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Antibiotic Use Among Hospitalized Patients with COVID-19 Infection (SARS-CoV-2 Omicron Variant) in Oman: A Single-center Retrospective Study

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ABSTRACT

Objectives: To identify and evaluate the prescribing pattern of antibiotics among hospitalized patients with SARS-CoV-2, Omicron variant in Oman, focusing on the prevalence of antibiotic use, rates of simultaneous infection, and potential overuse. ***Methods***: This retrospective study analyzed data from the electronic medical records of patients with COVID-19 caused by SARS-CoV-2 Omicron variant who were hospitalized at the Royal Hospital, Muscat, during December 2021–February 2022. Information on demographic and clinical details (including existing infections and comorbidities), hospital stays, and outcomes were collected. The prevalence and pattern of antibiotic use were examined, an association with their disease characteristics and simultaneous infection status were assessed. Statistical analysis was performed using R software. Associations between categorical variables were evaluated using chi-square test. ***Results:*** The participants were 176 hospitalized COVID-19 patients (mean age 59.3 ± 18.6 years), of whom 69.9% had mild disease and 22.7% had severe disease. Simultaneous infection (coinfection or superinfection) was present in 11 (6.3%) patients, including 7 (4.0%) bacterial infections as revealed by culture tests. Despite the low rate of simultaneous infections, 104 (59.1%) patients received antibiotics, as follows: ceftriaxone (45.2%), piperacillin and tazobactam (45.2%), and vancomycin (21.2%). Half of the patients who received antibiotics used them for only one to three days with a median duration of four days (range = 1–16). Antibiotic use was significantly associated with patient sex (p = 0.030), and the presence of simultaneous infection (p = 0.029). The number and duration of antibiotic treatment also showed significant associations with various patient and disease characteristics. ***Conclusions:*** Despite low rates of confirmed bacterial infections, antibiotics were administered to majority of hospitalized patients with COVID-19 (Omicron variant). This finding emphasizes the need for strengthening antimicrobial stewardship to curb unnecessary antibiotic use and reduce the risk of antibiotic resistance during pandemics in Oman.

The first case of COVID-19 in Oman was confirmed on February 3, 2020; by September 16, 2022, the cumulative cases rose to 397993, with 4628 deaths.[1] During the initial phase of the pandemic, antibiotics were commonly used for the disease treatment worldwide, most often empirically.[2] This was influenced by the experiences from the H1N1 influenza pandemic in 2009, which had a high prevalence of secondary bacterial infections in patients admitted to the intensive care units (ICU).[3–5] At the same time, evidence for the benefits of antimicrobial use in such patients was limited.[6] Over time, concerns regarding overuse of antibiotics and risk of bacterial resistance emerged. It was hypothesized that the COVID-19 pandemic may be accelerating the threat of antimicrobial resistance due to the increased use of antibiotics, increased exposure to hospital environments, and invasive procedures used in COVID-19 treatment.

A scoping review based on 118 studies conducted during the first six months of the pandemic reported that 40–50% of antibiotic prescriptions for COVID-19 patients lacked clinical indications.[6]

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A meta-analysis based on studies till June 2021 found that against a 5.6% bacterial coinfection rate, 61.8% of patients were prescribed antibiotics.[7]

International guidelines advise withholding antibiotics from COVID-19 patients without clinical evidence.[6] The National Institutes of Health's antibiotic recommendations for COVID-19 patients,[8] with periodic updates, were adopted as official guidelines in Oman. These recommend empiric antibiotic treatment only for suspected sepsis, septic shock, or bacterial pneumonia, with daily reevaluation. Antibiotic treatment for patients with critical or severe COVID-19 should align with established guidelines for hospitalized patients with ventilator-associated pneumonia, hospital-acquired pneumonia, or other nosocomial infections.[8]

Evaluating the pattern and appropriateness of antibiotic use across healthcare systems during various waves of the pandemic and the factors that influenced their prescribing will help develop future guidelines. A retrospective study at our institution, analyzing four years of data (2018–2021), found significant overuse of broad-spectrum antibiotics during the first phase of the COVID-19 pandemic, leading to a significant rise in antimicrobial resistance within a relatively short period.[9] However, there is a limited number of studies specifically evaluating the pattern and prevalence of antibiotic use among COVID-19 patients,[10,11] especially pertaining to the Omicron phase.[12] The present study aims to identify and assess the prescribing patterns of antibiotics among hospitalized patients with COVID-19 caused by the SARS-CoV-2 Omicron variant.

