Analysis of Pharmacist Interventions in Adult COVID-19 Patients Admitted to a Tertiary Care Hospital

Osama Al-Quteimat, MSc, BCOP[1] [iD]**, Mohammad Siddiqui, PharmD, MBA, CPHIMS[1], Lana Hussein, RPh, MBA[1], Haytham Al Emleh, PharmD[1], and Imad EL Dine Shamieh, BCPS[1]**

Abstract

Background: Pharmacists are integral members of the multidisciplinary healthcare team who, with their skills, knowledge, and training, are well positioned to prevent, identify, and manage medication-related issues. Many published articles related to COVID-19 management have highlighted the important role of the pharmacists in assuring the safe, effective, and cost-effective use of medications. During such challenging times of COVID-19 pandemic that resulted in a high demand on medical resources and healthcare providers, pharmacists are well positioned to contribute and add more efforts to the healthcare system to achieve best use of the available resources including medications and providing high quality pharmaceutical care to help the patients and support the healthcare providers. **Methods:** This is a retrospective chart review included all admitted adult patients with confirmed COVID-19 diagnosis from 1 March 2020 till 30 June 2020. The documented clinical pharmacist interventions were extracted from the EMR and reviewed by multiple clinical pharmacists to identify type, number, frequency, outcome, and physician's acceptance rate of documented interventions. **Results**: A total of 484 pharmacist interventions included in the final analysis. Antimicrobial stewardship interventions were the most reported (149, 30.8%) and antibiotics were the most reported class of medication, constituting 31.1% of the total interventions. "Optimized therapy" was the most commonly reported outcome (58.8%). Overall, 50.8% (246) of the interventions were rated as having "moderate" clinical significance using the clinical significance scoring tool. The physicians' acceptance rate was 94.7%.
Conclusion: Pharmacist interventions are associated with improved communication and medication use in admitted adult patients with COVID-19. Clinical pharmacists can play a crucial role in optimizing medication use in patients with COVID-19 through prevention, identification, and resolving existing or potential drug-related problems.

Keywords

COVID-19, pharmacist, inpatient, clinical pharmacy, hospital pharmacy, pharmacist interventions

Introduction

Since December 2019, the Coronavirus disease (COVID-19) pandemic has become a major global healthcare issue burdening numerous countries. Many trials have evaluated investigational drugs for the treatment of COVID-19. Such drugs include medications with antiviral activity, such as lopinavir/ritonavir, umifenovir, chloroquine, and hydroxychloroquine.[1] On October 22, 2020, remdesivir received FDA approval for the treatment of COVID-19 in adults and pediatric patients ≥12 years of age weighing at least 40 kg who are hospitalized or in a healthcare setting capable of providing acute care comparable to inpatient hospital care.[1]

The American College of Clinical Pharmacy (ACCP) has described important tasks of clinical pharmacists in the United States, including the provision of patient care that ensures the appropriateness, effectiveness, and safety of the patient's medication use, supporting other healthcare providers to develop and implement a medication plan to achieve desired clinical outcomes, and promoting rational use of medications.[2] Moreover, the American Society of Health-System Pharmacists (ASHP) has developed a comprehensive guide for pharmacists, including best practices, latest medications updates, evidence-based recommendations, and many clinical pharmacy resources in addition to pharmacy frontline stories

[1]Pharmacy Department, Cleveland Clinic Abu Dhabi, Abu Dhabi, United Arab Emirates

Corresponding Author:
Osama Al-Quteimat, MSc, BCOP, Pharmacy Department, Cleveland Clinic Abu Dhabi, Abu Dhabi, United Arab Emirates.
Email: Alquteo@clevelandclinicabudhabi.ae

showcasing the importance of the pharmacist's contribution to COVID-19 patient care.[1]

