

Evaluation of the Antibiotic Resistance in COVID 19 Infected Patients in Jeddah, Saudi Arabia-A Cross-Sectional Study

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Abstract

*Introduction: Antimicrobial resistance (AMR) is already common in Middle Eastern countries, with limited monitoring data. The COVID-19 pandemic has worsened this issue, especially in Saudi Arabia, where overuse and misuse of antibiotics have been widely reported in hospitals and the community. This increased antibiotic use has raised concerns about accelerating AMR. This study aims to assess the prevalence, diagnosis, and treatment of antibiotic resistance in COVID-19 patients in Saudi Arabia. Methodology: This single-site, retrospective cross-sectional study analyzed medical records of 266 COVID-19 patients at King Fahad Armed Forces Hospital from March 2020 to March 2022. Descriptive statistics (SPSS v25) were used to summarize patient demographics and outcomes. Results: Most participants were male (59%) and adults (55%). Over half (52.63%) had comorbidities, mainly diabetes mellitus and hypertension. Antibiotic overuse and misuse occurred in 71.08% of patients. As a result, 18.05% developed various types of AMR. The most common multi-drug resistant bacterial co-infections were *Candida* species, *Escherichia coli*, Methicillin-resistant *Staphylococcus aureus* (MRSA), *Klebsiella* species, *Pseudomonas aeruginosa*, Gram-positive cocci, *Enterococcus faecalis*, and *Streptococcus agalactiae*. The highest resistance was to ceftriaxone, followed by piperacillin/tazobactam, azithromycin, oseltamivir, meropenem, and others. Conclusion: This study found a high prevalence of bacterial co-infection and AMR among hospitalized COVID-19 patients. High AMR rates threaten antibiotic effectiveness, especially in hospitals. The study recommends considering co-infections in COVID-19 management and implementing antibiotic stewardship programs, supported by standard treatment guidelines, to reduce antibiotic resistance.*

Keywords: Prescribing; Antibiotics; Antimicrobial Resistance; Antimicrobial Stewardship; COVID-19; Kingdom of Saudi Arabia.

Introduction

COVID-19, first identified in Wuhan, China in December 2019, rapidly spread worldwide. The disease is caused by the virus SARS-CoV-2, which has infected millions and caused hundreds of thousands of deaths as of May 2020 (1). COVID-19 mainly affects the lungs but can also damage the heart, liver, and kidneys. Older patients and those with other health conditions have higher death rates (2)..

It can be hard to tell COVID-19 pneumonia apart from pneumonia caused by other germs. Because of this, doctors often give broad-spectrum antibiotics to hospitalized patients, as seen during MERS-CoV outbreaks. This practice can increase antimicrobial resistance (AMR) (3). While antibiotics may be needed if a bacterial or fungal infection is suspected, it is important to use them carefully to avoid unnecessary resistance (4).



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Recent studies have shown a rise in multidrug-resistant organisms (MDROs) during the COVID-19 pandemic (5–7). Prescribing antibiotics to COVID-19 patients may increase AMR (8). For example, in Wuhan, the most common bacteria found in COVID-19 patients with secondary infections were *Acinetobacter baumannii*, *Klebsiella pneumoniae*, and *Stenotrophomonas maltophilia* (7). In France, some COVID-19 ICU patients were infected with bacteria resistant to common antibiotics (9). Other studies found multidrug-resistant *A. baumannii* and methicillin-resistant *Staphylococcus aureus* (MRSA) in COVID-19 ICU patients (10).

Fungal co-infections are also a problem. Some COVID-19 patients developed bloodstream infections with MRSA, *Morganella morganii*, and *Candida glabrata*, which became resistant to antifungals after treatment (11). *Pseudomonas aeruginosa*, another bacteria, is often found in COVID-19 patients and is linked to antibiotic overuse (1).

AMR has increased in places with many severe COVID-19 cases, such as New York, Wuhan, France, Iran, and Brazil (12). This rise in resistance increases healthcare costs and can lead to more deaths (13). In the US, AMR costs over \$20 billion each year and causes over 35,000 deaths (14, 15).

In Saudi Arabia, overuse and misuse of antibiotics during the pandemic have been reported, both in hospitals and by people self-medicating (16). This could increase infections with resistant germs like vancomycin-resistant enterococci, MRSA, and *Pseudomonas aeruginosa* (1). The economic burden on Saudi healthcare could rise due to longer hospital stays and more expensive treatments (16).

