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A Review On Covid-19, Epidemiological Trends, Public Health Response & Policy Challenges

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Abstract
Significant morbidity, death, and economic disruption have resulted from the COVID-19 pandemic, posing hitherto unheard-of challenges to global health systems. This study aims to investigate the impact of COVID-19 on health systems globally and identify critical factors influencing the effectiveness of pandemic responses. The COVID-19 pandemic was brought on by the SARS-CoV-2 virus, which has had a major impact on people's everyday life, the global economy, and health. The economic effects of prolonged lockdowns and disruptions to healthcare systems are also examined in the research. Even though the rapid development of vaccinations and their extensive distribution have significantly reduced the virus's effect, problems like vaccine hesitancy and uneven access persist.The study also evaluates the impact of misinformation on public perceptions and adherence to health advice.
This also covers the effectiveness of the COVID-19 vaccinations in preventing hospitalization and severe illness. A meta-analysis of randomized controlled studies demonstrates that COVID-19 vaccines are very successful in lowering hospitalization and severe illness, with an estimated risk reduction of 80–90%. The findings show that COVID-19 vaccinations are very successful at averting major outcomes and justify their ongoing use in immunization efforts.
The COVID-19 epidemic has significantly impacted mental health on a global scale. This study investigated the relationship between COVID-19 and the stress and anxiety symptoms in a population of healthcare professionals. The results show a strong correlation between increased anxiety and depression symptoms and stress associated with COVID-19. The findings highlight the need for targeted mental health treatments to support healthcare providers during the pandemic. A timely and precise diagnosis of COVID-19 is necessary to stop the virus's spread. This study evaluates the efficacy of rapid antigen testing for COVID-19 diagnosis.
Keywords: *Covid-19, Pandemic, Vaccination, Diagnosis, Symptoms, Consequences*

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I. Introduction

The World Health Organization (WHO) has identified "2019-nCoV," "2019 novel coronavirus," or "COVID-19" as the source of the current pneumonia outbreak in Wuhan City, Hubei Province, China, which began in early December 2019. The COVID-19 virus is dangerous. Bats are the COVID-19 viral reservoir, according to phylogenetic analysis of available whole genome sequences; however, the intermediate host or hosts have yet to be discovered. Although there are now three major areas of research being conducted in China to advance our understanding of the outbreak's pathogenic etiology. These include early investigations of cases exhibiting symptoms in the vicinity of Wuhan in December 2019, ecological sampling from the Huanan Wholesale Seafood Market and other local markets, and the gathering of comprehensive reports on the origin and species of wildlife sold on the Huanan market, as well as the destination of those animals following the market's closure. [1]

As of current now, the exact mechanism of SARS-CoV-2 transmission remains unknown. Human-to-human droplet transfer is the main method of transmission within a susceptible population. Chinese Health officials reported a R0 of 1.4 to 2.5 to the WHO International Health Regulations (2005) Emergency Committee on January 23, 2020. Transmission by asymptomatic carriers cannot be ruled out. An asymptomatic family member who went from Wuhan, the outbreak's epicentre, was accused of causing a family cluster of COVID-19 pneumonia. Her reverse transcription polymerase chain reaction (RT-PCR) result was positive for SARS-CoV-2, but her chest CT scan showed no obvious abnormalities. Another possible method for viral transmission is the

oral-faecalroute. Scientific studies have shown that MERS-CoV and SARS-CoV may last in conditions that encourage oral-faecal transmission. While SARS-CoV was detected in the sewage water of two Chinese hospitals that treated SARS patients, MERS-CoV was shown to be viable on a variety of surfaces at low temperatures and low humidity. SARS-CoV-2 was detected in the stool and respiratory samples of COVID-19 pneumonia patients. Thus, it is possible that SARS-CoV-2 can also spread through the oral-faecal route and fomites. [2]

Across the nation, state governments began closing schools and colleges to stop the spread of the new coronavirus. In the second week of March, it was advertised somewhere as a short-term solution to get away from the mob. First, a one-month school closure was declared by the government, but over time, the closure period was prolonged, and it's unclear when they'll reopen. Numerous important events occur during this time, including competitive exams and entrance exams for different universities, board exams and semester exams in universities, admissions to nursery schools, and university admissions procedures. [3]

Fear is a frequent reaction to infectious outbreaks, and humans, having existed for ages and in response to past infectious epidemics like the plague, respond to the perceived threat in a variety of unique ways. For instance, fear and worry can lead to hypervigilance, which in extreme situations can develop depression and/or post-traumatic stress disorder (PTSD).Both healthy people and those with pre-existing mental health difficulties suffer anxiety when faced with unknowns, such as the spread of the illness and its implications on people, health, hospitals, and economies (Rubin & Wesley, 2020). Because of pandemics, people, families, and communities feel depressed, despondent, grieving, bereaved, and profoundly purposeless. Fear and anxiety are fueled by feelings of powerlessness because pandemic trends and recommendations on how to prevent their spread are always changing. perceived conflicting messages from the health or government. Additionally, leaders have the power to instill fear, doubt, and confusion among the population. [4]

The coronavirus disease 2019 (COVID-19) crisis and the national government's reaction to contain the virus's spread have had a profound influence on society. Adolescents, on the other hand, have received little attention in pandemic research thus far (Francisco et al., 2020). They might be particularly affected by the major changes in daily life that have happened since the COVID-19 epidemic. The social environment, particularly interactions with peers, becomes more important during adolescence, a period of social growth. Adolescents desire independence from their parents throughout this developmental period, and peer interaction and influence increase considerably. Due to the closure of schools and the strong recommendation that individuals work from home, teenagers and their families—including parents and siblings—were compelled to spend most of their time together at home. Additionally, adolescents had to transition to online learning in place of traditional classroom instruction. Other measures were tightened or implemented (e.g., limiting group sizes and wearing face masks), even though schools gradually reopened (with, in secondary schools, a combination of physical and online education) and other measures were partially lifted (e.g., restaurants and cinemas were allowed to open, as well as sport clubs, but with a maximized number of visitors to ensure social distancing). Additionally, starting on December 15, 2020, all non-essential stores and public areas were shuttered due to a strict lockdown. [5]

II. Impact& Variants Of Covid-19 In India

Impacts of Covid-19

Impact on Healthcare System
Impact on Education System
EnvironmentalImpact

Impact on Healthcare System

To date, India has seen three waves of the COVID-19 epidemic:

i. The First Wave
ii. The Second Wave
iii. The Third Wave

i. The First Wave

The first COVID-19 infection case in India was documented on January 27, 2020, when a 20-year-old woman with a history of travel to China arrived at the emergency room of General Hospital in Thrissur, Kerala, complaining of a dry cough and sore throat.Since then, COVID-19 has caused significant damage in India and throughout the world. On March 24, 2020, the Indian government imposed a 21-day countrywide lockdown, which was subsequently extended to combat the spread of the COVID-19 virus. The government did not lift the limits through a staged "unlock" until May 30. During this period, national advisories were formed, and the habits of "social distancing" and "working from home" were developed. [6]

ii. The Second Wave

The second wave is rapidly expanding and has already had a huge impact on the country. It is estimated to be the second-worst epidemic to strike the nation over a century later. The last threat was seen during the influenza outbreak that killed 12 million people in 1918. The daily positivity rate in the present COVID-19 scenario has sharply increased, rising from 1.62% on March 1, 2021, to about 20% on May 13, 2021. The resources are rapidly running out. There are no more intensive care units or isolation rooms in hospitals, life-saving medications are running out fast, oxygen supplies are being cut off, and corpses are scattered all over the place.The severe acute respiratory syndrome coronavirus 2 began to spread more rapidly than before in the third week of April, with a massive increase when the number of cases per day topped 200,000. The second wave of the virus was caused by the public's irresponsible, foolish, and badly managed government, which allowed the infection to spread. Since things are out of control right now, a quick and decisive decision is desperately needed. [7]

The Third Wave

Early control methods during the initial wave of COVID-19 contributed to the effective reduction of virus transmission. But since the second wave began with social activities being unlocked, India's positive cases from that wave are growing quickly.According to WHO data, in the first week of May 2021, India reported an average of 3.9 lakh new cases, accounting for 47% of all new cases recorded globally and 276 cases per million people. According to the conclusions of this study, the pandemic would peak in India during the second week of May 2021 and then gradually decline beginning in the first week of July 2021. However, according to the talk in the segment preceding this one, a third wave in India may occur. The projected data of the second wave from the suggested model are regarded as original data for predicting the third wave of COVID-19. [8]

