

# Characteristics of the COVID-19 patients treated at Gulu Regional Referral Hospital, Northern Uganda: A cross-sectional study

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## Research Article

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# Abstract

## Background

Coronavirus Disease 2019 (COVID-19) is a severe respiratory disease that results from infection with a new coronavirus (SARS-CoV-2). One of the most critical issues related to the COVID-19 is the high rate of spread, millions of people have been infected around the world, and hundreds of thousands of people have died till now. However, reports from Africa paint a different picture of the SARS-CoV-2 and its effects on the population.

## Objectives

The objective of this study was to describe the characteristics of the COVID-19 patients treated at the Gulu Regional Referral Hospital and determine factors associated with COVID-19 manifestations, socio-demographic characteristics, and treatment outcomes from March 2020 to October 2021.

## Methods

A retrospective data abstraction of all COVID-19 hospital admissions registered in the Gulu Health Management Information System (HMIS) database and other tools were conducted. The period of study was March 2020 to October 2021. Data that met the inclusion criteria were consecutively abstracted from the Gulu Hospital HMIS database. A local IRB approved the study. SPSS version 25.0 was used for data analysis, and a p-value of 0.05 was considered significant.

## Results

Data suggests there were three waves of COVID-19 in Uganda. Those with comorbidities, e.g., Diabetes mellitus 38(5.7%), hypertension 83(12.5%), cardiovascular diseases 58(8.7%), HIV and AIDS 61(9.2%), and other comorbidities such as liver cirrhosis and hepatitis B 40(6.0%) were more susceptible and presented with severe forms of the disease. Antibiotics 662(99.7%), steroids 73(11.0%), vitamin C 564(84.9%), Ivermectin 7(1.1%), and Vitamin D 24(3.6%) were the most used medicines for the treatment of COVID-19 patients. Most COVID-19 patients were unvaccinated 661(99.5%). However, the recovery rate was 632(95.2%). The commonest complications were pneumonia 60(9.0%), chronic fatigue 49(7.4%), acute respiratory distress syndrome (ARDS) 37(5.6%), depression 20(3.0%), systemic infections 19(2.9%), nightmares 15(2.3%) and septic shock 8(1.2%). The Adjusted Odds Ratios (AOR) on factors associated with recovery were treated with steroids AOR=138.835 at 95% CI:12.258-1572.50;  $p<0.000$  and Vitamin D AOR=0.016 at 95% CI:1.902-520.98;  $p=0.016$ .

## Conclusion

This study showed successful management of COVID-19 patients in low-resource settings with a recovery rate of 95.2%. The admission pattern suggests Uganda had three waves of COVID-19, contrary to the official government position of two. Treatment with steroids and Vitamin D is associated with the recovery of COVID-19 patients. There is a need to conduct more extensive studies on the role played by the two drugs in the successful recovery of COVID-19 patients.

# Introduction

Coronavirus Disease 2019 (COVID-19) is a severe respiratory disease that results from infection with a new coronavirus (SARS-COV-2) [1]. One of the most critical issues related to the COVID-19 is the high rate of spread, millions of people have been infected around the world, and hundreds of thousands of deaths till now have been recorded [1]. Patients suffering from different symptoms like fever, dry cough, and fatigue which is usually mild in about 80% of cases, but the more severe cases may progress to develop respiratory distress or respiratory failure, and hence the increased need for intensive care unit (ICU) services [1].

The severity of the disease is related to the age and comorbidities of the infected person; elderly persons are affected more severely with a need for ICU services [2]. The severity of symptoms is also related to its duration, where for mild cases, symptoms may last for two weeks, while for severe cases, it ranges from 3 to 6 weeks [3]. Direct contacts to confirmed cases are the disease's primary way of spreading because the SARS-COV-2 is transmitted through exhaled air and aerosols [4]. Diagnosis of COVID-19 is conducted using Reverse Transcriptase Polymer Chain Reaction (RT-PCR), Computed Tomography (CT) scan, and blood tests [5]. Supportive treatment is the primary choice for mild cases, including antibiotics, vitamins, trace elements, and antipyretics. At the same time, oxygen therapy with or without mechanical ventilation is introduced and individualized according to each case [6]. Many drugs have been included in clinical trials to act as antiviral agents to the coronavirus disease. Still, no precise results indicate the confirmed effect for any investigated drugs [7-9]. In addition to symptomatic therapy, corticosteroids as an anti-inflammatory agent have been found to play a vital role in the management of severe cases [10].

Thousands of infected patients have recovered from the disease, and this recovery is confirmed by another RT-PCR test or by the absence of the symptoms of the disease for several days. However, no documented study in Uganda provides information on the clinical characterization of COVID-19 cases, treatment outcomes, and factors associated with the clinical presentations and treatment outcomes.

The objective of this study was to describe the characteristics of the COVID-19 patients treated at the Gulu Regional Referral Hospital and determine factors associated with the COVID-19 manifestations, socio-demographic characteristics, and treatment outcomes.

## Materials And Methods

### Study site

This study was conducted at Gulu Regional Referral Hospital in Northern Uganda, covering admissions of COVID-19 patients from March 2020 to October 2021. Gulu Hospital is a regional referral center for patients from northern Uganda. However, it receives patients from neighboring countries, for example, South Sudan and the Democratic Republic of Congo (DR Congo). It is also a teaching hospital for Gulu University Medical school and many other health training institutions in the region. It is a 394-bed capacity hospital with outpatient and inpatients services estimated at 120,000 patients every year. The Hospital has specialized units such as internal medicine, surgery, pediatrics, reproductive health, TB, HIV, cardiac, chest, dental, dermatology, sickle cell disease, diabetes, hypertension, Ear, Nose and throat, nutrition, accident and emergency, laboratory, ophthalmology, mental health, and orthopedic clinics that consultants manage from Gulu Hospital and Gulu University.

Gulu Regional Referral Hospital was designated by the Ugandan Ministry of Health as a treatment center for COVID-19 patients in March 2020 when COVID-19 was declared a pandemic. As a result, a particular treatment unit for the management of COVID-19 (Gulu CTU) was established with a fully-fledged high dependency unit (HDU), with Oxygen

supply and staff to manage the department. The team leader for the Gulu CTU is a consultant physician who cares for all the COVID-19 patients admitted to the unit. In addition, the Ugandan Ministry of Health and WHO health experts provided additional support for managing the COVID-19 patients at the center using standard protocols developed and practiced in Uganda.

## **Study design**

A retrospective data review and abstraction of all COVID-19 hospital admissions registered in the Gulu Health Management Information System (HMIS) database and other tools were conducted. The period of the review was March 2020 to October 2021. Established by the Ugandan Ministry of Health, HMIS has been the primary source of information on COVID-19 hospital admissions and deaths. COVID-19 notification is compulsory in Uganda, and the emergency operation center at the Uganda National Public Health Institute receives reports on patients admitted to both public and private hospitals with COVID-19.

