NOVEL CORONA VIRUS (COVID-19) PNEUMONIA: CT MANIFESTATIONS AND PATTERN OF EVOLUTION.

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RADIO-DIAGNOSIS

ABBREVATIONS

+ssRNA	Positive-strand RNA viruses
≥	More than
ACE 2	Angiotensin-converting enzyme 2
ARDS	Acute respiratory distress syndrome
AST	Aspartate Aminotransferase
BatCov RaTG13	Bat coronavirus
bat-SL-CoVZC45	bat SARS-like coronavirus ZC45 (MG772934.1)
bat-SL-CoVZXC21	bat SARS-like coronavirus ZXC21 (bat-SL-CoVZXC21 (MG772933.1)
COVID-19	Coronavirus disease 2019
CRP	C reactive Protein
CT	Computed Tomography
GGO	Ground-glass opacity
H1NI Influenza pandemic	2009 swine flu pandemic
HRCT	High-Resolution Computed Tomography
ICU	Intensive Care Unit
IFG	Interferon Gamma
ILD	Idiopathic Pulmonary Fibrosis
IPF	Interstitial Lung Disease
ISG	Interferon-Stimulated Genes
LDH	Lactate Dehydrogenase
kVp	Kilovoltage Peak
mAs	Milli-ampere seconds
MERS-CoV	Middle East respiratory syndrome coronavirus
N95	Respiratory protective device
PAP	Pulmonary Alveolar Proteinosis
PCT	Procalcitonin
PE	Pulmonary Embolism
PPE	Personal Protective Equipment
PTT	Prothrombin Time
PHEIC	Public Health Emergency of International Concern
R_0	Reproductive Number
RT-PCR	Real Time, Reverse Transcription Polymerase Chain Reaction
S	Spike
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SARSr-CoVs	Severe Acute Respiratory Syndrome (SARS)-related Corona Viruses (SARSr-CoVs)
WHO	World Health Organization

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CHAPTER I
INTRODUCTION

In late December 2019, there were multiple reports describing the outbreak of a viral pneumonia of unknown origin that were affecting the residents of Wuhan which is located in Hubei, a part of mainland China after which the China Health Ministry notified the World Health Organization (WHO). The cases had been reported since 8 December 2019, although some authorities believe the virus could be in circulation as early as October 2019, with many of the affected people residing in or around the local seafood market in Huanan (Hongzhou Lu, 2020). The WHO first referred to the novel coronavirus as 2019-nCoV when the virus was identified in swab sample of a patient's throat dated 7 January 2019 (David S Hui 1, 2020). The Coronavirus Study Group eventually reclassified this pathogen as SARS-CoV-2 and the World Health Organization termed the sickness coronavirus 2019. (COVID-19). Since 30 January 2020, As reported by China, there were 7736 verified cases, 12,167 suspected cases, and 82 confirmed cases in 18 foreign countries on four other continents. A global pandemic was proclaimed on 11 March 2020 and the SARS-CoV-2 epidemic which was announced a Public Health Emergency of International Concern (PHEIC) by WHO (Burki, n.d.).

Most of the virus-infected individuals will experience a moderate to extreme respiratory disease and will get relief without any specialised treatment. Some people, however, will become unwell and require medical assistance. People who have pre-existing medical illnesses including cancer, diabetes, cardiovascular disease, or chronic respiratory diseases are more vulnerable to serious sickness. COVID-19 may make anyone severely unwell or cause death at any age (WHO, n.d.).

According to the National Health Commission of China, the rate of death among cases reported in China was 2.1% as of 4 February 2020 (Harapan Harapan, 2020), whereas the death rate of other nations was 0.2% (Covid CD, 2020). The hospitalised patient death rate varied between 11% and 15% (Chaolin Huang, 2020).

COVID-19 is a highly dynamic magnitude and the information is still scarce, it is possible to change the initial assessment that COVID-19 is fairly contagious and has a relatively high fatality rate among some people. As a result, the goal of this study is to give a better knowledge of the illness that will aid in the formulation of future health policy by detailing the pathophysiology, case detection and treatment, as well as management and prevention activities.

CHAPTER II
LITERATURE REVIEW

The virus: classification and origin

SARS-CoV-2 is a member of the Coronaviridae family and the Nidovirales order. Coronavirinae and Torovirinae are two Coronaviridae subfamilies. The representatives of the subfamily Coronavirinae are subdivided among four genera: (a) Alphacoronavirus; (b) Betacoronavirus; (c) Gammacoronavirus and; (d) Deltacoronavirus (Christopher Burrell, 2016).

SARS-CoV-2 is a Betacoronavirus, as are two other extremely deadly viruses, SARS-CoV and MERS-CoV. SARS-CoV-2 is an enclosed single-stranded RNA (+ssRNA) virus with a positive sense (Axel Kramer, 2006).

SARS-CoV-2 is thought to be a new betacoronavirus that infects humans (R. Lu, 2020). According to a phylogenetic examination of the SARS-CoV-2 genome, the virus is nearly linked to two bat-derived SARS-like coronaviruses discovered in eastern China in 2018. It also appears to be genetically distinct from SARS-CoV and MERS-CoV (R. Lu, 2020). Researchers showed that the virus is more closely linked to BatCoV RaTG13, a bat coronavirus previously reported in Rhinolophus affinis (bat) from Yunnan Province, using the genome sequences of SARS-CoV-2, RaTG13, and SARS-CoV (Peng Zhou, 2020). A research discovered no proof of instances from other bat-originating viruses, such as BatCoV RaTG13, SARS-CoV, and SARSr-CoVs, in the genome of SARS-CoV-2 (Peng Zhou, 2020). All notwithstanding, these findings provide a convincing argument that this virus may have originated in bats (R. Lu, 2020) (Peng Zhou, 2020).

It is uncertain, however, exactly how and what conditions may have made it easier for the virus to spread and infect humans. Due to a following numbers of factors, bats are very least likely to be held accountable for the spread of virus among individuals (R. Lu, 2020).

(1) In the seafood market of Huanan, a wide range of animals (including mammals) other than the aquatic ones were for sale. However, no bats were discovered for sale;

(2) SARS-CoV-2 and its close counterparts, bat-SL-CoVZC45 and bat-SL-CoVZXC21, have a somewhat lengthy branch, indicating that those viruses are not SARS-direct CoV-2's ancestors; and

(3) Other animals, such as civets and possibly camels, have served as temporary hosts in different coronaviruses where bats serve as the natural reservoir, such as SARS-CoV and MERS-CoV.

Nonetheless, bats do not necessarily require the services of an intermediate host to infect humans. For example, bats shedding into raw date palm sap in Bangladesh are the source of the Nipah virus transmission (Stephen P. Luby, 2009).

Transmission

The Huanan Market's impact to disease transmission is unknown. A lot of initial instances of Covid-19 were associated to the aforementioned market, revealing that the cases of SARS-CoV-2 transmission from non-humans to humans (Qun Li, 2020). However, a genomic study later revealed that the virus has been introduced to the market from a not known area, where it spread swiftly, irrespective of the fact that person-to-person transmission may have occurred earlier (Wen-Bin Yu, 2020). Human-to-human spread was verified by the infected family members cluster and hospital professionals (Jasper Fuk-Woo Chan, 2020). After 1 January 2020, the vast majority of new cases that were diagnosed did not show any association and had no exposure to the market (Qun Li, 2020).

Because they breathe in respiratory aerosols or droplets when a Covid-19 positive patient coughs or sneezes, near links are assumed to be the primary source of human-to-human spread. SARS-CoV has been proven to survive for up to 96 hours on surfaces (Axel Kramer, 2006) and other coronaviruses for up to 9 days, faeces are also likely to be a key source of transmission (Kampf G, 2020).

The widely held belief that disease can spread asymptomatically is up for discussion. Although first research suggested asymptomatic transmission on 30 January 2020 (Camilla Rothe, 2020), Later, it was discovered that the person, who had symptoms previous to spreading the disease, had not been expressly questioned by the investigators (Kupferschmidt, 2020).

Transmission without any symptoms was also observed in a research that was published on 21 February 2020 (Bai et al., 2020), although such research may be constrained by errors or contact with other cases and fomites.

Discoveries on sickness indicators are prone to selection prejudice and change rapidly. The incubation period was estimated to be 5.2 days in a preliminary investigation (Qun Li, 2020). Another study claimed that the incubation period might last up to 19 or 24 days (Yan Bai, 2020) (Daniel K W Chu 1, 2020), while the maximum incubation period is currently generally agreed to be 14 days (WHO, 2020).

R0 (Basic reproductive number) is a measure of the average infections in numbers that can occur in a fully susceptible community from a single infected patient) is a measure of the average number of infections that can occur in a fully susceptible community from a single infected patient (Chris T Bauch, 2013). The R_0 value was determined by studies from prior outbreaks to be 2.7 for SARS (Steven Riley, 2003) and 2.4 for the 2009 H1N1 influenza pandemic (Yang Yang, 2009). According to a preliminary investigation, the (R_0) was 2.2. (Li et al., 2020a). However, the R_0 value was eventually corrected to 3.28 in a study that examined 12 papers that were available (Ying Liu, 2020). R0 being an average number, it is crucial to understand the role of quick transmitters, that can be heavily involved in epidemics within large clusters but have little effect on R0 (A J Kucharski, 2015) The R0 value may alter during the acute or pre-pandemic stages of an outbreak (Chris T Bauch, 2013).

No information of intrauterine infection caused by vertical transmission has been observed, and COVID-19 infection did not result in markedly bad indicators than in people who are not pregnant, according to research on the consequences of COVID-19 during pregnancy (Huijun Chen, 2020).

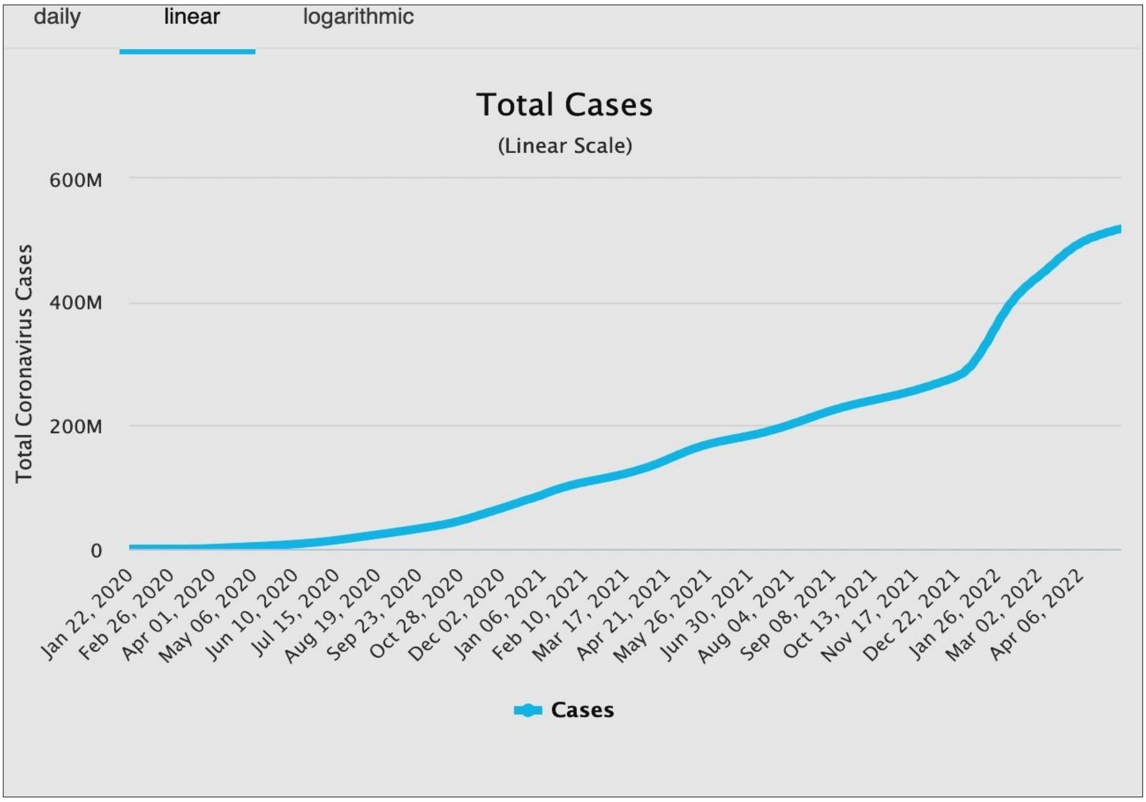


Figure 1: Total cases recorded all over the world from 22 January till 6 April 2022 (Source: https://www.worldometers.info/coronavirus/)

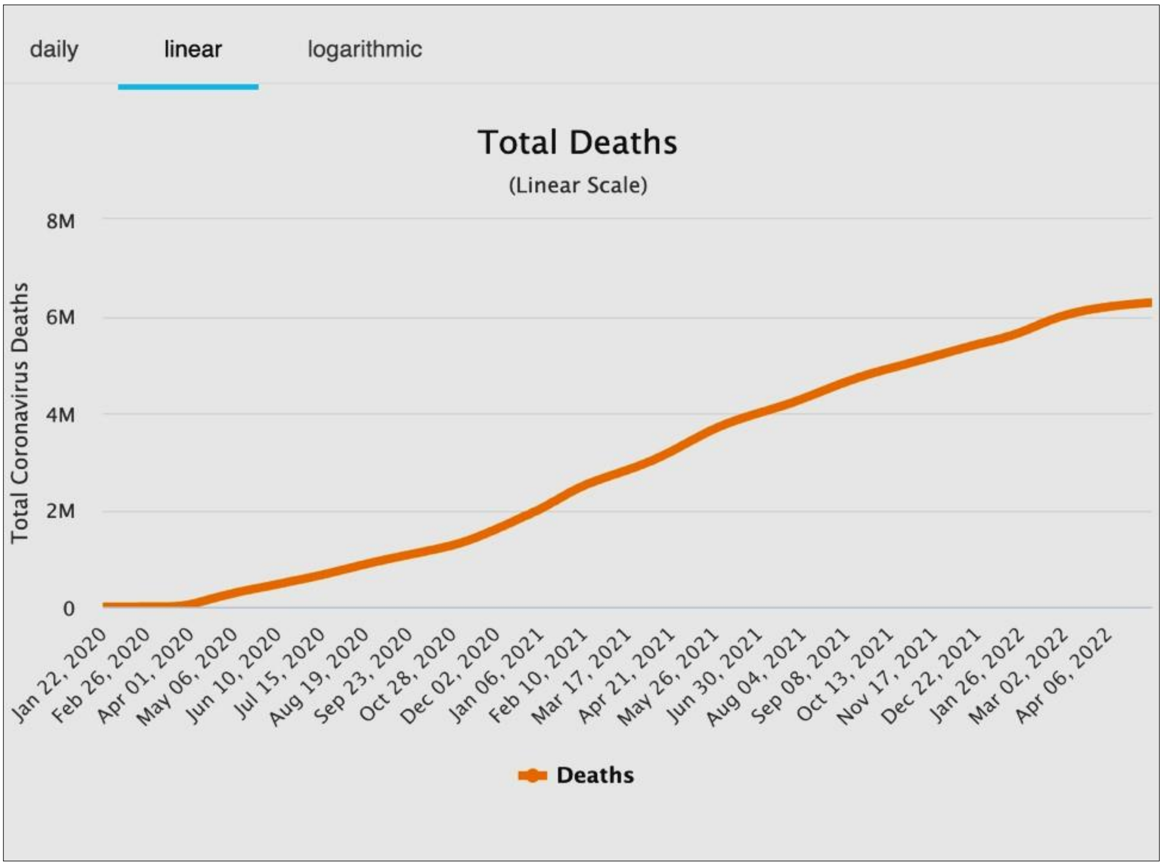


Figure 2: Total death recorded all over the world from 22 January till 6 April 2022 (Source: https://www.worldometers.info/coronavirus/)

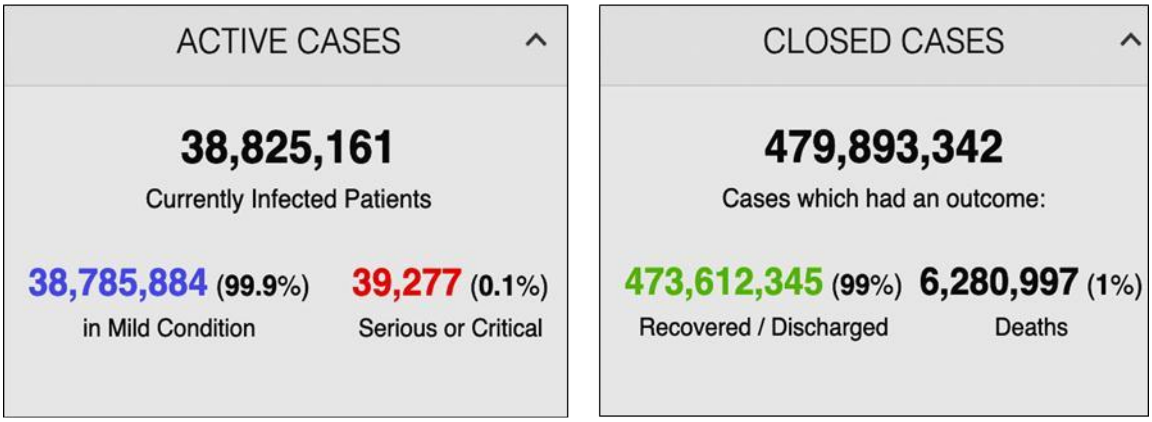


Figure 3: Active and Closed Cases (Global) (Source: https://www.worldometers.info/coronavirus/)

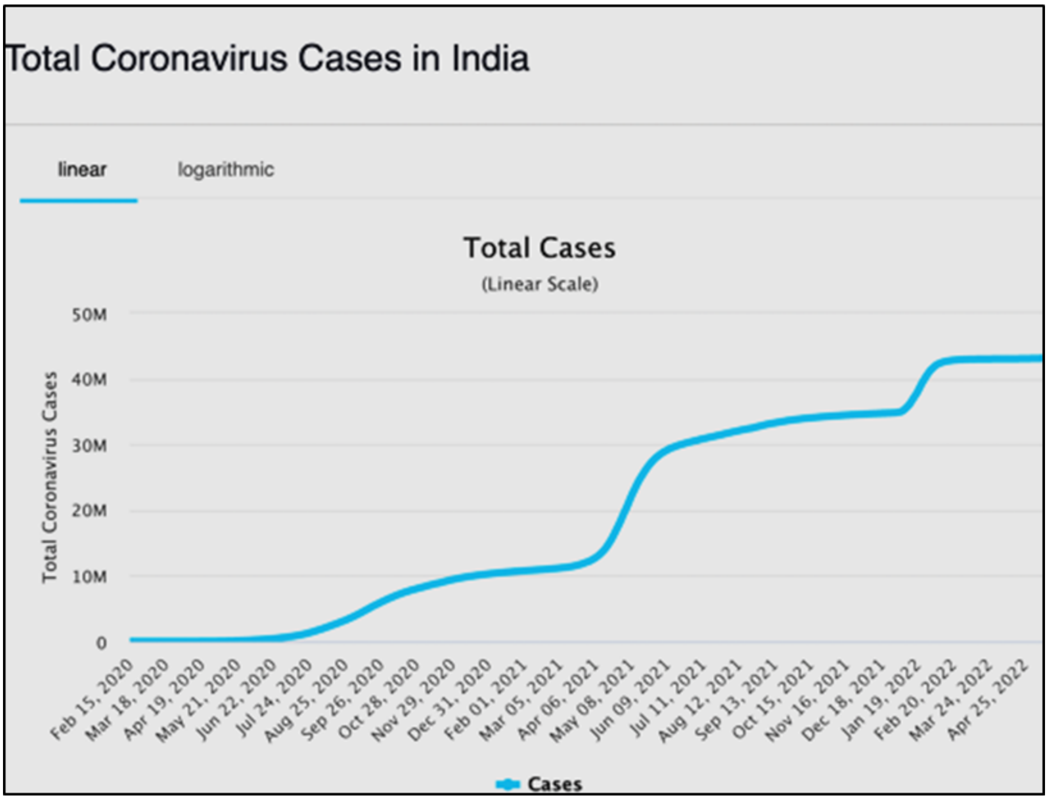


Figure 4: Total Coronavirus case in India from February 2020 to April 2022. (Source: https://www.worldometers.info/coronavirus/country/india)

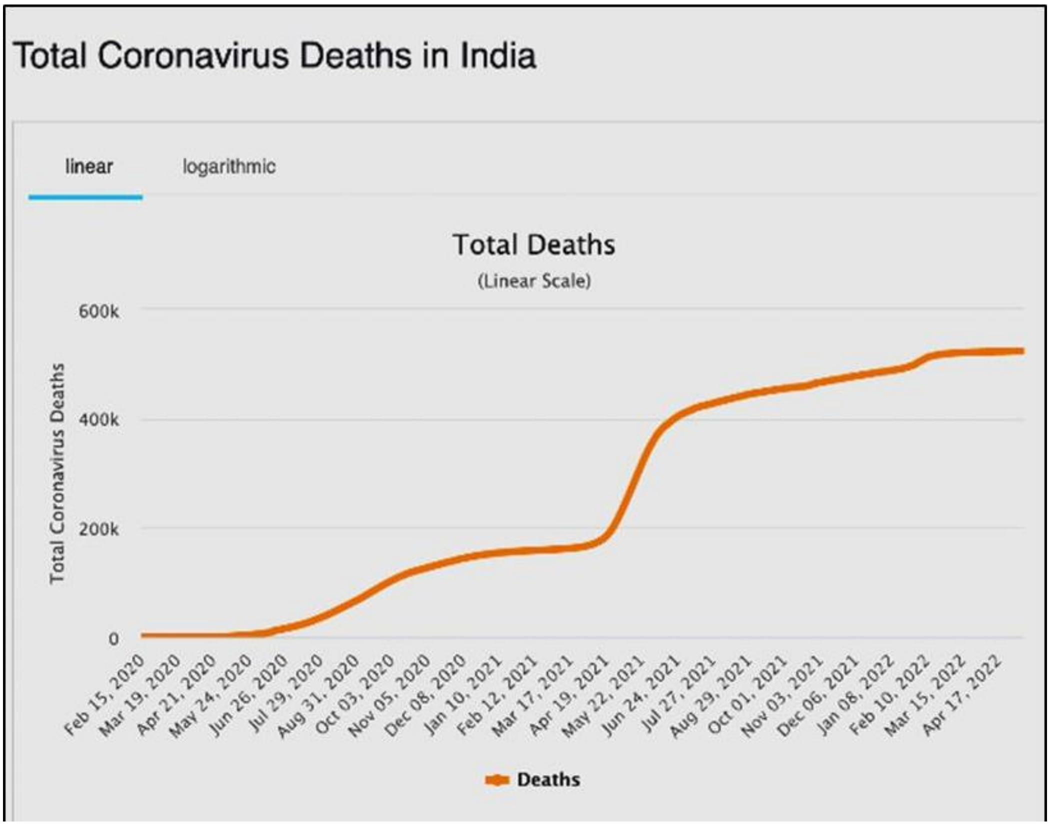


Figure 5: Total deaths in India from February 2020 to April 2022. (Source: https://www.worldometers.info/coronavirus/country/india)

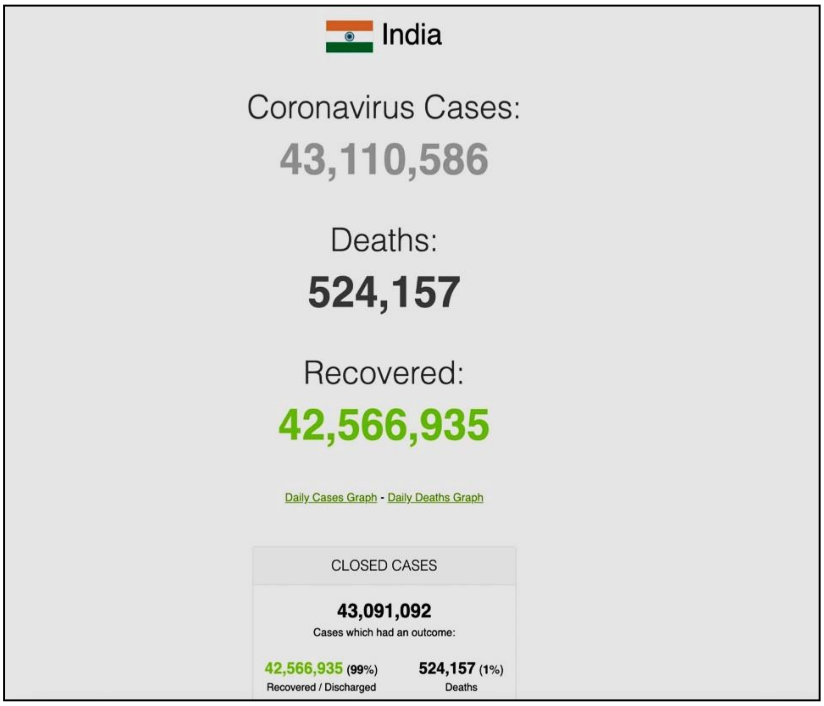


Figure 6: Total Closed and Recovered Cases. (India) (Source: https://www.worldometers.info/coronavirus/country/india/)

Risk Parameters

The majority of public affected with COVID-19 are adult males with a median age ranging from 34 to 59 years (Chaolin Huang, 2020) (Yan Bai, 2020) (Dawei Wang, 2020) (Huijun Chen, 2020). Individuals with chronic co-morbidities for example those with hypertension and/or diabetes are particularly have greater chance of developing getting infected (Huijun Chen, 2020). Adults who are ≥60 years of age and who are concurrently taking treatment for chronic ailments are particularly vulnerable for developing severe infection (Yan Bai, 2020) (Dawei Wang, 2020). Co-infection with other microbial infections can potentially result in serious disease (Huijun Chen, 2020).