Impact on Education System

Positive Impact

- COVID-19 has led to an increase in the use of digital technology in education. Educational institutions switched to a blended learning strategy.
- Learning management systems are becoming increasingly popular among educational institutions. It presented an excellent opportunity for firms to develop and improve learning management systems for use in educational institutions.
- Students relied on soft copies of study materials due to limited access to hard copies during lockdown.
- Collaborative learning and instruction can evolve in new ways. Teachers and scholars from all around the world may collaborate to mutually benefit.
- Teleconferencing, virtual meetings, webinars, and e-conferencing prospects have significantly increased because of the pandemic.
- The pandemic scenario promoted digital literacy by motivating individuals to study and use technology.
- Students may easily exchange study resources and ask questions via phone, SMS, email, and social media platforms such as Facebook and WhatsApp.
- Teachers and students may connect with peers from across the world. Students adapted to a globalized culture.
- Online learning allows students to better manage their time during pandemics.
- Most students choose the ODL mode during the epidemic because it promotes self-learning, gives them access to a variety of resources, and allows them to tailor their education to meet their individual requirements. [9]

Negative Impact

- Exams at various levels have been postponed, and classes have been suspended.
- Several boards have already delayed the yearly entrance exams and examinations.
- Most of the hiring was delayed because of COVID-19, and student placements may also be impacted by businesses holding up student onboarding.
- Not all instructors and students are proficient in it, or at the very least, not all of them were ready for the sudden transition from face-to-face to online learning.
- Some individuals will lose their jobs abroad, and COVID-19-related restrictions would make it impossible for graduates to obtain work outside of India.
- Although some parents are educated enough to teach their children at home, others might not be able to.
- The goal of the Government of India's school meal program, Midday Meals, is to provide healthier, more nutritious food to school-age children nationwide.

- Many students would have little to no internet access, and many might not be able to purchase a PC, laptop, or appropriate mobile phone.
- Online instruction and learning in the comfort of their own homes may produce a digital gap for students.
- A large number of Indian students attend several international colleges, especially those in the most affected countries. The demand for overseas higher education will eventually decline dramatically if the current trend of people leaving those countries continues. [10]

Environmental Impact

- China claims to have reduced its carbon emissions by 25%, yet industry closures and limits on vehicle mobility have resulted in a considerable increase in carbon emissions. Data from April 30, 2020, shows that after lockdown, CO_2 emissions significantly decreased in Kolkata, a metropolitan city in Eastern India with a population of 14.9 million and CO_2 emissions that are close to the global average of 417.31 ppm. On average, emissions decreased by more than 40% as sampled from three different locations (Dhar et al., 2020). CO emissions in 2 Kolkata have dropped by a variety of percentages, from 24.56% to 45.37% at Sealdah Station; following another independent analysis.This variance is due to the vegetation density in the different sample regions (Mitra et al., 2020a).
- In April 2020, India, the world's second-largest coal consumer, saw a sharp annual drop in power generation. The demand for industrial coal decreased in tandem with a roughly 19% decrease in average daily power generation, as seen by the purchasing index falling from 51.8 in March to 27.4 in April.
- The Central Pollution Control Board (CPCB) and state-level pollution monitoring centers oversee the National Air Quality Monitoring Program (NAMP). Monitoring Program that uses eight indicators (PM10, PM2.5, NO, SO, CO, O, NH, and Pb) to record the AQI of 24 cities around India. Such contaminants pose major environmental risks at high quantities. Nox can result in smog, acid rain, and nutrient pollution in coastal areas. For all Nox gasses, NO serves as indicator number two. The primary sources of NO emissions are power plant fuel use and vehicle exhaust (Wang and Su, 2020).
- With 97 communities along its path, the Ganga River, India's lifeline, handles 3500 MLD (million liters per day) of sewage, of which about industrial effluents make up 9%. During the countrywide lockout, dissolved oxygen (DO) and nitrate concentrations have increased, indicating an overall improvement in water quality. This is mostly due to increased freshwater inflow and decreased industrial and agricultural runoff. Both the Chemical Oxygen Demand (COD) and the Biological Oxygen Demand (BOD) decreased because of relatively less household wastewater entering the system. Because there was less buildup of household and industrial pollutants, the water in the cities' Rapti, Saryu, Ganga, and Yamuna rivers also became clear and translucent.
- Although dissolved oxygen concentrations were continuously higher than the bathwater standards (5 mg/l or higher) during the lockdown, only a small number of monitoring stations (like those in West Bengal) demonstrated a discernible improvement following the second week of lockdown, while most stations in Uttar Pradesh only displayed a modest improvement. Only the fourth week showed a marginal decrease in BOD. Except for West Bengal, a declining trend in nitrate content was noted.
- An analysis of the ichthyoplankton community surrounding the Haldia port-cum-industrial complex revealed that the community had recovered ecologically as a result of reduced lockdown-related oil-grease pollution in the estuary region (Pal et al., 2020). In April 2020, a related investigation conducted in Diamond Harbor along the Hooghly estuary found a greater standing stock of phytoplankton.
- Reports of seeing uncommon Gangetic Dolphin sightings have surfaced from Babughat (Kolkata) to Meerut, including severely endangered species of after being seen in the streets of Kozhikode, Kerala, and the Malabar Large Spotted Civet attracted headlines. [11]

Variants Of Covid-19

The WHO classified four strains—Alpha, Beta, Gamma, and Delta—as VOCs.

Alpha

By February of the following year, the UK-originating Alpha strain (B.1.1.7) was responsible for 96% of cases, up from 3% in October 2020, causing a third wave to sweep the nation.B.1.1.7 eventually dominated the US market because of its high transmission rate and lethality, which are 30–70% higher than those of the original strain found in Wuhan, China.

Beta

The Beta strain (B.1.351), which was initially identified in South Africa in May 2020 and made public in December, was believed to have a greater effect on younger age groups than previous iterations. Since then,

the strain's existence has been recorded in 80 countries. The third wave of coronavirus in South Africa is mostly caused by the E484K mutation, which makes this strain deadly since it avoids the immune system.

Gamma

The Gamma strain (P.1), which caused two waves of Coronavirus, first appeared in Manaus, Brazil, in November 2020. Patient data showed twice this Gamma strain's transmissibility in relation to earlier strains. Since only 54 to 79 percent protection was noted, this variation caused a lethal second wave. According to WHO, as of June 21, 2021, the fastest and most fit coronavirus strain to date is the highly contagious Delta variation (B.1.617.2), which primarily affects those with poor COVID-19 vaccination rates. Since the delta form, which was initially discovered in India, is 60% more contagious and has a higher chance of subsequent attacks, it may be more deadly.

Delta

The most susceptible people are eventually impacted by the delta variant, which could cause them to pass away. An existing version is that the Delta variant has caused India's catastrophic second wave of illnesses this summer, which is cause for concern.According to the WHO, the Delta variation is currently prevalent in 92 countries and is the cause of disease transmission. The most susceptible people are eventually impacted by the delta variant, which could cause them to pass away. This summer's catastrophic second wave of infections in India has been caused by the Delta variation, an existing variant of concern. [12]

Effect of Covid-19 on Respiratory System

Because of its pathogenicity, which in severe cases is quite similar to that of SARS, coronavirus has a major negative effect on the respiratory system. COVID-19 has extremely little or no negative effects, with an average of 14% of severe conditions requiring hospitalization and oxygen support and 5% requiring hospitalization. In severe cases, COVID-19 is associated with heart failure, sepsis, septic shock, acute respiratory distress syndrome (ARDS), and acute renal failure. Age and chronic conditions have been found to be risk factors for mortality. Recent multivariate analyses of old age have found a correlation between increased mortality and a high score on the sequential organic failure assessment (SOFA). The mortality rate from severe pneumonia in people over 80 has been reported to be more than 21, and the number of older patients needing hospitalization and respiratory support has increased dramatically. Although the sickness usually presents as a fever or without any respiratory symptoms, some people eventually experience varied degrees of pulmonary difficulties due to damage to their lung tissue. Lung scans revealed these events. [13]