METHODS

This retrospective study included hospitalized patients (≥18 years) with COVID-19 (Omicron variant) admitted to the Royal Hospital (RH), Muscat, between December 2021 and February 2022. RH is a 1200-bed tertiary acute-care center in Muscat and remains a major referral facility for COVID-19 patients. Ethical approval for the study was obtained from the hospital's Scientific Research Committee (SRC #26/2020).

Patient data was collected from the electronic patient records of RH. Participants included all hospitalized patients ≥ 18 years old, of any nationality, diagnosed with a COVID-19 Omicron variant infection as confirmed by reverse transcriptase polymerase chain reaction or rapid antigen test, and hospitalized for > 24 hours. Patients were excluded if they were < 18 years old, discharged directly from the emergency room, discharged or died within 24 hours of hospitalization, or infected by non-Omicron variants of SARS-CoV-2.

Parameters evaluated on the use of antibiotic: type, number, duration/dose, route of administration, reported or presumed indications, and the patterns of antibiotic use in both ICU and non-ICU patients.

Patient and disease characteristics: Characteristics (age, sex, presence of comorbidities such as diabetes mellitus, hypertension, asthma, etc.) of patients who used antibiotics versus non-users were assessed. Disease details including severity, status of stay in ICU, length of hospital stay, and outcomes at 14 days were documented. COVID-19 severity was classified as mild, moderate, or severe, based on WHO's *Living Guidance for Clinical Management of COVID-19*.[13] *Mild disease:* patient has symptoms of COVID-19 without evidence of viral pneumonia or hypoxia. *Moderate disease:* shows clinical signs of non-severe pneumonia (fever, cough, dyspnea, fast breathing) with SpO_2 ≥ 90% on room air. *Severe disease:* shows clinical signs of pneumonia (fever, cough, dyspnea) plus one of the following: respiratory rate > 30 breaths/min, severe respiratory distress, or SpO_2 < 90% on room air. For this study, we also included critical cases to the severe disease group. Outcomes at 14 days post-admission were classified into three categories: 'mortality,' 'remained hospitalized,' and 'recovered.'

Simultaneous infections: positive cultures of blood, urine, and endotracheal aspirates were considered COVID-19-related; other positive cultures were deemed unrelated. Any infection present alongside COVID-19 was considered as a simultaneous infection and categorized as either 'coinfection' or 'hospital-acquired infection/superinfection'. Clinically significant positive cultures sampled within the first 48 hours of admission were categorized as coinfection and those sampled after 48 hours as hospital-acquired infection /superinfection.[11] Individual patient cases were assessed for the presence of simultaneous infections, their characteristics, and the causative organism.

Data were analyzed using descriptive statistics and chi-square tests using R software version 4.2.2 (R Core Team, Austria). Association between variables (antibiotic use, infections, and clinical

characteristics) was examined. A *p*-value of < 0.05 was considered statistically significant.

RESULTS

A total of 225 patients were initially included, 49 were excluded due to incomplete or missing data, duplicated patient forms, discharge before 24 hours in the hospital, or being < 18 years old. Thus, the study included 176 (78.2%) patients with COVID-19 (Omicron variant).

Demographic and other details of the participants are listed in Table 1. Most patients (123; 69.9%) had mild disease. Older adults (≥ 61 years) accounted for half of all admissions (93; 52.8%); mean age of the participants was 59.3 ± 18.6 years. The majority of patients (139; 79.0%) had at least one comorbidity, hypertension (58; 33.0%) being the most common. At 14 days, (122; 69.3%) patients had recovered and 29 (16.5%) had died.