There are fewer COVID-19 infections that have been reported among youngsters under 15 years old (Chaolin Huang, 2020) (Yan Bai, 2020) (Dawei Wang, 2020). There were no incidences of COVID-19 infection in kids under the age of 15 years, according to introductory research of 425 COVID-19 patients conducted in Wuhan and published on 29 January 2020 (Qun Li, 2020) (Weiyong Liu, 2020). But by the end of January 2020, there were early reports of COVID-19 infections in children in other districts of China (Yang, 2020). Children often have a better prognosis because the disease's progression is thought to be gentler in them, with fewer signs and symptoms and no fever or pneumonia (Yang, 2020). The diseases progression in the paediatric population is typically thought to be milder, with fewer signs and symptoms and no fever or pneumonia, therefore they have a fair prediction (Yang, 2020). According to preliminary research, the patient was asymptomatic despite having radiological indicators such as ground-glass lung opacities (Jasper Fuk-Woo Chan, 2020). Therefore, it is certain that kids have fewer chance of getting infected or, if they do, the disease progresses more slowly. As a result, parents are unlikely to seek treatments, underestimating the occurrence of the virus in the paediatric public segment.

Pathogenesis and immune response

Subtle genetic alterations in the viruses are known to tremendously affect their infect tissues, infect different hosts and pathogenicity. SARS and MERS are both good examples that demonstrate this (Joseph S M Peiris, 2003) (Ali M. Zaki, 2012). Bats were identified as the natural reservoir in SARS and MERS, with humans serving as terminal hosts and palm civet and dromedary camel serving as interim hosts for SARS and MERS, respectively (Y Guan, 2003) (Abdulaziz N. Alagaili, 2014). Interim recipients are unquestionably crucial for intra- and inter-species spread as they can advance stronger link between a virus and a new recipient, allowing for alteration required for efficient duplicity in the new host (Greg Brennan, 2014).

The ability of a virus to infect different hosts is governed by its ability to interact with molecules and receptors. For COVID-19, receptor is identified to be the envelope spike protein (S) (R. Lu, 2020). Additional in-depth compositional study into the structures suggests firmly that COVID-19 may also exploit the host's angiotensin-converting enzyme 2 (ACE-2) receptor for invading into the cells (Yushun Wan, 2020), which is the same receptor that allows SARS to invade into the airway epithelium i.e., type 1 pneumocytes and type 2 pneumocytes which are cells that produce surfactant (Wenhui Li, 2003)The spike protein is further subdivided into S1 and S2 domains in which the role of S1 is for binding to the receptor and S2 causes integration with the cell membrane (R. Lu, 2020). Furthermore, the discovery of several critical residues (Gln493 and Asn501) that influence the binding of the SARS-CoV-2 receptor binding domain with ACE2 supports the notion that SARS-CoV-2 has acquired the ability to transmit from human to human (Yushun Wan, 2020).

SARS-CoV-2 penetrates recipient cell following connecting to the receptors, triggering the innate immune response. To effectively spread an infection in the new recipient, viruses should be able to either evade or inhibit innate immune signalling which is produced by the host. COVID-19 might have a similarities in pathogenesis process to SARS as they share many of the same clinical characteristics (Chaolin Huang, 2020). In reaction to infection, production of IFN-stimulated genes (ISGs) is induced which helps to inhibit viral replication. SARS-CoV incorporates a minimum of 8 viral antagonists that control the generation of interferons and cytokine storm hence circumventing the ISG effector function which counteracts this antiviral action (Allison L Totura, 2012).

The ARDS development and the severity of the lung injury that occurs in COVID-19 provide additional proof that ACE2 may be a source for COVID-19. This is due to ACE2 is commonly found on human alveolar type II cells which are cells that produce pulmonary surfactant and type I cells i.e., ciliated cells of the respiratory tract (I Hamming, 2004).

The pattern of damage which is caused due to an inflammatory reaction appears to be similar for both COVID-19 and SARS. In both these conditions, the inflammatory cytokines IL-1, IL-6, IL-12, monocyte inflammatory protein, interferon gamma and other inflammatory cells are increased which then lead to pulmonary inflammation and progress to lung damage.[(44)] As stated above, SARS-CoV-2 preferentially infects elderly patients and cases reported in paediatric patients seem to be uncommon (Chaolin Huang, 2020) (Huijun Chen, 2020). Similar process was observed in SARS-CoV primate models (Smits et al., 2010).

There is a need to research more towards the identification of the SARS-CoV-2 virus based parameters and host genes that allow the virus to overcome the species-specific hurdles and source deadly illness among the world population.

Clinical manifestations

The majority of the initial and common symptoms of SARS and COVID-19 have similarities, consisting of low or moderate grade body temperature rise, dry cough, breathlessness, chest discomfort, exhaustion, and myalgia (A J Kucharski, 2015) (Chaolin Huang, 2020) (Dawei Wang, 2020). Other symptoms like nausea, vomiting, diarrhoea, headaches, dizziness, and headaches are not prevalent (Chaolin Huang, 2020) (Dawei Wang, 2020).

Fever, dry cough, myalgia, and exhaustion are among the typical symptoms, according to a research based on the initial 425 positive and verified cases associated with Wuhan. Less frequent indicators include cough with expectoration, stomach discomfort, diarrhoea, headache, and haemoptysis (Qun Li, 2020).

Bilateral lung involvement is known to affect the great majority of cases (Huijun Chen, 2020). The presence of traditional upper respiratory tract clinical signs such as rhinorrhoea, sneezing, or sore throat in 19 patients shows that the virus might be more likely to infiltrate the lower respiratory tract. This distinguishes COVID-19 from other virus based illness associated with respiratory tract like MERS and SARS (Chaolin Huang, 2020).

Case based analysis of 99 patients highlights that 17% of them had ARDS and 11% collapsed from multiple organ failure (Huijun Chen, 2020). The average number of days between the onset of symptoms and the onset of ARDS was 8 days (Dawei Wang, 2020).

Diagnosis

For COVID-19 control measures, quarantine and isolation regimens, and clinically acceptable patient management, effective screening and diagnostic tools are needed. Respiratory infections other than Covid-19 might be more prevalent in public and should not be overlooked when SARS-CoV-2 spreads.

A set of rules for COVID-19 has been published by WHO on January 31, 2020 (WHO, 2020). Considering the climatic and locational parameters, the WHO recommends screening for more common causes of respiratory disease first for persons who fulfil specific parameters. If a negative result is discovered, the sample should be forwarded to a referral laboratory for SARS-CoV-2 diagnosis.

Case descriptions vary from nation to nation and are likely to change over time when the epidemiological landscape shifts in a specific area. Following cases descriptions are defined by WHO:

Persons believed of having COVID-19 are those who have (a) severe acute respiratory infections and no other aetiology that fully explains the clinical presentation, as well as a history of travel to or residence in China during the 14 days preceding symptom onset; or (b) any acute respiratory illness and at least one of the following during the 14 days preceding symptom onset: contact with a known or suspected case of SARS-CoV-2 infection, or worked in or visited a health care facility where patients with confirmed or suspected SARS-CoV-2 acute respiratory illness were being treated (WHO, 2020).

Inconclusive SARS-CoV-2 testing findings or positive pan-coronavirus assay results with no laboratory proof of other respiratory viruses are considered probable cases. Regardless of clinical indicators, a case is deemed positive and verified if SARS-CoV-2 infection has been proven within a laboratory.

According to CDC, the most prominent location to gather samples is upper respiratory tract (nasopharyngeal and oropharyngeal swabs) and, the lower respiratory tract from individuals who satisfy the diagnostic criteria for SARS-CoV-2 testing (sputum, tracheal aspirate, or bronchoalveolar lavage). The testing are carried out by approved government laboratories in each country.

Laboratory discoveries

Common laboratory findings in the patient which are not considered normal include a decreased lymphocyte count, (Huijun Chen, 2020) (Yan Bai, 2020) (Dawei Wang, 2020) a prolonged PTT, and an elevated LDH (Wang et al., 2020). Patients admitted to the ICU had greater laboratory abnormalities than patients who were not in the ICU (Chaolin Huang, 2020) (Huijun Chen, 2020).

Some patients had increased levels of Aspartate Aminotransferase (AS**T)** , Creatine kinase, Creatinine, and C-reactive protein (Huijun Chen, 2020) (Yan Bai, 2020) (Jasper Fuk-Woo Chan, 2020). The majority of individuals exhibited normal PCT levels in their serum (Dawei Wang, 2020) (Chaolin Huang, 2020) (Yan Bai, 2020).

Treatments

COVID-19, like MERS and SARS, does not have a specific antiviral medication. Secondary bacterial infections are treated with isolation and supportive care, such as oxygen therapy, hydration management, and antibiotics. Some of the infected patients experienced ARDS and septic shock instantly, and thereafter suffered multiple organ failure (Chaolin Huang, 2020) (Huijun Chen, 2020). As a result, COVID-19 initial therapy must focus on identifying suspects early and halting illness transmission through prompt isolation and infection control measures.

Vaccines

Since the pandemic began, vaccine research has rapidly increased with an emphasis on utilising the most recent findings in pathophysiology, genetics, and molecular biology of COVID-19.

Using of face masks and other personal sanitation practices are added to the present preventive techniques, which normally call for maintaining a 1-meter social distance. However, the introduction of vaccines as a main preventive is crucial for eradicating the illness in order to try to restore normalcy.

Humans develop an immunological response that is based on antibodies against the target spike protein.

Notable global vaccine manufacturers include: BioNTech/Pfizer, Moderna, AstraZeneca, Johnson & Johnson, Janssen, Gamaleya, and Sinopharm Vaccine. Vaccination schedules are commonly divided into two doses with the exception of Johnson & Johnson vaccination which required only a single dose.

The National Covid-19 Vaccination Strategy in India specifies that after the first dose is provided, the second dose should be given at a 12- to 16-week interval (or 84 days later).

According to prior studies on therapeutic treatments for SARS and MERS, drugs are being explored. In general, there is not enough proof to support the claim that these antivirals can considerably enhance clinical results. Patients with COVID-19 have also been treated with antiviral medications such oseltamivir in conjunction with empirical antibiotic therapy (Chaolin Huang, 2020).

Remdesivir, a broad-spectrum antiviral agent, has shown promise and reached advanced phases of clinical testing. Activity against COVID-19 in vitro and in vivo has been demonstrated. In addition, further possible antiviral medications have also been presented.

A COVID19 vaccine is a vaccination designed to confer required immunity against severe acute respiratory syndrome coronavirus 2 (SARS‑ CoV‑ 2), the source of coronavirus disease 2019. The vaccine given to the world population and Indian are given in Figure 7 and Figure 8.

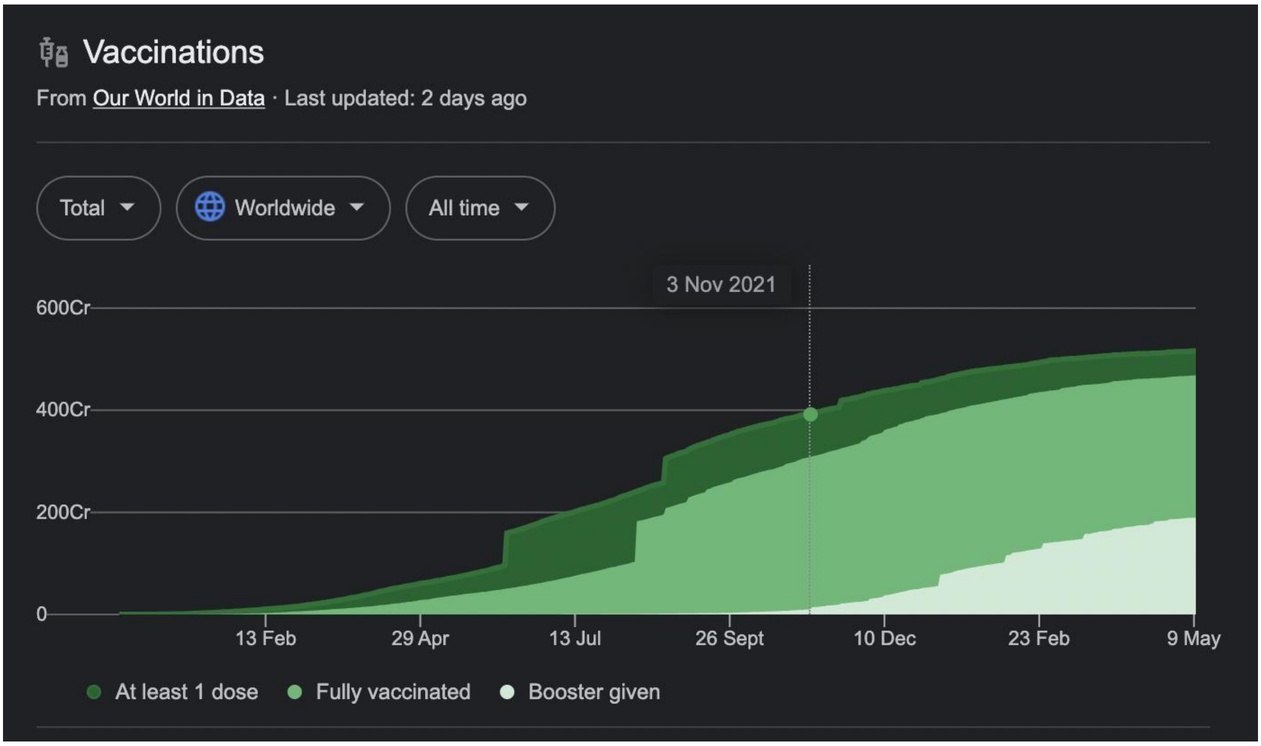


Figure 7: COVID-19 vaccine given to world population

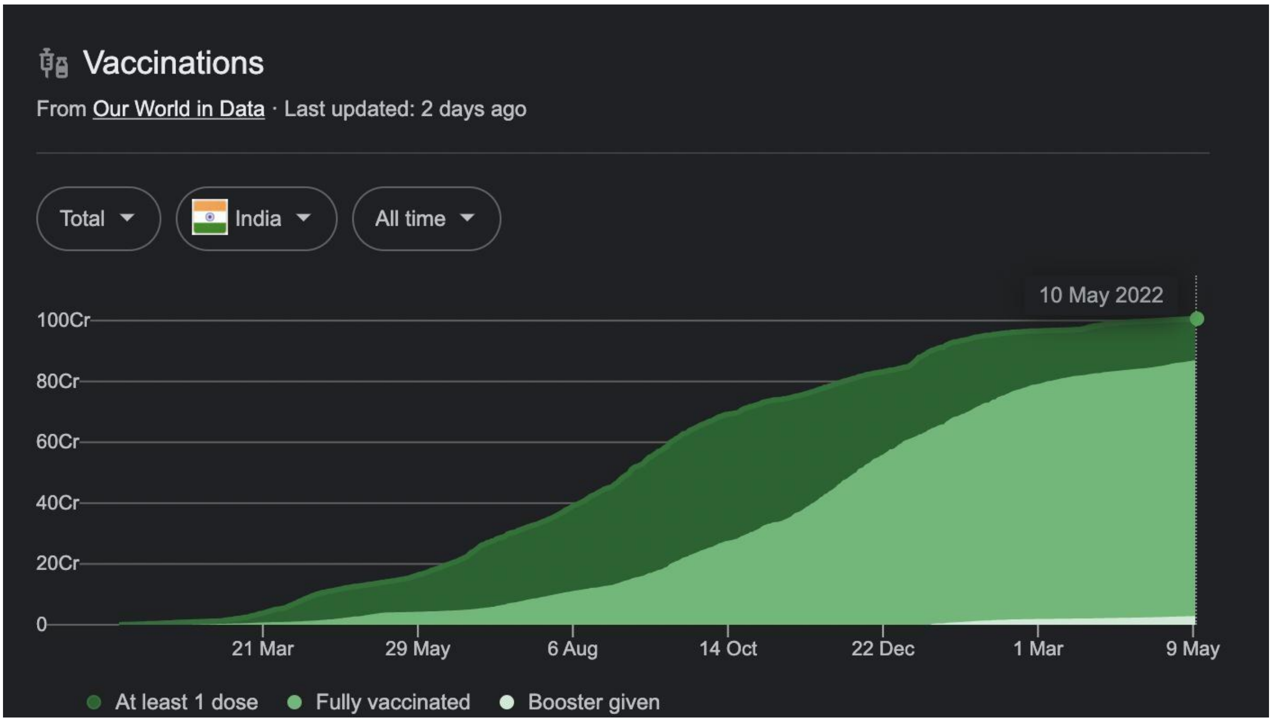


Figure 8: COVID-19 vaccine given to Indian population

Control and prevention measures

Unquestionably, Covid-19 is a sickness with global significance. The cessation of the transmission chain is regarded as crucial to preventing the disease spread, much like the knowledge gained from earlier illnesses like SARS and MERS. Numerous techniques should be used at the local, state, and international levels, particularly in healthcare settings.

Institutions that provide medical care are regarded as a significant source of virus transmission. Following effective infection control practices, isolating cases, and contact tracking is critical for keeping the virus from spreading in clinics and hospitals as has been learned from prior epidemics.

In order to confine the virus, cases with primary respiratory illness symptoms including a runny nose, fever, and cough required to cover the face with masks or other face covering and closely follow the triage method. They need to be kept apart from other patients at the medical facilities and put in a room that is properly ventilated and at least two meters away from other patients so that they have easy access to respiratory hygiene supplies. Positive air pressure and six air changes per hour should be provided in an individual patient quarter for confirmed COVID-19 infections that need hospitalization.

PPE (Personal protective equipment) include gloves, gowns, disposable N95, and eye protection which should be worn by active healthcare practitioners. It is critical to raise public awareness and educate the public about odd indicators such as a persistent cough or breathlessness so they can get professional help and attention in order to diagnosis of the virus as early as possible.

It is critical to raise public awareness and educate the public about odd indicators such as a persistent cough or breathlessness so that they can get professional help and attention in order to diagnosis of the virus as early as possible. In the case of extensive public spread, it is critical to encourage hand washing, facemask use, interim school closures, home isolation, close observation of those who are exhibiting symptoms, provision of life support, and minimizing social meetings to decline the transmission of the illness.

One of the first moves taken by Chinese authorities was the shutdown of Wuhan, which, in the grand scheme of things, aided in slowing the COVID-19 outbreak. Flying should be avoided in these circumstances unless it is absolutely necessary for significant medical reasons. Mandatory temperature checks at crossings and airports should be put in place to find the suspicious cases. More research is needed in terms of virus in order to understand the initiating point of the spread and offer justifications of potential outbreaks in upcoming years.

The COVID-19 outbreak is without a doubt a global social health concern. Our ideas of the virus, the ways in which it infects the cells and causes sickness, and its clinical manifestations all evolve very quickly. Global nations must put more focus on disease monitoring process, improve country preparation and operations, consisting of the development of quick response groups, and strengthen the health care organisations nationally.

Without a doubt, the present COVID-19 pandemic is a huge social health problem globally. We made rapid progress in understanding the virus, how it affects cells and produces disease, and how it manifests clinically. The national health care system's capability should be enhanced, as well as disease surveillance systems should be given greater attention. Country readiness and response activities should also be scaled up worldwide.

CHAPTER III
HRCT OF THE LUNG: IMAGING TECHNIQUE AND ANATOMY

High-resolution CT (HRCT) scan of the lungs, is a CT process in which thin-slice images of the lungs are gathered, slice thickness is taken less than 1.5 mm (range: 0.625-1.25 mm). The use of thin-slice images provides meticulous lung detail, which helps in picking up subtle findings and is also preferred for evaluation of conditions like interstitial lung disease (ILD).

This technique allows for detection of a wide range of pathologies, reformatted images in coronal and sagittal planes are also used to help in providing multiple frames of references.

Protocol for HRCT of Lungs

After proper positioning on the CT table with the patient routinely in supine position and entering the patient details, the technical parameters are adjusted which include taking a slice thickness which can range from: 0.625-1.25 mm, kV is set to 120 and mAs between 130. Collimation commonly used is set between 1.5-3 mm and a matrix size of 768 x 768 is preferred. The patient is asked to take a full inspiration and then hold their breath after which the scan is initiated. Scan time takes about 1 second after which the patient is shifted. Image are reconstructed in lung window with a width of 1200 and a level of -600H after which they are sent to a dedicated workstation for interpretation.

Anatomy of Lungs

There are three components to the right lung: the right upper, middle, and lower lobes (Figure 9). The distinction among the right upper and middle lobes is made by the smaller, horizontal fissure, whereas the larger oblique fissure separates the right upper and middle lobe from the right lower lobe.

On a high-resolution CT scan, the fissures are frequently identified as a curvilinear band from the lateral aspect to the hilum.

The left lung comprises of the left upper and lower lobes, which are separated by a single oblique fissure (Figure 10).

The apex, anterior border, much of the costal, and most of the medial surfaces of the lung are all located anterosuperior to the oblique fissure in the left upper lobe. The lingula is a short protrusion that is found near the lower end of the cardiac notch and is part of the left upper lobe.

The bigger left lower lobe is situated behind and below the fissure and contributes nearly the whole base, much of the costal surface, and the majority of the posterior border of the left lung.

Bronchopulmonary Segments

Each bronchi is divided into lobar bronchi. Segmental bronchi are primary branches of the right and left lobar bronchi that ramify in a physically separate, functionally independent unit of lung tissue known as a bronchopulmonary segment (Prof. Chevalier L. Jackson, n.d.).

