RADIOLOGICAL MANIFESTATIONS IN SYMPTOMATIC PATIENTS WITH POSITIVE (RT-PCR) COVID19 ADMITTED AT TIKUR ANBESSA SPECIALIZED HOSPITAL ADDIS ABABA, ETHIOPIA.

BY

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FEBRUARY 2022

DECLARATION

I, Dr **Luth Gregory Mwapule**, declare that this dissertation is my own origin work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature…… Date…….

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CERTIFICATION

The undersigned certify that he has read and hereby recommend for examination of dissertation entitled Radiological manifestations in symptomatic patients with positive (RT-PCR) covid19 admitted at TikurAnbessa Specialized Hospital Addis Ababa Ethiopia, in fulfilment of the requirements for Fellowship in Sub-speciality (PCCM) of College of Health Sciences Addis Ababa University.

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Dr Tewodros Haile

(Supervisor)

……..

Date:

ACKNOWLEDGEMENT

Many people have contributed in one way or another towards the completion of this study. I wish to express my sincere gratitude to all of you.

I wish to sincerely thank my supervisor Dr Tewodros Haile, for his valuable comments and tireless constructive guidance of this work. I also thank my co-supervisor Dr Amir Alwan for his valuable contributions.

I would like to acknowledge all members of the Department of Internal Medicine (CHS) under the head, Dr Abdurezak Ahmed, and the Unit of Pulmonary and Critical Care Medicine (PCCM) under the head, Dr Hanan Yusuf for their assistance and encouragement during all stages of preparation and accomplishment of this dissertation.

I appreciate the valuable statistical advice given by my friend Mr Eyob Kebede Etissa. He remain of hope.

I also thank Outpatient Service Director, Dr DesalewMekonnen, members of medical record department and staffs of covid19 ICU / isolation ward who agreed me to have patient's files for my study.

Special thanks go to my beloved children Aaron and Angela for bearing with me during my busy study work schedule.

Glory and honour be to GOD of all possibilities for carrying me throughout my research work.

ABBREVIATIONS

ARDS Acute Respiratory Distress Syndrome
CI Confidence Interval
CKD Chronic Kidney Disease
CRF Case Report Form
CT Computed Tomography
CVD Cardiovascular Disease
CXR Chest x ray
DM Diabetes Mellitus
DBP Diastolic Blood Pressure
GGO Ground Glass Opacities
HbA1c Glycated hemoglobin
HIV Human Immunodeficiency Virus
HR Heart Rate
IBM International Business Machines
ICU Intensive Care Unit
IQR Interquartile Range
OHA Oral Hypoglycemic Agents
OR Odds Ratio
PTB Pulmonary Tuberculosis
RNA Ribonucleic Acid
RR Respiratory Rate
RT-PCR Reverse Transcription-Polymerase Chain Reaction
SBP Systolic Blood Pressure
SD Standard Deviation
SPO2 Saturation of Oxygen
SPSS Statistical package for social sciences
TASH TikurAnbessa Specialized Hospital

ABSTRACT

Introduction: In severe form patients with positive (RT-PCR) covid19 can develop pneumonia or ARDS. It is reported that 30-50% of covid19 hospitalized patients can develop pneumonia. CXR/CT scan helps to identify covid19 pneumonia by recognizing radiological manifestations of covid19 out of other CXR/CT scan manifestations. Delay in diagnosis and subsequent treatment, develops serious acute respiratory failure, multiple end organ failure, or death. We describedsociodemographic, comorbidities and radiological manifestations in symptomatic patients with positive (RT-PCR) covid19 admitted at TASH.

Methodology: A descriptive hospital based retrospective study was conducted among symptomatic positive (RT-PCR) covid19 patients admitted in the covid19 ICU and isolation covid19 ward from November 2020 to October 2021. All adult patients with CXR/CT scan recorded in med-web (Tele-medicine internet software version 7.0.11) computerized hospital medical system were included. Arrangements was made for abnormal CXR/CT scan to be reviewed jointly with a Thoracic Radiologist. All information was recorded using case report form and analysis was done using SPSS version 23.0

Results: 243patients were recruited in this study, out of them 51.4% were female. Median age was 46years, IQR (30 - 60). The prevalence of radiological manifestations was 65.8%, out of them 51.9% were male.

Predominant CXR findings were bilateral 48.6%, multiple 47.3%, interstitial 42.0%, patchy opacities 40.3%, peripherally 21.0%, lower 55.1% and middle 46.1% lung zones. Most lesions had increased densities 44.9% followed by GGO densities 17.7%. Common CT scan findings were bilateral 70.6%, multiple lobes 70.6% and GGO 23.5%.

Majority of patients with old age (p-value=0.000*), CVD (p-value=0.016*), DM (p-value=0.013*), chronic lung disease (p-value=0.018*), PTB (p-value=0.038*), respiratory symptoms (p-value=0.000*), cough (p-value=0.000*), dyspnea(p-value=0.000*) chest pain (p-value=0.008*) and lower SPO2 (p-value=0.000*) when CXR/CT scan was taken had radiological manifestations. Majority cancer patients didn’t have radiological manifestations (p-value=0.000*)

Conclusion and Recommendation: Radiological manifestations in symptomatic patients with positive (RT-PCR) covid19 admitted in isolation and covid19 ICU at TASH are common.Early recognition of radiological manifestations and proper management of comorbiditieswill improve care in covid19 patients.

Patients with comorbidities, symptoms and radiological manifestations should be screened for covid19 (RT-PCR). COVID-19 Patients with cancer may not show radiologic abnormalities.

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INTRODUCTION

Up to February 19, 2022 the 2019 novel coronavirus has infected 420million people and cause 5.86 million deaths Worldwide, and the number is still increasing fast**. (1)** It was first identified in China in December 2019. It is believed to be originated from bats. **(2)** It is an ongoing global pandemic declared by World Health Organization on 11 March, 2020. **(3)**. In Ethiopia the first case was reported on 13 March 2020. Up to today Ethiopia has reported more than 468 thousand cases with more than 7435 deaths. **(4, 1)**

The 2019 novel coronavirus belongs to the order *Nidovirales*, family *Coronaviridae,* subfamily *Orthocoronavirinae* and genus *Beta*-coronavirus. These are positive-sense single-strand RNA viruses responsible for causing illness from common cold to very severe diseases**. (5, 6)**

The most common symptoms of COVID-19 are fever and cough, and some may develop shortness of breath, smell or taste disturbances, myalgia, diarrhoea and other symptoms. In more severe form, the virus can cause pneumonia, acute respiratory distress syndrome, organ failure, and death. **(6)** The tools for diagnostic available are laboratory testing with RT-PCR and imaging with Chest X ray (CXR) and Computed Tomography (CT). (7). CXR has a vital key role to play in 2019 novel coronavirus; it provides insight for diagnosis, evaluation of severity, complications and disease-progression. It can be done quickly and non-invasively. **(8)** Although it has a limited value during early stage of the disease, it is very useful in the intermediate and advanced stage of the covid19 disease with features of Acute Respiratory Distress Syndrome (ARDS). **(9)**.