Gross and MacDougall have described some of the essential roles of clinical pharmacists during the COVID-19 pandemic. As medication experts, pharmacists can review and interpret published literature related to medication use in COVID-19 and provide updated and evidence-based data to the physicians and other healthcare team members.[3] Such information includes medication dosing and administration, adverse drug reactions, and drug–drug interactions. The pharmacist can improve compliance with infection prevention measures by providing appropriate patient counseling and education. Improving personal protective equipment (PPE) usage and minimizing healthcare exposure (by adjusting medication time and frequency), medication inventory, and shortage management are among the major roles of pharmacists in this pandemic.[3]

In March 2020, the International Pharmaceutical Federation (FIP) published guidelines highlighting the potential roles of pharmacists in the COVID-19 pandemic. This guideline lists and defines many important roles for the pharmacist in exposure prevention, optimizing medication supply, promoting proper use of PPE and supplies, and ensuring safe and effective medication use.[4]

Moreover, clinical pharmacists involved in antimicrobial stewardship programs are well positioned to actively engage in planning and responding to such pandemics by applying their skills and expertise in developing local treatment protocols based on evidence-based recommendations regarding the use and monitoring of antimicrobial agents, including antibiotics and antivirals in COVID-19 patients.[5]

Despite these well-known essential tasks of clinical pharmacists in optimizing medication use and improving clinical outcomes, in many hospitals, clinical pharmacists assigned to patient care floors have been considered "non-essential" healthcare providers. Consequently, many have been instructed to focus on pharmacy operational tasks related to medication supply and dispensing rather than performing their routine clinical tasks.[6]

According to a recently published report addressing pharmacy leadership preparedness during emergency in the Middle East and South Africa, many clinical activities of pharmacists have continued and been performed through virtual tools and phone calls to maintain physical distancing, including medication reconciliation, bed-side discharge counseling, clinical rounds, anticoagulation, and heart failure clinics.[7]

In Cleveland Clinic Abu Dhabi, the clinical pharmacists have continued to perform clinical roles in all hospital medical wards and the emergency department and have even expanded clinical services to cover the newly opened COVID-19 patient care floors by offering high quality pharmaceutical care (eg, counseling and admission medication reconciliation) to COVID-19 patients while implementing precautionary measures and using telehealth technologies whenever possible, especially during the transition of care process.

To the best of our knowledge, this is the first study to assess the importance of the pharmacist interventions in admitted adult patients diagnosed with COVID-19 by reporting the classification, frequency, outcomes, and physicians' acceptance rate.

The aim of this retrospective review is to study the potential role of the hospital pharmacists in the management of admitted patients with COVID-19 by analyzing the documented pharmacists' clinical interventions and assess their type, rate, acceptance by physicians, clinical significance, and impact on overall patient care processes.

Methods

Study Design and Setting

This is a retrospective chart review study conducted at Cleveland Clinic Abu Dhabi, a 360-bed tertiary care hospital in the United Arab Emirates, Abu Dhabi. The clinical pharmacy services operate 7/24 and provide a wide range of pharmacy clinical services including anticoagulation, vancomycin and aminoglycosides dosing, therapeutic drug monitoring, patient counseling, and medication reconciliation.

Study Period

The chart review covered a 4-month period from March 1, 2020 until June 30, 2020.

Inclusion and Exclusion Criteria

The study population included all admitted adult patients (age ≥ age 18) with confirmed COVID-19 diagnosis. Pediatric patients (<age 18 years), COVID-19 patients treated in outpatient settings (not admitted or discharged from the emergency department), and suspected but unconfirmed COVID-19 cases were excluded from the study.

Study Outcomes

The primary study outcomes are type, number, and frequency of documented interventions, intervention outcomes, and the physician acceptance rate. Secondary outcomes include clinical significance of interventions (minor, moderate, or major) and the commonly involved medications and their classes.

Data Collection

The data collection process was performed by reviewing patients' charts to identify patient database information and extract the documented pharmacists' interventions report from the electronic medical record (EMR).

Intervention Documentation

The reported pharmacist interventions are documented either during order verification, clinical rounds, discharge counseling, or medication reconciliation by qualified, trained and board-certified clinical pharmacists using a specific electronic functionality (I-Vent) built in the electronic hospital health information system; Epic® in which the clinical pharmacist needs to enter the type, outcome, response and the associated medication to the intervention. Time spent, clinical significance, and other details of the clinical intervention are also included in the I-Vent.

