

Characteristics and outcomes of COVID-19 patients hospitalized at a Central Hospital in Harare, 2020-2022

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ABSTRACT

Introduction: In June 2021, Zimbabwe experienced a third COVID-19 wave characterized by a 3.5% case fatality rate compared to 1.5% in the first wave and 2.6% in the second wave. Sixty-eight percent of these deaths were among hospitalized patients. We investigated the characteristics and outcomes of hospitalized COVID-19 patients at a central hospital in Harare from 2020 to 2022. The findings are critical in informing strategies for managing future epidemics and public health threats in the country. **Methods:** We conducted an analytic cross-sectional study using secondary data from 384 randomly sampled COVID-19 patient admission records. Participants were any COVID-19 patients hospitalized at the central hospital in Harare from March 2020 to September 2022. Demographic and clinical characteristics, vaccination status, and treatment outcome were collected using an adapted abstraction tool. Descriptive statistics, odds ratios, and confidence intervals were generated using Epi Info. **Results:** Of the 384 hospitalized patients, 234 (60.9%) were females. Eighty-four of 384 (21.9%) patients were between 61-70 years. Common symptoms recorded were shortness of breath 286 (74.5%), cough 135 (35.2%), and fatigue 67 (17.5%). The top two comorbidities were hypertension, 125 (35.3%), and diabetes mellitus, 52 (13.5%). In-hospital mortality was 99/384 (25.8%). Oxygen saturation levels 80–88% on room air [AOR = 0.02; 95% CI: 0.001–0.30], 88–100% on oxygen [AOR = 0.03; 95% CI: 0.003–0.26], and 89–100% on room air [AOR = 0.004; 95% CI: 0.0002–0.05], moderate disease [AOR = 3.94; 95% CI: 3.23–4.81] and severe disease [AOR = 6.26; 95% CI: 5.46–7.18] were independently associated with in-hospital mortality among hospitalized COVID-19 patients. **Conclusion:** Most hospitalizations were among females and older people. Oxygen saturation levels and disease severity impacted hospitalization outcomes. We facilitated the intensification of case-based surveillance and review of case management protocols and recommended targeted vaccinations in high-risk groups.

KEYWORDS: SARS-CoV2, COVID-19, Hospitalization, Characteristics, Outcomes

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RECEIVED

29/05/2024

ACCEPTED

11/07/2025

PUBLISHED

14/07/2025

LINK

www.afenet-journal.net/content/article/https://afenet-journal.org/characteristics-and-outcomes-of-covid-19-patients-hospitalized-at-a-central-hospital-in-harare-2020-2022/

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CITATION

Linda Nyasha Kanzara et al Characteristics and outcomes of COVID-19 patients hospitalized at a Central Hospital in Harare, 2020-2022. Journal of Interventional Epidemiology and Public Health. 2025 Jul; 8(3):52

DOI:

<https://doi.org/10.37432/jieph.2025.8.3.172>

Introduction

Coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first reported in Wuhan, Hubei Province, China on 31 December 2019 [1]. The World Health Organization (WHO) declared COVID-19 a Public Health Emergency of International Concern (PHEIC) on 30 January 2020 and a global pandemic on March 11, 2020 [2]. The virus rapidly spread worldwide, with cases and fatalities surging across regions, particularly in Europe and the Americas by early 2022 [3]. COVID-19 cases reached Africa by February 2020, with Zimbabwe reporting its first case in March 2020 [4, 5]. The Zimbabwean government implemented several containment measures, including lockdowns and restrictions on travel and business operations. SARS-CoV-2 mutates over time resulting in varying changes to the virus's properties. Some of these changes may affect the virus' properties including transmissibility, associated disease severity, and the performance of vaccines, therapeutic medicines, and diagnostic tools [6]. These changes in turn have implications on public health and social measures. Thus, the importance of monitoring and tracking variants. The COVID-19 pandemic was characterized by different waves and variants since December 2019 to date.

The mutating variants of COVID-19 presented an urgent need to develop treatments and vaccines to control the rate of infection and spread. Zimbabwe initiated a nationwide COVID-19 vaccination campaign using the Sinopharm vaccine in February 2021, prioritizing high-risk groups like healthcare workers, essential personnel, and the elderly[5]. As the country received more vaccines, the vaccination program was extended to all eligible populations voluntarily and free of charge [7].