Different studies in the world had mentioned the radiological manifestations in covid19 patients. These includes a systematic review done by Z. Sun et al where they found the involvement of the ***bilateral*** lungs was much higher than that of the ***unilateral*** lung. Others studies were done in China such as those done by Ming-Yen Ng et al which found the predominant imaging pattern was of ***Ground glass opacification*** with ***consolidation*** in the ***peripheries***. H.Y.F Wong et al. found that ***Consolidation*** followed by ***ground-glass opacities***with ***peripheral*** distribution and ***lower zone*** distribution and ***bilateral*** involvement was the most common finding. Another study of the radiological manifestation in covid19 patients was done in Pakistan by Durran et al. showed majority of patients had ***peripheral*** lung involvement, ***bilateral, middle and lower*** zonal involvement. Another two studies on radiological manifestation in covid19 was done in Egypt by L.A Rousan whom

found the most common finding on chest x-rays was ***peripheral ground glass opacities*****(GGO)** affecting the ***lower lobes***and R, Yasinwho found ***consolidations*** opacities were the most common finding seenfollowed by ***reticular interstitial thickening*** and ***GGO***. ***Pulmonary nodules*** and ***pleural effusion*** was seen in few patients. Most of the patients showed ***bilateral*** lung affection with ***peripheral*** distribution and ***lower zone*** affection.

Recognizing the patterns of radiological manifestations of COVID-19 can help in the diagnosis of the disease in circumstances where the RT-PCR test become negative. There is no study in Ethiopia that described radiological manifestations of COVID-19 patients. We aimed todetermine the prevalence of radiological manifestations and to describe chest x ray findings of the patients with covid19 PCR positive attending a tertiary centre in Addis Ababa, Ethiopia.

SIGNIFICANCE OF THE STUDY

There are few or no published data for radiological manifestations in symptomatic positive (RT-PCR)covid19 patients in Ethiopia.

Fortunately most radiological manifestations can be successfully treated if diagnosed early.

By recognizing these radiological manifestations of patients with covid19, these physicians can determine early the appropriate diagnosis and therapy particularly when the RT-PCR test is negative or they will find out if there is a need for early referral to a Pulmonologist. This study hasreveal types, prevalence and associated comorbidities for radiological manifestations of symptomatic positive (RT-PCR)covid19 patients admitted at TASH. Such information and statistics can form an important basis for proper emphasis in early detection and appropriate management.

REVIEW OF THE LITERATURE

Radiological manifestations are the findings which are seen pertaining to radiology. Thereported CXR or CT scan findings can be classified based on *type of parenchyma opacity, distribution and other features.* **(10)**. Parenchyma opacity can be either *consolidation or ground glass opacity (GGO)*. Consolidation is when the alveolar airspaces are filled with fluid (exudate/transudate/blood), cells (inflammatory), tissue, or other material. *GGO* is typically defined as an area of hazy opacification due to air displacement by fluid, airway collapse, fibrosis, or neoplastic process. **(11, 12)** Distribution can be *peripheral predominance, perihilar predominance, unilateral involvement, bilateral involvement, upper zone or lower zone*. *Peripheral predominance* means more of the lesions being situated at the edge of the lung away from the tracheobronchial tree. *Perihilar predominance* means the lesion is situated central near the hilum region. *Unilateral* means involving one lung and *bilateral* means involving both lungs. *Upper zone* lesions extend from the inferior margin of the clavicles to the superior aspect of the hilum and *lower zone* when situated at the base. **(11, 12).**In a Systematic review of chest imaging finding in covid19 patients, 65.5% (36 studies) reported details regarding bilateral or unilateral lung involvement of which 17 studies reported a higher percentage of bilateral lung involvement (78.22%, 95% CI: 45–100%) than unilateral lung involvement (20.23%, 95% CI: 9.90–30%) . These studies consistently reported that the involvement of the bilateral lungs was much higher than that of the unilateral lung in patients with COVID-19, or bilateral involvement was more frequently observed in severe or emergency cases. Of the remaining 19 studies that did not report the details of lung involvement on chest CT, 8 reported involvement of pulmonary lobes or segments, with more than two lobes observed in all the studies. Two studies only reported the percentage of lung abnormalities on CXR and chest CT while the remaining nine studies did not report lung involvement. **(13)**

One study done in China by *Ming-Yen Ng et al* in 21patients showed that, the predominant imaging pattern was of ground-glass opacification with occasional consolidation in the peripheries. Pleural effusions and lymphadenopathy were absent in all cases. Patients demonstrated evolution of the ground-glass opacities into consolidation and subsequent resolution of the airspace changes. **(14)**

Another study in 64patients in China by *H.Y.F Wong* et al showed that Consolidation was the most common finding 47% followed by ground-glass opacities 33%. Abnormalities at chest radiography had a peripheral distribution 41% and lower zone distribution 50% with bilateral involvement 50%. Pleural effusion was uncommon 3%. The severity of findings at chest radiography peaked at 10-12 days from the date of symptom onset. **(15)**

A study from Pakistan of 30patients by *M.Durrani* et al showed that 7% patients had normal and seven 23% had classical COVID CXRs. 70% patients were in indeterminate group with only 3% having unilateral lung disease. 10% patients had diffuse lung involvement and 60% had peripheral lung involvement. Majority of patients 63% had bilateral middle and lower zonal involvement. **(16)**

In a study done for 190 chest X rays of 88 patients in Jordan by *L.A Rousan et al* found that 31% had abnormal chest x-rays. The most common finding on chest x-rays was peripheral ground glass opacities (GGO) affecting the lower lobes. In the course of illness, the GGO progressed into consolidations peaking around 6–11 days (GGO 70%, consolidations 30%). The consolidations regressed into GGO towards the later phase of the illness at 12–17 days (GGO 80%, consolidations 10%). There was increase in the frequency of normal chest x-rays from 9% at days 6–11 up to 33% after 18 days indicating a healing phase. The majority 92.3% of patients with abnormal chest x-rays were symptomatic ($P = 0.005$). **(17)**

In a study done in 220 patients In Egypt by *R Yasin et al* reported 62.9% had abnormal baseline CXR and 37.1% had normal baseline CXR. During follow-up chest X-ray studies, 13.7% of the normal baseline CXR showed CXR abnormalities. In abnormal chest X-ray, consolidation opacities were the most common finding seen in 81.3%, followed by reticular interstitial thickening seen in 39.9% and GGO seen in 32.5%. Pulmonary nodules were found 9.3% and pleural effusion was seen in 7.5%. Most of the patients showed bilateral lung affection 67.5% with peripheral distribution in 58.2% and lower zone affection in 73.1%. The total severity score was estimated in the baseline and follow-up CXR and it was ranged from 0 to 8. **(18)**

METHODOLOGY

Study design and setting:

It was a retrospective cohort of patients admitted in the isolation ward and covid19 ICU in the unit of Pulmonary and critical care, Department of Internal medicine, TikurAnbessa Specialized Hospital (TASH), Addis Ababa, Ethiopia.