The pharmacist has to choose the related type of the intervention from the system list that includes 23 types of intervention (Table 2 in the Supplementary material). The intervention outcome was determined by the clinical pharmacist who documented the intervention based on the expected impact of the pharmacist contribution. The interventions' outcomes were categorized into optimized therapy, avoided adverse drug event, improved communication, and cost saving.

Additionally, the pharmacist has the option to enter a free text documentation if needed to clarify and add more details about the intervention.

Data Analysis

All interventions documented by the clinical pharmacists for the included patients were analyzed to report the required outcomes of the study. The documented interventions were split amongst several clinical pharmacists and reviewed by the study team to ensure agreement on classification and clinical significance of the interventions. Interventions with incomplete or duplicate information were excluded from the analysis. The physicians' acceptance rate was calculated by dividing the number of accepted interventions over the total number of interventions (excluding the interventions with no decision or those used for documentation/communication purposes), then multiplying by 100.

Clinical Significance

The clinical significance of the pharmacist interventions was determined using a modified classification (Insignificant, Minor, Moderate, or Major) derived from the potential clinical impact tool used by Dodds[8] in addition to the professional clinical judgment of the clinical pharmacists who reviewed the documented interventions. The clinical significance assessment considered the impact of the recommendation or therapy change initiated by the pharmacist on patient care, cost saving, communication, and medication safety. The level of clinical significance of each intervention was reviewed independently by different clinical pharmacists to assure agreement and accuracy of the clinical significance classification.

(Table 1 in the Supplementary material lists the definitions of each category of the implemented clinical significance tool with respective examples for each category).

IRB Approval

This study was approved by the hospital institution review board and research ethics committee (REC) and conducted in compliance with the protocol and the applicable regulatory requirements (REC Number: A-2020-072).

Results

Demographic Characteristics of Participants

A total of 202 patient charts were included with 586 documented pharmacist interventions. Table 1 lists the database characteristics of the patients.

Types and Frequency of Interventions

The total number of pharmacist interventions included in the analysis after removing duplicated or incomplete interventions is 484. The type and frequency of the documented interventions are summarized in Table 2.

Antimicrobial stewardship interventions were the most reported (149, 30.8%). Antibiotics were the most reported class of medication, constituting 31.1% of the total interventions. Table 3 summarizes the commonly involved classes of medications.

Interventions Clinical Significance and Outcomes

Overall, 50.8% (246) of the interventions were rated as having "moderate" clinical significance using the clinical significance scoring tool. Figure 1 summarizes the numbers of interventions based on their clinical significance.

In terms of the reported outcome of the intervention, "optimized therapy" was the most commonly reported outcome (58.8%) followed by "avoided adverse drug event" (18%), "improved communication" (13%), and last "cost savings" (9%)(Figure 2).

Table 1. Patient Database Characteristics.

Number of Patients	202 Patients	
Gender		
Male	153(75.7%)	
Female	49(24.2%)	
Average age	46.3 Years	
Comorbidities[a]		Interventions
Yes	111 (55%)	306 (63%)
No	91 (45%)	178 (37%)
Average length of stay	13 Days	
Number of interventions	484	

[a]Comorbidities was defined as having any chronic disease treated with medications including diabetes, hypertension, heart failure, coronary heart disease, renal failure …etc.

Table 2. Type and Frequency of the Documented Interventions.

Intervention type	Count	Percentage, %
Antimicrobial stewardship interventions	149	**30.8**
Profile review	76	**15.7**
Pharmacist communication	32	**6.6**
Admission medication reconciliation	26	**5.4**
Dose change	26	**5.4**
Discharge medication reconciliation	25	**5.2**
Resolving duplicate therapy	22	**4.5**
IV to PO conversion	19	**3.9**
Drug discontinuation	19	**3.9**
Drug therapy recommendations	14	**2.9**
Order clarified	13	2.7
Lab request	13	**2.7**
Therapeutic interchange	12	**2.5**
Others[a]	38	7.9

Abbreviations: IV, intravenous; PO, oral.
[a]Others include initiate therapy, dosage form change, patient experience optimization, drug information, core measure, non-formulary/restricted drug, patient care rounds, anticoagulation dosing, and drug interaction.