The severity of the disease is classified as mild illness, moderate illness, severe illness, and critical illness [8]. Mild illness refers to when a patient has various signs and symptoms of COVID-19 but no shortness of breath, dyspnea, or abnormal chest imaging. Moderate illness is when patients show evidence of lower respiratory disease during clinical assessment or imaging and who have an oxygen saturation (SpO₂) \geq 94% on room air at sea level. Patients with critical illness have respiratory failure, septic shock, and/or multiple organ dysfunction [8]. Clinical presentations of COVID-19 vary widely, ranging

from asymptomatic to critical illness. [8]. Common symptoms include fever, cough, and respiratory distress, body aches, headache, loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting and diarrhea. These symptoms typically appear 2-14 days after exposure to the virus [9].

In June 2021, Zimbabwe experienced a third COVID-19 wave characterized by a 3.5% case fatality rate compared to 1.5% in the first wave and 2.6% in the second wave. Harare City recorded a case fatality rate (CFR) of 4.6% against a national CFR of 3.2% despite public health preparedness and response measures being put in place.

We analyzed the characteristics and outcomes of hospitalized COVID-19 patients at a Central Hospital in Harare to describe demographic characteristics, clinical presentation, comorbidities and treatment outcomes. This study is particularly relevant for the African context, where initial access to COVID-19 vaccines and therapeutics was limited, delaying population-level immunity and potentially impacting mortality outcomes. COVID-19 mortality data in Africa have been based on population-level estimates, often obscuring outcomes within specialized healthcare facilities [10]. The study will contribute to the development of more targeted and effective interventions and policies for managing future epidemics and public health threats.

Methods

Study design

An analytic cross-sectional study using secondary data was conducted to describe clinical characteristics and outcomes of COVID-19 patients within Harare and other provinces that required hospital isolation and were referred to the Central Hospital in Harare.

Study setting

The study was conducted at a Central Hospital in Harare which was the main public hospital for COVID-19 care in Zimbabwe. During the pandemic it had a dedicated COVID-19 ward with a maximum bed capacity of 425 created by converting existing wards. COVID-19 patients within Harare and other provinces requiring hospital isolation were referred to the Central Hospital. The hospital drew patients from across Zimbabwe, although most referrals were from Harare. It received patients from both public and private facilities in the region, many of whom required specialized hospitalization due to the

severity of their condition. The hospital is under the administration of the Ministry of Health and Child Care (MOHCC). COVID-19 patients were managed according to MOHCC COVID-19 case management guidelines.

Standard of care at study setting

The standard of care for COVID-19 patients at the Central Hospital in Harare evolved in response to emerging guidelines and resource availability throughout the pandemic. Initially, treatment focused on supportive care, including oxygen therapy and management of symptoms. The hospital adapted its protocols as WHO and Ministry of Health guidelines were updated, with a focus on providing optimal care despite the challenges of limited resources during the pandemic's peak.

Disease severity on admission was assessed using the WHO criteria. Mild illness was defined as a patient with various signs and symptoms of COVID-19 but no shortness of breath, dyspnea, or abnormal chest imaging. Moderate illness as a patient showing evidence of lower respiratory disease during clinical assessment or imaging and have an oxygen saturation (SpO₂) \geq 94% on room air at sea level. Patients with critical illness were those respiratory failure, septic shock, and/or multiple organ dysfunction [8].

Study population and data source

The study population was records of COVID-19 patients hospitalized at the Central Hospital from March 2020 to September 2022. COVID-19 patients' admission records were used as the data source. The COVID-19 patient admission records were kept as paper-based data sets at the hospital. Variables analyzed included age, sex, symptoms, comorbidities, severity of illness, oxygen saturation, and outcome of hospitalization.

Inclusion criteria: All patient records meeting the following criteria were included in the study:

1. **Confirmed COVID-19 diagnosis:** Only patients with a confirmed diagnosis of COVID-19 who required hospitalization were included.
2. **Time frame:** Records of patients admitted between March 2020 and September 2022 were eligible.

Exclusion criteria: All patients who had incomplete demographic, clinical characteristics, vaccination

status and outcome data were excluded from the study.

Data were extracted from paper-based hospital records, and any patients with incomplete critical information were excluded from the final analysis to maintain data quality and consistency.

Sampling strategy and sample size calculation

The sample size was calculated using Dobson formula; based on a reported in-hospital COVID-19 mortality rate of 11.5% by Macedo et al (2021), where (p=0.115), at a 95% confidence level, z=1.96 and d=0.5, and a non-response rate of 10%. [11]. A minimum sample size of 174 was calculated. A final sample size of 384 was used to ensure sufficient power and account for subgroup analysis in the study.