TASH is a referral teaching hospital of College of Health Sciences of Addis Ababa University. It has more than 700 beds. The hospital runs, among other department, the department of Internal Medicine in which there is Pulmonary and Critical care unit which is responsible for conducting everyday ward rounds in covid19 ICU and isolation ward.

There are 8 beds in the covid19 ICU and 30 beds in the isolation ward. There are 7 attending Pulmonologists, a total of 6 Paediatric / Adult Pulmonary and Critical Care Fellows, at least 3 Internal Medicine / Anaesthesiology / Emergence Medicine Residentsper 12hrs and 4 nurses per 6hrs working in both covid19 ICU and isolation ward.

Study duration

It was from November 2020 to October 2021

Study population: All symptomatic covid-19 patients whose RT-PCR test was positive

Inclusion Criteria

Patients who had been diagnosed to have positive covid19 test (RT-PCR) who had one or more chest x ray or CT scan done during their course of illness.

Exclusion criteria

All patients who aged less than 18years

End points
It was the presence of radiological manifestations.

Sample size Calculations
$$n = \frac{Z^2 \times P(1-p)}{D^2}$$
n= Sample size
Z= % point corresponding significant level of 5%= 1.96
P= Prevalence of abnormal CXR findings in covid19 patients in Egypt {P=62%} (18)
D= Maximum likely error= 5%
n = 362
Since the number of patient with covid19 was decreased as days goes on, the obtained sample size in this study was 243 patients.

Data Collection Procedure

The Medical file numbers of the patients who were admitted at the Covid19 isolation ward and covid19 intensive care unit was taken from Covid19 treatment Centre Register patients' books. These file numbers were followed in the Med web (Tele-medicine internet software version 7.0.11) Computerized Hospital system to find those who had one or more chest X ray or CT Scan taken during study period. Only Author had access to the Data.

At first it was approximated that more than half of the patients admitted in the covid19 ICU and covid19 isolation ward could have one or more chest x ray/ CT scan done during their course of the disease, and the average number of patients admitted per month in both covid19 and isolation ICU, it was about 50 to 70 patients, however as days goes on the number of patients as well as those who had chest x ray or CT scan were decreasing therefore, all consecutive patients were included in the study.

Individual data from those chosen to participate in the study was obtained from computerized electronic medical record (iCare Digital HMS v8.1.0.0) and Medical file charts by using specific case report form (CRF) which was designed for the purpose of the study

The CRF was used to collect all de-identifiable information in chronologic numeric assignment, including baseline characteristics (age, gender, address), time from

onset of the disease to when the chest x ray was done and patient comorbid conditions (Cancer, CKD, DM, Heart disease, HIV, Pregnancy, Chronic Lung Disease, Neurological disease, Smoking and Tuberculosis), long-term use of any medications, history of previous or current respiratory complaints, its frequency, duration and progression, and treatment modality for the Respiratory diseases of the patients were noted and recorded. Vital signs at the time of admission including Blood pressure, Heart rate, Respiratory rate, Body temperature, Oxygen saturation and glycated haemoglobin were recorded.

Radiological Interpretation

Chest X rays or CT scans which were available in the med-web (Tele-medicine internet software version 7.0.11) Computerized Hospital system were interpreted and classified by the Author. All the abnormal findings including detailed description of the lesions, anatomical tissue involved, size, side, number, distribution, position, shape, edges, pattern, density, lung volume and any noted radiological diagnosis were jointly reviewed with a Thoracic Radiologist. Then they were recorded in specific case report form (CRF) in frequency and percentage.

STATISTICAL CONSIDERATION

The collected data were analysed by SPSS statistical package software version 23(SPSS Inc. Released 2015. IBM SPSS statistics for windows, version 23.0), followed by data coding, checking, cleaning and analysis. The data were expressed as Numbers (No.), percentage (%), mean (X), median and standard deviation (SD)

The student's t-test was used for comparison of quantitative variables with normally distribution and Mann Whitney's test was used for those which were not normally distributed. Chi-square test (X2) was used for comparison of qualitative data. When the expected cells were less than 5, Fischer's exact test was used.

All analysis was performed at confidence interval of 95% (CI). A two-sided P-value<0.05 was considered statistically significant

