Review Article

BIOCHEMISTRY OF CORONA VIRUS: AN OVERVEIW

ABSTRACT

Coronaviruses forms large family of respiratory viruses having positive (+ve)-stranded RNA (C0V). Their names are derived from the crown-like shape that are present on their them (surface). The new viral strain SARS-CoV-2 was first discovered in Wuhan, China, in December 2019. Although airborne transmission, direct contact, and indirect contact are all possible, droplets are the most typical way to spread an infection. Like the other coronaviruses in the same family, it can cause everything from minor flu-like symptoms like; cold, sore throat, cough, and fever, to very serious ones like; pneumonia and breathing difficulties. It also has potential to be fatal. The primary constituents make up the coronavirus. For instance, the positive-stranded RNA molecule that the host cell will translate is carried by the endoplasm, cell membrane, and outer globular protein. The transit of substances into and out of the cell is regulated by the cell membrane and membrane protein. One or more of them include the pointed glycoprotein, envelope small membrane protein, hemagglutin esterase, nucleoprotein, and genomic RNA. The second coronavirus that causes severe acute respiratory syndrome is the reason for the ongoing coronavirus disease epidemic known as covid-19 pandemic or coronavirus pandemic (SARS-COV-2). It was originally discovered in December 2019 in Wuhan, China. The World Health Organization (WHO) classified the outbreak as a pandemic and a public health emergency of global concern in January 2020 and March 2020, respectively. As of March 7th, 2021, COVID-19, one of the most deadliest pandemics in recorded history, had been linked to over 2.59 million fatalities and over 11.7 million confirmed cases. Being vaccinated is one of many steps you may take to protect yourself and others from getting infected with COVID-19. Protection from COVID-19 is essential since it can cause severe illness or death in some persons. It takes all of the tools at our disposal to stop a pandemic. You can reduce your risk of getting sick or spreading the disease to others by taking additional precautions like wearing masks and avoiding social situations. Combining COVID-19 vaccine with following the CDC's recommendations for safeguarding both you and others will provide the best defense against the virus.

Key Words: COVID-19., SARS-CoV-1., Vaccine., Hemagglutin esterase

INTRODUCTION

A wide family of respiratory viruses with positive-stranded RNA is known as coronaviruses (C0V). The crown-shaped tips that are found on their surface are what give them their name. There are four different genera of coronaviruses (CoV), including:

1. The first is alpha-coronaviruses (α-CoV).

2. Beta Coronaviruses (β-CoV)

3. Gamma Coronaviruses (γ-CoV)

4. Delta Coronaviruses (δ-CoV)

While α-CoV and β-CoV can infect mammals, γ-CoV and δ-CoV typically infect birds. Six CoVs have previously been found to be human-susceptible, including the low pathogenic HCoVs HKU1 and HCoV-OC43, HCoV-229E and HCoV-NL63, and HCoV-229E, which cause mild respiratory symptoms in addition to the common cold (Hui *et al*., 2019). "SARS-CoV (Severe Acute Respiratory Syndrome-Coronaviruses) and MERS-CoV (Middle East Respiratory Syndrome-Coronavirus) are the other two –CoVs that causes potentially lethal respiratory tract infections that are severe" (Yin *et al*, 2017). Unaccounted-for pneumonia, later known as the coronavirus disease 2019, or COVID-19, first appeared in Wuhan, China, in December 2019. (Li *et al*., 2020).

The first case was associated with a wholesale seafood business in Wuhan. Human respiratory epithelial cells have produced a brand-new coronavirus that is a member of the sabevirus subgenus and the Coronavirus subfamily (Harding *et al*, 2020). "This virus, known as SARS-CoV-2, is the recent coronavirus strand that can infect people and it's different from the earlier isolated MERS-CoV and SARS-CoV" (Guo *et al*, 2020). The coronaviruses found in bats, pangolins, and other species are thought to serve as a "gene bank" for the creation of novel recombinants. "Frequent human-animal interactions have been theorized to be the very source of viral interspecies transmission, due to the usage of pangolins in traditional medicine and as food. Bat and pangolin-origin, coronavirus recombination events were expected to occur, according to the similarity analysis of SARS-CoV-2 and the animal-origin of coronaviruses" (Zhang *et al*, 2020). The similarity between SARS-CoV-2 and the closest bat relative is very high: all proteins in the coronavirus proteome (apart from ORF10) have identities of above 85%, and the genome length (30 kb) has been fully conserved (Ceraolo *et al*, 2020). Seven coronaviruses that harm individuals have been identified so far as being

widespread throughout the world. MERS-CoV, which frequently progresses to severe pneumonia with an estimated mortality rate between 30 and 40 percent, is the most dangerous of the known coronaviruses. "SARS-CoV, which causes fever, chills, and body aches and frequently progresses to pneumonia, a serious condition in which the lungs become inflamed and fill with pus, has an estimated mortality rate of 9.6%. The most recent coronavirus, SARS-CoV-2, has an estimated mortality rate" (Harding *et al*, 2020).

Table 1: List of viruses belonging to human coronavirus type, divided by lethality.

LESS LETHAL KNOWN CORONAVIRUSES	MOST LETHAL KNOWN CORONAVIRUSES
229E (the alpha coronavirus)	MERS-CoV (the beta coronavirus that causes the Middle East Respiratory Syndrome)
NL63 (the alpha coronavirus)	SARS-CoV (the beta coronavirus that causes the Severe Acute Respiratory Syndrome)
OC43 (the beta coronavirus)	2019 new coronavirus (SARS-CoV-2)
HKU1 (the beta coronavirus)	

(Harding *et al*, 2020).

