COVID-19 Pandemic: Changes in Drug Consumption and Implications for Treatment Strategies

Mehmet Kara¹*, Esma Yıldırım²

1 Department of Medical Pharmacology, Kayseri City Research and Training Hospital, Kayseri, TR
2 Pharmacy Department, Kayseri City Research and Training Hospital, Kayseri, TR

* Corresponding Author: Mehmet Kara E-mail: dr.mehmetkara@hotmail.com

ABSTRACT

Objective: This study aims to establish a roadmap for drug supply during potential future pandemic scenarios by examining the variations in drug consumption at Kayseri City Training and Research Hospital during the COVID-19 pandemic compared to the pre-COVID-19 period.

Materials and Methods: The study involved an analysis of one-year drug stock data before and after the pandemic. The start date of the pandemic was identified as April 2020 when the first COVID-19 case was admitted to our hospital. Data on drug stock inputs and outputs were obtained from the Hospital Information Management System. The data were calculated as percentages by considering the number of inpatients on a monthly basis. The drug groups investigated included antiviral, antibiotic, antihypertensive, antidiabetic, antifungal, antithrombotic, and psychiatric drugs. Specifically, the most commonly used antifungal agents were identified as liposomal amphotericin B, fluconazole, metronidazole, caspofungin, and nystatin; antihypertensive agents included amlodipine, perindopril, carvedilol, and furosemide; antidiabetic agents encompassed insulin glargine, insulin aspart, insulin glulisine, and metformin hydrochloride; psychiatric drugs consisted of quetiapine, escitalopram, and sertraline; antiviral agents were favipiravir, oseltamivir, and remdesivir; and antibiotics comprised ampicillin sodium, ceftriaxone, levofloxacin, moxifloxacin, and clarithromycin. Additionally, enoxaparin sodium was used as an antithrombotic agent, and levodropropizine as an antitussive during the pandemic at our hospital.

Results: Comparing the pre-COVID period, an increase in the number of drugs supplied per patient was observed across all drug groups. However, the usage rates of furosemide, carvedilol, metronidazole, liposomal amphotericin B, quetiapine, and metformin decreased in certain months during the pandemic. The drug categories with the highest usage rates were antithrombotics, antivirals, and antibiotics. Notably, antithrombotic consumption increased by a factor of 270 in the first year of the pandemic.

Conclusion: This study highlights the potential changes in drug consumption and requirements during pandemic periods, particularly in the case of antimicrobial and antithrombotic drugs, as demonstrated in our findings. It emphasizes the importance of proactive measures to adjust drug supply to meet the demands of clinics and inpatient services during critical periods.

Keywords: COVID-19; drug stock management; Antivirals, Antibiotics; Antifungals, Antidiabetics, Antihypertensives Antithrombotics. Antidepressants

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a highly contagious respiratory illness caused by the recently identified severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

Currently, there is no specific treatment available for COVID-19 that has been proven to be both safe and effective. Given the urgent nature of the ongoing pandemic, countries worldwide, including our own and others in Europe and the USA, have been actively exploring potential antiviral drugs for this disease. Some drugs that were previously approved for the treatment of other human diseases have shown safety and effectiveness against SARS-CoV in laboratory studies. These drugs have been suggested and utilized as potential antivirals for COVID-19. However, ongoing studies are still evaluating their efficacy and safety specifically for COVID-19.

The present study focuses on examining changes in the consumption of drugs used for both COVID-19 infection and the treatment of comorbid conditions during the COVID-19 period compared to before the pandemic. The objective is to gather data on drug supply during the pandemic process, providing valuable insights into drug stocking strategies.
MATERIAL and METHODS

The study examined one-year drug stock data before and after the pandemic. The start date of the pandemic was determined as April 2020, coinciding with the first COVID-19 case admission to our hospital. Drug stock input and output data were obtained from the Hospital Information Management System. The data were analyzed by calculating percentages based on the number of inpatients per month. Graphs were created to illustrate the consumption rates before and after the COVID-19 period on a monthly and yearly basis.