From the 1,690 available physical records, we selected 384 records using systematic random sampling to ensure representativeness. We calculated the sampling interval by dividing the total number of records (1,690) by the required sample size (384), yielding an interval of approximately every 4th record. Starting from a randomly chosen point within the first four records, we then systematically selected every 4th record.

Data collection and extraction

A pretested standard data abstraction form adapted from Morris et.al (2020) was used to collect study variables from the hard copy COVID-19 patient records of hospitalized patients at the Central Hospital [12]. Data was captured in Microsoft Excel (.xls) format and then imported into Epi Info for analysis.

Data analysis

Data were cleaned and key variables recoded to suit the study objectives. Descriptive statistics were used to summarize patient characteristics, with results presented as frequencies and proportions. Bivariate analysis using Pearson's Chi-square test assessed associations between in-hospital mortality and categorical independent variables. Crude odds ratios (ORs) with 95% confidence intervals (CIs) were calculated using bivariate logistic regression. Variables with a p-value \leq 0.25 were included in a multivariate logistic regression model using backward stepwise selection to control for confounding and identify independent predictors of in-hospital mortality. All analyses were conducted

using Epi Info version 7.2.4.0, and statistical significance was set at $p < 0.05$.

Permission and ethical consideration

Permission to conduct the study was obtained from the Health Studies Office (HSO), the Head of the Department of the COVID-19 isolation ward, and Hospital Executives. Ethical approval for this study was granted by the Hospital's Institutional Review Board (IRB)(PGH/42/123). In line with ethical standards, patient confidentiality was strictly maintained, and no identifying information was included in the data used for analysis. Sharing of the data was also restricted to educational and public health purposes.

Results

Demographic Characteristics

We analyzed 384 out of 1,690 medical records of COVID-19 patients admitted at the Central Hospital between 2020 and 2022. The study population comprised 234 (60.9%) females and 150 (39.1%) males. The largest age group was 61–70 years, representing 84 (21.9%) of patients (Table 1).

Clinical Characteristics

A total of 159 (41.4%) had moderate illness, and 20 (5.2%) had mild disease. Most patients (351; 91.4%) were unvaccinated. Oxygen saturation between 88–100% on oxygen was recorded in 292 (76.0%) patients, 89–100% on room air in 57 (14.8%) patients, and 80–88% on room air in 15 (3.9%) patients (Table 1).

The most common symptoms experienced by the patients were shortness of breath 286 (74.5%), cough 135 (35.2%), and fatigue 67 (17.5%). The least common experienced symptoms by hospitalized patients were loss of smell 4 (1.4%) and runny nose 3 (0.8%) (Table 3). More than half of the hospitalized patients (209; 54.4%) had at least one comorbidity. The most frequently reported conditions were hypertension and diabetes mellitus. Hypertension was present in 118 patients (30.7%) and diabetes in 78 patients (20.3%). Other recorded comorbidities included HIV (15; 3.9%), chronic kidney disease (7; 1.8%), asthma (6; 1.6%), coronary artery disease (5; 1.3%), and congestive heart failure (3; 0.8%). Only 15 (3.9%) of the patients had Asthma/COPD (Table 2, Figure 1).

Factors associated with hospitalization outcomes amongst COVID-19 patients

Out of the 384 patients analyzed, 285 (74.2%) were discharged and 99 (25.8%) died. Overall, most of the demographic and clinical characteristics of hospitalized patients were not significantly associated with mortality (Table 1). Oxygen saturation and disease severity were identified as independent predictors of death among hospitalized COVID-19 patients. Compared to patients with oxygen saturation levels below 88% while on oxygen, those with saturation between 80–88% on room air had significantly lower odds of death [AOR = 0.02; 95% CI: 0.001–0.30]. Patients with saturation between 88–100% on oxygen also had reduced odds of death [AOR = 0.03; 95% CI: 0.003–0.26], as did those with 89–100% on room air [AOR = 0.004; 95% CI: 0.0002–0.05]. Patients with moderate disease had nearly four times the odds of death compared to those with mild disease [AOR = 3.94; 95% CI: 3.23–4.81], while those with severe disease had more than six times the odds of death [AOR = 6.26; 95% CI: 5.46–7.18] (Table 3).