Angiotensin converting enzyme II (ACE2), the same cell entry receptor used by SARS-CoV, is used by SARS-CoV-2 to infect cells. This infection can either be completely asymptomatic or can cause flu-like symptoms like fever, coughing, and breathing problems (Guo *et al*, 2020). This later symptomatology, which is more prevalent and severe in elderly subjects who can also exhibit concurrent pathologies, is thought to occur in young subjects as well. Particularly, those with a weakened immune system such as, those receiving acute or chronic immunosuppressive therapy, those who are epigenetically predisposed, or those who are exposed to an excessive amount of environmental stress (Cannizzaro *et al*, 2019). These include individuals who engage in extreme or physically demanding activities, those who have a particulate allergy. In severe circumstances, COVID-19 can eventually present as pneumonia; patients may quickly experience acute respiratory distress syndrome and pass away from multiple organ failure. Given these presumptions and the lack of understanding regarding the protocols to be implemented in order to manage important events like the one we are currently experiencing. The goal of this review is to present a protocol designed to stop the spread of the SARS-CoV-2 infection. Additionally, we wish to provide an overview of SARS-CoV-2 and the approaches employed to combat this virus (Zhang *et al*, 2020).

CORONAVIRUS HISTORY

When an acute respiratory infection of farmed hens first appeared in North America in the late 1920s, there were the first reports of a coronavirus infection in the animal. The first comprehensive study describing a novel respiratory infection in chickens in North Dakota was written in 1931 by Arthur Schalk and M.C. Hawn. With significant death rates of 40–90%, the infection of newborn chicks was characterized by gasping and listlessness. The virus that caused the sickness was identified by Leland David Bushnell and Carl Alfred Brandly in 1933. At the time, the virus was called the infectious bronchitis virus (IBV). "In 1937, Charles D. Hudson and Fred Robert Beaudette successfully produced the virus. The Beaudette strain was given to the specimen. The mouse hepatitis virus (MHV), which causes hepatitis in mice and JHM which causes brain disease (murine encephalitis) were discovered in the late 1940s. The connection between these three distinct viruses was not known at the time" (Decaro, 2015).

In the 1960s, two special techniques were used in the US and UK to identify human coronaviruses. A distinct common cold virus known as B814 was discovered in 1961 by E.C. Kendall, Malcolm Bynoe, and David Tyrrell when they were working at the British Medical Research Council's Common Cold Unit. Standard methods that had been successful in growing known common cold viruses like adenoviruses and rhinoviruses could not be used to grow the virus (de-Groot et al, 2015). Tyrrell and Bynoe were able to successfully cultivate the new virus in 1965 by serially exposing it to a cultured human embryonic trachea organ. Bertil Hoorn introduced the novel cultivation technique to the laboratory. The isolated virus cold produced was administered intranasally to volunteers, and it was rendered inactive by ether, indicating it's possession of a lipid envelope. In 1962, John Procknow and Dorothy Hamre of the University of Chicago isolated a brand-new cold from medical students. The virus was identified as 229E after it was isolated and grown in kidney tissue culture. Like B814, the novel virus gave volunteers a cold and was destroyed by ether. In 1967, Tyrrell and Scottish virologist June Almeida at St. Thomas Hospital in London investigated the structural differences between IBV, B814 and 229E. The three viruses were demonstrated to be morphologically related via electron microscopy thanks to their characteristic club-like spikes and general shape. The same year, a team of researchers at the National Institutes of Health used organ culture to successfully isolate another member of this new group of viruses. One of the samples was given the designation OC43 (Geller et al, 2012). "The novel cold virus OC43 displayed unique club-like spikes under the electron microscope, similar to B814, 229E, and IBV. The novel cold viruses that resemble IBV were quickly discovered to share morphological similarities with the mouse hepatitis virus. Coronaviruses is the term given to this new class of viruses because of their unique physical characteristics. In the decades that followed, research on human coronavirus 229E and human coronavirus OC43 proceeded. Loss of the coronavirus strain B814 which was a human coronavirus. Since then, several human coronaviruses have been discovered, such as the SARS-CoV in 2003, the HCoV NL63 in 2003, the HCoV HKU1 in 2004, the MERS-CoV in 2013, and the SARS-CoV-2 in 2019. Since the 1960s, a significant number of animal coronaviruses have also been discovered" (Geller et al., 2012).

