Therapeutics and Clinical Risk Management

Dovepress

open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Drug Therapy Problems Identified by Clinical Pharmacists at a General Surgery Ward of an Academic Referral Hospital in Jordan

Hiba Al Fahmawi[1], Abla Albsoul-Younes[1], Mohammad Saleh[1,†], Mahmoud Abu-Abeeleh[2], Violet Kasabri[1]

[1]School of Pharmacy, The University of Jordan, Amman, Jordan; [2]Department of General Surgery, Jordan University Hospital, The University of Jordan, Amman, Jordan

[†]Dr Mohammad Saleh passed away on August 15, 2024

Correspondence: Abla Albsoul-Younes; Violet Kasabri, Email ablabsoul@ju.edu.jo; violetk70@gmail.com

Introduction: Drug therapy problems (DTPs) continuously occur in hospitalized patients. This study aims to emphasize the role of clinical pharmacists in evaluating the DTP's frequencies, causes, severity ratings, and contributing factors at a general surgery ward in Jordan.

Methods: This prospective observational study was conducted at one of the major teaching and referral hospitals in Jordan. Data were collected through clinical pharmacist reviews of paper and electronic medical records as well as patient interviews. DTPs were identified using Cipolle's classification system and rated for severity on a scale of 10. Multiple linear regression was performed to identify factors contributing to DTPs. Drug classes primarily associated with DTPs were specified.

Results: During enrollment, a total of 80 patients were recruited in this study. The mean age of the enrolled patients was 52.35 ± 14.82 years, and 49 (61.25%) of them were males. Within the study period, 192 DTPs were identified by clinical pharmacists in 87.5%of the total recruited patients. The mean number of DTPs per patient was 2.40 ± 1.83. The most common categories of DTPs were "needs additional therapy" 46 (23.96%), "unnecessary drug therapy" 45 (23.44%), and "dosage too low" 39 (20.31%). Of the total DTPs, 127 (66.15%) were rated as severe. Multiple linear regression revealed that patients' length of hospital stay and the number of current medications had a statistically significant effect on the number of DTPs identified during hospitalization. Endocrine and metabolic drugs 51 (26.56%) and cardiovascular drugs 36 (18.75%) were the most frequent classes of drugs contributing to DTPs.

Conclusion: DTPs are common in the general surgery ward. Clinical pharmacists can provide medication reviews for surgical patients to identify DTPs and rate their severities. Detecting risk factors for DTPs and the most common drug classes associated with them can assist in decision-making relevant to reducing DTPs in the surgical ward.

Keywords: drug therapy problems, clinical pharmacist, surgery ward, observational study

Introduction

In most instances, drug therapy directed toward a specific medical condition improves patient's quality of life.[1] Nevertheless, the improper use of drugs could be detrimental.[2] A Drug therapy problem (DTP) is any undesirable event experienced by a patient that involves or is suspected to involve drug therapy and that interferes with achieving the desired goals of therapy and requires professional judgment to resolve.[3]

DTPs continuously occur in hospitalized patients posing an increased risk of morbidity and mortality.[4] However, drug-related morbidity and mortality are preventable in most cases when patient-centered pharmaceutical care is adopted as a philosophy of practice.[5] Pharmaceutical care is a creditable professional practice that describes the original purpose of clinical pharmacies and was defined by Hepler and Strand in 1990 as "responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life".[5,6]

Received: 21 February 2024
Accepted: 8 July 2024
Published: 11 September 2024

Within the multidisciplinary healthcare team, DTPs are the primary focus of pharmaceutical care practitioners, namely, clinical pharmacists.[3] Clinical pharmacists' collaboration with other healthcare professionals plays a crucial role in assuring rational drug therapy,[2] which involves the appropriate use of medications to patients' clinical needs, in doses that meet their requirements, and for a sufficient period of time.[7] This assures the optimal selection of pharmacologic agents and the design of a therapeutic regimen that meets individual requirements, maximizes therapeutic benefits, reduces medication errors, and minimizes toxicity.[8]

In clinical settings, DTPs pose a challenge to physicians,[9] particularly in the surgery wards where the surgical procedure itself is the central priority of surgeons. Furthermore, surgery ward patients usually receive many medications that may be related or unrelated to the surgery itself; consequently, they might be at increased risk of DTPs as compared to patients admitted to other hospital wards.[4] Hence, identifying, resolving, and preventing DTPs is essential to the success of the pharmaceutical care process in surgical patients.[10]

Like other clinical problems, DTPs cannot be prevented or resolved except if the cause of the problem is recognized. Accordingly, it is essential to realize not only the DTP but also its most probable cause. Causes of DTPs can include inappropriate drug selection, lack of preventive therapy, and patient non-adherence, among others. These factors need to be thoroughly understood to effectively address DTPs. Only then can clinical pharmacists, with their pharmacotherapeutic background and skills as well as their regular interactions with prescribers and patients, apply clinical judgment and proceed with confidence to DTPs resolution or prevention.[3] Recognizing the clinical significance of DTPs is also of substantial value, especially for busy practitioners, because it facilitates the hierarchization of DTPs that require immediate attention. Despite that, several DTP classification systems are available in the literature, DTPs are not routinely classified with a severity score in most studies. Two previous studies developed validated tools to rate the severity of such problems, one for drug-related problems (DRPs) among chronic kidney disease patients in community pharmacies[11] and another for DTPs in patients transitioning from hospital to home.[12] These tools, however, may not apply to other research studies due to the limitations of the studied populations. In addition, Dean and Barber designed a validated tool to assess the severity of medication errors for patients who have unknown outcomes using a visual analog scale from 0 to 10.[13] This scale was applied more broadly to assess DTP severity in a previous study.[14] In addition to what has been mentioned, identifying the predictors and drug classes that are well correlated with DTPs is of considerable interest as this aids in placing greater emphasis on preventing the occurrence of those problems repeatedly in hospitalized patients.