Each segment has its own respiratory unit and is encased with connective tissue that is continuous with the visceral pleura.

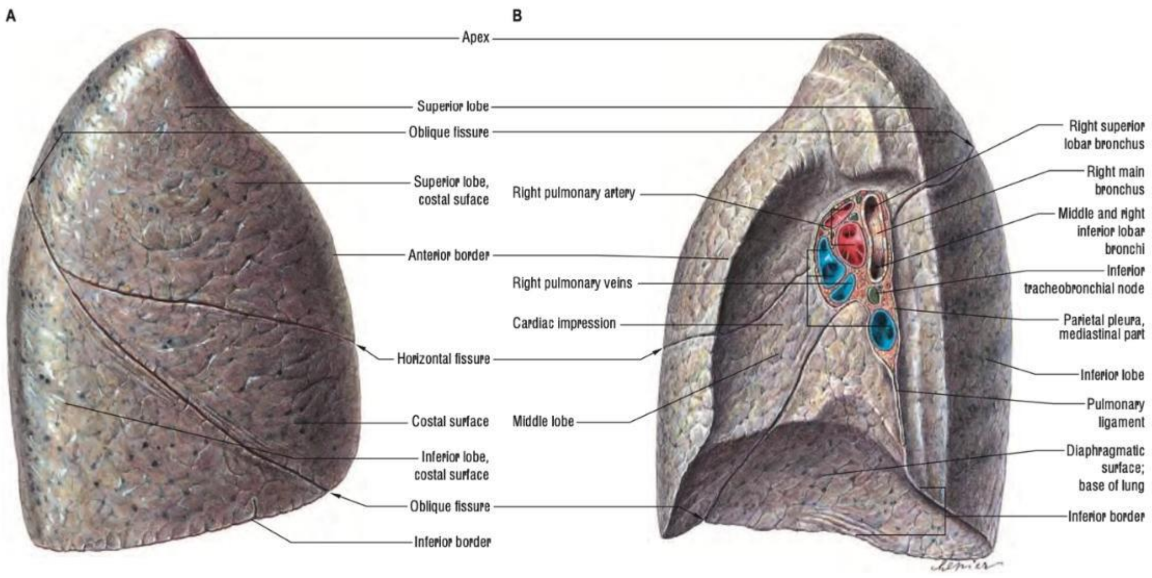


Figure 9: Lateral (A) and medial (B) surfaces of the right lung.

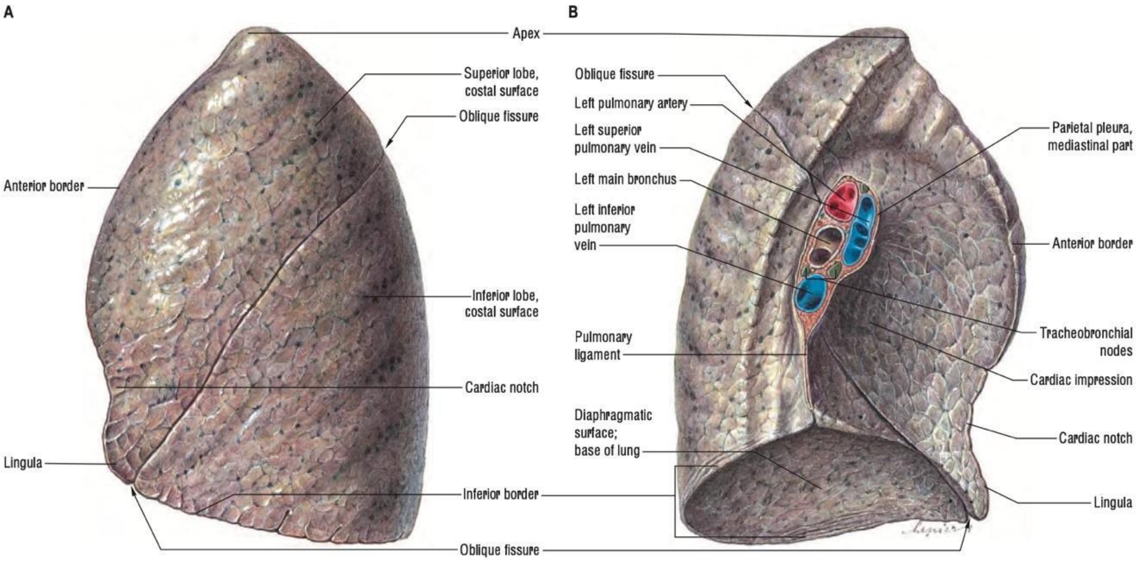


Figure 10: Lateral (A) and medial (B) surfaces of the left lung.

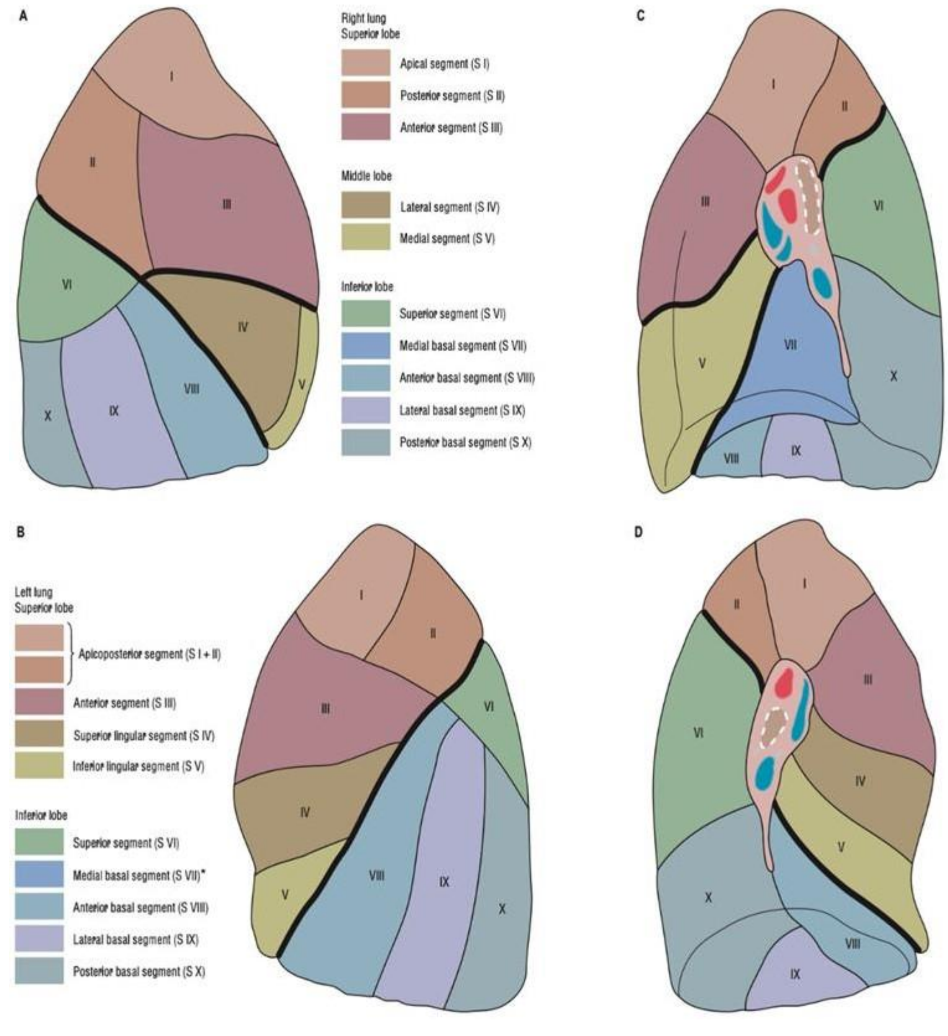


Figure 11: Bronchopulmonary segments of the right (upper) and left (lower) lungs.

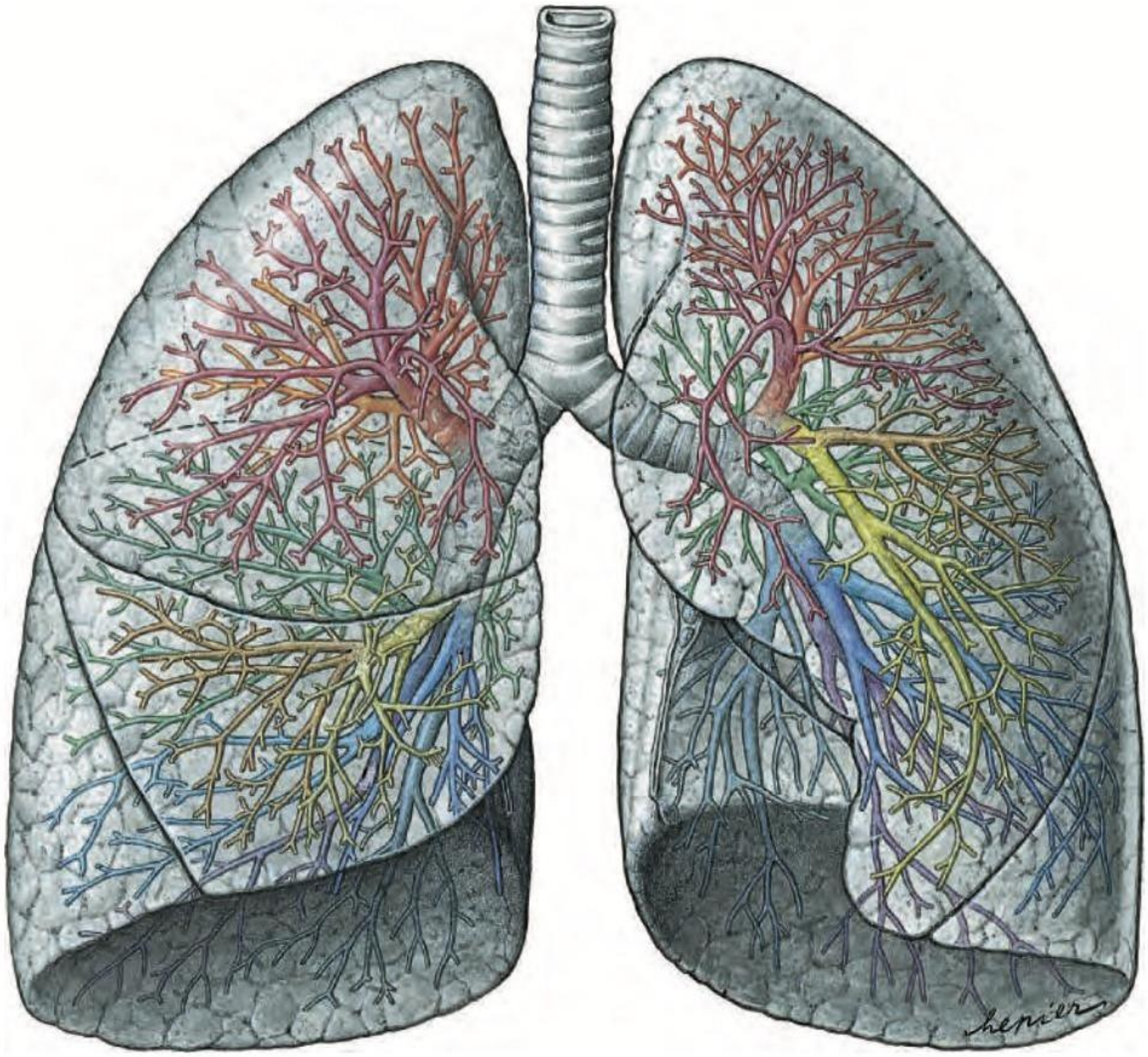


Figure 12:: Graphical depiction of lungs and bronchi.

	Right lung	Left lung
Superior lobe	I, apical; II, posterior; III, anterior	I, apical; II, posterior; III, anterior; IV, superior lingular; V, inferior lingular
Middle lobe	IV, lateral; V, medial	–
Inferior lobe	VI, superior (apical); VII, medial basal; VIII, anterior basal; IX, lateral basal; X, posterior basal	VI, superior (apical); VII, medial basal; VIII, anterior basal; IX, lateral basal; X, posterior basal

Figure 13: Coronal reconstruction in pulmonary window depicting the CT anatomy of the lungs. 1, Trachea; 2, Left main bronchus; 3, Right main bronchus; 4, Apical segmental bronchus.

Figure 14:L Coronal reconstruction in pulmonary window depicting the CT anatomy of the lungs. 1, Trachea; 2, Right upper lobe; 3, Right middle lobe; 4, Right lower lobe; 5, Left upper lobe; 6, Left lower lobe.\; White arrow, Minor fissure; Red arrow, Major fissure.

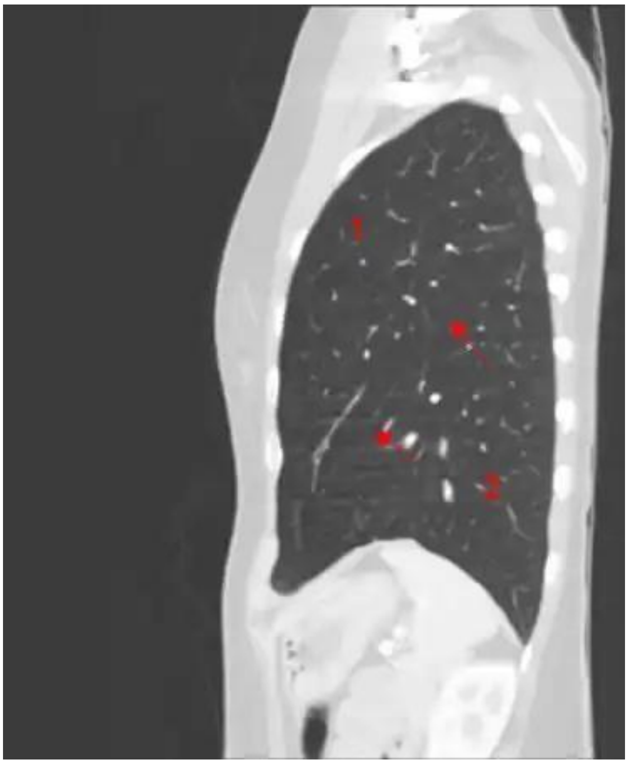


Figure 15: Sagittal reconstruction in pulmonary window depicting the CT anatomy of left lung; 1, Left upper lobe; 2, Left lower lobe; Red arrow, Major fissure.

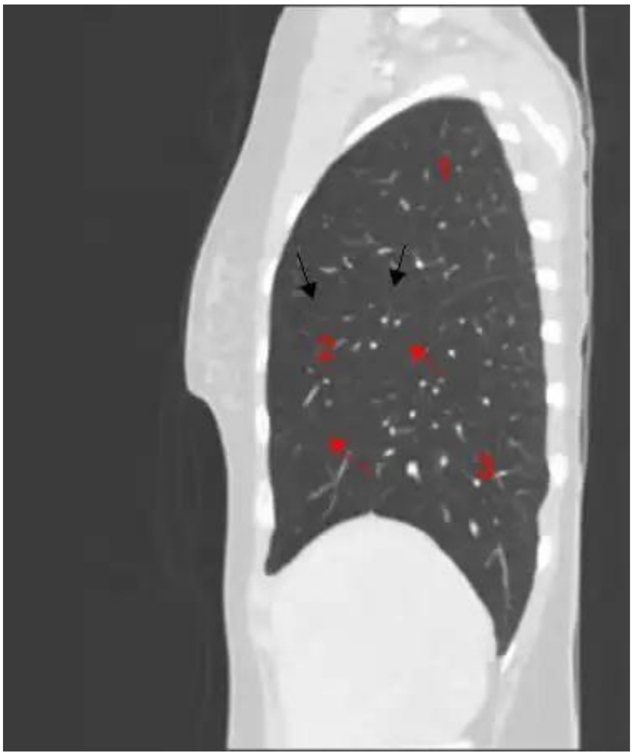


Figure 16: Sagittal reconstruction in pulmonary window depicting the CT anatomy of right lung; 1, Right upper lobe; 2, Right middle lobe; 3, Right lower lobe; Black arrow, Minor fissure; Red arrow, Major fissure.

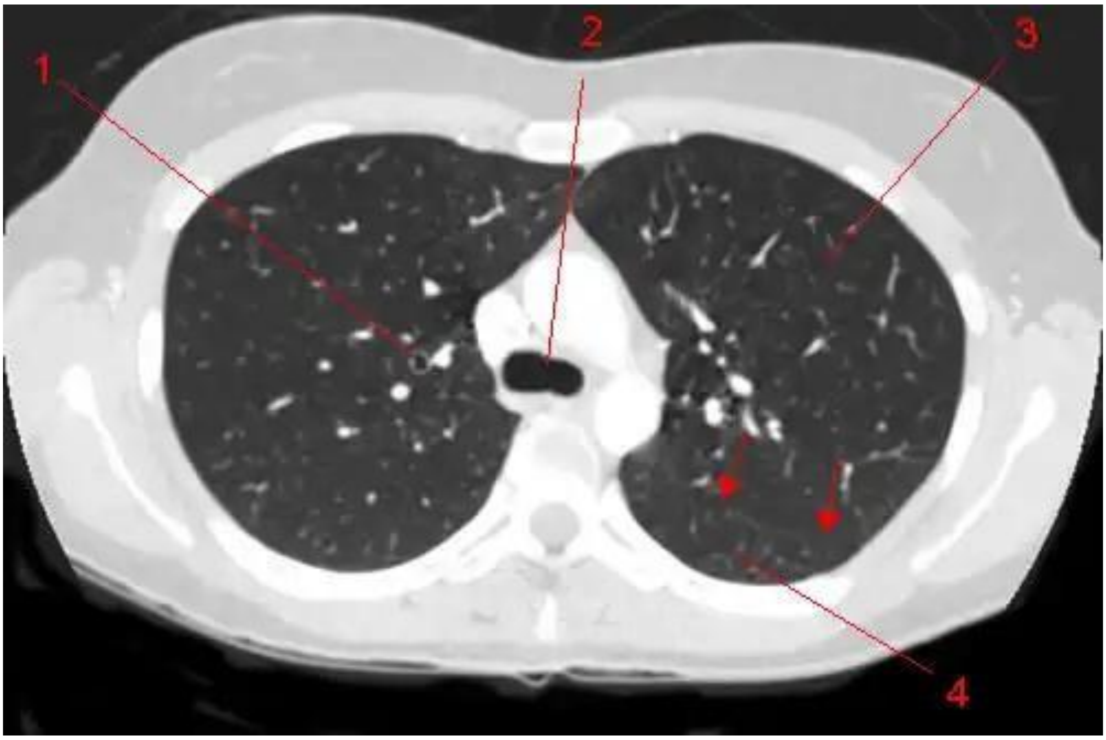


Figure 17: Axial reconstruction in pulmonary window depicting the CT anatomy of lungs. 1, Apical segmental bronchus of right upper lobe; 2, Tracheal bifurcation (Carina); 3, Superior segment of left upper lobe; 4, Lower lobe of left lung; Red arrow, Major fissure

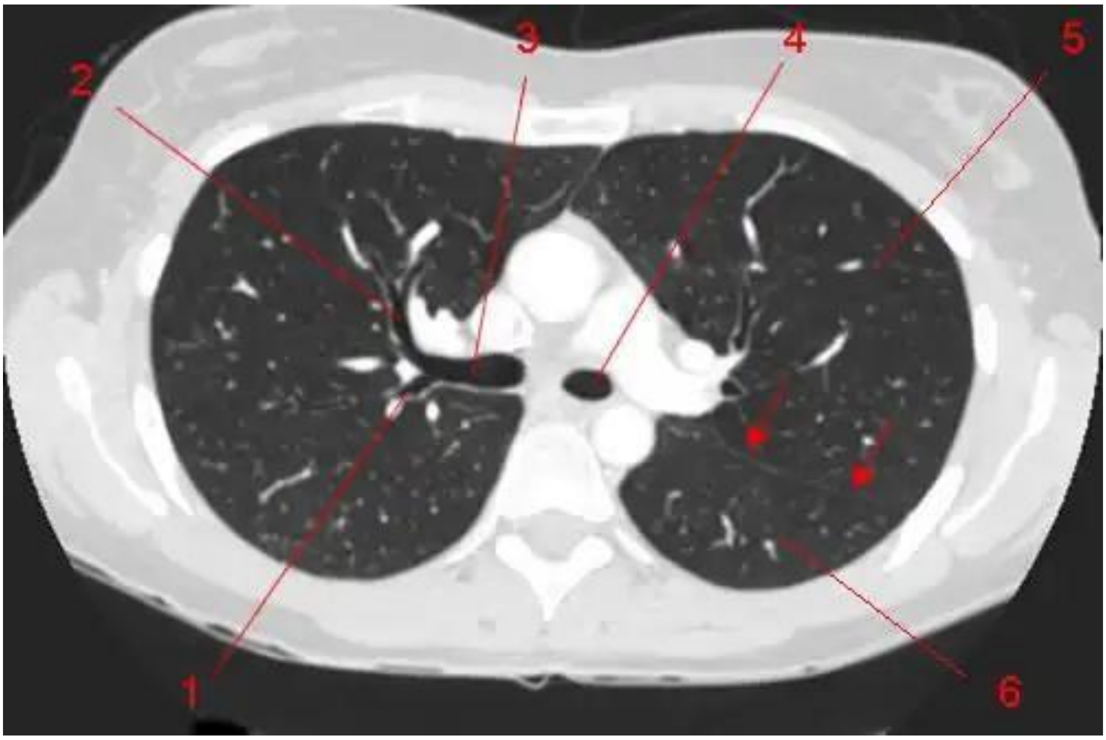


Figure 18: Axial reconstruction in pulmonary window depicting the CT anatomy of lungs. 1, Posterior segmental bronchus of right upper lobe; 2, Anterior segmental bronchus of right upper lobe; 3, Right main bronchus; 4, Left main bronchus. 5, Superior segment of l

Figure 19: Axial reconstruction in pulmonary window depicting the CT anatomy of lungs. 1, Bronchus intermedius; 2, Anterior junction line; 3, Left main bronchus; 4, Superior segment of left upper lobe; 5, Left lower lobe; Red arrow, Major fissure.