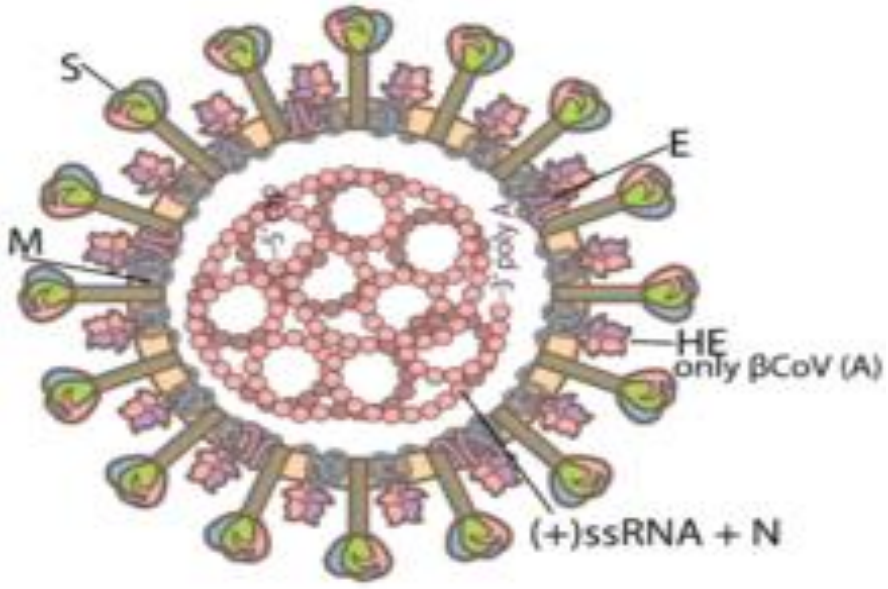

Fig 1: STRUCTURE OF CORONA VIRUS CELL (Geller et al., 2012).

Causes of the Corona Virus according to its Biochemistry

The severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) virus strain is the cause of COVID-19. The respiratory pathway is the major way that the 2019 coronavirus disease

(COVID-19) transmits from one person to another after an infected individual coughs, sneezes, sings, talks, or breathes (Lotfi et al, 2020). When a virus-fluid particle, such as respiratory droplets or aerosols, exhaled by an infected person enters the mouth, nose, or eyes of another person who is in close proximity to the infected person, a new infection takes hold. 1000 infectious SARS-CoV-2 strands on average are thought to start a new infection during human-to-human transmission (Meiler et al, 2015). The possibility of transmitting COVID-19 increases with proximity and duration of contact. Longer distances only involve aerosols, whereas closer distances can involve both bigger droplets (which fall to the ground) and aerosols. Aerosols (sometimes referred to as droplet nuclei) can be created by evaporating larger droplets. As of November 2020, it is unclear how important larger droplets and aerosols are in relation to one another. However, the virus is not known to travel significant distances, such as through air ducts, before entering a room. Airborne transmission is most likely to happen indoors, in high-risk settings including: dining establishments, choirs, gyms, nightclubs, offices, and places of worship, frequently when they are busy or poorly ventilated. It also happens in hospitals, frequently when COVID-19 patients have aerosol-producing medical procedures. There is no concrete evidence that the virus can be spread from person to person, despite the possibility. Although it is not believed to be the primary method of the virus transmission, a person could contract COVID-19 indirectly by touching a contaminated surface or object before touching their own mouth, nose, or eyes. The virus is not known to be transmitted through human waste, animal disease vectors, food, breast milk, food waste, or drinking water (although some animals can contract the virus from humans). During pregnancy, it is extremely rare for the virus to pass from mother to child (Meyerowitz et al, 2020).

TRANSMISSION MODE

The World Health Organization's (WHO) recent "Situation Report-12," relates details on human-to-human transmission of COVID-19 which occurs through droplets, aerosols, and direct body contact. Similarly, regarding the previous epidemics caused by other starins of coronavirus(MERS, Middle Eastern Respiratory Syndrome, and SARS, Acute Respiratory Syndrome), it is observed that the droplets produced by symptomatic patients while speaking, coughing, and sneezing can spread up to 1-2 meters. However, a recent study showed that the infection can also occur in asymptomatic individuals and before the beginning of symptoms. The inhalation of aerosols, which are microparticles with a diameter less than 5 cm that carry pathogens and are transported by the current of the air after being discharged in the air, enables the occurrence of diffusion even at great distances (with reverse ratio due to their

dilution) (Tellier et al, 2019). However, it has been determined that SARS-CoV-2 remains practicable in aerosols after 3 hours, with a reduction in the infectious titer from 103.5 to 102.7 TCID50 per liter of air. Currently, the literature is unable to provide information on the practicable concentration of SARS-CoV-2 to infect a human. This decrease, from 104.3 to 103.5 TCID50 per mL, was comparable to that seen with SARS-CoV-1. Based on the virus titer's projected exponential decay rates, the half-life of the live virus in aerosol was also calculated (Van et al., 2020).

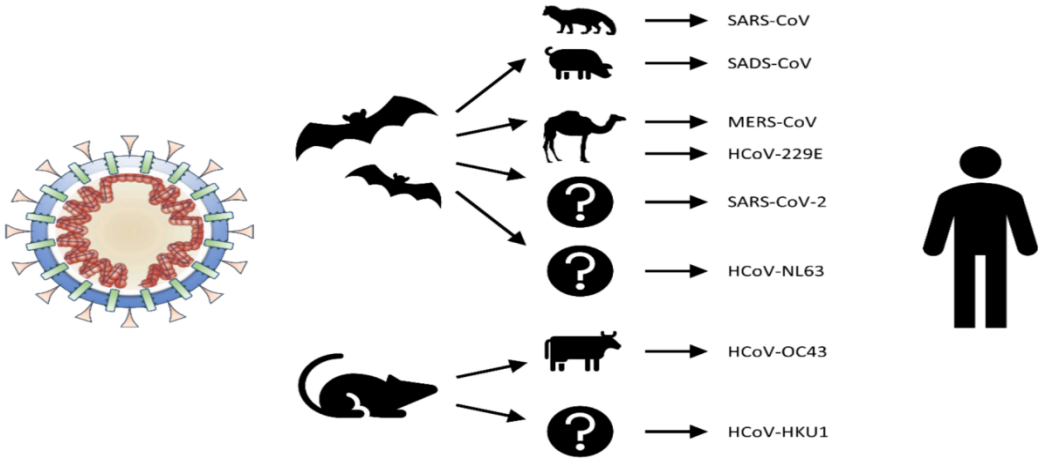

Fig 2: image showing the mode of transmission of corona virus disease from source to man (Van *et al*, 2020).