The drug groups investigated in the study included antiviral, antibiotic, antihypertensive, antidiabetic, antifungal, antithrombotic, antitussive, and psychiatric drugs. Data were collected at the level of active substances. The most commonly used antifungal agents identified were amphotericin B, fluconazole, metronidazole, caspofungin, and nystatin. The antihypertensive agents included amlodipine, perindopril, carvedilol, and furosemide. The antidiabetic agents encompassed insulin glargine, insulin aspart, insulin glulisine, and metformin. The psychiatric drugs consisted of quetiapine, escitalopram, and sertraline. Additionally, the antiviral agents were favipiravir, oseltamivir, and remdesivir. The antibiotics examined were ampicillin sodium, ceftriaxone, levofloxacin, moxifloxacin, and clarithromycin. The antithrombotic agent analyzed was enoxaparin sodium, and the antitussive agent was levodropropizin.

RESULTS

During the COVID-19 period, there was a noticeable increase in the number of drugs supplied per patient across all drug groups compared to the pre-COVID period. However, the usage rates of furosemide, carvedilol, metronidazole, liposomal amphotericin B, quetiapine, and metformin showed a decrease in certain months compared to the pre-COVID period. Conversely, anti-thrombotics, antivirals, and antibiotics exhibited the highest usage rates. Particularly, the consumption of antithrombotic agents increased significantly, reaching a 270-fold increase in the first year of the pandemic (refer to Figure 1-8).

It is important to note that the study has some limitations. Drugs such as remdesivir, hydroxychloroquine, and tocilizumab, which are commonly used in the treatment of COVID-19, were not included in the analysis. These drugs were not frequently used before the pandemic, but their consumption has significantly increased due to the ongoing global health crisis. Consequently, they were not considered in this study.

Figure 1: Antivirals Consumption Rates
Figure 2: Antihypertensives Consumption Rate

Figure 3: Antifungal Consumption Rates

Figure 4: Psychiatric Drugs Consumption Rates
Figure 5: Antidiabetic Consumption Rates

Figure 6: Enoxaparin Sodium Consumption Rates

Figure 7: Levodropropizin Consumption Rates
DISCUSSION

Currently, there is no established effective antiviral specifically designed for the treatment of COVID-19. However, several groups of drugs have shown potential in combating the virus. Some of these drugs aim to prevent the virus from entering the host cell (such as plasma, monoclonal antibodies, hydroxychloroquine, umifenovir, and niclosamide), inhibit viral protease (like lopinavir and ritonavir), or hinder viral RNA replication (such as remdesivir and favipiravir).

Among these antiviral options, favipiravir is the most commonly used drug in our center for the treatment of COVID-19. However, its efficacy has not been adequately established, and further studies are required (1). Given the viral nature of the COVID-19 pandemic and the inclusion of favipiravir in treatment protocols, its consumption has experienced the highest proportional increase compared to the pre-COVID period.

Hypertension has been identified as one of the significant risk factors for susceptibility to COVID-19 infection, and it also contributes to an increased risk of mortality. There have been concerns regarding the use of renin-angiotensin system (RAS) blockers, such as perindopril and ramipril, due to their potential to increase the expression of angiotensin-converting enzyme 2 (ACE2), which acts as a binding receptor for SARS-CoV-2. This has led to speculation that these agents might increase the risk of SARS-CoV-2 infection and worsen the progression of COVID-19 (2). However, current evidence does not support the detrimental effects of RAS-blocking drugs during the course of COVID-19 infection. As a result, a debate has emerged regarding the continuation or discontinuation of ongoing ACE inhibitor (ACEI) or angiotensin receptor blocker (ARB) therapy in COVID-19 patients, considering their widespread use in hypertensive individuals (3).

In terms of antihypertensive drug preference in our hospital during the COVID-19 period, amiodipine was predominantly favored, while furosemide consumption exhibited the most variability and remained relatively low during the peak periods of the pandemic.