Table 3. Common Classes of Involved Medications.

Medication class	Number	Percentage, %
Antibiotics	124	31.10
Other anti-infectives/miscellaneous	65	16.30
Anticoagulants	43	10.80
Antivirals	22	5.50
Gastrointestinal	21	5.30
Antihyperglycemics	20	5.00
Cardiac drugs	19	4.80
CNS drugs	18	4.50

Abbreviation: CNS, Central Nervous System. Piperacillin–tazobactam was associated with the highest number of interventions (54, 13.5%) followed by hydroxychloroquine (50), enoxaparin (27), lopinavir–ritonavir (17), and others.

Acceptance Rate

A total of 377 out of 484 interventions were included in the acceptance rate calculation after excluding the interventions that do not require a decision or those with incomplete documentation. The physicians' acceptance rate of the documented interventions was 94.7% (357 accepted out of 377 interventions included). The reported average time spent on interventions documentation was 10.7 minutes per intervention.

Discussion

In the literature, pharmacist interventions have been evaluated in different settings with documented improvement in outcomes related to patient care.[8,9] In this study, pharmacist interventions may also have a positive outcome on the care for patients with COVID-19 through providing proper medication use to assure safe and effective drug therapy along with improved resources management.

Antimicrobial Stewardship Interventions

We found that antimicrobial stewardship interventions were the most frequently documented interventions, comprising about one-third of the total interventions and indicating the important role of the clinical pharmacist in optimizing and controlling the use of antimicrobial medications which can potentially reduce unnecessary use of broad-spectrum agents, save resources, and limit microbial resistance. Under the antimicrobial stewardship category, many interventions were subclassified into dose optimization, de-escalation, duration of therapy, discontinuation, and others. Dose optimizations were reported as the most frequently documented subtype of this category.
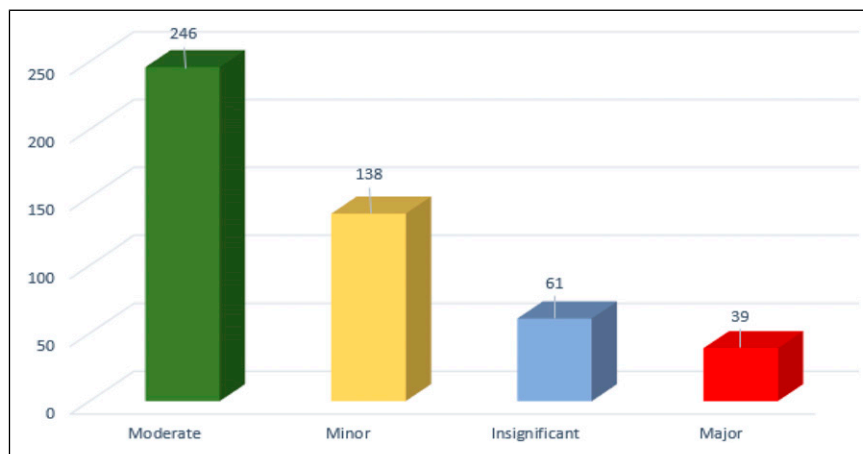
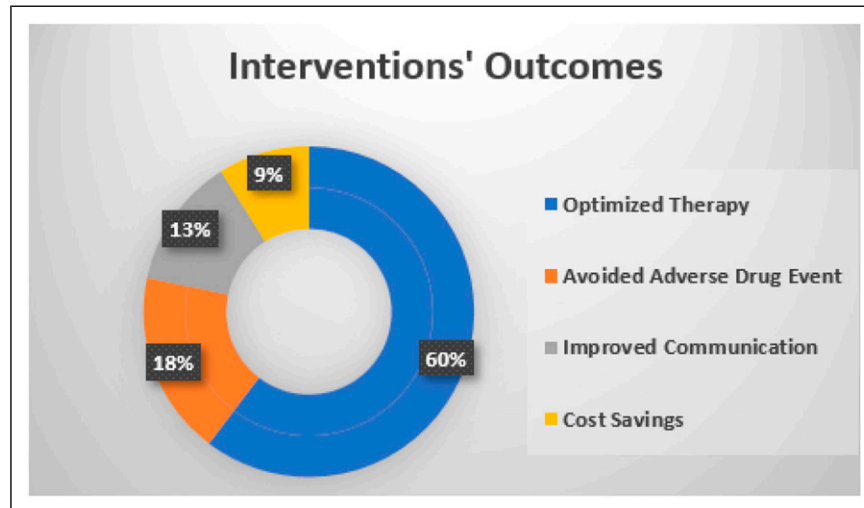**Figure 1.** Clinical significance of the pharmacist interventions.