Typically, COVID-19 enters the body through the respiratory system and progressively spreads throughout the body. The virus causes failure and malfunction in several organs. In 81% of cases, the illness is minor; in the other cases, it is severe. Five percent of the positive cases had respiratory failure, septic shock, and multiorgan dysfunction; in half of these cases, the patient dies. The cardiovascular system is closely followed by the lungs, which are the organ most impacted. The kidneys and intestines are two more organs that are experiencing serious malfunction. This patient subgroup is more in need of life-saving interventions like ventilation assistance. Stage 1 of a classic COVID-19 infection is an asymptomatic incubation phase; Stage 2 is a symptomatic time during which the virus is present; and Stage 3 is a severe respiratory symptomatic stage. Despite not being contagious in the first stage, the patient is very contagious in the next two, particularly in the third stage due to a high viral load. Because they unintentionally disseminate the illness across the population, asymptomatic carriers are to blame for its unpredictable spread. Figure 1 is a flowchart that illustrates how the respiratory characteristics change during the course of the various COVID-19 infection phases. [14]

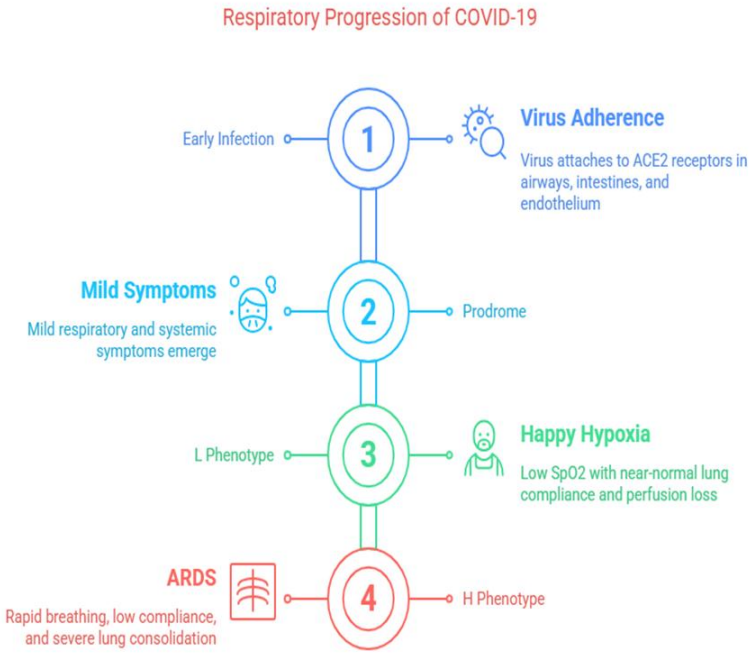

Fig. 1: Respiratory features of different stages of COVID-19 infection [14]

III. Effect Of COVID-19 On Cardiovascular System

It is well known that people who have more comorbidity are more likely to have severe COVID-19. Early-stage UK cohort research11,12 showed that visitors with pre-existing cardiovascular illness on April 28, 2025, COVID-19, had worse results, including a higher chance of mortality and a greater requirement for mechanical ventilation. However, after multivariable regression analysis, only heart failure (HF), and more especially severe HF (NYHA class III/IV), was associated with higher in-hospital mortality, according to large multinational cohort research that used data from the CAPCITY-COVID registry and the LEOSS study.It's interesting to note that, whereas risk factors for CVD are not associated with inpatient mortality, data from our institution shows that pre-existing CVD is. This implies that new CV issues may act as a partly mediating factor in the association between CVD and negative outcomes. [15]

A tiny proportion of individuals experience more serious COVID-19 symptoms in addition to its side effects, which include death, multiple organ failure (MOF), coagulopathy, and acute respiratory distress syndrome (ARDS), even though the majority of COVID-19 cases are moderate or asymptomatic. In patients with COVID-19, comorbid diseases such diabetes, hypertension, cerebrovascular disease, chronic renal disease, and chronic obstructive pulmonary disease have all been associated with an increased risk of severity and mortality. People with underlying cardiovascular problems have been shown to have worse outcomes when infected with COVID-19. The Chinese Center of Illness Control showed that patients with underlying cardiovascular disease had a case fatality rate of 10.5% in a survey of 72,314 cases, despite the lack of exact data on heart failure mortality. Due to the possibility of poor medication compliance and other problems related to treatment interruptions, the number of people with new or decompensated heart failure may increase. [16]

Of over 40,000 patients, most admitted to the intensive care unit, the WMI of shock or vasopressor therapy was 18.0% (range 0.2% to 71.0%). Shock was more common among men (43). Furthermore, a larger comorbidity burden and a higher risk of developing more severe sickness and shock were associated with age (131). Of patients with a severe COVID-19 infection, up to 50% experienced acute renal damage. There was significant variation in reports about the prevalence of renal replacement therapy (RRT) (WMI 5.1%; range 0.0% to 50.0%). In a prospective study conducted in two New York hospitals (17), RRT was required for one-third of severely sick patients. The majority of patients (67%) were males over 60 with a significant frequency of comorbid conditions, such as diabetes (36%), hypertension (63%), and chronic renal illness (19%). A multicenter cohort analysis of 2215 COVID-19 patients admitted to critical care units at 65 U.S. hospitals found that acute renal damage was common (43%), with 20% needing RRT. A significant death rate was associated with this. Extracorporeal membrane oxygenation (ECMO) was used seldom (WMI of 1.1%; range 0.0% to 8.1% in 50 studies with 38,471 individuals), possibly due to its restricted availability. [17]

Even if there was no previous history of heart failure, up to 25% of hospitalized COVID-19 patients and up to 33% of patients admitted to the intensive care unit (ICU) developed heart failure for the first time. This might be caused by systemic inflammation or the direct effect of the virus on the heart. The infection can manifest as severe acute myocarditis, which can result in multi-organ dysfunction syndrome (MODS), cardiogenic shock, and eventually death. Additionally, a pulmonary embolism and therefore sudden right ventricular failure might result from the aforementioned prothrombotic state. The impeller or other temporary cardiac pumps could be useful in these circumstances. A more conventional acute heart failure decompensation with elevated filling pressures and pulmonary edema might result from the sympathetic activation and widespread inflammatory response, which can also provide a picture resembling stress cardiomyopathy. [18]

A different study found that 23% of COVID-19 patients (44 out of 191) experienced acute heart failure. A number of precipitating etiologies were identified, including severe COVID-19 patients who may experience cardiogenic shock or abrupt heart failure due to coronary syndrome, cardiac arrhythmias, stress-induced cardiomyopathy, and fulminant myocarditis.The proteins lactate dehydrogenase (LDH), creatine kinase (CK), and their isoenzymes, as well as the protein troponin I (TnI), which showed enhanced cardiac selectivity, are linked to damage to the heart muscle. Chen et al. discovered that 13 (13%) and 75 (76%) of the 99 confirmed COVID-19 patients exhibited high CK and LDH, respectively. Wang et al. revealed the clinical characteristics of 138 hospitalized COVID-19 patients. Of these, 23 (16.7%) had arrhythmias, whereas 10 (7.2%) had elevated TnI. Guan et al. also demonstrated that 13.7% of COVID-19 patients had increased CK levels and 37.2% had elevated LDH levels. The exact source and causes for the increase in cardiac biomarkers in COVID-19 patients remain unclear, despite the fact that SARS-CoV-2 invades alveolar epithelial cells, perhaps triggering an early systemic inflammatory response. There are clues about the indirect relationship between coronaviruses and cardiovascular illness when angiotensin-converting enzymes are shown to be a functional receptor for these viruses, including SARS-CoV and SARS-CoV-2, enzyme 2 (ACE2). SARS-CoV-2 interacts to the ACE2 receptor, which is abundant in myocytes. Therefore, the primary cause may be myocyte damage caused by a direct viral infection. [19]