## **Sources of data**

For the period of this study, COVID-19 patients admitted to Gulu Regional Referral Hospital with COVID-19 were estimated at 900. We included each patient registered in the HMIS database, information on individual's socio-demographic characteristics, self-reported symptoms, signs, comorbidities, COVID-19 Treatment Unit (CTU) admissions, ICU admissions, and ventilatory support, dates of symptom onset, date of hospital admission, date of discharge, duration of the hospital stay, reported circumstances when the disease was contracted, vaccination status and in-hospital outcome (deaths, referrals, and releases/discharges).

HMIS data were accessed, which were already de-identified and publicly available documents. Following ethically agreed principles on open data access, this analysis did not require stringent ethical approval in Uganda as we mainly worked on records with no identifiers included. However, we obtained ethical and administrative licenses from the Gulu Regional Referral Hospital Institution and Ethical Review Committee to access the archived Gulu hospital data on COVID-19 patients.

## **Selection criteria**

**Inclusion criteria:** The following were the inclusion criteria for the participants (i) Confirmed cases of COVID-19 with RT-PCR results as positive (ii) records of patients 12 years and above (iii) completed information on the chart and other medical tools (iv) admission records

**Exclusion criteria:** We excluded (i) incomplete records, (ii) records with no RT-PCR results (iii) participants below 12 years.

**Selection of records:** The medical records for the COVID-19 patients in Gulu Regional Referral Hospital archives were accessed. The choice of the COVID-19 patients' files was conducted consecutively and reviewed by the research team. The selection criteria were applied to each admission file, and a total of 664 files were included in the participating medical records for this research.

**Sample size:** We determined the sample size for the study population using the selection criteria on the medical records. Six hundred and sixty-four (664) records were included as the sampled population.

**Training of research assistants:** To obtain excellent and clean information from these COVID-19 patients' medical files, the research team trained the research assistants who were four in number (two medical officers, one clinical

officer, and one nurse) on how to use the selection criteria, accurately record data from the admission forms and exclude forms that were considered incomplete. The research teams were trained on infection, prevention, and control of COVID-19 and were required to use facemasks, eye shields, and sanitizers during and after reviewing documents. The corresponding author supervised the data collection exercise from the beginning to the end, ensuring that he checked every file to confirm the completeness of the data collected.

**Procedures for data collection:** Consecutively registered COVID-19 patients treated at Gulu Regional Referral Hospital with a positive quantitative RT-PCR test result for SARS-CoV-2 admitted to Gulu Hospital were used. SARS-CoV-2 diagnostic tests followed national and international standards. They were done in certified laboratories of Gulu Regional Referral Hospital and Uganda Virus Research Institute (UVRI) as the Ugandan Ministry of Health protocols required.

**Variables for the study:** The dependent variables for this study were treatment outcomes (alive or dead). The independent variables were the socio-demographics of the COVID-19 patients (age, sex, occupation, religion, tribe, districts, and level of education), comorbidities and treatments used, oxygen saturation at admission, date of discharge from the hospital, duration of hospital stay, disease severity, and others), clinical presentations (signs and symptoms), vaccination status, place of residence and circumstance under which the patient contracted the virus.

**Data analysis:** The analysis period was from the epidemiological week (starting month and date of March 2020) to the epidemiological week (until month and date of October 2021). The analysis was pre-specified and defined before any reading of the medical data in the records of Gulu Regional Hospital. The sample size was all patients (aged  $\geq 12$  years) with COVID-19 diagnosis admitted to the Gulu Regional Referral Hospital and registered in the database between epidemiological weeks of March 2020 and October 2021.

Means, standard deviations, bar graphs, histograms, frequencies, and percentages were used to summarize continuous variables, while frequencies and proportions were calculated for categorical variables. Age-adjusted and sex-adjusted rates for each district by the direct method using the estimated Ugandan population for 2020 as a reference were calculated.

We used the Chi-Square tests at bivariate analysis to observe associations between independent and dependent variables at 95% confidence Intervals. Factors with p-values less or equal to 0.2 were entered into a multivariable regression analysis to determine factors associated with COVID-19 patients treated at Gulu Regional Referral Hospital. However, the Gulu Hospital HMIS data contained much-missing information for some variables, such as reported symptoms, medicines used, and comorbidities. Therefore, we used additional Gulu Regional Referral Hospital records to fill in the missing data. Also, in the post hoc analysis, we evaluated the missing data pattern and conducted a sensitivity analysis via multiple imputations by chained equations, generating 30 imputed datasets. SPSS version 25.0 was used for data analysis, and various imputations were performed utilizing the STROBE guideline recommendations. In addition, Adjusted Odds Ratios (AOR) for independent variables were calculated for the COVID-19 patients treated at the Gulu Regional Referral Hospital from March 2020 to October 2021.

**Ethical considerations:** This retrospective data review of COVID-19 patients' medical files at the Gulu Regional Referral Hospital was approved by the Gulu Regional Hospital Institutional, Ethics, and Review Committee.

## Results

This study abstracted six hundred and sixty-four (664) medical records of COVID-19 patients treated at the Gulu Regional Referral Hospital from March 2020 to October 2021. Only medical records of COVID-19 patients who met the

inclusion criteria for the study were included. Most COVID-19 patients treated at the Gulu Regional Referral Hospital recovered from the disease with a recovery rate of 632(95.2%) and a mortality of 32(4.8%). In addition, most COVID-19 patients treated at Gulu Regional Referral Hospital were unvaccinated 661(99.5%) for COVID-19.

In figure 1, there were three waves of COVID-19 in Gulu, Northern Uganda, and these were May and September in 2020. In addition, there was a small observable wave in July 2021.

In figure 2, COVID-19 discharges from the CTU of Gulu Regional Referral Hospital mirrored the admission pattern where June, October, and July registered the most releases from the CTU.

Figure 3 shows the peak duration of Hospital stays (days) among COVID-19 patients treated at GRRH as 16 days.

