochloride (2)					
78	Male	25.71	INJ	Extrapyramidal symptoms	Drug withdrawn
80	Male	21.87	INJ	Extrapyramidal symptoms	Drug withdrawn
Senna (1)					
74	Female	23.43	Oral	diarrhea	Drug withdrawn
Hypoglycemic Agents					
Dulaglutide (1)					
48	Female	29.40	INJ	Skin Rash	Drug withdrawn
27	Male	39.18	INJ	Pruritus and skin rash	Drug withdrawn
29	Male	21.25		Pruritus and skin rash	Drug withdrawn
Gliclazide (Diaoptim MR)					
51	Female	29.29	Oral	Skin rash	Changed to Gliclazide (Diamicrone)
Insulin					
64	Male	27.05	INJ	Rash and Pruritus and redness	shifted to oral hypoglycemia according to diabetologist advice
48	Male	28.40	INJ	Hypoglycemia	Dose reduced
Anti- Malarial Agents					
Quinine					
45	Male	31.02	INJ	Thrombocytopenia	Drug withdrawn
51	Male	24.22	INJ	Thrombocytopenia	Drug withdrawn

Monoclonal Antibodies					
Infliximab					
61	Male	26.02	INJ	Skin rash over the arms and Pruritus	Drug withdrawn
Omalizumab					
55	Female	26.12	INJ	Weight Gain	Drug withdrawn
50	Female	24.22	INJ	Pruritus, Redness	Drug withdrawn
Rituximab					
33	Male	23.30	INJ	Flushing, shortness of breath	Drug withdrawn
Anti- Tuberculosis Agents					
pyrazinamide, Rifampicin, INH					
57	Female	25.71	Oral	Increase liver enzymes and altered mental status	Drug withdrawn
Rifampicin					
56	Male	27.68	INJ	Bilirubin conjugated increased	Drug withdrawn
58	Male	20.36	INJ	conjugated Bilirubin increased	Drug withdrawn
31	Male	29.38	INJ	Pruritus	Drug withdrawn
Vitamins and Minerals					
Calcium polystyrene					
44	Male	24.22	Oral	constipation	Drug withdrawn
39	Female	29.29	Oral	Vomiting nusua	Pateint refused to complete using the drug
Ferric carboxymaltose					
33	Female	38.06	INJ	Palpitation, Nausea and Blurred vision	Drug withdrawn
14	Female	34.60	INJ	Pruritus and shortness of breathing	Stop Ferric carboxymaltose, and Give Hydrocortisone
Multivitamins					
58	Male	31.25	Oral	Abdominal pain	Drug withdrawn

37	Male	28.71	Oral	nausea and vomiting	Pateint refused to complete using the drug
Potassium chloride					
33	Male	25.78	INJ	Hyperkalemia	Drug withdrawn
47	Male	24.65	INJ	Hyperkalemia	Drug withdrawn
Vit B1.6.12. complex					
50	Female	28.04	Oral	Abdominal pain and gastritis	Drug withdrawn
ROA: Route of Administration, INJ: Injected.					

Discussion:

These incidences of ADEs are reflective of findings from similar studies that indicate medication safety is still a priority in many hospitals. Throughout the study period, Alnoor Specialist Hospital registered a cumulative of 173 patients who experienced ADEs, the highest implicated categories of drugs being antibiotics, blood thinners, and analgesics. These findings represent a global trend, regardless of the analyzed healthcare system, where the same group of medicines and, in particular, antibiotics and anticoagulants might be responsible for frequent ADEs, either because they are among the most prescribed or have well-known, potentially dangerous side effects.

The overall incidence rate of ADE found in this study is similar to the incidence rate reported by Sahilu et al. (2020) in Ethiopia. In fact, the incidence rates of ADE were determined at 36.4 / 100 admissions and 20.5 / 1000 person-days in a prospective cohort of 319 participants. This coincidence of the ADE rate, although conducted in different healthcare settings, shows a consistent pattern of ADE occurrence and therefore calls for enhanced effort to improve medication safety globally [15]. Tola et al., in 2023, detected 466 ADEs in a cohort of chemotherapy patients with an incidence rate of 638.36 per 100 participants [15]. That relatively high rate takes into account the increased possibility of certain populations, most notably those undergoing intensive treatments like chemotherapy, who would more frequently use drugs with narrow therapeutic windows and complex side effects [16].

Antibiotics were implicated in 44.5% of all ADEs in this study. This finding agreed with similar studies. For instance, Varallo et al. (2017) established that antibiotics were among the major causes of ADEs in hospitals. In their study, antibiotics accounted for a 10·5% increase in ADE detection through the application of trigger tools [17]. The high constellation rate for antibiotic-related ADEs, mostly complications deriving from ceftriaxone, is reasoned by the pervasive application of antibiotics in settings and their cross-sensitivity nature. The cases of pruritus, skin rash, and anaphylactic shock presented in this study are similar to the adverse reactions reported by Varallo et al. The fact that a high prevalence of ADEs related to antibiotics has been found indicates that a close follow-up is required regarding any kind of reaction to these medications, especially in settings where there is an extensive application of these kinds of drugs.