Discussion

The findings indicate that clinical severity and oxygen saturation levels at admission were significant predictors of in-hospital mortality among COVID-19 patients admitted to a central hospital in Harare. Patients who were female, older, severely ill, and unvaccinated formed the majority of those hospitalized, with hypertension and diabetes mellitus being the most reported comorbidities. Shortness of breath, cough, and fatigue were the top three reported symptoms. Nearly three-quarters of the hospitalized patients were discharged. Those admitted with lower oxygen saturation and more severe disease were less likely to survive, while patients with higher oxygen saturation and mild disease were more likely to be discharged.

COVID-19 hospitalizations at the Central Hospital in Harare increased with age, with most hospitalized patients falling between 61–70 years. The CDC (2021) indicated that the risk of severe COVID-19 illness resulting in hospitalizations and intensive care increases with age and particularly affects adults older than 50 years [13]. The same is supported by a study conducted in a Spanish cohort which identified older age as a risk factor for severe disease

necessitating hospitalization during the COVID-19 pandemic [14].

More females compared to males were hospitalized in this study. On the contrary, a study by Nechega *et.al.* (2020) in the Democratic Republic of Congo (DRC) reported more hospitalizations among males (65.6%) than females [15]. An analysis done in the United States of America in New York City and Bucks County, Pennsylvania in 2019 amongst hospitalized patients noted greater rates of hospitalization from COVID-19 among men than women [16]. The noted differences in hospitalization may be due to a range of contextual factors that include differences in health-seeking behaviours, with women potentially more likely to access care early in the context in which the study was carried out.

In this study, most of the patients had mild and moderate disease on admission. However, Nechega *et.al* (2020) in their study found that 24.9% of the patients had either severe or critical disease upon admission [15]. The referral system likely influenced the observed lower proportion of severe cases in this study. As a designated COVID-19 treatment facility, the Central Hospital likely received a substantial number of patients who would have initially been evaluated and immediately referred from other health facilities, potentially skewing our sample toward patients with mild to moderate disease upon admission. This referral pathway could thus explain why fewer severe cases on admission were documented.

In this study, less than a tenth of the hospitalizations were amongst vaccinated patients. Maslo *et.al.* (2022) in South Africa found that 24.2% of all the hospitalized patients in their study were vaccinated, slightly higher than the proportion observed in this study [17]. This is consistent with the timeline of Zimbabwe's vaccination rollout which was introduced in February 2021, hence, the high proportion of unvaccinated patients in this study could be attributable to patients hospitalized before the rollout of the vaccine [18].

Shortness of breath, cough, and fatigue were the most common symptoms reported by patients in this study. These findings are aligned with reports by the CDC, which listed cough, fatigue, and difficulty in

breathing among the common symptoms of COVID-19 [9].

Severe disease of COVID-19 has been reported to be more prevalent in patients with underlying comorbidities, which include cardiovascular disease, chronic lung disease, sickle cell disease, diabetes, cancer, obesity, or chronic kidney disease [15]. Kaswa *et.al* (2021) in their study conducted in South Africa, found that 188 (77.6%) hospitalized patients had clinical comorbidity on admission, with diabetes consisting of 36.8% and hypertension 33.1% amongst other comorbidities [19]. Comparably, in this study, the two most common comorbidities upon admission were hypertension and diabetes. Over half of the patients had at least one comorbidity, reaffirming the association between underlying conditions and hospitalization risk.

Nearly three-quarters of the hospitalized patients in this study were discharged. In a similar study in Saudi Arabia, 89% of hospitalized patients were discharged from the hospital [20]. Meanwhile, in-hospital mortality from COVID-19 hospitalizations in this study exceeded the global estimates, which range between 15% and 20% [21]. The high proportions of in-hospital mortality recorded in this study may be an indication of gaps in case management, limited critical care capacity and/or delays in presentation and admission to the hospital. In-hospital mortality was greater among patients with severe disease than patients with mild/moderate disease as reported by Nechega *et.al* (2020) from the findings of their study in DRC [15]. This correlates with the findings of this study where mild and moderate disease patients were more likely to be discharged than severe disease patients. Oxygen saturation was also an independent predictor of mortality. Patients who had less than 88% saturation and were on oxygen were unlikely to have a positive treatment outcome when compared to those with higher oxygen saturation on either air or oxygen. Similarly, mortality in patients receiving supplemental oxygen was greater than that among those who did not as revealed in this study conducted in DRC [15].

