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# COVID 19: Impact and Response Volume V

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# COVID 19: Impact and Response

## Volume V

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## **PREFACE**

*The new respiratory pandemic disease i.e. COVID-19 has caused disruptions in the lives and customs of people with significant impact on the economies of nations. The outbreak of the disease is a global health emergency and of international interest. This global health challenge leads to the infection, morbidity and mortality of many people.*

*In the weeks since the World Health Organization manifest the corona virus (COVID – 19) episode a worldwide unstipulated wellbeing crisis, the COVID-19 pandemic has influenced 212 nations and forfeit increasingly than 400,000 lives. Still today there is no successful remedy to lockup the spreading of this infection. The pandemic is developing prior disparities, uncovering vulnerabilities in social, political and financial frameworks which are thusly intensifying the effects of the pandemic.*

*Governments of various nations adopted restrictive measures involving both within the countries and at international borders as effective response to the corona virus pandemic. These measures includes confinements of workers and order to work from home, banning of social and religious gatherings, closure of market places, closure of workplaces including airports, building or creation of testing and isolation centers, quarantining/isolation of suspected persons, self-imposed isolations, and the use of face masks whether surgical or cloth type in situations where there is a cogent reason to defy the restriction.*

*Academic communities were not left out as institutions of learning were requested to close in many countries since it is very easy to spread the virus among students and youths in tertiary institutions where socialization is an essential part of their lives.*

*To address the various issues related with the COVID – 19 we have published the present book. The interdisciplinary approach of the book will make the book useful and informative to the students, teachers, researchers, scientists and policy makers in India and abroad.*

*We thank all contributors, publishers and all our well-wishers for their blessings, without which this book would not have come into existence.*

**- Editorial Team**

**COVID 19: Impact and Response Volume V**

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## GEOINFORMATION TECHNOLOGY FOR COVID-19 PANDEMIC

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### Abstract:

COVID-19 pandemic emerged in Wuhan City of Hubei Province, China in late December 2019 and dispersed over the rest of the world. Since then, it has affected virtually every country, and results in an unprecedented response by governments across the world to monitor and control its spread. The severity of COVID-19 calls for a synergy among researchers, scientists, health professionals, and policymakers to confront the problems posed by it. Its disaster is evidently spatial in nature, and examining its geographical aspect is imperative in comprehending the broad implications of the pandemic. Of course, investigations in relation to geography, space, and other spatiotemporal dimensions depend to a great extent on geospatial information (Geoinformation); which can be acquired, stored, processed, and displayed through Geoinformation Technology (GIT). Thus, this chapter is concerned with the application of GIT for monitoring COVID-19 Pandemic. The emphasis is on surveillance and data sharing; monitoring population and mobility; digital contact tracing; and modeling COVID-19. Besides affording the main view on how GIT has been deployed in COVID-19 research so far, this chapter demonstrates that GIT could be used in future public health emergencies along with statistical and other socio-economic modeling techniques. It also provides how both scientific communities and policymakers could leverage GIT for extracting valuable information to make an informed decision.

**Keywords:** Coronavirus, geospatial, mapping, monitoring, epidemic, technology

### Introduction:

The COVID-19 pandemic overwhelmed the world with a swiftly growing confirmed cases and case-fatalities around the globe (WHO, 2020). Following its emergence in Wuhan City of Hubei Province, China in late December 2019, World Health Organization (WHO) termed it an epidemic on 29<sup>th</sup> January, 2020 (McNeil, 2020), named it COVID-19 on 11<sup>th</sup> February 2020, and declared it a pandemic on 11th March 2020 (Liu *et al.*, 2020; Huang *et al.*, 2020). The epidemic intensity of COVID-19 has been influenced by crowding, demonstrated by greater occurrence in big cities as compared to rural communities (Rader, 2020). Yet, the

massive spread of the pandemic has also depended on other biological, environmental, and economic factors.

The pronouncement of COVID–19 as a pandemic and successive lockdown has significantly affected our society. Thus, the pandemic has attracted a huge amount of scientific studies addressing global awareness. Basically, the spread of infectious disease is a spatial process; as such, geoinformation technology (GIT), and analytical techniques have a major role to play in comprehending and responding to COVID–19 pandemic.

Reliable and sufficient geoinformation (geospatial information) has become the fuel driving the engine of growth and sustainable development of any nation. Over 80% of planning and decision making in many advanced countries are based on geoinformation. Geoinformation is any information that describes a geospatially referenced entity. Such entity involve locational and attribute data, and also cover natural, infrastructural, and cultural features. Locational referencing (knowing where things are) and there topology (how they spatially relate to each other) using geographic identifiers, enhances spatial understanding and also forms basis for intelligent administrative and economic decision making. Furthermore, attribute (non–spatial) data describe the geographic region or characteristics of the spatial features within geographic regions.

Geoinformation and location technologies (including GIS and other tools) are of significant support in combating infectious diseases. In the case of COVID–19 occurrence, GIS–based dashboards created by World Health Organization (WHO), Johns Hopkins University Center for Systems Science and Engineering dashboard (JHU CSSE), and Early Alert Inc., serves unique purpose in informing both the health professionals and general populace. Of course, dashboards and Web maps that connect place and time–sensitive occurrences with regards to a spreading disease gives travellers and officials the potential to reduce their exposure (Boulos and Geraghty, 2020). Furthermore, GIS analysis has been successively used for suitable site selection, whether for emergency treatment centers or long–lasting infrastructure. Equally, unmanned aerial vehicles (UAV) are used to convey important medical supplies and patient lab samples to the required destination, and the drone’s application has gained more popularity as it lessens human interaction with lab. Drones are also used for extensive decontamination of many areas. By and large, the focus of this chapter is on the role of Geoinformation technology in monitoring COVID–19 pandemic.

### **Monitoring COVID–19 pandemic:**

#### **Surveillance and Data Sharing:**

Geoinformation technology affords an effective tool for the management, storage, analysis, and mapping of disease information. It is of great importance in spatial analysis of a pandemic. GIT has improved disease surveillance systems and data sharing through monitoring

of disease epidemics, enabling contact tracing, and appraising the effectiveness of interventions. Thus, several researchers have deployed it in surveillance analysis of diarrheal (Kumar *et al.*, 2017), malaria (Kirk *et al.*, 2014; Ferrao *et al.*, 2018), Ebola (NicLochlainn *et al.*, 2018), and COVID–19 (Smith and Mennis, 2020; Franch–Pardo *et al.*, 2020; Rezaei *et al.*, 2020). The COVID–19 pandemic has validated the fundamental significance of sharing both spatial and non–spatial data. Of course, the present surveillance of COVID–19 at both the national and global levels is based on lessons learned from sustaining hitherto developed databases of contamination and disease such as the FluNet (Flahault, 2006).

An important aspect of monitoring the spread of COVID–19 and other infectious disease is spatial data infrastructure (SDI). SDI is the appropriate base assemblage of technologies, policies and institutional arrangements that enable the availability of spatial data. Generally, SDI covers the materials, technology, and people necessary to acquire, process, store, and disseminate such information. It is used to bring together geoinformation that defines the configuration and attributes of features and phenomena on earth. The major parts of an SDI as suggested by Boulos, (2004) are:

- i. geospatial culture and awareness
- ii. resources for information and communications technology
- iii. common standards for data integration and interoperability
- iv. a legal framework for data security and privacy
- v. a common lexicon
- vi. the use of robust statistical and epidemiological methods
- vii. interdisciplinary collaboration and partnerships

SDI and ESRI web platform makes it possible to visualize and monitor the progress of COVID–19 cases globally and in real time. In addition, online GIS dashboard is a dependable and reference source to monitor the spread of the virus allowing citizens to comprehend the latest situation and visualize the distribution pattern of the virus. With this tool, it has also been easy for governments to understand and analyze trends for forecasting scenarios and deciding what is required to fight the pandemic.

### **Monitoring Population and Mobility:**

Growth in population, mobility, urbanization, and environmental alterations are significant factors that contribute to the increase probability of pandemics occurrence (Zhu, 2019). Empirical studies have demonstrated the association between mobility and COVID–19 cases based on explanatory analysis. Thus, known population information including population density and population migration patterns has been used to forecast and monitor the spread of COVID–19, its concentration, and to also identify the potential hotspots of new infections (Christaki, 2015).

Human movement is a significant driver of geographic spread of infectious diseases (Kraemer *et al.*, 2019). Therefore, quantifying human movement can help in predicting and controlling the spread of infectious diseases (Hancock *et al.*, 2014). Of course, data on human mobility and mixing have been used to monitor the effectiveness of social distancing interventions in the ongoing COVID–19 pandemic. The reason for this is that COVID–19 is characterized by a high human–to–human transmission rate and can be transmitted during the preclinical incubation period. Restricting and tracking of human movement throughout the pandemic has proven effective at reducing its spread in different countries (Giordano *et al.*, 2020).

Evaluating the pattern of human population and movement at different spatial scales is important for better understanding of the infectious risk at a population level in the pandemic. Numerous spatially aggregated data on COVID–19 pandemic with respect to population mobility is released from different sources. These data have been used to report the effects of jurisdictional stay–at–home orders on population mobility and to analyze the efficacy of population mobility change for altering disease dynamics (Kraemer *et al.*, 2020). GIS–enhanced online real– or near–real–time mapping of disease offers a vital platform for timely understanding of new disease source. Such disease mapping may encompass disease spread, predictive risk mapping using population travel data, tracing or mapping super–spreader routes and contacts over space and time.

Geospatial technologies are effective in monitoring population distribution and mobility through the use of social media and location–tracking applications embedded in mobile telephones that employ GNSS, cell phone tower connections, and wireless connections (Buckee *et al.*, 2020). Also, GIS utilization to visualize the global spread of air transport passengers from the epicenter of COVID–19 and infected traveler’s ratio around the world (Christidis and Christodoulou) demonstrates a high level of potency. In spatial analysis of the pandemic, confirmed cases were normally georeferenced prior to the measurement and identification of the regions characterized by high risk of transmission at an initial period. Similarly, using case reports and human movement data, the spread and control of COVID–19 cases were analyzed using generalized linear regression model. This was based on spatial distribution mapping of the travel movements from Wuhan to each province and modeling of the spatial dispersal pattern of COVID–19 trajectories with or without Wuhan travel ban. It was discovered that Wuhan shutdown delayed arrival of COVID–19 in other cities by around three days (Tian *et al.*, 2020).

### **Digital Contact Tracing:**

Tracing individuals who have been in contact with confirmed or presumptive coronavirus carriers and moving them quickly to supported isolation is a significant operation in reducing COVID–19 transmission. Contact tracing process is a set of strategies that emphasize the

controlling and monitoring of infectious diseases (Vazquez–Prokopec, 2017). It is concern with examining cases to prove their infection to all other individuals that were in physical contact with the patients in the recent past, which will lead to establishing the course of the infectious disease (Armbruster and Brandeau, 2007).

Conventionally, contact tracing was performed by deploying a low technology, labour intensive army of tracers who call or visit people who have had contact with confirmed carriers. The process can be made more efficient and scaled up to large populations by exploiting digital contact tracing, which uses a variety of technologies such as, location–based services, geospatial technologies, proximity awareness technology, machine learning algorithms, and automated decision making to scrutinize individual’s digital footprint and trace those who are potentially infected, and locate their close contacts (Calvo *et al.*, 2020). Digital contact tracing decreases the response time compared to manual tracing through proximity awareness technology, allowing for quicker tracing of individuals exposed to the virus. Such technologies comprise mobile apps that could track users’ movements through GPS, location data and Bluetooth technology, and in some cases, GIS analysis and mapping). Once a person tests positive, authorities can use the location of his/her mobile phone to track the places he/she had visited in the recent past. Based on that information, the officials trace the individuals who have come in contact with the infected person. Those people are further tested and, if required, quarantined.

### **Modeling COVID–19:**

Geospatial technology has provided visualization and analytical tools to public health professionals and decision makers. It is used to execute diseases control programs in affected and suspected regions. It is also used to make analysis and predictions possible that was once technologically out of reach. Deploying maps for visualizing the link between location and health is not a new development. Maps were used in 1694 during the outbreaks in Italy, and during the 1918 pandemic for tracking infectious diseases, such as yellow fever, cholera, and influenza. However, it was only in the 1960s after the emergence of GIS that the capability to analyze, visualize, and detect disease spatial patterns radically ensued (Boulos and Geraghty, 2020).

Though a significant effort in spatial modelling of public healthcare information for disease prediction and prevention exist, there is a need for sophisticated integration of spatial analysis and GIS. Spatial analysis of surveillance data includes exploratory data analysis, spatial modeling, and cartographic visualization. Spatial modeling examines the elementary forms of spatial organization that explains the phenomenon under study (Brunet, 1993). Of course, GIS has become a global health tool for mapping and monitoring the spatial and temporal distributions of infectious diseases. Geographic information can play vital roles in tracking a pandemic, particularly in tasks such as spread identification, prevention and control, allocation of resources, detecting social sentiment (Gatto *et al.*, 2020) and responses during outbreaks (Boulos

and Geraghty, 2020). Thus, GIS can allow epidemiologists to map the present and past occurrence of diseases together with many other parameters representing the environment, geography, and demography. These data may help epidemiologists to understand the source of outbreaks as well as the spread pattern and intensity, thereby facilitating the implementation of appropriate disease control, preventive, and surveillance measures (Murugesan *et al.*, 2020; Sarfo and Karuppanan, 2020). Similarly, policy makers, public health agencies, and administrators can employ GIS tools to understand the overall outbreak patterns in real-time to identify high-risk populations and intervene accordingly by evaluating existing facilities or creating new healthcare infrastructure. GIS is capable of integrating diverse spatial datasets based on georeferencing, enabling the combination of health data with contextual characteristics. Descriptive modeling research that leverages this capability has examined the spatial associations of COVID-19 with socioeconomic and environmental characteristics.

### **Conclusion:**

This chapter discussed the increasing relevance of geoinformation technology in the public health domain, particularly for understanding and responding to COVID-19. Comprehending the spatial-temporal dynamics of COVID-19 is important to its mitigation. Geoinformation technology is characterized by a rich set of tools for comprehending spatial and temporal aspects in wide range of disciplines, dominantly in geospatial health research for creating the associations between diseases and in its suitable environment.

Geoinformation technology enables global map-enhanced communication and visualization, analysis, and sharing of disease information through interactive maps or animation in a collaborative manner with multiple partners. More operational cooperation with the support of disease maps over the internet will secure a quicker response to emergency circumstances. The development of SDI would further boost this online disease mapping architecture for decision and policy making.

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## **TALENTED TECHNIQUES FOR THE ANALYSIS OF VIRAL INFECTIONS**

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### **Abstract:**

Viruses are the most important microorganisms especially in health system. These viruses cause the lethal health problems in various regions of the world. Recently, the outbreak of COVID-19 caused by SARS-CoV-2 is good example that how virus cause infection and large threat to global public health as well as in economic sectors. The most important thing in the prevention of viral diseases is the timely, early and accurate diagnosis of the virus. The precise diagnosis of virus is a very important step for appropriate management, control and treatment. In the recent article we mention some latest molecular and immunological diagnostic techniques helpful for early and exact diagnosis of virus from a sample. The immunological diagnostic approaches are widely used and even can detect viral antigens or antiviral antibodies from the human clinical samples. Similarly, molecular diagnostic approaches also provide very accurate and rapid detection of virus from clinical sample. In the majority of laboratories are largely used commercially available immunological and molecular diagnostic kits/

### **Introduction:**

Virus is a very tiny creature composed of viral protein coat which enclosed the nucleic acid like deoxyribonucleic acid (DNA) or ribonucleic acid (RNA). The additional lipoprotein coat or envelope may also be present in some kind of viruses. Viruses are purely come under category of obligate intracellular parasites because they need host for their replication. Viruses hijack biosynthetic machineries of host cell after penetration in cell. They replicate their genomes and others proteins components using the host biosynthetic machinery [1, 2].

The viruses are the second common cause of human infections after bacterial infections. Worldwide, millions of people are suffering and dying from viral infections especially due to viral hepatitis and human immunodeficiency virus (HIV). The most recently pandemic outbreaks of SARS-CoV-2 are largely effect the whole world [3–9].

The death rate due to viral infections is remarkably high [10]. For example, in 2009 swine influenza A (H1N1) infections was outbreak in 214 countries as a pandemic and nearly 18,036 people were died [5]. Similarly, 61,000 people were died globally in 2010 due to rabies and 84% suffer were rural people [11]. HIV was also a very lethal viral infection and HIV virus infected about 35,000,000 people worldwide [10]. In 2015, according to World Health Organization (WHO), 1.34 million people were died due to viral hepatitis [12]. The most recently, novel corona virus disease influenced the whole world and it not only cause of death of millions people but also destroyed the economy of whole world [9, 14, 15].

The latest accurate and early diagnostic approaches are must be need of time to detect these viral infections. The accurate and early detection of these viral agents have important role in decreasing the unnecessary loss of human lives, minimizing the cost of therapy and timely selection of appropriate therapy. It also very helpful to establishes proper preventive measures and treatment plan for the disease, for example development of advance therapeutic agents and antiviral vaccines [14, 16, 17].

Previously, various old diagnostic approaches like tissue culture, through embryonated chicken eggs, visual examination of viral particles in sample using electron microscopy and in animal laboratory were carried for virus detection [16]. These conventional diagnostic approaches were time consuming, expensive, cumbersome and poorly reproducible [18, 19]. On the other hand, various advance diagnostic approaches were also discovered which created a revolution in diagnostic virology. These modern techniques were easily identified the components of virus like nucleic acid in a clinical sample of a patient [18]. These immuno-based and molecular based techniques are playing a great role in detection of viral agents and they replaced traditional methods [20]. In this review article we discuss some immunological and molecular diagnostic techniques which are commonly used in modern era.

### **Molecular Diagnostic Techniques of Medical Viruses:**

The one of most important molecular diagnostic techniques is nucleic acid based approach which have revolutionized in diagnostic virology as their fast, very sensitive and highly specific diagnosis [14, 23, 24]. Nucleic acid based diagnostic techniques can be used to detect any kind of virus that cause infection in humans because these approaches very easily detect or read the specific sequence of nucleic acid in viral genome [1].

### **Nucleic Acid-Based Amplification Techniques:**

Molecular diagnostic approaches involve viral genome amplification and provide rapid, extremely sensitive and specific diagnosis as well as consent the detection of several viruses in same time [16]. The genome amplification technique is very convenient for virus detection

because viruses are harmful to grow or culture, uncultivable or difficult to culture, delayed grow in culture or change their antigenic properties during culturing [1, 25]. Nucleic acid amplification diagnostic approach is very popular and widely used in detection or diagnosis different virus like Ebola virus, coronavirus, influenza viruses, Zika virus (ZIKV), human immunodeficiency virus (HIV), dengue virus, Epstein–Barr virus (EBV) and hepatitis C virus (HCV) [26–32].

### **Polymerase Chain Reaction (PCR):**

Mullis and Faloona discovered a nucleic acid amplification technique known as PCR and it has a great reformed in the field of molecular diagnosis [33]. This molecular technique involved DNA extraction, purification and using thermostable DNA polymerase enzyme and two forward and reverse oligonucleotide primer amplified the target sequence. After amplification product can be detected through various techniques like sequencing, colorimetric methods and gel electrophoresis method [10, 34, 35]. PCR can detect viral infections in human clinical samples with overall range 89% to 100% clinical specificity and 77.8% to 100% with overall clinical sensitivity [28, 36-38]. Many reports suggest that PCR used in several clinical samples for detection of virus. Some clinical laboratories still used conventional PCR method globally, but in recent era it is rapidly replaced with more variant advance approaches.

PCR is a highly versatile technique and several variants of the conventional PCR has been established. But the most important variant is real-time PCR was used to quantify deoxyribonucleic acid (DNA) in real time throughout the PCR reactions [39]. The other important variant of conventional PCR is reverse transcription-PCR was introduced for amplification of targets ribonucleic acid (RNA) [1].

### **Reverse Transcription-PCR (RT-PCR):**

RT-PCR was devised for amplification of target RNA sequence. In RT-PCR, the reverse transcriptase (RT) enzyme is used to changed RNA strand of virus into complementary DNA (cDNA). Next conventional PCR was used for amplification of complementary DNA. RT-PCR technique is widely used for diagnosis of RNA viral infection in human. But recently this technique is not commonly used for detection of virus from clinical samples due to time-consuming and high cost process [14].

### **Real-Time PCR:**

The amplification of nucleic acid of virus and detection are performed same time in RT-PCR. The fluorescence emits from the specimen who helps in detection of amplification products and emission from the specimen is monitored through special thermal cyclers who is connected with appropriate software through computer. During every reaction cycle amplification produces

which is recorded [34, 40]. SYBR green is also use for quantification and detection of amplification products. Cytomegalovirus with overall sensitivity of 100% and specificity of 99.9%, compared with standard rapid culture in liquid saliva was also detected through RT-PCR. Similarly, EBV with overall sensitivity of 95.7% and specificity of 100%, compared to serologic assays was also diagnosed through this technique. In encephalitis patient RT-PCR was also used to determine herpes simplex viral load. RT-PCR as multiplexing assays can also be served as identification of different viruses in a single PCR reaction. Different probes labelled with different dyes are used in multiplexing assays. Human adenovirus B, C and E from the throat swab samples with sensitivity of 100% and specificity of 99.6% were diagnosed with multiplex assay compared to immunofluorescence assay [42].

#### **Transcription-Based Amplification Methods:**

Both nucleic acid sequence-based amplification (NASBA) and transcription-mediated amplification (TMA) were used in transcription-based amplification. Both performed isothermal amplification and similar to each other except that NASBA used avian myeloblastosis virus reverse transcriptase (AMV-RT), RNase H, and T7 RNA polymerase in amplification process while TMA utilized RT and RNA polymerase. Both process was done at 41°C and first the viral RNA converted into cDNA, then multiple copies of viral RNA product were synthesized using RNA polymerase [34].

#### **Loop-Mediated Isothermal Amplification (LAMP):**

Both DNA and RNA in human clinical samples were also diagnosed using cost effective, specific, rapid and sensitive amplification technique known as Loop-Mediated Isothermal Amplification (LAMP). LAMP is a very popular viral diagnostic tool in virology [43]. The amplification of target DNA in LAMP was carried out using four to six unique primers and DNA polymerase with strand displacement activity [44, 45]. RT-LAMP also permit the amplification of RNA target.

#### **DNA Microarrays:**

**Another latest technology which has potential to identification of medical viruses is known as DNA microarray [45].** In this procedure, an array of oligonucleotide probes immobilized on a solid surface (glass slide) and fluorescently labeled viral nucleic acids in a test sample are used to screen. The results of hybridization between immobilized probes and target sequences labeled with fluorescent dyes are detected and quantified by fluorescence-based detection [16, 33]. Previous studies showed that DNA microarray extensively used for the detection of viruses in clinical samples of human. For example, nasopharyngeal aspirate samples

originated from children infected with respiratory virus were detected through DNA microarray [46]. DNA microarray compared to RT-PCR, used in detection of RSV, influenza A virus, and rhinovirus/ enterovirus with overall sensitivity of 87% to 90% and specificity of  $\geq 99\%$ . DNA microarray previously utilized in a study for simultaneous detection of various viruses like adenovirus, human herpes virus-6 types A and B (HHV-6 A/B), VZV, EBV and CMV from different clinical samples [47]. In case of meningitis and encephalitis, DNA microarray was also utilized for identification of virus with overall sensitivity of 93% and specificity of 100%, compared to single-virus PCR [48]. The gastrointestinal viruses were also diagnosed with DNA microarray approach [49], herpesviruses [50] and hepatitis virus [51]. During an outbreak of SARS in China in 2002, DNA microarray also served for the discovery of a new member of the coronavirus family.