Although evidence suggests that AMR increases after antibiotic use in COVID-19 patients (17, 18), there is little research on this issue in Saudi Arabia. This study aims to assess the prevalence, diagnosis, and treatment of antibiotic resistance in COVID-19 patients in Saudi Arabia. Understanding AMR patterns can help improve antibiotic use and patient care.

Methodology

The current study was conducted with the aim of evaluating the prevalence, diagnosis and treatment of antibiotic resistance in patients with Coronavirus (COVID-19), through the achievement of the following sub-objectives of this study:

1-To study the prevalence of antibiotic resistance with COVID 19 patient.

2-To study the current diagnosis practices and treatment of antibiotic resistance.



1. Design: This is a single site, retrospective cross-sectional study that observed and analyzed data from medical records. Data from the patient's medical records in King Fahad Armed Forces Hospital has been collected in the period between March 2020 to March 2022. Information on demographic characteristics, microbiological file, prescribed antibiotics and their frequent usage as well as baseline comorbidities for Covid-19 patients were extracted from the medical records and evaluated in detail.

2. Setting: The medical records of COVID 19 patients admitted to different wards of King Fahad Armed Forces Hospital, Jeddah, Saudi Arabia during the study period were analyzed.

3. Subject: All symptomatic patients with laboratory-confirmed COVID-19 infection who were hospitalized at King Fahad Armed Forces Hospital, Jeddah from March 2020 to March 2022, were eligible.

--Sampling technique: Convenience - non-probability sampling has been used for the study.

--Sample size: The sample size is 239. The sample size was calculated using calculator.net software.

The sample proportion selected is 20% of the population. The total number of inpatients in the study period was approximately 8000. When the sample was calculated using a 95% confidence level and a margin of error of 5%, the sample size was 239.

--Inclusion Criteria: Data from the medical records of all Covid-19 patients admitted to hospital during the study period were included and analyzed.

--Exclusion criteria: Covid 19 Patients who were not admitted to the hospital and treated as outpatients were excluded as the antibiotic resistance is not evaluated in the outpatient setting. Patients who were referred to any other hospital due to unavailability of a hospital treatment facility, and those who did not sign the study consent form were excluded. Ethical approval was granted prior to the start of the current study.

4. Tools for data collection: The data has been collected using patient's electronic files and medical records to obtain information on the current topic.

5. Outcome measurements: Patient related data including demographic data, patient history, diagnosis, current disease status, comorbidity, antibiotics used by the patient etc., and other drugs the patient is using were collected along with microbial culture reports.

6. Statistical Analysis: All data were collected using Microsoft Excel Sheet and SPSS version 25 was used for statistical analysis. Descriptive statistics including frequencies, percentages, charts and diagrams were used to report patient characteristics and outcomes.

The following Figure 1 summarizes the flowchart of the current research methodology:



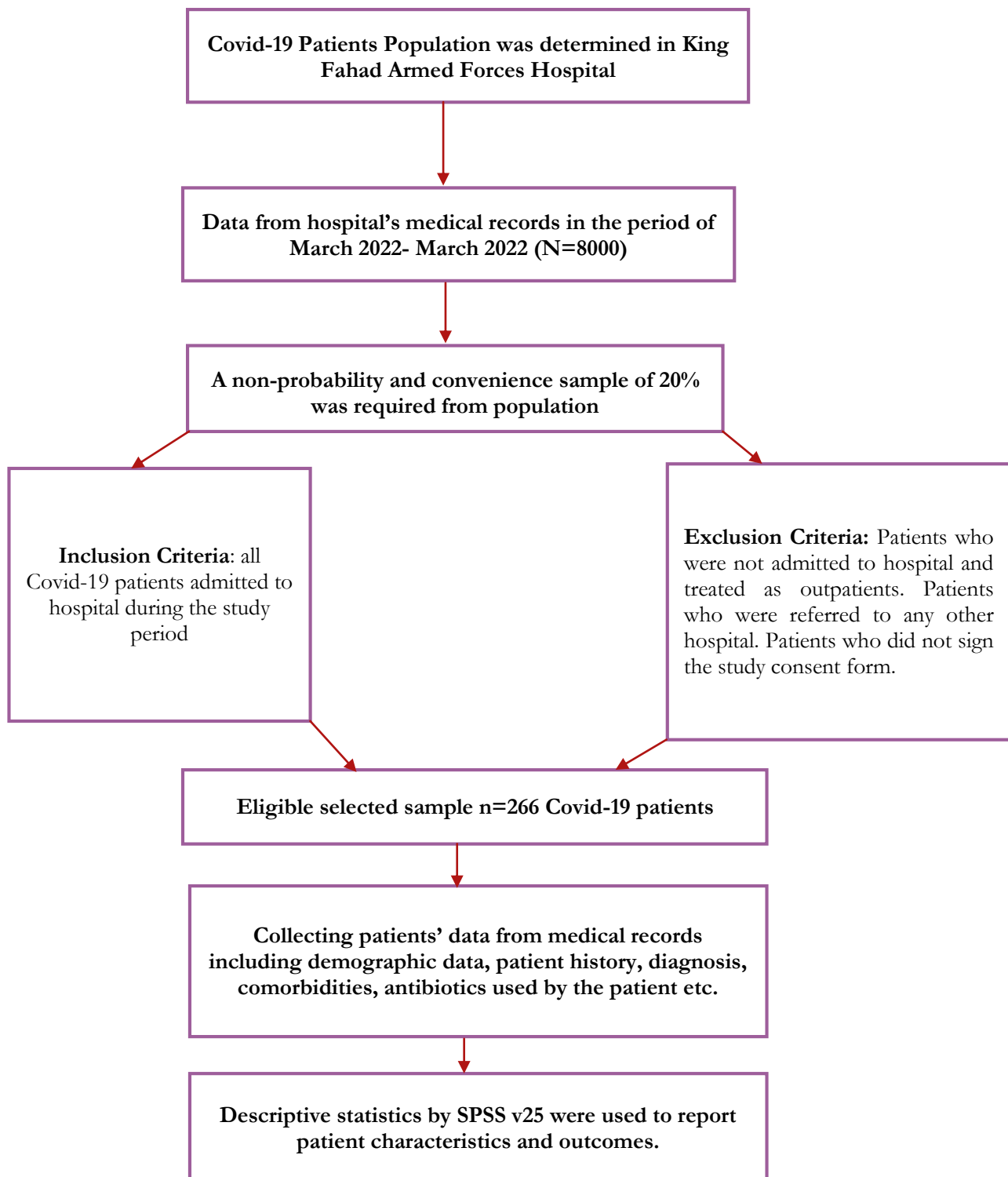


Figure 1: Study Method Flow chart

Medical records, laboratory data, and chest x-rays were reviewed for all COVID-19 patients in the study. Blood culture (BC) and endotracheal aspirate (ETA) results were collected from these records. The Ethics

Committee at King Fahad Armed Forces Hospital approved access to this data, and the study was also approved by the Institutional Research Review Board at Ibn Sina National College of Medical Studies.

Demographic Data

Out of 266 patients confirmed positive for COVID-19 by PCR, 59% were male and 41% were female (see Figure 2). Most patients were between 50 and 69 years old, with a good mix of younger and older patients. This age distribution is similar to findings in a previous study from Pakistan (13)

