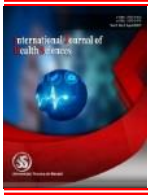

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Profile of Antibiotics Prescription Pattern and Their Outcome in Patients during COVID-19 Treatment in a Tertiary Hospital in Nigeria

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Abstract

This study evaluated antibiotic prescription patterns and treatment outcomes among hospitalized COVID-19 patients at the Centre for Communicable Diseases, Control, and Research, Federal Medical Centre, Asaba, Delta State, Nigeria, during the first and second waves of the pandemic. A retrospective review of 122 patient records examined demographic data, antibiotic use, dose regimen, hospitalization length, and comorbidities. The study aimed to determine antibiotic prescription patterns and treatment outcomes (primary outcomes) and identify factors predicting patient recovery (secondary outcomes). Chi-square analysis and Fisher's test were utilized to obtain the primary outcomes, and the secondary outcome was derived using regression analysis. A total of 299 antibiotics from ten classes were prescribed, with 98.4% of patients receiving azithromycin and penicillin/macrolides. Among the patients, 40 completed treatments at home, 53 had comorbidities, 19 died, and 100 recovered. Poor treatment outcomes were linked to older age, comorbidities, and multiple antibiotic combinations, while gender, hospitalization length, and antibiotic type did not significantly impact recovery. No significant differences were found in antibiotic prescriptions between patients with and without bacterial co-infections. These findings

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highlight the role of compromised immunity in poor outcomes and underscore the importance of evidence-based antibiotic use during outbreaks to enhance patient management and curb antimicrobial resistance.

Contents

1 Introduction

The recently identified coronavirus (2019-nCoV), the seventh coronavirus known to infect humans, was responsible for an outbreak of acute respiratory infections in Wuhan, China, in December 2019 (Li et al., 2020). The World Health Organization (WHO) declared the new coronavirus infection of 2019 to be a pandemic on March 11, 2020. It had been announced two months earlier as a public health emergency (Cucinotta & Vanelli, 2020; Jebril, 2020). On July 26, 2023, there were over 6.9 million casualties and 768 million cases worldwide (Peña et al., 2023).

The availability of drug use data has always been a major barrier to assessing drug utilization in most government-owned hospitals (Jarari et al., 2015). However, recent changes have improved availability and access to information, leading to a revelation of the irrational and often unnecessary use of antibiotics in most disease conditions (Machowska & Stålsby Lundborg, 2019). Studies show that antimicrobial stewardship programs are often associated with lower utilization of antibiotics and a decline in the occurrence of illnesses with drug resistance (Huang et al., 2022; Khadse et al., 2023).

Antimicrobial resistance is a serious challenge, and Africa needs to do more to reduce the burden (Majumder et al., 2020). Chinemerem Nwobodo et al. (2022), highlight how infections, hitherto treatable by antibiotics but now resistant to several medications, are expected to become one of the leading causes of global mortality. This situation may be worse in Africa, as it is one of the continents with the highest burden of infectious diseases. Additionally, it has poor socioeconomic indices, such as abject poverty and low levels of education. The irresponsible use of antimicrobial agents by Africans can potentially worsen the continents' antimicrobial burden (Fenollar & Mediannikov, 2018).

Sometimes, individuals with SARS-CoV-2 infections are routinely administered medications for possible bacterial co-infections (Lansbury et al., 2020; Rawson et al., 2020). However, this can contribute to antibiotic resistance, necessitating a need to mitigate this potential eventuality. COVID-19, though a viral illness caused by beta coronavirus SARS-CoV-2, can show clinical similarity to bacterial pneumonia (Cheng et al., 2020; Mirzaei et al., 2020). can cause some difficulty in distinguishing it from bacterial co-infections and could give rise to doctors prescribing too many antibiotics to COVID-19 patients.

The prevalence of bacterial co-infections and secondary infections is comparatively low among hospitalized patients, at 3.5% and 14.3%, respectively (Lansbury et al., 2020). The likelihood of severe antibiotic overuse in these circumstances is shown by the discrepancy between the incidence of bacterial infections and the frequency of antibiotic prescriptions (Llor & Bjerrum, 2014). When combined with the strain on healthcare resources and the reduced ability to monitor antibiotic-resistant organisms during the COVID-19 pandemic, antibiotic overuse in COVID-19 patients can increase the selective pressure for antimicrobial resistance, which may have long-term effects on antimicrobial resistance (Sulis et al., 2022). In order to address this issue, some organizational guidelines suggest commencing empiric antibiotic therapy if there is a suspicion of bacterial pneumonia or sepsis, but they also highlight the significance of daily re-evaluation (Liang & Kumar, 2015). The World Health Organization (WHO) provided recommendations on the use of antibiotics, advising COVID-19 patients against starting an antibiotic treatment until there are obvious signs and symptoms of a bacterial infection (World Health Organization, 2020).