This study is one of the few studies that have explored the characteristics and outcomes of COVID-19 hospitalized patients in Zimbabwe. However, some limitations inherent to the use of secondary data were noted. The lack of

detailed time-to-event and censoring information limited survival analyses, while missing data on specific therapeutics and clinical metrics constrained the assessment of quality-of-care impacts. The inclusion of patient records before or at the beginning of COVID-19 vaccination resulted in smaller sample sizes affecting regression analysis reliability for the vaccination category. Future studies should include sub-analysis for vaccinated and unvaccinated patients pre- and post-vaccine introduction. The study findings could not differentiate whether death was directly related to COVID-19 and no follow-up data was available following the discharge of patients. Hence the potential risk of underestimating or overestimating the death outcome. Our data source was limited to one public health facility and selection bias may have been introduced, thereby affecting the generalizability of the study findings.

Conclusion

In this study, patients hospitalized at the Central Hospital in Harare had a high in-hospital mortality compared to similar studies. The risk of hospitalization and death significantly increased with, severe disease and low oxygen saturation upon admission. Our study provides insights into public health social measures and medical countermeasures that can be implemented to address future respiratory pandemics.

We recommended strengthened pandemic preparedness and response capacities including continued COVID-19 surveillance as new SARS-CoV-2 variants arise, review and updating of COVID-19 case management guidelines using emerging evidence, treatments, and technologies, continued enforcement of public health social measures (PHSM) and vaccination to prevent severe diseases, particularly amongst high-risk populations i.e., older persons and those with comorbidities, and risk communication and community engagement focusing on early health-seeking behaviours and PHSM.

What is already known about the topic

- COVID-19 has presented a significant challenge to healthcare systems globally, with multiple waves of varying severity impacting different regions.

- Previous studies have identified age, gender, comorbidities, and disease severity as factors influencing COVID-19 outcomes and mortality rates.
- Hospitals play a crucial role in managing severe cases of COVID-19, with in-hospital mortality rates serving as a key indicator of disease burden and healthcare effectiveness.

What this study adds

- The study provides specific insights into the characteristics and outcomes of hospitalized COVID-19 patients in Zimbabwe, shedding light on the local impact of the pandemic.
- By identifying oxygen saturation levels and comorbidities as significant factors associated with in-hospital mortality, the study offers actionable information for improving patient management and outcomes in Zimbabwean healthcare settings.
- The study's recommendation for targeted vaccinations in high-risk groups underscores the importance of tailored public health strategies to mitigate the impact of COVID-19 on vulnerable populations, contributing to more effective disease control efforts locally.

Competing Interest

The authors declare that they have no competing interests.

Funding

The authors did not receive any specific funding for the work.

Acknowledgements

We would like to acknowledge the Ministry of Health and Child Care, African Field Epidemiology Network, and Health Studies Office: University of Zimbabwe.

Authors' contributions

Linda Nyasha Kanzara, Hamufare Mugauri, Isaac Phiri, Tsitsi Patience Juru, Gerald Shambira, Notion Tafara Gombe, Mufuta Tshimanga: conception, design, and acquisition of data. Linda Nyasha Kanzara, Hamufare Mugauri, and Isaac Phiri conducted data analysis and interpretation of data. Linda Nyasha Kanzara, Hamufare Mugauri, and Isaac Phiri wrote the first draft of the manuscript.

Tsitsi Patience Juru, Gerald Shambira, Notion Tafara Gombe, and Mufuta Tshimanga: reviewed several drafts of the manuscript for intellectual

content. The manuscript was read and approved by all authors.

Table 1: Characteristics of COVID-19 patients hospitalized at a Central Hospital in Harare, 2020-2022