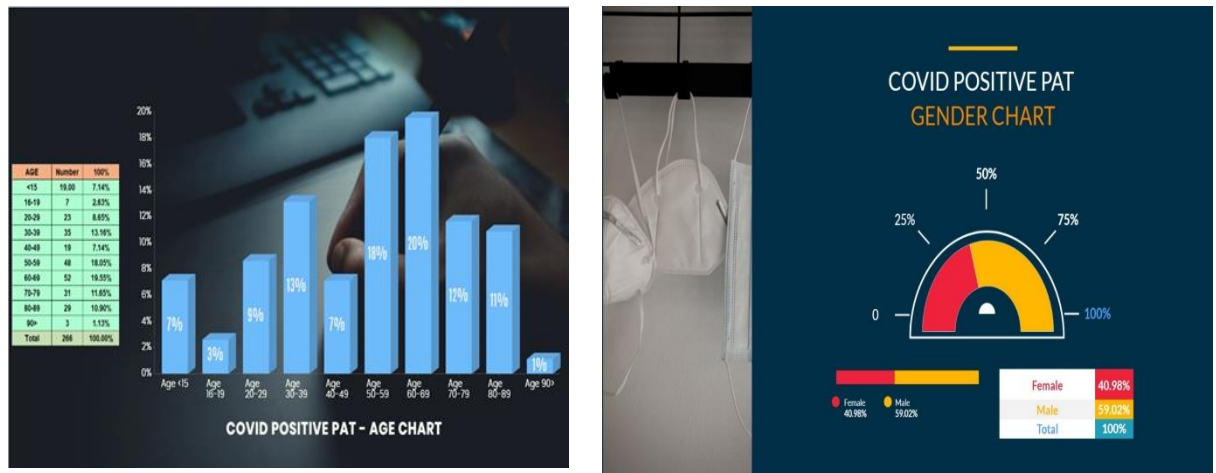


Figure 2: Age and gender of COVID patients

Majority are in their middle age and more male have participated in the study.

Comorbidities

COVID-19 patients with other health problems (comorbidities) often have worse outcomes. In this study, 52.63% (n=144) had comorbidities. The most common were diabetes mellitus (21.05%), hypertension (15.41%), coronary heart disease (7.14%), chronic kidney disease (5.26%), and coronary

artery disease (3.76%) (see Figure 3)