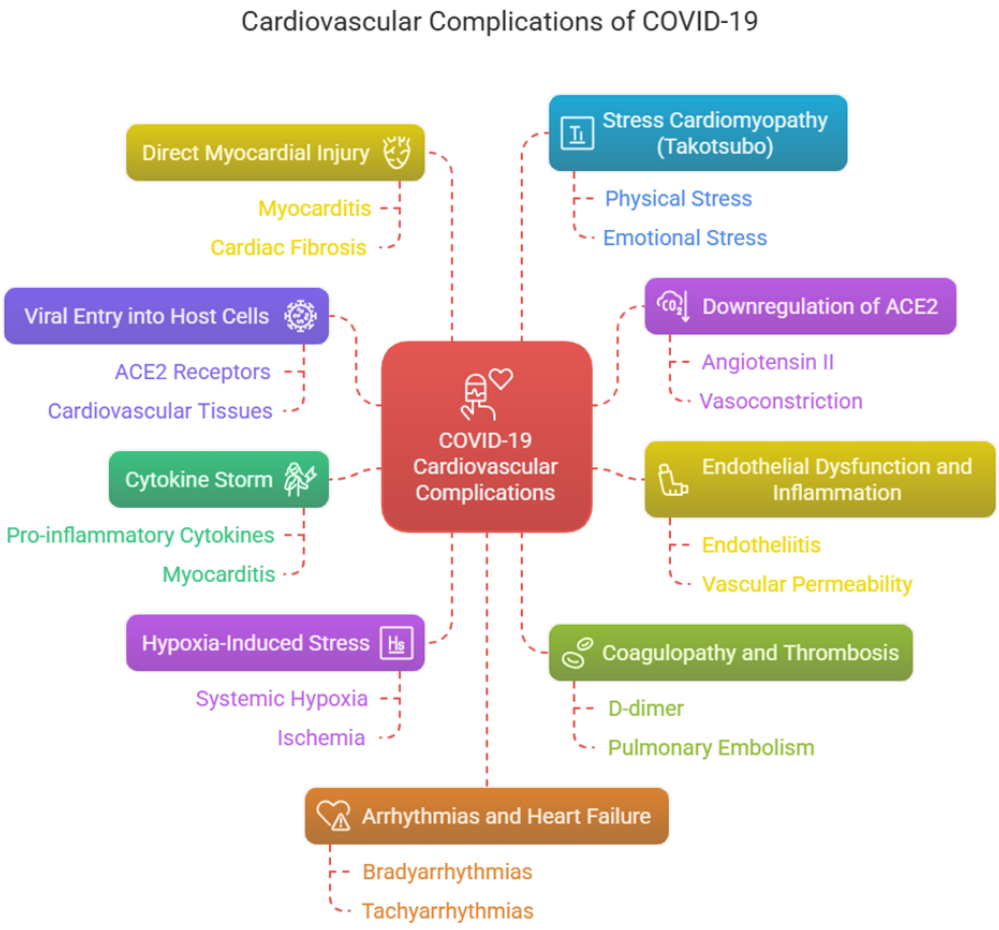

Fig. 2: Cardiovascular Complication due to COVID-19

IV. Effect Of COVID-19 On Nervous System

Severe neurological COVID-19 issues seem to be uncommon and diverse. SARS-CoV-2 appears to be able to damage nearly every part of the neurological system. Neurological disease brought on by an inflammatory response to the virus, an infection, or a direct viral invasion may be the consequence of metabolic issues and extensive cardiorespiratory failure. Only the latter two will be discussed. Headaches are a common symptom of COVID-19, affecting up to 40% of patients (Ding et al., 2020). Frequently, the headache has been mild regarded as a minor. The frequency of headaches caused by viral meningitis is yet unknown and further study is required to find out.Similarly, it is typical to observe altered states of consciousness in severely ill COVID-19 patients, which is a result of SARS-CoV-2's CNS viral invasion rather of the overall systemic illness. SARS-CoV-2 was detected in the CSF of a man who was displaying symptoms, according to at least one study (Michael and Easton 2020). [20]

SARS-CoV-2 shouldn't be shocking because other coronaviruses have been known to produce issues with the central nervous system. SARS-CoV-1 has been detected by polymerase chain reaction in the brain fluid of two women: a 32-year-old SARS patient who had generalized tonic-clinic seizures (Lau et al. 2004) and a 59-year-old woman with IgA nephropathy and SARS who had encephalopathy and uncontrollable seizures (Hung et al. 2003). About 12% of children hospitalized with respiratory illnesses and symptoms similar to acute encephalitis had an acute coronavirus infection (Li et al. 2016). MERS has been shown to be made worse by Bickerstaff's encephalitis (Kim et al. 2017) and other encephalitis (Arabi et al. 2015). The corpus callosum, the basal ganglia, and the white matter of the deep and subcortical hemispheres all showed hyperintense signal abnormalities on T2-weighted imaging in magnetic resonance imaging studies (Arabi et al. 2015). [20]

The severe acute respiratory syndrome coronavirus (SARS-CoV) and the Middle East respiratory syndrome coronavirus (MERS-CoV) were previous coronaviruses that produced rare neurological issues. For SARS-CoV and MERS-CoV, the cautious estimates of the prevalence of CNS issues were 0.04 and 0.20%, respectively. However, considering the size of the COVID-19 pandemic, even a low-rate neurological outcome might lead to numerous cases. According to research by Mao et al., 214 COVID-19 patients in Wuhan, China, had 36.4% of neurologic symptoms.As of their publication on May 19, 2020; Ellul et al. estimated that, of the approximately 4.8 million COVID-19 cases recorded globally, between 1805 and 9671 people had CNS issues. They did not, however, account for the rising frequency of COVID-19 issues associated with stroke. The overall number of COVID-19-related CNS issues is significantly higher than previous estimates, especially when the number of stroke patients is taken into account and the total number of COVID-19 patients has grown by more than seven times since Ellul et al.'s publication. [21]

The neural system is probably involved in the neurological symptoms of COVID-19, as seen in many other zoonotic viruses, such as SARS-CoV-2 infection. Strong evidence of CoV neuroinvasive potential has been supplied by the demonstration of these neurological symptoms in previous CoV infections, including SARS-CoV and MERS-CoV. The respiratory infection caused by SARS-CoV was found to be indicative of numerous neurological disorders, such as polyneuropathy, encephalitis, and aortic ischemic stroke. Additionally, they have demonstrated anomalies in demyelination, ischemic alterations in neurons, and monocyte and lymphocyte infiltrations in the brain. SARS-CoV has been consistently found in brain tissue samples by autopsy investigations of patients exhibiting meningeal vasodilation and neuronal edema. Patients infected with SARS-CoV have also been documented to experience cerebrovascular complications and neuropathological symptoms, such as ischemic stroke and GBS, respectively [22]

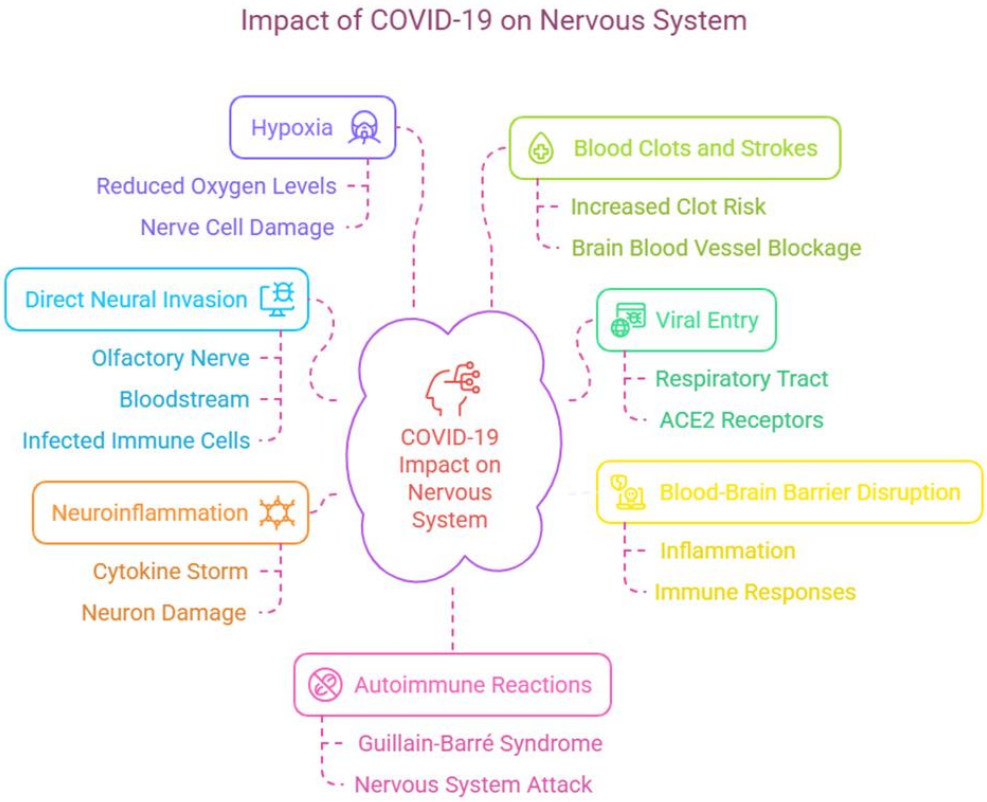

Fig. 3: Impact of COVID-19 on Nervous System [22]