Figure 2. The reported outcomes of the pharmacist interventions.

Piperacillin–tazobactam, an antipseudomonal penicillin plus beta-lactamase inhibitor, was the most involved medication in the clinical pharmacist interventions followed by hydroxychloroquine, enoxaparin, and the protease inhibitor combination ritonavir–lopinavir. Having these medications reported more frequently in the documented interventions is an important factor to consider in developing local guidelines for ordering, dosing, and monitoring to ensure the safe, effective, and cost-effective use of such medications.

The rapidly changing management guidelines have led to frequent changes in many institutional guidelines developed to manage COVID-19 patients. Some medications were used initially in the management but were later removed from these guidelines due to serious heart rhythm problems and other safety issues based on the U.S. Food and Drug Administration (FDA) recommendations,[10] including hydroxychloroquine which has been reported in our study as the second most frequent medication associated with clinical pharmacist interventions.

Patient Profile Review

The second most frequently documented class of interventions is patient profile review. These interventions are performed to document many clinical activities like reviewing patient specific clinical information and healthcare multidisciplinary progress notes to identify patient needs and optimize medication use. This category of interventions includes review of kidney and liver function tests, adjusting administration times and frequency of medications, changing dosage forms in the case of patients on feeding tubes, and using the appropriate volume and type of diluents for intravenous medication in patients with special indications when needed. Most interventions in this category have resulted in improved outcomes related to cost saving and improved communication between the pharmacy caregivers and the multidisciplinary healthcare team. Also, worth noting is that adjusting administration times

and medication frequency were effective in reducing the use of personal protective equipment by minimizing patient room entry by nurses and other staff, thereby allowing the best use of PPE resources while taking care of COVID-19 patients.

Transition of care is another field where pharmacists can play a significant role in ensuring accurate and accessible records of medications by identifying and resolving any discrepancy, deletion, or addition of medications during patient admission, transfer, or discharge. In this study, a total of 51 interventions (addition, deletion, or discrepancy in medication record) were related to the medication reconciliation process relative to hospital admission, transfer, or discharge.

Clinical Significance

Based on the tool used to assess the clinical significance of the interventions, interventions ranked as "moderate" constituted most of the reported interventions (51%), followed by those with minor (28.5%), insignificant (12.6%), and major (8.1%) clinical significance. Having major interventions as the lowest reported category can be attributed to the competency observed in ordering medications, especially high-alert drugs, by prescribers and in some cases to the built clinical decision tools in the EMR which captures any major medication-related issue by applying precise clinical decision tools and safety measures, preventing any potential harm to patients.