Some antibiotics are effective against specific viruses, such as Ebola, Zika, respiratory syncytial virus, influenza H1N1 virus, enterovirus, and rhinovirus. An example is Azithromycin, whose antiviral action has been demonstrated both in vitro and in vivo (Abdulaziz et al., 2022). Its antiviral activity reveals a wide range of antiviral activities, such as preventing virus entry into cells and enhancing the immune system's defenses against viruses by increasing the production of type 1 and type 111 interferons (Sa Ribero et al., 2020).

Patients in the older age groups and patients with more serious illnesses have been shown to have higher antibiotic prescription rates, as they sometimes develop infections or/and require mechanical breathing (Langford et al., 2020). The prevalence of antibiotic usage among COVID-19 patients was assessed, and risk variables for antibiotic use during hospitalization were identified (Martin et al., 2020; Thapa et al., 2022). The results indicated a rise in the frequency of using antibiotics while hospitalized. The increased use of antibiotics may be related to hospital-acquired infections, potentially leading to more antibiotics courses, admission to the intensive care unit (ICU), and a prolonged length of stay (Silva et al., 2021; Ventola, 2015).

These unintended outcomes show the value of antimicrobial stewardship while treating COVID-19 patients and generally to rein in antimicrobial resistance (Llor & Bjerrum, 2014; Lucien et al., 2021). The early stage of the pandemic was a chaotic one in the health sector, especially in Nigeria, with no available guidelines on how to manage patients (Jacobs & Okeke, 2022). Regulatory agencies like the WHO released interim guidelines at the end of 2019. The recommendation in the guideline included, among other things, the administration of empirical antibiotic therapy as quickly as feasible to treat all suspected pathogens causing Severe Acute Respiratory Infection (SARI) and sepsis, i.e., only in the most severe cases of COVID-19 infection (World Health Organization, 2020).

There are limited studies on the profile and patterns associated with antibiotic use in COVID-19 patients in Nigeria, thus, this study aimed to assess antibiotic prescription practices and treatment outcomes in hospitalized COVID-19 patients.

2 Materials and Methods

Study Design

The study was a retrospective observational review of clinical records of patients diagnosed with COVID-19 at the Federal Medical Centre (FMC), Asaba, Delta State, Nigeria. The study focused on the patient population diagnosed across 24 months, from March 2020 to February 2022.

Study Population and Sampling

The records of all 122 patients diagnosed with COVID-19 during the study period were included in the study. The period encompassed the first and second waves of the COVID-19 pandemic, from June 2020 to May 2021.

Inclusion /Exclusion Criteria:

Patients on home care management during the COVID-19 pandemic from the start of treatment and patients who tested negative to the COVID-19 PCR test at the Centre's holding rooms were excluded. All COVID-19 positive patients admitted and treated at the Centre both in the first and second waves of the COVID-19 pandemic were included.

Data Collection:
The patient records collected included patient demographics, type of lab investigations done, diagnosis, antibiotics prescribed, dosage forms, length of hospitalization, co-morbidities, and outcome of the treatment. The charts were reviewed manually, hence, each folder used during the study was tagged to avoid multiple entries for a patient. The data retrieved was recorded in a form designed for this purpose.

Clinical Outcomes
The Primary outcomes were the antibiotic pattern, the treatment outcome measured by a negative PCR test, and the relationship of the treatment outcome with other clinical outcomes. The secondary outcomes were factors to predict treatment outcomes. The other clinical outcomes include the mortality rate, duration of hospitalization, and the time to resolution of symptoms. These outcomes were assessed through various means, including clinical evaluation, laboratory tests, and patient follow-ups.

Study Variables
The dependent variable in the regression analysis was the treatment outcome of COVID-19 patients, while independent variables included factors such as patient demographics like gender and age, length of hospital stay, and antibiotic usage.