#### **Next-Generation Sequencing (NGS):**

NGS is a very important and useful tool in diagnostic virology because it easily detects the viral nucleic acid piece isolated from the clinical samples. Normally, test sample preparation, using one of the available NGS platforms for sequencing of the target nucleic acid fragments and utilize suitable bioinformatics tools for analysis of the sequence data are the some important steps for NGS [10]. Many industries formed different NGS tools which use various approaches for data analysis, toolssequencing and reagents.

#### **Immunological Diagnostic Techniques of Medical Viruses:**

Immune system produced antibodies in response of virus infection. These antibodies are used as the immunological diagnostic tool for detection of virus. Various immunological diagnostic tool like enzyme-linked immunosorbent assay, western blotting, immunofluorescence assay, and hemagglutination inhibition assay are available for detection of virus from clinical samples. The antigen-antibody complex formation is the main principle used in these assays [10, 19, 20].

#### **Enzyme-Linked Immunosorbent Assay (ELISA):**

In ELISA, specific antibodies conjugated with enzymes are used to bind with specific viral antigen in clinical sample. During positive sample color is produced between the reaction of enzymes conjugated antibodies and colorless chromogenic substrate. The color intensity depends on the antigen-antibody complex. While in case of negative sample no color is produced as no antibody antigen complex take place. The spectrophotometer or even naked eye can easily observe the change in color [19, 22].

### **Western Blotting Analysis:**

Viral protein or antiviral antibodies is also detected by a latest diagnostic tool known as Western blotting or immunoblotting assay. First, sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) was used to separate the whole denatured viral proteins. Next the separated viral protein electrotransferred onto nitrocellulose membrane and enzyme conjugated antibodies specific for the viral proteins attached on the membrane. The viral protein bound with enzymes conjugated antibodies. Due to a chromogenic substrate at the sites of the viral antigens color band appeared which indicate positive test [19, 1, 16]

### **CRISPR- based Diagnostic Technique for Virus:**

Various methods have been used for detection of clinical samples but most of them are time consuming require lengthy molecular amplification strategies. There are multiple approaches were introduced for rapid detection including for emerging pandemic viruses and acute infections. CRISPER technology is one of the emerging gene editing toll that significantly involve in nucleic acid base viral detection. Particularly, CRISPER achieved analytical sensitivity using Cas9 or Cas13a enzymes for cut the target viral nucleic acid guided by single guide RNA. In a 2016 study, the specific endonuclease activity of Cas9 was used to detect pathogenic viruses such as ZKV and DNV with femtomolar detection sensitivity, including distinguishing between the American and African version of ZKV.

### **Conclusion:**

The latest viral diagnostic technologies revolutionized in the field of clinical microbiology and greatly participate in minimizing the outbreak of serious viral diseases. The main advantages of molecular techniques are its higher sensitivity and specificity compared with other conventional diagnostic methods.

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## CHANGING FACE OF FACE MASKS

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### Abstract:

The most important weapon in the war against COVID-19 was the use of masks which is the simplest, Cheapest and effective to fight during the pandemic. Transmission of bacteria and viruses takes place mostly through social contacts in human population therefore face masks to prevent the transmission of SARS-CoV-2 during the period when therapeutic intervention was lacking finds its place. Evidences suggest the historical existence of humans wearing masks for as long as we have been humans. The Covid pandemic is writing a fascinating new chapter in the cultural history of human masks. Globally the use of facemasks was a fairly accepted practice for protection against the infection during the COVID-19 pandemic although scientific discussions are going on up to now, the answers to these can be found in the history of medicine and science. In this chapter, we made an attempt to review the Changing face of masks from the middle age to modern times.

**Keywords:** History of face masks, Surgical mask, Pandemic, Infection, Behaviour, Viral transmission, Bacterial transmission, Covid 19, (OPEs).

### Introduction:

One of the primary reasons to use face mask is to help ensure protection from disease transmission and to suppress transmission for life saving. Need of masks arises as a useful along with a comprehensive 'DO IT ALL!' approach including cleaning hands, physical distancing, avoiding crowded places, good ventilation, covering sneezes and coughs, and more. Mask to be used depends on its use either protection of healthy persons or prevention of onward transmission. It is Wells (Wells, 1934) who first hypothesised droplet nuclei transmission of airborne infections in the 1930s, Transmission of pathogens through airborne routes have also been identified (Fiegel *et al.*, 2006, Eames *et al.*, 2009). Coughing and sneezing produces droplets containing infectious particles (viruses and bacteria) are released when an infected person coughs or sneezes (Nicas *et al.*, 2005, Chao *et al.*, 2009). Severe acute respiratory syndrome and human swine influenza pandemics in 2003 and 2009 respectively Sought

immediate attention globally which was not taken seriously earlier despite the potential public health implications or airborne transmission. These pandemics gave a new dimension to studies and research to find out the ways to control and reduce infections caused by airborne pathogens. Originally the face masks were used to offer protection from surgical wounds from staff-generated nasal and oral bacteria (Meleny and Stevens, 1926, Romney, 2001) among others. The governments all over the globe during the current COVID-19 pandemic have issued mandatory regulations for the use of masks and other face coverings and therefore face masks are being used in much broader sense in situations where contact of people is frequent and inevitable at places such as gatherings, public transports, workplaces and likewise. There are situations where physical distancing and hand hygiene is challenging where comes the role of face masks but it's not an alternative to it. The speed of infectious respiratory droplets being blown into the environment can be reduced using face masks. In this review we have made an attempt to study the history, type of masks used and the advantages and disadvantages of using the various masks available in the market during the present scenario.

**Review:**

**“Masks are mandatory for all now”** <https://www.thehindu.com/news/cities/chennai/masks-are-mandatory-for-all-ow/article31400601.ece>

The Prime Minister in his address to the nation on the 14th of April said: "Completely adhere to the 'Lakshman Rekha' of Lockdown and Social Distancing. Please also use homemade face-covers and masks without fail". This headline appeared in 'The Hindu' on an article regarding Masks are mandatory for all now in times of the COVID-19 outbreak. This is the most recent expression of the use of face masks. However, facemasks have been used since the Middle Ages.

**Middle ages to renaissance:**

The history of early modern age has the reference of the pictures of working medical professionals treating patients suffering from bubonic plague wearing beak-like masks which were supposedly filled with herbs such as clove or cinnamon as well as liquids and led to the term 'beak-doctors' (Byrne, 2006) (Fig. 1). During the Middle Ages the doctors wearing black cloaks and dark hats were considered the symbol of the deathly epidemic. It is said that the masks were used to offer protection from the 'blight', the miasma, which was considered the cause of the plague back then. There was a promulgation that the spoiled air from east has caused the epidemic but there is no proof of existence of 'plague-doctors with beak-like masks' (Mussap CJ, 2019) (Snowden F, 2020).



**Figure 1: Coloured version of a copper engraving of Doctor Schnabel (i.e., Dr. Beak), a plague doctor in seventeenth-century Rome, circa 1656 by Paul Fürst (1608–1666) of Nuremberg made for a broadsheet, German derivative of a sheet of Sebastiano Zecchini, 1656 (source Wikipedia [https://de.wikipedia.org/wiki/Pestdoktor#/media/Datei:Paul\\_Fürst,\\_Der\\_Doctor\\_Schnabel\\_von\\_Rom\\_\(coloured\\_version\).png](https://de.wikipedia.org/wiki/Pestdoktor#/media/Datei:Paul_Fürst,_Der_Doctor_Schnabel_von_Rom_(coloured_version).png))**

### **The Manchurian plague, 1910–1911:**

The masks made up of 4\*6-inch cotton rectangle was used during the Manchurian Plague which was used on mouth by a long piece of gauze. It was made in such a way that the rectangle was contained within the gauze lengthwise this mask was made in such a way that it had the appearance of the modern-day cotton mask but nose and mouth used to be covered thicker than they are now (Lynteris, 2018).

### **The Spanish influenza of 1918–1919:**

In 1918-1919 during the influenza outbreak masks were made compulsory which were made up of layers of cotton gauze with occasionally another layer of a less porous material surrounded by a metal frame. The significance of these masks was they were reusable and sterilizable (Schlich, 2020) and thus, these masks protected the population to stop the spread of the disease which lasted for about 18 months (Patrick, 2009).

Advancement in the knowledge and discoveries on infectious diseases almost a century later, with new discoveries and advancements in knowledge of infectious diseases, Face masks became the first line of defence during the outbreak of severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) and Covid 19 pandemic outbreak caused by SARS-CoV which has devastated the world (Prather *et al.*, 2020), (Cunha CB and Opal SM 2014).



**Figure 2 Left: A nurse wearing a cloth mask during the Spanish flu (1918–19) (Photo: Harris & Ewing photographers / Public domain, via Wikimedia Commons), Right: A plague worker during the Manchurian epidemic (1910–11) (Photo: Thomas H. Hahn Docu-Images — Historical photographs of China, Public domain, via Wikimedia Commons)**

#### **Facemasks in the COVID-19 era:**

Facemasks can be categorised depending on the use into two types the medical masks worn by healthcare workers (Prather *et al.*, 2020), (Kool *et al.*, 2005) certified by National Institute for Occupational Safety and Health (NIOSH)-certified N95 mask, and Surgical masks (Prather *et al.*, 2020). The N95 face masks consist of electret filter media and have the ability to seal tightly to the face of user, while surgical masks may or may not be made of electret filter media and have loose fitting. The N95 protects the user from inhalation exposure to infectious and harmful particles from the environment while surgical masks act as barrier against splash, spittle and other body fluids to spray from the wearer (such as surgeon) to the sterile environment (patient during operation) for reducing the risk of contamination (Prather *et al.*, 2020). The third type is the non-medical masks made of cloth or fabric or a variety of woven and non-woven materials such as Cellulose, Polypropylene, Cotton, Silk, Gauze and Polyester, they are neither a medical device nor personal protective equipment but some standards have been developed for their use by governments.

#### **Dangers of using the new generation COVID-19 face masks:**

There is paucity of literature on studies relating to the evaluation of components in masks that may have adverse effects on health. In one study it was found that prolonged use of face masks poses a potential risk to humans. Health care workers using filtering facepiece (FFP)2 respirators for a long time have the risk of carbon dioxide retention due to re-breathing as studied by Ozdemir *et al.* (2020). The materials used for the production of single use face masks are

polymers such as polycarbonate, polystyrene, polypropylene, polyethylene or polyester, polyurethane, polyacrylonitrile, (Potluri and Needham, 2005). The chemical compounds such as plasticizers and flame retardants contained in these polymers may have adverse health effects. The commercially produced masks contain chlorinated phenols, polycyclic aromatic hydrocarbons (PAHs), and some plasticizers such as phthalates which are toxic to human health. The health hazards due to the use of Organophosphate esters (OPEs) as plasticizers and flame retardants in masks production for example disruption of endocrine, reproductive, nervous system functions and carcinogenicity has been observed due to the component tri-n-butyl phosphate (TNBP) in one of the study (He *et al.*, 2020). Exposure of (1,3-dichloro-2-propyl) phosphate (TDCIPP) is found to be associated with the decline in semen quality. Asthma and allergies are also found to be associated with the use of (OPEs) (Meeker and Stapleton, 2010; Van der Veen and De Boer, 2012).

### **Conclusion:**

It is now accepted that wearing a mask is the very basis of protection against respiratory diseases. History signifies the power of masks to communicate a wide range of individual and culturally held beliefs. During the 17th and 18th century Europe plague masks came into existence to take care of disease, suffering and death. With the advancement in science and medicine masks came to signify and communicate antiseptic practice and the containment of respiratory pathogens. However, the COVID-19 pandemic has given a new dimension to face masks. It seems that disposable masks are not any longer appropriate for the protection of populations, both due to stocks that are difficult to regulate and since of the very negative ecological impact on the planet. The era of all-plastic, all-disposable masks shouldn't be a part of the “new world” after COVID-19.

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## **CHEMISTRY OF COVID-19**

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### **Abstract:**

Chemistry has a vital role in understanding the chemical nature of all microbes including Corona virus. It helps in fighting against Covid -19 diseases in all possible ways. like isolation and preparation of chemicals in the form of vaccine and therapies ,development of different technique to be used by virologist and doctors, determination of structure of corona virus, method and mechanism of virus pathogenesis, understanding of its effect on cell and tissues etc. In the SARS-CoV-2 virus body the genetic material is RNA which is bonded to the protein. Some of the protein Evolved in the form of spikes that helps in attachment of virus to the human cells. The lipids in the form of the layers act to protect the RNA and protein of the virus. Genetic material RNA of corona virus is made up of about 30,000 nucleotides units in the form of single helical stand. The replication of virus RNA in the human cell is responsible for its quadratic growth in number. The mechanism of pathogenesis of viral disease has four different steps. This article highlights the structure, mechanism of spreading of corona virus infection and its effect on living cell.

### **Introduction:**

Chemistry is the study of matter, its properties, how and why matter combine or separate to form other type of matter, and how it interact with energy. Chemistry may also be defined as a branch of physical science that studies matter in terms of: it's Composition, Structure, Properties and changes from one form to other. Chemistry is everywhere in every discipline anyone can imagine, for example- Biology (Biochemistry); Medicine (Medicinal chemistry); Industry (industrial chemistry); Pharmacy (Pharmaceutical Chemistry); Food (Food Chemistry); Agriculture (Agricultural Chemistry); Plant Science (Phytochemistry); Geology (Geochemistry); Radiology (Radiochemistry); Astrology (Astrochemistry); etc. It is interesting to note that Chemistry can be found in the body of living organism, non living organism and in the body of virus those are known as chain bet living and non living organism. Chemistry has a vital role in

understanding the chemical nature of all microbes including Corona virus. It helps in fighting against Covid -19 diseases in all possible ways. like isolation and preparation of chemicals in the form of vaccine and therapies ,development of different technique to be used by virologist and doctors, determination of structure of corona virus, making of PPE kit and related material,method and mechanism of virus pathogenesis, understanding of its effect on cell and tissues etc. This article highlights the structure, mechanism of spreading of corona virus infection and its effect on living cell.

### **Discussion:**

From last month of year-2019 a novel pathogen in the form of virus named SARS-CoV-2 has emerged as a major threat to the humanity all around the world. This pathogen causes the infection associated to the severe respiratory syndrome which leads to the total no of twenty three crore infections and nearly 47 lakh death as of September 2021 all around the world and this number day by day still continuously increasing. The world Health Organization declared this disease as a public health emergency of international concern in Jan 2020 as it is confirmed that SARS-CoV-2 is a transmitting disease. Due to the very fast rate of spreading of this disease coming with its very serious impact on humanity in terms of all aspect like death, mental health, social health, economic view etc, urgent requirement for powerful and concentrate effort in scientific research in order to allow the deeper understanding about the structure of virus, its pathogenic mechanism and material and method associated with this virus interaction to human body to fight and stopping the diseases is needed. The structure of corona virus, its pathogenesis mechanism and its effect on human cell is given below-

### **Structure of Corona virus:**

Generally the virus body is made up of three components (A) Genetic material in the form of nucleic acid. The nucleic acid may be DNA or RNA (B) Protein, the polymer of amino acids (c) Lipids, polymer of fatty acids and glycerol.

In the SARS-CoV-2 virus body the genetic material is RNA which is bonded to the protein. Some of the protein Evolved in the form of spikes that helps in attachment of virus to the human cells. The lipids in the form of the layers act to protect the RNA and protein of the virus. Genetic material RNA of corona virus is made up of about 30,000 nucleotides units in the form of single helical stand. The replication of virus RNA in the human cell is responsible for its quadratic growth in number. Proteins are the high molecular weight polymers of simple amino acids. Amino acids are those chemical compounds which have at least one amino and one carboxylic group. The protein has primary, secondary, tertiary and quaternary structure on the

bases of sequence, stereochemistry, different shape and structural arrangement of amino acids. As amino group and carboxylic group both are capable of forming hydrogen bond therefore protein stand can fold in various ways to give different shape and structures. The specific structure in the body of some virus is due to this protein folding for example the hydrogen bonding between amino and carboxylic group of peptides chain are responsible for corn like structure on the body surface of corona virus. Hydrogen bonds are those electrostatic attractive forces that's act between partial positive hydrogen and partially negative Nitrogen, Oxygen or Fluorine atom of same or different molecule. The size and shape of the corona virus spikes is found to be appropriate to the shape of Angiotensin converting enzyme-2 receptor attached to the outer surface of the cells of lungs, arteries, heart, kidney and intestine of human body. Thus make these organs more sensitive to be affected by this virus. The lipids are the organic compound made up of hydrocarbon and oxygen atom and are generally soluble in non-polar solvents. These are the polymer of fatty acid containing long non-polar hydrocarbon tail and small polar head part made up of polar organic functional group. These lipids in the form of layer covers the genetic and protein part of the corona virus and thus help in protecting the virus against unfavorable condition.

#### **Structure of corona virus spike:**

Most type of corona virus has five type of structural protein in their genome. These are (1) The spike protein-S, (2) Membrane protein-M, (3) Envelope glycoprotein-E, (4) Hem agglutinin-esterase-HE, (5) Nucleocapsid protein-N.

The spike made up of protein (S) on the surface of corona virus body is responsible for attachment of virus to the cells of different organs of human body. The Corona virus binds to the human cell with great affinity to the ACE-2 receptor of the cell as compare to the other viruses. This is responsible for the fact that it is more contagious than other virus. The corona virus spikes have three parts, a large ectoderm part, a single pass membrane anchor part and a short intercellular tail part. The outer part called ectoderm is made up of a receptor binding subunit called S-2. The electron microscopy studies shows that the spikes are the clove shapes trimmers (a unit of three S-1 head and S-2 spikes). The S-1 subunit form the globular head and S-2 unit contribute the stalk like region of the spikes. The ectoderm the S-2 units contain two region with a 4, 3 hydrophilic replete. These two hydrophobic regions are conserved in a position and sequence among the different member of this corona virus anti genome classes. Studies show that there hydrophobic unit is involved in viral fusion with cell.

**Mechanism-** Virus is known to be organism at the edge of life. viruses is forced to be in the form of a non living particles or virion outside the body of infectious cell. It infects all type of living organism as animals, plants, microorganism including mono cellular Bacteria. Virus in the form of non living particles is found in all type of environmental condition. Virus spread in many ways from vector like coughing and sneezing, fecal route, hand to hand contact, food to water route, inhalation, sexual contact, infected blood receiving airways etc. The process by which any infection leads to disease is called pathogenesis. Pathogenesis may be take place by bacteria, protozoa, and virus or by other microbes. The mechanism of pathogenesis of viral disease has following steps-

- (A) Implantation of virus at the entry surface generally cell of host body.
- (B) Local replication within the host cell.
- (C) Spread to the target organ of host body.
- (D) Spread to the site where virus can enter into surrounding environment.

The factor that affect the mechanism of pathogenesis depends to the accessibility of virus in the form of virion to the group of cell in the form of tissue, susceptibility of cell toward virion, multiplication capacity of virus within the cell and the power of defense of infected cell and surrounded attached cells. During the viral infection in the step one the attachment depends upon the size, shape and chemical nature of spikes of corona virus and the receptor part of host cells ACE-2 which is receptor in the case of human cell. After attachment the virus enters the host cell for multiplication. The penetration that is entry of virus into the host cell occurs mainly by two main pathways called as endocytic and non-endocytic pathways. In membrane fusion process the viral envelope form the cell membrane of host cell to form a pore or tube through the membrane by which the nuclear material and protein of the virus enter the cell. SARS-CoV-2 was initially thought to enter the human cell through the direct fusions with the cell membrane. Some studies show that virus entry may also take place by endocytic process. In this case virus enters the cell via Ph and receptor dependent endocytosis. The SARS-CoV-2 spikes protein interact with angiotension converting enzye-2(ACE-2), which is the function receptor of SARS-CoV-2 from the cell surface to the endoplasm of the host cell. Some studies suggest that virus entrance was motivated by a clathrin and coveolae independent mechanism. The cholesterol and sphinogolipid rich lipids soft micro domains in the plasma membrane were shown to be involved in the process. The unmasking of membrane penetrating peptide also depends upon the cellular cues that act on the virus surface during cell entry. These cellular cues controlling the viral material entry in the cell are receptor, enzymes and chemicals like proteases, metal ion and some reducing agents. Mechanical process also observed to control the viral entry in the cell. Virus also uses internal genome pressure to destabilize their capcid. The symmetry of the host cell and virus

body also plays an important role in viral entry to the host cell. After viral entry in the cytoplasm of the cell, the cytoplasmic proteases remove the capsid of the virion. In enveloped virus the lysosome of the host cell helps in fusing the envelope with the help of lysosomal enzymes and mechanical forces. The nucleic acid replication is the important part of the viral infection cycle. In this part the virion nucleic acid hijacks and controls the cell 'self replication mechanism in the host cell for replication of viral nucleic acid in the multiplication method. The newly replicated viral nucleic acid material use the transition mechanism in the host cell and produce viral proteins. These proteins bind with each other as well as with nucleic acid. By this method the new and many genetic RNA with proteins formed those gets escaped from the host cell by different methods. These Genetic stand which get enveloped protein pass out the cell membrane while the naked genetic material lies in the cell. The escaped enveloped genetic RNA acquire a Cottoning that act as envelope in the form of lipids and thus a no of new virion produced which can affect other cell by some already mention methods in this article. The viral RNA synthesis follows the translation as well as assembly of the viral nuclease. The synthesis produces both genome and sub-genome RNAs. Sub genome RNAs act as messenger RNA which guides the poly proteins replication. This takes place by positive stand synthesis and also occurred during the discontinuous extension of negative stand RNA. Corona virus has also the ability to recombine using both homologous and non-homologous recombination. The recombination plays a prominent role in viral evolution and is the base for targeted RNA recombination.

#### **Effect on the cell and tissues:**

In the mild case of corona virus infection a certain degree of damage take palace to the host cell. In the severe case of corona virus infection the death of the cell may also possible. The cause of the damage and death of the cell is due to the diversion of the vital cell energy from the normal activity of cell metabolism. The infection may also shut down the cells macromolecules synthesis processes for its routine activity. Other Common Reason is the competition of viral mRNA for cellular ribosome and Competition of viral proteins. Beside above stated factors for cell death and decay, some indirect damage may also results like integration of the viral genome, inflammation, induction of mutation in the host cell genome and the immune related response of the body system against virus infections. Most of the viruses spread among the cell by extracellular method but in some cases they may spread inter cellular thus causing local infection and localized diseases in the affected tissue and organ of the human body. The most affected organs of human body by the corona virus are the respiratory system. The respiratory system is the group of organs and tissues like lungs, trachea, nasal way etc. The reason for this is the receptor of this cell in the form of enzyme is ideal for the attachment of the corona virus spikes

with it. From there they can spread in the body can also damage the heart, liver and kidneys. The degree of the loss of the cell and organs depends upon the no of viral stand and there speed capacity of replication .When the virus enters in the host cell the routine mechanism of the cell is disrupted and destroyed. The virus also controls all the cell activity in its favor to grow his number. Sometimes the decay and death of the cell is so severe that it affects all the tissues of infected organs. These results in the multiple organ failure which may leads to the death of affected living being.

### **Conclusion:**

The severity of effect caused by corona virus disease on the human race depends upon the rate of spreading the infection caused by this virus. The rate of infection depends upon many factors like corona virus structure, its attachment's ability, the immune power of the affected living being etc. For the control of these serious effects of the corona virus disease, urgent requirement for deep understanding of corona virus structure, its path genetic mechanism and effects on host cell is needed. The chemistry can help in solving these issues by giving a clear picture of methods to be used in fighting against corona virus in near future.