Variable	Total (%)	Discharged N=285 (n, %)	Died N=99 (n, %)	P-value
Age (years)				
Median		55 (35 -65)	55 (35 -65)	
Less than 30	55 (14.3)	43 (78.1)	12 (21.8)	0.88**
31 – 40	59 (15.4)	41 (69.5)	18 (30.5)	
41 – 50	57 (14.8)	40 (70.2)	17 (29.8)	
51 – 60	55 (14.3)	41 (74.5)	14 (25.5)	
61 – 70	84 (21.9)	62 (73.8)	22 (26.2)	
71 – 80	50 (13.0)	40 (80.0)	10 (20.0)	
>80	24 (6.2)	18 (75.0)	6 (25.0)	
Symptom Duration (days)				
0-3 days	206 (53.7)	161 (78.2)	45 (21.8)	0.36**
4-7 days	144 (37.5)	101 (70.1)	43 (29.9)	
8-11 days	10 (2.6)	7 (77.8)	3 (22.2)	
12-15 days	17 (4.4)	11 (64.7)	6 (35.3)	
>15 days	7 (1.8)	5 (71.4)	2 (28.5)	
Sex				
Female	234 (60.9)	173 (73.9)	61 (26.1)	0.97**
Male	150 (39.1)	112 (74.7)	38 (25.3)	
Oxygen Saturation				
< 88% on oxygen	20 (5.2)	11 (55.0)	9 (45.0)	< 0.001*
80-88% on air	16 (4.8)	7 (46.7)	9 (53.3)	
88-100% on oxygen	291 (75.8)	232 (79.7)	59 (20.3)	
89-100% on air	57 (14.8)	35 (61.4)	22 (38.6)	
Comorbidities				
No	175 (45.6)	126 (72.0%)	49 (28.0%)	0.43**
Yes	209 (54.4)	159 (76.1%)	50 (23.9%)	
Pregnancy				
No	378 (98.4)	281 (74.3)	97 (25.7)	1.00
Yes	6 (1.6)	4 (66.7)	2 (33.3)	
Alcohol Use				
No	380 (98.9)	282 (74.2)	98 (25.8)	0.26*
Yes	4 (1.04)	3 (75.0)	1 (25.0)	
Disease Severity				
Mild	20 (5.21)	14 (70.0)	6 (30.0)	< 0.001*
Moderate	159 (41.4)	99 (62.3)	60 (37.7)	
Severe	205 (53.4)	172 (83.9)	33 (16.1)	
Vaccination Status				
Unvaccinated	351 (91.4)	258 (73.5)	93 (26.5)	0.29**
Single dose	27 (7.03)	23 (85.2)	4 (14.8)	
Two or more doses	6 (1.6)	4 (66.6)	2 (33.3)	
*Significant (P < 0.05); **Non-significant (P > 0.05)				

Table 2: Clinical presentation of COVID-19 patients hospitalized at a Central Hospital in Harare, 2020–2022

Symptoms	Cases N=384 n (%)	Discharged n (%)	Dead n (%)
Shortness of breath	286 (74.5)	213 (74.4)	73 (25.5)
Cough	135 (35.2)	99 (73.2)	36 (26.6)
Fatigue	67 (17.5)	13 (19.4)	54 (80.6)
Headache	42 (10.9)	25 (59.5)	17 (40.5)
Fever	41 (10.7)	30 (73.2)	11 (26.8)
Joint and muscle pain	29 (7.6)	14 (48.3)	15 (51.7)
Loss of appetite	25 (6.5)	20 (80)	5 (20)
Vomiting	17 (4.4)	8 (47.1)	9 (52.9)
Sore throat	11 (2.9)	9 (81.8)	2 (18.2)
Chills	10 (2.6)	7 (70)	3 (30)
Nausea	7 (1.8)	3 (42.9)	4 (57.1)
Loss of taste	6 (1.6)	3 (50)	3 (50)
Loss of smell	4 (1.4)	1 (25)	3 (75)
Runny nose	3 (0.8)	3 (100)	0

Table 3: Independent factors associated with death outcome amongst hospitalized COVID-19 patients at a Central Hospital in Harare, 2022

Variable	COR	95% CI	P-value	AOR	95% CI	P-value
Oxygen Saturation						
< 88% on oxygen	Ref			Ref		
80-88% on air	0.02	0.002 – 0.14	< 0.001*	0.02	0.001 – 0.30	0.004*
88-100% on oxygen	0.01	0.001 – 0.099	< 0.001*	0.03	0.003 – 0.26	0.002*
89-100% on air	0.001	0.000 – 0.022	< 0.001*	0.004	0.0002 – 0.05	< 0.001*
Disease Severity						
Mild	Ref			Ref		
Moderate	1.01	0.12 – 8.49	0.99	3.94	3.23 – 4.81	< 0.003*
Severe	14.87	1.95 – 113.15	< 0.001*	6.26	5.46 – 7.18	< 0.001*
*AOR = adjusted odds ratio, COR = crude odds ratio, Ref = reference category *Significant ($P < 0.05$); **Non-significant ($P > 0.05$)						