V. Effect Of COVID-19 On Digestive System

Fever and respiratory problems are the most common COVID-19 symptoms. However, in other instances, unique illness presentation was also reported. Pooled data from 11 articles and 15 studies showed that 2645 COVID-19 patients from China, Hong Kong, and Singapore had a variety of gastrointestinal symptoms during their illness. These gastrointestinal symptoms include diarrhea, vomiting, nausea, anorexia, and soreness in the abdomen. The overall prevalence of GI symptoms was 17.6%, according to a recent meta-analysis of 60 studies with 4243 patients from the US, UK, Singapore, China, and South Korea. 14 Anorexia (26.8%), diarrhea (12.5%), nausea and vomiting (10.2%), and abdominal pain or discomfort (9.2%) was the most often reported symptoms among these. There was no discernible subgroup variations between studies based on country of origin. At least one gastrointestinal symptom was reported by 50% of hospitalized patients, and the severity of the illness increased with the intensity of the symptoms. Additionally, it was shown that patients with GI symptoms had a lengthier time between the beginning of symptoms and admission. They had a higher risk of liver damage and antibiotics. [23]

The most prevalent clinical signs of COVID-19 are respiratory symptoms, such as fever, coughing up phlegm, and dyspnoea, according to research that is now being published. As the COVID-19 pandemic continues to evolve, additional case data has been collected on digestive system symptoms in COVID-19 patients. The illness's most often reported gastrointestinal symptoms are diarrhoea, anorexia, nausea, vomiting, abdominal pain, and gastrointestinal bleeding. The three most prevalent digestive problems among COVID-19 patients were lack of appetite, vomiting, and diarrhoea. There have been reports of a small number of individuals arriving with only diarrhoea and vomiting, without a fever or cough. [24]

Nausea had a quick beginning, indicating that it may be the initial indication of a SARS-CoV-2 GI infection, since it is part of the body's epithelial defences and an early warning sign of a problem in the upper digestive tract. Given that nausea and vomiting may be the presenting symptoms, as the early COVID-19 cases in China and the US show, this might be a serious omission. Diarrhoea was another common gastrointestinal ailment among COVID-19 participants. Diarrhoea often occurred 1–8 days after initiation, with a median of 3.3 days; for COVID-19 patients, the average duration was 4.14.1 ± 2.5 days. There were 3.3 episodes of diarrhoea every month, and occasionally up to nine episodes per day. 34.3% were due to watery stool. [25]

We needed to pay attention to the fact that a considerable portion of COVID-19 patients had liver impairment in addition to gastrointestinal symptoms such nausea, vomiting, and diarrhoea. Aspartate

aminotransferase (AST), alanine aminotransferase (ALT), and lactate dehydrogenase levels were slightly elevated in the majority of the reported cases. Showed that 43% of the patients had varied degrees of liver failure with high AST and ALT, and 18% of the patients had elevated total bilirubin. Liver injury is associated with a higher chance of admission as well as a higher risk of death and/or admission to an intensive care unit, according to a number of studies that have looked at the relationship between abnormal liver function and the severity of the illness or its effects. [25]

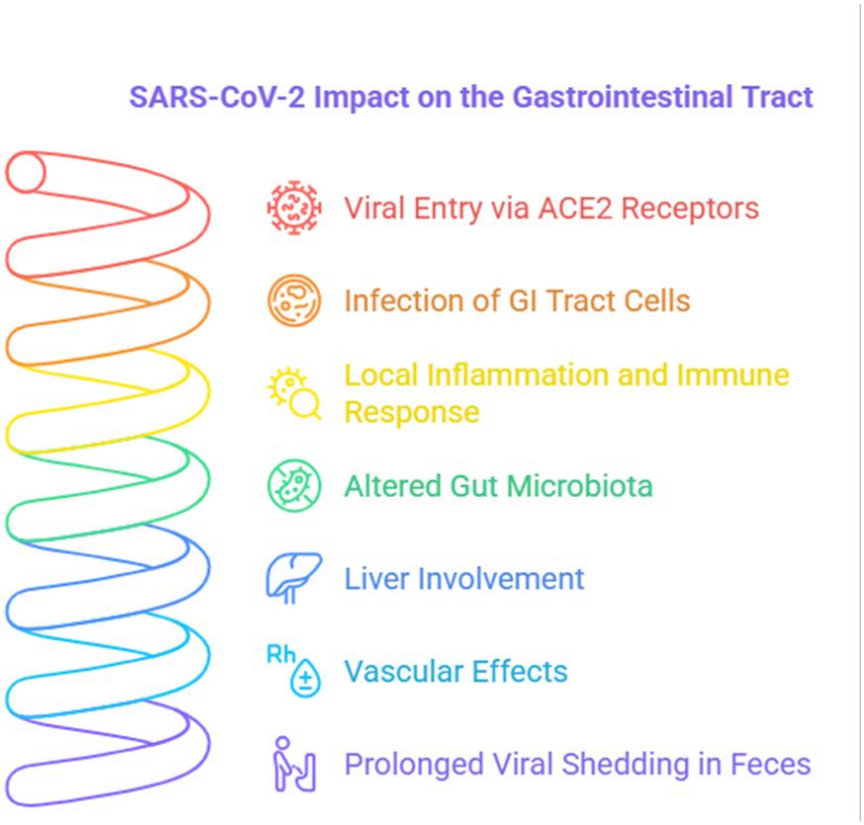

Fig. 4: COVID-19's effects on the gastrointestinal tract

VI. COVID-19's Impact On Mental Health

When an infectious disease epidemic occurs, the public's psychological reactions play a critical role in determining the spread of the disease, the prevalence of emotional distress, and the ensuing social unrest. Despite this, there are typically insufficient resources available to prevent or mitigate the negative effects of pandemics on mental health and wellness. Even while it may make sense in the acute phase of an epidemic when health services focus testing, minimizing transmission, and providing critical patient care, psychological and behavioural requirements should not be ignored during any stage of pandemic management.

There are several reasons for this. It is commonly known that psychological factors play a major role in how individuals manage the risk of illness and the ensuing losses, as well as how successfully they adhere to public health initiatives (such as immunizations). Managing any infectious illness, but especially COVID-19, requires careful consideration of these factors. Psychological responses to pandemics include protective responses, maladaptive behaviors, and emotional discomfort. People who are prone to psychological problems are especially vulnerable. [26]

As a result, patients and healthcare systems throughout the world will be under tremendous stress, and people with serious mental illnesses should be provided with proper information about techniques related to the COVID-19 medication. It will also be essential to address the social and psychological effects of this epidemic on sufferers. Worry may exacerbate pre-existing feelings of anxiety and depression.Important interventions can be linked to teaching people about the common negative psychological effects, encouraging healthy behaviors, helping to solve problems, and, finally, empowering patients, their families, and healthcare professionals. Psychiatrists can play a critical role in promoting the health of those affected and their families. The present focus on the global spread of the COVID-19 virus may distract the public from the psychological implications of the outbreak for both the affected individuals and the general community. [27]

Interestingly, the coronavirus pandemic has a new facet in the age of social media, when people are constantly exposed to unsubstantiated reports. Such rumours and unconfirmed information lead to worry, anxiety, and fear when there is a fast and nearly constant flow of news reports concerning an outbreak. Many Indians were exposed to either good individuals or folks who were in danger when traveling abroad. However, many are not coming forward for testing due to stigma and social isolation. They fear rejection, criticism, and being cut off from their family members.