Another significant class arising from this review was anticoagulants, which formed 12.13% of the ADEs. These results agree with a study by Hu et al. (2020), who established that elderly individuals, particularly polypharmacy ones, were highly susceptible to ADEs regarding anticoagulants such as warfarin and heparin [18]. Given the age-related drug metabolic and excretional changes, along with other factors associated with polypharmacy, older adults are usually highly vulnerable to ADEs. As also shown in the study of Hu et al., our study indicates that patients who are on anticoagulants need increased monitoring

and dose adjustment because small changes in drug levels result in significant adverse events such as bleeding and thrombocytopenia.

Tola et al., (2023) studied other hematologic toxicities such as anemia and neutropenia as common ADEs among their pediatric cancer population. Although our study did not target pediatric populations, the identification of blood thinners as a significant source of ADEs across various patient groups reinforces the need for vigilance in the administration of such medication [19]. Due to the life-threatening condition emanating from some ADEs involving blood thinner medicines, such as bleeding and clotting disorders, early detection and careful management become required to avoid serious complications [20].

Moreover, gastrointestinal symptoms such as nausea and vomiting were highly experienced in our present study, especially among the patients undergoing antibiotic and analgesic treatments. These fall in line with the trends observed by Bekele et al. (2021), who evaluated drug-related problems of the inpatients in hospitals located in southwestern parts of Ethiopia [18]. These gastrointestinal adverse effects have appeared related to particularly antibiotics and analgesics in our work, which testifies to the necessity of adjusting the dose and educating patients with the purpose of minimizing the consequences of such common ADEs [19]. Education of the patient about side effects that may/might occur and adherence to dosages prescribed are very important steps in preventing more serious ADEs and increasing the safety of patients [20].

The result from the Naranjo scale was used as a probability scale that assessed an adverse event being drug-related. Thus, 45.6% of the ADEs identified during this study were rated as probable, while only 4.6% were rated as definite. This distribution underlines the use of standardized tools such as the Naranjo scale in helping health professionals to better identify and classify more ADEs [21]. Hu et al., (2019) stated that a detection based on such scales can highly enhance both identification and classification of ADEs so that the option of healthcare professionals to follow through with appropriate measures in the future can be guaranteed in reducing risks [22]. Again, it calls into the limited scope of more specific training for healthcare professionals in using these tools to enhance the accuracy of ADE identification and improvement in patient outcomes [23].

Regarding demographic factors, it was noted that both older adults and elderly patients over 60 developed ADEs. The average age among the patients with ADEs in this study was 47.06 years, with a significant number of them being for older adults themselves [24]. This finding agrees with the conclusion of the Harvard Medical Practice Study, which stated that because of polypharmacy and other factors, including multiple chronic illnesses, older adults are at an increased risk for ADEs [23]. The World Health Organization has made a call for older populations to be subjected to targeted global efforts in the case of preventable ADEs due to their disproportionate medication-related complications [24].

Recommendations

Based on these findings, it is recommended that better monitoring systems be put in place in the hospitals through measures such as electronic health records that have integrated trigger tools in the identification and mitigation of ADEs in older adults or those receiving high-risk medications such as anticoagulants and antibiotics [25]. Other than that, the staff members are supposed to be given regular training in pharmacovigilance for early detection and proper management of ADEs [26,27].

Limitations

This study may be considered to have a limitation of retrospective design, with a potential for incomplete or missing data that can introduce bias. Besides, the sample was limited to only one hospital, which may reduce the generalizability of the findings to other healthcare settings [28]. Future studies should consider a multi-center approach in order to increase the representativeness of the results.

Conclusion

The incidence of ADEs in Alnoor Specialist Hospital therefore calls for strict medication safety, particularly for antibiotics and anticoagulants, which were the major classes of drugs implicated. The findings of the

present study conform to those from related literature about the prevalence of ADEs among patients and assert that the elderly and those patients with multiple medications have a high risk of suffering from ADEs. The use of trigger tools, as identified in related studies, has been successful in enhancing ADE detection and is therefore worthy of consideration for wider application. The economic and healthcare burden of ADEs, reflected both in the current study and in international research, underlines that interventions, like improved practices related to pharmacovigilance and the improved use of technology in the identification and prevention of ADEs, are direly needed. Health facilities should commit themselves to the implementation of these strategies in everyday clinical practice with the aim of improving patient safety and reducing the rate of preventable ADEs. Implementation of these measures enables hospitals to reduce hospitalization rates and reduce costs arising from ADEs, thereby achieving improvement in the quality of healthcare provision.

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