Worldwide, several studies have described the role of clinical pharmacists in identifying, resolving, and preventing DTPs and DRPs in different hospital wards, such as the internal medicine ward,[2,15,16] the surgical ward,[4,17–19] and the intensive care unit[20–22] utilizing various classification systems like Hepler-Strand classification, one of the earliest, which categorizes DRPs into eight distinct categories, focusing on the nature of the problem,[23] Pharmaceutical Care Network Europe (PCNE) Classification which provides a more structured and detailed approach by breaking down DRPs into primary domains such as problems, causes, and intervention,[24] Cipolle et al classification which involves four major categories: indication, effectiveness, safety, and compliance, providing a clear framework for identifying and resolving DTPs ensuring optimal therapeutic outcomes,[25] and others.[26] These classifications, while differing in structure and focus, share the common goal of improving patient outcomes through systematic identification and resolution of DRPs and DTPs. However, the Cipolle system for DTP classification provides more comprehensive coverage of drug-related needs. It offers a detailed framework that covers all aspects of the medication use process, including assessment, care planning, and follow-up thus ensuring a holistic approach to pharmaceutical care rather than focusing solely on identifying and categorizing DTPs.

Even though drug classes frequently involved in DTPs were investigated in one study conducted in the surgical ward,[4] a classification system for categorizing the clinical significance of identified DTP was not utilized by prior studies held in the surgery ward. Pertaining to Jordan, a single study evaluated the value of pharmaceutical care services in the identification and reduction of DRPs at a surgery ward.[27] However, to date, no available studies in Jordan to assess the most common factors associated with DTPs incidence in the surgical setting.

The current study aimed at describing DTPs and their severities as evaluated by a clinical pharmacist at a general surgery ward in a large hospital in Jordan, as well as identifying the contributing factors and drug classes associated with such DTPs to assist indecision-making relevant to reducing DTPs in the general surgical ward.

Methods

Trial Design and Setting

The present study is a prospective observational study that was conducted at the general surgical ward of one of the major teaching and referral hospitals in Amman, the central and capital city of Jordan.

Patient Enrollment

Inclusion criteria were patients (1) aged 18 years or older, (2) admitted to the general surgery ward for surgical intervention during the period from September 29th, 2019 to February 6th, 2020, and (3) stayed in the surgical ward for at least 3 days. Exclusion criteria were patients (1) with active malignancy (undergoing active chemotherapy protocol), (2) drug or alcohol abuse, (3) breastfeeding, (4) pregnancy. Patients who were readmitted later than 3 days after hospital discharge were considered new patients.

Ethical Approval

The study protocol was approved by the Institutional Review Board (IRB) of JUH (Ethical Approval Number 80/2019/1943). Written consent was obtained from all the patients who met the study eligibility criteria. Patients' data were kept confidential.

Study Protocol

Data were collected utilizing a form that consists of 3 sections as follows:

- Section 1: Patient's demographics (name, date of birth, gender), administrative information (patient identification number, admission date, consultant name), lifestyle/social history (diet, exercise, smoking status, marital status), and medical information (height, weight, allergies, past medical and surgical history, chief complaint, history of present illness, diagnosis, vital signs, blood glucose readings, laboratory results, and medications including dose, frequency, and route of administration).
- Section 2: This section used Cipolle's Classification for DTPs, which includes 4 drug-related needs (indication, effectiveness, safety, adherence) under which all patient problems involving drug therapy are pooled into 7 extensive categories: unnecessary drug therapy, needs additional therapy, ineffective drug, dosage too low, adverse drug reaction, dosage too high, and nonadherence or noncompliance.[3] Based on this classification system, each DTP category is further sorted according to the most likely cause of the problem. In this study, an eighth category was added to account for DTPs that do not fulfill the above-mentioned categories. This category was designated as unclassified DTPs.
- Section 3: Severity rating system for DTPs in which each DTP is rated on a scale from 0 to 10, where 0 represents an event with no potential effect on the patient and 10 represents an event that would be fatal.[13] According to this scale, a mean score of 0 to 3 indicates the lowest severity (extremely unlikely to result in adverse effects), 4 to 7 indicates moderate severity (likely to result in some adverse effects or affect therapeutic goals), and 7 to 10 indicates the highest severity (likely to result in permanent impairment or death).[14]

All pertinent data were obtained from patients' paper and electronic medical records in the hospital by a 6-year experience PharmD who has board certification in pharmacotherapy. This was followed by a patient or, when necessary, caregiver interview to determine patient eligibility for the study and inquire more about past medical and surgical histories, recent laboratory results, and prior-to-admission medications using the structured data collection form. Data concerning vital signs, laboratory results, medication sheets, and all other diagnostic tests were reviewed, documented, and updated daily by the clinical pharmacist. The clinical pharmacist participated in the surgical ward rounds and assessed the therapeutic regimen of each enrolled patient on a daily basis to identify all DTPs and their severities.