These people must get treatment from psychologists and other mental health professionals who reassure them that they have done nothing wrong in order to lessen and limit the epidemic. People in such a traumatic position want kindness, therapy, social and psychological support, and answers to their questions. We must take note of the detrimental impacts that stigma and social exclusion have had in the past on HIV prevention. Because mental health problems are stigmatized, people can be reluctant to get care. Over 100,000 individuals have already died as a result of this epidemic, and we do not yet know how many more will. In a case like this, supporting bereaved family members and providing psychosocial support are essential. Children who experience stress may exhibit a range of symptoms, such as increased clinginess, anxiety, withdrawal, agitation or rage, bedwetting, etc. Children need the affection and support of adults at difficult times. They need more attention and time. It is important to keep children with their parents and other family members as much as possible and to avoid separating them from their caretakers. [28]

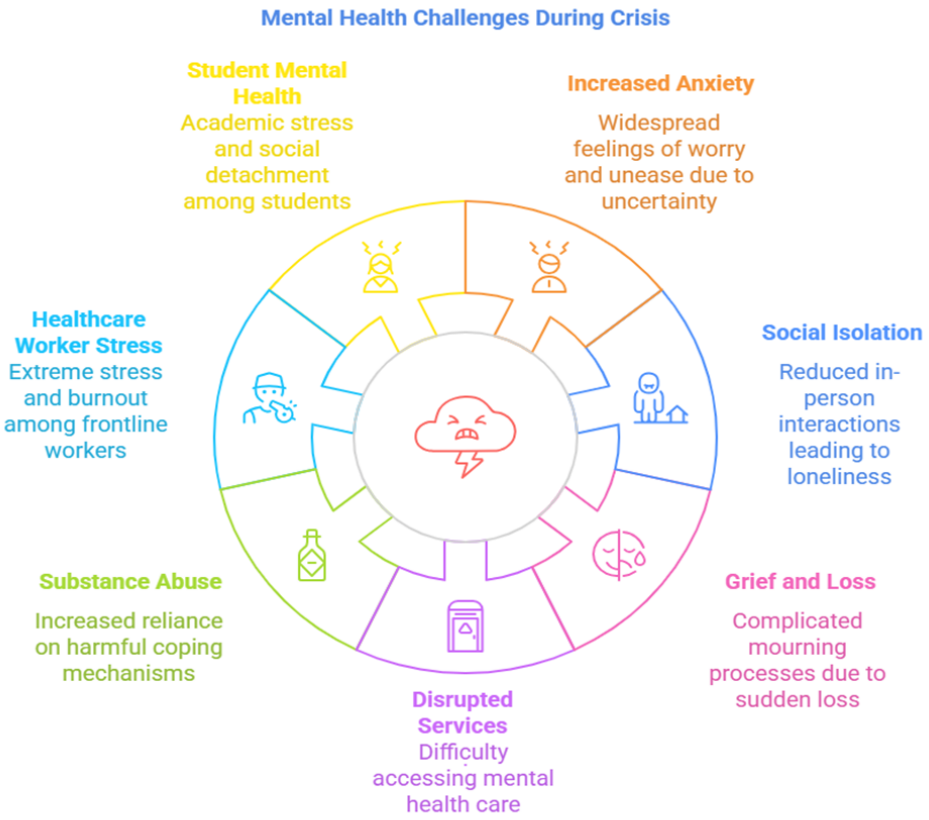

Fig. 5: Mental Health Challenges during Crisis

Signs & Symptoms of COVID-19

During the pandemic, people face a lot of trouble in terms of finance, mental health, educational loss, and a lot more. But the person who was suffering with COVID-19 had been through a very traumatizing situation. The signs & symptoms of COVID-19 are mentioned below:

i. Cough
ii. Sore throat
iii. High temperature
iv. Diarrhea
v. Headache

vi.Muscle & Joint pain
vii.Loss of sense of smell & taste

COUGH

Coughing is the most common reason people seek medical assistance worldwide. Coughs are categorized as acute (less than three weeks), subacute (three to eight weeks), or chronic (more than eight weeks) based on how long they last. A persistent cough frequently resists therapy, lowers health-related quality of life, and necessitates frequent medical visits. Coughing thus has a significant socioeconomic impact. Among working-age individuals in Finland, the point prevalences of daily acute, subacute, and chronic cough are 5.4%, 3.4%, and 7.2%, respectively. [29]

Sore throat

The unique COVID-19 variation B.1.1.7, also known as VUI 202012/01, which was discovered in the Southeast East of England, increases the risk of The Office for National Statistics reports that compared to individuals with other variations; those with this one are more likely to suffer from myalgia, fatigue, or sore throat. [30]

High temperature

In addition to calculating the daily means of the average, minimum, and maximum temperatures in January 2020, we compiled the total number of confirmed cases of COVID-19 in all cities and areas worldwide from January 20 to February 4, 2020. Next, the function of constrained cubic spline and the correlations were examined using a generalized linear mixture model. The daily confirmed new COVID-19 cases that are formally reported in China and other countries make up the study populations. The total number of confirmed cases in all cities and regions from January 20 to February 4, 2020, is calculated. The reports published on the official websites of China's Health Commissions at all levels, as well as the health authorities of other nations, served as the source of the population data. [31]

Diarrhea

Diarrhea is a common symptom in coronavirus infections, affecting up to 30% of individuals with MERS-CoV 10.6% of patients had SARS-CoV. Diarrhea is becoming more common among patients, despite its initial rarity. The following search phrases were used, either alone or with the Boolean operators "AND" or "OR." "COVID-19," "SARS-CoV-2," "coronavirus," "pandemic," "epidemic," "outbreak," "diarrhea," "gastrointestinal symptom," "stool," or "feces." [32]

Headache

Headache is one of the COVID-19-related symptoms with substantially varied frequencies across studies. Some research and reviews emphasize that headache is the most prevalent neurological symptom, generally accompanied by fever. [33]

Muscle & Joint pain

COVID-19 often causes musculoskeletal complaints, including tiredness, muscle and joint discomfort. The frequency of these symptoms hasn't been well studied, though. Usually, studies are retrospective and single centre. [34]

Loss of sense of smell & taste

The significance of abrupt loss of smell or taste as a predictor of COVID-19 in individuals with chemosensory symptoms is uncertain, whether alone or in combination. Currently, guidelines for self-isolation and testing based on acute loss of smell or taste are limited. A small number of nations have embraced it, with the bulk focusing on fever and respiratory problems. [35]