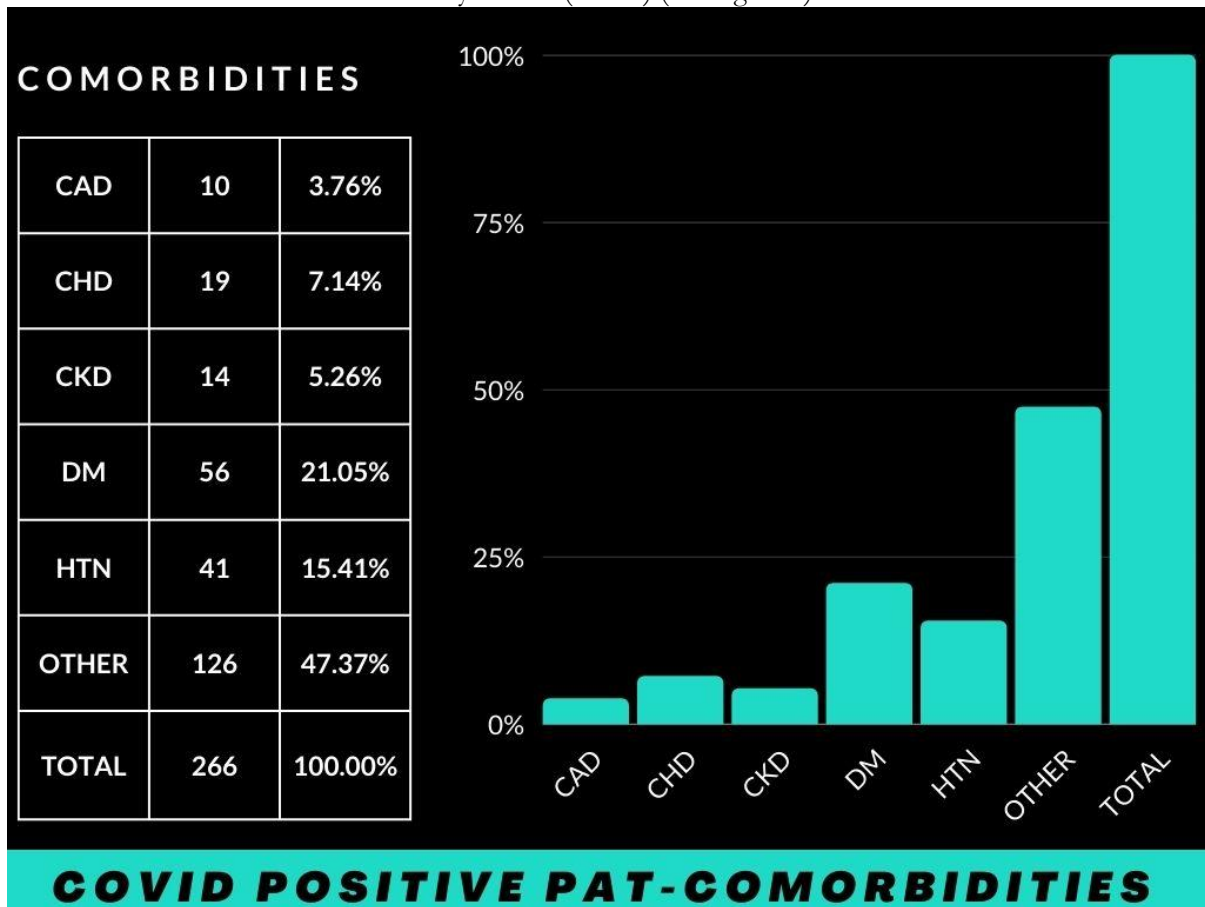


Figure 3: Rate of comorbidities among hospitalized COVID-19 patients

Patients with comorbidities are at higher risk for severe COVID-19 and bacterial co-infections, which can make treatment more difficult and increase the chance of antibiotic resistance.

Antibiotic Prescription

Although antibiotics are not recommended for viral infections like COVID-19, their use was high during the early pandemic. Figure 4 shows that 71.80% of COVID-19 patients in the study were prescribed antibiotics. This high rate suggests possible overuse or misuse, which can contribute to antimicrobial resistance.

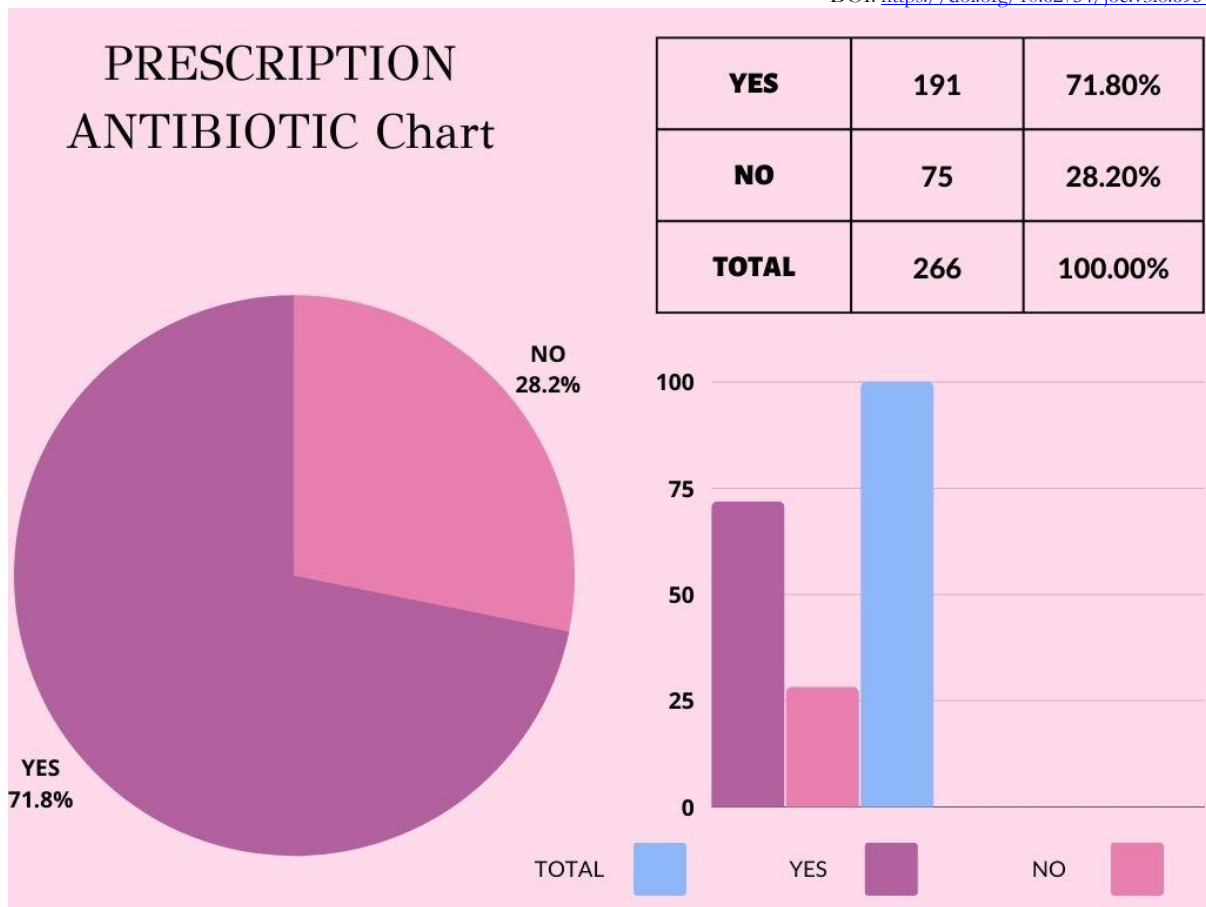


Figure 4: Chart of the extent to which antibiotics are prescribed to patients

Prevalence of Antimicrobial Resistance (AMR)