Table 2 describes the 33 patients admitted to the ICU, nearly half of whom (14; 42.4%) were older than 60. Most ICU patients were men (20; 60.6%). The mortality rate (33.3%) was high at 14 days.

Simultaneous infections were rare among our 176 patients, with only 11 (6.3%) cases of simultaneous infections. Bacterial infections were confirmed in seven of these patients and fungal infection (*Candida* spp.) in the remaining four [Table 3].

The most common type of infection among individuals with simultaneous infection was sepsis (five coinfections and six superinfections) [Table 3].

The majority of patients (104; 59.1%) received at least one antibiotic during their stay in the hospital, only 11 had confirmed simultaneous infection based on culture results. Frequently used antibiotics included ceftriaxone (45.2%), piperacillin-tazobactam (45.2%), and vancomycin (21.2%) [Table 4]. All antibiotics were administered intravenously except for two patients who took them orally (azithromycin and doxycycline).

Nearly half of these patients (51/104; 49.0%) were given antibiotics for 1–3 days (median = 4 days; IQR = 1–16) [Figure 1].

The association between simultaneous infection status and disease characteristics is shown in Table 5. Patients with simultaneous infection had a significantly higher rate of severe disease (63.6% vs.

Table 1: Patient demographics and clinical characteristics (N = 176).

Parameters	n (%)
Sex	
Male	105 (59.7)
Female	71 (40.3)
Age group, years	
18–30	13 (7.4)
31–45	33 (18.8)
46–60	37 (21.0)
61–75	54 (30.7)
> 75	39 (22.2)
Presence of comorbidities	
Yes	139 (79.0)
No	37 (21.0)
Severity of COVID-19 infection	
Mild	123 (69.9)
Moderate	13 (7.4)
Severe	40 (22.7)
Stayed in intensive care unit	
Yes	33 (18.8)
No	143 (81.3)
Hospital stay, days	
1–3	61 (34.7)
4–6	60 (34.1)
7–9	15 (8.5)
10–12	13 (7.4)
> 12	27 (15.3)
Outcome at 14 days	
Mortality	29 (16.5)
Recovered	122 (69.3)
Remained hospitalized	25 (14.2)

Table 2: Demographics and clinical outcomes of patients admitted in the intensive care unit (ICU) (n = 33).

Parameters	n (%)
Admitted to ICU	33 (100)
Age, years	
18–30	3 (9.2)
31–45	7 (21.2)
46–60	9 (27.3)
61–75	8 (24.2)
> 75	6 (18.2)
Sex	
Male	20 (60.6)
Female	13 (39.4)
Outcome at 14 days	
Mortality	11 (33.3)
Recovered	6 (18.2)
Continuing	16 (48.5)

Table 3: Common organisms isolated from COVID-19 (Omicron) patients with coinfections and superinfections (n = 11).

Parameter	n
Type of infection	
Coinfection	5
Superinfection	6
Type of organisms	
Bacterial	7
Fungal	4
Bacteria	
Escherichia coli	2
Enterobacteriaceae	2
Pseudomonas aeruginosa	2
Stenotrophomonas maltophilia	1
Staphylococcus aureus	1
Fungus	
Candida spp.	4
Diagnosis	
Sepsis	10 (90.9)
Urinary tract infection	2 (18.2)
Catheter-related bloodstream infection	1 (9.1)
Pneumonia	1 (9.1)

Table 4: Antibiotics administered to hospitalized patients with COVID-19 (Omicron variant) (n = 104).

Antibiotic	n (%)
Ceftriaxone	47 (45.2)
Piperacillin + tazobactam	47 (45.2)
Vancomycin	22 (21.2)
Meropenem	16 (15.4)
Amoxicillin + clavulanic acid	15 (14.4)
Amikacin	1 (1.0)
Azithromycin	1 (1.0)
Clarithromycin	1 (1.0)
Doxycycline	1(1.0)
Gentamicin	1(1.0)

Totals exceed the number of patients as some received more than one antibiotic.

20%; $p = 0.003$) and mortality at 14 days (72.7% vs. 12.7%; $p < 0.001$) and remained hospitalized significantly longer (≥ 10 days) ($p = 0.002$).