ETHICAL CLEARANCE

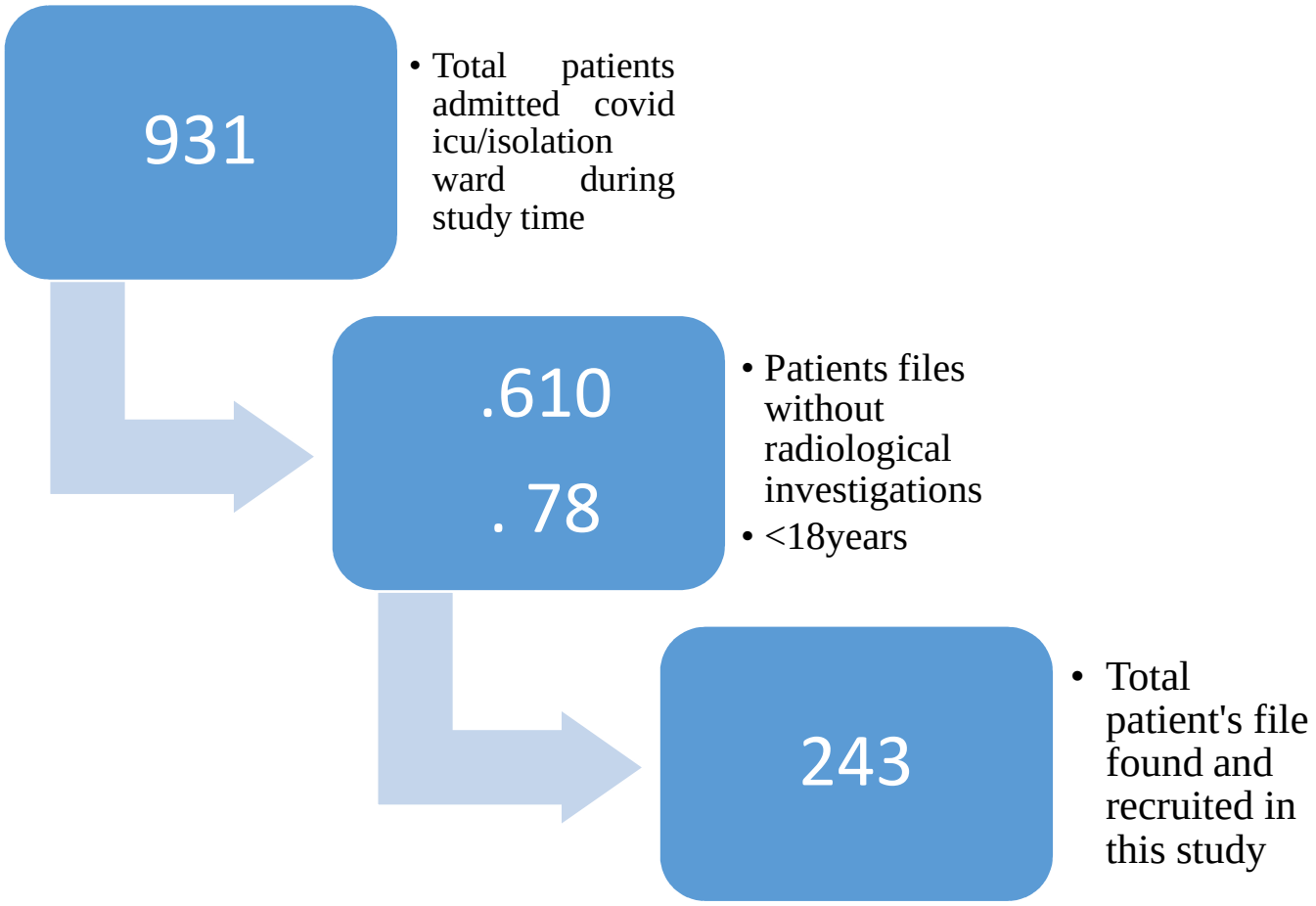
The ethical clearance to conduct this study was obtained from the Institutional Review Board of department of Internal medicine, College of Health Sciences, Addis Ababa University

RESULTS

Over a period of one year (November 2020 to October 2021) 931 adult symptomatic covid19 patients with positive RT-PCR were admitted at TikurAnbessa Specialized Hospital, (Isolation ward and covid19 ICU).

610 patients did not have imaging and 78 patients were less than 18 years old therefore they were excluded from the study. 243 patient's files were available to be recruited in this study. Male were 118(48.6%) and female were 125(51.4%)

Figure 1: PATIENT FLOW CHART



The median age was 46 years, IQR (30 - 60). The minimum age was 18 years and the maximum age was 88 years. About half of the study population 124 (51%) were above 46 years. More than half of the study population 166 (68.3%) were coming from Addis Ababa **(Table 1).**

Two hundred nine (86%) of the study population had one or two preexisting medical condition, out of these 83 (34.2%) had cancer as a medical condition.**(Figure 2)**
With respect to the use of medications, 19 patients (7.8%) were on steroids prior to covid19 diagnosis.

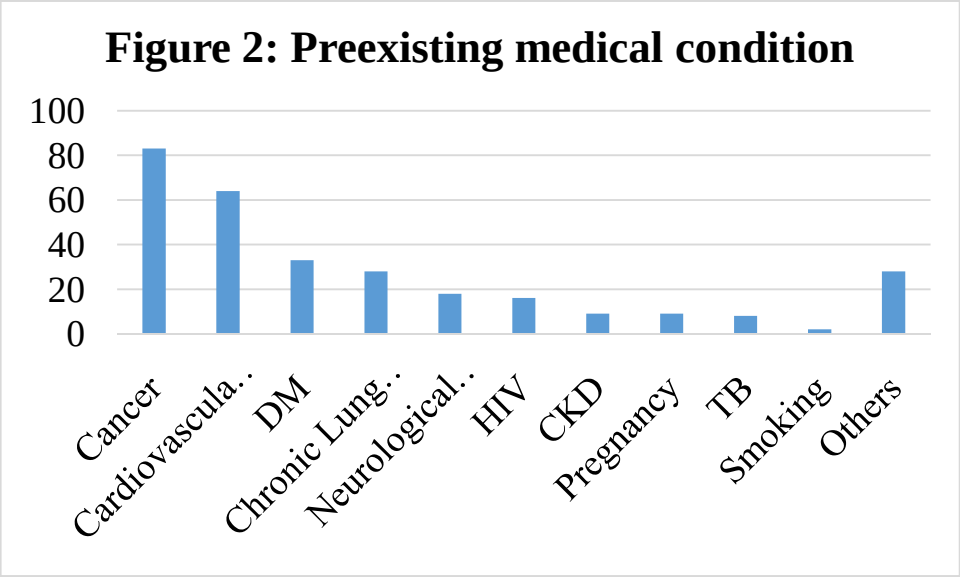


Table 1: Sociodemographic and basic information

Characteristics		**n (%)**
Age Median, IQR: 46 (30-60)	<30	59 (24.3)
	30-45	60 (24.7)
	46-59	62 (25.5)
	≥60	62 (25.5)
Sex	Male	118 (48.6)
	Female	125 (51.4)
Address	Addis Ababa	166 (68.3)
	Out of Addis Ababa	74 (30.5)
	Not recorded	3 (1.2)
Any other medical condition	Yes	209 (86.0)
	No	34 (14.0)
Medical conditions		

Cancer	Yes	83 (34.2)
Cardiovascular	»»	64 (26.3)
DM	»»	33 (13.6)
Chronic lung disease	»»	28 (11.5)
Neurological disease	»»	18 (7.4)
HIV	»»	16 (6.6)
CKD	»»	9 (3.7)
Pregnancy	»»	9 (3.7)
TB	»»	8 (3.3)
Smocking	»»	2 (0.8)
Other	»»	28 (11.5)
Medications used		
Anti HTN	Yes	66 (27.2)
Anti-cancer	»»	42 (17.3)
OHA Insulin	»»	33 (13.6)
Steroids	»»	19 (7.8)
HAART	»»	12 (4.9)
Antibiotics	»»	8 (3.3)
Anti-TB	»»	8 (3.3)
Beta agonist	»»	7 (2.9)
Anti-coagulant	»»	7 (2.9)
Vitamin Supp	»»	6 (2.5)
Diuretics	»»	5 (2.1)
Any other medications	»»	25 (10.3)

Seventy nine patients (32.5%) had a history of recorded respiratory disease in the past 12months.In 61 patients (25.1%) the previous respiratory diseases were treated with Antibiotics.