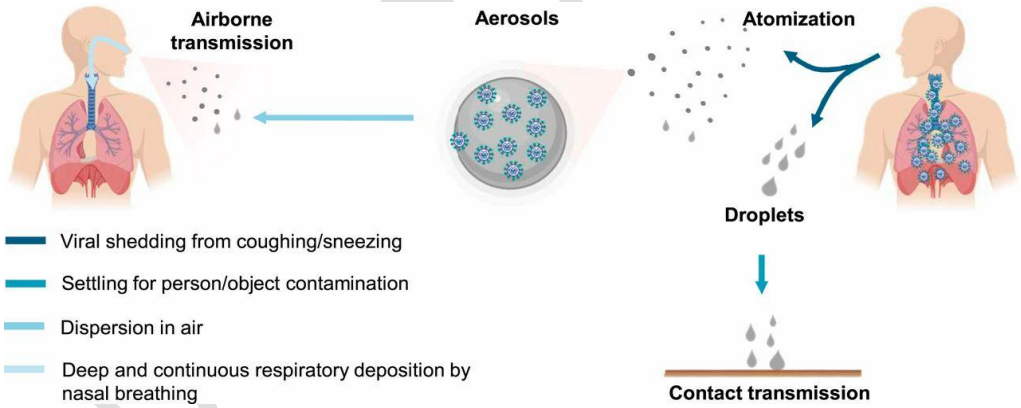

Fig 3: Image showing mode of transmission of corona virus disease from person to person (Tellier *et al*, 2019).

Last but not least, SARS-CoV-2 can spread through direct or indirect contact with infected people as well as by dropping droplets containing the virus on any living thing (e.g., a handshake, hug, or greeting) or inanimate object. These droplets can then contaminate other people's hands by later entering the body through access points like the mouth, nose, eyes, or other mucous membranes. No research has been published that actually show what level of SARS-

CoV-2 is required to infect a person via inanimate surfaces. Rather, it has been demonstrated that the SARS-CoV-2 half-life changes on many surfaces, including plastic, stainless steel, copper, and cardboard (Table 2). (Chen *et al*, 2020).

Table 2: Conditions of 21-23 0c and 40% relative humidity over 7 days

SURFACE MATERIAL	TITER OF VIABLE VIRUS	THE HALF-LIFE OF VIABLE VIRUS
Stainless steel	48 h	5h
Plastic	72h	7h
Copper	8h	1h
Cardboard	48h	3h

(Chen et al, 2020).

EPIDEMIOLOGY

The world health organization (WHO) information on coronavirus disease (COVID-19) situation report contains daily updates of the epidemiological information regarding SARS-CoV-2 illness. The infection was more likely to impact older males with comorbidities, with severe symptomatic episodes of serious or even deadly respiratory diseases including; the acute respiratory distress syndrome, according to a first study done in Wuhan on a small cohort of 99 participants (Zhonghua et al., 2020). The Chinese Center for Disease Control and Prevention's large epidemiological study, which indicated that mortality rates increased from 0.2% in patients between the ages of 10 and 39 to 14.8% in those over 80, and that men are more likely to die (2.8%) than women (1.7%), confirmed the statistics. The concurrent existence of pre-existing illnesses, particularly cardiovascular ones, metabolic disorders including diabetes, chronic respiratory failure, and hypertension has been found as another mortality factor. However, the mortality rate is 0.9% for those who were in excellent health prior to infection. In addition, studies have indicated that 80.9% of infections are asymptomatic or have a mild course, 13.8% are severe, and 4.7% of infected individuals experience major clinical signs such respiratory failure, septic shock, or multi-organ failure (Zhonghua *et al*, 2020).

PHARMACOLOGICAL APPROACH AND TESTING

It's critical to use appropriate and focused diagnostic methods to identify the SARS-CoV2 virus early in the body. Despite the widespread use of laboratory testing, screening techniques needs to be modified to the local environment, and procedures should be evaluated and upgraded based on the most recent data. In this regard, a report with recommendations for action was evaluated and released by the World Health Organization. Together, together with the standard tests, these offer additional and detailed details on the actual presence of this particular virus in the samples examined. In connection to the individual, we should continue in detail using several tactics. We can utilize the PCR test, which detects specific genetic material that forms the virus, and to determine who has had

contact with COVID-19 case. Health care professionals may swab the back of the throat with the swab stick, collect a saliva sample, obtain a liquid sample from the lower respiratory tract, and secure a stool sample depending on the type of PCR they have available. "The real-time reverse transcription polymerase chain reaction (rRT-PCR) test which is specific for the qualitative detection of SARS-CoV2 virus. The nucleic acid in upper and lower respiratory specimens such as nasopharyngeal or oropharyngeal swabs, sputum, lower respiratory tract aspirates, bronchoalveolar lavage, and nasopharyngeal wash or nasal aspirate, should also be used. There are currently no COVID19 serologic assays available" (Won et al, 2020).

There are presently no known cures for coronavirus infections, and effective vaccines needed to safeguard us against these viruses are not yet available. Most victims of coronavirus infection either recover on their own or receive treatment based on the severity of their symptoms, such as supportive therapy or mechanical respiration assistance, or standard antiviral therapies.