Data Analysis
GraphPad Instant and SPSS statistical software (version 20.0) were used to attain accurate analysis of data collected. Frequencies and percentages were used to express demographic variables and measures of central tendency for continuous variables like age, antibiotics per encounter, and duration of antimicrobial agents were reported. Two hypotheses were tested using the chi-square test and the one-way analysis of variance (ANOVA), respectively. The hypotheses are as follows: There is a significant association between categorical variables (comorbidities and antibiotic combinations) and treatment outcomes among COVID-19 patients, and there is a significant difference in the number of antibiotics prescribed across different age categories among COVID-19 patients. A regression analysis was performed using the multivariate regression model to test the Hypothesis: There is a significant predictive relationship between the number of antibiotics used, length of hospital stays, age, and outcome of therapy among COVID-19 patients. Charlson Comorbidity Index (CCI) was used to assess the comorbidity burden among the patients. Comorbidities were coded according to the international classification of disease (ICD) (Charlson et al., 1987). The WHO core prescribing indicators were calculated as follows:

$$\text{Average number of drugs per encounter} = \frac{\textit{Total number of drugs}}{\text{Total } \textit{number of encounters}}$$

Variables showing ρ-values <0.05 were considered statistically significant.

Discharged criteria: Patients were discharged mostly after staying on admission for 10 days without a symptom for 3 days.

Ethical Considerations
The study was conducted by the ethical principles outlined in the Declaration of Helsinki, which guides research involving human participants. Ethical approval for this study was obtained from the Federal Medical Centre Asaba's Research and Ethics Committee (Reference Number: FMC/ASB/A81 VOL. XIII/221). Confidentiality was maintained throughout the study period. Informed consent was obtained from all participants involved in the study. For deceased patients, consent was obtained from their next of kin.

Data Availability Statement
The data underlying this study will be shared upon reasonable request to the corresponding author.

3 Results and Discussions

3.1 Results

Demographic and clinical characteristics

A total of 122 patients were attended to at the CCDR during the 1st and 2nd waves of COVID-19. Each patient was admitted to the center after testing positive for COVID-19 in a Polymerase Chain Reaction (PCR) test. Over half of the patients were male, and most of the patients (21.3%) were spread across 61 to 70 years. The patients had a mean age of 53.4 years and ranged in age from 1 to 89 years. Many of the patients had other conditions besides their COVID-19 diagnosis. Of these, more than a third (40.2%) had two or more co-morbidities, 20.5% had hypertension, and 22.1% had hypertension and diabetes mellitus.

Though more males had various underlying medical illnesses, there was no significant difference between gender and co-morbidity ($\chi^2 = 3.187$; $\rho = 0.20$). Of the patients studied, 45% had a low comorbidity burden (CCI score 0-1: 45.9%; score 2-4: 42.6%; score ≥5: 11.5%). There was no significant association between gender and the Charlson Comorbidity Index ($\rho = 0.16$). A summary of the baseline demographics is shown in Table 1.

Drug utilization data for antibiotics

A total of 299 antibiotics were prescribed across the study population, resulting in an average of 2.5 per patient (Table 1). Few (1.6%) patients had no antibiotics prescribed, while 44.3% of the patients had at least 2 types of antibiotics.

Four major classes of antibiotics were prescribed to the patients (Figure 1). These classes are macrolides, penicillin, cephalosporins, and fluoroquinolones. Other classes prescribed include nitroimidazoles, tetracyclines, beta-lactams, glycopeptides, aminoglycosides, and lincosamides. The macrolides (Azithromycin) were the most singly prescribed at 26.2%, while 20.6% of the patients had more than 4 different classes of antibiotics during their stay (Figure 2). The mean duration for the prescribed antimicrobial agents was 5 days.

Table 1
Demographics of the patients

Characteristics	Value (n = 122)
Gender	
Male	64(52.5)
Female	58 (47.5)
Age (years)	
<21	6(4.9)
21 – 30	*7(5.7)*
31 – 40	16 (13.1)
41 – 50	23(18.9)
51 – 60	23(18.9)
61 – 70	26(21.3)
71 – 80	12(9.8)
>80	9(7.4)
Number of co-morbidities	
None	35(28.7)
1	38(31.1)
≥2	49(40.2)

Characteristics	Value (n = 122)
Charlson Co-morbidity index (CCI)	
0 – 1	56(45.9)
2 – 4	52(42.6)
≥5	14(11.5)
	p-value
Gender vs co-morbidity	0.20
Age vs co-morbidity	0.00
Gender vs CCI	0.16

A comparison of the number of antibiotics prescribed between the genders showed a statistically significant association (ρ = 0.03) with the females receiving the highest number of antibiotics combination, nine (9), throughout the hospital stay. A significant association was also observed between co-morbidity and the number of antibiotics each patient was administered (ρ = 0.008*),* and it was observed that those with two or more co-morbid conditions received more combinations of antimicrobial agents. Nearly all patients (**99.2%**) received at least one antibiotic, and **50.8%** of prescriptions included an injectable form. Empirical antibiotic use was highly prevalent, observed in **98.4%** of cases, while **67.3%** of patients received more than one class of empirical antibiotics. These findings highlight a high reliance on empirical antibiotic therapy and combination treatments, emphasizing the need for careful antibiotic stewardship to prevent overuse and antimicrobial resistance.