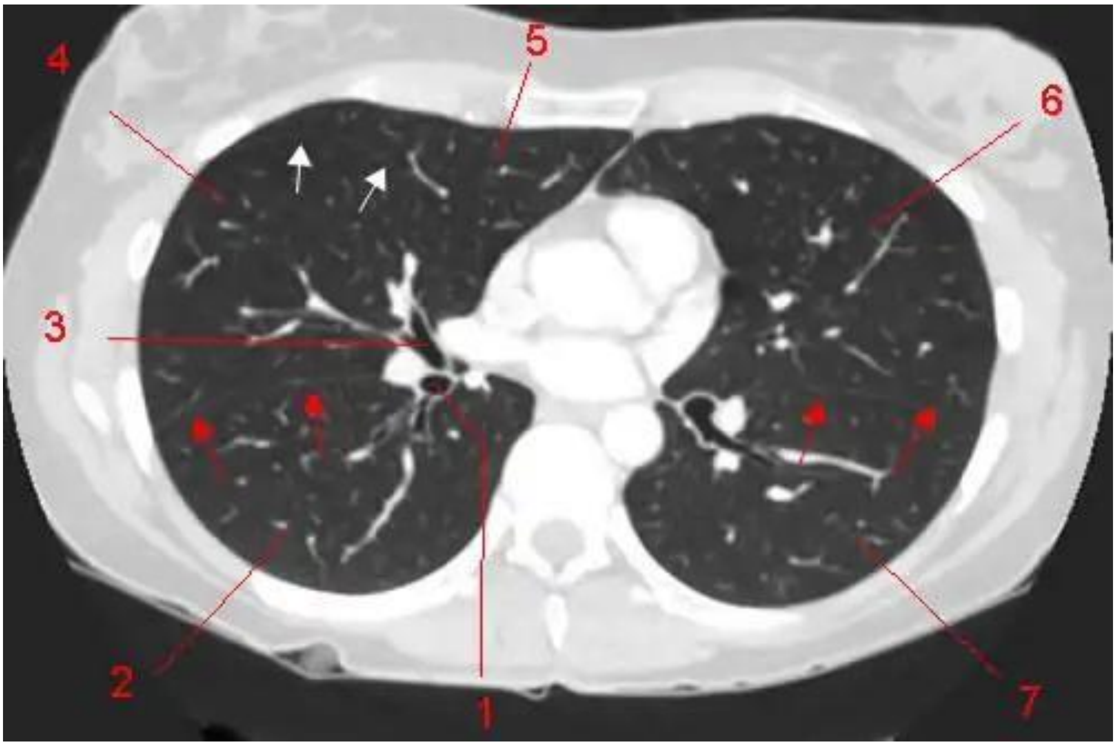


Figure 20: Axial reconstruction in pulmonary window depicting the CT anatomy of lungs. 1, Right lower lobe bronchus. 2, Right lower lobe; 3, Right middle lobe bronchus; 4, Right middle lobe; 5, Right upper lobe; 6, Left upper lobe; 7, Left lower lobe; White arrow

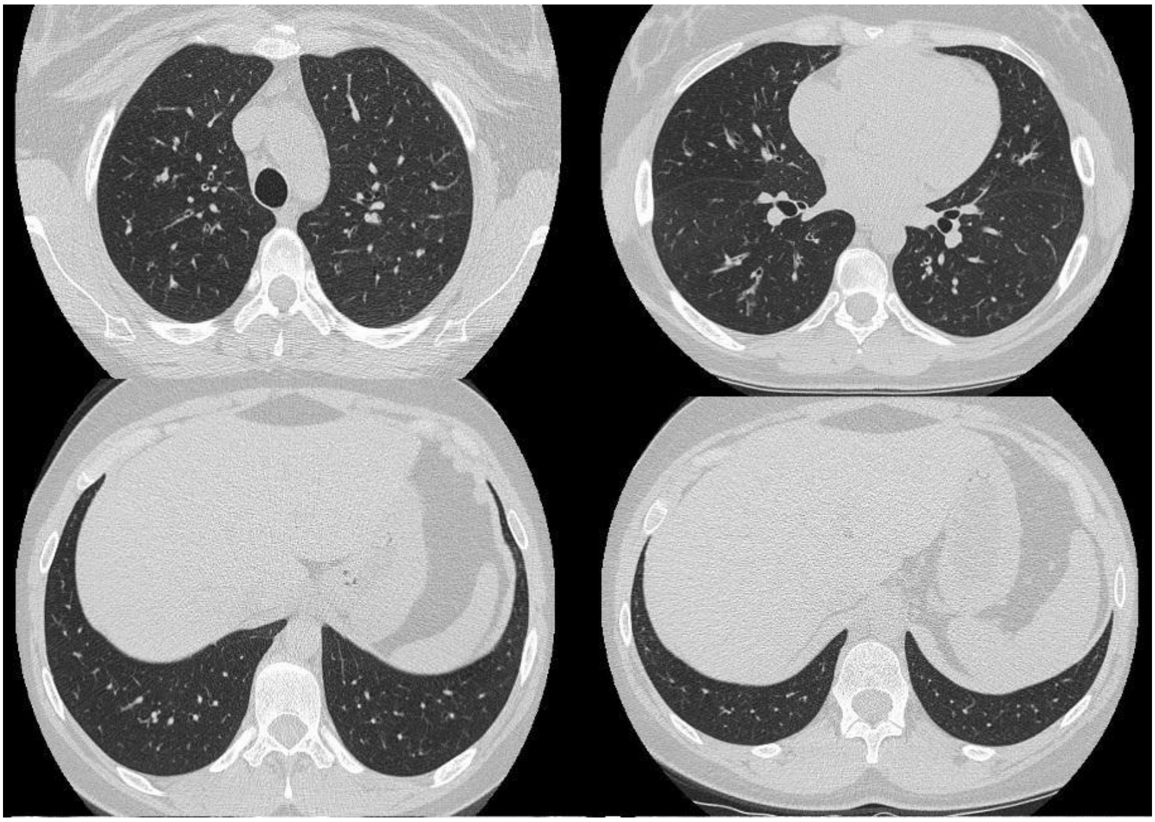


Figure 21: HRCT scan obtained at maximal inspiration shows the typically rounded trachea, well defined pulmonary fissures and bases.

CHAPTER IV
OBJECTIVES AND RESEARCH METHODOLOGY

Need of the Study

1. To determine the degree of infection and severity in COVID-19 patients.

2. To examine the recovery of the patients after completion of treatment.

3. To yield a better picture on the progression of illness and insights into the peculiarities of the pandemic in India.

Aim and Objectives

1. To elucidate the CT manifestations in the infected humans with COVID-19 Pneumonia.

2. To identify and explain the characteristics pulmonary abnormalities and recognizable patterns of evolution in patients with COVID-19 Pneumonia.

3. To contribute our research experience to the society for a better understanding of COVID-19 pandemic.

Materials and Methods

Study Design:

Cross-Sectional Prospective Study.

Study Setting:

Patients suspected with COVID-19 and referred to the Department of Radio- Diagnosis and Imaging, Shri B.M. Patil Medical College, Vijayapura.

Patients presenting to the Flu clinic and who are admitted in Department of Respiratory Medicine, Shri B.M. Patil Medical College, Vijayapura.

Study Population:

The study will be done in 90 patients above the age of 18 years who are presenting with clinical features of COVID-19. Initial scan will be done at the time of admission and a follow up scan will be done after the patient has completion of treatment and recovery.

CT Technical Parameters:

All CT scans were carried out on a Siemens Medical Solutions Somatom 16-CT scanner with a 1-mm thickness, 15-mm table speed per rotation, 0.5-second gantry rotation time, 120kVp, and 130mAs.

At full inspiration, scans were taken from the apex of the lung to the base. Software techniques were used to recreate contiguous slices at 1.5 mm intervals. Lung windows with a width of 1200 and a level of -600H will be applied to all images. In addition, coronal and sagittal reformatted images were obtained.

Images interpretation was done on a dedicated workstation.

Sampling Method:

With anticipated Proportion of Crazy paving pattern p 36.6 %[ref], the study would require a sample size of 90 individuals with 95% level of confidence and 10% absolute precision**.**

Formula used

$n=z^2\ p*q\ d^2$

Where Z= Z statistic at α level of significance d^2= Absolute error
P= Proportion rate

q= 100-p

Statistical Analysis

The gathered data will be included into a Microsoft Excel spreadsheet for performing a statistical analysis using a statistical tool for the social sciences (Version 20).

The results will be provided as mean (median) standard deviation, counts and percentages, and graphs.

The Chi square test will be considered to compare categorical variables. McNemer's chi square test will be used to compare paired data, and p0.05 will be regarded statistically significant.

All statistical tests are two-tailed. $P < 0.05$ will be considered statistically significant.

Inclusion Criteria

• Patients must be at least 18 years old.

• RT-PCR confirmed cases of COVID-19.

Exclusion Criteria

• Patients must not be less than 18 years old.

• Individuals who are diagnosed with other respiratory illnesses.

• Female patients who are gravid.

• Patient refusal.

CHAPTER V
OBSERVATION AND RESULTS

Descriptive statistical analysis of age distribution of the patients studied is done based on numbers and percentages is done and presented in Table 1 and Figure 22 respectively revealing that 1.1% of the patients were less than 20 years of age, 17.8% between the ages of 20-29 years, 22.2% between the ages of 30-39 years, 25.6% between the ages of 40-49 years, 18.9% between the ages of 50-59 years, 7.8% between the ages of 60-69 years, 2.2% between the ages of 70-79 years, 3.3% between the ages of 80-89 years and 1.1% above the age of 90 years.

Age(Years)	**No. of Patients**	**Percentage**
< 20	1	1.1
20 - 29	16	17.8
30 - 39	20	22.2
40 - 49	23	25.6
50 - 59	17	18.9
60 - 69	7	7.8
70 - 79	2	2.2
80 - 89	3	3.3
90+	1	1.1
Total	90	100.0

Table 1: Age Wise Distribution

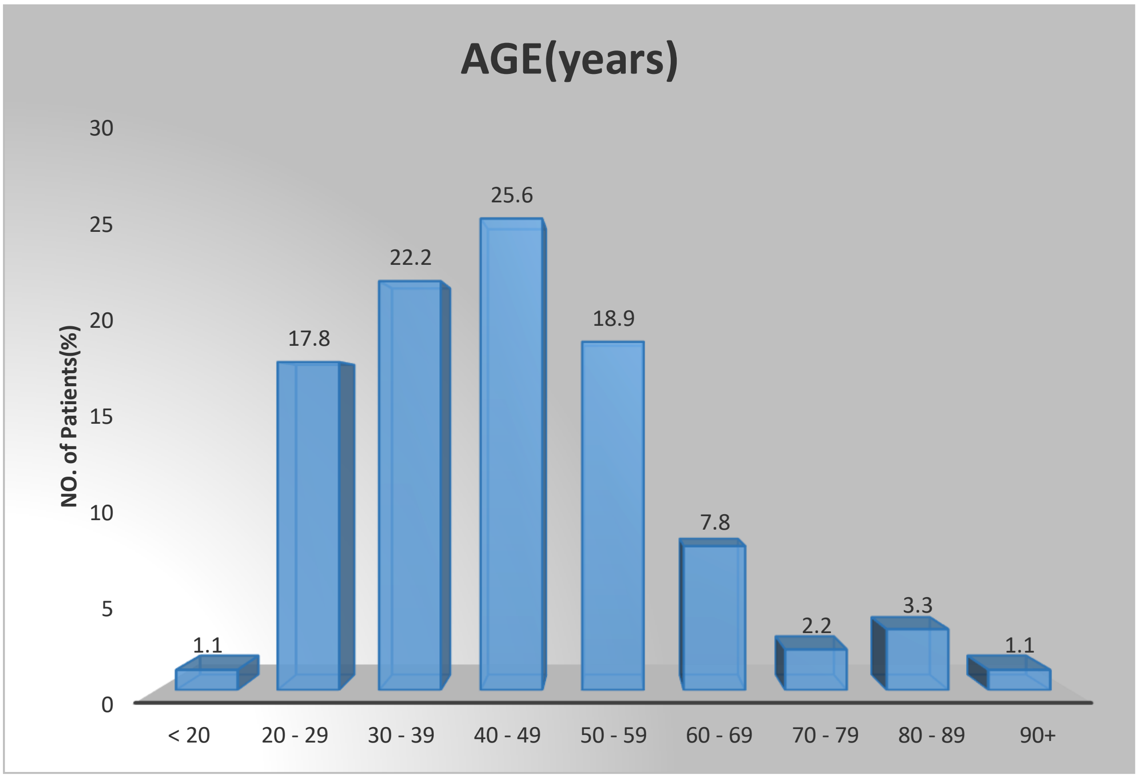


Figure 22: Statistical Analysis- Age distribution

Descriptive statistical analysis of gender distribution is done based on numbers and percentages is done and presented in Table 2 and Figure 23 respectively revealing that 39% of patients were men and 61% of patients were women.

Gender	No. of Patients	Percentage
Female	35	38.9
Male	55	61.1
Total	90	100.0

Table 2: Gender Wise Distribution

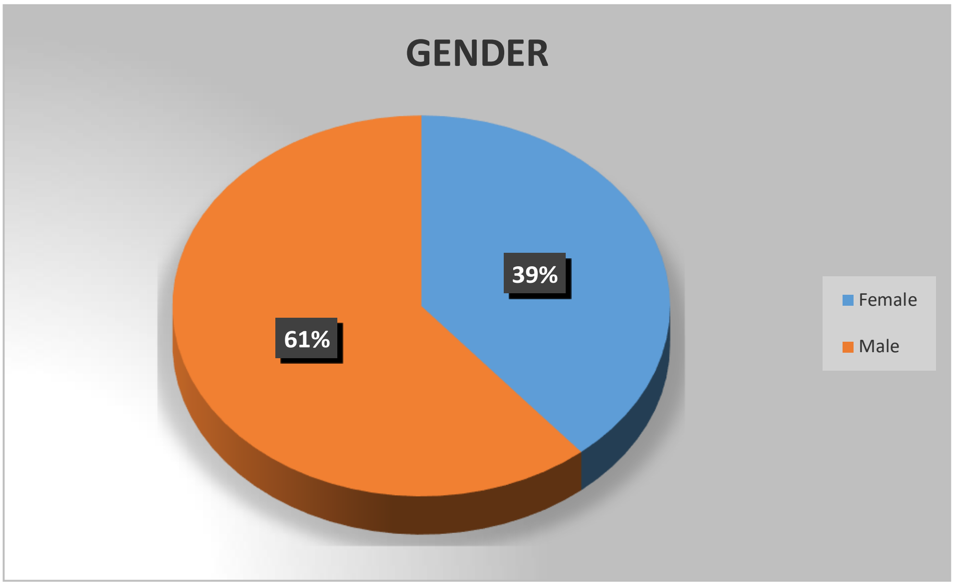


Figure 23: Statistical Analysis- Gender distribution

Descriptive statistical analysis of CT severity score is done based on numbers and percentages is done and presented in Table 3 and Figure 24 respectively revealing that 45.6% of patients had a CT severity score of less than or equal to 8, 23.3% of patients had a CT severity score between 9 to 15, and 31.1% of patients had a CT severity score of more than 16.

CT SEVERITY SCORE (OUT OF 25)	No. of Patients	Percentage
<= 8	41	45.6
9 - 15	21	23.3
16+	28	31.1
Total	90	100.0

Table 3: CT Severity Score

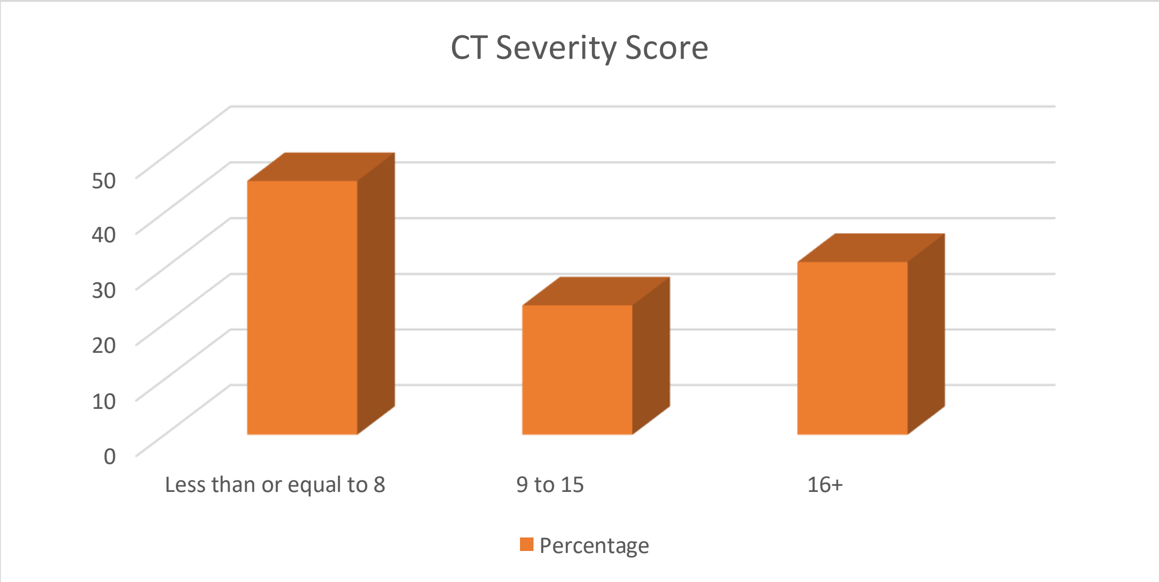


Figure 24: Statistical analysis - CT severity score

Descriptive statistical analysis of assessment of patients with findings of crazy paving pattern is done based on numbers and percentages is done and presented in Table 4 and Figure 25 respectively revealing that 62.2% of patients did not show crazy paving pattern on CT and 37.8% of patients showed crazy paving pattern on CT.

Crazy Paving Pattern	Frequency	Percent
NO	56	62.2
YES	34	37.8
TOTAL	90	100

Table 4: Crazy Paving Pattern

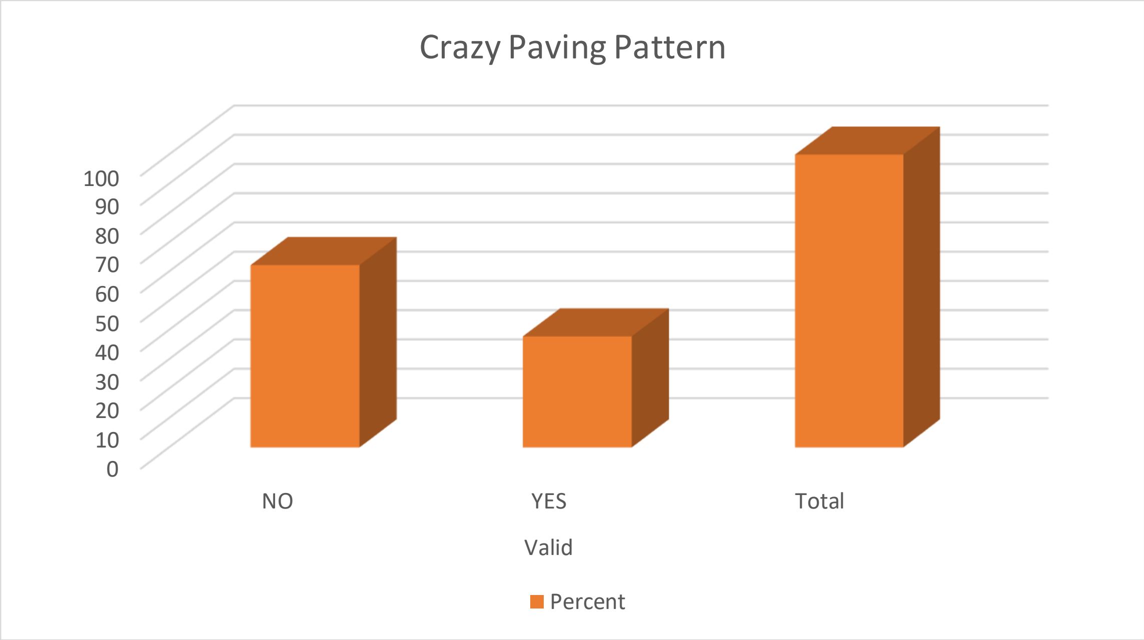


Figure 25: Statistical analysis - Crazy paving pattern

Severity Grade	No. of Patients	Percentage
MILD	27	30.0
MODERATE	21	23.3
SEVERE	28	31.1
Total	76	84.4

Note: 14(15.6%) are nil

Table 5: CT Severity Grade

Descriptive statistical analysis of assessment of patients with findings of presence of pleural effusion is done based on numbers and percentages is done and presented in Table 6 and Figure 26 respectively revealing that on 6.6% of patients had minimal to mild pleural effusion, 1.1% of patients developed bilateral pleural effusion and 92.2% of patients did not have pleural effusion.

Pleural Effusion	Frequency	Percentage
MILD	4	4.4
MINIMAL	2	2.2
NO	83	92.2
YES BILATERAL	1	1.1
Total	90	100.0

Table 6: Pleural Effusion

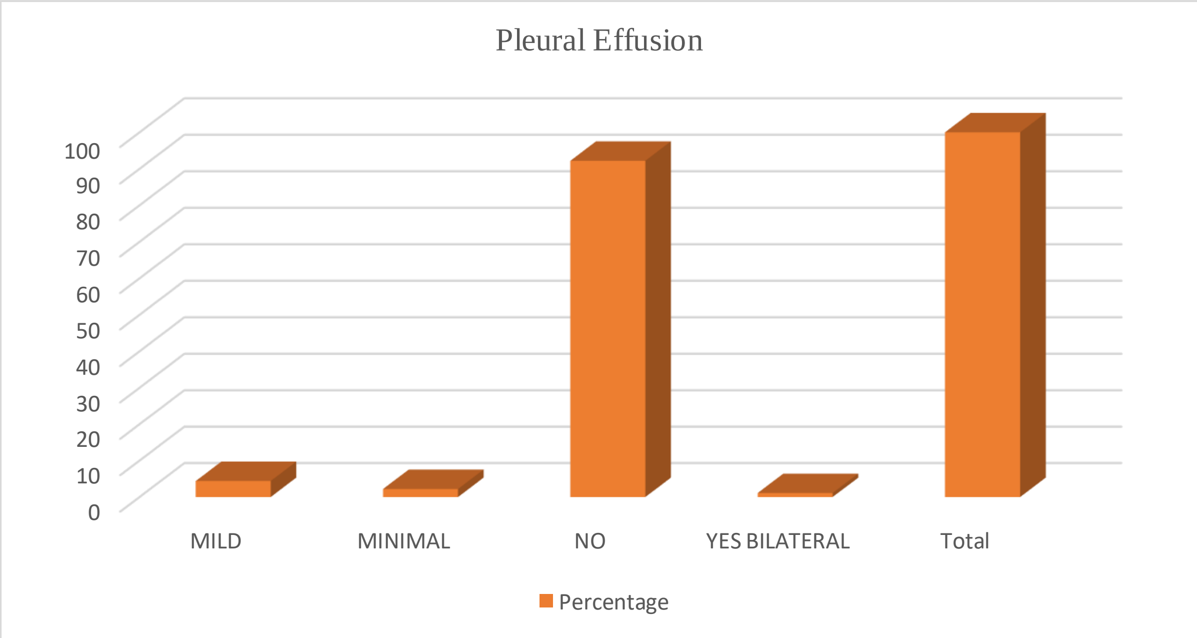


Figure 26: Statistical analysis - Pleural effusion

Descriptive statistical analysis of assessment of patients with findings of ground glass opacity is done based on numbers and percentages is done and presented in Table 7 and Figure 27 respectively revealing that 16.7% of patients did not disclose development of ground glass opacities, 73.3% of patients showed ground glass opacities, 2.2% of patients developed ground glass opacities which were not predominant in distribution, 3.3% of patients showed ground glass opacities with air bronchograms and 4.4% of patients showed ground glass opacities with few areas of air bronchograms.