Several medications now in use and untested medications that may be helpful for the treatment of COVID-19 Patients have been recently discovered. Different agents have been found in the screenings of the medications authorized by the National Medical Products Administration (NMPA) and other chemical entities. For the treatment of COVID-19 patients, several clinical trials have recently been planned to examine medications with various modes of action. The use of remdesivir, an antiviral medication that has already been used to treat Ebola and other viral infections, has a wide range of antiviral activity (Warren et al., 2016). In example, this medication demonstrated effective antiviral action against a variety of RNA viruses that were genetically unrelated to SARS-CoV2 but similar to it, including SARS-CoV and the Middle Eastern respiratory syndrome coronavirus (MERS-CoV) (Siegel et al, 2017).

Remdesivir has proved promising towards the treatment of COVID-19 when used in conjunction with chloroquine. This research knowledge has increased understanding towards the activity or action of Remdesivir against coronaviruses. In-vitro experimental models have demonstrated that the anti-malarial medication chloroquine, which has also been investigated for its application in pulmonary system disease (Gordon *et al*, 2020), is effective against SARS-CoV2 infection. The ability of this medication to modify (raise) the endosomal pH, which is essential for virus-cell fusion, as well as its interference with the glycosylation of SARS-CoV-2 cell receptors, are credited with conferring antiviral activity. Furthermore, it has been suggested that, at levels safe for use in humans, chloroquine may also be able to prevent the viral replication of SARS-CoV-2. A new study suggests that hydroxychloroquine may be more effective than chloroquine against SARS-CoV-2 at lower dosages. These medications also have immunomodulation properties, which may work in concert to increase the antiviral effect in vivo (Yao *et al*, 2020).

Favipiravir is another antiviral medication being studied for the treatment of COVID-19. The medication has been used off-label in various nations to treat viral diseases, such as Ebola, and more recently, it was approved in China to treat SARS-CoV-2 flu. When used as a prodrug, this medication's active metabolite, favipiravir ribofuranosyl-5I-triphosphate, fights viruses (Won et al, 2020). It functions as an antiviral drug that can stop RNA viruses' RNA-dependent RNA polymerase (RdRp). It is a nucleoside analog in particular, and its antiviral effect may be mostly attributed to its integration into viral RNA, which in turn exerts mutagenesis activity in viruses, ultimately leading to their death. In addition to antiviral medications, various medications are now being researched for the treatment of COVID-19. This includes the treatment of cytokine release syndrome brought on by chimeric antigen receptor (CAR)-modified T cells, and tocilizumab, a humanized monoclonal antibody that binds and neutralizes IL-6R, resulting in the inhibition of various IL-6-mediated biological activities, including inflammation-related, immunomodulatory rheumatoid arthritis (RA) and systemic juvenile idiopathic arthritis. Patients with SARS-CoV-2 infection may use this medication off-label. Its use is justified by the data showing that COVID-19 infection causes an excessive and abnormal immune response that is linked to acute respiratory distress syndrome and, in the majority of critically ill patients, a "cytokine storm" (increased plasma and tissue levels of different cytokines that cause long-term damage and fibrosis of lung tissue) (Xu et al, 2020).

The angiotensin-converting enzyme 2 (ACE2) has drawn the attention of numerous research teams in recent days as a potential target for the therapy of SARS-COV-2. There are actually two variants of the ACE2 enzyme. Full-length ACE2 (angiotensin-converting enzyme 2) is the first one, and it has a structural transmembrane domain that can mediate SARS-CoV-2 cell adhesion and its subsequent fusion with lung cell membranes (Du et al, 2009). The second one lacks the domain region that can bind to cell membranes and is a soluble circulating version. Studies conducted in vitro revealed that this form binds the virus and prevents cell fusion. The proposed pharmaceutical strategy for attenuating or eliminating COVID-19 may rely heavily on the mechanism of action of soluble recombinant ACE2 protein (Batlle et al, 2020). Unfortunately, there isn't much study available right now on the medications mentioned above's potential health benefits. On the other hand, adequate studies, randomized with realistic eligibility criteria, and studies that would take into account an adequate classification of patients for clinical trials are needed for the evaluation of medications suited for COVID-19 therapy. It's critical that these trials are finished quickly in order to find successful pharmacological therapies (Batlle et al, 2020).

SIGNIFICANCE OF COVID-19

COVID-19 symptoms might range from little discomfort to serious sickness. Headache, loss of taste and smell, rhinorrhea and nasal congestion, coughing, painful muscles and throats, fever, diarrhea,

and breathing problems are just a few of the typical symptoms. When a person has the same ailment, their symptoms may vary from person to person and fluctuate over time. There are three typical symptom clusters that have been identified: one respiratory symptom cluster, which includes a cough, sputum production, shortness of breath, and fever; another musculoskeletal symptom cluster, which includes pain in the muscles and joints, headaches, and fatigue; and a third digestive symptom cluster, which includes nausea, vomiting, and diarrhea. Loss of taste and loss of smell are linked to COVID-19 in individuals without a history of ear, nose, or throat conditions. While the majority of patients (81%) experience mild to moderate symptoms (up to mild pneumonia), 14% experience severe symptoms (dyspnea, hypoxia, or more than 50% lung involvement on imaging), and 5% experience critical symptoms (respiratory failure, shock, or multi-organ dysfunction). Infected individuals make up at least one-third of those who never show any symptoms of the virus. These asymptomatic carriers can transmit the disease because they frequently refuse to get tested. Other infected individuals will experience "pre-symptomatic" signs later on or may only experience very minor symptoms, but they can still spread the virus (Furukawa et al, 2020). “As is typical with infections, there is a lag time between the initial infection and the onset of the first symptoms. The COVID-19 median delay is four to five days. The majority of symptomatic individuals show symptoms between two and seven days after exposure, and almost all do so within 12 days. The acute stage of the disease is usually finished with for most people. However, some people—referred to as protracted COVID—continue to endure a variety of consequences for months following recovery, and organ damage has been noted. Studies over several years are being conducted to learn more about the disease's long-term impact” (Gandhi et al, 2020).