Laboratory Investigation

Baseline blood tests such as full blood count and serum creatinine levels were ordered for most of the patients. The laboratory investigations done for microbial culture or sensitivity were not documented inside the patient's folders.

Presence of Bacterial Co-Infection

Nine percent of the patients had a bacterial co-infection on admission. Of these, 5.7% were males, and 3.3% were females. Patients who also had bacterial infections did not exhibit noticeably prolonged stays in the hospital (ρ = 0.99). Likewise, no statistically significant association was found between treatment outcome and the presence of bacterial co-infection in the patients (ρ = 0.71).

Clinical outcome

The average length of admission was 10 days, though this ranged from two to 20 days. At the end of the treatment period, 15.6% of the patients died, 45.1 % had a negative PCR result after treatment, and 2.5% of the patient's refused admission against medical advice. The male patients spent more days on admission compared to the females, but a chi-square test revealed no significant relationship (p = 0.11) between gender and in-patient bed days. The study also showed that fewer patients were admitted during the second wave of the pandemic, as 31.1% of the study population were managed via home and telehealth.

Table 2
Distribution of prescribed antibiotics by gender

Gender	No. of Antibiotics prescribed										
	0	1	2	3	4	5	6	7	8	9	
Male	0	14	18	17	8	3	3	0	1	0	X^2 = 7.284
Female	2	24	15	7	6	2	0	1	0	1	ρ = 0.03

The number of antibiotics prescribed for a patient showed a significant association with the final treatment outcome (*p <0.0001)*, and at the same time, some of the people who died had significantly higher antibiotic combinations prescribed to them, as summarized in Table 4. Having a co-morbid condition significantly affected the treatment outcome either positively or negatively among the genders (*p = 0.01).* While 78.9% of all those who had two or more co-morbid conditions died, the highest proportion of negative PCR results were seen in patients with no co-morbid conditions.

Regression Analysis

A multivariate regression analysis was conducted to examine the relationship between several predictor variables and the outcome of therapy (Table 5). The result indicated that the number of antibiotics used could not significantly predict treatment outcome (R2 = .019, F (1, 117) = .000, p = 1000). Similarly, the length of hospital stay was not a significant predictor of treatment outcome (R2 = .000, F (1, 117) = 2.26, p = .136). Gender was also not a significant predictor of treatment outcome (R2 = .05, F (1, 85) = .40, p = .551). However, the age of patients showed a significant negative association with treatment outcome (R2 = .076, F (1, 115) = 9.40, p = .003). The odds ratio for age was 0.982 (95% CI: 0.965 - 0.999), signifying that for each year increase in age, the odds of a particular treatment outcome decrease by a factor of 0.982.

Table 3
Comparison of the treatment outcome with the number of antibiotic combinations prescribed and co-morbidity

		OUTCOME				**X^2 value (Sig)**
		Discharges	**DAMA**	**Died**	**Total**	
Antibiotic combination given	Zero-One	67	0	1	68	23.7, 0.00
	Two-Three	17	3	9	29	
	>3	16	0	9	25	
Total		**100**	**3**	**19**	**122**	
Co-morbidity	None	67	2	0	69	
	One	25	1	4	30	14.2, 0.01
	≥2	8	0	15	23	
Total		**100**	**3**	**19**	**122**	

DAMA: Discharge Against Medical Advice

Table 4
Regression analysis of the number of antibiotics used, length of hospital stays, and age as predictors for the outcome of therapy