Ground Glass Opacity	Frequency	Percent
NO	15	16.7
YES	66	73.3
YES BUT NOT PREDOMINANT	2	2.2
YES WITH AIR BRONCHOGRAMS	3	3.3
YES WITH FEW AREAS OF AIR BRONCHOGRAMS	4	4.4
Total	90	100

Table 7: Ground Glass Opacity

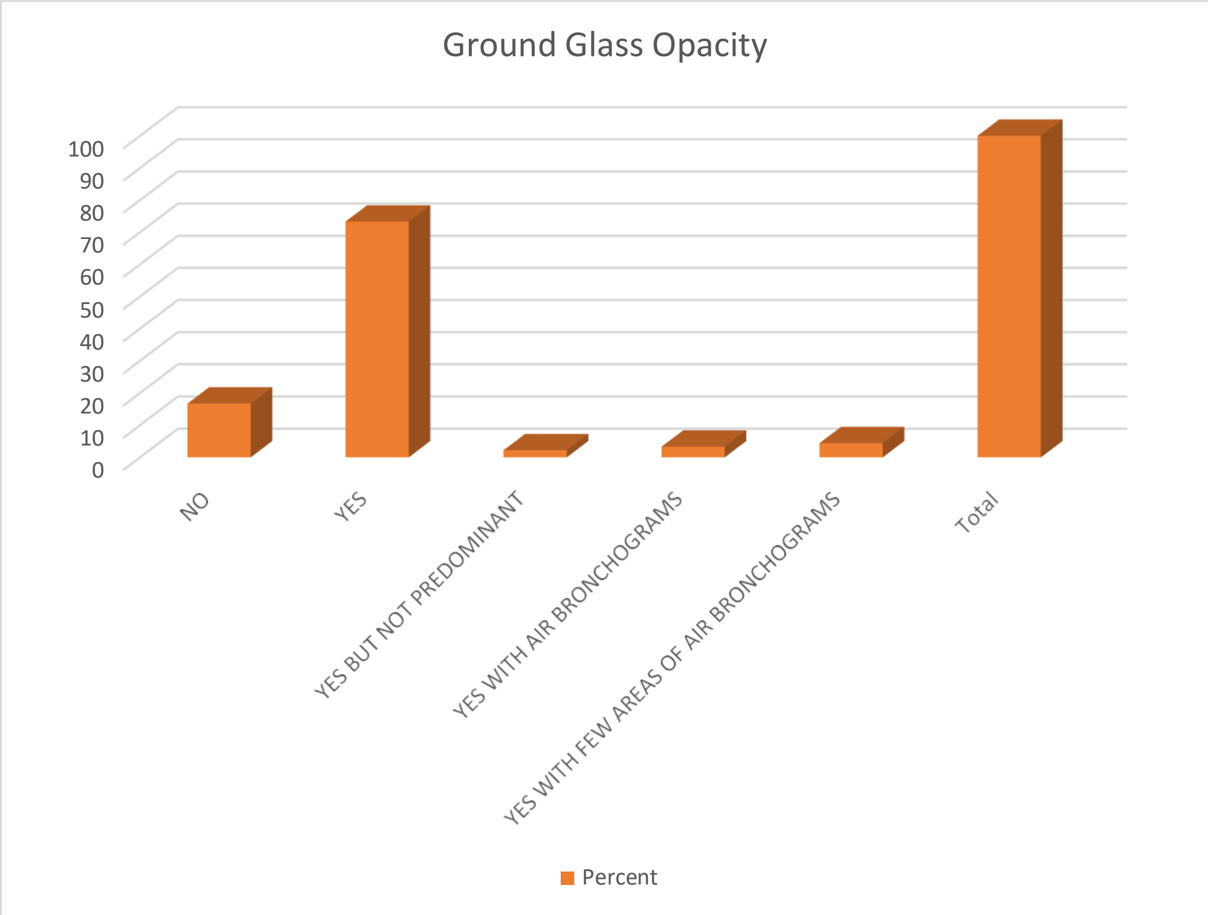


Figure 27: Statistical analysis - Ground glass opacity

Descriptive statistical analysis of assessment of patients with findings of consolidation is done based on numbers and percentages is done and presented in Table 8 and Figure 28 respectively revealing that 97.8% of patients did not show consolidation whereas 2.2% of patients showed consolidation with areas of air bronchograms.

Consolidation	**Frequency**	**Percent**
NO	88	97.8
YES PREDOMINANT WITH AIR BRONCHOGRAMS	2	2.2
Total	90	100.0

Table 8: Consolidation

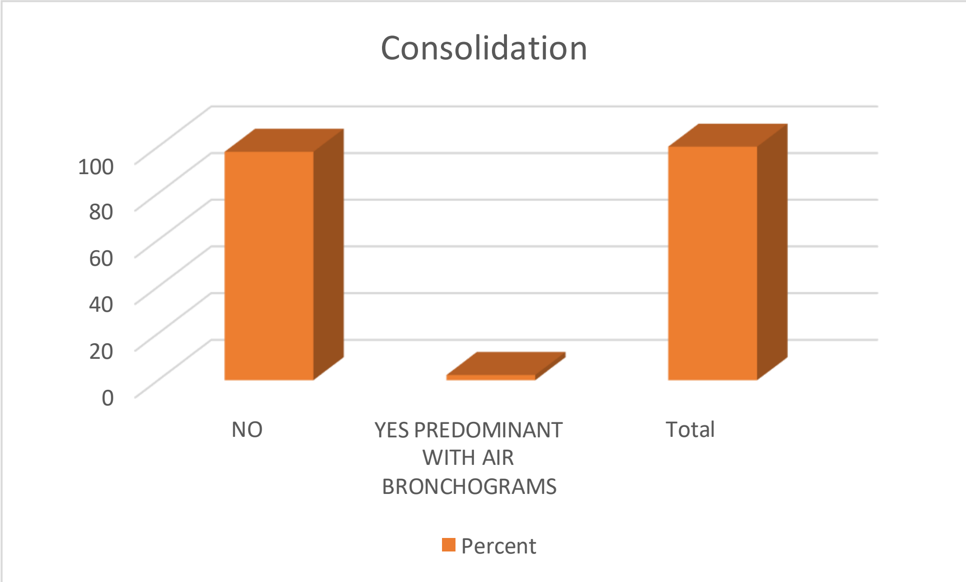
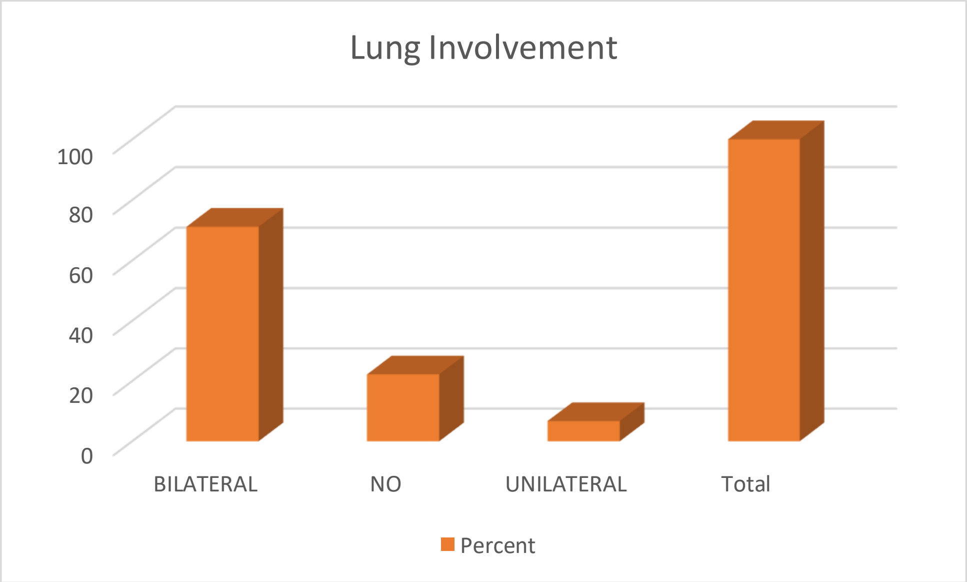


Figure 28: Statistical analysis - Consolidation

Descriptive statistical analysis of assessment of patients with findings of distribution of findings and lung involvement is done based on numbers and percentages is done and presented in Table 9 and Figure 29 respectively revealing that 71.1% of patients had bilateral lung involvement, 6.7% of patients had unilateral lung involvement and 22.2% of patients showed no discernible findings in bilateral lung parenchyma.

Lung Involvement	Frequency	Percent
BILATERAL	64	71.1
NO	20	22.2
UNILATERAL	6	6.7
Total	90	100.0

Table 9: Lung Involvement



Note: NO signifies absent findings or a normal scan.

Figure 29: Statistical analysis - Lung involvement

Descriptive statistical analysis of assessment of patients with findings of mediastinal lymphadenopathy is done based on numbers and percentages is done and presented in Table 10 and Figure 30 respectively revealing that 68.9% of patients did not show any evidence of enlarged mediastinal lymph nodes and 31.1% of patients showed significantly enlarged mediastinal lymph nodes. The most common position of enlarged lymph nodes was the para-aortic region with 15.5%.

Mediastinal Lymphadenopathy	Frequency	Percent
NO	62	68.9
PARATRACHEAL AND SUBAORTIC	**2**	**2.2**
PARAAORTIC	14	15.5
PARATRACHEAL	4	4.4
PREVASCULAR	2	2.2
SUBAORTIC	3	3.3
SUBCARINAL	3	3.3
Total	90	100.0

Table 10: Mediastinal Lymphadenopathy

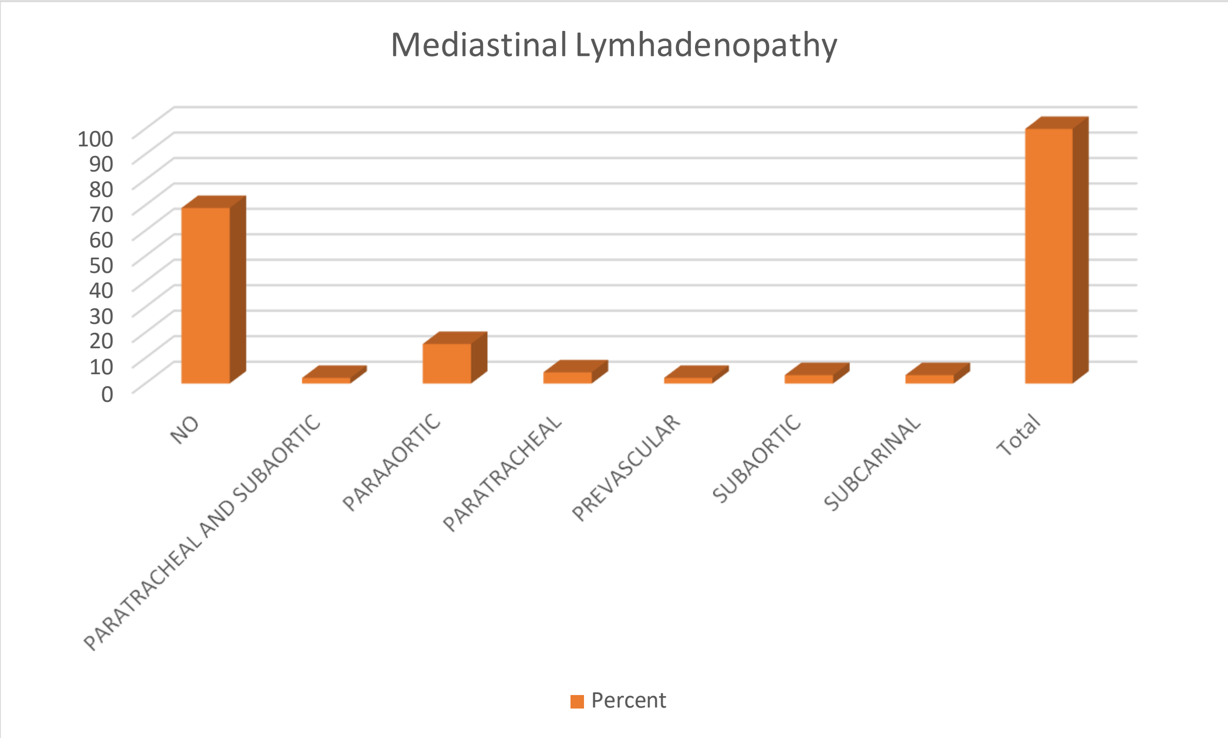


Figure 30: Statistical analysis - Mediastinal lymphadenopathy

Descriptive statistical analysis of assessment of patients at follow up study after 2 weeks with pattern of evolution is done based on numbers and percentages is done and presented in Table 11 and Figure 31 respectively revealing that 51.1% of patients had complete resolution, 27.8% of patients developed fibrotic like changes and 20 % of patients showed residual ground glass opacity. In addition, 1.1% of patients showed residual ground glass opacity with fibrotic like changes.

Pattern of Evolution	Frequency	Percent
Complete resolution	46	51.1
Fibrotic like changes	25	27.8
Residual GGO	18	20.0
Residual GGO with fibrotic like changes	1	1.1
Total	90	100.0

Table 11: Pattern of Evolution

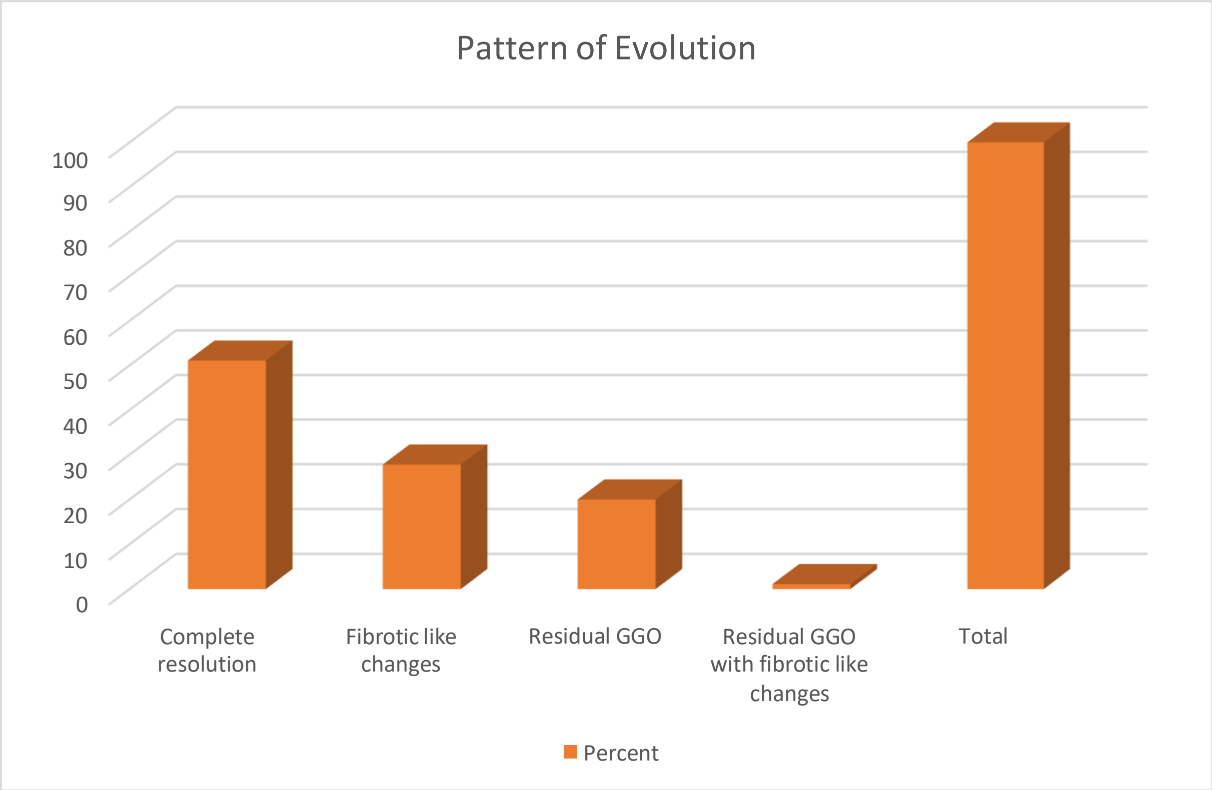


Figure 31: Statistical analysis - Pattern of evolution

CHAPTER VI
DISCUSSION

Definitions

Ground Glass Opacity

A hazy rise in lung opacity on HRCT that is not linked with vascular obscuration and may thus be distinguished from airspace consolidation.

This result is generic and can be caused by limited interstitial thickness, partial airspace filling, a combination of interstitial and airspace abnormalities, partial collapse of alveoli (i.e., dependent opacity), or increased capillary blood volume (J H Austin, 1996) (Webb, 1998) (A N Leung, 1993) (M Remy-Jardin, 1993) (M Remy-Jardin, 1993).

This finding suggests an active or acute process in a variety of diseases to differing degrees, although lung fibrosis can also result in this appearance (A N Leung, 1993) (M Remy-Jardin, 1993) (M Remy-Jardin, 1993). In general, GGO should be diagnosed only when findings of fibrosis or reticulation are not visible in the same lung regions; that is, the GGO is isolated.

Ground-glass opacity visible on CT scans obtained with thick collimation (>5 mm) is much less specific because of volume averaging, and it has been recommended that this term be applied only to HRCT (M Remy-Jardin, 1993). Ground- glass opacity can be diffuse, patchy, or nodular. When possible, it should be distinguished from *mosaic perfusion*, which can resemble it.

Consolidation

An increase in lung opacity visible on plain radiographs or HRCT that obscures underlying arteries. This observation typically implies the replacement of alveolar air or the filling of air gaps with fluid, cells, or tissue, although it can also be found in patients with severe interstitial illness.

On HRCT, it should be differentiated from ground-glass opacity, when increased lung opacity does not cover underlying vessels (David M Hansell, 2008).

Equivalents: airspace consolidation, airspace opacification, airspace attenuation

Crazy-Paving Pattern

The appearance of interlobular septal thickening due to the superimposition of ground-glass opacity and a reticular pattern (T Franquet, 1998) (T Johkoh, 1999) (S Murayama, 1999). This pattern was first identified in patients with pulmonary alveolar proteinosis (PAP) (C R Murch, 1989) and is highly characteristic of PAP, but it can also be seen in individuals with a range of other disorders.

Ground-glass opacity in patients with crazy paving may reflect the presence of airspace or interstitial abnormalities (T Johkoh, 1999) (S Murayama, 1999); reticular opacities may represent interlobular septal thickening, intralobular interstitium thickening, irregular areas of fibrosis, or a predominance of an airspace filling process at the periphery of lobules or acini (T Johkoh, 1999).

Air Bronchogram

The appearance on radiographs or CT of an air-filled bronchus surrounded and outlined by abnormally dense lung, whether it is densely consolidated or of ground-glass opacity (David M Hansell, 2008). An air bronchogram's presence implies patency of proximal airways and a lung abnormality characterized by replacement of alveolar air.

Parenchymal Band (Fibrotic changes)

Linear opacities that can be 1 to 3 mm thick and up to 5 cm long that can be observed patients with pulmonary fibrosis or other causes of interstitial thickening (J H Austin, 1996) (David M Hansell, 2008) (D. Aberle, 1989) (D R Aberle, 1988). They are often peripheral and generally contact the pleural surface.

Parenchymal bands reflect the presence of thickened interlobular septa which are contiguous, peribronchovascular fibrosis, scars or atelectasis occurring secondary to lung or pleural fibrosis, commonly representing sequelae to pulmonary infection (M, et al., 1990) (D A Lynch, 1988). They are most common in patients who have asbestos exposure and sarcoidosis.

CT abnormalities with very high suspicion for COVID-19

In majority of RT-PCR positive COVID-19 cases the findings that are strongly suspicious for atypical viral pneumonia like COVID-19 include the presence of multiple, patchy ground-glass opacities which can either be random or subpleural in location, vascular enlargement, Bilateral GGO's affecting predominantly the lower lobes which show a posterior predilection are the classical imaging appearances (Hugo J A Adams, 2020). The presence of these chest CT abnormalities in endemic areas raises the risk of COVID-19 infection (Hugo J A Adams, 2020).

CT abnormalities with moderate suspicion for COVID-19

Less commonly, patients infected with COVID-19 disclose CT findings that include linear opacities, consolidation, bronchiectasis, crazy-paving pattern, air bronchogram sign, septal thickening and/or reticulation, nodules, bronchial wall thickening and reversed halo sign (Hugo J A Adams, 2020).

The distribution of these findings can be unilateral, multifocal, diffuse or focal. These findings may have a middle or upper lobe predilection with central or peripheral location (Hugo J A Adams, 2020).

CT abnormalities with low suspicion for COVID-19

Findings that are not commonly associated with COVID-19 infections include pleural effusions, mediastinal lymphadenopathy, centrilobular nodular opacities giving "tree-in-bud" appearance, fibro-cavitatory lesions, lesions that are central in distribution and pericardial effusion (Hugo J A Adams, 2020). A different diagnosis is more likely to be suspected if one or more of these observations are made (Hugo J A Adams, 2020) Additionally, some of these signs might not appear later as the disease progresses in some patients.

Imaging Classification	Explanation	Imaging Findings
Highly suspicious for COVID-19	Commonly reported imaging features of greater specificity for COVID-19 pneumonia	GGOs that are bilaterally and peripherally distributed, with or without consolidation or apparent inter/intralobular septal thickening ("crazy-paving" pattern). Multifocal GGOs with rounded morphology and evident inter/intralobular septal thickening ("crazy-paving" pattern). Other signs of organising pneumonia include the reverse halo sign.
Moderately suspicious for COVID-19	COVID-19 pneumonia imaging characteristics that are not specific	Absence of the above results and the presence of the following features: diffuse, multifocal, unilateral, or peri-hilar GGO with or without non-peripherally dispersed consolidation. Few small GGO with a nonrounded and non-peripheral distribution.
Low suspicion for COVID-19 infection – Other diagnoses to be considered first.	Uncommonly or not reported features of COVID-19 pneumonia. Findings that are commonly associated with other infections.	The absence of the aforementioned features, as well as the presence of the following findings: lobar or segmental consolidation without GGO; discrete small nodules, centrilobular nodular opacities ("tree-in-bud" appearance); cavitatory lesions; smooth interlobular septal thickening; and pleural effusion.
Negative for COVID-19 infection	There are no signs of pneumonia.	There are no CT findings that suggest pneumonia / Normal examination.

Table 12: Imaging Classification and Imaging findings of COVID-19 Pneumonia

In our study, patients who were classified under “severe” category, i.e. CT severity score more than 15 during the first CT examination turned out to be an independent prognostic factor for the subsequent development of fibrotic changes during follow-up. Previous research on idiopathic pulmonary fibrosis (IPF) found that CT score is related to the degree of pulmonary fibrosis in pathologic specimens (E A Kazerooni, 1997). A latest study also showed that a CT severity score of more than 18 is connected with a higher risk of death (Marco Francone, 2020).

Hence, as a result, there is a greater death rate and more severe pulmonary consequences, and the future emergence of complications in survivors may be related to a widespread lung injury during the acute phase.

A study by (Xiaoyu Han, 2021) demonstrated that the development of fibrotic-like changes in lungs is attributed to lung injury which occurs as a complication of invasive mechanical ventilation. Lab findings patients affected demonstrate high d-dimer and increased CRP levels.

Furthermore, because patients with higher CT severity scores are more likely to get non-invasive mechanical breathing, these patients are more vulnerable to the progression of findings into fibrotic-like alterations. Using previously published data as a foundation (S R Desai, 1999), it is now understood that mechanical ventilation is actively responsible for the development of fibrosis which occurs after ARDS.

Significant reduction in CT severity score for the number and distribution of findings like GGO and consolidation were noted on follow-up imaging when equated with initial CT severity score in patients who had lower initial baseline score. In a large proportion of patients who were classified under “mild” category, complete resolution of findings was noted on follow up imaging.

When GGO was the primary CT finding on the follow-up CT, evidence of increased extension of GGO was noted in few patients with decrease in the attenuation, this is referred to as the "tinted" sign (Dehan Liu 1 2, 2020) or "melting sugar" sign. Few studies that have concluded these findings have suggested that these findings may signify a gradual reduction in inflammation and alveolar re-expansion (Yueying Pan 1, 2020) (Dehan Liu 1 2, 2020).

During the acute phase of COVID-19 infection, the presence of GGO can also signify inflammatory infiltrates, edema, or haemorrhage (Zhe Xu, 2020) (Jia Liu 1 2, 2020). Also, few studies have noted that since COVID-19 infected patients have a tendency to develop increase in D-dimer levels, they are more susceptible to develop complications like pulmonary embolism, which on CT is also reflected by GGO (Matthijs Oudkerk, 2020) (Philippe Thoma, 2009).