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## COMPARATIVE STUDY BETWEEN FIRST AND SECOND WAVE OF COVID-19

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### Abstract:

COVID-19 was declared as a pandemic on March 11, 2020 by World Health Organization (WHO). Since its beginning it has completely destroyed public life across the world. Coronavirus disease 2019 (COVID 19) was basically engulfed RNA viruses, which have a range of about 60nm to 140nm in diameter and has a crown like appearance. It is found particularly in mammals and birds. It basically had seven strains which were known till yet and they are HKU1, NKL63, 229E and OC43, SARS-CoV, MERS-CoV and SARS-CoV-19. Among them the most dangerous was SARS-CoV-19 which affected more than half of the population of world. India experienced the first wave of COVID 19 in 2020, which was less critical then the second wave took place in year 2021. Around half of the population died due to COVID-19 in India and more than half of the populations are being infected by this disease. Second wave was more dangerous due to the double and triple mutations of the strains of Coronavirus. Various vaccinations are invented for getting rid of this deadly virus and to control the cause and spread of this virus along with various safety measures. Around half of the populations of India are partially vaccinated and one fourth of populations are fully vaccinated.

**Keywords:** COVID-19, WHO, Vaccine, SARS-CoV-19, RNA Viruses

### Introduction:

World Health Organization declared Coronavirus Disease 2019 (COVID 19) as a pandemic on March 11, 2020, which is continuously disrupting and destroying public life across the world (Davies *et al.*, 2021). Coronaviruses are basically enclosed RNA viruses, having range from 60nm to 140nm in diameter having crown-like appearance, which is found particularly in

mammals most commonly in humans and birds. It was observed and also proved that Coronaviruses have mutated and recombined behavior which causes respiratory, enteric, neurological and hepatic diseases. Around seven strains of coronavirus are known till yet, which include HKU1, NKL63, 229E and OC43, SARS-CoV, MERS-CoV and SARS-CoV-19. Among these the first four have mild impact on infested human having mild respiratory disease, and the other three causes the fatal impact on humankind (Singhal, 2020; Sohrabi *et al.*, 2020). In year 2002-03, more than 8000 cases of corona were noted among which 774 died due to SARS. In 2012, MERS-Co-V infected about 2494 people and around 858 people died worldwide. In 2020-21 till September 22, 229373963 cases of COVID-19 were reported and around 4705111 people died due to SARS-CoV-19 worldwide. Due to continuous mutation and recombination property of SARS-CoV-2, its genomic sequence is different from the very first reported sequence.

COVID-19 showed first outbreak in Wuhan, Hubei Province in early Dec 2019, people suffering from viral pneumonia were found there and they were epidemiologically associated with the Huanan seafood market in Wuhan. World Health Organization on 30<sup>th</sup> January 2020 declared and outbreak which was officially named as an outbreak of disease linked with the coronavirus as COVID-19. Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-Cov-2) was considered as the main root cause behind COVID-19 disease (Chakraborty and Maity, 2020; Lu *et al.*, 2020; Zhou *et al.*, 2020; Zhu *et al.*, 2020). Including all other countries, India having the second largest population in the world also reached to 1 lakh infection on 18<sup>th</sup> May 2020 and at the end of the year the rate of infections reached to 978,34,141. Along with this in second wave of COVID-19 infected 3.37 Cr people in India ([www.ndtv.com](http://www.ndtv.com)).

Apart from killing people through virus incursion, COVID-19 also affected people mental and economic health, where the developing countries also suffered from hunger and unemployment. India has gone through several phases of Lockdowns in first as well as second wave of COVID-19, which increased the unemployment and hunger rate in India. India is expecting the third wave of COVID-19 soon, but according to various doctors and scientists, the third wave will be less deadly ([www.indiatoday.in](http://www.indiatoday.in)).

### **First wave of COVID-19:**

In early January 2020, not even a single person in India was suffering from COVID-19. Corona virus cases happened in India due to its abroad connections rather than transmissions within the country. First three COVID-19 cases occurred on 30 January and 3<sup>rd</sup> February in Kerala as they returned from Wuhan, China (Patrikar *et al.*, 2020). Not only this within a month other two cases were reported on 3<sup>rd</sup> March, in which one patient had the travel history of Hyderabad to Dubai and the other had a history of Italy. Along with this other new cases were also observed in Jaipur and other States of country (Basu, 2020). In order to control the spread of

pandemic, the Ministry of Health and Family Welfare (MoHFW) issued few travel advisory restrictions which were same as other pandemics such as SARS, bubonic plague and Ebola. They also included the self-quarantine rules for 14 days in their advisory restrictions to all the international travelers entering the country. All the travel visas were also restricted along with proposal of various measures such as social distancing of 1m in order to avoid the spread of deadly virus (Ophthalmol, 2020; Kumar, 2020). On 22<sup>nd</sup> March, Prime Minister of India encouraged people to follow Janata curfew of about 14 hrs and then on 24<sup>th</sup> March 2020, first phase of 21 days Lockdown started in India (The Times of India, 2020; Pulla, 2020). As COVID-19 continued to its peak India gone through various Lockdown phases so as to overcome the transmission of deadly virus. In order to make the lockdown and social distancing effective, India also levied the Law of Quarantine under Epidemic Disease Act, 1897, which states that the country or states are allowed to inspect people traveling by ships and railways and divide suspects in hospitals, under temporary accommodations (Varalakshmi and Swetha, 2020). As the first case of COVID-19 was reported on 30<sup>th</sup> January 2020, till 15<sup>th</sup> March 2020, 107 cases were observed. As the COVID cases kept on rising in year 2020 at the end of lockdown phases, India reported total of 1,90,648 confirmed case which included 5407 deaths due to this disease (Ghosh *et al.*, 2020). Some Cities such as Bhopal, Chennai, Indore, Ahmedabad, Bengaluru, Delhi, Hyderabad, Jaipur, and Kolkata were considered as the COVID-19 hotspots along with four major metropolitan cities which reported for nearly 40% of the COVID-19 cases in India (Rafiq *et al.*, 2020).

It was also identified that the disease is majorly caused in a higher age groups (Ragavi and Geetha, 2020). The clinical feature of COVID-19 consists of fever (not in all), cough, breathing difficulty, headache, lethargy, myalgia, sore throat, and also in some cases conjunctivitis (also in some cases). But, the biggest challenge was to distinguishing this disease from other respiratory infections (Chen *et al.*, 2020). In the early phase of COVID -19 there was unavailability of successful antiviral treatment or vaccine. Therefore, Patients suffering from severe acute respiratory infection, respiratory distress, hypoxemia, or shock were given immediate oxygen therapy. Apart from this few practices were also instructed by WHO like regular washing of hands using alcohol-based hand sanitizer or soap and water, avoid touching of eyes, nose and mouth outside, wearing masks, etc.

Testing of COVID-19 started at the Indian Council of Medical Research's National Institute of Virology, Pune, the only lab of testing coronavirus in beginning and at the end of the year the number of labs reached to 1105 (788 govt labs and 317 private labs) to deal with COVID-19 cases (Xu *et al.*, 2020). Additionally, around 2.02 crore N95 masks and 1.18 crore PPE kits were distributed in Indian states. India also launched 'Arogya Setu' mobile application

for tracking COVID-19. As till then there was no vaccine or antiviral drug available against SARS-CoV-2, so Hydroxychloroquine (HCQ) was being advised as chemoprophylaxis drug for asymptomatic healthcare personnel handling COVID-19 cases, frontline workers, and asymptomatic contacts of the confirmed cases while later it was proved that hydroxychloroquine-azithromycin combination is strictly recommended for patients with serious sickness (Indian Council of Medical Research, 2020)

First phase of COVID improved the air quality particularly the reduction of NO<sub>2</sub>.

### **Second wave of COVID-19:**

After the outcome of first wave of COVID-19, the second wave of COVID-19 was more severe in India has had severe having spiralling cases, which reduced supplies of essential treatments, and finally this leads to increased deaths particularly in the young population. According to various studies, it was identified that there are various circulating double-mutant and triple-mutant strains of SARS-CoV-2 across several regions of India, which are more pathogenic and crucial than the initial strains of COVID-19 and also had high rate of transmission. Such altered pathogenicity indicates evolution of the virus. More the population density more will be the chances of viral replication, mutation, and evolution, as proven by Moya and colleagues. Other countries discovered variants, such as B.1.351, B.1.1.7, and P.1, as reported by Boehm and colleagues (Indian Council of Medical Research, 2020; Moya *et al.*, 2004), were also circulating within India along with its new discovered variants. The SARS-CoV-2 double mutant strain B.1.617, possessed the main structural mutations Glu484Gln and Leu452Arg in the spike protein, which was considered as highly infectious and less affected vaccine responses, and was also proved as the a central cause of the COVID-19 surge in India (Boehm *et al.*, 2021). Additionally, during the period of second wave in India, most of the cases of mucormycosis, were also noted which is commonly known as the black fungus, in patients with diabetes and patients with COVID-19, including those patients also who were recovering from infection. COVID-19 involved the excessive use of steroids in its treatment and immune-suppression by the virus was major cause of the emergence of this opportunistic fungal infection (Cherian *et al.*, 2021). In first wave also few cases of black fungus were reported, but the cases during the second wave have become more common in many cities of India, leading state governments to declare this too as an epidemic.

On June 7, 2021, the Indian Ministry of Health had recorded 28,252 cases of black fungus along with the cases of COVID-19. Apart from this the risk of the white fungus Aspergillosis— were assumed to be even more fatal than the black fungus, which was also reported in parts of India (Dyer O, 2021).

Infected age groups of Patients in the first wave were commonly older than 60 years and those with critical conditions were at increased risk of death. However, in this case younger individuals appeared to be more prominent to infection and even most of the patients have died at a young age, including patients aged between 25 and 50 years (Sahoo *et al.*, 2021). The reason behind this was considered beyond the scientific explanations.

Second wave peak increased due to sudden decrease in the oxygen saturation of some patients, even after their recovery. Researchers were further focusing on the drugs and vaccines to fight against current pandemic situation. Half of the population is being vaccinated till now with 70-80% protection rate against COVID-19. Identification of immune-based markers (eg, numbers of T-cells and their subsets, B-cells, and natural killer cells, or protein markers such as interleukins 6 and 10, ferritin, C-reactive protein, and procalcitonin) to prejudge the possibility of recovery among COVID-19 patients will also help in the focused treatment of patients. These markers were considered as having a certain link with severe and mild forms of COVID-19 infection.

### **Comparison between first and second wave of COVID-19:**

In first wave only the individuals were being affected but in second wave whole families dealt with COVID. Only the older age group people were more being affected in the first wave where as second wave affected more prominently the young individuals.

According to the study of *Lancet Global Health* in February, it was stated that the first wave infected up to 50% of people in urban areas (Jain *et al.*, 2021) whereas, the second wave showed its adverse transmission effect more to rural areas, where people travel far to get to the nearest health centres. Due to the delay of cause of travel in Punjab. In the state of Punjab health records showed that over 80% of patients had severe symptoms once they arrived. People in the 30-50 year age group seemed to be particularly affected by the second wave more prominently in New Delhi. Anecdotal studies reported a differently greater number of deaths among younger people in second wave but the cause of younger people are being more effected by second wave was yet to be explained as they as affected even with no symptoms. Most of the reports are of reinfections. One of the studies was conducted in which 1300 people were tested positive, were published in March 2021 in *Epidemiology and Infection*, the Indian Centre for Medical Research identified a reinfection rate of 4.5% (Comunian *et al.*, 2020) with a large proportion of these people who showed no symptoms at the first time but still had COVID. “Reinfections were rare in first wave but in second wave it became more common. Hoping for the recovery of what have been lost due to this pandemic. Around half of the country has been vaccinated and still the vaccination drive is going on in country.

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## **COVID-19 NARRATIVE FROM PUNJAB – A NORTHWESTERN STATE OF INDIA**

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### **Abstract:**

The COVID-19 outbreak, currently a pandemic, has created a stressful condition not only for individuals, but also for communities, and governments at large. The virus is infectious and spreads at a fast speed. Naturally it is affecting the general public in their minds. It is therefore important to understand public response to government policies, and decisions in an uncertain situation. This article analyses the positive aspects of the decisions/actions taken during the lockdown due to COVID-19 outbreak in Punjab, India at macro/micro level by the center and the state governments, local administration, and the community in an otherwise stressed environment. This article may be useful to inform policy makers and administrative authorities about public aspirations, and their response to government policies/decisions, community needs in a pandemic.

**Keywords:** COVID-19; Coronavirus; Pandemic; Community support; Administration's role; digital technology.

### **Introduction:**

The COVID-19 pandemic took the world by surprise. Though news related to a coronavirus outbreak in the Wuhan city of China started pouring in around December 2019, but hardly anyone expected that it will reach every nook and corner of the world and that too so fast. World Health Organization (WHO) declared it a Pandemic on 11<sup>th</sup> March, 2020.

COVID-19 affects lungs and spreads primarily through respiratory droplets of an infected person when they cough, sneeze, or even speak. Normal people can get the COVID-19 infection when they breathe in the virus or touch a virus infected surface, and then touch their eyes, nose, or mouth without thoroughly washing hands with either an alcohol based hand rub or a soapy solution (World Health Organization, 2020). COVID-19 infection can cause serious illness, and lung damage is a major hurdle to recovery in those severe patients (Shi, 2020). Unfortunately, there is no vaccine available for this novel coronavirus. Therefore, drastic control measures are

necessary otherwise this deadly virus has the potential to spread at a fast rate with a basic reproductive number (the expected number of secondary cases generated by a primary case) being around 2 and can expectedly infect  $\frac{1}{2}$  of the population (Wu *et al.*, 2020).

To stop the global spread of the disease, the governments' world over took strict actions to make everyone stay at home except the people involved in essential services. The Prime Minister of India announced a 21-day countrywide lockdown on 24<sup>th</sup> March, 2020 at 8pm from 12:01 am of 25th March, 2020. He said in his address "In order to protect the country, and each of its citizens, from midnight tonight, a complete ban is being imposed on people from stepping out of their homes."

Looking at the gravity of the situation, center government's bold decision to close every establishment (leaving the essential supplies) brought a first sigh of relief. No doubt, the lockdown is costly in terms of job loss and rural distress, but it is vital to flatten the curve (Penarredonda, 2020) to reduce the pressure on healthcare services. Health infrastructure is not that great in India commensurate with the population of 1.3 billion persons. In India, state governments are responsible for organizing and delivering health services to their residents. The state government of Punjab has 314 ventilators for a population of 30 million (Khaira, 2020). But as per the world reports, ventilators are very important in containing deaths from the COVID-19 disease (Penarredonda, 2020). Perhaps keeping this in mind, social distancing was thought to be an immediate solution to stop the spread. The state of Punjab was the first to announce curfew, and enforced strict implementation in a very aggressive way. The quick decision to impose curfew was the first important thing to contain the spread. In this article, we discuss positive aspects of the decisions/actions taken at macro, micro level by the centre and the state governments, local administration, and the community in an otherwise stressed environment. This article may be useful to inform policy makers and administrative authorities about public aspirations in a pandemic.

### **Government Support:**

As soon as the lockdown happened, people panicked and started hoarding essential goods like groceries and medical supplies. However, the state and district authorities in Punjab, and in many other states of the country, handled this situation in a praiseworthy manner. The district administration released an area wise list of suppliers of essential goods (District wise orders, 2020), and ensured to the general public that essentials will be available at control rates amidst the lockdown. Now, everything (read essential items) is available through home delivery only, businesses are not open for direct on the counter sale. Food aggregators like Zomato, and Swiggy are engaged for home delivery. At least in the urban areas, things are being managed in more

than expected way. General public was not expecting such a swift action from the government agencies.

Centre and State governments have also ramped up the digital infrastructure to diffuse pandemic related guidelines and notifications to the public without any delay. Relevant and up-to-date information is available at Ministry of Health and Social Welfare (MoHSW) website (<https://www.mohfw.gov.in/>). The central government launched the Aarogya Setu app (<https://www.mygov.in/aarogya-setu-app/>) on 2<sup>nd</sup> April, 2020 to establish a direct contact with the general public as a user can not only assess his own symptoms using the app, but can also inform the authorities if someone around is having the symptoms. The state government of Punjab released the COVA (COrona Virus Alert) application on 7th March, 2020 to help citizen's access authentic information, report violations, and access medical advice in addition to delivery of essential goods.

Social media is also playing a big role in bringing government decisions and announcements to the general public with no delay. Punjab police department is very active on social media platforms like Twitter (@PunjabPoliceInd), and motivating people to stay indoors with the help of slogans, and songs. Though social media platforms helped spread the word about the disease, but the general public was not ready to stay indoors. The police department of the state government has to act tough to stop people from roaming around, and defying the curfew orders. The police department was chided for its aggressive approach in managing the public.

### **Community Support:**

It is a dismal time for daily wagers who need to work daily to feed their families. With majority of the workforce in India engaged in unorganized sector, arranging two square meals a day is a big concern for people belonging to low-income group especially city dwellers. District administration has identified such colonies, and is providing them food and other essential items to ensure that they can stay at home without bothering about food and shelter. Several stories surfaced where police personnel and NGOs are distributing food and other essentials to the needy in distress.

In general, the public is very supportive in this crisis. Using WhatsApp group feature, every piece of information related to essential supplies, and other important issues is available to the community members. People donating stuff to the needy and sharing it on the social media platforms is motivating. General public is also sensible to the plight of people surviving on daily

wages. Majority of them told their domestic helps to not to report for work even before the lockdown keeping in mind the virus spread, and are paying them full wages as well.

Community responds instantly to the panicked members facing an illness (not related to COVID-19) or other emergency situations such as someone broke charging pin for mobile. Many doctors in the residential colonies are making their contact numbers available in the social media community groups for any medical emergency help. Medical, health and fitness experts are also contributing by debunking many myths around the COVID-19 treatments.

Community support is very important to deal with the psychological effects of a pandemic. During the lockdown, people are following social distancing but successfully engaging with neighbours from rooftops. Doing yoga together, dancing, singing songs including devotional, playing tombola games are some of the ways people are helping and supporting one-another. All these activities provide not only relaxation to body and mind in this chaotic environment but also help in strengthening social connections. MoHSW website also provides links to several resources for mental health and stress management. In addition, health experts through social media platforms are addressing the common stress responses like insomnia, and health-anxiety by advising the public to follow relaxation techniques, maintain sleep hygiene, and be active. Sports and film celebrities are also regularly sharing their own lockdown routine with their followers, and motivating them to stay calm. Certain behaviors like panic buying, xenophobia got mended with the help of community intervention. One thing that perhaps worked to restrict panic buying in the local community, as we observed, was that lockdown became effective just 4 hours after its announcement, and a majority of shops were already closed by that time. Moreover, reassurances from the community members, and their buying behavior helped to restraint others from panic buying.

#### **Nature at its best:**

The lockdown, a move to contain the spread of the Coronavirus, is having an amazing impact on our environmental. Pollution in the air has gone down due to transport networks, power plants and other industrial facilities going standstill. Clear view of the Dhauladhar of the Himalayan mountain ranges from rooftops at a distance of 213 km post lockdown indicates that this surreal view was hidden by polluted air. Water quality in the Ganga and the Yamuna rivers has improved as the polluting industry units stopped due to lockdown. Wild animals are being spotted on empty beaches, and city streets (Sharma, 2020). We know that this change is temporary, and things will perhaps be the same as the human activity starts again but it has shown a baseline to compare the pollution, and noise created by humans.

### **Digital Technology's Role:**

The Internet in general and the social media platforms in particular have emerged as important tools for sharing and caring for others in the COVID-19 pandemic. Leveraging this technology, teaching-learning process is continuing in online/remote/virtual mode despite the disruption due to the lockdown. Guru Nanak Dev University, Amritsar, India organized an online workshop on the Zoom platform on 10th April to which 500 faculty members/researchers registered, and 96% attended the full day program. As social distancing is one of the key measures in this pandemic, technology is helping people to reach out to certified doctors and health experts to get online medical consultation. MoHSW has issued guidelines to the medical fraternity to use text/video/audio mediums to prescribe medicines.

No doubt, fake news and misinformation about the COVID-19 is also spreading at a fast rate through WhatsApp messages and Facebook posts. For example, a message on social media claims that gargling salt water could flush out the infection, but there is no evidence. Several reliable sources like (Myths and Facts, 2020; Powder, 2020) have come up on the Internet to help verify the claims. To debunk the fake news and spread of misinformation, several Indian scientists voluntarily formed a group (<https://indscicov.in/>) to explain disease related information to the general public in a scientific way. As social media is prevalent in information dissemination, social media companies like WhatsApp are also upgrading and adding features to distinguish fake content.

### **Conclusions:**

This article highlights some positive aspects of the otherwise stressing situation due to the COVID-19 outbreak. Government and community support, in a pandemic, is observed to be very vital for a positive narrative. There had been countless pandemics that the mankind has faced over the period of time, but COVID-19 is the first one in the digital age. Digital technology is playing a significant role in managing the crisis - be it physical, mental, or economic health, and is helping to mitigate the impact of the disease.

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## THE CASE FOR CYBER SAFETY DURING THE COVID19 OUTBREAK IN THE PHYSICAL WORLD

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### **Abstract:**

Due to the lockdown imposed in the physical world to contain the COVID19 coronavirus, people have moved their work and social lives online i.e. the virtual or cyber world. But they are not safe even in the cyber world. This study identifies the cyber security risks while working from home or socializing only online. It also introduces several safety measures to protect from cyber frauds.

### **Introduction:**

Nations across the globe are trying to mitigate the adverse health and economic impact caused by the COVID-19 pandemic (WHO, 2020). Due to the lockdown imposed in the physical world to contain the coronavirus, people have moved their work and social lives online i.e. the virtual or cyber world. But swindlers in the cyber world have not taken the COVID-19 break; rather their activities have increased during the pandemic. Phishing emails are now using COVID-19 as a lure, for example claiming to have a cure for the virus, offering financial help or asking for donations (Abroshan *et al.*, 2021). User is prompted to click a given link, which takes the user to a dodgy web site and that may infect user's device with malicious code or steal important information including user credentials. The cyber scammers also send messages/ make telephone calls pretending to be from legitimate organizations such as income tax department, banks in an effort to trick people to share their valuable personal information (Tam *et al.*, 2021). Fraudsters created fake accounts for PM Relief Fund for Coronavirus on social media to loot unsuspecting citizens. Several fake websites of Government of India's PM CARES Fund sprang up within hours of official announcement. Across the globe, 4000 fraud portals related to coronavirus surfaced in the past two months.

Cyber scammers may use your device as a conduit to gain entry into your organization's network if you are working from home. Many organizations are advising their workers to use separate devices for work related communication. Therefore it is very important to manage cyber

security risks while working from home or socializing only online. This article explains some of the fundamental concepts related to cyber security that every Internet user should be familiar with. Towards the end, we discuss several safety measures to protect ourselves from cyber frauds.

### **User Authentication:**

Authentication is the process of verifying that those requesting access are the people they claim to be. The commonest way of authentication is to look for correct username/password. Many times passwords are found to be inadequate to protect identity of a user on a system as people tend to use very simple (or easy to guess) passwords to prefer convenience over security, or they may end up in revealing their passwords (Mehra *et al.*, 2020). Therefore, some other factors are used for creating more secure access to the service. Along with username/password, a user may be asked to enter a pin that the service sends to the user through a trusted mode of communication (email or mobile phone e.g. an OTP in case of a bank transaction) called dual factor (or 2 factor) authentication. For example, an ATM doesn't identify a person using an ATM card as the owner of the card. It will ask for some information which only the owner should know. Therefore, there are two factors for user authentication – the card gives user identity, but the PIN confirms the identity. Similarly, biometrics can also be used as a second factor. In this case, user identity is confirmed by something which the user possesses like finger prints, iris/face scan etc. A third factor for authentication can be your device giving you multi factor authentication. If you normally use the service from your desktop/laptop, there will be a security alert when you use it from your mobile phone. If your IP address indicates your location different from the one with which you configured your account, you will be notified through a security alert. Your geolocation is also tracked to prevent payment frauds when a card is used at one location, and next use is attempted within a short span of time from a different location which is impossible for a user to cover in this time period. Nowadays multi factor authentication is becoming very common.

Some web services provide SSO (single sign on) authentication in which user logs in for one service, and all other services also become accessible. For example, you may login Gmail service, and you will get access to YouTube and other Google services automatically.