Table 6 shows the association between antibiotic use versus patient/disease characteristics. Women received significantly more antibiotics (69.0%) than men (52.4%); $p = 0.030$. Most patients (90.9%) with a simultaneous infection received antibiotics, compared with 94 (57.0%) patients without

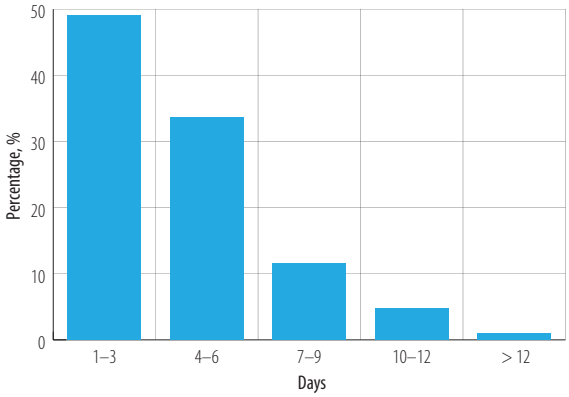

Figure 1: Durations of antibiotic treatment for patients diagnosed with COVID-19, Omicron variant (n = 104).

Table 5: Comparison between COVID-19 Omicron patients with versus without simultaneous infections (N = 176)

Parameters	Total	Simultaneous infection		*p*-value
		Present n (%)	Absent n (%)	
Total patients	176	11 (6.3)	165 (93.8)	
Severity				0.003*
Mild	123	4 (36.4)	119 (72.1)	
Moderate	13	0 (0.0)	13 (7.9)	
Severe	40	7 (63.6)	33 (20.0)	
Need for ICU				0.006*
Yes	33	6 (54.5)	27 (16.4)	
No	143	5 (45.5)	138 (83.6)	
Outcomes at 14 days				< 0.001*
Mortality	29	8 (72.7)	21 (12.7)	
Recovered	122	1 (9.1)	121 (73.3)	
Remained hospitalized	25	2 (18.2)	23 (13.9)	
Presence of comorbidities				0.123
Yes	139	11 (100)	128 (77.6)	
No	37	0 (0.0)	37 (22.4)	
Total stay in hospital, days				0.002*
1–3	61	2 (18.2)	59 (35.8)	
4–6	60	1 (9.1)	59 (35.8)	
7–9	15	1 (9.1)	14 (8.5)	
10–12	13	4 (36.4)	9 (5.5)	
>12	27	3 (27.3)	24 (14.5)	
Stay in ICU,† days	33	n = 6	n = 27	0.175
1–3	13	1 (16.7)	12 (44.4)	
4–6	8	1 (16.7)	7 (25.9)	
7–9	3	2 (33.3)	1 (3.7)	
10–12	3	1 (16.7)	2 (7.4)	
>12	6	1 (16.7)	5 (18.5)	

*ICU: intesive care unit. *Significant; †Stay in ICU applies only to patients requiring ICU admission.*

Table 6: Demographics, severity, and outcomes of COVID-19 Omicron patients with or without antibiotic treatment (N = 176).

Parameters	Total	Antibiotics given n (%)	Antibiotics not given n (%)	*p*-value
Total patients	176	104	72	
Age group, years				0.164
18–30	13	7 (53.8)	6 (46.2)	
31–45	33	17 (51.5)	16 (48.5)	
46–60	37	17 (45.9)	20 (54.1)	
61–75	54	36 (66.7)	18 (33.3)	
> 75	39	27 (69.2)	12 (30.8)	
Sex				0.030*
Male	105	55 (52.4)	50 (47.6)	
Female	71	49 (69.0)	22 (31.0)	
Disease severity				0.308
Mild	123	69 (56.1)	54 (43.9)	
Moderate	13	10 (76.9)	3 (23.1)	
Severe	40	25 (62.5)	15 (37.5)	
Intensive care unit stay				0.238
Yes	33	23 (69.7)	10 (30.3)	
No	143	81 (56.6)	62 (43.4)	
Length of hospital stay, days				0.060
1–3	61	29 (47.5)	32 (52.5)	
4–6	60	37 (61.7)	23 (38.3)	
7–9	15	13 (86.7)	2 (13.3)	
10–12	13	7 (53.8)	6 (46.2)	
>12	27	18 (66.6)	9 (33.3)	
14–day outcomes				0.196
Death	29	21 (72.4)	8 (27.6)	
Recovered	122	67(54.9)	55 (45.1)	
Remained hospitalized	25	16 (64.0)	9 (36.0)	
Comorbidities				0.997
Yes	139	82 (59.0)	57 (41.0)	
No	37	22 (59.5)	15 (40.5)	
Presence of simultaneous infection				0.029*
Yes	11	10 (90.9)	1 (9.1)	
No	165	94 (57.0)	71 (43.0)	