MEDICAL STRATEGY

CORONA VIRUS ACTION MECHANISM

HUMAN INFECTION:

The risk factors for different coronaviruses vary greatly. Some are comparatively mild, like the common cold, while others, like MERS-CoV, can kill more than 30% of those who are infected. Coronaviruses are known to bring on colds with severe symptoms like fever and a sore throat brought on by swollen adenoids. Both primary viral pneumonia and secondary bacterial pneumonia, as well as bronchitis, are brought on by coronaviruses (either direct viral bronchitis or secondary bacterial bronchitis). SARS-CoV, a human coronavirus identified in 2003 that causes both upper and lower respiratory tract infections, has a distinct pathophysiology. It is the cause of the severe acute respiratory syndrome (SARS). There are six recognized species of human coronaviruses, and one of those species has two distinct strains, for a total of seven strains (Forgie et al, 2015). Despite speculation that they once exhibited more aggressive behavior, the symptoms of four human coronaviruses are often modest.

1. Human coronavirus OC43, often known as -CoV

2. Human coronavirus HKU1, also known as -CoV

3. Human coronavirus 229E, often known as -CoV

4. The human coronavirus NL63, sometimes known as the -CoV

There are three human coronaviruses that can cause potentially serious symptoms:

Coronaviruses linked to the Middle East respiratory sickness (MERS-CoV) and -CoV

2. The SARS coronavirus (SARS-CoV), often known as the -CoV

3. SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), -CoV (Ren et al, 2020).

Typical cold

Worldwide, the common cold is caused by the human coronaviruses HCoV-OC43, HCoV-HKU1, HCoV-229E, and HCoV-NL63, which are continuously circulating in the human population. About 15% of common colds are brought on by these coronaviruses, while 40% to 50% of colds are brought on by rhinoviruses. In temperate areas, the four mild coronaviruses exhibit a wintertime seasonal occurrence. In tropical areas, there is never a season that predominates (Abdul-Rasool, 2015).

Acute Respiratory Syndrome with Severity (SARS)

"The World Health Organization (WHO) announced in a news release in 2003 that a novel coronavirus identified by several laboratories was the cause of the severe acute respiratory syndrome (SARS) outbreak that had started the year before in Asia and secondary cases everywhere in the world. The SARS coronavirus was the official name of the virus (SARS-CoV). More than 8,000 individuals from 29 different nations and territories contracted the illness, and at least 774 of them died" (Ren et al, 2020).

Middle Eastern respiratory illness (MERS)

A new coronavirus strain was discovered in September 2012; it was initially known as Novel Coronavirus 2012 but is now known as Middle East respiratory syndrome coronavirus (MERS-CoV). Soon later, the World Health Organization sent out a global alert. The virus does not appear to spread quickly from person to person, according to the WHO bulletin from September 28, 2012. However, on May 12, 2013, the French Ministry of Social Affairs and Health acknowledged a case of human-to-human transmission in France. The Ministry of Health in Tunisia also recorded incidents of human-to-human transmission. Two documented cases were individuals who appeared to have contracted the illness from their deceased father, who are unwell following travels to Saudi Arabia and Qatar. Despite this, it seems the virus has problems transferring from person to person because the majority of affected people do not propagate the virus. In Saudi Arabia, there were 124 cases and 52 fatalities as of October 30, 2013. (Abdul-Rasool, 2015).

The virus was renamed Human Coronavirus—Erasmus Medical Centre after being sequenced by the Dutch Erasmus Medical Centre (HCoV-EMC). The Middle East respiratory syndrome coronavirus is the virus's full name (MERS-CoV). The only two cases in the US (both of which survived) were noted in May 2014.

When a guy who had recently returned from the Middle East sought treatment for his sickness at four hospitals in the Seoul region in May 2015, there was an epidemic of MERS-CoV in the Republic of Korea. One of the largest MERS-CoV epidemics outside of the Middle East resulted from this. Laboratory tests had identified 2,468 instances of MERS-CoV infection as of December 2019, of which 851 were fatal, representing a mortality rate of roughly 34.5%. (Forgie *et al*, 2015).

2019 Coronavirus disease (COVID-19)

A pneumonia outbreak was reported in Wuhan, China, in December 2019. On December 31, 2019, the World Health Organization (WHO) identified a new coronavirus strain as the source of the outbreak; this coronavirus was later dubbed SARS-CoV-2 by the International Committee on

Taxonomy of Viruses. More than 113,375,335 confirmed cases and at least 2,515,896 confirmed deaths have been attributed to the COVID-19 pandemic as of February 27, 2021. The Wuhan strain has been identified as a fresh 2B betacoronavirus strain with a genetic resemblance to the SARS-CoV of about 70%. Since the virus shares 96% of its similarities with a coronavirus found in bats, it is largely believed to have come from bats as well (Eschner, 2020).