Table 1  
Socio-demographic characteristics of COVID-19 patients treated at  
Gulu Regional Hospital

<b>Variables</b>	<b>Frequency</b>	<b>Percent (%)</b>
<b>Gender</b>		
Male	443	66.7
Female	221	33.3
<b>Age (years)</b>		
<20	41	6.2
20-29	139	20.9
30-39	204	30.7
40-49	151	22.7
≥50	129	19.4
<b>Subtotal</b>	<b>664</b>	<b>100.0</b>
<b>Tribes</b>		
Acholi	386	59.2
Lango	19	2.9
Baganda	70	10.7
Madi	22	3.4
Others	155	23.8
<b>Subtotal</b>	<b>652</b>	<b>100.0</b>
<b>Religion</b>		
Catholics	95	46.3
Protestants	51	24.9
Born Again	6	2.9
Muslims	44	21.5
Others	9	4.4
<b>Subtotal</b>	<b>205</b>	<b>100.0</b>
<b>The highest level of education attained</b>		
No formal education	64	13.7
Primary	43	9.2
Secondary	59	12.7
Certificates	152	32.6
Diploma	65	13.9

<b>Variables</b>	<b>Frequency</b>	<b>Percent (%)</b>
Degrees	72	15.5
Postgraduate degrees	11	2.4
<b>Subtotal</b>	<b>466</b>	<b>100.0</b>
<b>Occupation</b>		
Business	95	18.6
Civil Servants	97	19.0
Health workers	47	9.2
Teachers	7	1.4
Uniformed security forces	27	5.3
Peasant Farmers	76	14.9
Others	161	31.6
<b>Subtotal</b>	<b>510</b>	<b>100.0</b>
<b>Districts</b>		
Agago	9	1.4
Amuru	59	8.9
Gulu	226	34.0
Kitgum	50	7.5
Lamwo	16	2.4
Nwoya	16	2.4
Omoro	37	5.6
Pader	24	3.6
Others	227	34.2
<b>Subtotal</b>	<b>664</b>	<b>100.0</b>

In Table 1, most COVID-19 patients treated at the Gulu Regional Referral Hospital from March 2020 to October 2021 were males 443(66.7%), age-group 30-39 years old 204(30.7%); Certificate holders of education 152(32.6%), Acholi 386(59.2%), Catholics 95(46.3%), Civil Servants 97(19.0%) and from Gulu District 226(34.0%).

Table 2  
Symptoms and comorbidities among COVID-19 patients treated at Gulu Regional Hospital

<b>Symptoms and signs</b>	<b>Yes (%)</b>	<b>No (%)</b>
Cough	331(49.8)	331(49.8)
Tiredness	128(19.3)	536(80.7)
Body aches and pains	192(28.9)	472(71.1)
Sore throat	117(17.6)	546(82.2)
Headache	225(33.9)	438(66.1)
Loss of taste	44(6.6)	619(93.2)
Loss of smell	43(6.5)	621(93.5)
Shortness of breath	171(25.8)	493(74.2)
Loss of speech	20(3.0)	644(97.0)
Vomiting	21(3.2)	643(96.8)
Diarrhea	20(3.0)	643(96.8)
Conjunctivitis	1(0.2)	662(99.7)
<b>Comorbidities</b>		
Diabetes Mellitus (DM)	38(5.7)	626(94.3)
Chronic Obstructive Pulmonary Diseases (COPDs)	38(5.5)	656(94.5)
Hypertension	83(12.5)	581(87.5)
Other Cardiovascular Diseases (CVDs), e.g., Stroke, valvular diseases, and heart failures	58(8.7)	605(91.3)
Obesity	3(0.5)	661(99.5)
Asthma	15(2.3)	648(97.7)
Cancers	4(0.6)	648(99.4)
HIV and AIDS	61(9.2)	603(90.8)
Other comorbidities (Hepatitis B, Liver diseases, Severe malaria)	40(6.0)	624(94.0)
<b>Systolic Blood pressure (mmHg)</b>		
≤120	177(26.7)	
121-140	298(44.9)	
>140	169(25.5)	
<b>Diastolic Blood pressure (mmHg)</b>		
≤ 80	329(49.5)	
81-120	183(27.6)	
121-140	132(19.9)	

Symptoms and signs	Yes (%)	No (%)
Duration of Symptoms (days)		
1-7 days	236(63.1)	
8-14 days	107(28.6)	
15-21 days	22(5.9)	
22-28 days	16(2.4)	
>28 days	9(2.4)	
Duration of Hospital Stay (Weeks)		
0-1	318(47.9)	
2-4	300(45.2)	
>4	24(3.6)	
Oxygen saturation (SpO <sub>2</sub> ) of COVID-19 patients at admission		
<80	9(1.4)	
80-95	85(12.8)	
≥96	403(60.7)	
Clinical presentations		
Symptomatic	509(76.7)	
Asymptomatic	154(23.2)	
Body Temperature (°C)		
≤ 37.2	525(79.1)	
37.3-38.9	11(1.7)	
≥39	2(0.3)	
Random blood sugar level (RBS)		
Normal (≤8 mmol/L)	11(25.6)	
Abnormal (>8mmol/L)	32(74.4)	
Fasting Blood Sugar level (FBS)		
Normal (≤7 mmol/L)	9(36.0)	
Abnormal (>7mmol/L)	16(64.0)	
The circumstance of contracting the virus (at Elegu border point with international truck drivers)	50(7.5)	
Number of COVID-19 patients who died from Gulu Regional Referral Hospital	32(4.8)	
Number of unvaccinated COVID-19 patients treated at Gulu Hospital	661(99.5)	

Table 3  
Medicines used for the treatment of COVID-19 patients at  
Gulu Regional Referral Hospital

Medicine used	Frequency (n=664)	Percent (%)
Hydroxychloroquine	0	0.0
Chloroquine	0	0.0
Steroids	73	11.0
Aspirin	2	0.3
Antibiotics	662	99.7
Vitamin D	24	3.6
Vitamin C	564	84.9
Ivermectin	7	1.1

Table 3 shows medicines used for the treatment of COVID-19 at GRRH: antibiotics 662(99.7%), Vitamin C 564(84.9%), steroids 73(11.0%), Vitamin D 24(3.6%), Ivermectin 7(1.1%), and Aspirin 2(0.3%) in the descending order.

Table 4  
Complications in the COVID-19 patients treated at the Gulu Regional Hospital

Complications	Frequency (n=664)	Percent (%)
Depression	20	3.0
Nightmares	15	2.3
Multiple Organ Failure (MOF)	5	0.8
Acute Respiratory Failure (ARF)	30	4.5
Pneumonia	60	9.0
Acute Respiratory Distress Syndrome (ARDS)	37	5.6
Acute Liver Injury	2	0.3
Acute Cardiac Injury	2	0.3
Systemic infections	19	2.9
Acute kidney injury	5	0.8
Blood clots	3	0.5
Chronic fatigue	49	7.4
Septic Shock	8	1.2
Disseminated Intravascular Coagulation (DIC)	3	0.5

In Table 4, complications observed in COVID-19 patients treated in GRRH were Pneumonia 60(9.0%), Chronic fatigue 49(7.4%), acute respiratory distress syndrome (ARDS) 37(5.6%), Acute Respiratory failure 30(4.5%); depression 20(3.0%), systemic infections 19(2.9%), nightmares 15(2.3%) and septic shock 8(1.2%).