Both SARS and SARS-CoV-2 enter the body via ACE2 receptor, while MERS uses DPP4 as the receptor (4). The expression pattern of both enzymes changes in diabetes, although in different ways, which puts diabetic patients at high risk for severe disease. Moreover, patients with diabetes are among the risk groups for COVID-19 infection due to impaired immune response in diabetes (4).

The acute inflammatory response leads to insulin resistance and subsequent hyperglycemia, necessitating intensification of treatment for pre-existing diabetes. In this case, it is expected that the use of antidiabetic drugs will increase. There was an increase in annual consumption in all of them during the COVID period, with the most increase observed in insulin glargine and insulin glulisine (4).

Uncertainty in the pandemic process, social isolation, also raises mental health problems. Fear of infection, frustration, boredom, long quarantine periods have led to an increase in mental problems such as depression, anxiety, post-traumatic stress disorder, panic disorder, and obsessive-compulsive disorder. The frequency of anxiety and depression during the pandemic period ranges from 6.7-22.4% (5).

In the study, the use of antidepressants increased, especially in the early stages of the pandemic. In the early stages of the pandemic, the situation in which patients’ drug needs against stress increase and then regress can be explained by people’s tolerance mechanisms to the current situation. In addition, the effect of COVID-19 infection on the prognosis of antidepressant groups has been reported, and it has been shown that tricyclic antidepressant drugs cause a worse prognosis compared to SSRI group drugs (6). As a limitation of our study, tricyclic antidepressants were not included in the study because they were not used frequently in our hospital. Sepsis-related coagulopathy is an important cause of mortality in COVID-19 patients (7). Several studies have demonstrated the efficacy of antithrombotic therapy, particularly enoxaparin, in reducing mortality rates (7).
As a result, there has been a significant increase in the use of antithrombotic drugs, with enoxaparin sodium being the second most commonly used drug during the COVID-19 period, following favipiravir.

The effects of antitussive drugs on COVID-19 infection are not well-established. Cough is a common symptom for which patients seek medical attention. However, treatments for acute and chronic cough have been unsatisfactory. Levodropropizin, a peripherally acting cough suppressant, has shown good tolerability and safety profiles (8). It has been the most commonly used antitussive drug in our center, and its consumption has not significantly changed during the COVID-19 period due to the unknown effect profile in COVID-19.

Hypoxemic acute respiratory failure requiring ICU admission is a complication of severe COVID-19 cases. These patients have been increasingly reported to experience secondary bacterial and fungal infections. Immune dysfunction or imbalance has been identified as an important risk factor for invasive fungal diseases, as evidenced by the reduced fungicidal activity of neutrophils in COVID-19 patients (9). Consequently, there has been an increased use of all antifungal drugs during the COVID-19 period, with fluconazole being the most commonly used agent.

Macrolides, such as erythromycin, clarithromycin, and azithromycin, possess not only antibacterial activity but also anti-inflammatory and immunomodulatory effects. They modulate the immune response by acting on inflammatory cells, fibroblasts, and epithelial cells, regulating cytokine/chemokine production, inhibiting mucus hypersecretion, and suppressing transcription factors and inflammatory cytokine gene expression. In severe cases of COVID-19, an uncontrolled release of circulating inflammatory cytokines, known as cytokine release syndrome, can lead to adverse outcomes (10). Clarithromycin has been the most commonly consumed antibiotic during the COVID-19 period, followed by ceftiraxone. Ampicillin consumption, on the other hand, has decreased compared to the pre-COVID period.

CONCLUSION

This study sheds light on the changes in drug consumption during the COVID-19 pandemic. The usage of antithrombotics, antivirals, and antibiotics increased significantly, highlighting the need to address coagulopathy, viral infections, and bacterial complications associated with COVID-19. Antidiabetic drug consumption also showed an increase, reflecting the impact of the acute inflammatory response and hyperglycemia. Mental health issues were observed, with an increase in antidepressant use. Levodropropizin remained a commonly used antitussive, while flunazolone and clarithromycin were the most consumed antifungal and antibiotic agents, respectively. These findings provide insights for optimizing drug supply and treatment strategies during future pandemics. Further research is needed to understand the long-term implications of these changes.

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REFERENCES


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