**Significant.*

(p = 0.029). Notably, four of these 11 patients had a fungal infection for which antibiotics are not indicated.

Table 7 shows associations between the number of antibiotics used and patient/disease characteristics. Patients with severe disease were significantly more likely to receive three antibiotics (24.0%) compared to those with moderate (10.0%) or mild (1.4%) disease (p = 0.002). Significant difference was also observed between patients with severe, moderate, or mild disease who received two or more antibiotics (p = 0.002). A significantly higher percentage of ICU patients received two or more antibiotics compared to non-ICU patients (p = 0.030). The 14-day mortality rate was also significantly higher among those who received two or more antibiotics (p = 0.002).

DISCUSSION

The main finding of this study was that most COVID-19 (Omicron) patients who received antibiotics had no confirmed bacterial coinfection, suggesting there was no clear indication for their necessity. Patient demographics and disease details also offered some significant results. For example, most of our hospitalized patients were aged 61 or older, reflecting the higher severity of the Omicron

Table 7: Number of antibiotics administered per patient compared with patient/disease characteristics (n = 104).

Parameters	Number of antibiotics used						*p*-value
	Total	One n (%)	Two n (%)	Three n (%)	Four n (%)	Five n (%)	
Total patients	104	66	28	8	1	1	
Age group, years							0.224
18–30	7	5 (71.4)	2 (28.6)	-	-	-	
31–45	17	13 (76.5)	3 (17.6)	1 (5.9)	-	-	
46–60	17	7 (41.2)	10 (58.8)		-	-	
61–75	36	24 (66.7)	8 (22.2)	2 (5.6)	1 (2.8)	1 (2.8)	
> 75	27	17 (63.0)	5 (18.5)	5 (18.5)	-	-	
Sex							0.375
Male	55	33 (60.0)	16 (29.1)	6 (10.9)	-	-	
Female	49	33 (67.3)	12 (24.5)	2 (4.1)	1 (2.0)	1 (2.0)	
Disease severity							0.002*
Mild	69	49 (71.0)	19 (27.5)	1 (1.4)	-	-	
Moderate	10	8 (80.0)	1 (10.0)	1 (10.0)	-	-	
Severe	25	9 (36.0)	8 (32.0)	6 (24.0)	1 (4.0)	1 (4.0)	
Intensive care unit admission							0.030*
Yes	23	10 (43.5)	8 (34.8)	3 (13.0)	1 (4.3)	1 (4.3)	
No	81	56 (69.1)	20 (24.7)	5 (6.2)	-	-	
Total stay in hospital, days							0.101
1–3	29	18 (62.1)	9 (31.0)	2 (6.9)	-	-	
4–6	37	28 (75.7)	8 (21.6)	1 (2.7)	-	-	
7–9	13	9 (69.2)	2 (15.3)	2 (15.3)	-	-	
10–12	7	2 (28.6)	5 (71.4)	-	-	-	
>12	18	9 (50.0)	4 (22.2)	3 (16.7)	1 (5.6)	1 (5.6)	
Outcome at 14 days							0.002*
Mortality	21	8 (38.1)	8 (38.1)	4 (19.0)	1 (4.8)		
Recovered	67	50 (74.6)	16 (23.9)	1 (1.5)	-	-	
Remained hospitalized	16	8 (50.0)	4 (25.0)	3 (18.8)	-	1 (6.3)	
Comorbidities							0.386
Present	82	53 (64.6)	22 (26.8)	6 (7.3)	1 (1.2)	-	
Absent	22	13 (59.1)	6 (27.3)	2 (9.1)	-	1 (4.5)	
Simultaneous infections							0.002*
Present	10	2 (20.0)	5 (50.0)	2 (20.0)	1 (10.0)	-	
Absent	94	64 (68.1)	23 (24.5)	6 (6.4)	0 (0.0)	1 (1.1)	