Table 5

Crosstabulations among variables in COVID-19 patients treated at Gulu Regional Referral Hospital

<b>Variables</b>	<b>Chi-square</b>	<b>df</b>	<b>p-value</b>
<b>Crosstabulations between duration of symptoms (days) and other variables</b>			
Symptomatic patients	10.301	4	<b>0.036</b>
Age of patients	14.585	16	0.555
Gender of patients	6.284	4	0.179
The highest level of education attained	30.42	32	0.547
<b>Crosstabulations between Diabetes Mellitus and other variables</b>			
Symptomatic patients	5.314	1	<b>0.021</b>
Age of patients	22.66	4	<b>0.000</b>
Gender of patients	0.016	1	0.901
The highest level of education attained	32.532	8	<b>0.000</b>
<b>Crosstabulations between Chronic obstructive pulmonary diseases (COPDs) and other variables</b>			
Symptomatic patients	0.014	1	0.905
Age of patients	6.195	4	0.185
Gender of patients	6.346	1	<b>0.032</b>
The highest level of education attained			
<b>Crosstabulations between Other cardiovascular diseases (CVDs) and other variables</b>			
Symptomatic patients	4.462	1	<b>0.035</b>
Age of the patients	22.562	1	<b>0.000</b>
Gender of the patients	4.996	1	<b>0.025</b>
The highest level of education attained	22.451	8	<b>0.004</b>
<b>Crosstabulations between Hypertension and other variables</b>			
Symptomatic patients	3.045	1	0.081
Age of the patients	35.169	4	<b>0.000</b>
Gender of patients	1.187	1	0.276
The highest level of education attained	21.624	8	<b>0.006</b>
<b>Crosstabulations between obesity and other variables</b>			
Symptomatic patients	0.173	1	0.678
Age of patients	1.272	4	0.866
Gender of patients	1.512	1	0.219
The highest level of education attained	2.083	8	0.978

<b>Variables</b>	<b>Chi-square</b>	<b>df</b>	<b>p-value</b>
<b>Crosstabulations between Asthma and other variables</b>			
Symptomatic patients	0.0920	1	0.762
Age of patients	3.7700	4	0.438
Gender of patients	2.8110	1	0.094
The highest level of education attained	10.3790	8	0.239
<b>Crosstabulations between Cancer and other variables</b>			
Symptomatic patients	1.2200	1	0.269
Age of patients	1.7470	4	0.782
Gender of patients	3.1440	1	0.076
The highest level of education attained	12.6480	8	0.125
<b>Crosstabulations between HIV and AIDS and other variables</b>			
Symptomatic patients	0.070	1	0.791
Age of patients	8.515	4	0.074
Gender of patients	3.646	1	0.056
The highest level of education attained	2.107	8	0.978

Table 6  
 Characteristics of COVID-19 patients treated at Gulu Regional Referral Hospital

Variables		Frequency	Percent (%)
Duration of Hospital Stay (Weeks)	less than a week	56	11.6
	One	216	44.9
	Two	158	32.8
	Three	39	8.1
	Four	5	1.0
	Five	4	0.8
	Six	3	0.6
Oxygen saturation Admission (SpO <sub>2</sub> )	<80	7	1.5
	80-96	80	16.6
	>96	394	81.9
Aspirin	Yes	2	0.4
	No	479	99.6
Antibiotics	Yes	480	99.8
	No	1	0.2
Vitamin D	Yes	23	4.8
	No	458	95.2
Steaming	Yes	2	0.4
	No	479	99.6
Vitamin C	Yes	385	80.0
	No	96	20.0
Ivermectin	Yes	7	1.5
	No	474	98.5
Lemon	Yes	3	0.6
	No	478	99.4
Ginger	Yes	1	0.2
	No	480	99.8
Garlic	Yes	2	0.4
	No	479	99.6
Steroids	Yes	66	13.7
	No	415	86.3

In Table 6, most COVID-19 patients treated in GRRH were in the hospital for one week 216(44.9%); oxygen saturation (SpO<sub>2</sub>) at admission was >96 394(81.9%); did not use Aspirin 479(99.6%), steroids 415 (86.3%), Garlic 480 (99.8%), Lemon 478(99.4%), Ivermectin 474(98.4%), Vitamin D 458(95.2%), and steaming 479 (99.6%) but used Antibiotics 480(99.8%) for treatment.

Table 7  
Factors associated with COVID-19 patients treated at Gulu Regional Referral Hospital CTU

Variables	Freq (n=664)	Chi-square	df	p-value
Duration of symptoms (1-7 days)	236(35.5%)	1.101	4	0.8940
Diabetes Mellitus	38(5.7%)	51.156	1	0.0000
Chronic obstructive pulmonary diseases (COPDs)	8(1.2%)	1.041	1	0.3070
Other Cardiovascular diseases (CVDs)	58(8.7%)	34.819	1	0.0000
Hypertension	83(12.5%)	10.807	1	0.0010
Obesity	3(0.5%)	0.153	1	0.6960
Asthma	15(2.3%)	0.113	1	0.7370
Cancers	4(0.6%)	3.565	1	0.0590
HIV and AIDS	61(9.2%)	6.488	1	0.0110
Pregnancy	1(0.2%)	1.011	1	0.8560
Other comorbidities	40(6.0%)	37.013	1	0.0000
Symptomatic	509(76.7%)	2.170	1	0.1410
Age (>50 years)	129(19.4%)	40.601	1	0.0000
Gender (Females)	221(33.3%)	7.986	1	0.0005
The highest level of education attained (graduates)	72(10.8%)	39.213	1	0.0000
Steroids (1)	66(13.7%)	157.639	1	0.0000
Aspirin (1)	2(4.16%)	0.124	1	0.7250
Antibiotics (1)	480(99.8%)	0.062	1	0.8040
Vitamin D (1)	23(4.8%)	113.521	1	0.0000
Steaming (1)	2(0.4%)	0.124	1	0.7250
Vitamin C (1)	385(80.0%)	56.548	1	0.0000
Ivermectin (1)	7(1.5%)	82.886	1	0.0000
Garlic (1)	2(0.4%)	0.124	1	0.7250
Ginger (1)	1(0.2%)	0.062	1	0.8040
Lemon (1)	3(0.6%)	0.186	1	0.6660
Oxygen Saturation (SpO <sub>2</sub> ) (<80)	7(1.5%)	49.799	2	0.0000
Oxygen Saturation (SpO <sub>2</sub> ) (80-96)	80(16.6%)	29.357	1	0.0000
Oxygen Saturation (SpO <sub>2</sub> ) (>96)	394(81.9%)	42.962	1	0.0000
Duration of Stay (Less than one week)	56(11.6%)	57.690	6	0.0000
Duration of Stay (One week)	216(44.9%)	1.930	1	0.1650