To see if antibiotic use led to antimicrobial resistance, the study counted patients with AMR. As shown in Figure 5, 48 out of 266 patients (18.05%) developed some form of AMR.

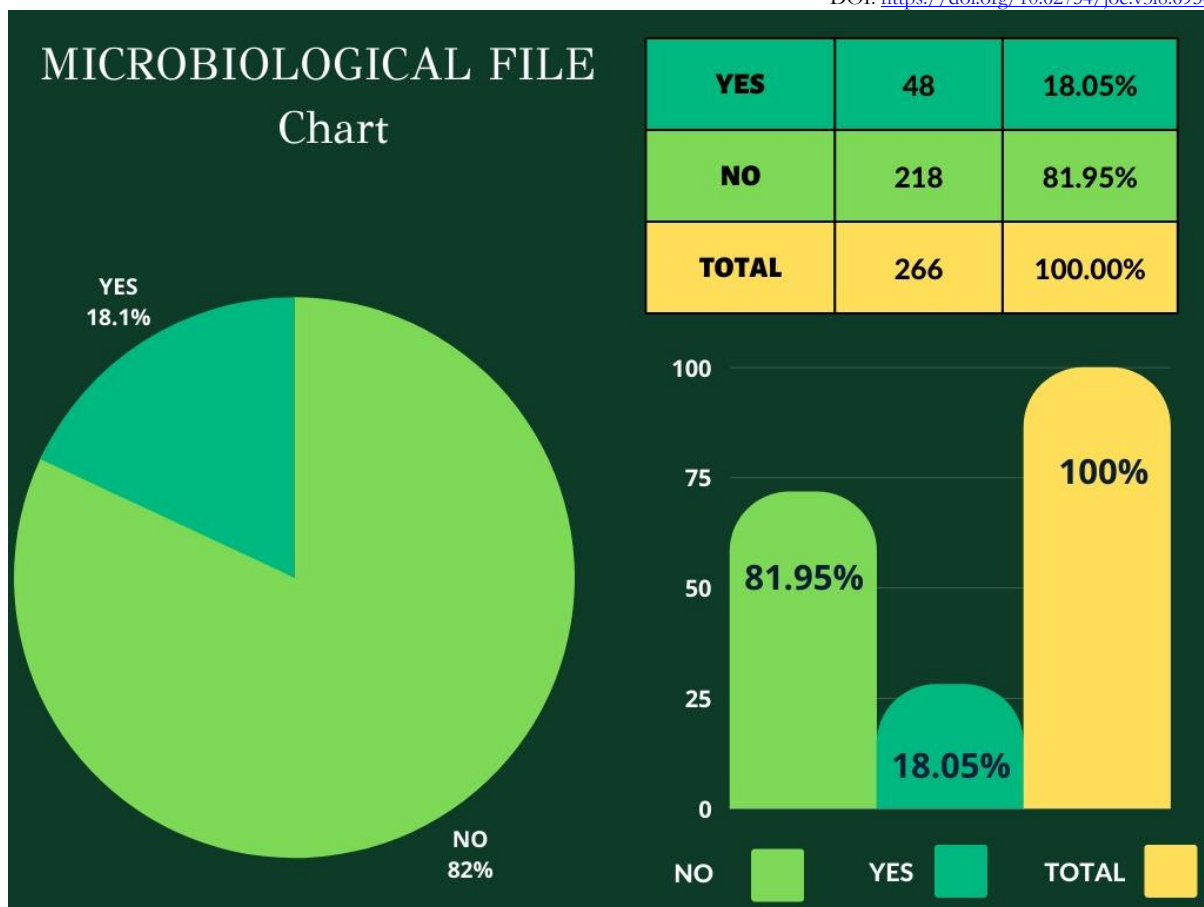


Figure 5: Prevalence of antimicrobial resistance among COVID-19 patients

Types of Resistant Bacterial Co-Infections

Among the 48 patients with AMR, the most common multi-drug resistant organisms were identified using BC and ETA data. Table 1 lists the prevalence of each type