Acceptance Rate

To evaluate the clinical pharmacist interventions as perceived by the primary physicians, the acceptance rate was calculated for the clinical interventions with a documented decision of either accepted or unaccepted (those with no, an incomplete, or an unclear decision were excluded). The reported physician acceptance rate of the interventions in this study was approximately 95%, indicating a high acceptance of

interventions compared with the reported rate in many published studies in various practice settings with different patient populations. For example, the physician acceptance rate of the clinical pharmacist interventions during rounds in an acute care psychiatric hospital was 92.4%,[11] while another study reported that 92.8% of the recommendations submitted by pharmacists were accepted.[12] In addition, a prospective study evaluating the impact of clinical pharmacists on an inpatient medical oncology service reported a high acceptance rate by physicians of 98%.[13]

A high physician acceptance rate reflects confidence in the quality of pharmaceutical care provided and indicates that the contribution of clinical pharmacists is recognized. Furthermore, it highlights the well-established professional relationship between pharmacy caregivers and the medical team that facilitate providing effective pharmaceutical care.

Intervention Outcomes

During the electronic documentation of interventions, the pharmacist includes the proposed outcomes. These outcomes were double-checked and reviewed by the study team to ensure accuracy and appropriateness of the documentation based on the expected impact on medication therapy efficacy, safety, cost, and communication. The most documented outcome was "optimized therapy," constituting 60% of the total outcomes reported where the clinical pharmacist intervention led to improved medication use based on evidence-based recommendations. Furthermore, 18% of the interventions resulted in prevention of potential adverse drug reactions while the remainder led to either improved communication or cost saving. Cost saving–related interventions may include—but not limited to—IV to PO conversion, discontinuing unnecessary medication orders and adjusting frequency and medication administration times to limit multiple entry to isolation rooms thus reducing PPE use.

Such beneficial outcomes of the pharmacist contribution can be of high importance during COVID-19 pandemic as having a high demand on limited resources can be a challenge to provide high quality patient care.

Study Strengths

Pharmacist interventions have been studied in many patient populations, but this study specifically assessed interventions in a unique population, COVID-19 patients, for whom pharmacy practice research is limited. This study includes and analyses some important aspects of clinical pharmacy practice in a hospital setting and opens the door for more research regarding the role of clinical pharmacists in providing care for COVID-19 patients.

Study Limitations

The current study is a retrospective chart review and included only adult patients. Using a prospective method and including different categories of patients (pediatric patients and those treated as outpatients) to diversify and increase the study sample size may improve the generalizability and strength of the results and give a more accurate assessment of the clinical pharmacist role in the pediatric population or ambulatory setting.

Being a single-center study may have limited the number of patients included and the number of interventions analyzed. We believe that the data presented in this study can be applied in most clinical pharmacy practice models in different hospital settings, but this could be further confirmed if the study design included multi-center practices from other hospitals. Additionally, conducting an evaluation of the impact of interventions on patient clinical outcomes can further confirm the impact of the pharmacist contribution in COVID-19 patients.

A focused cost-effectiveness analysis is required to clearly identify the impact of the clinical pharmacist interventions on cost reduction of patient care. Data on cost reduction presented by this study reflect only the assumption of the clinical pharmacists while documenting the intervention, but this assumption needs to be confirmed in order to reach an accurate conclusion regarding cost-effectiveness.

A lack of complete documentation was a barrier to achieving a fully comprehensive analysis of all the documented interventions. In our study, about 50 out of 587 interventions were excluded due to incomplete documentation of all the required fields of the pharmacist intervention electronic template. Last, we believe that involving physicians in future studies can be an important tool to further strengthen the methods and reduce potential bias in assessing the clinical significance or potential outcomes of the interventions.

Conclusion

This retrospective chart review indicates that pharmacist interventions are associated with improved communication and improved medication use in admitted adult patients with COVID-19. Clinical pharmacists can play a crucial role in optimizing medication use in patients with COVID-19 through prevention, identification, and resolving existing or potential drug-related problems.

Author Contributions

Osama Al-Quteimat: Writing the protocol and the manuscript, journal submission, data collection, and analysis, Mohammad Siddiqui: Writing the protocol, final review, data collection, and analysis, Lana Hussein, Haytham Al Emleh, and Imad EL Dine Shamieh: Writing the protocol and the manuscript, data collection and analysis and final review.

ORCID iD

Osama Al-Quteimat https://orcid.org/0000-0001-6526-1023

Supplemental material

Supplemental material for this article is available online.

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