*Dashes (-) indicate zero patients in that category. *Significant.*

variant among the elderly, consistent with Chinese[14] and Japanese[15] studies. However, our overall results also aligned with the reports elsewhere of the relative mildness of the Omicron variant, as most of our hospitalized patients had mild disease (69.9%).[16,17]

During the pre-Omicron period (March 2020 – November 2021), all COVID-19 cases admitted to RH were moderate to severe. With the emergence of the Omicron variant (December 2021 – February 2022), most cases were mild. During this period, many patients admitted for other reasons were found to be Omicron positive as well—with mild symptoms. A Japanese study reported that during the Omicron period, coinfection or deterioration of an underlying disease had a more significant effect on hospitalization than COVID-19 infection itself.[15] In the present study, 69.3% of the patients recovered from the disease while 16.5% died by 14 days, somewhat high for Omicron, but explained by older age and comorbidities. In an Omicron-period study in Iran, the death rate among hospitalized patients with Omicron BA.5 variant was 6.25%.[18] In California, USA, adults hospitalized during Omicron period had lower likelihood of ICU

admission, perhaps due to higher proportion of vaccinated patients.[19]

In our cohort, only 6.3% of patients had simultaneous infections (bacterial and fungal) and only 4.0% had bacterial infection. Comparable rates have been reported in Germany (7.1%),[20] though higher rates were reported elsewhere (USA: 19%; Iran:14.4%),[21] but significantly lower in Pakistan (1.4%).[22] A Japanese study reported significantly higher rates of coinfections in the Omicron period than in the pre-Omicron period (44.4% vs. 0.8%).[15] A 2023 WHO study which included 592898 patients from 65 countries between January 2020 and March 2023 (covering all major variants of SARS-CoV2) estimated an overall co-infection rate of 7.9%.[23]

In the present study, *E. coli* was the most prevalent pathogen (2; 18.2%), which could be related to urinary source being the second most common infection after septic shock. Data from Europe (17.5%) and USA (26%) also reflect the high prevalence of E. coli.[24,25] Candida *spps.* was isolated in four of our patients, suggesting superinfections rather than coinfections.

Overall, 59.1% of this cohort received antibiotics similar to the Hong Kong study.[12] In 2023, the WHO global review on antibiotic use showed wide inter-regional variations ranging from 83.0% in the Eastern Mediterranean Region to 32.8% in the Western Pacific Region.[23] High rate of antibiotic use was also reported before the Omicron wave—USA (67%), Jordan (69%), Ireland (78.4%), and Pakistan (93.7%).[22,25–27]

Despite a low rate of confirmed coinfections, 59.1% of our patients received antibiotics, likely due to the challenge of ruling out bacterial infections in severely ill presentations. However, our antimicrobial stewardship team reviewed such empirical antibiotic use, which were typically discontinued within 72 hours if cultures were negative. A pre-Omicron period study in Ireland reported 66.4% of empirical antibiotic prescription for suspected pneumonia in their COVID-19 patients.[27] Another early study in Pakistan (April 2021) revealed an extremely high rate of 96.3% .[22]