CHAPTER VII
SUMMARY

The clinical features, course, outcome and degree of pulmonary involvement of patients COVID-19 patients is variable.

The classical findings which are observed on CT imaging in patients infected with COVID-19 include the presence of ground-glass opacities which are bilateral in distribution predominantly affecting the lower lobes with a posterior predilection.

Over time, COVID-19 usually appears in a rather predictable fashion on CT scanning of the chest. Notably, the number of individuals with COVID-19 and are symptomatic which disclose normal chest CT examination is not negligible, while few of the asymptomatic patients frequently have normal chest CT examination results.

It must also be emphasised that lung findings on computed tomography images are somewhat non-specific for COVID-19. It is not advisable to use chest CT as a standalone modality to rule out or confirm COVID-19 due to these limitations. The norm for diagnosis and a crucial factor in clinical decision-making are the results of RT-PCR tests. The ideal treatment plan for COVID-19 patients would be a multimodality, multidisciplinary approach that took into consideration the patient's medical history, laboratory results, and imaging findings. This will significantly aid in improving patient care.

Over all, more than a 33% of the patients who recovered from severe COVID-19 had lung abnormalities resembling fibrosis on follow-up imaging performed within two weeks of the commencement of the disease. These individuals were older and had more severe sickness during the acute period. However, it is still largely unknown how these CT findings will affect the respiratory system in the long run. This research provides a framework for future, extensive, in-depth studies that examine these high-risk populations.

Furthermore, chest CT can detect COVID-19 progression or secondary cardiopulmonary problems such ARDS, PE, superimposed pneumonia, or heart failure. Future research into the prognostic value of chest CT in COVID-19 is required.

CHAPTER VIII
CONCLUSION

In conclusion, more particular imaging characteristics that are typical and frequently observed in COVID-19 viral pneumonia include the presence of ground-glass opacities which are bilateral and peripherally distributed with or without consolidation or visible intralobular septal thickening commonly referred to as “crazy-paving” pattern. The distribution of ground-glass opacities might be either subpleural or random. Consolidation, although not predominant can be present as the disease progresses.

Non-specific or ambiguous imaging features COVID-19 pneumonia is distinguished by the absence of the aforementioned results as well as the occurrence of the following factors: multifocal, diffuse, perihilar, or unilateral ground-glass opacity with or without consolidation and a few small ground-glass opacities with a nonrounded or non-peripheral distribution.

Imaging findings that are uncommon or suggest an unusual appearance of COVID-19 pneumonia include isolated lobar or segmental consolidation without ground-glass opacities and discrete tiny nodules (centrilobular nodular opacities i.e. “tree- in-bud” appearance, fibro-cavitatory lesions, interlobular septal thickening and pleural effusions. The presence of such findings should strongly hint towards another diagnosis.

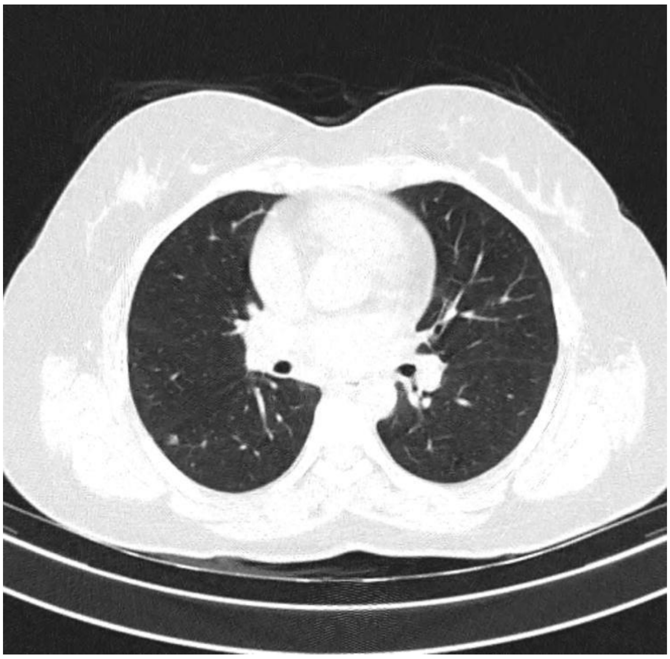
CT follow-up in individuals who recovered exhibited lung alterations that resembled fibrosis. Longer hospital admissions, acute respiratory distress syndrome and a high initial chest CT severity score were all linked to these alterations as well as an older age.

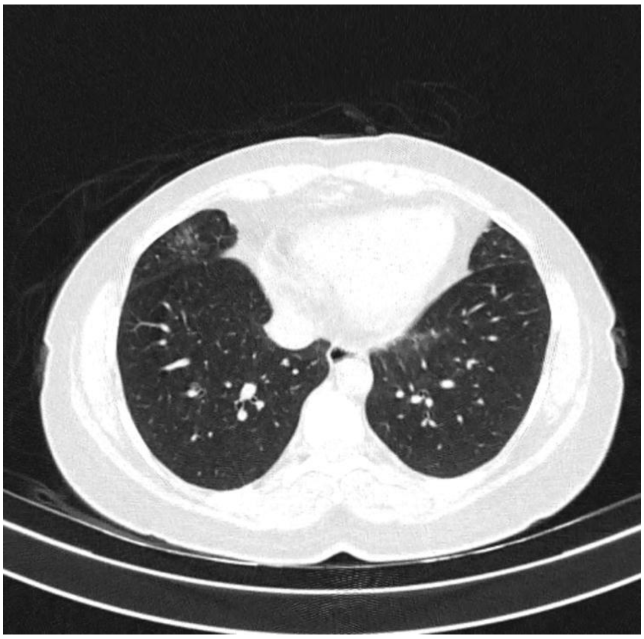
Development of residual ground glass opacities is also noted on follow up studies, the pattern of which is likely to denote resolving changes.

In younger patients with COVID-19 pneumonia, particularly those patients who are less than 30 years of age and do not have any co morbidities some individuals with positive RT-PCR for COVID-19 might also disclose absence of lung findings on HRCT chest in the presence of disease, if findings are present however, the progression of disease is less severe with moderate to low initial chest CT severity scores. In majority of such patients complete resolution of findings is commonly noted at follow up studies.

ILLUSTRATIVE CASES

Case 1

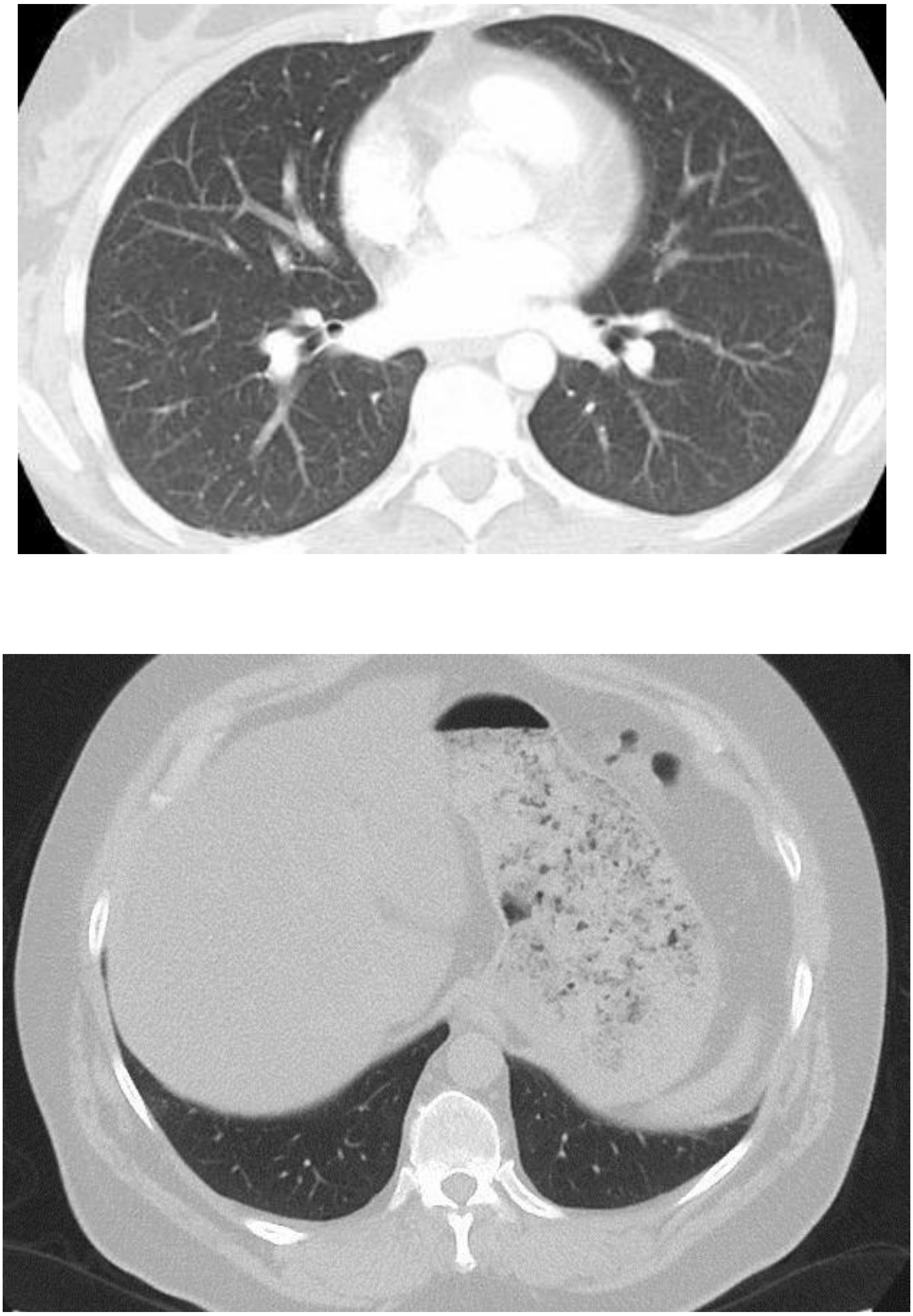




Axial CT section with lung window of a 59 year old female patient with primary complaints of fever and breathlessness on exertion causes a few small mild patches of ground glass attenuation in the right upper and middle lobes, which are distributed subpleurally. Few small areas of ground glass attenuation are also noted involving the postero-basal segments of bilateral lower lobes.

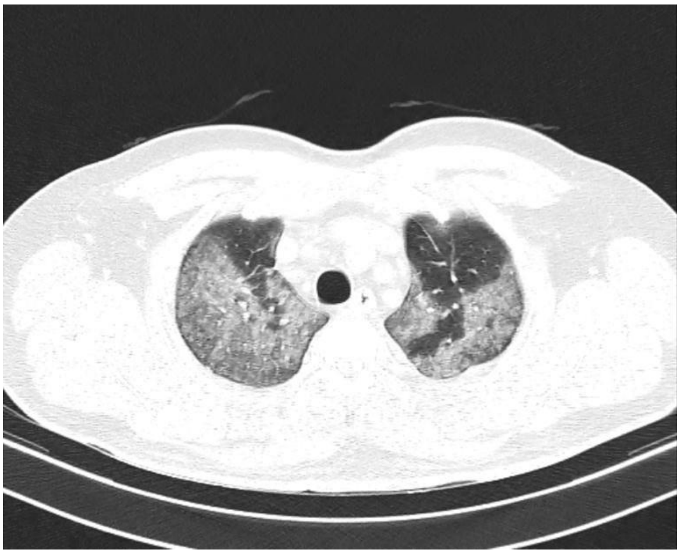
CT SEVERITY SCORE:- 05/25 (MILD)

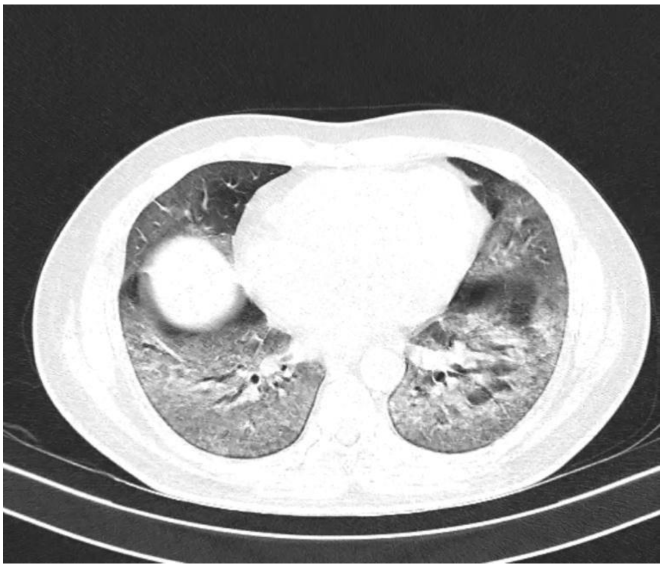
	Right side	Left side
Upper Lobe	0	0
Middle Lobe / Lingular Lobe	1	--
Lower Lobe	1	1
TOTAL SCORE	2	3

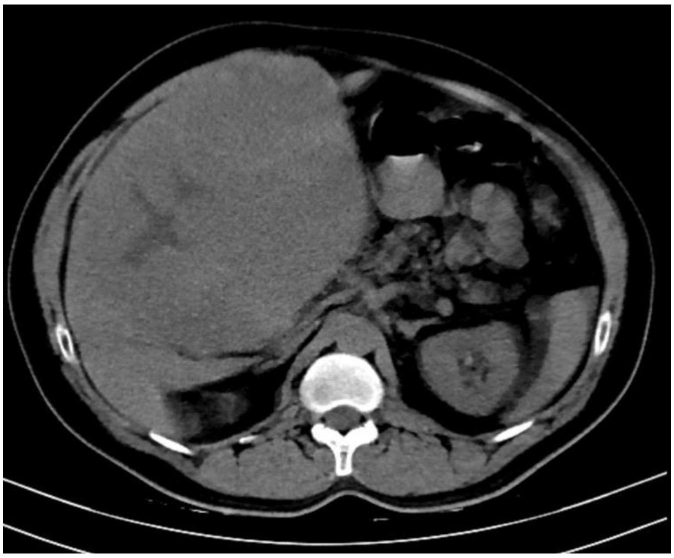


Axial CT scan of chest with lung window of the same patient after 2 weeks of treatment shows complete interval resolution of findings.

Case 2







Axial CT sections with lung and soft tissue windows of a 40-year-old man who had shown 2 days earlier with rapid onset of breathlessness at rest and fever with cough show diffuse areas of ground glass attenuation involving bilateral lung parenchyma with relative sparing of the anterior parts of bilateral upper lobes and right middle lobe.

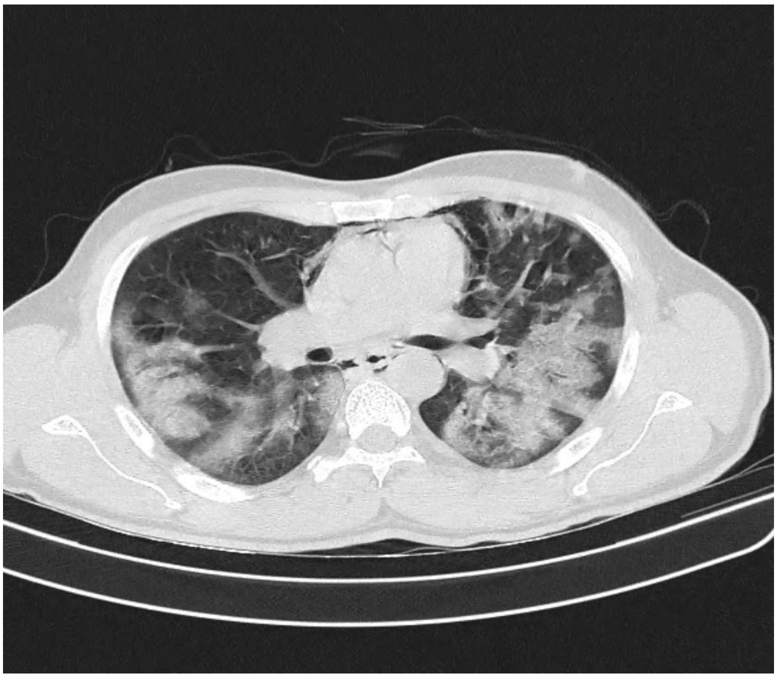
Incidentally, the limited sections of the patient's abdomen acquired during the chest study show that there is a relatively large homogenous lesion involving the liver with central stellate scar. This turned out to be a Focal Nodular Hyperplasia on further workup.

CT SEVERITY SCORE :- 20/25 (SEVERE)

-	**Right side**	**Left side**
Upper Lobe	4	4
Middle Lobe / Lingular Lobe	4	--
Lower Lobe	4	4
TOTAL SCORE	12	8

Axial CT scan of chest with lung window in the same patient after 2 weeks of supportive treatment shows residual patchy subpleural surfaces of ground glass attenuation, more apparent in postero-basal segments of bilateral lower lobes.

Case 3



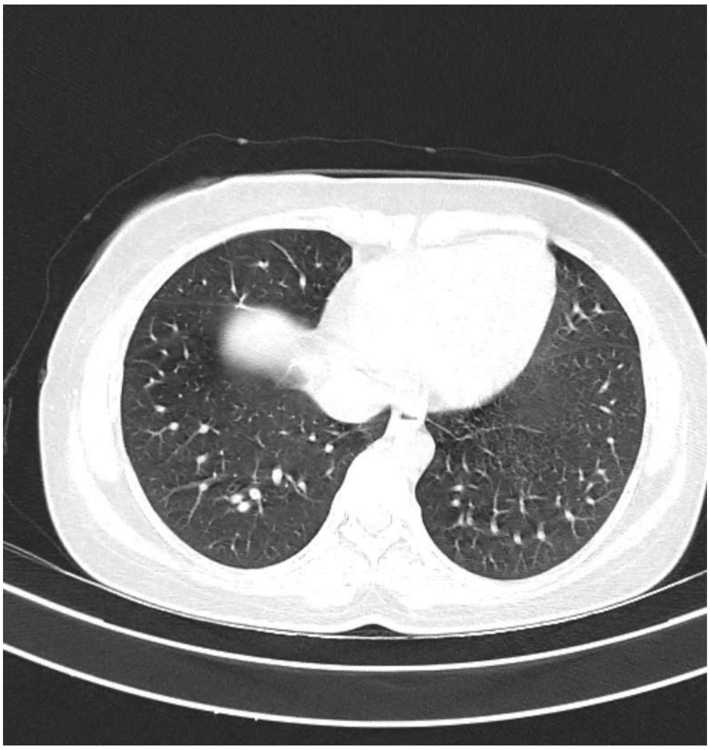
Axial CT sections in lung window of a 35-year-old man who presented with chest pain, fever and breathlessness on rest demonstrate a number of patchy moderate to large sized patches of ground glass attenuation with crazy paving pattern predominantly involving the bilateral lower lobes.

In addition, the mediastinal and paratracheal soft tissues reveal surgical emphysematous changes. This patient had undergone endotracheal intubation immediately after admission due to decreasing Spo2 levels. CT also revealed a 0.5 cm posterior wall defect in the trachea at T3-4 level (not shown). Tracheal injury is an infrequent and severe complication of endotracheal intubation which needs to be diagnosed and treated urgently.

CT SEVERITY SCORE:- 18/25 (SEVERE)

-	Right side	Left side
Upper Lobe	3	3
Middle Lobe / Lingular Lobe	3	--
Lower Lobe	5	4
TOTAL SCORE	11	07

Case 4

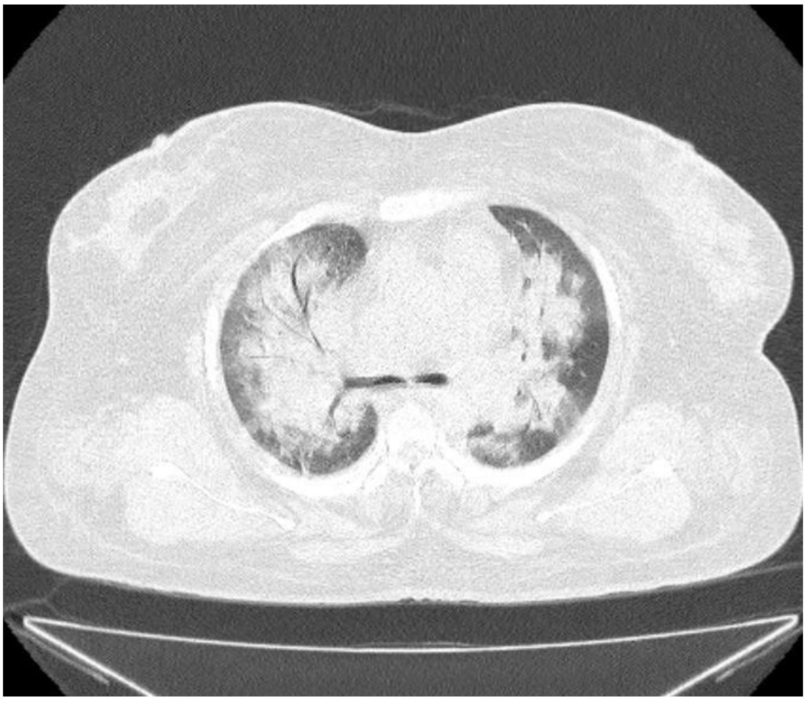


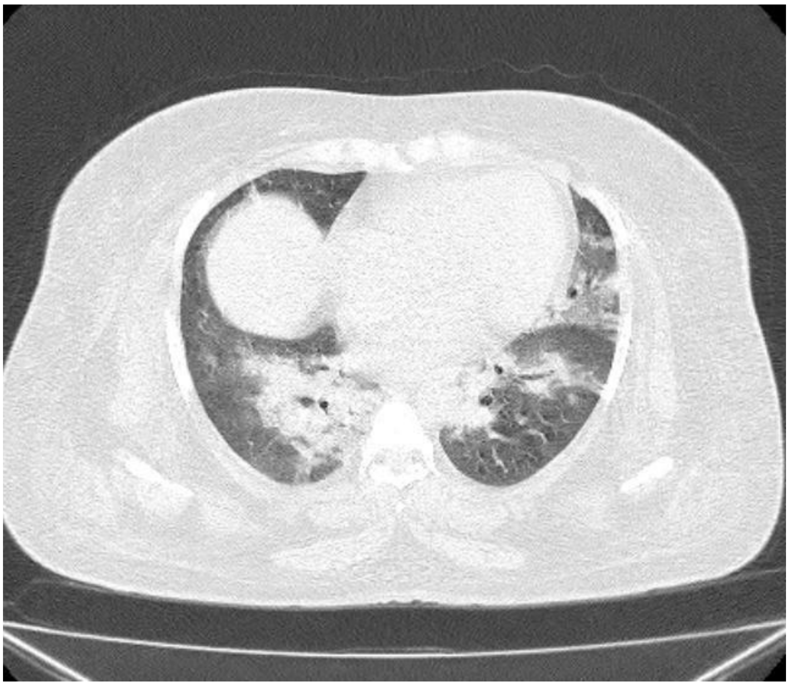
Axial CT sections in lung window of a 24-year-old woman who had a high degree fever unexpectedly and RT-PCR positive for COVID-19 reveal a normal CT scan of lung. It is imperative to note that few patients, especially young patients with no co-morbidities may have completely normal lung findings in the presence of disease.