Variables	Freq (n=664)	Chi-square	df	p-value
Duration of Stay (Two weeks)	158(32.8%)	6.569	1	0.0100
Duration of Stay (Three weeks)	39(8.1%)	2.690	1	0.1010
Duration of Stay (Four weeks)	5(1.0%)	0.312	1	0.5770
Duration of Stay (Five weeks)	4(0.8%)	0.249	1	0.6180
Duration of Stay (Six weeks)	3(0.6%)	4.180	1	0.0410
Overall Statistics		256.221	18	0.0000

In Table 7, factors associated with COVID-19 patients treated at Gulu Regional Referral Hospital were Diabetes mellitus  $\chi^2 = 1.156$ ; df=1; p<0.0000; other cardiovascular diseases (CVDs)  $\chi^2 = 34.819$ ; df=1; p<0.0000; hypertension  $\chi^2 = 10.807$ ; df=1; p=0.0010; HIV and AIDs  $\chi^2 = 6.488$ ; df=1; p=0.011; treatment with steroids  $\chi^2 = 157.639$ ; df=1; p<0.0000; Vitamin D  $\chi^2 = 113.521$ ; df=1; p<0.0000; vitamin C  $\chi^2 = 56.548$ ; df=1; p<0.0000; Ivermectin  $\chi^2 = 82.886$ ; df=1; 0.0000; Oxygen saturation(SpO<sub>2</sub>) 80-96  $\chi^2 = 29.357$ ; df=1; p<0.0000; Oxygen saturation (<96)  $\chi^2 = 42.962$ ; df=1; p<0.0000; duration of hospital stay (less than one week)  $\chi^2 = 57.690$ ; df=1; p<0.0000; duration of hospital stay (two weeks)  $\chi^2 = 6.569$ ; df=1; p=0.010 and duration of hospital stay (six weeks)  $\chi^2 = 4.180$ ; df=1; 0.041

Table 8

Multivariable logistic regression showing treatment, Oxygen saturation, and duration of hospital stay for COVID-19 patients treated at GRRH

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Step 1 <sup>a</sup>								
Steroids (1)	4.933	1.238	15.87	1	0.000	138.8350	12.258	1572.50
Aspirin (1)	-18.74	26237.08	0.000	1	0.999	0.0000	0.0000	0.0000
Antibiotics (1)	14.645	40192.96	0.000	1	1.000	2292669.4160	0.0000	0.0000
Vitamin D (1)	3.449	1.432	5.803	1	0.016	31.4780	1.9020	520.975
Steaming (1)	-20.277	40192.97	0.000	1	1.000	0.0000	0.0000	0.0000
Vitamin C (1)	-0.42	0.68	0.380	1	0.537	0.6570	0.1730	2.4940
Ivermectin (1)	3.504	3.438	1.039	1	0.308	33.2620	0.0390	28095.88
Garlic (1)	4.933	56841.43	0.000	1	1.000	138.8330	0.0000	0.0000
Ginger (1)	16.441	69616.26	0.000	1	1.000	13810166.505	0.0000	0.0000
Lemon (1)	-19.579	40192.87	0.000	1	1.000	0.0000	0.0000	0.0000
Oxygen (SpO <sub>2</sub> <80)			1.124	2	0.570			
Oxygen (80-96)	0.174	1.502	0.013	1	0.908	1.1900	0.0630	22.6030
Oxygen (>96)	0.873	1.5	0.338	1	0.561	2.3930	0.1260	45.2910
DoS (<1week)			7.140	6	0.308			
DoS (1 week)	1.126	0.723	2.423	1	0.120	3.0820	0.7470	12.7180
DoS (2 weeks)	2.222	1.188	3.498	1	0.061	9.2290	0.8990	94.7440
DoS (3 weeks)	18.867	5359.821	0.000	1	0.997	156228723.90	0.0000	0.0000
DoS (4 weeks)	19.883	15112.35	0.000	1	0.999	431532567.24	0.0000	0.0000
DoS (5 weeks)	15.986	19996.241	0.000	1	0.999	8765685.4620	0.0000	0.0000

DoS=Duration of Hospital stay.

DoS (6 weeks)	-2.766	2.391	1.338	1	0.247	0.0630	0.0010	6.8250
Constant	29.894	47998.53	0.000	1	1.000	9612933355043.54		
DoS=Duration of Hospital stay.								

In Table 8, the Adjusted Odds Ratios (AOR) for factors associated with COVID-19 patients treated at Gulu Regional Referral Hospital. Treatment with Steroids AOR=138.835 at 95% CI: 12.258-1572.50; p<0.000 and Vitamin D AOR=0.016 at 95% CI:1.902-520.98; p=0.016

## Discussions

The most significant findings were the three waves of COVID-19 in Gulu in Northern Uganda, and these were in May and September of 2020 and July of 2021 (Figure 1, Figure 2, and Figure 3). The third wave of COVID-19 in 2021 was less pronounced (Figure 1, Figure 2, Figure 3). This finding contrasts with the official Ugandan Ministry of Health position on the number of COVID-19 waves Uganda has gone through since the pandemic began in March 2020. The Ugandan Ministry of Health specified two waves of the COVID-19: one in 2020 and another in June 2021. This Ugandan Ministry of Health report is not surprising as regional waves of COVID-19 have been reported in many studies [11, 12, 13, 14]. This finding has implications on how Uganda could respond to the COVID-19 waves as the regional approach to managing and controlling the pandemic has become eminent. The regional occurrence of the COVID-19 wave has advantages in that the Ugandan Ministry of Health could use this information to harness support and allocate resources to effectively manage and control the pandemic at the regional level in different parts of the Country. This may include mass mobilization and sensitization of the population at a regional level to embrace mass vaccination with COVID-19 vaccines now that they are available in the Country. It is expected that this approach could limit the spreading of COVID-19 country-wide and reduce the morbidity and mortality of the coronavirus in Uganda.

### Socio-demographic characteristics of the COVID-19 patients

Findings from this study show that most COVID-19 patients treated at the Gulu Regional Referral Hospital were males, 30–39-years-old, Acholi, Catholics with certificates as the highest level of education, civil servants, and from Gulu District (Table 1). These socio-demographic characteristics are comparable to previous studies conducted in Northern Uganda, where the most affected people were males and certificates at their highest level of education (Table 1). What is different in this study population is that the most affected age group is a decade older (Table 1) compared to previous studies in Northern Uganda, where most participants were 20–29-years-old [15, 16].