### **Identity Theft:**

Nowadays almost every organization asks for your personal information such as name, phone number, account numbers, and address and sometimes credit card numbers as well. An individual's identity can be stolen with an intention to impersonate the individual for opening a loan account, or to use as a target in marketing campaigns. In this Information age, it has become

very easy to steal identity data of thousands of individuals by accessing organizational databases. Several organizations have become victims of Data Breach that reveals identity information of all their customers. On the other hand, some organizations are found to be sharing customer data for commercial motives.

**Malicious software:**

If you are infected, your data may be corrupted, compromised, stolen, or lost. Malicious software (short name malware) is programs whose purpose is to disrupt operations of the computer where it executes, steals data from the computer, or damages its software/hardware (Mylonas and Gritzalis, 2012). Malware exists in many forms: Virus, Worms, Trojan horse, Ransomware, spyware, adware. Virus is a malware which just sits on the computer where it is downloaded and infects the files on the machine. Worm is more dangerous that it can replicate to other devices peripherals/computers connected to the computer. Trojan horse is even bad than the previous two in the sense that it can sit on the machine and do all the activity but in hiding. Ransomware can change files in plain text to cipher text (called encryption). Victim gets a ransom message to pay money (mostly in bitcoins) to the attacker. After the money exchange, the attacker may (or may not) release the key to decrypt the data files.

**Social Engineering:**

Normally Internet users understand that sharing username/password details with others is dangerous. They are advised to not even write down their password in plaintext in diaries etc. But cyber criminals have found other ways to make people reveal their account details (Wang *et al.*, 2021). Social engineering is one such method in which service user may be tricked to put his/her accounts details in a lookalike web site. You may have noticed certain email messages which appear to be from genuine service providers asking for the user to click on a link (in the email message body) and complete an action which needs urgent attention. Another example is of an email message that says that you have won a big sum of money or you are a lucky winner of a travel lottery. These are the phishing attacks to either lure or intimidate a user to reveal her identity, or financial details. Nowadays, coronavirus-themed emails/phone calls are being used to victimize susceptible users. In a phone call pretending to be from a bank, user is asked to share OTP (One Time Password). As the user shares the OTP, their bank account is emptied. Phishing emails are normally sent to a large audience and a very low response rate is expected. Fishing is another way of getting the information by using voice calls to contact/engage the user. Similarly Smishing is a type of social engineering in which text messages are used to establish contact with the victim. In Spear-phishing, attackers don't choose their victims randomly, but select their next

victim after a thorough investigation. Victim assumes that conversation is happening with a known person (from neighborhood/office) as the attacker mentions certain things the victim finds correct in the physical world. Whaling is another mechanism in which the victim is at a very high rank in an organization, and the attacker drives the victim to reveal some very important information about the organization.

Let us look into some of the ways to protect against cyber scammers:

**Be vigilant when using email:**

Don't click on any email attachment until you are sure of the sender. A genuine looking tax refund PDF file may contain a malicious program. Furthermore, never click on any hyperlinks in an unexpected, suspicious email message, or from an unknown sender. Never click on a hyperlink in email message to open sensitive accounts, for example your bank web site, lest you may fall victim to the modus operandi that hackers use to get your username/password from you. When you click a malicious link, it will take you to a lookalike of the web site, and prompt you to input username/password. As you enter your credentials, they land up at the attacker's web server for further misuse. Always type the bank web address in the web browser's address bar yourself. You should not share your personal information when you respond to unsolicited email messages. Moreover, you shouldn't reply to such messages because scammers may just be confirming that your email address is active so that they can send more such messages to your inbox in future.

**Update software as soon as notified:**

Some Software/hardware component of your device may have a vulnerability (loophole) that can be exploited by a malicious program to compromise the data on the device. Software/hardware vendors release patches/updates as soon as they become aware of any vulnerability of their product. Users mostly ignore the notification of software update, and keep on postponing it. Always update your device as soon as there is a notification. When automatic notifications are not available, regularly check the vendor's web site for updates and don't click on advertisement or email links for downloading and installing updates. Such links are put by cyber attackers to make a user reveal his/her account details. Download and install software updates using trusted Internet connections only. Stop using a software program if it is not supported by the software vendor any more. Unsupported software with security vulnerabilities may be exploited by cyber attackers to inject malicious code onto your device. Don't ignore any piece of software running on all your devices PC, phone, routers such as operating system, browser, anti-virus software, router firmware for updates.

**Use strong passwords:**

Your password should not be a simple sequence like 1234 or qwerty. A hacker will take less than a minute to crack it, whereas it may take millions of years to crack a strong password. A strong password has a good length (8+ characters) and includes the upper and lowercase letters, numbers, and special characters. You can also twist normal words to create hard to guess passwords (Woo and Mirkovic, 2018). For example use ‘Kemistrie’ instead of chemistry, use password phrases like ‘Iluv2eeticecream’. However, avoid common phrases, famous quotations or the ones that you use in your normal conversation.

Never use words that can be found in a dictionary. Such passwords can be cracked using dictionary attacks in which a hacker uses a computer program to crack the password that may contain dictionary words. Don’t repeat same password for multiple websites. You may reveal your one password accidentally, and it will have a ‘domino effect’ and your other accounts will be also compromised. Always log out if you have to use a public computer for accessing a web service. Another word of caution about the way you may be sprinkling your personal information on the Internet through social media quizzes to pass time during the lockdown. Inadvertently, while responding to questions on your favorite movie or your first pet, you may be providing hints to your security questions that you selected to recover a lost password.

**Regular data backups:**

There are some malicious programs (called Ransomware) which may encrypt data on user’s device. Then the user is asked to pay ransom to get the key which can help to decrypt the data lest he/she will lose the data. The safe measure to prevent becoming a victim of this attack is to always back up data on a removable storage media.

**Only Private WI-FI for sensitive accounts such as bank/email/social media:**

An unsecured Wi-Fi is an easy tool for people on war driving who are driving through streets with a Wi-Fi enabled device and looking for unsecured Wi-Fi connections only to use them for their malicious online activities. During crime investigation such an activity can be easily traced back to your Wi-Fi. Moreover, your own Internet traffic is also prone to monitoring. So always secure the Wi-Fi that you own and configure it for at least WPA3 (Wi-Fi Protected Access) level encryption.

As a user you should know that most of the public Wi-Fi connections are not secure; they exchange data in plaintext which a hacker can sniff. Another thing that may put you off from using public Wi-Fi is the awareness of Evil Twin Attacks. In this attack an adversary places an unsecured Wi-Fi with a very strong signal; unsuspecting users chose to connect due to good

signal strength. Any data that the user sends over the Internet through this connection goes directly into the hands of the adversary.

**Don't fall prey to illegitimate sites:**

Just checking the padlock in the address bar of web browser when you open a web page to ensure that you are connecting to a legitimate site is not sufficient (Fields and Kafai, 2007). Its presence merely indicates that connection with the web server is secure. That means, someone cannot read or modify data you exchange with the server. However, its presence doesn't indicate the trustworthiness of the site. Towards the end of 2019, 74% of the phishing websites used the https protocol or web browser displayed a padlock against their URL in the address bar. You should never submit sensitive information to a web application without checking the principal entity behind the web address.

**Virtual Private networks (VPN):**

Nowadays many companies and organizations have a VPN. VPNs allow employees to connect securely to their network when away from the office. VPNs encrypt connections at the sending and receiving ends and keep out traffic that is not properly encrypted. If a VPN is available to you, make sure you log onto it any time you need to use a public wireless access point.

**Never leave your device unattended:**

People can steal your data if you are not around your device. You may have saved your passwords on your device for many web services that you use every day. Someone may discover your passwords in your absence.

**Check privacy policy of the organization before providing your personal/financial information:**

When you post your information online on a public platform, keep in mind that it is almost not possible to later remove it completely from the Internet or any devices attached to it. Therefore, put only that much information which is essential, does not reveal your routine, and cannot to be used against you at some time in future. You might have noticed that you get spam in the email account that you have shared the most. Therefore always check the privacy policy of an organization with which you share your private data (Sigmund, 2021).

While sharing your personal information with organizations/companies, beware of the fact that all the organizations don't protect your data. Some may lose it inadvertently to a data breach, or may unfortunately trade for money or other favours. Always change your passwords, if you are notified of a data breach attack on an organization with which you have shared your information.

**Be a digital citizen:**

Last but not the least, you can make cyber world a safe and happy place by being nice to people online.

**Nevertheless, If you become a victim:**

If you find that you have revealed your account details to a con web site, immediately report to the organization managing your account for example your bank to freeze your bank account, or your mail server to get back control of your email account. You should also report to the cyber-crime cell of your local police. Immediately change the password if you have used the same password for other services.

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## **COVID-19: A COMPREHENSIVE OVERVIEW**

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### **Introduction:**

#### **Coronavirus diseases:**

Coronavirus illnesses are caused by viruses belonging to the coronavirus subfamily, a group of closely related RNA viruses that infect mammals and birds. The group of viruses causes respiratory tract infections in humans and birds that can range from moderate to fatal. Some cases of the common cold (which can also be caused by other viruses, primarily rhinoviruses) [1] are mild, whereas more lethal strains can cause SARS, MERS, and COVID-19 in humans [2,3]. As of 2021, 45 species of coronaviruses [4] have been identified, and 11 illnesses have been identified, as stated in Table 1.

Coronaviruses have a shape that resembles a stellar corona, such as the one seen during a total solar eclipse; corona comes from the Latin word corona, which means "garland, wreath, crown [5]." Professor Tony Waterson [6-8] coined the term in a meeting with June Almeida and David Tyrrell, the founding fathers of coronavirus research, and it was first used in a Nature article in 1968 [9], three years after the International Committee for the Nomenclature of Viruses approved it [10].

The first coronavirus sickness was discovered in the late 1920s, however coronaviruses are thought to have evolved as recently as 8000 BCE [11]. In the 1960s, human coronaviruses were found in the United States and the United Kingdom through a series of experiments [12]. In human coronaviruses, bats are a common source [13].

#### **Coronavirus disease 2019 (COVID-19): What is it?**

A coronavirus is a common virus that infects the nose, sinuses, and upper throat. The vast majority of coronaviruses are harmless. The World Health Organization classified SARS-CoV-2 as a novel coronavirus type in early 2020, following a December 2019 epidemic in the Wuhan city of China [35]. The epidemic soon spread around the globe. SARS-CoV-2 causes COVID-19, a condition that causes a respiratory tract infection, according to specialists. It can affect either the upper (sinuses, nose, and throat) or lower respiratory system (windpipe and lungs). It spreads like other coronaviruses, primarily through direct contact between people. The severity of infection varies from moderate to fatal.

**Table 1: Coronavirus diseases**

<b>Disease</b>	<b>Cause</b>	<b>First identified</b>	<b>Details</b>
Avian infectious bronchitis	<i>Avian coronavirus (IBV)</i>	1920s [14] (isolated in 1938) [15]	Originated from North America[14].
Transmissible gastroenteritis	Transmissible gastroenteritis virus (TGEV)	1965 (recognized in 1946) [16]	Infects pigs [16], cats [17], and dogs [18].
Common cold, pneumonia, bronchiolitis, etc.	<i>Human coronavirus 229E (HCoV-229E)</i>	1930s (isolated in 1965) [19]	Likely originated from bats[20].
Murine encephalitis	JHM (named after John Howard Mueller), a murine coronavirus[21]	1949 [22]	
Common cold	<i>Human coronavirus OC43 (HCoV-OC43)</i>	1967[23]	Likely originated from rodents, then transmitted to humans through cattle[24].
Acute infectious diarrhea	<i>Porcine epidemic diarrhea virus (PEDV)</i>	1971[25]	Caused outbreaks in 1972[26] and 1978 [27], 2010, 2013, 2014, and 2015[28]. Infects pigs and sows.
Severe acute respiratory syndrome (SARS)	Severe acute respiratory syndrome coronavirus (SARS-CoV or SARS-CoV-1), a strain of <i>severe acute respiratory syndrome-related coronavirus (SARSr-CoV)</i>	2002	Caused the 2002–2004 SARS outbreaks. Likely originated from horseshoe bats [29].
Common cold	<i>Human coronavirus HKU1 (HCoV-HKU1)</i>	2004	Originated from Hong Kong[30].
Respiratory infection	<i>Human coronavirus NL63 (HCoV-NL63)</i>	2004	Originated from Amsterdam, Netherlands [31]. Likely originated from tricolored bats [32].
Middle East respiratory syndrome (MERS)	<i>Middle East respiratory syndrome-related coronavirus (MERS-CoV)</i>	2012	Caused outbreaks in 2012, 2015, and 2018. Likely originated from the Middle East, particularly Jeddah[33].
Porcine diarrhea	<i>HKU15</i>	2014	Discovered in Hong Kong.[34]
Coronavirus disease 2019 (COVID-19)	Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a strain of SARSr-CoV	2019	Cause of the COVID-19 pandemic. Originated from Wuhan, China;[35] possibly from horseshoe bats, pangolins, or both [36].

### **Common strains of SARS-CoV-2:**

Two strains are discovered in a Chinese analysis of 103 COVID-19 cases, which they designated as ‘L’ and ‘S’. Although the ‘S’ type is older, the ‘L’ type was more prevalent in the outbreak's early phases. They believe one causes more sickness instances than the other, but they are still figuring out what that implies. A virus's ability to adapt or evolve as it infects people is also common, and this virus has done so. There are various variations that are named after the localities where they are first discovered, but they have already spread to other areas and countries, with some proving to be more contagious and deadly than others.

### **How are variants classified?**

To improve coordination among the Centers for Disease Control and Prevention (CDC), National Institutes of Health (NIH), Food and Drug Administration (FDA), Biomedical Advanced Research and Development Authority (BARDA), and Department of Defense, the US Department of Health and Human Services (HHS) established a SARS-CoV-2 Interagency Group (SIG), and Department of Defense (DoD). This interagency group is focused on the rapid characterization of new variations and their potential influence on crucial SARS-CoV-2 countermeasures, such as vaccines, treatments, and diagnostics.

The SIG meets on a regular basis to assess the risk posed by SARS-CoV-2 variants circulating in the United States and provide categorization recommendations. This assessment is carried out by a group of subject matter experts who look at the available data, such as variant proportions at the national and regional levels, as well as the potential or known impact of the mutation constellation on the effectiveness of medical countermeasures, disease severity, and the ability to spread from person to person.

Variants may be reclassified based on their qualities and prevalence in the United States, given the continual evolution of SARS-CoV-2 and our awareness of the impact of variants on public health (Table 2) [37].

- Variants Being Tracked (VBM) - View current VBM being monitored and categorized by government agencies in the United States.
- Variant of Interest (VOI) – Currently, no SARS-CoV-2 variants have been recognized as VOI.
- Variant of High Consequence (VOHC) – There are currently no SARS-CoV-2 variants that are of high consequence.
- Variant of Concern (VOC)- View current in the United States that are being closely watched and classified by federal agencies.

**Table 2: Classifications of SARS-CoV-2 variant**

WHO Label	Pango Lineage	Date of Designation		
Alpha	B.1.1.7, Q.1-Q.8	VOC: December 29, 2020		VBM: September 21, 2021
Beta	B.1.351, B.1.351.2, B.1.351.3	VOC: December 29, 2020		VBM: September 21, 2021
Gamma	P.1, P.1.1, P.1.2	VOC: December 29, 2020		VBM: September 21, 2021
Epsilon	B.1.427 B.1.429	VOC: March 19, 2021	VOI: February 26, 2021 VOI: June 29, 2021	VBM: September 21, 2021
Eta	B.1.525		VOI: February 26, 2021	VBM: September 21, 2021
Iota	B.1.526		VOI: February 26, 2021	VBM: September 21, 2021
Kappa	B.1.617.1		VOI: May 7, 2021	VBM: September 21, 2021
N/A	B.1.617.3		VOI: May 7, 2021	VBM: September 21, 2021
Zeta	P.2		VOI: February 26, 2021	VBM: September 21, 2021
Mu	B.1.621, B.1.621.1			VBM: September 21, 2021

**Expected lifespan of the coronavirus:**

It is impossible to predict how long the pandemic will last. Many elements are at play, including public attempts to slow the spread of the virus, researchers' efforts to understand more about the virus, they hunt for a treatment, and vaccine success.

**COVID-19 Symptoms:**

The most significant signs and symptoms were displayed in Figure 1. Pneumonia, respiratory failure, heart disease, liver disease, septic shock, and death are all possible outcomes of the infection. A cytokine release syndrome, sometimes known as a cytokine storm, is thought to be the source of many COVID-19 problems [38]. When our immune system detects an infection, it releases inflammatory proteins known as cytokines into our bloodstream. They can cause tissue death and organ damage. Lung transplants are required in some instances. Medical experts advise us to take medical care if the following has severe symptoms:

- Breathing difficulties or shortness of breath

- Chest discomfort or pressure that persists
- A new source of perplexity
- Unable to completely awaken.
- Lips or face that are bluish

COVID-19 has also been linked to strokes in some persons.

IS IT THE FLU OR COVID-19?			
	SYMPTOM	FLU	COVID-19
	FEVER	✓	✓
	FATIGUE	✓	✓
	COUGH	✓	✓
	SORE THROAT	✓	✓
	HEADACHES	✓	✓
	RUNNY NOSE	✓	✓
	SHORTNESS OF BREATH	✓	✓
	BODY ACHES	✓	✓
	DIARRHEA AND/OR VOMITING	✓	✓
	ONSET	1-4 days after infection	About 5 days after infection but can range from 2-14 days
	LOSS OF TASTE AND/OR SMELL		✓
	RED, SWOLLEN EYES*		✓
	SKIN RASHES*		✓

\*EMERGING SYMPTOMS BASED ON RECENT DATA

Figure 1: The most significant signs and symptoms of Flu and COVID-19

We should keep in mind the acronym FAST:

**Face.** Is the person's face numb or drooping on one side? Is their grin crooked?

**Arms.** Is one of our arms numb or weak? Does one arm slump as they try to raise both arms?

**Speech.** Are they able to communicate clearly? Request that they repeat a sentence.

**Time.** When someone is experiencing symptoms of a stroke, every minute counts.

If we are infected, symptoms can appear in as little as two days or as many as fourteen. It differs from one person to the next.

These are the most common symptoms among COVID-19 patients, according to researchers in China (Figure 2):

Some COVID-19 patients have serious blood clots in their legs, lungs, and arteries, which require hospitalization.

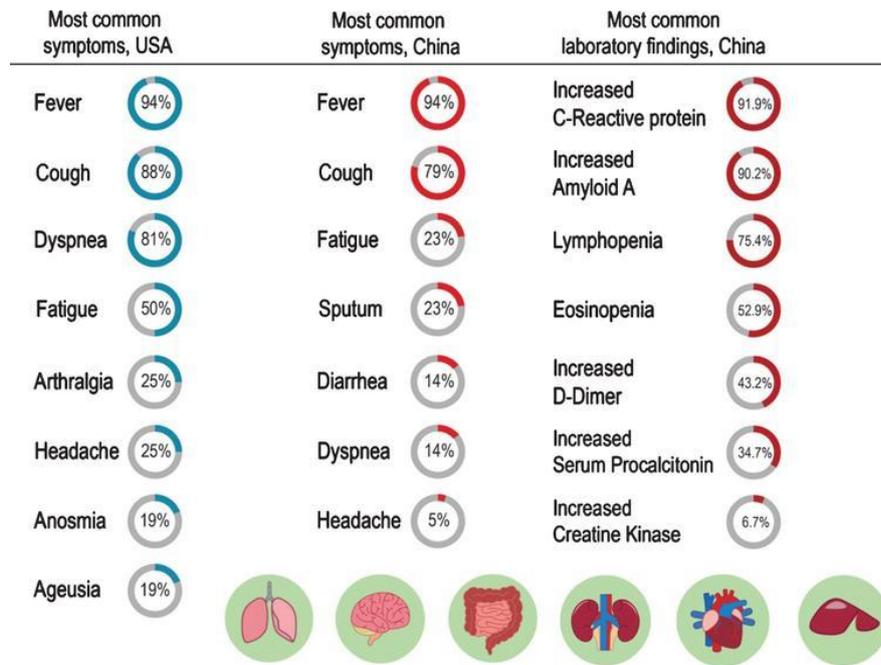


Figure 2: The most common symptoms of COVID-19 in USA and China

### What should we do if we suspect we have got it?

If we reside in or have visited a COVID-19-affected location, we should take the following precautions:

**Stay at home if we are unwell.** Stay in until we feel better, even if we have minor symptoms such as a headache or runny nose. This allows doctors to focus on patients who are more gravely ill while also protecting health care employees and others we may encounter. Self-quarantine is a term we could hear. Keep yourself in a separate room from the rest of our family. If possible, use a separate bathroom. If we are having problems in breathing, we should consult a doctor immediately. We must get medical assistance as soon as possible. Instead of showing there, calling beforehand will allow the doctor to direct us to the appropriate location, which may or may not be our doctor's office. We should follow our doctor's instructions and stay informed about COVID-19. We will get the care we need from our doctor and healthcare authorities, as well as advice on how to prevent the infection from spreading.

### Difference between COVID-19, a cold, and the flu:

COVID-19 symptoms are comparable to those of a nasty cold or influenza. If we have a fever and a cough, our doctor might suspect COVID-19. Within the last 14 days, we are exposed to persons who had it.

### COVID-19 is more dangerous virus than influenza:

Because the coronavirus is so new, it has not yet inoculated many people, unlike the flu. If we get it, our body produces antibodies in response to the virus. Antibodies are being studied to see

whether they can keep us from contracting the virus again. In addition, the coronavirus appears to cause more severe disease and death than the flu. However, symptoms might differ greatly from one person to the next.

**Is COVID-19 like the flu in that it is seasonal?**

Higher temperatures and humidity levels are expected to help prevent the spread of the coronavirus, but this did not happen. Experts advise caution, claiming that comprehensive public health initiatives have a greater impact on the spread of the disease than the weather. Furthermore, previous flu pandemics occurred all year.

**The new coronavirus's reasons for existence:**

Its cause is unknown, and inquiries into its cause are continuing. Coronaviruses come in a variety of types. Bats, camels, cats, and cattle, for example, are all known to have them. COVID-19 is caused by SARS-CoV-2, a virus that is related to MERS and SARS. Bats are the source of all of them.

**Risk factors for coronary artery disease:**

COVID-19 can infect anyone, and the majority of cases are minor. The danger of serious sickness increases as we become older. If we have one of the following health conditions, we are at a higher risk of serious illness:

- Chronic kidney disease
- Chronic obstructive pulmonary disease (COPD)
- A weakened immune system because of an organ transplant
- Obesity
- Serious heart conditions such as heart failure or coronary artery disease
- Sickle cell disease
- Type 2 diabetes
- Conditions that could lead to severe COVID-19 illness include:
  - Moderate to severe asthma
  - Diseases that affect our blood vessels and blood flow to our brain
  - Cystic fibrosis
  - High blood pressure
  - A weakened immune system because of a blood or bone marrow transplant, HIV, or medications like corticosteroids
- Dementia
- Liver disease
- Pregnancy
- Damaged or scarred lung tissue (pulmonary fibrosis)

- Smoking
- Thalassemia
- Diabetes type 1 is a condition in which the body produces insulin

Some COVID-19-infected kids and teens develop an inflammatory illness known as a multisystem inflammatory syndrome in children, according to doctors. It is possible that the virus is to blame, according to doctors. It causes symptoms that are comparable to toxic shock and Kawasaki illness, which causes inflammation in the blood vessels of children.