Appropriateness of each medication indication and dosage regimen, potential adverse drug reactions (ADRs), and the presence of drug-drug interactions were evaluated using updated evidence-based guidelines, the drug information handbook *Iexicomp*, and the electronic clinical resource UpToDate (www.uptodate.com). For renal dosage adjustment, appropriate equations were used to estimate patients' exact doses. Specifically, the Cockcroft-Gault equation was used in

patients with stable kidney function,[28] and the Jelliffe and Jelliffe equation was used in patients with unstable serum creatinine.[29] On the other hand, the presence of untreated conditions, actual ADRs, allergic reactions, and inappropriate patient knowledge or adherence to pharmacological or non-pharmacological therapy were identified through patient interviews and clinical judgment.

Sample Size

A convenience sample of 80 patients was selected.

Outcomes Measured

The primary outcomes of the study were to emphasize the role of clinical pharmacists in identifying the frequencies, causes, and severity ratings of DTPs among general surgery patients and to assess the associated factors and drug classes that contribute to the occurrence of DTPs in the surgical setting.

Statistical Analysis

Descriptive statistics were used to summarize the demographics and clinical characteristics of the patients enrolled in the study. Continuous data were reported as mean ± SD, and categorical data were reported as frequency (proportion). Multiple linear regression analysis with forward selection was conducted to investigate possible associations between the number of DTPs identified during hospitalization and the predictor variables. Statistical Package for Social Sciences (SPSS) 24.0[30] was used for all statistical analyses.

Results

During the enrollment period, a total of 80 patients were recruited in this study. All of them were adult patients hospitalized in the general surgery ward for at least 3 days. One patient was readmitted later than 3 days after discharge and thus was considered a new patient.

Baseline Demographics and Clinical Characteristics of the Study Population

The mean age of enrolled patients was 52.35 ± 14.82 years, and 49 (61.25%) of them were males. Thirty-five (43.75%) of the patients were smokers. They had an average of 1.85 ± 1.32 past medical conditions, 0.98 ± 1.23 past surgical conditions, and were taking 3.49 ± 3.09 medications prior to admission. On average, patients were receiving 7.08 ± 3.73 medications during their length of stay in the general surgery ward.

Only 5 (6.25%) of the patients recruited in the study had an allergy to one or more medications (eg, penicillins, cephalosporins, carbapenems, fluoroquinolones, sulfa drugs, or nonsteroidal anti-inflammatory drugs), substances (eg, contrast media), or foods (eg, mustard). In addition, the majority (79 (98.75%)) had stable serum creatinine upon admission and during hospitalization. The mean length of the hospitalization was 6.85 ± 5.67. Patients' demographics and clinical characteristics are outlined in Table 1.

Frequencies, Causes, and Severity Ratings of DTPs

Within the study period, 192DTPs were identified by clinical pharmacists in 87.5% of the total recruited patients. The mean number of DTPs per patient was 2.40 ± 1.83. The most common categories of DTPs were "needs additional therapy" 46 (23.96%), "unnecessary drug therapy" 45 (23.44%), and "dosage too low" 39 (20.31%). Within these

Table 1 Demographics and Clinical Characteristics of Patients (n=80)

Patient Characteristic	Mean ± SD or n (%)
Gender	
Male	49 (61.25%)
Female	31 (38.75%)

(*Continued*)

Table 1 (Continued).

Patient Characteristic	Mean ± SD or n (%)
Age in years	52.35 ± 14.82
Smoking status Non-smoker Current smoker	 45 (56.25%) 35 (43.75%)
Allergy	5 (6.25%)
BMI (kg/m²)	28.46 ± 5.69
CrCl (mL/minute)	91.18 ± 36.60
Past medical conditions	1.85 ± 1.32
Past surgical conditions	0.98 ± 1.23
Prior to admission medications	3.49 ± 3.09
Regular medications*	7.08 ± 3.73
Duration of hospitalization	6.85 ± 5.67

Notes: Percentages are within each patient characteristic. Data represent n (%) for categorical variables and mean ± SD for continuous variables. *Medications that the patients were receiving throughout hospitalization.
Abbreviations: BMI, body mass index; SD, standard deviation.

categories, preventive therapy, no medical indication at this time, and ineffective dose were the most prevalent causes of DTPs, respectively (Table 2). One hundred twenty-seven (66.15%) DTPs were rated as severe according to the utilized severity rating tool of DTPs. The rest of the DTPs were "moderate" in severity, and none was classified as "minor" (Table 3). An example of DTPs is a 40-year-old male patient with a known case of hypertension and peripheral arterial disease who was complaining of pain from his right foot ischemic ulcer and was admitted to the general surgery ward for

Table 2 Drug-Related Needs with Respective DTP Categories and Causes

Drug-Related Need	DTP Category and Associated Causes	n (%)
INDICATION	**1. Unnecessary drug therapy**	**45 (23.44%)**
	Duplicate therapy	5 (2.60%)
	No medical indication at this time	28 (14.58%)
	Nondrug therapy more appropriate	0 (0.0%)
	Addiction/recreational drug use	12 (6.25%)
	Treating avoidable adverse reaction	0 (0.0%)
	2. Needs additional therapy	**46 (23.96%)**
	Preventive therapy	27 (14.06%)
	Untreated condition	12 (6.25%)
	Synergistic therapy	7 (3.65%)
EFFECTIVENESS	**3. Ineffective drug**	**20 (10.42%)**
	More effective drug available	8 (4.17%)
	Condition refractory to drug	0 (0.0%)
	Dosage form inappropriate	0 (0.0%)
	Contraindication present	0 (0.0%)
	Drug not indicated for condition	12 (6.25%)

(*Continued*)

Table 2 (Continued).