One hundred forty three patients (58.8%) were found to have respiratory symptoms in addition to constitutional symptoms by the time CXR/CT scan was taken. Out of the presented respiratory symptoms dry cough was in 101 (46.6%), difficulty in breathing was in 89 (36.6%) and chest pain was in 31 (12.8%).

In 44 patients (18.1%), the duration of chest symptoms to chest CXR/CT Scan was one week, in 42 patients (17.3%) it was less than 7days, in 29 patients (11.9%) it was more than a months, in 14 patients (5.8%) it was two weeks and in 7 patients (2.9%) it was three weeks.**(Table 2)**

Table 2: History of previous and current respiratory manifestations

Characteristics		**n (%)**
Any recorded history of respiratory disease in the past 12 months?	Yes	79 (32.5)
	No	164 (67.5)
How many times the patient did had respiratory disease in the past 12 months?	1-3 times	49 (62.0)
	4-10 times	14 (47.7)
	>10 times	16 (20.2)
How was the respiratory disease treated?		
Antibiotics	Yes	61 (25.1)
Oxygen therapy	»»	23 (9.5)
Anti-tuberculosis	»»	17 (7.0)
Steroids	»»	10 (4.1)
Beta agonist	»»	8 (3.3)

Pleural procedures	»»	8 (3.3)
Respiratory symptoms when Chest X-ray/CT scan was taken	Yes	143 (58.8)
	No	100 (41.2)
Current Respiratory symptoms		
Cough	Yes	101 (41.6)
Difficulty in breathing	»»	89 (36.6)
Chest pain	»»	31 (12.8)
Coughing up blood	»»	4 (1.6)
Other respiratory symptoms	»»	6 (2.5)
Time from respiratory symptoms to Chest X-ray/CT Scan exposure	Days	42 (17.3)
	Weeks	44 (18.1)
	Two weeks	14 (5.8)
	Three weeks	7 (2.9)
	Months (s)	29 (11.9)
	None	107 (44.0)

The mean Saturation of oxygen (SPO2) was 91% (±8.29), the median (IQR) was 96 (89 - 97.5) **(Table 3)**

Table3: Clinical Measurements

Characteristics	**Mean (SD)**	**Median (IQR)**
SBP (n=238)	117.51 (±18.2)	120 (115-135)
DBP (n=238)	73.4 (±10.6)	70 (70-80)
HR (n=239)	96.6 (±16.6)	96 (81.5-109)
SpO_2 (n= 238)	91.0 (±8.29)	96 (89-97.5)

RR (n=238)	24.0 (±6.19)	20 (20-23)
Temperature (n=33)	37.1 (±0.70)	37.0 (36.6-37.1)
HbA1c (n=10)	8.65 (±1.97)	9 (7.45-10.95)

In this study the most predominant CXR findings were found to be bilateral 118 (48.6%), multiple 115 (47.3%), interstitial 102 (42.0%), patchy opacities 98 (40.3%), mostly distributed peripherally 51 (21.0%) in the lower 134 (55.1%) and middle 112 (46.1%) lung zones. Most lesions had increased densities 109 (44.9%) followed by ground glass densities 43 (17.7%). **(Table 4)**

Table 4: Chest x-ray findings (For 243 patients)

Characteristics		**N (%)**
Type of Chest X-ray view	Anterior Posterior view	1 (0.4)
	Posterior Anterior View	242 (99.6)
Anatomical tissue involved		
Trachea and bronchi	Yes	7 (2.9)
Hilar structures	»»	10 (4.1)
Lung zones	»»	134 (55.1)
Pleura	»»	32 (13.2)
Lung lobes & fissures	»»	9 (3.7)
Costophrenic angles	»»	1 (0.4)
Heart	»»	15 (6.2)

Bones	»»	1 (0.4)
Size of the lesion	Small (<1cm)	5 (2.1)
	Moderate (1cm-3cm)	5 (2.1)
	Large (>3cm)	145 (59.7)
	Other	4 (1.6)
	None	84 (34.6)
Side	Unilateral	44 (18.1)
	Bilateral	118 (48.6)
	None	81 (33.3)
Number	One	26 (10.7)
	Two	12 (4.9)
	Three	5 (2.1)
	Four	1 (0.4)
	Five	2 (0.8)
	Multiple	115 (47.3)
	None	82 (33.7)
Distribution of lesion (s)		
Peripheral	Yes	51 (21.0)
Localized	»»	36 (14.8)
Diffuse	»»	29 (11.9)
Symmetrical	»»	19 (7.8)
Central	»»	16 (6.6)
Asymmetrical	»»	15 (6.2)
Position of the lesion		
Paratracheal	Yes	6 (2.5)
Hilla	»»	10 (4.1)
Pulmonary arteries	»»	6 (2.5)
Upper zone	»»	39 (16.0)
Middle zone	»»	112 (46.1)
Lower zone	»»	134 (55.1)
Shape		
Round	Yes	14 (5.8)
Lobulated	»»	14 (5.8)
Speculated	»»	2 (0.8)
Coarsed	»»	2 (0.8)
Patchy opacity	»»	98 (40.3)
Homogenous opacity	»»	24 (9.9)
Other	»»	25 (10.3)
Edge	Regular	22 (9.1)
	Irregular	140 (57.6)

	None	81 (33.3)
Pattern		
Consolidation	Yes	11 (4.5)
Interstitial	»»	102 (42.0)
Nodular or mass	»»	27 (11.1)
Atelectasis	»»	28 (11.5)
Other	»»	4 (1.6)
Density	Increased density	109 (44.9)
	Soft tissue density	7 (2.9)
	Ground glass density	43 (17.7)
	Low density	3 (1.2)
	None	81 (33.3)
Additional descriptions		
Blunting of the costophrenic angle	Yes	31 (87.2)
Air bronchogram	»»	23 (9.5)
Silhouette sign	»»	8 (3.3)
Pneumothorax	»»	2 (0.8)
Other additional description	»»	8 (3.3)
Lung volume	Normal	220 (90.5)
	Reduced	23 (9.5)
Radiological diagnosis	**YES**	**160 (65.8%)**
	NO	**83 (34.2%)**

The commonly seen pattern of CT scan in this study were bilateral 12 (70.6%) multi lobes involvement 12 (70.6%) with ground glass attenuation 4 (23.5%) and nodules 4 (23.5%) **(Table 5)**

Table 5: Chest CT-Scan findings (For 17 Patients)