Most empiric antibiotics administered to our cohort were systemic—ceftriaxone, piperacillin and tazobactam (45.2%); vancomycin (21.2%); and meropenem (15.4%). Ceftriaxone was also the most prescribed empiric antibiotic in USA and Bangladesh.[25,27] Azithromycin was the least used antibiotic in our cohort, but an Omani study by Khamis et al,[10] reported it to be the preferred antibiotic, administered to 71% of COVID-19 patients early in the pandemic, till April 2020. In the early days of the pandemic, azithromycin was commonly prescribed until later studies disproved its presumed benefits. In USA, empirical use of vancomycin was common, as in our cohort.[25] Early in the pandemic (till May 2020) an Irish study by O'Kelly et al,[26] found the most common empirical antibiotic prescribed to be piperacillin and tazobactam, ceftriaxone and co-amoxiclav. In another early study conducted in Jordan (October–December 2020), fluoroquinolone (31.9%), macrolide (25.0%), and third generation cephalosporin (17.6%) were prominent.[28]

These variations in antibiotic use across studies could be due to differences in study timing, national guidelines, drug availability, and local resistance patterns. In our study, nearly half of the patients received antibiotics for one to three days only. In the Jordanian study above, only 17.5% of patients were on antibiotics for less than three days.[28] Early discontinuation because of negative microbial culture may help reduce the risk of antibiotic resistance, emphasizing the value of antibiotic stewardship.

We found that the presence of simultaneous infection was positively associated with severity of the disease, mortality, and duration of hospital stay. Similar findings were reported in a Chinese cohort comprising severe and critical hospitalized Omicron patients.[14]

We also noted that the antibiotic usage rate differed significantly with sex and presence of simultaneous infection. Antibiotics were more frequently used among female patients than male patients. Most of our patients with a simultaneous infection (90.9%) received antibiotics compared with 57.0% of those without. It is not clear why our female patients were more likely to receive antibiotics compared to men, which requires further investigation. Unlike our study, where no significant correlation between antibiotic use and 14-day outcome, data from Jordan found that non-survivors were more likely to be prescribed antibiotics than survivors (93.1% vs. 65.2%).[28]

Furthermore, we found a significant association between the number of antibiotics used and disease severity, simultaneous infection, ICU admission, and 14-day outcome. Multiple antibiotic use was

positively associated with disease severity. Patients with more severe disease and/or comorbidities tend to be prescribed multiple antibiotics and treated longer. Furthermore, the prolonged hospital stay increases the risk of nosocomial infections, calling for more antibiotic use. In the scoping review by Cong et al,[29] the antibiotic prescribing rate for severe COVID-19 cases was 75.3% and 48.3% compared with 75.1% and 15.5% for mild and moderate cases according to results from two study periods in the pre-Omicron phase.

Despite no significant difference in overall mortality between patients who did or did not receive antibiotics, antibiotic usage (two or more antibiotics) was more common among patients with severe disease and where death was the 14-day outcome. This may be due to simultaneous infection and comorbidities among these patients. Single antibiotic use was more likely among survivors (50.0%) than those who died (38.1%). It is possible that survivors had milder disease without comorbidities. On the other hand, in the study in Jordan, non-survivors were more likely to have been prescribed single antibiotics (55.2%) compared to survivors (34.8%).[28] In the WHO's global review, a sensitivity analysis focusing on patients without suspected or confirmed bacterial infection showed nearly twice the risk of death among mild/moderate patients receiving empiric therapy compared to those not receiving antibiotics and a 16% higher risk among severe/critical patients.[2]

The study has several limitations. Being single center and retrospective, our findings may not be fully generalizable. Although the RH was at the forefront in managing COVID-19 cases and formulating national guidelines, antibiotic usage patterns may vary in different regions of Oman. Additionally, our analysis of antibiotic use is limited to patients infected with the Omicron variant of the disease, for which published studies are fewer, limiting robust comparisons.

CONCLUSION

The key finding of this study was that in vast majority of the patients who received antibiotics, there was no reported bacterial coinfection, indicating potentially unwarranted use. Although antibiotics did not clearly affect overall outcomes, the use of two or more antibiotics was more common in severe cases and those with 14-day mortality. These findings highlight the need for stricter antimicrobial stewardship, particularly in the absence of confirmed bacterial infections. Detailed evaluation, education, and development of policies are crucial to limit unwarranted antibiotic use in the future.

Disclosure

The authors declare no conflicts of interest. No funding was received for this study.

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