Drug-Related Need	DTP Category and Associated Causes	n (%)
	4. Dosage too low	**39 (20.31%)**
	Ineffective dose	26 (13.54%)
	Needs additional monitoring	9 (4.69%)
	Frequency inappropriate	1 (0.52%)
	Incorrect administration	0 (0.0%)
	Drug interaction	2 (1.04%)
	Incorrect storage	0 (0.0%)
	Duration inappropriate	1 (0.52%)
SAFETY	**5. Adverse drug reaction**	**10 (5.21%)**
	Undesirable effect	2 (1.04%)
	Unsafe drug for the patient	4 (2.08%)
	Drug interaction	2 (1.04%)
	Incorrect administration	2 (1.04%)
	Allergic reaction	0 (0.0%)
	Dosage increase/decrease too fast	0 (0.0%)
	6. Dosage too high	**5 (2.60%)**
	Dose too high	3 (1.56%)
	Needs additional monitoring	2 (1.04%)
	Frequency too short	0 (%)
	Duration too long	0 (0.0%)
	Drug interaction	0 (0.0%)
ADHERENCE	**7. Non adherence or noncompliance**	**21 (10.94%)**
	Does not understand instructions	13 (6.77%)
	Cannot afford drug product	0 (0.0%)
	Patient prefers not to take	6 (3.13%)
	Patient forgets to take	2 (1.04%)
	Drug product not available	0 (0.0%)
	Cannot swallow/administer drug	0 (0.0%)
	8. Unclassified	**6 (3.13%)**
	The patient is not instructed about his pharmacological therapy	4 (2.08%)
	Wrong medication order	2 (1.04%)
TOTAL		**192 (100%)**

Notes: Percentages of DTPs categories are within the total number of drug therapy problems (192 DTPs), while percentages of DTPs causes are within each DTP category.
Abbreviation: DTP, Drug Therapy Problem.

above-knee amputation. The patient was maintained on pentoxifylline post-operation. This DTP was classified as unnecessary drug therapy (No medical indication at this time) and rated as moderate.

Correlation Between the Independent Variables and the Number of DTPs Identified at Baseline

Multiple linear regression analysis revealed that patients' length of hospital stay and number of current medications had a statistically significant effect on the number of DTPs identified during hospitalization (Table 4).

Endocrine & metabolic drugs 51 (26.56%) and cardiovascular drugs 36 (18.75%) were the most frequent classes of drugs contributing to DTPs among all patients (Figure 1, Table 5). Within the most prevalent drug classes related to DTPs, insulin 30 (15.63%), proton pump inhibitors (PPI) 25 (13.02%), and low-dose aspirin 23 (11.98%) were the distinct drugs/drug subclasses across all patients (Table 5). Drugs in Table 5 have been organized into classes based on

Table 3 Severity Rating for DTPs

Type of TRP	Clinical Significance n (%)		
	Major	**Moderate**	**Minor**
1. Unnecessary drug therapy	25 (55.56%)	20 (44.44%)	0 (0.0%)
2. Needs additional therapy	32 (69.57%)	14 (30.43%)	0 (0.0%)
3. Ineffective drug	8 (40%)	12 (60%)	0 (0.0%)
4. Dosage too low	26 (66.67%)	13 (33.33%)	0 (0.0%)
5. Adverse drug reaction	6 (60%)	4 (40%)	0 (0.0%)
6. Dosage too high	5 (100%)	0 (0.0%)	0 (0.0%)
7. Non adherence or non compliance	21 (100%)	0 (0.0%)	0 (0.0%)
8. Unclassified	4 (66.67%)	2 (33.33%)	1 (0.0%)
Total DTPs	127 (66.15%)	65 (33.85%)	0 (0.0%)

Note: Data represent frequency (proportion) within each category of DTPs.
Abbreviation: DTP, Drug Therapy Problem.

Table 4 Regression Analysis Summary for the Number of DTPs Identified at Baseline

Independent Variables	β	*P* value
Age	0.17	0.16
Gender	−0.04	0.70
BMI (kg/m²)	−0.04	0.70
Smoking status	0.06	0.54
CrCl (mL/minute)	0.10	0.40
Past medical conditions	0.06	0.66
Past surgical conditions	0.02	0.85
Prior to admission medications	−0.22	0.18
Current medications*	0.14	**0.007**
Type of surgery	−0.05	0.67
Length of hospital stay	0.09	**0.006**
Number of readmissions within 30 days of hospital discharge	0.05	0.62

Notes: β represents e standardized regression coefficient. The fit of the regression model: R^2 = 0.20, P<0.001.

their therapeutic use in the hospital where the study was conducted. For instance, magnesium sulfate is included under cardiovascular drugs due to its use in treating certain cardiovascular conditions in this particular clinical setting, although it is recognized that it may have applications in other therapeutic areas.