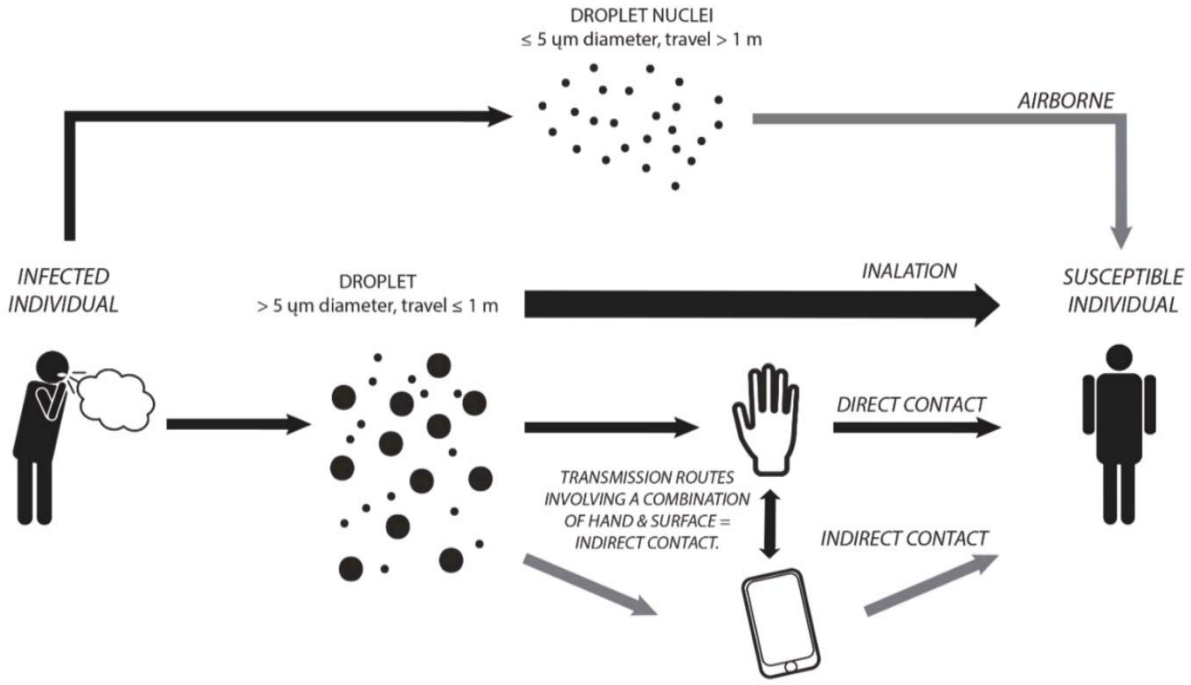

Fig 4: Image showing means of transmission of corona virus disease (Eschner, 2020).