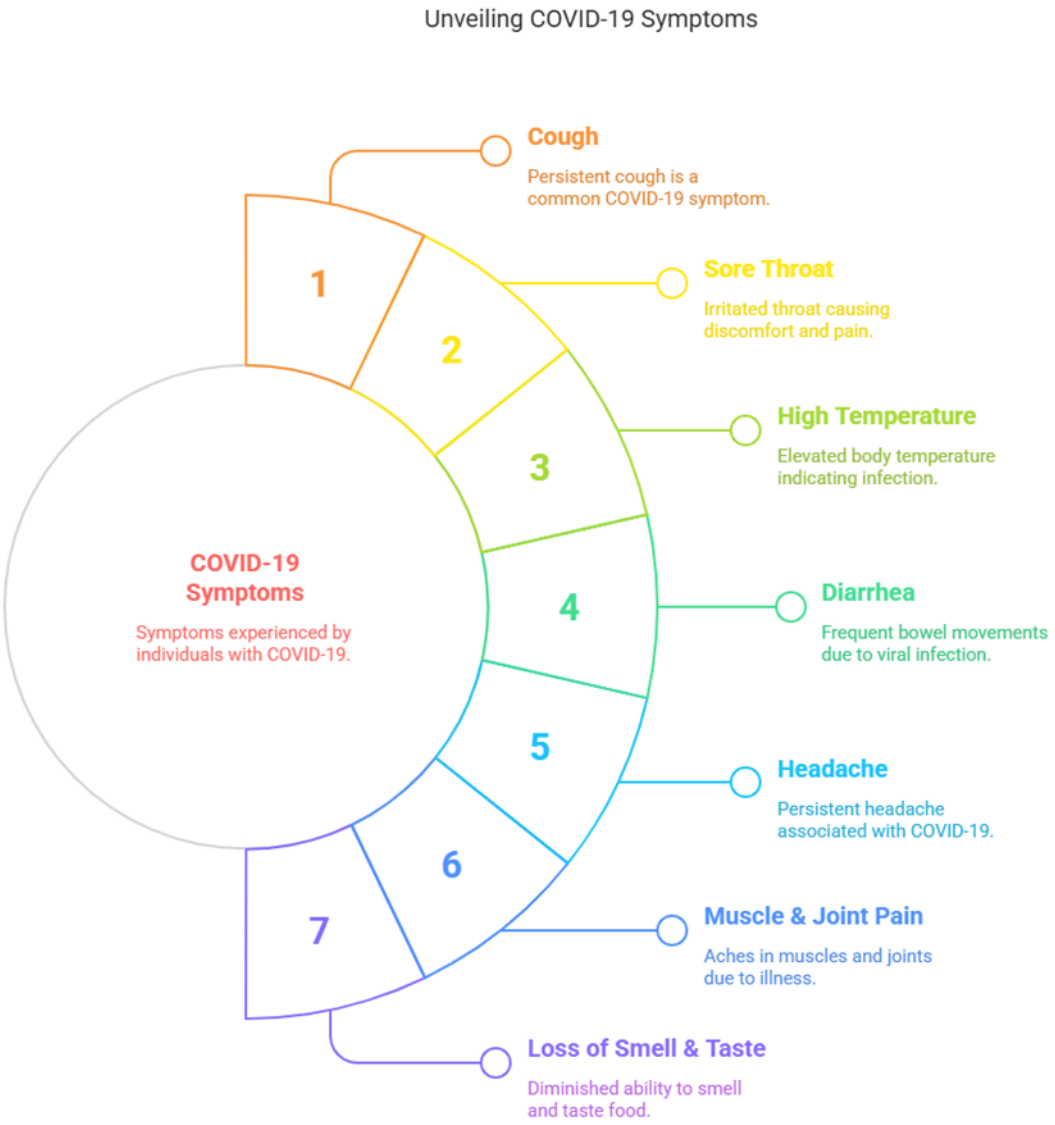

Fig. 6: Signs & Symptoms of COVID-19

Vaccine

The main vaccines approved and widely used in India during the pandemic were

Covishield

Scientists worldwide have developed and approved 18 COVID-19 vaccines for emergency use. Currently, current vaccinations trigger strong immune responses against the SARS-CoV-2 spike protein. However, the newly emerged SARS-CoV-2 variants have led to breakthrough infections after completion of the vaccination regimen. Hence, it is crucial to evaluate the natural, induced humoral immunity to SARS-CoV-2 and the phenomenon of breakthrough infection to understand the immune escape due toemergency of developing VOCs. Covishield™, a replication-deficient viral vector-based SARS-CoV-2 recombinant vaccine, has been used in India's national COVID-19 immunization program Iacobucci et al. reported substantial immunological responses. Research done in England and Wales found full seroconversion after the second dosage of Covishield. The Delta variant's mutations in the spike area may offer a challenge to vaccinations designed to target the spike gene. [36]

Covaxin

The COVID-19 pandemic has wreaked havoc across the world, but especially in India. Some of the viruses that caused the most illnesses and fatalities were found in India. The virus entered the country at the middle of March 2020. Numerous facets of life have been severely disrupted by the crisis, most notably the socioeconomic and medical spheres. Creating efficient vaccines is a crucial tactic in the fight against the plague in India and throughout the world. Via a number of programs, the Indian government has aided vaccine development. Outside of India, a number of domestic vaccines are being developed, both technologically and non-technically. For those who have seen India's reliance on imported food and medications, this is a great moment. Together with ICMR and the National Institute of Virology (NIV), Bharat Biotech created COVAXIN, an indigenous COVID-19 vaccine, to fight the coronavirus. Whole Virion Inactivated Vero Cell-derived platform technology was used to create the vaccine. With more than 300 million doses, the Vero cell production platform has a demonstrated safety record. Since inactivated vaccines cannot multiply, it is unlikely that they would have pathological effects. The dead viruses used to make these vaccines are incapable of infecting people, but they can still activate the immune system's defenses against infection. [37]

Observation after vaccination

The percentage and probability of self-reported local and systemic side effects within 8 days of vaccination were examined in this prospective observational study conducted in the UK in participants who used the COVID Symptom Study app and received either one dose of the ChAdOx1 nCoV-19 vaccine or one or two doses of the BNT162b2 vaccine. Furthermore, we compared the infection rates in a group of vaccinated individuals who were subsequently tested for SARS-CoV-2 using PCR or lateral flow testing to the infection rates in unvaccinated controls. All analyses additionally considered comorbidities (binary variable, with or without comorbidities), obesity (BMI <30 kg/m² vs. ≥ 30 kg/m²), sex, age (≤ 55 years vs. >55 years), and health-care professional position (binary variable). [38]

By examining their social media posts on Twitter, the investigation aims to investigate how Indian citizens view the COVID-19 vaccine and its adverse effects. Tweets containing the phrases "Side effects" and "COVID Vaccine" were eliminated using the Python Library Twint. Data has been collected via Twitter. In the wake of the COVID-19 outbreak, more people are expressing their views using "Tweets" on Twitter. Since the leaders disseminate information on COVID-19 directly to the public, Twitter is also presented as a powerful public health tool in addition to more traditional media like radio, newspapers, and television.According to earlier research, social media is a very dependable way to observe and record public behavior during unusual periods like the current one. For this study, tweets that included the phrases "COVID vaccine" and "Side effects" were examined. Only tweets from India were analyzed by using the geographic filtering function of the Twint Python module. Only tweets written in English were examined for the study; tweets written in other languages were disregarded. Following the removal of tweets in other languages, only English-language tweets were taken into consideration for this study. [39]

A cross-sectional survey was conducted among the Indian medical student cohort for approximately five weeks, from February 2 to March 7, 2021. According to previous estimates, the percentage of medical or nursing students who declined or were unwilling to get the COVID-19 vaccine ranged from 6% in Egypt to 13.9% in Italy and 23% in the US. This information was utilized to establish the sample size. This yielded the lowest frequency of 6% from Egypt, a 5% alpha value, and a 25% relative accuracy with a sample size of 962 individuals. The quiz was made so that medical students could comprehend India because English is the main language of instruction for medical schools. It was designed to collect information on basic demographics, prior vaccination experiences, attitudes of the COVID-19 vaccine, and awareness of and access to information about the vaccine. Google Forms was used to make this survey accessible online. Through WhatsApp groups that included students from a certain batch enrolled in medical schools, as well as on an individual basis, the student investigator spread its link throughout the medical students' social media network. Students who were enrolled in the same medical school as them shared it with their peers. Following completion of the survey, data were downloaded in comma-separated values format and analyzed using SPSS software v23.0 and EpiInfo™ v7.2.4. The odds ratio for a univariate approach was used to determine vaccine aversion after the survey's categorical parameters were totaled. Multivariate logistic regression was used to assess for probable reasons for vaccine reluctance after adjusting for gender, medical college type, being in the pre-clinical or clinical section of the course, and absence of prior vaccination experience. A similar analysis was carried out once again to look at the factors affecting unwillingness to participate in the COVID-19 vaccine project. If a two-tailed P-value was less than 0.05, it was deemed significant. The initiative has been approved by the Institutional Ethics Committee of the All-India Institute of Medical Sciences (AIIMS) in Jodhpur. No student's name, email address, or phone number was utilized to personally identify them; all data collecting was completely anonymous.The medical schools' names that are being collected. [40]

VII. Conclusion

Without a doubt, the COVID-19 pandemic has altered public health globally, revealing both important benefits and drawbacks in terms of health systems, policy frameworks, and societal resilience. As this study has demonstrated, the emergence of SARS-CoV-2 in late 2019 set off a chain of epidemic events that quickly escalated into a significant global health crisis. Because of the virus's high transmissibility and potential for serious disease, especially among sensitive groups, governments, health authorities, and communities throughout the world had to respond quickly and adaptably. As demonstrated by the epidemiological patterns of COVID-19, which were marked by many waves, fluctuating variations, and fluctuating case fatality rates, a novel illness may swiftly overwhelm even the most advanced healthcare systems.

The public health response to COVID-19 included a range of strategies, from aggressive containment and mitigation measures to behavioural therapy and health promotion at the community level. Physical isolation, mask restrictions, lockdowns, and hygiene promotion were all part of the pandemic control measures. Mass vaccination programs were started at record speed thanks to unmatched scientific teamwork, which marked a major improvement in the decrease of severe sickness and mortality. However, vaccine hesitancy, logistical challenges, and misinformation hindered widespread immunization coverage. The infodemic that followed the pandemic significantly impacted adherence to control measures and trust in public health messages.

Policy issues during COVID-19 were intricate and dynamic. Governments found it difficult to reconcile public health issues with social, educational, and economic objectives. Early on in the pandemic, policy decisions were often made in the face of uncertainty and rapidly shifting facts. Political polarization, bureaucratic sluggishness, and the lack of pre-existing pandemic preparation measures sometimes delayed effective action.One of the most significant lessons from the pandemic is the need to invest in resilient and flexible health systems. This includes improving primary care, expanding the health workforce, ensuring the supply chain is robust, and integrating digital health technologies.