Metric	Value
Correlation (Outcome, Antibiotics)	-0.138 (p = 0.068)
Model Significance	p = 0.136, R Square = 0.019
Coefficient (Antibiotics)	-0.105 (p = 0.136), Odds Ratio: 0.901 (95% CI: 0.802 - 1.012)
Correlation (Outcome, Hospital Stay)	0.000 (p = 0.500)
Model Significance	p = 1.000, R Square = 0.000
Coefficient (Hospital Stay)	-3.046E-5 (p = 1.000), Odds Ratio: 0.999 (95% CI: 0.999 - 1.000)
Correlation (Outcome, Gender)	0.068 (p = 0.531)
Model Significance	p = 0.551, R Square = 0.005
Coefficient (Gender)	-0.629 (p = 0.551), Odds Ratio: 0.533 (95% CI: 0.253 - 1.124)
Correlation (Outcome, Age)	-0.275 (p = 0.001)
Model Significance	p = 0.003, R Square = 0.076
Coefficient (Age)	-0.018 (p = 0.003), Odds Ratio: 0.982 (95% CI: 0.965 - 0.999)

3.2 Discussions

The COVID-19 pandemic brought the problem of microbial resistance to the fore as antimicrobial drugs were used indiscriminately to treat a viral illness (Adebisi et al., 2021; Chinemerem Nwobodo et al., 2022). With the extenuating circumstances, the fight against microbial resistance in Africa is very concerning (Palmer & Buckley, 2021).

Langford et al. (2020), estimated a 74.6% (95% CI 68.3–80.0%) prevalence of antibiotic prescribing with COVID-19. This is slightly lower than the result obtained in this study, which was 99.2%, but comparable to a report by Martin et al. (2020) and Khan et al. (2021). These results reveal a pattern of high antimicrobial use in middle- and low-income countries (85%) compared to high-income countries (58%). Beyond prescriptions, taking antibiotics without consulting a doctor and prescribing them without doing culture and sensitivity tests are common in middle-income and lower-income countries (Khan et al., 2022; Parveen et al., 2020). The possibility of increasing bacterial resistance as a result of this overprescribing is now seen to represent a separate public health emergency from the epidemic (Pulia et al., 2021).

The trend of high consumption of antimicrobials in COVID-19 was reported to have worsened after the results of the early studies in China revealed that about half of the patients who died were as a result of secondary bacterial infection (Lucien et al., 2021).

The presence of bacterial infection or the development of secondary bacterial infections is one of the possibilities associated with COVID-19 infections, as a result, the WHO (2020) advises thorough monitoring of all severe patients for the early diagnosis of clinical deterioration. This study showed a point prevalence of 9% for bacterial co-infection in the study population. This estimate is slightly higher than the estimates in other studies. Zhou et al. (2020), Crotty et al. (2020), and Rawson et al. (2020), an estimated 2-8% of the population under study had bacterial co-infection. However, Martin et al. (2020) reported that 12% of the study participants had microbiologically confirmed bacterial infection for initial antibiotic use. The low estimated prevalence of bacterial coinfections in COVID-19 patients suggests a chance to safely avoid routine, empiric antibiotic prescribing for this population (Pulia et al., 2021).

Azithromycin was the most prescribed drug in this study. Significant antiviral capabilities and immunomodulatory effects of azithromycin, which have been demonstrated in vitro and in vivo on a wide range of viruses, including Ebola, may have contributed to its usage across all age groups. The two most commonly prescribed medications in the study from a Scottish hospital and Singapore, respectively, were co-amoxiclav, amoxicillin, and doxycycline, in stark contrast to Molla et al. (2021), findings in Bangladesh, where third-generation cephalosporins and meropenem were the two most commonly prescribed medications (Seaton et al., 2020). Additionally, the findings of the meta-analysis by Langford et al. (2020), revealed that out of the 10 classes of antibiotics examined, fluoroquinolones, macrolides, -lactam/-lactamase inhibitors, and cephalosporins were the most often administered antibiotic classes. The differences in antibiotic prescription across several studies point to varied approaches to empirical therapy, drug use policy, and COVID-19 treatment therapy payment. For instance, some patients were given drugs without having to pay for them (Molla et al., 2021).

The modal age category for this study was 61-70 years, and this age bracket usually consists of patients with one or more co-morbid conditions. Of all the co-morbidities observed, none was independently associated with increased antimicrobial usage, whereas having two or more co-morbid conditions was significantly associated with age (ρ = 0.000) and antimicrobial usage (ρ = 0.008). Hypertension and diabetes were the most common comorbidities in this study. This finding contrasts with that which was shown to independently link increasing antibiotic consumption to diabetic mellitus (DM) in Bangladesh (Molla et al., 2021). Contrary to the report from Bangladesh, a Scottish study showed that COPD was positively associated with antimicrobial usage, while DM was negatively associated with antimicrobial usage (Seaton et al., 2020).