The age factor could be explained by the susceptibility pattern of the COVID-19 among the older population of Northern Uganda and elsewhere. The aging population appears more vulnerable and susceptible. The overall reasons for the susceptibility in the older people in Northern Uganda may not be known for now but perhaps attributable to lifestyles, exposure to multiple risk factors, comorbidities, and immunity problems of the more aging population. As shown in Table 1, the younger age groups were least affected as per the GRRH COVID-19 treatment center's admission details. However, it could also mean that many of the younger age groups got affected but remained asymptomatic, did not test for COVID-19, did not develop severe disease, and did not get hospitalized with the coronavirus.

Findings from this current study show that nearly one-fourth of the COVID-19 patients treated were asymptomatic, and less than 10% of the patients were below 20 years of age (Table 3). These authors argue that this information

was not wholly new. Similar findings in many studies conducted elsewhere in the world show that younger persons were least susceptible to severe COVID-19 and hospitalization [13, 14, 17].

### **Factors associated with the COVID-19 patients treated at the Gulu Regional Referral Hospital**

This report shows that most COVID-19 patients treated for severe COVID-19 and died at the GRRH had comorbidities, for example, Diabetes mellitus, cardiovascular diseases (CVDs) including (Stroke, valvular heart diseases, dysrhythmias, heart failure, and cardiac septal defects), hypertension, and symptomatic cases (Table 2 and Table 3). Many studies have observed similar findings, particularly those with comorbidities [2, 17, 18]. This finding implies that the Ugandan Ministry of Health could adopt the "Enhanced shielding" approach, where persons with comorbidities and the elderly are shielded from the general population to protect them from contracting the COVID-19 virus [12, 19]. These suggestions have implications on the approach the Ugandan health systems could adopt to control the spreading of COVID-19 among the elderly and those with comorbid conditions. The rural structure and relationship between the elderly and younger generation need thorough analysis as the elderly in the rural community live with and together with the young people who provide support and protection to the elderly. The practicality of this approach needs thorough thinking as this new approach may disrupt traditional ways of how people in the African rural communities live. These authors argue that with the lockdown, the economy, and health systems collapsing in many African countries, it is high time government planners came with solutions that allow the economy to be opened but ensure a reduced incidence and prevalence of COVID-19 in communities. One of the recommended approaches was to practice the enhanced shielding approach, which is more favorable to a country's social and economic systems. In addition, there is a need to sensitize and mobilize the population to embrace mass COVID-19 vaccination as vaccines are now available in the country to reduce the incidence of severe diseases which require hospitalization.

### **Treatment and complications observed among COVID-19 patients in Gulu Regional Referral Hospital**

Findings from this study show that most COVID-19 patients were treated with antibiotics, vitamin C, steroids, Ivermectin, and vitamin D (Table 3, Table 4, Table 5, Table 6, and Table 7) and the outcomes of the treatment have been encouraging as shown by a very high recovery rate at 95.2% and a statistically significant association with steroid and Vitamin D treatment (Table 8).

In the same study, the most typical complications observed among the COVID-19 patients were pneumonia, acute respiratory distress syndrome (ARDS), systemic infections, septic shock, chronic fatigue, depression, and nightmares (Table 4). These authors argue that there were justified reasons for using antibiotics in treating COVID-19 patients at Gulu Regional Referral Hospital, as many cases developed complications treated with antibiotics.

In addition, the role played by the other drugs in the management of COVID-19 was suggested by scholars and academicians across the world and particularly their use as immune system modulators [17]. To come up with a conclusive decision on the beneficial effects of the two drugs for managing COVID-19 patients at GRRH, formal Randomized controlled Trials will be required.

On the mental health complications observed among the COVID-19 patients treated at the Gulu Regional Referral Hospital, the authors recommend comprehensive mental health support for COVID-19 patients and the follow-up after recovery. Effective management of mental health conditions such as depression relieves the ever-increasing sense of depression and isolation experienced by the COVID-19 patients. If the numbers of mental health cases become widespread, a grassroots approach using trained village health teams (VHTs) would be the recommended approach for handling the problem. Notably, the VHTs should be trained and capable of dealing with COVID-19 related

Psychosocial symptoms in the community. This idea is supported by studies conducted elsewhere in Africa, which suggest a grass-root approach to mental health problems after the lockdown in African [12, 19].

**The independent determinants of COVID-19 cases treated at Gulu Regional Referral Hospital:** This study showed that the recovery rate from the COVID-19 treated at the Gulu Regional Referral Hospital was 95.2%, yet 99.5% of the COVID-19 patients were unvaccinated (Table 3). Furthermore, this study found the Adjusted Odds Ratios (AOR) for factors associated with COVID-19 patients' recovery at GRRH were treatment with steroids AOR=138.835 at 95% CI:12.258-1572.50;  $p < 0.000$  and Vitamin D AOR=0.016 at 95% CI:1.902-520.98;  $p = 0.016$  (Table 8). Statistically significant associations of Vitamin D and steroids with a positive outcome in the treatment and management of COVID 19 patients in our study have also been observed in previous studies [20, 21]. Could these successes be for this center only, or could this apply to diverse settings worldwide? A formal review study in different locations would be required in the long term to determine the effectiveness of the drugs in managing mild and severe cases of COVID-19. Authors recommend global studies on the two drugs to assess their actual effects on the treatment outcomes of COVID-19 patients.

### **Circumstances under which the coronavirus infected participants**

Findings show that most of the circumstances were unknown 581(87.5%), others were congregated situations such overcrowding at Elegu border and interacting with international truck drivers 50(7.5%), Aswa Dam construction workers 12(1.8%) who lived in dormitories, health facility 2(0.3%), persons who nursed a relative with COVID-19 2(0.3%), bars 1(0.2%) and others 16(2.4%). This finding implies that the known source of the COVID-19 infection in Northern Uganda was from international truck drivers and mainly at the Elegu border point. Other sources such as bars, churches, and markets were fewer. Authors argue that regional controls of COVID-19 would be ideal for the East African region, where there is brisk trade among the countries. Therefore, the management and surveillance of international truck drivers as a regional approach would be suitable for controlling the coronavirus, ensuring that COVID-19 testing and management were conducted as per the international protocols across all the East African countries [11].

### **Strengths and limitations of the study**

This study was a retrospective review of datasets from the COVID-19 medical records of Gulu Regional Referral Hospital. The period of the evaluation was from March 2020 to October 2021. The study has limitations on how Gulu Hospital handled records and record keeping. In addition, vital information, for example, weight, height, and BMI of COVID-19 patients, was not recorded due to the emergency handling of the cases at the beginning of the pandemic in March 2020. The missing variables in the Gulu Hospital HMIS records excluded some files from participating in this study. In this, authors have suggested a need for a prospective or longitudinal assessment of the COVID-19 cases in the future, ensuring that all data were measured and recorded accordingly.