### **Transmission of Coronavirus:**

The virus SARS-CoV-2 travels mostly from person to person. When a sick person coughs or sneezes, it usually spreads quickly. They have the ability to shoot aerosol droplets up to 6 feet distant. The virus can infect our body if we inhale or consume them. Although some persons with the virus show no symptoms, they might still spread it. We can also obtain the virus by touching a virus-infected surface or object and then touching our mouth, nose, or eyes, though this is less likely. Most viruses can survive on a surface for several hours. SARS-CoV-2 can survive on a variety of surfaces for several hours, according to a study:

- Copper (pennies, teakettles, cookware) - 4 hours
- Cardboard (shipping boxes)- up to 24 hours
- Plastic (milk containers, detergent bottles, subway and bus seats, elevator buttons)-2 to 3 days
- Stainless steel (refrigerators, pots and pans, sinks, some water bottles)- 2 to 3 days

To get rid of the virus, it is critical to wash or sterilize our hands and disinfect surfaces on a frequent basis. The virus has been found in some dogs and cats. Nevertheless, only a few have displayed symptoms of sickness. Although, there is no proof that humans may contract this coronavirus from an animal, it appears that it can be transmitted from humans to animals.

### **Community spread:**

When doctors and health officials are unsure of the source of an infection, they use this word. When it comes to COVID-19, it usually refers to someone who contracts the virus despite not having visited outside of the country or being exposed to someone who has travelled abroad or has COVID-19. The Centers for Disease Control and Prevention (CDC) confirmed a COVID-19 infection in California in February 2020 in a person who had not gone to an affected area or been exposed to someone who had the disease. This was the first time in the United States that a community spread has happened. That person was most likely exposed to someone who was afflicted, but did not realize it. This type of occurrence has also occurred with the variations.

### **Rate of spread:**

Every day, the number of people infected with SARS-CoV-2 fluctuates. For the most up-to-date information on this developing storey, visit our news storey.

### **Is the coronavirus contagious?**

The rate of transmission is quite high. According to preliminary study, one individual who has it can spread it to between 2 and 3.5 other people. According to one study, the rate was greater, with one case infecting between 4.7 and 6.6 persons. In comparison, one individual infected with the seasonal flu will infect between 1.1 and 2.3 people. According to the CDC, there is evidence that it can be spread if we spend 15 minutes within 6 feet of someone who is infected. Previously, it was thought that the exposure had to be done in 15-minute increments. When we can not stay 6 feet away from others, we should use cloth face masks, wash our hands frequently, keep common surfaces clean, restrict our contact with others, and become vaccinated.

COVID-19 is considerably more likely to spread from person to person than it is to spread via packaging, goods, or food. If we are in a high-risk group, stay at home and order groceries online or have a friend to do shopping for us. If possible, request that they place the items outside our front door. Wear a cotton face mask and keep at least 6 feet away from other customers if we are doing our own shopping. Before and after bringing objects inside our home, wash our hands for at least 20 seconds. Because, the coronavirus can linger on hard surfaces, disinfect countertops and everything else our bags have come into contact with. If we like, we can clean plastic, metal, or glass packaging using soap and water. There is no evidence that COVID-19 was acquired through food or food containers.

### **Diagnosis of Coronavirus:**

If we think we have been exposed and are experiencing symptoms like these, contact our doctor or our local health department.

- Fever of 100° F or higher
- Cough
- Trouble in breathing

In most regions, testing facilities are easily available. In addition, certain home testing kits are now accessible. The most common procedure is a swab test. It scans our upper respiratory tract for symptoms of the infection. A swab is inserted into our nose by the individual doing the test to obtain a sample from the back of our nose and throat. The sample is normally sent to a lab where it is examined for viral material, but certain places may have fast tests that can provide results in as little as 15 minutes.

The test is positive if there are symptoms of the infection. A negative test could indicate that the virus is not present or that there was not enough to measure. This can happen early in the course of an infection. The tests must be collected, kept, delivered to a lab, and processed, so findings are usually available within 24 hours.

The FDA has issued emergency use authorizations for tests such as home nose swab testing, which we collect ourselves and return to the lab for analysis by express mail. Several at-home quick

tests have been approved by the government. To ensure that, the results are recorded, we must obtain these via prescription. In a matter of minutes, we will have those outcomes. A swab test can only tell us, if the virus is currently present in our body. However, even if we did not have symptoms, we should consider getting an antibody test to see if we have ever been exposed to the virus. This is critical information for officials trying to figure just how widespread COVID-19 is. It might also help them figure out who is immune to the virus in the future. More tests are being developed by the FDA in collaboration with laboratories across the country.

### **Prevention of Coronavirus:**

Vaccination against COVID-19 is an important aspect of prevention. However, we should additionally do the following steps:

In public, cover our mouth and nose. We can spread COVID-19 even if we do not feel unwell if we have it. To keep people safe, cover our face with a handkerchief. This is not a substitute for social isolation. We must maintain a 6-foot gap between ourselves and anyone in our immediate vicinity. Use a face mask designed for healthcare workers instead. Also, do not put a face covering on anyone under the age of two.

### **Having difficulty in breathing?**

They are either unconscious or unable to remove the mask on their own for various reasons. Hands should be washed often with soap and water or with an alcohol-based sanitizer. This disinfects our hands and kills viruses. Keep our hands away from our face. Coronaviruses can survive for several hours on surfaces that we contact. They can get into our body if they get on our hands and we contact our eyes, nose, or mouth.

Distancing ourselves from others is a good idea. Because we can contract the virus and spread it without even realizing it, we should stay at home as much as possible. If we must go out, keep at least 6 feet away from other people. Disinfect and clean surfaces we touch frequently, such as tables, doorknobs, light switches, toilets, faucets, and sinks, can be cleaned with soap and water first. Use a household cleanser that is approved to treat SARS-CoV-2 or a mixture of household bleach and water (1/3 cup bleach per gallon of water, or 4 tablespoons bleach per quart of water). To see if ours was included on the list, go to the Environmental Protection Agency's website. When cleaning, wear gloves and dispose of them afterward. Herbal remedies and teas have not been proven to protect against infection.

### **Preparing for COVID-19**

We can also:

- Meet as a family or as a household to discuss who needs what.
- Ask their doctor what to do if we have people who are at a higher risk.

- Discuss disaster preparedness with our neighbours. Stay in contact by joining a neighbourhood chat group or visiting a website.
- Find community-based organizations that can assist with health care, food distribution, and other necessities.
- Make a list of emergency contacts. Family, friends, neighbours, carpool drivers, doctors, teachers, employers, and the local health department are all good sources of information.
- Select a room (or rooms) where we can isolate anyone who is sick or has been exposed from the rest of the group.
- Discuss keeping up with assignments with our child's school.
- If our office is closed, set ourselves up to work from home.
- If we live alone, reach out to friends or family. Make arrangements for them to call, email, or video chat with us.

#### **Usefulness of face mask:**

If we haven't been vaccinated, the CDC suggests wearing a cloth face mask before going out in public. We should also wear it if we are at home with someone who has been infected or exposed. On top of social distancing efforts, a mask adds an extra degree of protection for everyone. Even if we don't realise we have the virus or aren't showing indications of infection, we can transfer it by talking or coughing. Surgical masks and N95 masks, according to the CDC, should be designated for health care personnel and first responders.

#### **Is travelling during a pandemic safe?**

COVID-19 can be spread more easily in crowded environments. During the pandemic, the CDC advises avoiding international or cruise ship travel. Some localities are employing "vaccine passports" to open up to vaccinated travellers, and restrictions are being relaxed for people who have been vaccinated.

A few questions may assist us in determining whether or not it is safe to travel:

- Is the coronavirus circulating in the area where we're going?
- Will we be in close contact with other travellers on our journey?
- Are we at a higher risk of being seriously unwell if we contract the virus?
- Do we live with someone who suffers from a terrible illness?
- Is the location where we'll be staying going to be cleaned?
- Will we be able to get food and other essentials?

Stay away from sick people if we wish to travel. Hands should be washed frequently, and we should avoid touching our face. When we are with other individuals, wear a cotton face mask. Customers are required to use them by all airlines. Other modes of public transportation, such as railroads and buses, also require them.

### **What can we do to help stop the coronavirus from spreading?**

Because the virus travels from person to person, it is crucial to keep our contact with others to a minimum and stay away from crowded groups. Although many governments and localities have lifted restrictions, this does not mean that the virus is no longer present. Continue to use safety precautions like wearing a cloth face mask and washing our hands in public places. While many organizations continue to adopt work-from-home policies, many employees are unable to do so. Some people work in "important businesses," such as health care, law enforcement, and public utilities, which are critical to daily existence. Everyone else should restrict their time in public as much as possible, and when they can not, wear a cotton face mask.

#### **The terms listed below are now widely used:**

- When we have to go out, we need to maintain social or physical distance from other individuals.
- If a person has been exposed to the virus, quarantine is required (Quarantine means keeping them at home and away from other people).
- Isolation, which includes utilizing a separate "ill" bedroom and bathroom if possible, to keep sick individuals away from healthy ones.
- Even if we have been vaccinated, we should still take precautions.

#### **Vaccine against Coronavirus:**

The FDA awarded final approval for the Pfizer-BioNTech COVID-19 vaccine in the United States on August 23, 2021, for use in people aged 16 and up. The move comes eight months after an emergency use authorization was granted (EUA). Currently, an EUA permitting the Pfizer vaccine to be used in children aged 12 to 15 years old is in effect. In addition, the Advisory Committee on Immunization Practices (ACIP) of the Centers for Disease Control and Prevention (CDC). The FDA is considering whether a supplemental dosage of the vaccine should be approved to assist tackle highly contagious strains.

Vaccines developed by Moderna and Johnson & Johnson also have EUAs in place. The Pfizer and Moderna vaccinations, both require two doses, spaced a few weeks apart, whereas the J & J vaccine just requires one injection. Initially, healthcare workers and the elderly were given precedence in receiving the vaccines, but by May 2021, anyone could receive them.

These vaccinations were produced at a breakneck pace, with human testing set to begin in March 2020. According to the FDA, no corners are made in order to gain approval, and the vaccines are safe. According to the CDC, COVID-19 vaccination is safe for pregnant women, and there is no evidence that antibodies produced by the vaccine create problems during pregnancy. Other vaccinations are still undergoing clinical studies. Here are some resources for more information if we are interested in volunteering for a COVID-19 vaccine trial.

### **Sites supported by the government:**

COVID-19 Prevention Network is a non-profit organization dedicated to preventing the spread (CoVPN). The National Institute of Allergy and Infectious Diseases is funding the project, which is being led by Seattle's Fred Hutchinson Cancer Research Center. Its goal is to enroll thousands of people in COVID vaccine studies around the country. This portal is used by many research centres to identify volunteers.

Clinicaltrials.gov. is a government database that contains information about public and commercial clinical trials conducted around the world. The website also discusses the pros and downsides of participating in a clinical trial.

Sites that connect volunteers with trials across the country include:

- CenterWatch \sCOVID Without COVID, there is no Dash World.
- Individual hospitals, universities, research centres, and other organizations may also provide COVID-19 vaccination clinical trial possibilities. Some examples are:
  - Kaiser Permanente
  - Medical University of South Carolina
  - Meridian Clinical Research
  - Penn Medicine
  - Saint Louis University
  - SAResearch (Clinical Trials of Texas)
  - University of California, Davis
  - University of California, San Diego
  - University of Maryland
  - University of Rochester Medical Center
  - Vanderbilt University
  - Wake Research

We can also contact our local hospital or research institution to see if they are participating in any trials by calling or visiting their website.

### **Treatment for Coronavirus:**

COVID-19 does not have a specific treatment. Mild cases require treatment to alleviate symptoms, such as rest, water, and fever management. If we have a sore throat, body aches, or a fever, take over-the-counter treatment. However, aspirin should not be given to children or teenagers under the age of 19. We may have heard that taking ibuprofen to treat COVID-19 symptoms is not a good idea. People infected with the virus, however, can continue to take nonsteroidal anti-inflammatory medicines (NSAIDs) or acetaminophen as usual, according to the National Institutes of Health.

Antibiotics are ineffective because they treat bacteria rather than viruses. Antibiotics are given to persons who have COVID-19 for an infection that comes with the disease. Patients with severe symptoms should be admitted to the hospital.

Remdesivir (Veklury), an antiviral drug, was the first to be approved by the FDA for the treatment of COVID-19 patients hospitalized. Evidence reveals that those who were treated with remdesivir recovered in roughly 11 days, compared to 15 days for those who were given a placebo. Many clinical trials are currently underway to investigate and develop new COVID-19 therapies that have been utilized to treat other diseases.

Tocilizumab, a drug used to treat autoimmune diseases, is now undergoing clinical testing. The FDA is also permitting clinical research and hospital use of blood plasma from persons who have recovered from COVID-19 to aid in the development of immunity in others. This is referred to as convalescent plasma. There is currently insufficient evidence of its effectiveness. The antimalarial medications hydroxychloroquine and chloroquine were explored as possible therapies early in the pandemic. After tests revealed that the medications were ineffective and the hazards outweighed the benefits, the FDA revoked the emergency use order. Dexamethasone, a steroid medicine used to treat arthritis, blood/hormone/immune system abnormalities, and allergic responses, is one of the steroid treatments utilized. More efficacy research is still being carried out on this

### **Is there a way to stop the new coronavirus from spreading?**

There is currently no treatment, but experts are working diligently to develop one.

### **Outlook for COVID-19:**

Every situation is unique. After exposure, we may experience minor flu-like symptoms for a few days before feeling better. However, certain cases can be serious or even fatal. Even if the symptoms are minor, they can last for weeks. According to a CDC poll, more than a third of those over the age of 18 who show symptoms of the virus are not fully recovered after two or three weeks. The symptoms that are most likely to linger fatigue and cough. Others who have had COVID-19 develop a condition that is akin to myalgic encephalomyelitis, or chronic fatigue syndrome. They may have brain fog, extreme exhaustion, pain, difficulty thinking, or dizziness.

### **Rate of coronavirus recovery:**

COVID-19 infections and recoveries are being monitored by scientists and researchers all the time. They do not, however, know how each infection will turn out. COVID-19 recovery rates are expected to range between 97 and 99.75 percent, according to preliminary estimations.

Reinfection has been recorded in a few cases, however, it is still thought to be an uncommon occurrence. We have a period of immunity to other coronaviruses that solely cause colds, but this wears off over time. This coronavirus appears to be the same. The duration of immunity is predicted to be three to four months.

### **Coronaviruses in older times:**

In the 1960s, coronaviruses were discovered for the first time. A coronavirus infection affected almost everyone at some point in their lives, most commonly while they were children. Regular coronavirus infections were more likely in the United States in the fall and winter, although they could strike at any time.

Most coronaviruses cause symptoms that are similar to those of any other upper respiratory infection, such as runny nose, coughing, sore throat, and, in some cases, fever. We will not know if we have a coronavirus or another cold-causing virus, such as a rhinovirus, in the majority of cases. This type of coronavirus infection is treated in the same way that a cold is treated.

### **Coronavirus epidemics in the past:**

Coronaviruses have caused two major outbreaks: Middle East respiratory syndrome and avian influenza (MERS). MERS, which first arose in Saudi Arabia and then spread to other Middle Eastern, African, Asian, and European countries, has claimed the lives of around 858 people. In April 2014, the first MERS patient in the United States was admitted to a hospital in Indiana, and another case was reported in Florida. Both had recently returned from a trip to Saudi Arabia. MERS was first detected in South Korea in May 2015, and it was the largest epidemic outside of the Arabian Peninsula.

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## COVID – 19: DIFFERENT ASPECTS OF THIRD WAVE

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### **Abstract:**

Coronaviruses belongs to a large family of viruses that are caused from Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS). A mild respiratory illness was caused by coronavirus (SARS Coronavirus-2 of the genus Betacoronavirus). Symptoms of COVID-19 may include cough, fever, chills, nausea, vomiting, runny nose, or diarrhea, headache, fatigue, breathing difficulties, sore throat and loss of smell and taste. Transmission can occur sprayed with contaminated surfaces and fluids in the eyes, nose or mouth. The standard type of detection of the virus nucleic acid is by reverse transcription loop-mediated isothermal amplification (RT-LAMP), real-time reverse transcription polymerase chain reaction (rRT-PCR), or by transcription-mediated amplification (TMA), or from a nasopharyngeal swab. The Delta variant is also called as lineage B.1.617.2 of SARS-CoV-2, the virus that causes COVID-19. It was first found out in India in late 2020. Delta variant symptoms are same as typically, vaccinated people have very mild symptoms if they contract the Delta variant.

**Keywords:** COVID-19, SARS, MERS, rRT –PCR, Delta Variant

### **Introduction:**

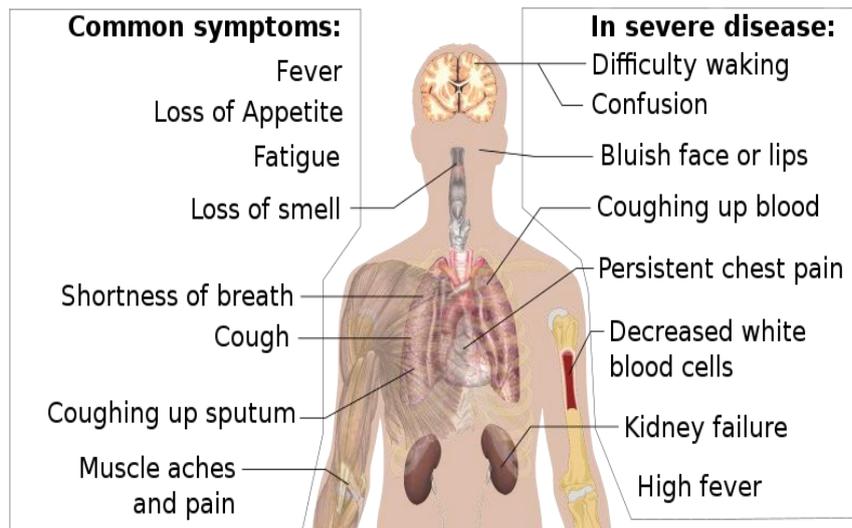
Coronavirus disease 2019 or (COVID-19) is defined as an illness that was caused from novel coronavirus named SARS Coronavirus 2 (SARS-CoV-2; commonly called 2019-nCoV). It was first identified through an outbreak of respiratory illness and found in Wuhan City, Hubei Province, China. The World Health Organization initially reported on 31 Dec'2019 about the identification of this deadly virus in humans. On 30 Jan'2020, WHO declared the COVID-19 outbreak as a global health emergency. On 11 Mar. 2020, COVID-19 was declared as a global pandemic, after the first such designation named H1N1 influenza a pandemic in 1918.

A mild respiratory illness was caused by coronavirus (SARS Coronavirus 2 of the genus Beta coronavirus). It was known to be transmitted due to mediator with infectious material i.e respiratory droplets or contaminated surfaces of objects by the contraction virus.

Also, it was characterized by fever, cold, cough, and shortness of breath which may even progress to respiratory failure and pneumonia disease. Other symptoms included body aches, headache, and fatigue, chills, nausea, vomiting, runny nose, diarrhea, sore throat and loss of taste or smell. On 14 March 2020 a health emergency was declared in Spain and in national state with a special call to house confinement in an attempt to stop the progression of the pandemic (Boletín *et al.*, 2020). This emergency was due to the urgent pandemic management of myocardial infarction. A deadly coronavirus killed thousands of people in China and has affected approximately at least 44 countries.

### Signs and Symptoms:

Symptoms of COVID-19 may include cough, fever (Islam, 2021), chills, nausea, vomiting, runny nose, or diarrhea, headache (Islam, 2020), difficulties in breathing, fatigue and loss of smell and taste (Saniasiaya *et al.*, 2021; Saniasiaya and Agyeman *et al.*, 2020). Symptoms may begin from 1-14 days after the person is infected with virus. Some people suffering from COVID-19 don't develop noticeable symptoms (Oran *et al.*, 2021). Older age people have higher risk of developing severe symptoms. Some people who are infected from COVID-19 have been observed damage to organs (CDC, 2020).



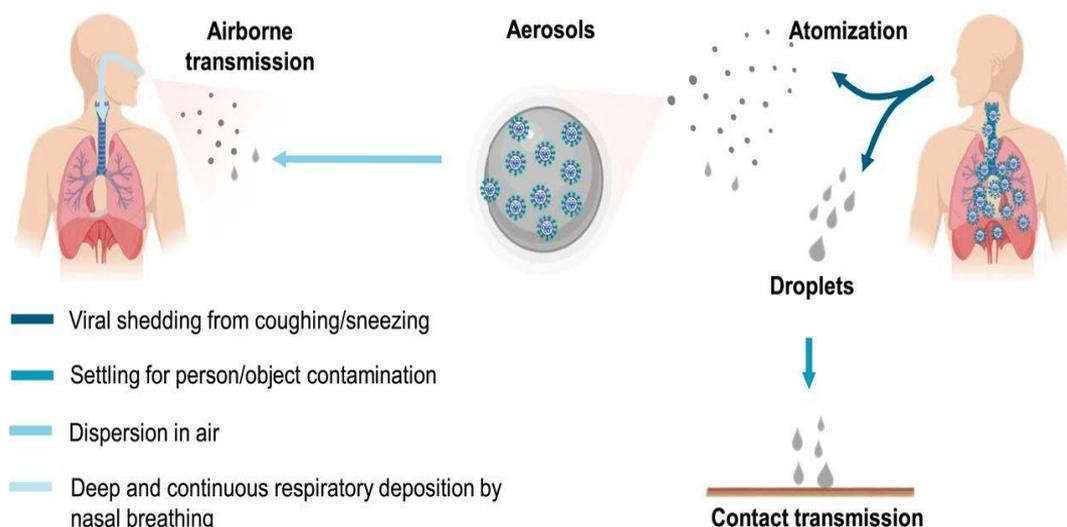
**Figure 1: Signs and Symptoms of COVID-19**

### Cause:

COVID-19 is led by infection with the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) virus strain (Hu *et al.*, 2021).

### Transmission of COVID-19 Virus:

Droplets or tiny particles called aerosols transport the virus into the air from an infected person's nose or mouth when they cough, sneeze, or talk. It can be breathed into the lungs by anyone within 6 feet of that person.



**Figure 2: Transmission of COVID-19**

**Testing Method:**

Several types of testing methods were developed to diagnose the disease. The standard detection method of the virus nucleic acid by reverse transcription loop-mediated isothermal amplification (RT-LAMP), or by real-time reverse transcription polymerase chain reaction (rRT-PCR), transcription-mediated amplification (TMA), or from a nasopharyngeal swab.

**Table 1: Classification of COVID-19**

<b>Specialty</b>	<b>Infectioustype disease</b>
Symptoms	High Fever, shortness of breath, cough, fatigue, vomiting, loss of smell or taste (Islam, 2020)
Complications	Pneumonia Disease, viral sepsis, acute respiratory syndrome, kidney failure disease, cytokine release syndrome, respiratory failure, chronic COVID syndrome
Usual onset	2–14 days from infection
Duration	5 days to chronic
Causes	Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)
Diagnostic method	rRT-PCR testing, CT scan, Rapid antigen test
Prevention	Face coverings, quarantine, physical/social distancing, ventilation, hand washing (Saniasiaya, 2020), vaccination (Agyeman, 2020)
Treatment	Symptomatic and supportive
Frequency	221,067,018 (Oran, 2021) confirmed cases
Deaths	4,574,501 (Oran, 2021)

**Prevention:**

Some preventive measures includes physical or social distancing, coughs, sneezes, quarantining, covering and ventilation of indoor spaces and keeping unwashed hands away from the face. It is mediatory to used face mask to minimize the risk of transmissions. While work is underway to develop drugs that inhibit the virus.

**Origin of COVID-19:**

During the initial epidemic of coronavirus in Wuhan, the virus and disease were referred to as "coronavirus" and "Wuhan coronavirus" (NPR, 2020; McNeil, 2020; Griffiths, 2020), with the virus and disease being referred to as "Wuhan pneumonia" at times (NPR 2020; McNeil 2020; Griffiths, 2020) (Jiang *et al.*, 2020). Many diseases, such as Middle East respiratory syndrome, Spanish flu, and Zika virus, were originally named after geographical regions (Shablovsky 2017). On February 11, 2020, the WHO announced the official names of COVID-19 and SARS-CoV-2 (WHO, 2015).