Discussion

In this study, one hundred ninety-two DTPs were identified by the clinical pharmacist. The primary categories of DTPs were "needs additional therapy", "unnecessary drug therapy", and "dosage too low". This is consistent with the results of a cross-sectional study aimed at describing DRPs at a surgical intensive care unit in the United States of America, where

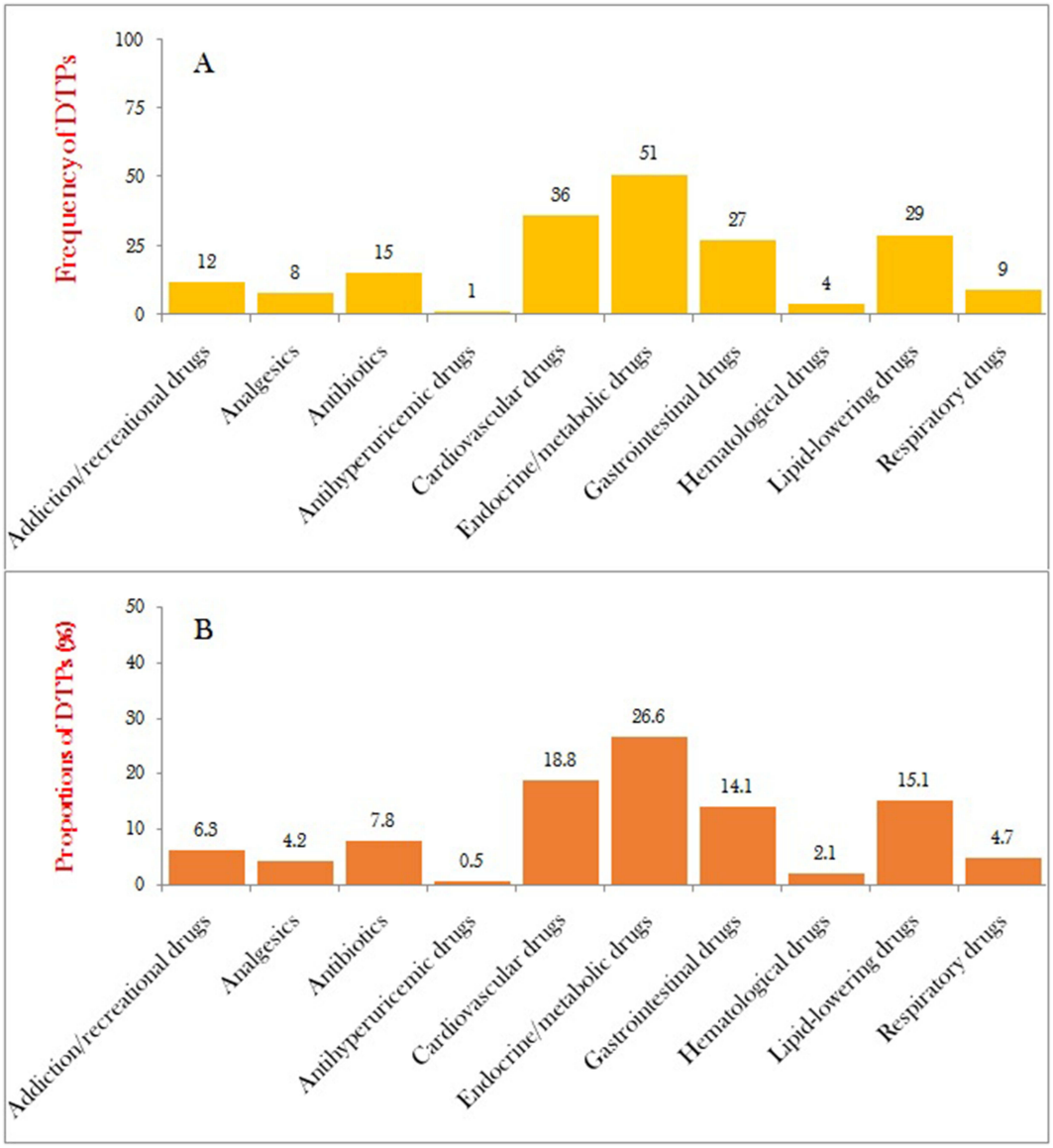

Figure 1 (**A**) Frequencies of DTPs associated with each drug class (within the total 192 DTPs); (**B**) Proportions of DTPs (%) associated with each drug class (proportions are).

"unnecessary drug therapy" was the most commonly reported DRP.[18] Another recently published study that assessed DTPs at a surgical ward in Ethiopia reported that "Dose too low" was the most common type of DTPs across the study population.[4] "Needs additional therapy" was among the DRPs/DTPs that were detected in these two studies as well.

The most common clinical significance category was "major". This is in line with the result of a study conducted at an internal medicine ward in Italy.[16] However, comparing this finding with other research findings in the surgical ward was not possible because no study in the literature has measured the severity of DTPs in a general surgery ward.

Because many DTPs are preventable, risk factors for their occurrence are worth critical attention. The frequency of DTPs in the present study was a function of patients' length of hospital stay and the number of medications that they were maintained on during hospitalization. This matches the results of previous studies in the area[4,31] and stresses the importance of the presence of a drug expert responsible for medication optimization in the surgical ward.

Patients in the surgical ward are usually maintained on various drug classes for different medical conditions, which necessitates rational drug use to achieve better clinical outcomes. Several drug classes have been known to be associated with an increased incidence of medication errors in different hospital wards. In the current study, endocrine & metabolic