This data is vital as it is one of the well-documented completed data for over 664 cases of COVID-19 treated in a Regional Referral Hospital in Uganda. Findings from this study show tremendous and good clinical practices at Gulu Regional Referral Hospital despite the challenges faced during the pandemic.

### **Generalization of the data from this study**

These findings should be cautiously interpreted and generalized only to Regional Referral Hospitals in Uganda. However, they could be similarly observed in many hospitals in African countries with low-resource settings.

## Conclusion

This study shows successful management of COVID-19 patients in low resource settings in Gulu Regional Referral Hospital with a recovery rate of 95.2%. The pattern of admission to the Hospital suggests Uganda has experienced three waves of COVID-19, contrary to the official government position of two waves. Treatment of COVID-19 patients with steroids and Vitamin D is associated with recovery of COVID 19 patients. However, there is a need for Randomized Controlled Clinical Trials to determine the actual effects of these drugs in the Treatment of COVID-19 infections.

## Declarations

**Ethics approval and consent to participate:** The Gulu Regional Referral Hospital Institutional and Ethics Committee approved this study, and all participants consented to the study. In addition, the study was conducted following the relevant institutional guidelines and regulations.

**Availability of data and material:** All datasets supporting the conclusion in this article is within this article and is accessible by a reasonable request to the corresponding author.

**Competing interests:** All authors declare no conflict of interest.

**Funding:** Most funding for this study was contributions of individual research members of the Uganda Medical Association (UMA) Acholi branch.

**Authors contributions:** DLK, ENI, PL, JNO, JA, and FWDO participated in designing the study, SB and DLK were responsible for data abstraction supervision, BS, JA, ENI, and DLK were responsible for data analysis, interpretation, writing, and CO, NAO, WAO, BT, JE, PA, PL, FPP, DA, JNO, FWDO, for revising the manuscript.

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## Annex I: Informed Consent

**Title: Characterization of COVID-19 patients admitted at Gulu Regional Referral Hospital, Gulu, Northern Uganda, from March 2020 to October 2021**

**Principal Investigator:** Prof. David Kitara Lagoro

This qualitative component will occur at most health facilities and in the nine districts in the Acholi subregion in Northern Uganda.

**The purpose:** Since the outbreak of COVID-19, there has been no global consensus on how the virus has to be controlled and managed. North America and western Europe have demonstrated that eradicating the disease requires a safe and effective vaccine, simultaneous and multiple public health approaches. We need to assess the views of the health managers and policymakers, such as the district task force members, on what they feel should be done to curb the spread of the virus in the region.

We want to invite you to participate in this qualitative research. Participation is entirely voluntary and decides if you wish to participate in it or not. The need to read the following information carefully and ask if there is anything unclear is paramount and if you would like more information.

**The benefit of this study:** There are no direct benefits to you. We aim to determine the opinions of the population of northern Uganda to COVID-19 spread, prevention, and control. Findings may shed light on how we could inform policy which may further allow us to undertake future strategies and interventions to educate and reduce the spread of COVID-19 in our communities.

**Confidentiality:** Informed consent will be obtained from each participant before this study. Confidentiality will be maintained during and after the study. Every participant's personal information will be de-identified and given a unique code identifier for the analysis. Only the Principal Investigator will have access to the data for the study. At the end of the project, all the data will be submitted to Gulu University, Faculty of Medicine, Department of Surgery for archiving.

**Voluntary Participation:** Your participation in this study is voluntary. You are free to withdraw from the study at any time without any adverse consequences. You have the right not to answer any question you wish not to. You are free to ask any questions regarding the information you gave on this questionnaire.

I fully understand the aims of the study explained to me in a language that I know and have been allowed to ask questions that have been answered and give my consent to participate in the study.

Name of study participant.....signature.....Date.....

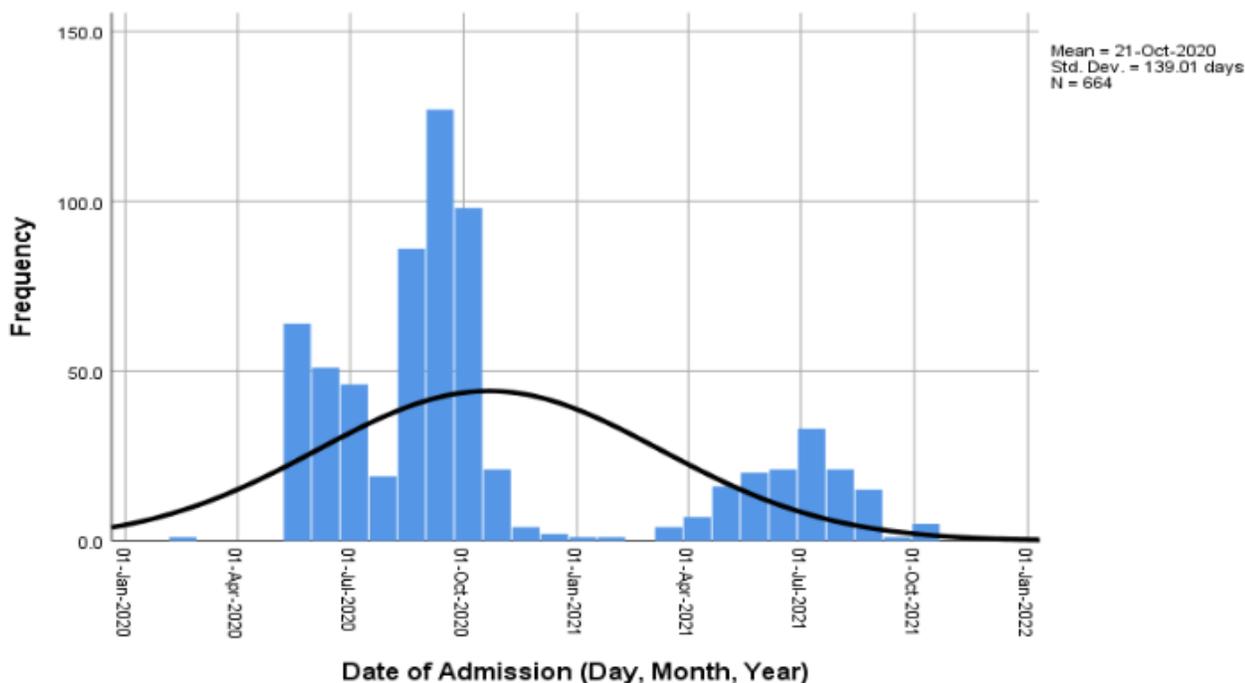
Name of Interviewer.....Signature.....Date.....

If you need additional information on this research, contact the following persons.