Characteristics	**N=17**	**N (%)**
Attenuation	Normal attenuation	3 (17.6)
	Ground Glass attenuation	4 (23.5)
	Consolidation attenuation	2 (11.8)
	Crazy paving attenuation	1 (5.9)
	Ground glass with traction bronchiectasis	1 (5.9))

	Consolidation with traction bronchiectasis	1 (5.9)
	Nodules	4 (23.5)
	Consolidation with traction bronchiectasis and fibrosis	1 (5.9)
Lobe involved	Upper lobes	2 (11.8)
	Lower lobes	1 (5.9)
	Multi lobes	12 (70.6)
	None	2 (11.8)
Side	Unilateral	3 (17.6)
	Bilateral	12 (70.6)
	None	2 (11.8)

Out of 243 patients recruited in the study, 160 patients (65.5%) were found to have radiological manifestations. Out of them 51.9% (n=83) were male and 48.1% (n=77) were female. Median age was 50years, IQR (30 - 52). The minimum age was 21years and the maximum age was 88years.86.9% (n=139) were found to have preexisting medical conditions. The most frequently observed medical condition in the patient with radiological manifestations was cardiovascular diseases which was 31.3% (n=50)

Majority of patients with old age (P-value=0.000*), Cardiovascular diseases (P-value=0.016), Diabetes mellitus (P-value= 0.013), chronic lung disease (P-value=0.018) and pulmonary tuberculosis (P-value=0.038) were found to have radiological manifestations. Majority of the patients with cancer did not have radiological manifestations (p-value=0.000*). **(Table 6)**

TABLE 6: Comparison of study participants with and without radiological diagnosis

Variables		Radiological diagnosis		X^2	P-value
		Yes n=160	No n=83		
Age Median: IQR		50 (30-52)	38 (27-50)		**0.000***
Age	<30	35 (21.9%)	24 (28.9%)	17.11	**0.001***
	30-45	30 (18.8%)	30 (36.1%)		
	46-59	43 (26.9%)	19 (22.9%)		
	≥60	52 (32.5%)	10 (12.0%)		
Sex	Male	83 (51.9%)	35 (42.2%)	2.061	0.151
	Female	77 (48.1%)	48 (57.8%)		
Any other medical condition	Yes	139 (86.9%)	70 (84.3%)	0.292	0.589
	No	21 (13.1%)	13 (15.7%)		
Cancer	Yes	38 (23.8%)	45 (54.2%)	22.55	**0.000***
Cardiovascular	Yes	50 (31.3%)	14 (16.9%)	5.82	**0.016***
DM	Yes	28 (17.5%)	5 (11.3%)	6.13	**0.013***
Chronic lung disease	Yes	24 (15.0%)	4 (4.8%)	5.55	**0.018***

Neurological disease	Yes	13 (8.1%)	5 (6.0%)	0.35	0.553
HIV	Yes	11 (6.9%)	5 (6.0%)	0.06	0.800
CKD	Yes	8 (5.0%)	1 (1.2%)	2.20	0.172
Pregnancy	Yes	6 (3.8%)	3 (3.6%)	0.003	1.000
TB	Yes	8 (5.0%)	0 (0.0%)	4.29	**0.038***
Smocking	Yes	1 (1.2%)	1 (0.6%)	0.22	1.000
History of respiratory disease in the past 12 months?	Yes	66 (41.3%)	13 (15.7%)	20.77	**0.000***
	No	94 (58.8%)	67 (80.7%)		
Respiratory symptoms when Chest X-ray/CT scan was taken	Yes	115 (71.9%)	28 (33.7%)	32.82	**0.000***
	No	45 (28.1%)	55 (66.3%)		
Cough	Yes	86 (53.8%)	15 (18.1%)	28.64	**0.000***
Difficulty in breathing	Yes	75 (46.9%)	14 (16.9%)	21.20	**0.000***
Chest pain	Yes	27 (16.9%)	4 (4.8%)	7.13	**0.008***
Coughing up blood	Yes	2 (2.4%)	2 (1.3%)	0.45	0.500
SpO_2 Median: IQR		92 (87-94.5)	95.0 (92.5-97.0)		**0.000***

DISCUSSION

Most predominant CXR findings in this study were bilateral 48.6%, multiple 47.3%, interstitial 42.0%, patchy opacities 40.3%, peripherally 21.0% in lower 55.1% and middle 46.1% lung zones with increased densities 44.9% and ground glass densities 17.7%. Common CT scan findings were bilateral 70.6%, multilobes involvement 70.6% and GGO 23.5%. The prevalence of radiological manifestations in this study was found to be 65.8%. Majority of patients with old age, Cardiovascular diseases, Diabetes mellitus, chronic lung disease and pulmonary tuberculosis were found to have radiological manifestations (P-value=0.000*, 0.016, 0.013, 0.018 and 0.038 respectively). Majority of the patients with cancer did not have radiological manifestations (p-value=0.000*).

In this study the median age was 46years, IQR (30 - 60), this mean that the study population comprised of many people with younger age. The most dominant preexisting medical condition was cancer. This can be contributed with the fact that TikurAnbessa Specialized Hospital attends Cancer patients from all over the

Country.

The patients with radiological manifestations were found to be older than those without radiological. For those with radiological manifestations, 52 (32.5%) of them were more than 60years old. This can be a possible confounder, since covid19 infection tend to be worse in elderly. This is in keeping with the findings of a systematic review with meta-analysis done by KR Starke et al which showed that the risk of hospitalization increased by 3.4% per age year, the risk of in-hospital and case mortality increased per age year by 5.7% and 7.4% respectively **(19)**

This study has found majority of patients with CVD, DM, Chronic Lung Disease and PTB had radiological manifestations. This can also be a confounder since these patients can also complicate pulmonary edema or can have previous lung scars which can also contribute to radiological manifestations. These findings are similar to another studies done by Htun Y. M et al in Myanmar which found that the most common comorbidities were Hypertension 58.3%, Diabetes mellitus 29.8% and Heart diseases 26.2%, **(20)** also a systematic review and meta-analysis done by Zhou Y et al found the most prevalent comorbidities were obesity (42%, 95% CI 34-49%), Hypertension (40%, 95% CI 35-45%), followed by diabetes (17%, 95% CI 15-20%), cardiovascular disease (13%, 95% CI 11-15%) and Respiratory disease (6%,95% CI 6-10%). **(21)**In contrast to other studies such as Calles. A et al which was done in Madrid Hispania **(28)** and found that there was a high variability on thoracic imaging findings, in cancer patients with covid19, with multilobar pneumonia as the most commonly found pattern (74%) in this study majority of patients with cancer did not have radiological manifestations. This is a rare finding. Further researches are warranted for thorough investigations.