Table 5 Frequency of DTPs Within Each Drug Class

Drug Class With Specific Drugs Or Drug Subclasses	DTPs
Addiction/recreational drugs	**12 (6.25%)**
Tobacco	12 (6.25%)
Analgesics	**8 (4.17%)**
Gabapentin	6 (3.13%)
Paracetamol	2 (1.04%)
Antibiotics	**15 (7.81%)**
Carbapenem	5 (2.60%)
Cephalosporin	2 (1.04%)
Fluoroquinolone	1 (0.52%)
Linezolid	1 (0.52%)
Metronidazole	1 (0.52%)
Penicillin	2 (1.04%)
Vancomycin	3 (1.56%)
Antihyperuricemic drugs	**1 (0.52%)**
Allopurinol	1 (0.52%)
Cardiovascular drugs	**36 (18.75%)**
ACE inhibitor	1 (0.52%)
Alpha-1 blocker	1 (0.52%)
ARB	1 (0.52%)
Aspirin	23 (11.98%)
β-blocker	2 (1.04%)
Clopidogrel	1 (0.52%)
Digoxin	1 (0.52%)
Enoxaparin	2 (1.04%)
Isosorbide dinitrate	2 (1.04%)
Magnesium sulfate	1 (0.52%)
Trimetazidine	1 (0.52%)
Endocrine and metabolic drugs	**51 (26.56%)**
Bisphosphonate	1 (0.52%)
Calcium carbonate	4 (2.08%)
Insulin	30 (15.63%)
Levothyroxine	4 (2.08%)
Metformin	10 (5.21%)
Sulfonylurea	1 (0.52%)
Systemic corticosteroid	1 (0.52%)
Gastrointestinal drugs	**27 (14.06%)**
H2RA	1 (0.52%)
Osmotic laxative	1 (0.52%)
Proton pump inhibitor	25 (13.02%)
Hematological drugs	**4 (2.08%)**
Ferrous gluconate	4 (2.08%)
Lipid-lowering drugs	**29 (15.10%)**
Fenofibrate	1 (0.52%)
HMG CoA reductase inhibitor	28 (14.58%)

(*Continued*)

Table 5 (Continued).

Drug Class With Specific Drugs Or Drug Subclasses	DTPs
Respiratory drugs	**9 (4.69%)**
Anticholinergic/ β2 agonist	4 (2.08%)
β2 agonist	1 (0.52%)
Inhaled corticosteroid	4 (2.08%)
TOTAL	**192 (100%)**

Notes: Data represent frequency (proportion) (bolded) of DTPs within the total 192 DTPs. Drugs are organized into classes based on their therapeutic use in the hospital where the study was conducted.
Abbreviations: ACE, angiotensin-converting enzyme; ARB, angiotensin II receptor blocker; DTP, Drug Therapy Problem; G, Gastrointestinal; HMG CoA, 3-Hydroxy-3-methylglutaryl-coenzyme; H2RA, Histamine-2 receptor antagonist; PPI, proton pump inhibitor.

and cardiovascular drugs accounted for the highest proportion of drug classes implicated in DTPs in the general surgery ward. This result is, in part, similar to the findings of other studies that were conducted in medical wards and reported that endocrine,[32] vitamins, electrolytes, minerals,[7,32,33] and cardiovascular drugs[7,32] were among the drug classes commonly involved in medication errors in hospitalized patients. The sole study that examined drugs typically contributed to DTPs in a surgical ward concluded that antimicrobial (73.8%), hematologic (8.2%), and cardiovascular (6.0%) drugs were the most common.[4]

In the present study, insulin, low-dose aspirin, and proton pump inhibitors (PPI) were the most prevalent drugs/drug subclasses accounted for DTPs. It is worth mentioning that it is a common practice at the hospital where the study was held to maintain hospitalized patients on gastroprotective drugs, specifically PPI, without certain indication. Several studies surrounding this practice took place in Jordan.[34,35] While specific deprescribing protocols for PPIs have not been systematically implemented across all hospitals in Jordan, awareness of the need for such protocols is growing to reduce unnecessary PPI use and emphasize the importance of reevaluating the indications for continued use.

The impact of clinical pharmacists in the surgery ward was emphasized by several research studies on different outcomes. Most of these studies concluded that clinical pharmacists have a positive impact in the surgery ward.[17–19,31,36–40] The current study spots light on the imperative roles that clinical pharmacists can assume in the general surgery ward. According to the results of this study, the addition of clinical pharmacy services to the multidisciplinary healthcare team can result in improved patient care because once a DTP is identified and clearly categorized based on its cause and severity, the clinical pharmacist can instantly intervene or communicate with the responsible surgeons or relevant patient to design a rationale care plan that ensures optimal medication prescribing and dosing and/or to provide patient counseling. Moreover, the identification and categorization of DTPs and their risk factors not only facilitates their resolution but also enables the decision-makers to target preventative measures that preclude the subsequent occurrence of similar DTPs in the surgical ward.

Limitations

The authors do acknowledge that this study has some limitations. First, this is a single-center study; accordingly, the findings may not be extrapolated to other settings. Second, the small sample size of the study may also decrease the generalizability of the results. Third, a single clinical pharmacist scored the severity of each DTP.

Despite these limitations, it should be noted that the study took place in a large referral hospital in the capital city of Amman. This hospital takes on board patients from all 12 governorates of Jordan. Thus, the outcomes do have - generalisability in terms of transferability, universality, validity, as well as general applicability.

Besides, the small sample size in the study was a result of the study's focus on a specific timeframe, which was chosen to allow sufficient data collection while ensuring the feasibility of continuous clinical pharmacist involvement. Initially, the study was intended to extend beyond February, but the onset of the COVID-19 pandemic in 2020 necessitated an earlier conclusion to ensure the safety and focus of healthcare resources. Future research could indeed

benefit from comparing the pre-pandemic period, as described in this study, to post-pandemic data to evaluate any changes in DTPs.