CT SEVERITY SCORE:- 0/25

-	**Right side**	**Left side**
Upper Lobe	0	0
Middle Lobe / Lingular Lobe	0	--
Lower Lobe	0	0
TOTAL SCORE	0	0

Case 5

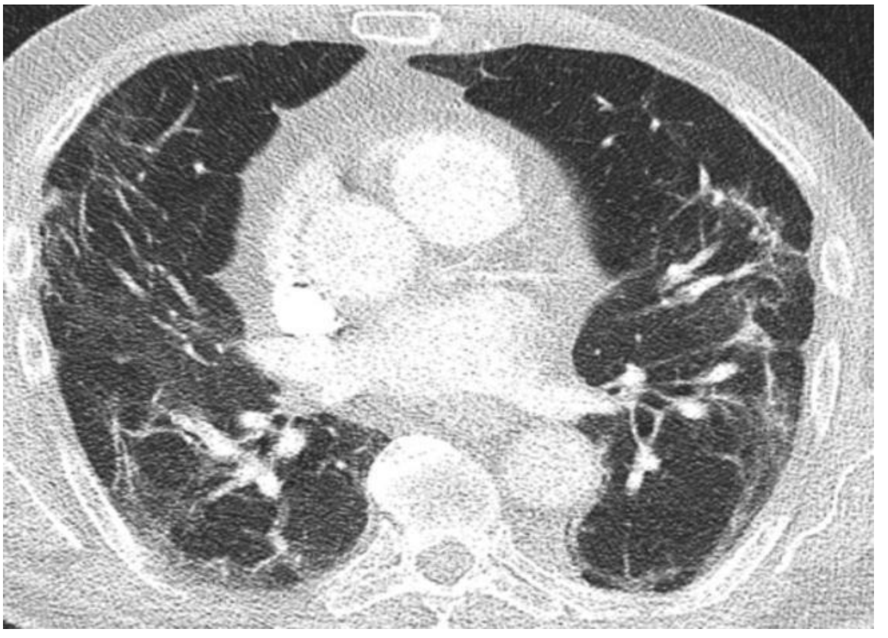




Axial CT sections with coronal reformatted images in lung window of a 35-year-old female complaining of chest pain, breathlessness and fever show many patchy moderate to large sized randomly scattered ground glass attenuation zones, many of them showing alveolar exudates within is noted in bilateral lung fields predominantly in peri-hilar regions.

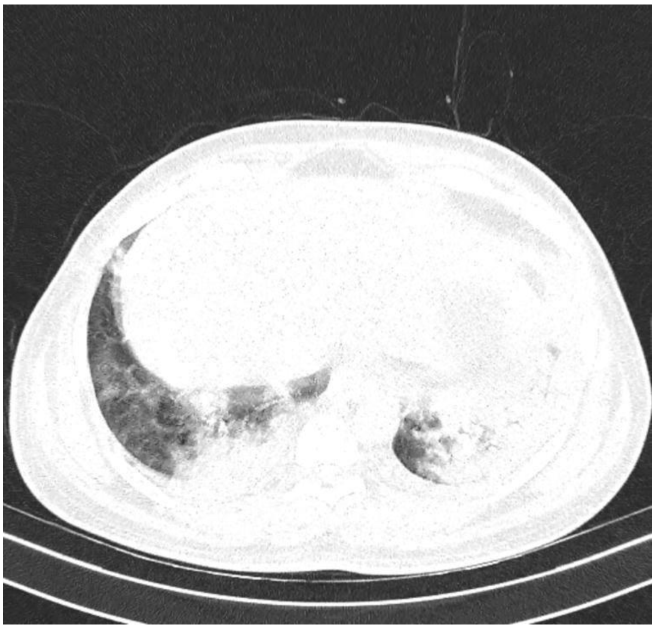
CT SEVERITY SCORE:- 16/25 (SEVERE)

-	Right side	Left side
Upper Lobe	4	4
Middle Lobe / Lingular Lobe	2	--
Lower Lobe	3	3
TOTAL SCORE	9	7



After 3 weeks, an axial CT picture in the lung window shows bilateral curvilinear parenchymal bands with lung architecture distortion.

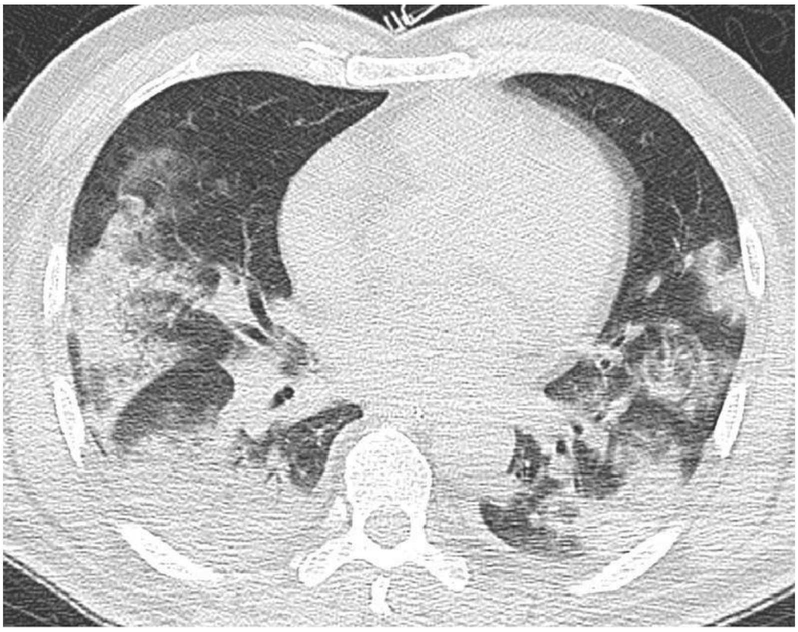
Case 6



Axial CT sections in lung window of a 52-year-old man with chest pain, breathlessness, and fever show multiple patchy moderate to large sized randomly distributed and subpleural areas of consolidation with air bronchogram sign involving bilateral lung parenchyma.

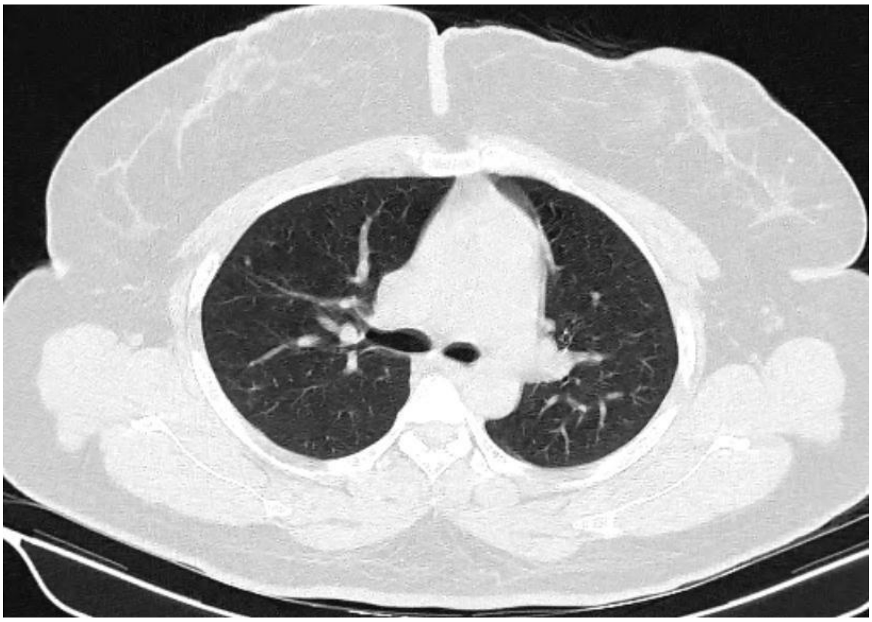
CT SEVERITY SCORE: - 23/25 (SEVERE)

-	Right side	Left side
Upper Lobe	4	5
Middle Lobe / Lingular Lobe	5	--
Lower Lobe	4	5
TOTAL SCORE	13	10



Axial CT scan of the same patient after 2 weeks of treatment shows reduced / resolving areas of consolidation

Case 7



An axial CT slice through the lung window of a 32-year-old female patient with cough and fever reveals a weak tiny area of ground glass attenuation affecting the right upper lobe.

CT SEVERITY SCORE:- 01/25 (MILD)

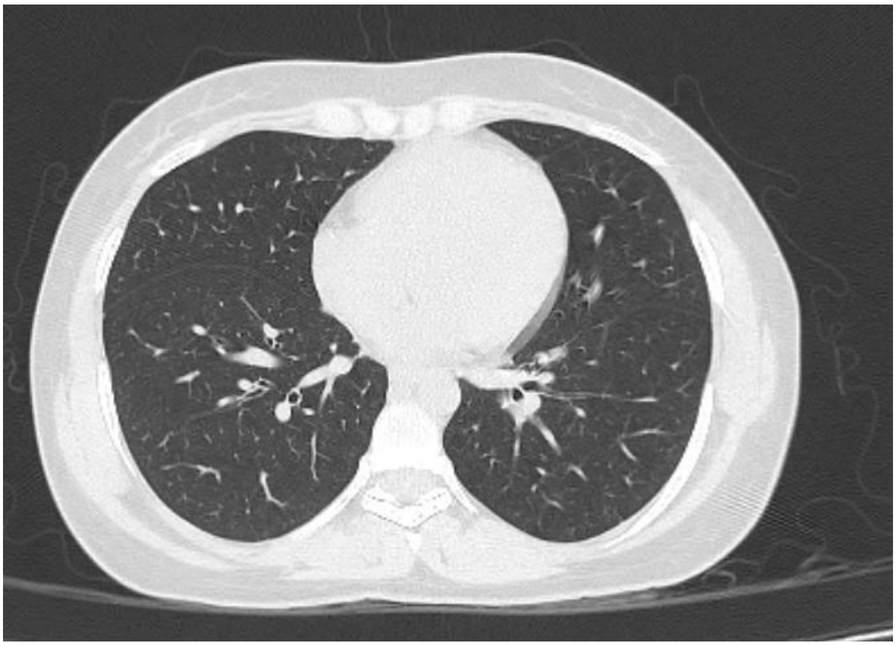
	Right side	Left side
Upper Lobe	1	0
Middle Lobe / Lingular Lobe	0	--
Lower Lobe	0	0
TOTAL SCORE	1	0

Case 8

Axial CT section of a 27-year-old woman with primary complaints of sudden onset of cough and fever displays a few patchy subpleural patches of ground glass attenuation in the right middle and left lower lobes.

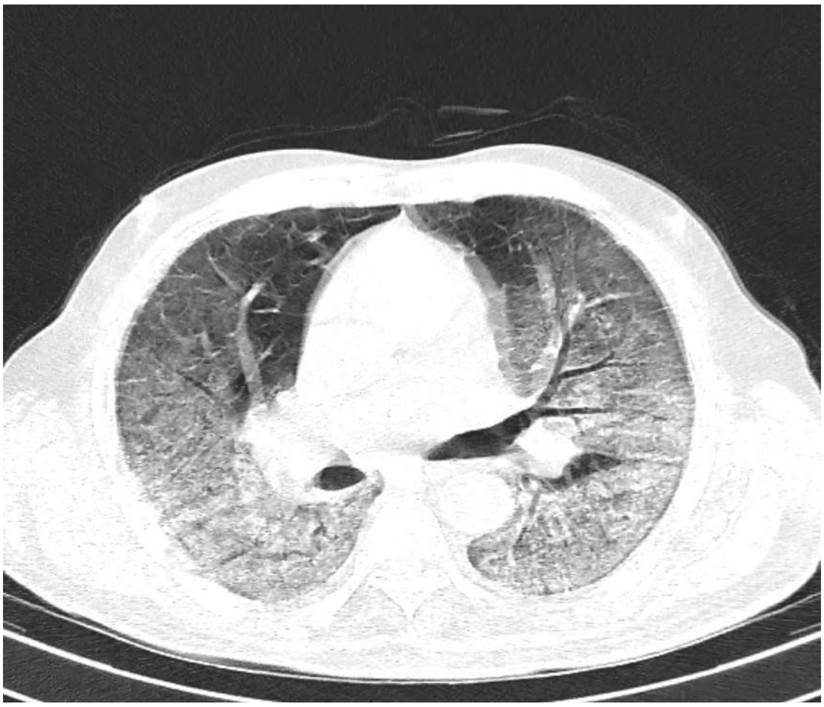
CT SEVERITY SCORE:- 10/25 (Moderate)

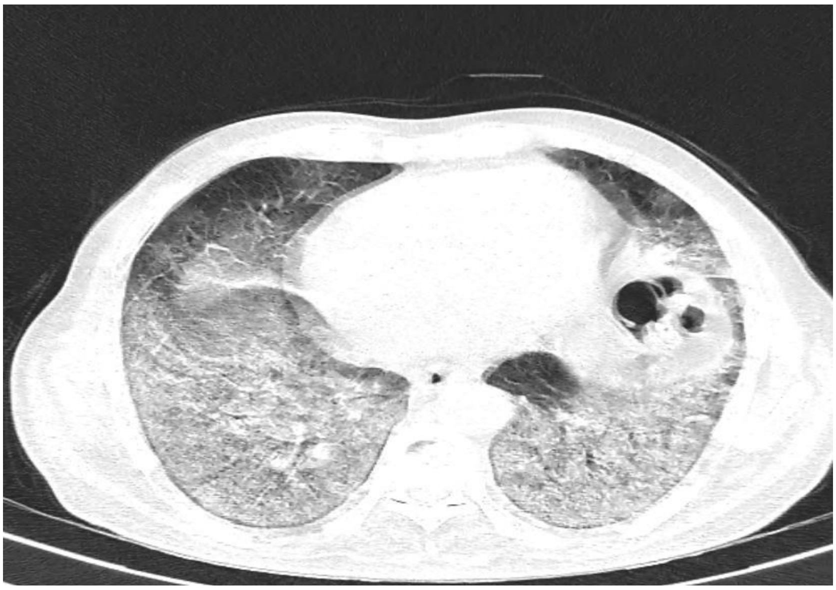
	Right side	Left side
Upper Lobe	3	1
Middle Lobe / Lingular Lobe	3	--
Lower Lobe	1	2
TOTAL SCORE	7	3

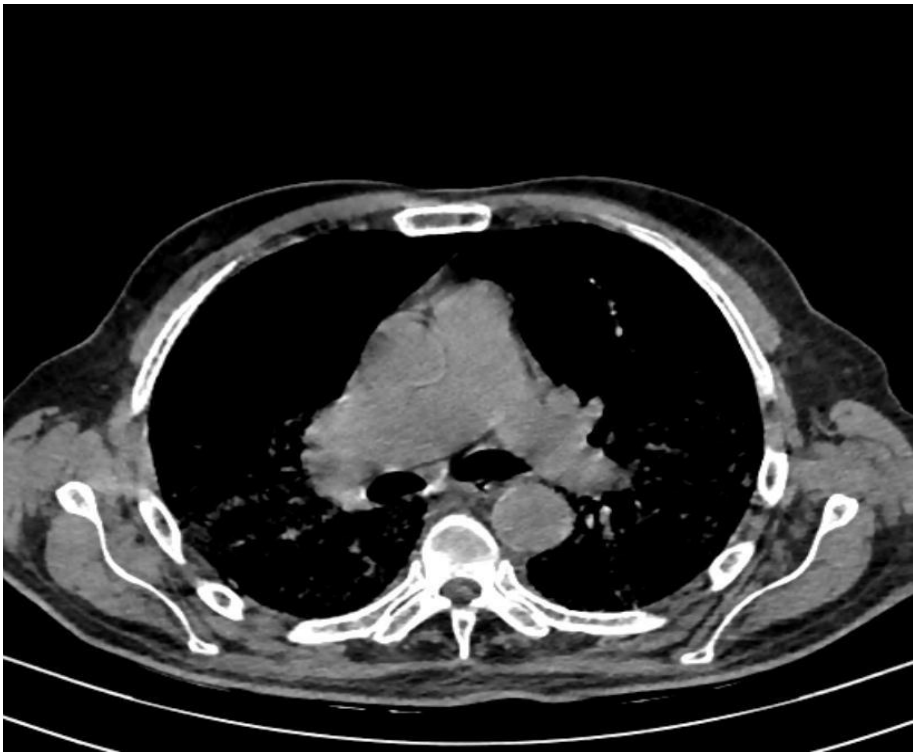


Axial CT section of the same patient after 2 weeks of treatment and alleviation of symptoms shows complete interval resolution of findings.

Case 9



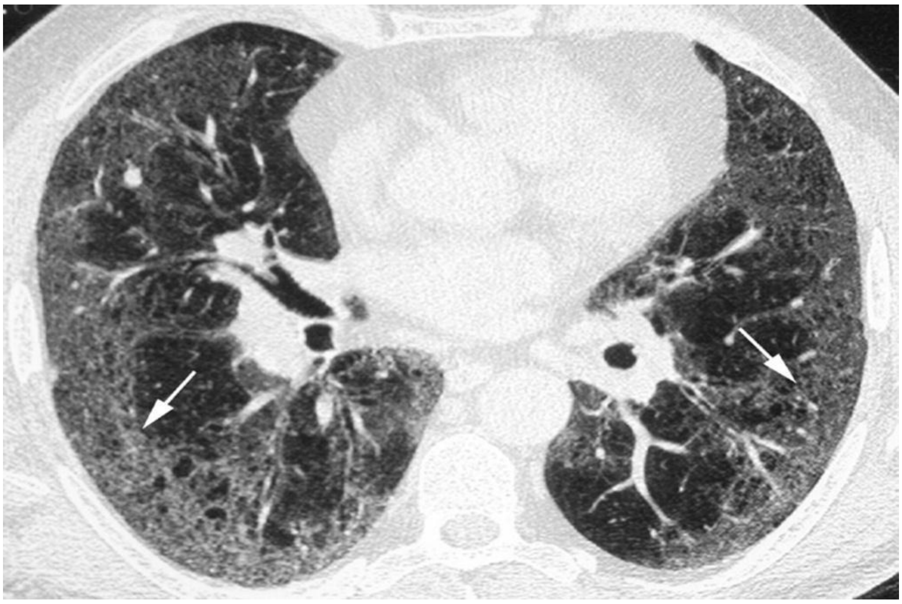




Axial CT sections with lung and mediastinal window of a 65-year-old man patient reported of chest pain, breathlessness and fever show diffuse areas of ground glass attenuation with crazy paving pattern and air bronchograms in left upper lobe showing alveolar exudates within in bilateral lung parenchyma.

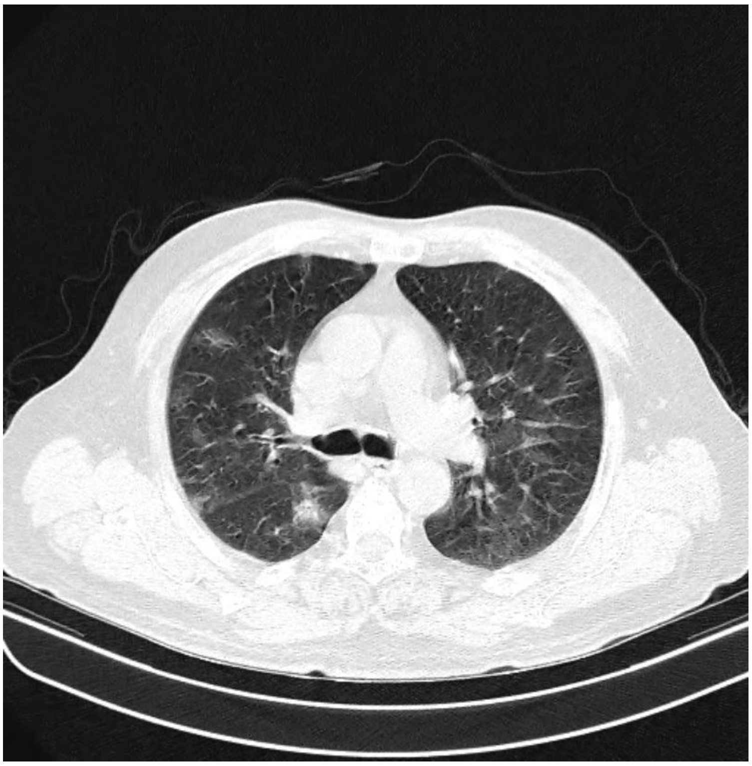
CT SEVERITY SCORE:- 25/25 (Severe)

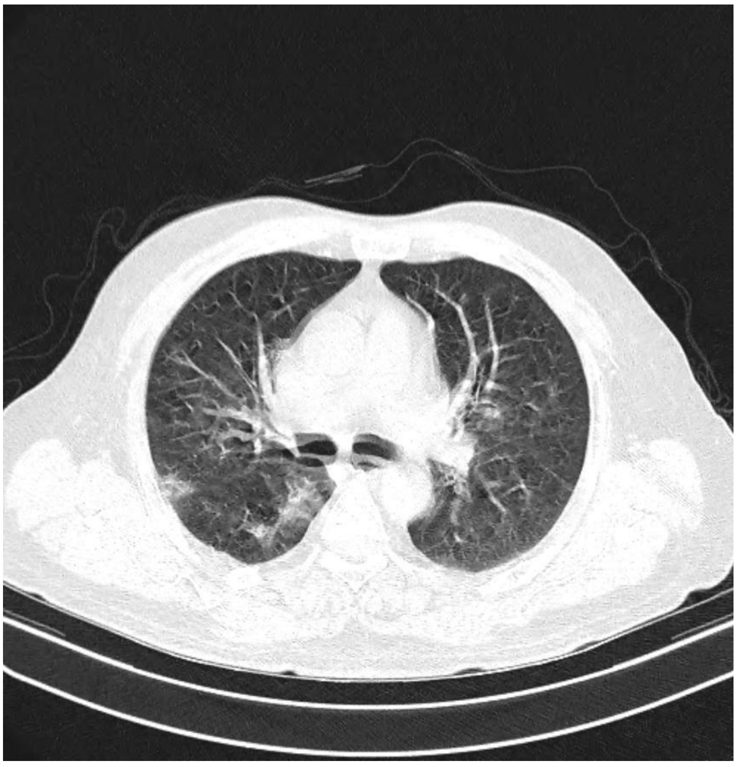
	Right side	**Left side**
Upper Lobe	5	5
Middle Lobe / Lingular Lobe	5	--
Lower Lobe	5	5
TOTAL SCORE	15	10



After 2 weeks of follow-up, an axial HRCT scan shows multifocal patches of ground glass opacity (arrows) in a peripheral dispersion with areas of reticulations.

Case 10

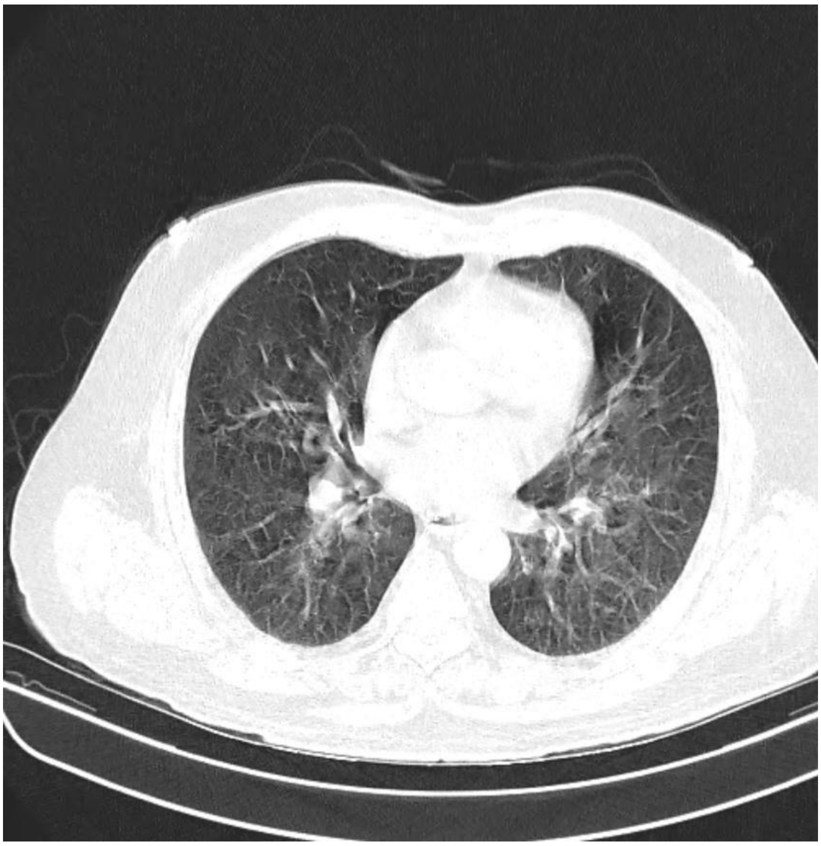




Axial CT sections with lung window of a 72-year-old man experienced of chest pain, breathlessness and fever shows few small subpleural areas of ground glass attenuation involving bilateral lung parenchyma.