There was statistical significant difference in terms of presence of respiratory symptoms when chest x rays/CT scans were taken. The symptoms were found to be more in those who turn out to have radiological manifestations. Statistical significant respiratory symptoms in this study were cough, difficulty in breathing and chest pain. This findings are not far from a conclusion drawn from a study done by Sacha F de Stoppelaar et al **(22)** which suggested that a CXR has no diagnostic value in patients with suspected infection without respiratory signs and symptoms, if a reliable medical history can be obtained (Pneumonia on CXR 0%).

The vice versa has shown to be true in this study.

With respect to clinical measurements, there was statistical significant difference in terms of oxygen saturation. Those patients with radiological manifestations were found to have lower oxygen saturations compared to those without radiological manifestations. These findings are similar to a study done by Metwally M. I et al in Egypt which found that there was significant negative correlation between CT Severity and Oxygen saturation ($r= -0.49$, $p< 0.001$) **(23).** In another study done by Ong SWX et al they found that having a high risk baseline CXR was significantly associated with requiring supplemental oxygen in multivariate (adjusted odds ratio 8.38, 95% CI 2.43-28.97, P=0.001) analyses **(24).**

The prevalence of radiological manifestations was 65.8%. This is close to a study done in China by Wong HYF et al which found that 59% of patients had initial positive findings with RT-PCR testing and abnormal findings at baseline chest radiography **(15).**This is smaller compared to a similar study which was done in Spain by Turan O et al which found that of the hospitalised COVID-19 patients, 84.9% had pneumonia and 83.5% had typical radiological COVID-19 appearances **(25).**

The pattern of radiological manifestations which obtained from this study is not far from a pattern found by Wong HYF et al which showed that consolidation was the most common 47%, followed by ground-glass opacities 33% peripheral distribution 41% and lower zone distribution 50% with bilateral involvement 50%. Pleural effusion was uncommon 3% **(15).**In contrast to this study Smith DL et al found the presence of patchy and/or confluent, bandlike ground-glass opacity or consolidation in a peripheral and mid to lower lung zone distribution in only 10% while 57% of the patients exhibited nonspecific findings CXR findings **(10).**

The findings of our study are in keeping with the findings from a systematic review don by Sun Z et al. in which Pulmonary lesions more often involved bilateral lungs 78% and were more likely to have a peripheral 65.35% and peripheral plus central distribution 31.12%, but less likely to have a central distribution 3.57,. Ground glass opacities (GGO) in 58.05%, consolidation in 44.18%, and GGO plus consolidation 52.99%. These were the most common findings reported in 94.5% of the studies, followed by air bronchogram 42.50%, linear opacities 41.29%, crazy-paving pattern 23.57% and interlobular septal

thickening 22.91% **(13).**

In this study, the most observed Chest CT scan findings were Bilateral 70.6%, multilobes 70.6% and lower lobe 5.9%, Ground Glass attenuation 23.5%, Nodules 23.5%, Consolidation attenuation 11.8%, Crazy paving attenuation 5.9%, Ground glass with traction bronchiectasis 5.9%, Consolidation with traction bronchiectasis 5.9%, and consolidation with traction bronchiectasis and fibrosis 5.9%

These findings are similar to a study done in Egypt by Sabri et al which found that bilateral affection was in 76.36%. Multilobar affection was in 84.54%. Lower lobes affection was in 81.36%. Peripheral/sub pleural affection was in 92.27% **(26).**

The lung zone attenuation found in this study are in keeping with another study which was also done in Egypt by Hefeda M.M et al where they found the patchy pattern was seen in 58.4%, the nodular pattern was in 13.5%. The diffuse pattern was in 13.6%. The ground glass density was in 56.2%. The crazy pavement sign was in 56.9% for hospitalization and 40.2% for ICU patients and 39.2% deceased patients **(27).**

The findings from this study are also in keeping with a case series study which was done in Africa, Nigeria by O. K Ajiboye et al which found that of the three cases series first showed bilateral, nodular opacities with a peripheral and predominantly lower lung zone distribution, the second showed bilateral lung consolidation with a pan-lobar affectation and air-bronchograms. Peripheral ground-glass opacification in the left upper lobe and the third case showed bilateral, nodular, ground-glass opacities in the lower lobes with a peripheral distribution **(8).**

STUDY LIMITATIONS

The retrospective nature of the study might have resulted in missing variables. There could be a recall bias in recording the frequency of previous respiratory diseases and recording the type of medications the patient has been using. The required sample size was supposed to be 362, but due to the scarcity of recorded data, the available sample size was 243.

STRENGTH OF THE STUDY

It has provided the estimate of the prevalence and pattern of radiological manifestations in symptomatic positive (RT-PCR) covid19 in the isolation and covid19 ICU at TASH.

CONCLUSION

Radiological manifestations in symptomatic patients with positive (RT-PCR) covid19 admitted in isolation and covid19 ICU at TASH are very common. The most observed radiological findings are bilateral multiple peripheral interstitial patchy opacities with increased and ground glass densities in the mid and lower lung zones.

Old age, preexisting cardiovascular disease, diabetes mellitus, chronic lung disease, pulmonary tuberculosis, respiratory symptoms of dry cough, difficulty in breathing, chest pain and lower oxygen saturation were strongly found to be associated with the presence of radiological manifestations in this study, however large studies are warranted. Early detection and proper management of these factors will prevent the development of these radiological manifestations. However, COVID-19 Patients with cancer may not show radiologic abnormalities.

FUNDING

This research has been funded by **Muhimbili National Hospital** where the Author is a current permanent employee. However Muhimbili National Hospital has no any benefit from this research.

ETHICAL DECLARATION

The ethical clearance to conduct this study was obtained from the Institutional Review Board of department of Internal medicine, College of Health Sciences, Addis Ababa University

RECOMMENDATION

When patients with these associated factors, present with these symptoms and radiological manifestations they should be screened for covid19 (RT-PCR).