References:

[1] Fong SJ, Dey N, Chaki J. An Introduction To COVID-19. In: Artificial Intelligence For Coronavirus Outbreak. 2021. P. 1-22.
[2] Ciotti M, Angeletti S, Minieri M, Giovannetti M, Benvenuto D, Pascarella S, Et Al. COVID-19 Outbreak: An Overview. Chemotherapy. 2020;64(5-6):215-23.
[3] Tarkar P. Impact Of COVID-19 Pandemic On Education System. Int J Adv Sci Technol. 2020;29(9):3812-4.
[4] Usher K, Durkin J, Bhullar N. The COVID-19 Pandemic And Mental Health Impacts. Int J Ment Health Nurs. 2020;29(3):315.
[5] Van Loon AW, Creemers HE, Vogelaar S, Miers AC, Saab N, Westenberg PM, Et Al. Prepandemic Risk Factors Of COVID-19-Related Concerns In Adolescents During The COVID-19 Pandemic. J Res Adolesc. 2021;31(3):531-45.
[6] Kapoor M, Kaur NK, Saeed S, Shannawaz M, Chandra A. Impact Of COVID-19 On Healthcare System In India: A Systematic Review. J Public Health Res. 2023;12(3):22799036231186349.
[7] Kumar S. Second Wave Of COVID-19: Emergency Situation In India. J Travel Med. 2021;28(7):Taab082.
[8] Kavitha C, Gowrisankar A, Banerjee S. The Second And Third Waves In India: When Will The Pandemic Be Culminated?. Eur Phys J Plus. 2021;136(5):596.
[9] Dar SA, Lone NA. Impact Of COVID 19 On Education In India. J Indian Art Hist Congr. 2021;26(2):46-55.
[10] Jena PK. Impact Of Pandemic COVID-19 On Education In India. Int J Curr Res. 2020;12.
[11] Roy N, Chaube R. Environmental Impact Of Covid-19 Pandemic In India. Int J Biol Innov. 2021;3(1).
[12] Roy B, Dhillon JK, Habib N, Pugazhandhi B. Global Variants Of COVID-19: Current Understanding. J Biomed Sci. 2021;8(1):8-11.
[13] Rahimi B, Vesal A, Edalatifard M. Coronavirus And Its Effect On The Respiratory System: Is There Any Association Between Pneumonia And Immune Cells. J Family Med Prim Care. 2020;9(9):4729-35.
[14] Kapoor MC. Respiratory And Cardiovascular Effects Of COVID-19 Infection And Their Management. J Anaesthesiol Clin Pharmacol. 2020;36(Suppl 1):S21-8.
[15] Roy R, Mcdonaugh B, O'Gallagher K. COVID-19 And The Heart. Br Med Bull. 2022;144(1):4-11.
[16] Yonas E, Alwi I, Pranata R, Huang I, Lim MA, Gutierrez EJ, Et Al. Effect Of Heart Failure On The Outcome Of COVID-19—A Meta-Analysis And Systematic Review. Am J Emerg Med. 2021;46:204-11.
[17] Pellicori P, Doolub G, Wong CM, Lee KS, Mangion K, Cleland JG, Et Al. COVID-19 And Its Cardiovascular Effects: A Systematic Review Of Prevalence Studies. Cochrane Database Syst Rev. 2022;2022(4).
[18] Bader F, Manla Y, Atallah B, Starling RC. Heart Failure And COVID-19. Heart Fail Rev. 2021;26(1):1-10.
[19] Paramasivam A, Priyadharsini JV, Raghunandhakumar S, Elumalai P. A Novel COVID-19 And Its Effects On Cardiovascular Disease. Hypertens Res. 2020;43(7):729-30.
[20] Berger JR. COVID-19 And The Nervous System. J Neurovirol. 2020;26:143-8.
[21] Divani AA, Andalib S, Biller J, Di Napoli M, Moghimi N, Rubinos CA, Et Al. Central Nervous System Manifestations Associated With COVID-19. Curr Neurol Neurosci Rep. 2020;20:1-20.
[22] Norouzi M, Miar P, Norouzi S, Nikpour P. Nervous System Involvement In COVID-19: A Review Of The Current Knowledge. Mol Neurobiol. 2021;58:3561-74.
[23] Aguila EJT, Cua IHY, Dumagpi JEL, Francisco CPD, Raymundo NTV, Sy-Janairo MLL, Et Al. COVID-19 And Its Effects On The Digestive System And Endoscopy Practice. JGH Open. 2020;4(3):324-31.
[24] Cao TT, Zhang GQ, Pellegrini E, Zhao Q, Li J, Luo LJ, Et Al. COVID-19 And Its Effects On The Digestive System. World J Gastroenterol. 2021;27(24):3502.
[25] Wang MK, Yue HY, Cai J, Zhai YJ, Peng JH, Hui JF, Et Al. COVID-19 And The Digestive System: A Comprehensive Review. World J Clin Cases. 2021;9(16):3796.
[26] Cullen W, Gulati G, Kelly BD. Mental Health In The COVID-19 Pandemic. QJM. 2020;113(5):311-2.
[27] Kontoangelos K, Economou M, Papageorgiou C. Mental Health Effects Of COVID-19 Pandemia: A Review Of Clinical And Psychological Traits. Psychiatry Investig. 2020;17(6):491.

[28] Kumar A, Nayar KR. COVID-19 And Its Mental Health Consequences. J Ment Health. 2021;30(1):1-2.
[29] Kaulamo JT, Lätti AM, Koskela HO. Cough In The Elderly During The COVID-19 Pandemic. Lung. 2022;200(2):161-8.
[30] Mahase E. Covid-19: Sore Throat, Fatigue, And Myalgia Are More Common With New UK Variant.
[31] Wang M, Jiang A, Gong L, Lu L, Guo W, Li C, Et Al. Temperature Significantly Change COVID-19 Transmission In 429 Cities. Medrxiv. 2020.
[32] D'Amico F, Baumgart DC, Danese S, Peyrin-Biroulet L. Diarrhea During COVID-19 Infection: Pathogenesis, Epidemiology, Prevention, And Management. Clin Gastroenterol Hepatol. 2020;18(8):1663-72.
[33] Uygun Ö, Ertaş M, Ekizoğlu E, Bolay H, Özge A, Kocasoy Orhan E, Et Al. Headache Characteristics In COVID-19 Pandemic—A Survey Study. J Headache Pain. 2020;21:1-10.
[34] Eren F, Demir A, Ozkan B. Evaluating Muscle/Joint Pains And Related Factors In Patients With COVID-19. Authorea Preprints. 2021.
[35] Makaronidis J, Mok J, Balogun N, Magee CG, Omar RZ, Carnemolla A, Et Al. Seroprevalence Of SARS-Cov-2 Antibodies In People With An Acute Loss In Their Sense Of Smell And/Or Taste. Plos Med. 2020;17(10):E1003358.
[36] Sapkal GN, Yadav PD, Sahay RR, Deshpande G, Gupta N, Nyayanit DA, Et Al. Neutralization Of Delta Variant With Sera Of Covishield™ Vaccinees And COVID-19-Recovered Vaccinated Individuals. J Travel Med. 2021;28(7):Taab119.
[37] Darbar S, Agarwal S, Saha S. COVID-19 Vaccine: COVAXIN®-India's First Indigenous Effective Weapon To Fight Against Coronavirus (A Review). Parana J Sci Educ. 2021;7(3):1-9.
[38] Menni C, Klaser K, May A, Polidori L, Capdevila J, Louca P, Et Al. Vaccine Side-Effects And SARS-Cov-2 Infection After Vaccination In Users Of The COVID Symptom Study App In The UK: A Prospective Observational Study. Lancet Infect Dis. 2021;21(7):939-48.
[39] Sv P, Tandon J, Hinduja H. Indian Citizen's Perspective About Side Effects Of COVID-19 Vaccine–A Machine Learning Study. Diabetes Metab Syndr. 2021;15(4):102172.
[40] Jain J, Saurabh S, Kumar P, Verma MK, Goel AD, Gupta MK, Et Al. COVID-19 Vaccine Hesitancy Among Medical Students In India. Epidemiol Infect. 2021;149:E132.