CT SEVERITY SCORE:- 11/25 (Moderate)

-	Right side	Left side
Upper Lobe	3	2
Middle Lobe / Lingular Lobe	2	--
Lower Lobe	2	2
TOTAL SCORE	7	4



Axial CT section with lung window of the same patient done 15 days later after admission and supportive treatment shows interval resolution of findings.

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ANNEXURE

CT SEVERITY SCORE:-

-	Right side	Left side
Upper Lobe	0	0
Middle Lobe / Lingular Lobe	0	--
Lower Lobe	0	0
TOTAL SCORE	0	-

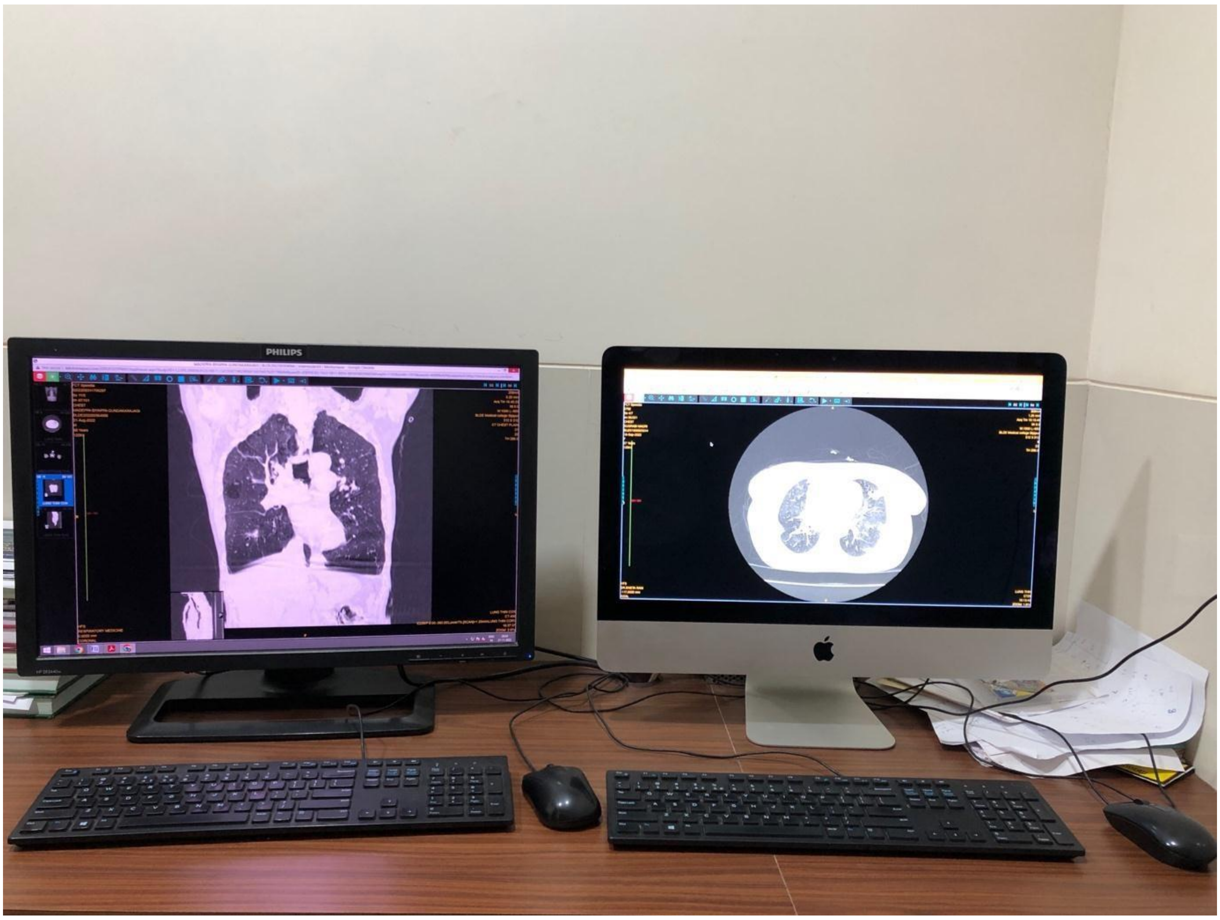
CT SEVERITY SCORE—0/25

SCORE IN EACH LOBE	% INVOLVEMENT OF EACH LOBE
0	0%
1	<5%
2	5-25%
3	25-50%
4	50-75%
5	75-100%
MAXIMUM SCORE--25	

CO-RADS CLASSIFICATION:-

	Level of suspicion	CT Findings
CO-RADS 1	NO	Normal / non-infectious abnormalities
CO-RADS 2	LOW	Abnormalities consistent with infections other than COVID -19
CO-RADS 3	INDETERMINATE	Unclear whether COVID -19 is present
CO-RADS 4	HIGH	Abnormalities suspicious for COVID -19
CO-RADS 5	VERY HIGH	Typical COVID -19
CO-RADS 6	PCR+	

Siemens Somatom 16 CT Scanner used for the study.



Dedicated workstations used for interpretation of images.

IEC/NO-09/2021
Date-22/01/2021

B.L.D.E. (DEEMED TO BE UNIVERSITY)

(Declared vide notification No. F.9-37/2007-U.3 (A) Dated. 29-2-2008 of the MHRD, Government of India under Section 3 of the UGC Act, 1956)

The Constituent College

SHRI. B. M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Institutional ethical committee of this college met on 11-01-2021 at 11-00 am to scrutinize the synopsis of Postgraduate students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected and revised version synopsis of the Thesis has been accorded Ethical Clearance

Title: Novel coronavirus (COVID-19) pneumonia: CT Manifestations and pattern of evaluation.

Name of PG student: Dr Mohammad Saad Mustafa, Department of Radiology

Name of Guide/Co-investigator: Dr Satish D Patil Assoc.Professor of Radiology

DR .S.V.PATIL
CHAIRMAN, IEC

Institutional Ethical Committee
B L D E (Deemed to be University)
Shri B.M. Patil Medical College,
VIJAYAPUR-586103 (Karnataka)

Following documents were placed before Ethical Committee for Scrutinization:

1. Copy of Synopsis / Research project
2. Copy of informed consent form
3. Any other relevant documents.

Institutional Ethical Clearance Certificate

NAME OF PATIENT	AGE/SEX	PATIENT ID	RT-PCR	CT	DATE	CT SEVERITY SCORE (OUT OF 25)	SEVERITY GRADE	CORADS	RUL	RML	RLL	LUL	LLL	Pleural Effusion	Crazy Paving Pattern	Ground Glass Opacity (Predominant lung pattern)	Consolidation	Bronchiectasis (Other findings)	Emphysema	Unilateral/Bilateral Lung Involvement	Mediastinal Lymphadenopathy	Pattern of Evolution
TARABAI PATIL	60/F	44596	POSITIVE	404	02-May-21	1	SEVERE							NO	NO	YES	NO	NO	NO	UNILATERAL	YES PARAAORTIC	Fibrotic like changes
RAMANGOUDA BIRADAR	49/M	60652	POSITIVE	459	18-May-21	1	MODERATE							NO	YES	YES	NO	NO	NO	BILATERAL	NO	Residual GGO
NEELAKANT HOSAMANI	45/M	46124	POSITIVE	46124	11-May-21	2	SEVERE							MINIMAL	YES	YES WITH FEW AREAS OF AIR BRONCHOGRAMS	NO	NO	NO	BILATERAL	YES PARAAORTIC	Fibrotic like changes
RAMACHANDRA KOLI	39/M	46038	POSITIVE	261	05-May-21	2	SEVERE							MILD	YES	YES WITH AIR BRONCHOGRAMS	NO	NO	NO	BILATERAL	YES PARAAORTIC	Fibrotic like changes
BASAPPA R RANAGATTI	53/M	52781	POSITIVE	839	10-May-21	1	SEVERE							NO	YES	YES	NO	NO	NO	BILATERAL	NO	Residual GGO
ANURADHA DESHPANDE	16/F	44404	POSITIVE	941	02-May-21	1	MODERATE							NO	NO	YES BUT NOT PREDOMINANT	YES PREDOMINANT WITH AIR BRONCHOGRAM	NO	NO	BILATERAL	NO	Complete resolution
VIJAY PATTAR	38/M	56999	POSITIVE	179	14-May-21	2	SEVERE							NO	YES	YES WITH AIR BRONCHOGRAMS	NO	NO	NO	BILATERAL	YES PREVASCULAR	Fibrotic like changes
MADIVALAPPA BYALAL	48/M	55357	POSITIVE	2	12-May-21	1	MODERATE							NO	YES	YES	NO	NO, PLEURAL CALCIFICATION ON LEFT	NO	BILATERAL	YES SUBAORTIC	Residual GGO
PRIYANKA UMBARAJE	27/F	39169	POSITIVE	299	27-Apr-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
SAILEE BELVI	28/F	45990	POSITIVE	33	03-May-21	1	MODERATE							NO	YES	YES	NO	NO	NO	BILATERAL	YES SUBCARINAL	Complete resolution
NEELABAI M YARNAL	65/F	19417	POSITIVE	606	08-May-21	1	MODERATE							NO	YES	YES	NO	NO	NO	BILATERAL	YES PARAAORTIC	Complete resolution
RATNABAI KAKANDKI	50/F	51309	POSITIVE	602	08-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NO	NO	NO	NO	NO	NO	NO	NO	Complete resolution
BASAVARAJ	45/M	51293	POSITIVE	586	07-May-21		MILD							NO	NO	YES	NO	NO	NO	NO	NO	Complete resolution
KSHAMASHANTI KULKARNI	39/F	51273	POSITIVE	578	07-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NO	NO	NO	NO	NO	NO	NO	NO	Complete resolution
BHIMANGOUDA PATIL	48/M	51258	POSITIVE	578	07-May-21	1	SEVERE							NO	YES	YES	NO	NO	NO	BILATERAL	YES PARATRACHEAL	Complete resolution
SUNANDA BIRADAR	26/F	51254	POSITIVE	577	07-May-21	1	SEVERE							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
BHIMASHANKAR JUMANAL	30/M	51175	POSITIVE	559	07-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
DUNDIBAI JADHAV	44/F	51075	POSITIVE	548	07-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	YES PREVASCULAR	Complete resolution
H L PATIL	52/M	50859	POSITIVE	543	07-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	YES PARATRACHEAL	Complete resolution
R M PATIL	29/M	50862	POSITIVE	542	07-May-21		MODERATE							NO	YES	YES WITH AIR BRONCHOGRAMS	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
MAHADEVI S SAKRI	60/F	50889	POSITIVE	539	07-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NO	NO	NO	NO	NO	NO	NO	NO	Complete resolution
RAJASHREE MAHANTHMATH	50/F	50526	POSITIVE	527	07-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
PRABHU HIREMATH	49/M	50435	POSITIVE	722	07-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	YES SUBAORTIC	Fibrotic like changes
BHIMASHANKAR SAHUKAR	56/M	50047	POSITIVE	701	07-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NO	NO	NO	NO	NO	SMALL LUNG CYST IN RIGHT UPPER L	NO	NO	Complete resolution
SHARISHAIL KAMAGOND	40/M	49998	POSITIVE	700	07-May-21	2	SEVERE							NO	YES	YES	NO	NO BUT LARGE LIVER LESION ?FNH	NO	BILATERAL	NO	Fibrotic like changes
KAMLESH AMBIGER	35/M	50064	POSITIVE	699	07-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
RAVI BAGALKOT	40/M	50062	POSITIVE	698	07-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	YES PARAAORTIC	Complete resolution
ANIL SHIRGANVI	37/M	50055	POSITIVE	697	07-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NO	NO	NO	NO	NO	NO	NO	NO	Complete resolution
BHIMARAY BOOSTI	35/M	49964	POSITIVE	460	06-May-21	1	SEVERE							NO	YES	YES WITH FEW AREAS OF AIR BRONCHOGRAMS	NO	TRACHEAL INJURY	NO	BILATERAL	NO	Fibrotic like changes
MAHABUBI BAIGANPALLI	58/F	49959	POSITIVE	459	06-May-21		MILD							NO	YES	YES	NO	YES IN LINGULAR SEGMENT - OLD	NO	BILATERAL	YES PARAAORTIC	Complete resolution
SIDDALINGAVVA MALI	50/F	49970	POSITIVE	664	06-May-21	2	SEVERE							MILD	YES	YES WITH FEW AREAS OF AIR BRONCHOGRAMS	NO	NO	NO	BILATERAL	YES PARAAORTIC	Fibrotic like changes
SUBHASH ACHIGAR	48/M	49950	POSITIVE	455	06-May-21	2	SEVERE							NO	YES	YES	NO	NO	NO	BILATERAL	YES PARAAORTIC	Fibrotic like changes
ARCHANA SEVARGI	24/F	49934	POSITIVE	443	06-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NO	NO	NO	NO	NO	NO	NO	NO	Complete resolution
RAVIKUMAR KANNOLLI	33/M	49948	POSITIVE	454	06-May-21	1	MODERATE							NO	YES	YES	NO	NO	NO	NO	NO	Fibrotic like changes
DUNDAPPA JIRAGALE	44/M	49982	POSITIVE	468	06-May-21	1	MODERATE							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
BASHIRAHAMAD ATTAR	50/M	49922	POSITIVE		06-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	MILD	NO	NO	NO	NO	NO	NO	NO	Complete resolution
SUNIL AWADI	23/M	49937	POSITIVE	448	06-May-21	1	MODERATE							NO	YES	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
YAMUNA JANAKAR	46/F	49983	POSITIVE	461	06-May-21		MILD							NO	NO	YES	NO	NO	YES PARASEPTAL	BILATERAL	NO	Complete resolution
NANDAPPA BIRADAR	39/M	49975	POSITIVE	656	06-May-21	1	MODERATE							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
R M POTEKAR	55/M	127720	POSITIVE	663	06-May-21	1	MODERATE							NO	YES	YES	NO	NO	NO	BILATERAL	YES PARAAORTIC	Complete resolution
LALITABAI NADAVINMANI	50/F	49958	POSITIVE	458	06-May-21	2	SEVERE							NO	NO	YES	NO	NO	NO	BILATERAL	YES PARAAORTIC	Fibrotic like changes
MANJULA BAILPATTAR	36/M	279511	POSITIVE	0	12-Aug-22	1	SEVERE							NO	NO	YES WITH FEW AREAS OF AIR BRONCHOGRAMS	NO	NO	NO	BILATERAL	YES	Residual GGO
GOURAWWA MARIYANI	75/F	57054	POSITIVE	133	13-May-21		MILD							NO	YES	YES	NO	YES CYSTIC IN POST BASAL SEG OF LL	NO	BILATERAL	NO	Complete resolution
SUNANDA BIRADAR	42/F	57052	POSITIVE	134	13-May-21	1	MODERATE							NO	YES	YES	NO	NO	NO	BILATERAL	NO	Residual GGO
SHRIGIRI G SADHU	70/M	57024	POSITIVE	123	13-May-21	2	SEVERE							NO	YES	YES	NO	NO	NO	BILATERAL	YES PARAAORTIC	Residual GGO
ZUBEDA HADAGINAL	55/F	57023	POSITIVE	118	13-May-21	1	MODERATE							NO	YES	YES	NO	NO	NO	NO	NO	Residual GGO
SHILPA S MELIGERI	33/F	56917	POSITIVE	127	13-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	Complete resolution
RAJAGOUDA PATIL	52/M	56575	POSITIVE	128	13-May-21	2	SEVERE							MILD	NO	YES BUT NOT PREDOMINANT	YES PREDOMINANT WITH AIR BRONCHOGRAM	NO	NO	BILATERAL	YES SUBCARINAL	Residual GGO
REVANASIDDA NANDUR	42/M	46786	POSITIVE	130	13-May-21	2	SEVERE							NO	YES	YES	NO	NO	NO	BILATERAL	YES PARAAORTIC	Fibrotic like changes
MALASIDDAPA KOSTI	45/M	33740	POSITIVE	117	13-May-21	1	SEVERE							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
SHRIKANT MAHAMUNI	63/M	25607	POSITIVE	131	13-May-21	2	SEVERE							NO	NO	YES	NO	NO	NO	BILATERAL	YES SUBCARINAL	Residual GGO
NINGAPPA M MUDHUR	50/M	5036	POSITIVE	126	13-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
PRAVEENKUMAR HONWAD	35/M	39128	POSITIVE	420	06-May-21		MILD							NO	YES	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
SHAKUNTALA MATHAPATI	87/F	BLDE-2021	POSITIVE	111	04-May-21		MILD							NO	NO	YES	NO	NO	NO	UNILATERAL	NO	Complete resolution
VISHALAKSHMI HIREMATH	33/F	BLDE-2021-000	POSITIVE	541	27-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	Complete resolution
MANJUNATH Y HOSAMANI	26/M	23827	POSITIVE	1	04-May-21		MILD							NIL	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
BHARATI RAJPUT	47/F	BLLDE-2021-000	POSITIVE	847	10-May-21		MODERATE							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
PUNDALIK RATHOD	58/M	40852	POSITIVE	851	10-May-21	1	SEVERE							MINIMAL	NO	YES	NO	NO	NO	BILATERAL	YES PARATRACHEAL	Residual GGO
NINGAPPA KURI	36/F	BLDE-2021-000`	POSITIVE	882	10-May-21		MILD							NO	NO	YES	NO	NO	NO	UNILATERAL	NO	Complete resolution
CHANDRAKANT JINAJAGI	56/M	BLDE-2021	POSITIVE	919	26-May-21	2	SEVERE							NO	YES	YES	NO	NO	NO	BILATERAL	NO	Residual GGO
MAHESH CHOUDHARI	27/M	BLDE-2021	POSITIVE	933	11-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
MUSKAN SOUDAGAR	22/M	54952	POSITIVE	951	11-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
KALLAPPA GERGAL	60/M	1966612	POSITIVE	981	11-May-21	1	MODERATE							NO	NO	YES	NO	NO	NO	BILATERAL	PARATRACHEAL AND SUBAORT	Fibrotic like changes
SHREESHAIL KADAGOL	23/M	196620	POSITIVE	983	11-May-21		MILD							NO	NO	YES	NO	NO	NO	UNILATERAL	NO	Complete resolution
KRISHNAGOUDA PATIL	82/M	126151	POSITIVE	18	12-May-21	2	SEVERE							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Residual GGO
VIDYA PATIL	41/F	32909	POSITIVE	29	12-May-21		MILD							NO	YES	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
SIDDALING KOKATANUR	25/M	BLDE-2021-000	POSITIVE	50	12-May-21	1	MODERATE							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Residual GGO
SATYAVVA KARALI	60/F	BLDE-2021-000	POSITIVE	507	19-May-21	2	SEVERE							NO	YES	YES	NO	NO	NO	BILATERAL	YES PARATRACHEAL	Residual GGO with fibrotic like changes
SANTOSH BILAGI	45/M	30393	POSITIVE	589	21-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
NAMDEVA AKASHI	95/M	63142	POSITIVE	603	21-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
JAYASHREE NAD	28/F	205535	POSITIVE	641	22-May-21		MILD							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
VITTAL MALAGAVI	38/M	21002	POSITIVE	764	26-May-21	2	SEVERE							NO	YES	YES	NO	NO	NO	BILATERAL	NO	Residual GGO
PAVITRA BILUR	21/F	BLDE-2021-00	POSITIVE	843	28-May-21		MILD							NO	NO	YES	NO	NO	NO	UNILATERAL	NO	Complete resolution
DEEEPA V YALAVAR	50/M	68211	POSITIVE	856	29-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	Complete resolution
ABDULGANNI	65/M	61500	POSITIVE	528	20-May-21	2	SEVERE							NO	YES	YES	NO	NO	NO	NO	YES PARAAORTIC	Residual GGO
JYOTI S HATTI	40/F	46147	POSITIVE	86	04-May-21	1	MODERATE							NO	NO	YES	NO	NO	NO	NO	NO	Residual GGO
GEETANJALI ALUR	47/F	47419	POSITIVE	690	04-May-21	1	MODERATE							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
NINGAPPA SOUDI	45/M	50028	POSITIVE	285	15-May-21	1	MODERATE							YES BILATERAL	NO	YES	NO	NO	NO	BILATERAL	YES PARAAORTIC	Residual GGO
PRASHANT PATIL	455/M	57503	POSITIVE	280	15-May-21	2	SEVERE								YES	YES	NO	NO	YES PARASEPTAL	BILATERAL	NO	Fibrotic like changes
RAVICHANDRA JADHAV	31/M	58474	POSITIVE	284	15-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	Complete resolution
MALLAPPA METRI	80/M	57667	POSITIVE	281	15-May-21	1	SEVERE							NO	YES	YES	NO	NO	NO	BILATERAL	YES SUBAORTIC	Fibrotic like changes
REVANADIDDA PUJARI	30/M	58454	POSITIVE	277	15-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	N	N	N	N	N	N	N	N	Complete resolution
SAGAR RATHOD	23/M	58460	POSITIVE	282	15-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	N	N	N	N	N	N	N	N	Complete resolution
PREMA NATIKAR	35/F	50442	POSITIVE	560	21-May-21	1	SEVERE							NO	NO	YES	NO	NO	NO	BILATERAL	NO	Complete resolution
SANTOSH HIPPARAGI	27/M	46143	POSITIVE	81	03-May-21	NIL	NIL		NIL	NIL	NIL	NIL	NIL	N	N	N	N	N	N	N	N	Complete resolution
MD RAFIQ GUGI	48/M	55256	POSITIVE	948	11-May-21	2	SEVERE							NO	YES	YES	NO	NO	CYSTIN APICAL SEGMENT	BILATERAL	NO	Residual GGO
RESHMA P RATHOD	26/F	58596	POSITIVE	309	16-May-21		MILD							NO	NO	YES	NO	NO	NO	NO	NO	Complete resolution
MAHADEVI PATIL	56/F	57572	POSITIVE	177	14-May-21	1	MODERATE							NO	YES	NO	NO	NO	NO	BILATERAL	NO	Fibrotic like changes
SUMA PATIL	32/F	58597	POSITIVE	310	16-May-21		MILD			NIL	NIL	NIL	NIL	NO	NO	YES	NO	NO	NO	UNILATERAL	NO	Complete resolution
MAHADEVI	39/f	58591	POSITIVE	112	13-May-21	11-Jan-0	MODERATE							NO	YES	YES	NO	NO	NO	BILATERAL	NO	Complete resolution

Masterchart