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APPENDICES

APPENDIX I: QUESTIONARE

RADIOLOGICAL MANIFESTATIONS IN SYMPTOMATIC PATIENTS WITH POSITIVE (RT-PCR) COVID19 ATTENDING TASH

Questionnaire number [__ ___] Date of interview [__/___/ 2021]

Name of Data Collector _____

A. Sociodemographic and Basic information

Quest No.	Questions	Coding categories	Response
Q 1	**Patient's name**		
Q 2	**Hospital file No:**		
Q 3	**Patient's Region**	1. Addis Ababa 2. Oromia 3. Amhara 4. Others	**[ ]**
Q 4	**Age**	Age in years	**[ ]**
Q 5	**Gender**	1.Male 2.Female	**[ ]**

Q 6	**Level of Education?**	1. Informal education 2. Primary education. 3. Secondary education. 4. Post-Secondary/University. 5. Not recorded	**[ ]**
Q 7	**Marital status?**	1. Single 2. Married 3. Separated 4. Divorced 5. Cohabiting 6. Widowed 7. None	**[ ]**
Q 8	**Any other medical conditions?**	1. Cancer 2. CKD 3. DM 4. Heart disease 5. HIV 6. Pregnancy 7. Chronic Lung Disease 8. Neurological Disease 9. Smoking 10. Tuberculosis 88. None	**[ ]**
Q 9	**Use of any Medications**	1- Antibiotics---------- 2- Steroids---------- 3- OHA/Insulin---------- 4- Beta agonist---------- 5- Anti HTN_____	**[ ]**

		6- HAART_____ 7- Anticoagulants---------- 8- Anti TB_____ 9- Vitamin supp_____ 10- Others (Specify)_____ 88. None	

History of previous and current Respiratory manifestations

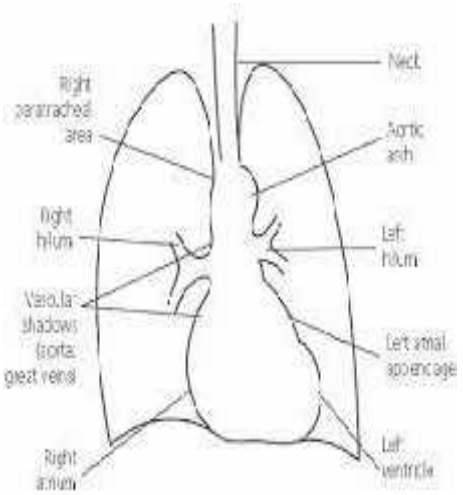
Q 10	Any recorded history of respiratory disease in the **past 12 months**	1- No 2- Yes 88-None	**[ ]**
Q 11	How many times the patient did had respiratory disease in the **past 12 months?**	1- 1-3times 2- 4-10times 3- >10Times 88-None	**[ ]**
Q 12	How was the respiratory disease treated?	1- Anti-tuberculous medications 2- Antibiotics_____ 3- Beta agonist 4- Steroids_____ 5- Pleural procedures_____ 6- Oxygen therapy 7- No treatment 8- Local remedies 88. None	**[ ]**
Q 13	**Date of Covid19 RT-PCR diagnosis**	Date __/__/____	**[ ]**
Q 14	**Respiratory symptoms when Chest X-Ray/CT**	1-No 2- Yes	**[ ]**

	scan was taken		
Q 15	**What respiratory symptoms was the patient presenting with**	1. Dry Cough 2. Difficulty in breathing 3. Chest pain 4. Chest pressure 5. Sore throat 6. Running nose 7. Coughing up blood 8. Others (specify) 88. Not applicable	**[ ]**
Q 16	**Duration of Covid19 symptoms**	1. 0-7 days 2. 7-14 days 3. 15- 21days 4. > 21days	**[ ]**
Q 17	**Time from Respiratory Symptoms to Chest X-Ray/CT Scan exposure**	1. Days… 2. Week…. 3. Two weeks…. 4. Three weeks…. 5. Month(s)….	**[ ]**

C. Clinical Measurements

Q 18	**Vital signs**	SBP1 _____SBP2_____AveSBP_____ DBP1 _____DBP2_____AveDBP_____ HR---------- SPO2---------- RR---------- Temp---------- HbA1C……..……%

D. Radiological findings

Q 19	**Type of chest x ray view**	1. Anterior Posterior view 2. Posterior Anterior view 3. Lateral view	**[ ]**
Q 20	**Mark on the figure the anatomical tissue involved**  	1. Trachea and bronchi 2. Hilar structures 3. Lung zones 4. Pleura 5. Lung lobes and fissures 6. Costophrenic angles 7. Diaphragm 8. Heart 9. Mediastinum 10. Soft tissues 11. Bones 12. One or more option 88. None	
Q 21	**Size of the lesion**	1. Small (<1cm) 2. Moderate (1cm - 3cm) 3. Large (>3cm) 88. None	**[ ]**
Q 22	**Side**	1. Unilateral 2. Bilateral 88. None	**[ ]**
Q 23	**Number**	1. One... 2. Two… 3. Three…	**[ ]**

		4. Four… 5. Five… 6. Multiple… 88. None	
Q 24	**Distribution of the lesion(s)**	1. Peripheral 2. Central 3. Symmetrical 4. Asymmetrical 5. Localized 6. Diffuse 7. Others(specify) 88. None	**[ ]**
Q 25	**Position of the lesion**	1. Paratracheal 2. Hilla 3. Pulmonary arteries 4. Upper zone 5. Middle zone 6. Lower zone 88. None	**[ ]**
Q 26	**Shape**	1. Round 2. Lobulated 3. Spiculated 4. Others (specify) 88. None	**[ ]**
Q 27	**Edge**	1. Regular 2. Irregular 88. None	**[ ]**

Q 28	**Pattern**	1. Consolidation 2. Interstitial 3. Nodular or mass 4. Atelectasis 88. None	**[ ]**
Q 29	**Density**	1. Increased density 2. Soft tissue density 3. Ground glass density 4. Low density 88. None	**[ ]**
Q 30	**Additional description**	1. Blunting of the costophrenic angles 2. Air bronchogram 3. Silhouette sign 4. Pneumothorax 5. Others (specify) 88. None	**[ ]**
Q 31	**Lung volume**	1. Normal 2. Reduced 3. Increased	
Q 32	**Respiratory condition(s)**	1. Yes 2. No	**[ ]**
Q 33	**Respiratory investigations**	1. Sputum for gene expert…… 2. Sputum for AFB…… 3. Sputum for culture	**[ ]**

		4. Pleural fluid analysis 5. Not done 88. None	
Q 34	**What covid19 Medications did the patient used**	1. Steroids 2. Antibiotics 3. Anticoagulants 4. Remdesivir 5. Tocilizumab 6. Ivermectin 7. Hydroxychloroquine 8. Others 88.None	**[ ]**
Q 35	**Outcome of the patient**	1. Death 2. Discharge	**[ ]**

APPENDIX II. INTRODUCTION LETTER

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ዶ/ር ሉት ሞሞፑል ለሚያደርጉት ጥናት "Radiological manifestations in symptomatic patients with positive (RT-PCR)Covid 19 attending TASH"ከተመለከተ የህመምን ካርድ የሚያስፈልጋቸውን መረጃ እንዲያገኙ አስፈላጊውን ትብብር እንዲደረግላቸው በትህትና እንጠይቃለን::

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