1. Dr. Baifa Arwinyo (Chair Ethics and Research Committee, Gulu Regional Referral hospital on 0782047694
2. Dr. Elima James (Gulu Hospital Director) on 0772540956
3. Prof. David Kitara Lagoro (Lead Researcher-Gulu University, Faculty of Medicine) on 0772524474 and email: [klagoro@gmail.com](mailto:klagoro@gmail.com) or [klagoro2@gmail.com](mailto:klagoro2@gmail.com)

## Figures

**Figure I: The pattern of COVID-19 admission into the Gulu Treatment Unit (CTU)**

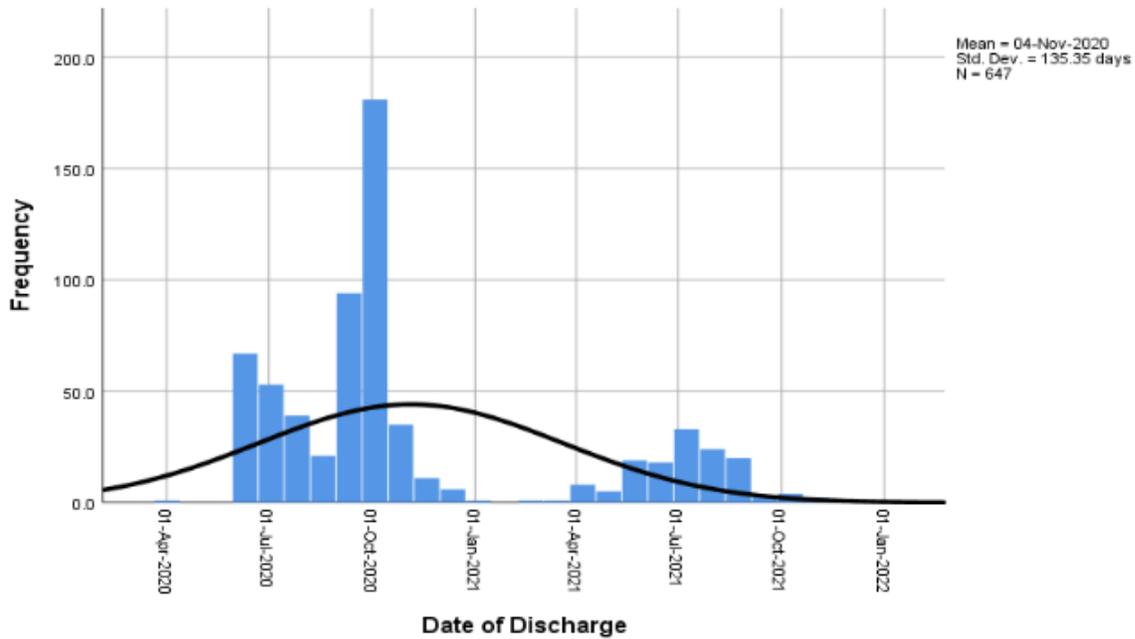


In figure I, there were three waves of COVID-19 in Gulu, Northern Uganda, and these were May and September in 2020. In addition, there was a small observable wave in July 2021.

**Figure 1**

**The pattern of COVID-19 admissions to the Gulu Treatment Unit (CTU).** In figure 1, there were three waves of COVID-19 in Gulu, Northern Uganda, and these were May and September in 2020. In addition, there was a small observable wave in July 2021.

**Figure 2: The pattern of discharges of COVID-19 patients treated at the CTU of Gulu Regional Referral Hospital**



In figure 2, the pattern of COVID-19 discharges from the CTU of Gulu Regional Referral Hospital mirrored the admission pattern where June, October, and July registered the most numbers of releases from the CTU.

**Figure 2**

**The pattern of discharges of COVID-19 patients treated at the CTU of Gulu Regional Referral Hospital.** In figure 2, COVID-19 discharges from the CTU of Gulu Regional Referral Hospital mirrored the admission pattern where June, October, and July registered the most releases from the CTU.

**Figure 3: Duration of Hospital stays (days) of COVID-19 patients treated at Gulu Regional Referrals Hospital**

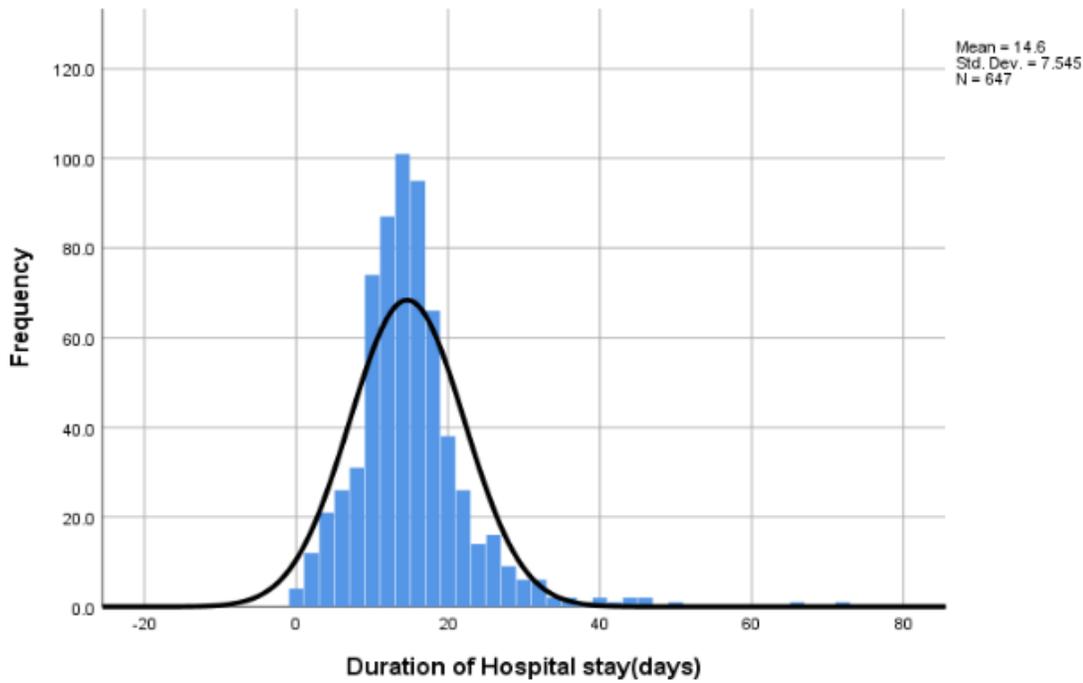


Figure 3 shows the peak duration of Hospital stays (days) among COVID-19 patients treated at GRRH at 16 days.

### Figure 3

**Duration of Hospital stays (days) of COVID-19 patients treated at Gulu Regional Hospital.** Figure 3 shows the peak duration of Hospital stays (days) among COVID-19 patients treated at GRRH as 16 days.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryMaterialS1.docx](#)