Table 1: Prevalence of multi-drug resistant bacterial co-infections in COVID-19 patients

Bacterial co-infection	Frequency (N)	Percentage (%)
Candida species	7	14.6%
Methicillin-resistant Staphylococcus aureus	7	14.6%
Escherichia coli	7	14.6%
Klebsiella species	6	12.5%
Pseudomonas aeruginosa	5	10.4%
Gram-positive cocci	3	6.25%
Enterococcus faecalis	3	6.25%
Streptococcus agalactiae	2	4.17%
Gram negative cocci	2	4.17%
Gram-negative rods	2	4.17%
Citrobacter freundii	2	4.17%
Proteus mirabilis	1	2.08%
Acinetobacter baumannii	1	2.08%
Total	48	100%

According to Table 1, the most common microorganisms isolated through bacterial culture and are multi-drug resistant are *Candida* species (14.6%), *Escherichia coli* (14.6%), Methicillin-resistant *Staphylococcus aureus* (MRSA) (14.6%), *Klebsiella* species (12.5%), *Pseudomonas aeruginosa* (10.4%), Gram-positive cocci (6.25%), *Enterococcus faecalis* (6.25%), *Streptococcus agalactiae* (4.17%), Gram negative cocci (4.17%), Gram-negative rods (4.17%), *Citrobacter freundii* (4.17%), *Proteus mirabilis* (2.08%) and *Acinetobacter baumannii* (2.08%).

Moreover, the results related to the most prevalent antibiotic resistance patterns among patients are summarized in the following Figure 6:

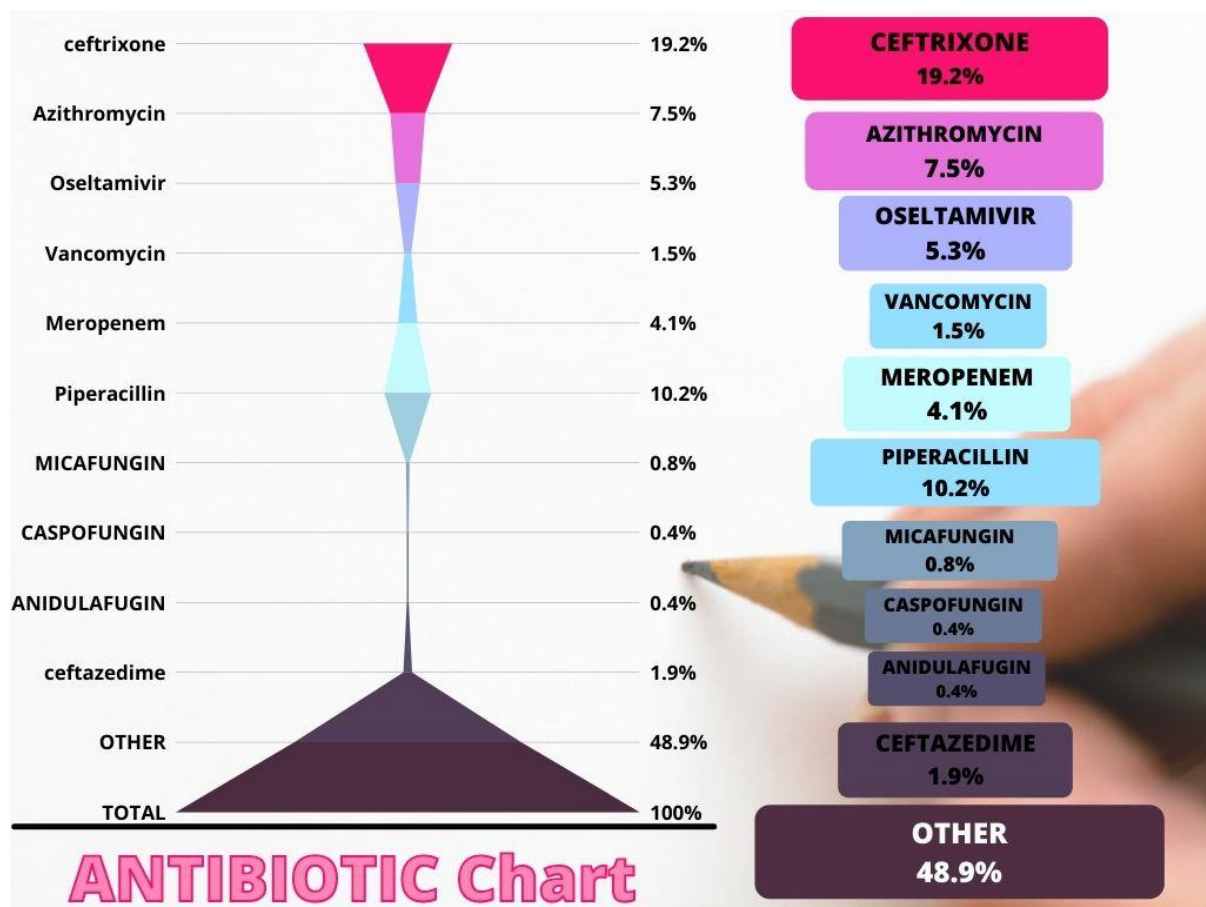


Figure 3: The antibiotic resistance patterns in Covid-19 patients

This chart shows the percentage of each type of multi-drug resistant bacteria found in COVID-19 patients.

Discussion

This study found that antibiotic resistance is a significant problem among COVID-19 patients in Jeddah, Saudi Arabia. About 18% of the patients developed antimicrobial resistance (AMR), and most of these patients had other health problems such as diabetes and hypertension. This matches findings from other countries, where patients with comorbidities are more likely to get severe infections and develop resistance (1,2).

The majority of patients in this study were middle-aged and male, which is similar to previous studies (3). More than half of the patients had at least one comorbidity, which is known to increase the risk of

complications and secondary infections (4). This highlights the need for careful monitoring and treatment in these groups.

A high percentage (71.8%) of COVID-19 patients received antibiotics, even though COVID-19 is caused by a virus and antibiotics are not effective against viruses. This overuse of antibiotics may have contributed to the high rate of AMR found in the study (5,6). Other studies have also reported increased antibiotic use during the pandemic, raising concerns about rising resistance (7,8).

The most common resistant organisms found were *Candida* species, *Escherichia coli*, MRSA, *Klebsiella* species, and *Pseudomonas aeruginosa*. These organisms are also frequently reported in other studies of COVID-19 patients with secondary infections (9,10). The presence of these resistant bacteria makes treatment more difficult and can lead to longer hospital stays and higher healthcare costs (11).

Our results show that antibiotic resistance in COVID-19 patients is a growing problem in Saudi Arabia, similar to trends seen globally (12,13). This is likely due to the increased use of broad-spectrum antibiotics during the pandemic, sometimes without clear evidence of bacterial infection (14). This highlights the importance of antimicrobial stewardship programs, which help ensure antibiotics are used only when necessary (15).

The findings of this study are important for healthcare providers and policymakers. There is a need to improve antibiotic prescribing practices, especially during pandemics. Hospitals should strengthen infection control measures and promote the use of guidelines to prevent unnecessary antibiotic use (16,17).

Study Limitations

This study was conducted at a single hospital, which may limit how well the results apply to other settings. The sample size was also limited. More research is needed across different hospitals and regions to better understand the extent of AMR in COVID-19 patients in Saudi Arabia (18)

Conclusion

This study found that antibiotic resistance is a significant and growing problem among COVID-19 patients in Jeddah, Saudi Arabia. Nearly one in five patients developed antimicrobial resistance, with the highest risk seen in those with other health conditions like diabetes and hypertension. The most common resistant organisms were *Candida* species, *Escherichia coli*, MRSA, *Klebsiella* species, and *Pseudomonas aeruginosa*.

A high rate of antibiotic use was observed, even though COVID-19 is a viral infection. This likely contributed to the development of resistance. These findings highlight the urgent need for better antibiotic prescribing practices and stronger antimicrobial stewardship programs in hospitals. Improving infection control and following guidelines can help reduce unnecessary antibiotic use and slow the spread of resistant bacteria.

Further research is needed in other hospitals and regions to fully understand the extent of antimicrobial resistance in COVID-19 patients across Saudi Arabia. Continued monitoring and education about responsible antibiotic use are essential to protect public health

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