To the best of the authors' knowledge, this is the first study that took place at a general surgery ward in Jordan to describe the frequencies, causes, and clinical significance of DTPs and to investigate the associated factors and most common drug classes closely linked to these DTPs. It reveals a patient population that deserves further research. Future large-scale and multicenter studies are necessary to assess the clinical, humanistic, and economic outcomes of clinical pharmacy services in surgical patients within the Jordanian healthcare system. Furthermore, it is recommended that a clinical significance assessment tool specifically designed for rating the severity of DTPs is validated in future research studies.

Conclusion and Future Directives

To seek preventive measures in medication-related issues in the general population, this comprehensive work underscores the very need to readdress constantly this issue mostly via the recruitments of the clinical pharmacists' roles and interventions. Also given that DTPs are common in the general surgery wards, clinical pharmacists can provide medication reviews for surgical patients to identify DTPs and rate their severities. Henceforth, clinical pharmacists should be initiators of interdisciplinary collaborative dialogue to detect risk factors for DTPs and their most common drug classes. This can serve as the basis for a screening tool that identifies patients at risk for DTPs. In effect facilitating the hierarchizations of DTPs can require immediate attention and enabling of clinical pharmacists and decision-makers to target preventive strategies in limiting the DTPs incidence in the general surgery ward.

Data Sharing Statement

Materials supporting the findings are available from the corresponding author on reasonable request.

Ethical Approval and Consent to Participate

It was granted by the JUH-IRB committee – as it complies fully with the Declaration of Helsinki- along with consent forms signed by study participants.

Ethical Approval Number

80/2019/1943.

Consent for Publication

Consent for publication was granted by all authors and study participants.

Acknowledgments

The authors would like to extend sincere gratitude and appreciation to all the surgical doctors practicing at the general surgery ward and the SICU of Jordan University Hospital for their cooperation throughout the study period.

In loving memoriam of our lately deceased Professor Mohammad Saleh (15 August 2024). Your loss is immeasurable but so are your highly invaluable contributions to pharmacy sciences, you are greatly missed. We dedicate this publication to your name.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Disclosure

The authors declare that there are no conflicts of interest in this work.