The severity of any infection usually increases the length of hospitalization. Although this study did not capture data on the severity of the patients on admission, our results showed a significant association between length of hospitalization (in-patient bed days) and treatment outcome (*ρ = 0.001).* Also, having a co-morbid condition was not significantly associated with length of hospitalization (*ρ = 0.36).* There was no statistically significant correlation between length of hospitalization and having a bacterial co-infection, in contrast to Cheng et al. (2020), who found that patients with co-infections had a considerably longer length of hospitalization. Despite the result of this study showing that only a few of the patients had a documented bacterial infection and most of the prescriptions had at least one antimicrobial agent, many received antibiotics empirically. WHO Coronavirus (COVID-19) dashboard (2019) suggests that the patient's general health state, local epidemiology, and the treating physician's clinical judgment be considered to allow for judicial antimicrobial usage, in contrast to empirical antimicrobial prescribing in severe instances.

The number of antibiotics used did not significantly predict therapy outcomes, suggesting that the complexity of COVID-19 cases extends beyond the sheer quantity of prescribed antibiotics. In contrast, the analysis involving age demonstrated statistical significance, with older age associated with a decrease in expected treatment success. This reinforces the need for a comprehensive understanding of patient demographics in treatment planning, aligning with recent calls for personalized medicine approaches in infectious disease (Equils et al., 2023).

The study's principal limitations include the cohort's limited size, which would make it harder to extrapolate the findings to other hospitals in the State. Additionally, more details regarding the choice, time of administration, and duration might aid in making an accurate assessment of how suitable the antimicrobial therapy is.

The study highlights the importance of addressing the issue of antibiotic overuse in COVID-19 patients to mitigate the development of antimicrobial resistance. Implementing the recommendations below can contribute to more judicious antibiotic use and better patient outcomes.

1) Antimicrobial Stewardship Programs: Given the high prevalence of antibiotic prescribing for COVID-19 patients, there is a need to implement and strengthen antimicrobial stewardship programs in healthcare settings. These programs can help ensure that antibiotics are used judiciously and only when clinically necessary, reducing the risk of antibiotic resistance.
2) Avoidance of Empirical Antibiotic Use: Antibiotics should not be prescribed empirically for all COVID-19 patients, especially when there are no clear signs and symptoms of bacterial infections. Following the World Health Organization's guidance, antibiotics should be reserved for cases where bacterial co-infections are suspected.
3) Clear Guidelines and Education: Healthcare institutions and regulatory agencies should provide clear and evidence-based guidelines for the use of antibiotics in COVID-19 patients. Pharmacists and pharmacy staff can play a crucial role in educating healthcare professionals about appropriate antibiotic use.

4) Regular Re-evaluation: Pharmacists can collaborate with healthcare providers to re-evaluate the need for antibiotics, reducing unnecessary use. Mechanisms for the regular review and monitoring of antibiotic prescriptions should be put in place. Patients receiving antibiotics should be regularly reviewed, and the need for continued antibiotic therapy should be re-evaluated. This can prevent the prolonged and unnecessary use of antibiotics.
5) Microbial Culture and Sensitivity Testing: To determine the need for antibiotics more accurately, healthcare facilities should prioritize microbial culture and sensitivity testing to identify the specific pathogens causing infections. This can guide targeted antibiotic therapy.
6) Public Awareness: Public awareness campaigns should be conducted to educate the general population about the appropriate use of antibiotics and the risks associated with overuse. This can reduce pressure on healthcare providers to prescribe antibiotics unnecessarily.
7) Data Collection and Research: Continued research on antibiotic usage in the context of COVID-19, including larger and more diverse patient populations, can provide valuable insights into trends and help refine guidelines and policies.

4 Conclusion

The study revealed that almost all patients received antimicrobial agents, primarily macrolides or penicillin/macrolides combinations. Notably, azithromycin, known for its antiviral properties, was frequently administered. The study identified a significant association between treatment outcomes and comorbidities, as well as the number of antibiotics received. A diverse range of antibiotics was prescribed across different age groups, with a moderate negative correlation found between age and therapy outcome, indicating decreased expected outcomes with increasing age. There was no difference between the antimicrobial agents prescribed for patients that had bacterial co-infection and those that did not have. These findings underscore the importance of careful consideration in antibiotic use, especially in the context of a viral infection. In light of these, the study contributes valuable insights for developing targeted interventions and antibiotic stewardship programs in managing COVID-19 patients, addressing concerns related to antimicrobial resistance.

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