**Different Waves of COVID-19:**

The WHO and other international health organizations often refer to "waves" of a pandemic, but no formal definition exists. A wave refers to a rising number of COVID-19 cases which has a specific peak and then declines. It looks similar to the shape of a wave that can increase, tops out, and then decrease on a graph. A wave can also be referred to in some cases as a surge or outbreak. Public health scientists were first describing the different peaks and valleys of infections during outbreaks of influenza in the late 1800s and the 1918-1929 "Spanish flu." We use this historical pandemic to categorize disease spread and help as models that might help us predict how COVID-19 will act in modern times. Each wave has different symptoms, features and can impact different populations, even within the same country. This depends on seasonal disease if it is a particularly distinct illness like H1N1 in 2009-2010, which may also impact older people with underlying illnesses more than other populations. There refers to three types of waves.

**First Wave of COVID-19:**

In the first wave, the virus starts to spread among many people, more and more each day, and reached a peak number of daily cases. During this time, positive COVID-19 tests for people with and without symptoms, case numbers, hospitalizations, and deaths are also increasing. After reaching a peak, the virus spreads less as more people have either been infected or have learned how to prevent themselves from getting infected or spreading the virus, so rates of transmission get lower and fewer people are getting sick over that period of time.

### **Symptoms:**

COVID-19 was affected lots of peoples in different ways. Different infected people was developed many kind of mild to moderate illness and recover without hospitalization.

Common symptoms are fever, dry cough, tiredness, aches and pains, sore throat, diarrhea, conjunctivitis, headache, loss of smell or taste. Serious symptoms: difficulty for breathing, chest pain or pressure, loss of speech or movement. It takes about 5–6 days to show their symptoms after infected with the virus; however it can take up to 14 days.

### **Second Wave of COVID-19:**

It is stated that the delay in the diagnosis of the virus is leading to the delay of COVID second wave treatment, making the scenario more severe than anticipated. The second wave occurs when daily case numbers begin increasing again. This wave prefers to be more common than the first wave of severe illnesses. The term "second wave" is used to distinguish it from the first surge in cases. The treatments and vaccines were starting to be tested at this period of time. Therefore scientists may hopefully to know more about this virus, like its genetics or not, how can it spreads, and what kinds of impacts reached in body during this time. During the second wave doctors are typically able to diagnose the illness more easily.

### **Symptoms:**

Common symptoms are, body ache, Pain in the near the kidney or back, severe headache, sore throat , conjunctivitis, hearing impairment, loose motions, fever, cough, tingling in the fingers or toes. These symptoms were not seen frequently in the first wave however, in the second strain, these Coronavirus symptoms are a lot more evident. There have been instances where people experiencing pain in the lower back area mistook it for a normal issue.

### **Precautions of First and Second Wave:**

The virus spreads from person to person via respiratory droplets when the infected person coughs or sneezes or even comes in physical contact (handshake, fist bump, and so on) with the non-infected person. For some people, staying at home or working from home is possible while for others, they have to move out of the house. Either way, it is necessary to make sure that all the safety protocols and necessary precautions are being taken at home and also when you are moving out. For Households with elderly people or those with co-morbidities like blood sugar, hypertension, heart disease, and so on; taking precautionary measures becomes even more mandatory. Here are some of the steps that you need to follow:

**Sanitize before Entering Home:** If you or anyone from your household has to go out for work, make sure that they sanitize before entering the house. Keep the footwear outside, use a disinfectant spray that can be used on the skin - spray it on surfaces that you or they have touched, and only then enter the house. And once you enter the house, take a hot water shower and sanitize entirely.

**Wash your Hands:** Ensuring good hygiene is one of the best ways of preventing COVID-19. Make sure to wash your hands frequently for at least 20 seconds of being in a public place or after blowing your nose, sneezing, or coughing. Also, ensure to wash your hands in the following circumstances: Before eating or preparing food; before touching your face; before using the public or common restroom; after handling your mask; after caring for someone who is unwell; after touching animals or pets. Carry a sanitizer with you that contains at least 60% alcohol or disinfectant sprays that can be used on the human skin directly. Sanitize all the parts of your hand and make sure that they are sanitized properly.

**Aspects of Third Wave of COVID-19/ SARS-CoV2 Delta Variant:**

The Delta variant is also called as lineage B.1.617.2 of SARS-CoV-2, the virus that causes COVID-19. It was first find out in India in late 2020. The WHO was described it the Delta variant on 31 May 2021. The variant was spread about 163 countries by 24 August 2021, and the WHO was declared that it is becoming the dominant strain globally.

It gene encoding mutations may occur in SARS-CoV-2 spike protein (Shang *et al.*, 2020), which can cause the substitutions of T478K, P681R and L452R (Starr *et al.*, 2021). It was affected with transmissibility of the virus and it was also neutralized by antibodies for previously circulating variants of the COVID-19 virus. Immunity from previous recovery (Sivan and Pfizer, 2021) or COVID-19 vaccines are very effective for preventing severe disease or hospitalization from infection with the variant (Burn, 2021).

On 7 May 2021, it changed their classification of lineage B.1.617.2 from a variant under investigation (VUI) to a variant of concern (VOC) which based upon their assessment of transmissibility being at least equivalent to B.1.1.7 (Alpha variant). On 11 May 2021, the WHO showed their classification evidence of highly transmissibility and it may reduce neutralization. On 15 June 2021, the Centers for Disease Control and Prevention (CDC) declared Delta a variant of concern (CDC 2021).

The variant was responsible for India's second wave of the pandemic beginning in February 2021 (WHO 2021). It later contributed to a third wave in Fiji, the United Kingdom (Mishra *et al.*, 2021; Callaway and Ewen 2021; Rob 2021) and South Africa (Africa 2021).

**Symptoms:**

Delta variant symptoms are same as typically, vaccinated people have very mild symptoms if they contract the Delta variant. Their symptom includes common cold, cough, fever or headache, with the addition of significant loss of smell.

**What is a wave in an epidemic?**

We don't have a proof to define what constitutes a wave in an epidemic. The epidemic is used to describing the rising and declining trends of infections over a prolonged period of time.

The shape of wave will resembles by growth curve. Historically, the term wave used to refer to the seasonality of the disease. Different types of viral infections disease are seasonal in nature, but they recur after a fixed period of time. Infections rise and then come down, only to rise again after some time.

Smaller regions within a state, a city or a country would have own waves. For example, Delhi has so far experienced for waves by three distinct peaks in their growth curve even before the current wave. While as we talking about in states like Rajasthan or Madhya Pradesh; the growth curves had a lot of diffused looks until February, lacking a sharp peak. It would be difficult to identify many distinct waves in such a situation.

### **How would one identify a third wave, if it comes?**

The third wave will be currently under discussion which refers by growth curve of national level. The national curve will seems to have entered a declining phase now, after having peaked on May 6. It has dropped about 2.6 lakh from the peak of 4.14 lakh, while the active cases have come down to 32.25 lakh, after touching a high of 37.45 lakh. On behave, it would be aspect or classified as the third wave will coming.

### **Will the third wave be stronger?**

It will be expected that every upcoming wave would be weaker than the previous one. So, the virus will relatively free to run and has to observe their entire population is susceptible. There would be far lower number of susceptible people because it will gained immunity. There is no reason for spread the slowed down; it has been considering that such a large proportion of the population was still susceptible. The reasons for the five-month continuous decline in cases in India are still not very well understood. However, gene mutations are also altering these calculations of virus.

Of course, all three waves are caused due to different human behaviors, a lack of governmental actions and rules, travel, daily activities, viral variants, and more. Waves can occur in different regions at different times and look different in each place.

### **Drugs active against SARS-CoV-2:**

Testing for molecules that are potentially active against SARS-CoV2 has been based on different approaches. These included the selective testing of molecules previously shown to be active against SARS-CoV and/or MERS-CoV or suspected to have a broad enough range of activity to merit testing on SARS-CoV-2; high through put testing of drug libraries; and in silico prediction followed by confirmation of drug activity in vitro. Based on previous studies on SARS-CoV, chloroquine (CQ) and hydroxychloroquine (HCQ) were among the earliest tested molecules against SARS-CoV-2 (Yao and Wang *et al.*, 2020; Liu and Weston *et al.*, 2020). Both compounds were shown to be efficient, but HCQ exhibited a less toxic profile (Liu *et al.*, 2020). Of the 20 drugs previously demonstrated to have in vitro antiviral activity against SARS-CoV

and MERS-CoV, several were found to be effective in vitro on SARS-CoV-2, including antitumoral drugs, which are likely not to be easily applicable to treatment in humans, and antimalarial drugs such as amodiaquine and, again, CQ and HCQ (Weston *et al.*, 2020). This large study identified 69 compounds, including FDA-approved drugs that target drug able human proteins of host factors, and then performed screening in viral assays.

**Other therapeutic options:**

**1. Ivermectin:** A retrospective comparative study reported that ivermectin was associated with lower mortality of COVID-19 patients, compared to standard of care, especially in patients who required higher inspired oxygen or ventilator support (Pandey *et al.*, 2020). Besides, a randomized controlled trial showed that ivermectin was not significantly different from hydroxychloroquine and azithromycin as reference treatment (Pandey *et al.*, 2020).

**2. Teicoplanin:** Although there are some case reports on teicoplanin use as an anti-SARS-Cov2 agent (Ceccarelli *et al.*, 2020), there is no clinical series, no observational and or randomized studies that allow to conclude.

**3. Nitaxozanide:** Nitaxozanide, an anti-parasitic drug used for the treatment of giardiasis and cryptosporidium infection has been considered a therapeutic option against COVID-19. A randomized control trial is ongoing in Mexico (Clinical Trials.gov Identifier: NCT04341493)

**4. Convalescent plasma:** Plasma therapy consists in administering plasma or derivatives obtained in convalescent patient, to patients with acute infectious disease. It has been used against Ebola Virus disease and Spanish flu and recently against COVID-19. Two observational studies showing improvements in a small number of patients have been reported, but its use has been reported disappointing (Roback *et al.*, 2020) by some experts. In fact, convalescent plasma therapy might probably be useful in immune compromised patients with a persistent viral shedding and no reactive immunity.

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## **COVID-19: MULTI-DIMENSIONAL IMPACT**

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COVID-19, a catastrophic, calamitous and cataclysmic pandemic originated in Wuhan city, China back in December 2019 created a havoc and total disaster for the whole world. This cosmopolitan, contagious and communicable disease which includes a group of symptoms has seized out many lives of people. This coronavirus displays a multi-dimensional impact on this universe in different aspects. The most vulnerable and deadly pandemic which was never seen before. This isn't compared to an ordinary flu or normal fever but way too severe and complex one which is still persisting till date worldwide. Basically, focusing on its multi-dimensions of how it has an impact over our lives, our people our world. There are six major dimensions which have sub-dimensions and divisions which will enlighten us elaboratively.

The following study highlights six major dimensions which wraps up the entire content.

1. Disease
2. Epidemiology
3. History
4. Impact
5. Mitigation
6. Response

### **Disease:**

This dimension of COVID-19 elaborates about: signs, symptoms, transmission, causes, diagnosis, treatment, prevention and vaccines about this disease. COVID-19 also known as Coronavirus disease. This specific name comes because of the disease causing severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As the name suggests its not a single symptom but a group of symptoms (Syndrome). The symptoms of this disease include: fever, cough, fatigue, shortness of breath, vomiting, loss of taste or smell and many others depending on the severity of the situation. In case of adverse, severe, critical conditions due to delayed diagnosis and treatment this can lead to further complex complications as in Pneumonia, kidney

failure, respiratory failure, pulmonary fibrosis, chronic COVID syndrome too etc. The onset of these signs and symptoms in the form of infection persists typically for 5 days but it can lead to 14 days as well based on individual's immunity, precautions taken, and recovery time. For this certain period of time, a person should exclude himself/herself from the family members and be in isolation in order to follow home or self-quarantine as a result it won't get contagious for others. But if it gets worsen, as they say, "Good things take time". Similarly, if a person's health goes critical the duration of the infection from 5 days can go in chronic conditions as well. The deciding factors are – persons mental, social & physical well-being, treatment provided, precautions & protocols followed food supplements supplied etc. Basically this COVID-19 is easily susceptible and vulnerable to people as its transmitted when normal, healthy individuals breathe in air contaminated by droplets and small air-borne particles containing the virus. Transmission can also occur of splashed or sprayed with contaminated fluids in the eyes, nose or mouth and rarely via contaminated surfaces. Even after encounter with this 'crown-shaped virus' people do not develop immediate symptoms which become difficult for identification of infection hidden with.

Medically speaking, until and unless we perform some tests we are unaware about what's actually wrong with our body. Because of which medical diagnosis is carried out in a variety of methods for detection of the presence of COVID. The tests like 'RT-PCR', 'TMA', 'RT-LAMP' are administered using a nasopharyngeal swab. Apart from this 'CT Scan' and 'Rapid Antigen Test' are also in use for diagnosis purpose. This SARS-CoV-2 virus can infect a wide range of cells and systems of the body. It is most prevalent for affecting the upper and lower respiratory tract. Our respiratory organs i.e Lungs are most affected by COVID-19. Apart from respiratory system, it also has an impact over gastrointestinal tract and cardiovascular system too. Acute myocardial injury, thrombosis and venous thromboembolism have been found in patients who were transferred to ICU's with COVID-19 infections.

A diseased or infected person needs to visit hospital they say, so as to receive proper treatment in order to get better. Speaking of this deadly syndrome treatment as such there is no available, effective and progressive cure for corona virus disease. Scientists and doctors have come up with some treatment, methods like relieve symptoms, fluid therapy, oxygen support along with supportive care. In case of mild COVID-19 supportive care includes medication like Paracetamol to relieve fever, body aches, cough added with proper intake of fluids, rest and nasal breathing. Healthy diet and steam inhalation is mandatory. In severe cases people need to be admitted for further treatment. With those found having low oxygen levels for them the usage of 'Glucocorticoid dexamethasone' is highly recommended. Non-invasive ventilation and

ultimately, admission to ICU for mechanical ventilation may be required to support breathing. The world famous phrase by ‘Desiderius Erasmus’ is true in terms of COVID-19 also i.e “Prevention is better than cure”.

The personal hygiene, safety precautions like wearing a face mask, wearing hand gloves, washing our hands with soap or hand wash or hand rub with alcohol based sanitizer, maintaining proper social distancing, all these are considered as ‘Golden rules’ and are asked by government to be followed strictly. We do believe in that things are not done half way, so in order for complete safety Vaccines were designed by different companies and laboratories. These were introduced for the purpose of reducing the chances of fatalities and severity of this serious disease by introducing the induced form of virus in bodies of human population for providing acquired immunity to resist SARS-CoV-2.

The types of vaccines are as follows:

1. RNA Vaccine – Pfizer – BioNTech & Moderna vaccines
2. Adenovirus vector vaccines – Oxford – AstraZeneca COVID-19 vaccine, Sputnik-V COVID-19 vaccine, Conuidecia and Janssen COVID-19 vaccine.
3. Inactivated Virus Vaccines – CoronaVac, BBIBP-Cor V WIBP-Cor V; Covaxin, CovoVac; Qaz Vac, COVIran Barekat vaccine.
4. Sub unit vaccines – Peptide vaccine EpiVac corona, ZF2001, MVC-COV1901.
5. Intranasal – Flumist (USA), Fluenz Tetra (European Union); Influenza vaccine.

All the above mentioned vaccines are authorized by WHO and are in use by the world to fight back corona virus disease. Government officials made it compulsory for the people to get their self vaccinated in order to visit abroad, out of station, public places etc. The vaccinated individuals will receive online certificate as they are vaccinated to show it as proof when demanded by the concerned authorities. Children below 18 years of age, pregnant women, elderly senior citizens and people with already suffering hereditary diseases, these category people shouldn’t be taking vaccines. There are many myths and wrong information being spread regarding vaccines which are not true but are simply spoiling the minds of people.

### **Epidemiology:**

As we step into this dimension, we encounter with its background, the number of affected cases and the number of deaths caused, (IFR) Infection Fatality Ratio, (CFR) Case Fatality Ration. This COVID-19 is defined as illness caused by a novel corona virus called Severe acute respiratory syndrome coronavirus 2 (SARS- CoV-2) formerly called 2019-nCoV which was first identified amid an outbreak of respiratory illness cases in Wuhan city, Hubei Province China.

The SARS- CoV-2 virus is a beta coronavirus, like MERS-CoV and SARS- CoV. All 3 of these viruses have their origins in bats. “Post Acute Sequelae of SARS-CoV-2 infection” is also called ‘Long COVID’. It is estimated to affect approximately 10-30% of individuals who had COVID-19 earlier. It was studied that approximately a third of the patients suffered this ‘Long COVID’ were initially asymptomatic. Symptoms of PASC are varied and on-going, including neurological challenges, cognitive problems such as brain fog, shortness of breath, fatigue, musculoskeletal pain and mobility issues.

### **Case Fatality Ratio:**

It is the measure of the number of deaths among all persons with a disease, it is termed as “Case Fatality Ration”.

The highest CFR in the world is of Mexico i.e 7.6% and the lowest CFR is of Turkey i.e 0.9%.

$$\text{Case Fatality Ration (CFR)} = \frac{\text{Number of deaths from disease}}{\text{Number of confirmed cases of disease}} \times 100$$

### **History:**

This dimension covers the origin of COVID-19, previous condition and present scenario of the disease.

### **Year 2019:**

The origin of this deadly COVID-19 marks back in Wuhan, China in the month of December. Gradually the cases started to increase and reach 60 by 20<sup>th</sup> December and finally 266 by 31<sup>st</sup> December. On the 27<sup>th</sup>& 28<sup>th</sup> December it came to be recognized as ‘coronavirus’. WHO, in March 2021, published their report on the potential zoonotic source of the virus. Worldwide observation states facts about the number of cases affected and number of deaths across the globe by COVID.

➔ Total cases till date = 23,31,36,147

➔ Total deaths till date = 47,71,408

Across the globe, the three countries U.S.A, India & Brazil rank high with the highest numbers of cases and deaths. Whereas places like Cook Islands, Kiribati, Micronesia, Nauru, Nive etc. have been recorded as nil cases.

Sr. No	Country	Cases: Cumulative Total	Deaths: Cumulative Total
1	U.S.A	4,29,66,938	6,88,099
2	India	3,37,39,980	4,48,062
3	Brazil	2,13,81,790	5,95,446

**Infection Fatality Ratio:**

It is calculated by dividing the total number of deaths from the disease by the total number of infected individuals.

$$\text{IFR} = \frac{\text{Number of Deaths}}{\text{Number of Infected individuals}} \times 100$$

They concluded that human spill-over via an intermediate animal host was the most likely explanation, with direct spill-over from bats next most likely and introduction through the food supply chain as another possible explanation.

**Year 2020:**

On 11<sup>th</sup> January, WHO received further information from the Chinese National Health Commission that the outbreak is associated with exposures in one seafood market in Wuhan and that the Chinese authorities had identified a new type of coronavirus which isolated on 7<sup>th</sup> January. In early and mid January, the virus spread to other Chinese provinces, helped by the ‘Chinese New Year Migration’. Rapidly virus started mutating, developing, growing and spreading across the globe. On 30<sup>th</sup> January with 7818 confirmed cases across 19 countries, WHO declared the COVID-19 outbreak a “Public Health Emergency of International Concern” and then a ‘pandemic’ on 11<sup>th</sup> March as Italy, South Korea, Japan reported increasing number of cases. On 31<sup>st</sup> January, Italy has its first confirmed cases, two tourists from China brought this. 19<sup>th</sup> March – Italy took over China, 26<sup>th</sup> March – U.S.A took over China & Italy, likewise indifferent countries, different mutants were found and there was an increase in affected individuals with maximum deaths. Some 12 human cases of the mutated variant were identified in September 2020.

On 14<sup>th</sup> December, Public Health England reported a new variant had been discovered in the South-East of England, predominantly in Kent. The variant names “Variant of Concern 202012/01” showed changes to the spike protein which could make the virous more infectious.

**Year 2021:**

On 2<sup>nd</sup> January, “VOC-202012/01”, a variant of SARS-CoV-2 first discovered in the UK had been identified in 33 countries in the world, including Pakistan, South Korea, Switzerland, Taiwan, Norway, Italy, Japan, Lebanon, India, Canada, Denmark, France, Germany, Iceland and China. On 6<sup>th</sup> January, the “P.1 variant ” was first identified in Japanese traveller who had just returned from Brazil.

**Impact:**

This dimension wraps up different impacts like economies, supply strategies, Oil and energy markets, culture, politics, agriculture, education, racism, environment & climate, discrimination and prejudice.

This outbreak is a major de-stabilizing threat to the global economy. Global stock markets fell on 24<sup>th</sup> February due to a significant rise in the number of COVID-19 outbreak. Because of lifting up of lockdown, tourism is one of the worst affected sectors due to travel bans, closing of public places including travel attractions. Airlines had been cancelled. Cruise line industry was hit. Hundreds of millions of jobs could be lost globally. Supplies were falling short important necessities like food, water, toilet papers etc. were being evacuated as people started buying in excess because of the fear of lockdown. There was an observant decline in oil prices due to lower demand from China. The performing arts and cultural heritage sectors have been profoundly affected by the pandemic for ex. Museums, libraries, performance venues.

In April and May, a severe wave of infections hit India, where the “Delta Variant” was first identified. In Mid-April, the variant was first detected in UK and two months later it has catalyzed a “thirs-wave” in the country.

As of 1<sup>st</sup> October 2021, more than 233 million cases have been reported worldwide due to COVID-19; more than 4.78 million have died.

We can draw a conclusion as seen in 3 years i.e 2019,2020and on-going 2021that COVID-19 came into existence and as days pass by the virus is mutating into different, extreme and more vulnerable variants. These have been categorized as 1<sup>st</sup> wave, 2<sup>nd</sup> wave and 3<sup>rd</sup> wave. Scientifically speaking these are named as ‘Alpha, Beta, Gamma and Delta’ for the different strains and variants.

Vaccines are in progressive use and are being administered on a large scale not for eradication or elimination but for prevention and reducing its severity and harsh effects on body.

**Mitigation:**

The present dimension figures out about breaking of chain not only through lockdown but with screening and containment. It also highlights about health care availability to provide

for the needs of those infected. Thermal screening of people at every destination, location, organization, place etc. was fixed up and check was made to ensure the body temperature of a person. Those who were having a normal body temperature were permitted to enter but the infected ones whose temperature was high were not allowed. Next were told to go for self-quarantine. The affected individuals were in 'containment zones' to stop the spread of virus. Masks, hand gloves, face shields, sanitizing hands, getting vaccinated or getting a negative test all these follow-ups were mandatory to follow. Contact tracing was also done in order to ensure public safety. PPE kits were also made for doctors, Nurses, surgeons and other hospital staff. More beds, oxygen cylinders, more health care equipment's were required so the arrangements were made accordingly. Other cultural institutions had been indefinitely closed with their exhibitions, events and performances cancelled or postponed. Some services continued through digital platforms such as live streaming concerts or web based arts festivals. All religious groups started taking their prayers, devotions and services through online medium. This pandemic called out suspensions of legislative activities, isolations, rescheduling of elections only because on the fear about spreading of virus. It has disrupted agricultural and food systems worldwide. Hunger, malnutrition, scarcity of food all these started showing up. Farmers were not allowed to return back to their native places. Famines also started to appear. Pandemic severely impacted educational systems globally. Schools, colleges and institutions had been closed and online education was preferred. This had a diverse impact on the minds of students, teachers and families too. People started to unveil by portraying racism, discrimination, in-justice, in-equality, and prejudices all on the basis of COVID-19 as displaying a reason for all of this.