References

1. Olsson IN, Runnamo R, Engfeldt PJH, Tham K. Medication quality and quality of life in the elderly, a cohort study. *Health Qual Life Outcomes*. 2011;9(1):1–9. doi:10.1186/1477-7525-9-1
2. Abunahlah N, Elawaisi A, Velibeyoglu FM, Sancar M. Drug related problems identified by clinical pharmacist at the Internal Medicine Ward in Turkey. *Int J Clin Pharm*. 2018;40(2):360–367. doi:10.1007/s11096-017-0585-5
3. Cipolle RJ, Strand L, Morley P. *Pharmaceutical Care Practice: The Patient-Centered Approach to Medication Management*. 3rd ed. Mcgraw-hill; 2012.
4. Tefera GM, Zeleke AZ, Jima YM, Kebede TM. Drug therapy problems and the role of clinical pharmacist in surgery ward: prospective observational and interventional study. *Drug Healthc Patient Saf*. 2020;12:71. doi:10.2147/DHPS.S251200
5. Hepler CD, Strand LM. Opportunities and responsibilities in pharmaceutical care. *A. J Hosp Pharm*. 1990;47(3):533–543.
6. Hepler CD. Clinical pharmacy, pharmaceutical care, and the quality of drug therapy. *Pharmacother J Human Pharmacol Drug Ther*. 2004;24 (11):1491–1498. doi:10.1592/phco.24.16.1491.50950
7. Reddy KS. A study on role of clinical pharmacist in identification and prevention of medication errors at a Tertiary Care Hospital. *Indian J Pharm Pract*. 2018;11(4):199.
8. Francis J, Abraham S. Clinical pharmacists: bridging the gap between patients and physicians. *Saudi Pharm J*. 2014;22(6):600–602. doi:10.1016/j.jsps.2014.02.011
9. Adusumilli P, R A. Drug related problems: an over view of various classification systems. *Asian J Pharm Clin Res*. 2014;7(4):7–10.
10. Basger BJ, Moles RJ, Chen TFJAo P. Development of an aggregated system for classifying causes of drug-related problems. *Ann Pharmacother*. 2015;49(4):405–418. doi:10.1177/1060028014568008
11. P Q-B. A new tool for evaluating the severity of drug-related problems. *Can Pharm J*. 2012;145(4):S37.
12. Westberg SM, Derr SK, Weinhandl ED, et al. Drug therapy problems identified by pharmacists through comprehensive medication management following hospital discharge. *J Pharm Technol*. 2017;33(3):96–107. doi:10.1177/8755122517698975
13. Dean BS, Barber ND. A validated, reliable method of scoring the severity of medication errors. *Am J Health Syst Pharm*. 1999;56(1):57–62. doi:10.1093/ajhp/56.1.57
14. Wong ICK. Improving medication safety and diabetes management in Hong Kong–a multi-disciplinary approach. *Hong Kong Medl J*. 2017;23 (2):158–167. doi:10.12809/hkmj165014
15. Guignard B, Bonnabry P, Perrier A, Dayer P, Desmeules J, CFJEjoim S. Drug-related problems identification in general internal medicine: the impact and role of the clinical pharmacist and pharmacologist. *Eur J Internal Med*. 2015;26(6):399–406. doi:10.1016/j.ejim.2015.05.012
16. Lombardi N, Wei L, Ghaleb M, et al. Evaluation of the implementation of a clinical pharmacy service on an acute internal medicine ward in Italy. *BMC Health Serv Res*. 2018;18(1):1–9. doi:10.1186/s12913-018-2988-y
17. Schneider R, Ranft D, Heinitz K, et al. Pharmaceutical care in a visceral surgical ward. *Zentralblatt fur Chirurgie*. 2012;137(2):173–179. doi:10.1055/s-0031-1271426
18. Alves GMR, Varallo FR, Lucchetta RC, Mastroianni Pd C. Role of the clinical pharmacist in detection of drug therapy problemas in critically impatients: experience report. *J Phamacovigil*. 2014;2(4):1–6.
19. Ngige G, Carton E, Zaborowski A, Brown A, Conyard E, Gaskin J. 4CPS-239 Evaluation of clinical pharmacist interventions in surgical patients. *BMJ*. 2018. doi:10.1136/ejhpharm-2018-eahpconf.329
20. Li X-X, Zheng S-Q, Gu J-H, et al. Drug-related problems identified during pharmacy intervention and consultation. *Impl Intensive Care Unit Pharm Care Model*. 2020;11:1417.
21. Toukhy A, Fayed S, Sabry N, Shawki MJTAJot MS. The impact of an established pharmaceutical care pathway on drug related problems in an Intensive Care Unit. *Am J Med Sci*. 2021;362(2):143–153. doi:10.1016/j.amjms.2021.03.007
22. Anjalimol P, Thampi A, Suresh A, et al. A study to evaluate the impact of clinical pharmacist on patient care by drug therapy assessment in Intensive Care Units. *Neurology*. 2019;31:17–22.
23. Hepler CD, Strand LM. Oportunidades y responsabilidades en la Atención Farmacéutica. *Pharm Care Esp*. 1999;1(1):35–47.
24. Europe PCN. The PCNE classification V8.02; 2018.
25. Cipolle R, Strand L, Morley P, Kellenberger T, Frakes M. Pharmaceutical care of patients and documentation system therefor. Google Patents; 2006.
26. van Mil JF, Westerlund LT, Hersberger KE, Schaefer MA. Drug-related problem classification systems. *Ann Pharmacother*. 2004;38(5):859–867. doi:10.1345/aph.1D182
27. AbuRuz S, Jaber D, Basheti I, et al. Impact of pharmacist interventions on drug-related problems in general surgery patients: a randomised controlled trial. *Eur J Hosp Pharm*. 2020;28(Suppl 2):e72–e78. doi:10.1136/ejhpharm-2020-002206
28. Cockcroft DW, Gault H. Prediction of creatinine clearance from serum creatinine. *Nephron*. 1976;16(1):31–41. doi:10.1159/000180580
29. Jelliffe RW, Jelliffe SM. A computer program for estimation of creatinine clearance from unstable serum creatinine levels, age, sex, and weight. *Math Biosci*. 1972;14(1–2):17–24. doi:10.1016/0025-5564(72)90003-X
30. Spss I. Statistics for Windows, Version 24. 0 [Computer Software]. Armonk, NY: IBM Corp; 2016.
31. Hale A, Coombes I, Stokes J, et al. Perioperative medication management: expanding the role of the preadmission clinic pharmacist in a single centre, randomised controlled trial of collaborative prescribing. *BMJ Open*. 2013;3(7):e003027. doi:10.1136/bmjopen-2013-003027
32. Muroi M, Shen JJ, Angosta A. Association of medication errors with drug classifications, clinical units, and consequence of errors: are they related? *Appl Nurs Res*. 2017;33:180–185. doi:10.1016/j.apnr.2016.12.002
33. Boostani K, Noshad H, Farnood F, et al. Detection and management of common medication errors in internal medicine wards: impact on medication costs and patient care. *Adv Pharm Bull*. 2019;9(1):174. doi:10.15171/apb.2019.020
34. Alqudah M, Al-Azzam S, Alzoubi K, Alkhatatbeh M, Rawashdeh N. Overuse of proton pump inhibitors for stress ulcer prophylaxis in Jordan. *Sepsis*. 2016;4:2.
35. Abukhalil AD, Ali O, Saad A, et al. Evaluation of proton pump inhibitors prescribing among hospitalized patients: a cross-sectional study. *Int J Gen Med*. 2023;16(16):141–150. doi:10.2147/IJGM.S396202
36. Gemensky J. The pharmacist's role in surgery the indispensable asset. *US Pharmacist*. 2015;40(3):HS8–HS12.

37. Neville HL, Chevalier B, Daley C, et al. Clinical benefits and economic impact of post-surgical care provided by pharmacists in a Canadian hospital. *Int J Pharm Pract*. 2014;22(3):216–222. doi:10.1111/ijpp.12058
38. Axelsen TB, Nielsen KT, Jepsen H, Sørensen CA, Brejnholt AK. Prescription and administration of medicine in a surgical department. Clinical pharmacists increase the safety of medical treatment of surgical patients. *Eur J Hosp Pharm Sci Pract*. 2012;19(2):231–232. doi:10.1136/ejhpharm-2012-000074.383
39. Kessemeier N, Meyn D, Hoeckel M, Reitze J, Culmsee C, Tryba M. A new approach on assessing clinical pharmacists' impact on prescribing errors in a surgical intensive care unit. *Int J Clin Pharm*. 2019;41(5):1184–1192. doi:10.1007/s11096-019-00874-8
40. de Boer M, Ramrattan MA, Kiewiet JJ, et al. Cost-effectiveness of ward-based pharmacy care in surgical patients: protocol of the SUREPILL (Surgery & Pharmacy In Liaison) study. *BMC Health Serv Res*. 2011;11(1):55. doi:10.1186/1472-6963-11-55