**Response:**

This dimension gathers up many responses responded according to the situation. National response and International response vary from each other. National reaction or response to this was containment measures such as quarantine and curfew (stay home, stay safe) lockdowns were lifted up and only essential service was being provided. The WHO's recommendation on curfews and lockdowns is that they should be short-term measures to reorganize, regroup, rebalance, resources and protect health workers who are exhausted.

For the prolonging of normal and controlled life a strict personal hygiene, effective contact tracing and isolating when ill. But there was a positive and negative response to the strict measures. Some people started to fight, argue and debate as protest against governmental measures and tried to oppose then too. Travelling abroad or to foreign countries was also stopped

too to break the chain. New situation changed now. Lockdowns are lifted. Most of the organizations and other things have already opened up some them will start off soon.

**Conclusion:**

With this a deep conclusion arises as in COVID-19 which is a severe, deadly and hazardous disease came into this world and created and also creating havoc, trouble, a complete mess most specially life at a stake and it is a virus, it keeps mutating constantly to form varying variants. There is no such a thing as in a permanent cure or treatment, only vaccines can alone reduce the severity of the illness and prevent from death. High possibilities are there but sometimes tables turn out and even people die after vaccination. It happens often that doesn't mean we can wander freely after taking vaccines. Health & hygiene, wearing mask, washing hands constantly and social distancing should be carried on for a longer run.

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## SOCIO-ECONOMIC IMPACT OF COVID-19 IN INDIA

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### Abstract:

Coronavirus (COVID-19) pandemic has created an unprecedented loss and disruptions in India. The socioeconomic impact has put significant strain on different sectors such as manufacturing sector, agriculture and allied sector, banking sector, aviation and tourism, education, healthcare, retail, IT, recreation, media, and others. When the pandemic struck, the Indian economy was already in the longest slowdown in recent decades. Countless lives have been lost in India, adding to the social and economic devastation caused by the second wave of COVID-19. The pandemic has further increased informality and caused a severe drop in pay for the majority of workers, leading to a sudden increase in poverty, with women and younger workers being the most affected. The solution for households has been to reduce food intake, take out loans, and sell assets. Daily wage earners, migrant workers, and factory workers are facing uncertainty and hardships. The lockdown has caused high unemployment and a negative effect on the economy, hitting individuals, communities, health systems, increased domestic violence, and so forth at large.

**Keywords:** COVID-19, Indian Economy, Lockdown, Sector, Digital India.

### Introduction:

Coronavirus disease (COVID-19) has spread worldwide since December 2019, when it was first identified in Wuhan, China's Hubei province (Alghamdi, 2021). On March 11, 2020, the World Health Organization declared COVID-19 is a pandemic (Tharayil *et al.*, 2021). The dramatic rise in COVID 19 cases and the consequent mortality have put immense pressure on the global health systems (Sandeep *et al.*, 2020; Dhattrak, 2020). The socioeconomic impact has placed a considerable burden on individuals, families, and communities (Dhamodhar *et al.*, 2021; Mulugeta *et al.*, 2021; Yoganandham *et al.*, 2020). The virus has spread widely, and as governments try to slow its spread, the number of cases is on the rise daily. India had responded quickly, implementing a proactive, nationwide lockdown with the goal of flattening the curve

and giving it the time to plan and allocate resources effectively (Satyasai *et al.*, 2020). India's efforts to eradicate COVID-19 virus have been praised throughout the world but COVID-19 has now become a systemic economic risk, no matter how small or large (Rasul *et al.*, 2021). The situation in India is particularly dire, as a deadly second wave of infections is plaguing the country (The Hindustan Times, 2021). During the initial lockdown and the months following it, nearly 84% of Indian households saw a decrease in their income (Ideas for India, 2021). This pandemic has had a devastating impact on a large number of the Indian population and had a broad impact on industries, including tourism, healthcare, retail, banks, hotels, real estate, education, health, IT, recreation, media, and others (Chaudhary *et al.*, 2020). Because of the shutdown of businesses, daily wage earners, migrant workers, and factory workers face uncertainty and hardships (Lahiri and Sinha, 2021). Although the well-off can survive, there are serious concerns about how the poor will handle and weather future lockdowns. The unorganized sector has been facing unprecedented losses. Several employees have lost their jobs, and many others have been forced to accept pay cuts and cutbacks in benefits. Last year's nationwide lockdown disrupted food supply chains, and food security was a very real concern for millions of households in India. Although the measures appear promising, the COVID-19 pandemic has posed a challenge in the efficient distribution of midday meals and the public distribution systems (PDS), especially for migrant families (Ideas for India, 2021). Due to high globalization, economic integration, and interdependence between the different sectors of the economy, a change in any part of the economy or country now affects other sectors of the economy in other parts of the world.

#### **Impact on Agriculture and Allied Sector:**

In India, the agriculture sector's contribution to the economy is vital (Kesavan *et al.*, 2020). COVID-19 and the restrictive measures taken to contain its spread have had a serious impact on the agricultural workforce and jeopardized food security. These disruptions affected the agricultural sector, which faces the inevitable risk of low incomes as planting time passes and restrictions are imposed in some regions. Agriculture has a higher risk profile than other sectors, in terms of climate, natural disasters, labor, etc., because of its nature (Cevher *et al.*, 2021). Agricultural production is already a high-risk sector in pre-pandemic times. Farmers suffer from the pandemic's severe economic consequences. The agriculture sector directly and indirectly employs around 800 million people (Kesavan *et al.*, 2020).. The Government of India has taken a number of proactive steps to protect the interests of the stakeholders, especially the farming community, to combat covid's adverse impact on agriculture. Recently, a survey on the impact of COVID-19 on Indian agriculture and rural economy has been done by the Department of

Economic Analysis & Research, NABARD (The NABARD, 2020). They have clearly pointed different impacts on agriculture and allied sector. In the survey, it was mentioned that nearly half (47%) of the sample districts in India were affected by COVID-19, while agriculture production (-2.7%) was not significantly affected, primarily because harvesting of Rabi crops like wheat. However, production in the allied sector had fallen significantly, primarily due to a sudden fall in demand for these products, possibly due to the widespread fear of non-vegetarian food after COVID 19. Now the scenarios have little progressed although second phase of pandemic is running now. Allied sector of agriculture such as horticulture, poultry, dairy, fisheries, and pig/sheep/goat have effected seriously during this pandemic. Horticulture, a perishable crop, is being adversely impacted during the lockdown, even though there is no restriction on the sale of fruits and vegetables on the market. The poultry industry is being most severely impacted in all states in India. After crop production, the dairy sector is not affected severely as consumer demand is relatively stable and the supply chain did not experience significant disruptions during the lockdown. In fishery sector, all the activities needed to deliver fish and fish products from production to the end consumer can suffer indirect effects from the pandemic due to changes in consumer demand, market access, or logistical problems related to transportation and border restrictions, which have led to severe disruptions in the fisheries supply chain. The pig, sheep, and goats sector had also been affected adverse due to the increased pig/sheep/goat consumption in some areas, which is considered a safer alternative to poultry (The NABARD, 2020).

### **Impact on Manufacturing Sector:**

The government in all of the countries focuses on encouraging the manufacturing sector due to involvement of 16% GDP growth in the world as reported in 2017. MIC 2025 is the first stage of a larger three-stage plan to make China a leading manufacturing power (Kapparashetty, 2020). Make in India, an initiative launched in 2015, aims to promote the production of goods in India, which aims to reduce India's dependence on exporting nations by encouraging their production. After the lockdown was imposed last year, India's manufacturing had stopped except in the rice milling sector, where production had dropped by half, according to a study by the United Nations Industrial Development Organization (UNIDO) (The WIRE, 2021). In India, State-imposed lockdowns eroding the economy and placing several restrictions on key businesses have hampered the manufacturing sector. Since there was less labor during this time, labor-intensive industries such as manufacturing, real estate, construction, and infrastructure began to slow down (The WIRE, 2021). Metals and chemical products, motor vehicles, machinery and equipment, textiles, among other industries, were among the most affected.

Micro, small, and medium enterprises (MSMEs) in India as a whole play a key role in creating job opportunities and also in the country's exports (Aneja and Ahuja, 2020). According to recent annual reports on Micro, Small, and Medium Enterprises (MSMEs), the sector contributes to nearly 30% of India's GDP and, according to conservative estimates, employs 50% of industrial workers. Over 97% of MSMEs can be classified as micro firms. These MSMEs are uniformly distributed across rural and urban areas and are equally represented in the manufacturing, trade, and services industries. But this sector is severely affected by lower cash flows, supply chain disruptions, migrant workers affected by reverse migration, less demand, and so on.

### **Impact on Aviation and Tourism:**

The Aviation and Tourism sectors' are the major source of economic growth, contributing a large part to GDP, foreign exchange earnings and employment. These sectors' respective contributions to our GDP are about 2.4% and 9.2%. In FY18-19, the tourism sector was responsible for the employment of 43 million people (The Times of India, 2021). But the COVID-19 pandemic has had a devastating effect on travel and tourism around the world, including India (Nagaj and Žuromskaite, 2021). The industry stabilizes the economy in all sectors, such as transport, food, beverage, culture, sports, and more. The travel and tourism industry is the most affected by the closure of hotels, planes on the ground, and travel restrictions (Yadav and Qureshi, 2021). Tourism helps to promote cultural diplomacy, brings people together, and promotes friendship and cooperation between India and other countries. Tourism is one of the industries hardest hit by the restrictive measures imposed by governments after the pandemic, which resulted in restrictions on the mobility of global travelers, as well as social distancing (Dhatrak, 2020). When an economic slowdown hits the world or the country, people have less money, dispose of it less, and save more for future emergencies. Fear of the virus causes discord among people, which will hinder tourism. The new and stricter measures introduced by governments further exacerbated the tourism crisis. Health and safety is always the top priority, and traveling is always the last for everyone. Foreign travelers from many countries have cancelled their bookings (Yadav and Qureshi, 2021). They cut seat capacity, increasing flight costs, and thus increasing travel costs; because of the social distancing directives they give to the public transport industry and the directive that air travel must leave the middle seat empty to maintain social distancing.

### **Impact on Banking Sector:**

Banking sector disburses loans, advances, short-term loans, letters of credit, bank guarantees, forex support, e-commerce, telebanking, e-kiosk, etc (Mishra *et al.*, 2021). Online and offline payments are taken out through major companies, which may have an adverse effect

until it becomes unpredictable. India has recently moved towards digital banking owing to demonetisation and digital initiatives by the government of India (Saldanha and Nitin, 2021). Almost 40% of all online payments are made via hotel booking websites, movies, occasion booking gateways, entertainment media, electric power bills and telecom services. Because of the current pandemic, online payment companies have facing major difficulties as people are more hesitant to travel outside.

### **Impact on E-commerce and Digital Trade:**

During the pandemic, the government restricted the company to sell only essential goods and services that are vitally required to live a normal life. The companies understood the importance of social distance and promised to ship the goods contactless or, even, there was a proposal to suggest paying online instead of cash on delivery, which forced customers to go digital in paying their bills (The Financial Express, 2021). The rapid internet penetration created awareness about health programs and services, and the online registration process covers functions such as patient care, lab services, work-based documentation, and information exchange, medical records, online registrations and appointments, payments, viewing diagnostic reports online, online blood availability, tracking, and approval processes for drugs, clinical trials, medical devices, vaccines, and others. E-commerce is in a state of flux as it continues to grow (The Financial Express, 2021).

### **Impact on Education:**

COVID-19 has been one of the most destructive to India. Beyond its appalling impact on human life, COVID-19 has greatly affected India's educational system, with 247 million primary and secondary school children out of school. Many educational institutions have had to cancel classes, exams, internships, etc., due to the lockdown, and opt for online entry (Jena, 2020). The teachers assigned work to students over the Internet, delivered lectures by video conferencing through different apps such as Zoom, Google Meet, etc. It was a challenging role in convincing the teachers and the students to adapt. At first, the educators and the students were confused and didn't know how to cope with this sudden crisis that forced the shutdown of educational activities (Jena, 2020). Recent analyses of the pandemic's impact on learning and social-emotional well-being suggest that the poorest children will be the hardest hit. These students are less likely to have access to relevant learning digital resources and less likely to have a suitable home learning environment. Before this situation, most teachers lost their jobs as the schools and colleges were closed, and they were called back after taking the courses online; this affected private school, and college teachers across the country (Bharathi and Dinesh, 2021).

### **Conclusion:**

The COVID-19 pandemic, which affected many other countries, devastated India's economy. It is disrupting the livelihoods of peoples and making an unprecedented challenge for India. Restricting social gatherings and encouraging people to stay and work from home are effective strategies to stem the spread of the virus as well as coordination between the health care system, financial system, and the general public is crucial for effectively handling the COVID-19 pandemic and maintaining quality of life. Corona virus directly impacts on major industries like manufacturing sector, agriculture and allied sector, banking sector, aviation & tourism, education, healthcare, retail, IT, recreation, media and the informal sector. Bank plays a vital role in supporting the country's economy by maintaining liquidity. The Indian travel and tourism industry is a major contributor to the country's GDP and generates many jobs. The government must take preventive measures to avoid potential economic loss. Due to the present choice of digital platforms, students who are not as fortunate as the others will suffer, but universities and the Indian government are trying hard to figure out a solution to this problem. India should learn from epidemic diseases and create a special emergency plan to fight COVID-19.

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## ROLE OF HAND SANITIZER USED IN CONTROLLING COVID-19

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### Abstract:

COVID-19, the latest name for the disease caused by the recently discovered corona virus (CV) SARS-CoV-2, has been making the rounds in the media. There is a lot of knowledge available on how to keep COVID-19 from influencing you and your family. The most critical point to remember is that medical professionals agree on the following: Hand washing (HW) with soap and water is one of the most successful ways to remain healthy. If those aren't available, hand sanitizer (HS) will help you get rid of germs on your palms.

**Keywords:** Hand sanitizer (HS), COVID-19, ingredients, Isopropanol (C<sub>3</sub>H<sub>8</sub>O).

### Introduction:

HS are a magic solvent based on science that extracts dirt and germs from your hands in seconds without the use of water [1]. They are also successful against viruses, but you must be confident of the sanitizer's part - make sure to review the bottle. HS are hot right now and they protect you from the CV epidemic. It may be found in the absence of soap and water [2]. However, there is a catch when it comes to using HS: not all HS's are successful at shielding you from the CV. According to a report conducted by the CDC, HS's containing 60–95 percent alcohol (-OH) are good at destroying germs [3]. If you're looking for a HS that will shield you from the CV, look for the following ingredients on the label: The concentration of ethyl alcohol (-OH)/ethanol (C<sub>2</sub>H<sub>5</sub>OH) should be greater than 60% [4].

HW and the use of HS's have been important for infection control when we struggle with the consequences of the COVID-19 pandemic. Skin was already vulnerable to dryness and a weakened skin layer in many of the populations originally impacted by COVID-19, and hand eczema was more common as a result of these causes alone [5]. The effects of HW and HS on

skin and how they deter infection are explored in this report, as well as ways to improve skin health while ensuring the highest level of infection prevention possible [6].

The virus, like many others, is a self-assembled nanoparticle (NPs) of which the outer lipid bilayer is the most fragile structure. Soaps destroy the virus's lipid envelope, rendering it inactive; they are also alkaline surfactants that suck up contaminants such as soil, bacteria, and viruses, which are then washed away from the skin's surface [7]. As compared to the usual outer skin pH of 5.5 or below, the alkalinity of the soap (pH roughly 9-10) will affect the skin barrier as well as the resident skin micro flora during the washing process. In an analysis of the volar forearm [8] discovered that an acid skin pH (4-4.5) retains the resident bacterial flora bound to the skin, while an alkaline pH (8-9) facilitates dispersal from the skin [9].

When it comes to the efficacy of HW against viruses, the amount of time spent doing so has been found to have an effect on the occurrence of influenza-like disease [10]. Bin Abdulrahman *et al.* found that those who spent just 5-10 seconds HW with soap and hand rubbing (HR) had a greater chance of influenza-like disease (odds ratio, 1.37; 95 percent confidence interval, 1.08-1.75) than those who washed their hands for 15 seconds or longer. Furthermore, HW with soap and HR together after shaking them was discovered to be an independent preventive agent against influenza-like illness (adjusted or, 0.59; 95 percent confidence interval, 0.37-0.94) [11]. Previous study on the effect of HW on bacterial and parasitic infections came up with related findings: Infection is minimised when hands are cleaned for 15-20 seconds or longer [12].

Since the late 1800s, alcohol (-OH), a well-known disinfectant, has been recommended for hand disinfection [13]. Isopropanol ( $C_3H_8O$ ), ethanol ( $C_2H_5OH$ ), N-propanol ( $C_3H_8O$ ), or a mixture of these drugs makes up the majority of alcohol (-OH)-based hand antiseptics. Alcohols' (-OH) antimicrobial function is due to their capacity to denature and coagulate proteins, causing microorganisms' (MO's) cells to lyse and their cellular metabolism to be disrupted [14]. The most powerful alcohol remedies are those that contain 60 percent to 95 percent alcohol (-OH). Notably, very high doses of alcohol (-OH) are less potent since higher concentrations of alcohol (-OH) contain less water, and proteins do not readily denature in the absence of water [15]. Different work styles, such as glycerine ( $C_3H_8O_3$ ) and/or aloe vera, are often used in alcohol (-OH)-based HS to help avoid skin dryness and replace water material that is stripped by the application of alcohol (-OH) on the skin surface [16]. A HS with lower alcohol (-OH) content cannot be effective against such germs, such as viruses and bacteria. They will only slow down the propagation of germs, not eradicate them altogether.

The elements of a good HS are mentioned below:

Ethanol (C<sub>2</sub>H<sub>5</sub>OH): 60-85%

Isopropanol (C<sub>3</sub>H<sub>8</sub>O): 60-80%

N-propanol (C<sub>3</sub>H<sub>8</sub>O): 60-80%

What is the mechanism of action of an alcohol (-OH)-based HS?

By attacking the cell structures of germs like bacteria, alcohol (-OH) renders them inactive. Alcohol (-OH), for example, destroys the lipid coating that surrounds the novel CV. As a result, the virus is unable to kill anyone [17].

With all of this in mind, Indus HS was created to be easily accessible to the general public in order to avoid the transmission of CV.

Indus HS contains the following ingredients:

Ethanol (C<sub>2</sub>H<sub>5</sub>OH): 80 % V/V

Glycerol (C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>): 1.45 % V/V

Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>): 0.125 %

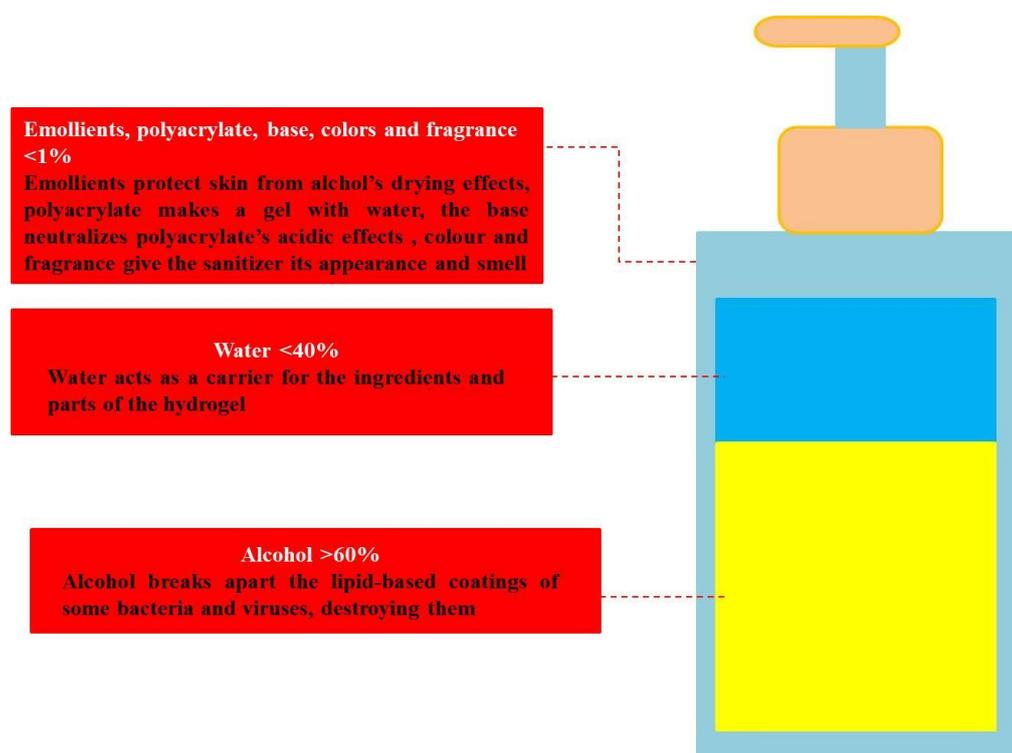
Distilled water (DW)

Diethyl phthalate (C<sub>12</sub>H<sub>14</sub>O<sub>4</sub>): 1%

As the outbreak of the novel CV SARS-CoV-2 spread in early 2020, HS sales continued to rise. The WHO declared the epidemic a global pandemic on March 11 [18]. People should stop rubbing their faces and clean their hands after touching public surfaces such as door handles and handrails, according to health authorities around the world. Moët Hennessy Louis Vuitton SE [19].

COVID-19, a disease caused by the SARS-CoV-2 virus, was first observed in the United States on January 20. HS revenues in the US rose 73 percent in the four weeks ended February 22, according to market research company Nielsen [20]. HS are no longer accessible, according to signs placed on storefront doors around the world. As a result, Moët Hennessy Louis Vuitton SE, Badische Anilin und Soda Fabrik, and chemistry students from around the world are working to develop new supplies [21].

Is the common use of HS, however, justified? While most health authorities suggest washing your hands with soap and water to keep them clean of infections, HS are the next best option when you aren't near a tap, according to experts [23]. The CDC advises that people use a HS that contains at least 60% alcohol (-OH), coat all surfaces of their hands with the medication, and rub them together when dry to get the most value from it. Doctors realised the connection between HW and health long before scientists discovered germs [24].



**Figure 1: Hand Sanitizer ingredients**

In the 1840s, both American medical reformer Oliver Wendell Holmes and Hungarian "Savior of Mothers" Ignaz Philipp Semmelweis attributed bad hand hygiene to elevated rates of postpartum infections, almost 20 years before renowned French biologist Louis Pasteur reported his first germ theory findings. Lupe Hernandez invented an alcohol (-OH)-based, gel-based HS for hospitals in 1966, while still a nursing student [25]. Purell, the first alcohol (-OH)-based gel sanitizer for customers, was launched by Gojo in 1988. While some HS's are sold without alcohol (-OH), it is the primary ingredient in the majority of the drugs being grabbed off store shelves right now. This is because alcohol (-OH) is a strong disinfectant that is still tender on the skin. Alcohol's (-OH) role is to split up bacteria and virus outer coatings [26].

An enveloped virus, ARS-CoV-2, is what it's called. Just a protein cage prevents certain viruses [27]. However, when enveloped viruses leave infected cells, they wrap themselves in a coat made of some of the cells' lipid-based walls as well as their own proteins.

The lipid bilayers that surround enveloped viruses like SARS-CoV-2 are bound together by hydrogen bonds and hydrophobic interactions, according to chemist Pall Thordarson of the University of New South Wales. Alcohols (-OH) have a polar and nonpolar area, close to the lipids that shield these MO's, so "ethanol ( $C_2H_5OH$ ) and other alcohols (-OH) disturb these supramolecular connections, essentially 'dissolving' the lipid membranes," Thordarson states [28]. However, he says, cutting off the organisms' defensive layer involves a very high

concentration of alcohol, which is why the CDC suggests using HS that contain at least 60% alcohol (-OH). However, HR alcohol (-OH) with high amounts on your skin is not good. Since it disrupts the protective coating of oils on your skin, alcohol (-OH) will easily dry out your skin. To counteract this drying, HS's provide a moisturiser [29].

In resource-constrained or rural places where staff don't have access to sinks or other hand-cleaning equipments; the WHO provides two basic formulas for producing your own HS liquids. One mixture contains 80 percent ethanol ( $C_2H_5OH$ ), and the other contains 75 percent isopropyl alcohol ( $C_3H_8O$ ), also known as rubbing alcohol (-OH) [30]. Both recipes require a small amount of hydrogen peroxide ( $H_2O_2$ ) to deter bacteria from developing in the sanitizer and a small amount of glycerol ( $C_3H_8O_3$ ) to keep skin moisturised and prevent dermatitis. Poly (ethylene glycol) ( $C_{2n}H_{4n+2}O_{n+1}$ ) and propylene glycol ( $C_3H_8O_2$ ) are two other moisturising molecules used in liquid HS's. When you massage an alcohol (-OH)-based HS into your skin, the ethanol ( $C_2H_5OH$ ) evaporates, leaving these calming compounds behind [31].

In hospitals, wall-mounted dispensers conveniently pass runny, liquid HS's like those made from WHO formulas to the hands of patients, physicians [32], and guests. Since it's easier to squeeze a gel from the tube without pouring it anywhere, HS gels are far easier to hold and dispense on the go for customers. Gels also delay the evaporation of alcohol (-OH), giving it enough time to coat your hands and fight off any bacteria that might be present [33].

Many who have attempted to make their own gel-based HS's know that traditional gelling agents such as gelatin or agar would not behave when combined with the high concentrations of alcohol (-OH) used to destroy viruses and bacteria [34]. Since polar alcohol (-OH) groups disrupt intermolecular bonds, these agents cannot form a stable gel [35]. Manufacturers get around this problem by using acrylic acid ( $C_3H_4O_2$ ) cross-linked polymers with a high molecular weight [36]. The covalent cross-links assist in the creation of a viscous gel that is resistant to the influence of alcohol (-OH). While the majority of HS's contain either ethyl or isopropyl alcohol ( $C_3H_8O$ ), alcohol (-OH)-free HS are also available [37]. Antimicrobial compounds such as benzalkonium chloride ( $C_{27}H_{42}NO_2.Cl$ ) are commonly found in these, and they offer long-term protection against bacteria. However, the CDC does not prescribe alcohol (-OH)-free drugs for battling the novel CV since it is uncertain if they would be selective against SARS-CoV-2 [38].

The WHO has advised against manufacturing your own HS because certain additives could be inadequate at best and potentially dangerous at worst. Recognizing the need for additional security, the WHO has published a PDF that includes detailed directions for making

your own clean and reliable HS. Regrettably, it's a long and winding road. HW with soap and water as much as possible is your best bet [39].

HS guidelines that have been certified by the WHO

Components

Isopropyl alcohol (C<sub>3</sub>H<sub>8</sub>O) 99.8% - 7515 ml

Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) 3% - 417 ml

Glycerol (C<sub>3</sub>H<sub>8</sub>O<sub>3</sub>) 98% - 145 ml

DW

The healthcare industry has long been a major player in the global HS market. The healthcare industry led with 62 percent of the market share in 2019, followed by the residential sector [40]. In the healthcare industry, the selling of sanitising goods has risen significantly. Individuals' the knowledge of contagious diseases and the value of ensuring good hand hygiene is fueling segment growth. The residential market is another important end-user for vendors to consider [41]. End-users have been more aware of the risks of germs and pathogens in the workplace over the past two years. They choose items relating to health and hand hygiene with greater consideration and caution. In this category, foam-based HS are common, but gel-based HS are also gaining popularity [42].

### **Conclusion:**

Germs are all over the place! They will get into our hands and other things that we come into contact with during our everyday lives and make us sick. One of the most effective precautions you can take to prevent being ill and transferring germs to those around you is to wash your hands with soap and water or a HS that contains at least 60% alcohol (-OH) at crucial moments. The use of HS and HW with soap and water has significant variations. Soap and water eliminate all kinds of germs from palms, while HS destroys particular germs on the scalp. While alcohol (-OH)-based HS's can effectively minimise the number of germs in a variety of conditions, they can only be used when necessary.

HS's are less effective than soap and water at killing such germs and toxins, such as norovirus, Cryptosporidium, and Clostridioides difficile. HS's may not be effective at removing toxic chemicals like pesticides and heavy metals like lead. HW helps to minimise the amount of germs, chemicals, and metals on your body. Knowing when to wash your hands and how to disinfect them would give you the best chance of staying well.

The world HS industry is dominated by global vendors. Procter and Gamble, Reckitt Benckiser Group, Unilever, Sabra, Steubenand Vi-Jon are the major industry players. Purell by

GOJO Industries and Dettol by Reckitt Benckiser were the most common personal grooming products in 2018. Several foreign players are expected to expand their presence globally, especially in APAC and Latin America's developing countries. During the forecast era, global understanding of the benefits of HS's is expected to grow. Hand purifiers have a high rate of acceptance by end-users all over the world. As a result of the increased demand, many new vendors have entered the market. Price, creativity, consistency, product style, and brand are all aspects in which main players compete. As a result, the vendors must concentrate on achieving profitability, extending into new geographies, and reviving domestic demand. Vendors can maximise profits by employing effective manufacturing strategies that decrease commodity costs while also mitigating risk.

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## VACCINATION STRATEGIES AGAINST COVID-19

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### Introduction:

The novel beta-corona virus SARS-CoV-2 pandemic has imposed a heavy disease burden all over the world. The corona virus diseases also known as COVID-19 pandemic has imposed a heavy disease load around the world (Huang *et al.*, 2020) beginning from the year 2019 in Wuhan from Bats which is still in effect till date. The beta-corona viruses have included between the species and it has caused three zoonotic outbreaks that is, SARS CoV (2002-03), MERS-CoV (2012), and SARS-CoV-2 (2019- till date) in the last 2 years. The myriad presence of coronaviruses in bats, along with multiple Severe Acute Respiratory Syndrome related Coronaviruses (SARS-related CoV) and the irregular species crossing over of barriers from COVID-19 to humans, indicate that existence of zoonotic transmission events may continue (Ou *et al.*, 2020). As long as its appearance in Nov 2019, it has spread to 188 countries and 25 territories throughout the world, although elaborate efforts by WHO and Governments to accommodate the infection, firstly due to the highly infectious nature of this virus (Anon, 2020a; Anon, 2020b). Around 10,533,779 cases have been reported on 2 July 2020, world-wide with 512,842 people losing their lives (WHO, World Health Organisation, 2020).

SARS-CoV are a group of viruses related to each other that can cause airborne infection in humans that may vary from mild symptoms to lethal effects. Till now, there are seven genera of CoVs that are studied to infect humans (<https://www.cdc.gov/coronavirus/types.html>). Four of these genera, including HCoV-OC43 (Human Coronavirus OC43), HCoV-229E (Human Coronavirus 229E), HCoV-HKU1 (Human Coronavirus HKU1), and HCoV-NL63 (Human Coronavirus NL63), only cause comparatively mild and self-limiting respiratory symptoms (van der Hoek, 2007). On the other hand, these three Coronaviruses: SARS-CoV (Severe Acute

Respiratory Syndrome Coronavirus), MERSCoV (Middle East Respiratory Syndrome Coronavirus), and SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), are extremely pathogenic and can lead to severe respiratory diseases and fatal outcome in infected patients. The first lethal coronavirus, SARS-CoV emerged in 2002 in the province of China named Guangong. During the 2002–2004 epidemic, SARS-CoV had infected 8,098 people and led to 774 SARS-associated deaths across 29 countries before it escaped (World Health-Organization; 2003).

In 2012, MERS-CoV appeared in Saudi Arabia and led to two outbreaks in South Korea in 2015 along with Saudi Arabia in 2018, and till dates reports of irregular cases are registered. MERS have a mortality rate of around 35% as there are 2,519 confirmed cases till January, 2020 with 866 deaths in 27 countries (World-Health-Organization MERS situation update, January 2020). In December, 2019, a new type of Coronavirus that has the potential to cause severe respiratory illness appeared in Wuhan, China. This novel virus was named as SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) by WHO and the disease was named as Corona virus Disease 2019 or COVID-19. The clinical demonstration of COVID-19 show a range that can vary from symptomless to mild flu-like symptoms to ARDS (Acute Respiratory Distress Syndrome) and also can lead to death. There are cases related to neurological complications, long term pulmonary and cardiology complications, have been reported in Corona virus Disease 2019 cases (Del Rio *et al.*, 2020). The comparison of SARS-CoV and MERS-CoV, resulted in the conclusion that the SARS-CoV-2 is extremely infectious with an approximated 2.2 reproductive number which means that the one surviving COVID-19 case can cause an average of 2.2 new infections (Li *et al.*, 2020). Additionally, its ability to spread by asymptomatic patients has posed a significant challenge to containment measures. In October 2020, SARS-CoV-2 has infected over 43 million individuals and caused in about 1.15 million deaths in 235 countries (Gandhi *et al.*, 2020, World-Health-Organization, 2020). Allowing the fast spread and high death rate of COVID-19, an effective vaccine is urgently necessary to control this pandemic. In this review, we define the compatible CoV biology, SARS and MERS immunization strategies, and recent efforts of COVID-19 vaccine development.

### **Biology of Coronavirus and its possible future effects on vaccine development:**

Coronaviruses when observed under the electron microscope showed crown-like presence, this property of its structure made it derive its name. It has a diameter of 80 to 160nm and have RNA as a genome (Adv Virus Res., 2006, Stadler *et al.*, 2003). The corona virus has a single stranded RNA (positive sense) of ~30 kb size and among all the RNA viruses known, it has the largest genome. There are two overlapping open reading frames (ORFs) in the 5'-terminus of the CoV genome that is ORF 1a and ORF 1b. It covers the two-thirds of the whole genome length. These two ORFs can be translated into two polyproteins (pp) that are pp1a and

pp1ab. These polyproteins are also associated in the replication of viral genome along with sub-genomic synthesis of mRNA as it is cleaved into 16 non-structural proteins (Nsps). On the other hand, 3'-terminus encodes for membrane (M), envelope (E), spike (S), and nucleocapsid (N) proteins, the four significant structural proteins (World-Health-Organization 2020, Adv Virus Res. 2006, Stadler *et al.*, 2003).

Spike, Envelope and Membrane protein makes enwrap of the CoV, and the capsid to pack genomic RNA is formed by N protein. There are accessory proteins in corona virus which are genus specific and help the virus to elude the immune system with increase malignancy is encoded by 3'-terminus of the CoV genome. For example, SARS-CoV include accessory protein ORF 3a, 3b, 6, 7a, 7b, 8a, 8b and 9b, and SARS-CoV-2 contains ORF 3a, 6, 7a, 7b, 8, 10 (Enjuanes *et al.*, 2016, NCBI-Reference-Sequence 2020, HCoV-EMC/2012, complete genome, 2020). Several viral proteins are necessary for the CoVs life cycle. For arriving target cells, S protein primarily binds to cellular receptors by its receptor-binding domain (RBD), and the receptor-virus complex is later deviated to endosomes (NCBI-Reference-Sequence, 2020). The viruses have different receptors like the S protein of SARS-CoV and SARS-CoV-2 ins bind to angiotensin-converting enzyme 2 (ACE2), while the S protein of MERS-CoV binds to dipeptidylpeptidase-4 (DPP4) cellular receptor. S protein is forward cleaved into S1 AND S2 subunits at the endosome, S1 is the RBD-containing while S2 is non-RBD-containing, and the S2 subunit resolve fusion among the viral envelope and the host cell membrane (NCBI-Reference-Sequence, 2020). Subsequently, entering the cell, various Nsps, especially Nsp12 which is RNA-dependent RNA polymerase and Nsp13 which is a helicase, moderate replication along with transcription of the genome of coronavirus. The mRNA of corona virus is translated into various structural as well as non-structural proteins. The viral nucleocapsids are formed when N proteins bind to Corona virus genomic RNA, and Spike, Envelope, Membrane proteins form the envelope of Corona virus. The S protein is especially important for virus-cell receptor binding further virus-cell membrane fusion, including that it can be an effective target for CoV vaccine design (NCBI-Reference-Sequence.2020). Certainly, research have shown that antibodies develop against the S protein are persisting and immuno-dominant in recovered SARS patients (Du *et al.*, 2009, Cao *et al.*, 2010). Furthermore, there are certain studies that demonstrate that SARS-CoV and MERS-CoV can be neutralized by the anti S antibody along with providing protective effects in humans and animals (Zhong *et al.*, 2005, Qiu *et al.*, 2005, Tang *et al.*, 2014). Potent immune responses along with protective effects in pre-clinical models have been obtained by several S protein-based vaccines developed against SARS-CoV and MERS-CoV (Li *et al.*, 2015; Li *et al.*, 2013; He *et al.*, 2006; Tai *et al.*, 2017; Tai *et al.*, 2016). These results confirmed that the S protein of corona virus could work as an ideal target for the vaccine to induce

protective immunity and neutralizing antibodies. Apart from S protein, there are other structural proteins that have also been tested to be the targets for vaccine. The vaccines which are based on N protein, normally are not able to induce neutralizing antibodies as N protein is not present on the surface. N protein is more conserved than S protein in corona virus, that makes S protein a potential target for the vaccine which is T-cell inducing (NCBI-Reference-Sequence, 2020). One of the recent studies have demonstrated that a vaccine with viral expressing N protein may induce CD4+T cell-dependent immunization against SARS-CoV and MERSCoV, offering the utility of N protein-based T-cell inducing CoV vaccines (Wang *et al.*, 2017). On the other hand, M protein-based vaccines can induce a high titer of antibody response in immunized animals (Zhao *et al.*, 2016). Although there are no data on the protection ability of M protein induced neutralization antibody vaccines in preclinical models have been determined. Very few reports of immunization studies based on E protein have been found. There are also immuno-pathological complications associated with the MERS-CoV and SARS-CoV vaccines that require addressing and further optimization. One negative effect is the induction of antibody-dependent enhancement (ADE) effect, which is generally caused by vaccine-induced suboptimal antibodies that ease viral entry into host cells (World-Health-Organization. 2020, Buchholz UJ *et al.*, 2004). It was found in *in vitro* study that SARS-CoV vaccine is based on S protein (full length) that increases SARS-CoV infection in human cell lines (Huisman *et al.*, 2009). Besides, two studies have also shown that there was an increase in the viral infectivity due to the anti S protein serum of SARS-CoV (Kam *et al.*, 2007; Jaume *et al.*, 2011). These outcome raised safety concerns for the vaccines based on S protein to treat SARS-CoV and MERS-CoV.

#### **Pre- progress of SARS-CoV and MERS-CoV immunization strategies all over the world:**

Several forms of vaccines targeting SARS-CoV and MERS-CoV have been developed and also tested in preclinical models. Still, only a few of them invade clinical trials and not anyone have been FDA approved. These path include virus-like particle vaccines, protein subunit vaccines, DNA vaccines, whole-inactivated vaccines, viral vector vaccines, and live-attenuated vaccines.

#### **Protein subunit vaccine:**

It consist of viral antigenic fragments which is produced by recombinant protein techniques and it is easy to produce, relatively safe and well tolerated compared to viral vector vaccines and whole virus vaccines. The disadvantage of protein subunit vaccines is their low immunogenicity. Consequently, fusion and adjuvants with immunostimulatory molecules are generally used together with subunit vaccines to reduce this challenge. The SARS-CoV protein subunit vaccines was firstly developed by surrounding full-length S protein vaccines and later specified on S protein RBD-based vaccines. Any of the SARS-CoV protein subunit vaccines

have not entered the clinical trials even if they showed potent protective effects and antibody responses in preclinical models (Li *et al.*, 2015, Li *et al.*, 2013, Huisman *et al.*, 2009, Honda-Okubo *et al.*, 2015, He *et al.*, 2004, Du *et al.*, 2009, Du *et al.*, 2007). Studies have demonstrated that extracellular domain of the S protein, full-length S protein as well as the trimeric S proteins (triSpike) are all immunogenic and also shows protection against SARS-CoV infection (Li *et al.*, 2015, Li *et al.*, 2013, Huisman *et al.*, 2009). However, Kam *et al.* and Jamue *et al.* in their *in vitro* study have discovered that triSpike vaccine may also cause Fc $\gamma$  receptor II (Fc $\gamma$ RII)-dependent SARS-CoV infection in B cells of humans (Huisman W *et al.*, 2009, Kam *et al.*, 2007). On the other hand, S protein RBD-based vaccines induced high-titer neutralizing antibodies with no lethal side effects. This is possible as the RBD-based vaccines has no involvement of the non-neutralizing epitopes as compared to full-length S protein vaccines. One study has demonstrated that RBD-based vaccines not only protect mainly SARS-CoV challenged mice with no observable viral RNA in the lung, but may also induce long-lasting S-specific antibodies which can be maintained for 12 months (Du *et al.*, 2009). Additionally, RBD-based SARS-CoV vaccines have also been demonstrated to induce RBD-specific IFN- $\gamma$  forming cellular immune responses in mice (Du L *et al.*, 2009). Therefore, SARS-CoV RBD has remained the main target for SARS vaccines. Eventually, SARS-CoV subunit vaccines form S2 subunit as well as M and N structural proteins have also been tested (Du *et al.*, 2010, Guo *et al.*, 2007). Although, no evidence has demonstrated in support of the potential protective effects or neutralizing antibodies against viral challenge.

#### **Virus-like particle vaccine:**

Virus-like particles (VLPs) are self-build viral structural proteins that imitate the structure of native viruses basically they lack the viral genome. If a comparison is drawn with protein subunit vaccines, VLP vaccines bind with epitope has conformation which are more similar to the native virus that leads to the better responses of immunization. Compared to the whole virus vaccines, the VLP vaccines production does not involve live or inactive virus that results in safer candidates of vaccines. The Virus-like particle vaccines that has most repetitive antigenic surface also help to induce stronger response of antibody by reliably cross-linking B-cell surface receptors. Till now, VLP vaccines have been used to make vaccines against hepatitis B virus and HPV, human papillomavirus (Lan *et al.*, 2014). Few MERS-CoV and SARS-CoV, VLP vaccines have been reported earlier. For SARS-CoV, Lokugamage *et al.* in their study have demonstrated that chimeric VLPs are composed of S protein of SARS-CoV and M, E and N proteins of mouse hepatitis virus that can induce neutralizing antibody responses and reduce SARS-CoV virus titer in mice lung after viral challenge (Qian *et al.*, 2020). In addition, another study performed by Liu *et al.* showed that chimeric VLPs consisting of SARS-CoV S protein and

influenza virus M1 protein can induce neutralizing antibodies and provide protection against lethal challenge in mice (Lokugamage *et al.*, 2008). However, one study used the same chimeric VLPs as Lokugamage *et al.* used in their study and showed that this VLP vaccine can lead to pulmonary immunopathology on challenge with SARS-CoV. Therefore, potential adverse effects of coronavirus VLP vaccines should be monitored. For MERS-CoV VLP vaccines, Wang *et al.* have shown that VLPs containing MERS-CoV S, E and M proteins can induce specific antibody response and T1-mediated cellular immunity in rhesus macaques (Liu *et al.*, 2011). The same research group developed another chimeric VLP vaccine containing the fusion of the receptor-binding domain (RBD) of MERSCoV S protein and the canine parvovirus (CPV) VP2 structural protein (Wang *et al.*, 2017). They showed that this VLP vaccine induces MERS-CoV-specific antibody response and T-cell immunity in mice. These studies suggested that VLP vaccines hold the potential for clinically effective coronavirus vaccines.

#### **DNA vaccine:**

DNA vaccines consist of genes encoding viral antigenic components which is expressed by plasmid vectors and delivered into cells by electroporation. When a comparison is drawn with other vaccine technologies, DNA vaccines are faster and more adjustable platform for development and production of vaccine that makes it a technology to combat emerging epidemics like SARS-CoV-2. Furthermore, DNA vaccines involving antigen production in the target cells, helps to epitomize the native conformation and also post-translational modification of viral antigens. Although important disadvantage of DNA vaccines is their particular immunogenicity due to amplification in *in vivo* study and inability to spread. Consequently, it is important to examine strategies which can enhance the potency of DNA vaccines, such as adding adjuvant or using a prime-boost regimen. Apart from, DNA vaccines genomic integration towards the host chromosome is another are of concern in terms of biosafety that can lead to oncogenesis and mutagenesis (Wang *et al.*, 2017). In previous studies, the risk of plasmid inserted vaccine inside the host chromosome is quite low has been demonstrated. The WHO and FDA still recommends the integration studies to be involved as part of the safety program of DNA vaccines (Rauch *et al.*, 2018, Wang *et al.*, 2011).

Various candidates of DNA vaccines have been notified for SARS-CoV, along with the S-, M-, and N protein based vaccines (Schalk *et al.*, 2006, Yang *et al.*, 2004, Kim *et al.*, 2004, Zhao *et al.*, 2004, Okada *et al.*, 2007). Still all of them can develop a and cell-immune responses and certain level of antibody only S protein-based DNA vaccine has been shown to induce protective effect against SARS CoV infection and it possibly due to the indispensable role of S protein in receptor binding (Schalk *et al.*, 2006).

### **Viral vector vaccine:**

Viral vector vaccines are recombinant viruses which encodes antigens of interest in an unconnected modified virus. They deliver antigen into the cells mimicking natural infection, so they induce and humoral immune responses and strong antigen-specific cellular, In addition, viral vectors are able to accept large insertions in their genome, providing a flexible platform for antigen design. Despite these advantages, there are several drawbacks. The manufacturing process for viral vector vaccines is more complicated than other approaches, including the optimization of cellular systems and the exclusion of contaminants, which can greatly affect the efficiency of viral vectors. Moreover, the recombinant viruses have the potential to carry the risk of genome integration into humans, so additional assessment of biosafety will be required prior the clinical trials. Finally, if the selected viral vector has the potential to infect the populations, the pre-existing immunity could dampen the induced immune response of the virus, which has been seen in Adenovirus and Measles virus-based vaccines (Al-Amri *et al.*, 2017, Fausther-Bovendo *et al.*, 2014). Similar to protein and DNA subunit vaccines, most of the coronavirus vaccines of the viral vector target the S antigen. Numerous viral vectors have been employed to develop MERS-CoV and SARS-CoV vaccines (Knuchel *et al.*, 2014, Enjuanes *et al.*, 2008).

### **Viral vector vaccine SARS-CoV:**

It is a popular viral vector vaccine that has been tested in clinical trials for a huge variety of diseases, and several studies have also observed the efficacy of adenovirus-based SARS-CoV vaccine. In the study of Gao et al and Liu et al, the feasibility of vector vaccine of SARS adenovirus was first observed. They demonstrated that adenoviral vector has the ability to induce neutralizing antibodies in monkeys as well as rats by the expression in S1 fragment but neither study showed evidences of *in vivo* protection against SARS CoV challenge (Schindewolf *et al.*, 2019, Gao *et al.*, 2003).

### **Viral vector vaccine MERS-CoV**

Several vaccines based on adenovirus-MERS-CoV have been developed. In mice, Human adenovirus type 41 (Ad41) and type 5 (Ad5) along with expressing S1 or S protein of MERS-CoV have been shown to induce neutralizing antibodies. However, the protection effect of Ad41- and Ad5- based MERS vaccines have still not been evaluated (Kapadia *et al.*, 2014, Guo *et al.*, 2015) Notably, a combination of Ad5-MERS-S vaccine with S protein nanoparticles have also been used (Jung *et al.*, 2018). Heterologous immunization by priming with Ad5/MERS and boosting with spike protein nanoparticles has demonstrated not only protective effect in hDPP4-transduced mice against MERS-CoV challenge, but also more balanced T1/T2 responses than Ad5- or nanoparticles-alone homologous prime-boost vaccines (Jung *et al.*, 2018). The Ad5

vector has already been applied to SARS-CoV-2 vaccine development, and promising results have been demonstrated in phase I and II clinical trials (Zhu *et al.*, 2020)

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# COVID 19: Impact and Response (Volume V)

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