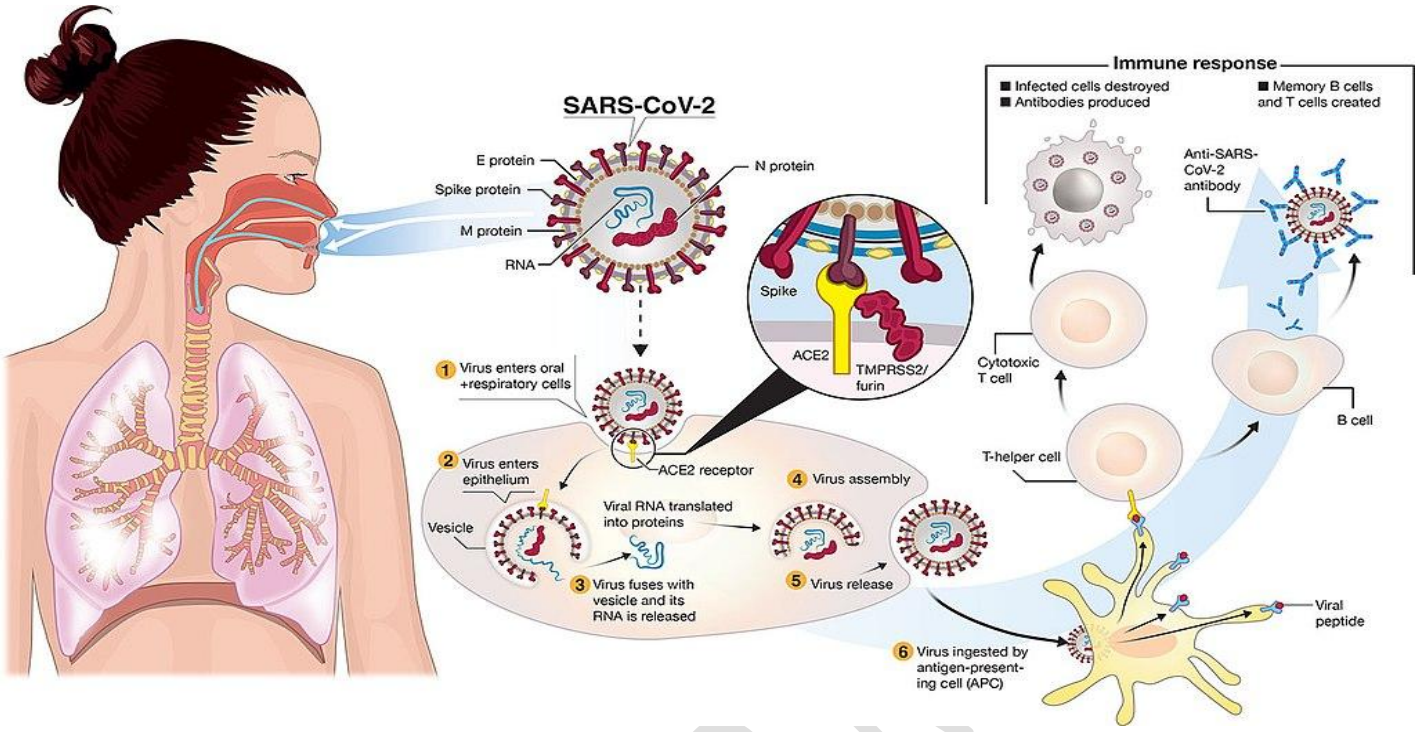

Fig 5: Image showing mode of infection of corona virus disease in host body (Ren *et al*, 2020)

Coronaviruses have been known to cause pathogenic diseases in animals since the 1930s, according to veterinary medicine. Various animals, such as pigs, cattle, horses, camels, cats, dogs, rodents, birds, and bats are infected by them. The majority of coronaviruses associated with animals infect the gastrointestinal system and spread via the fecal-oral pathway. These animal coronaviruses have been the subject of extensive research, especially by virologists with an interest in veterinary and zoonotic illnesses (Tirotta et al, 2015).

Animal Farms

Domesticated birds can contract coronaviruses. Avian infectious bronchitis is brought on by the infectious bronchitis virus (IBV), a subtype of coronavirus. The virus is a problem for the poultry business due to the high infection death rate, quick transmission, and production-related effects. The virus significantly reduces egg and meat output and results in significant financial loss. Infectious bronchitis virus in hens attacks the urogenital tract in addition to the respiratory system. The virus can spread throughout the chicken's many organs. Aerosols and food tainted with feces are the two main ways the virus is spread. There are several IBV vaccinations that have assisted in preventing the spread of the virus and its variations. One of the many strains of the avian coronavirus species is the infectious bronchitis virus. Turkey coronavirus (TCV), another avian coronavirus subtype, causes enteritis in turkeys (Johansen et al, 2017).

Other areas of animal husbandry, such pig and cattle production, are also impacted by coronaviruses. Pigs have diarrhea from the Swine Acute Diarrhea Syndrome Coronavirus (SADS-CoV), which is related to the bat coronavirus HKU2. The recently discovered coronavirus known as porcine epidemic diarrhea virus (PEDV) also causes diarrhea in pigs. Another coronavirus that causes diarrhea in young pigs is transmissible gastroenteritis virus (TGEV), which belongs to

the family Alphacoronavirus 1. Bovine coronavirus (BCV), a member of the species Betacoronavirus 1 and a relative of HCoV-OC43, is the cause of severe, profuse enteritis in newborn calves in the cattle sector (Johansen et al, 2017).

Household pets

Domestic pets including cats, dogs, and ferrets can contract coronaviruses. There are two varieties of feline coronavirus, both of which belong to the Alphacoronavirus 1 genus. The feline enteric coronavirus is a pathogen with little clinical significance, but it has the potential to spontaneously mutate into the fatal feline infectious peritonitis (FIP). Dogs are susceptible to two distinct coronaviruses. A member of the Alphacoronavirus 1 family, the canine coronavirus (CCoV) is responsible for minor gastrointestinal illness. Canine respiratory coronavirus (CRCoV), a member of the Betacoronavirus 1 species and a close relative of HCoV-OC43, is a respiratory disease-causing agent. The coronavirus that affects ferrets comes in two different varieties. The digestive disorder epizootic catarrhal enteritis (ECE), which is brought on by the ferret enteric coronavirus, and the more fatal ferret systemic coronavirus (FSC), which is similar to FIP in cats, are both caused by the virus (Meyerowitz et al, 2020).

Experimental Animals

Laboratory animals are infected with coronaviruses. The murine coronavirus species' mouse hepatitis virus (MHV) causes an epidemic murine disease with a high fatality rate, particularly in colonies of laboratory mice. Prior to the identification of SARS-CoV, MHV was the coronavirus that had undergone the most in vivo, in vitro, and molecular investigation. As a mouse model for multiple sclerosis, several MHV strains in mice produce progressive demyelinating encephalitis. The extremely contagious sialodacryoadenitis virus (SDAV), a strain of the murine coronavirus species, infects laboratory rats and can spread between people through direct touch and indirectly through aerosol. In young European rabbits, the rabbit enteric coronavirus produces acute gastrointestinal illness and diarrhea. High mortality rates (Shiu et al, 2019).

MEASURES TO PREVENT THE CORONA VIRUS

Organization-wide actions

The competent authorities have imposed general organizational measures for the containment and control of the epidemiological emergency of COVID-19 for an adequate and proportionate management of the epidemiological situation's evolution. Therefore, the goal of organizational prevention and protection strategies is to reduce the likelihood of SARS-CoV-2 exposure. In order to achieve this, precautions must be taken to prevent both new infections and the transmission of the virus where it currently exists (Consiglio et al, 2020). Therefore, it is advantageous for businesses where a variety of people come and leave during the day to rigorously limit visitor admittance while also restricting access to all topics, including staff. Additionally, they ought to stop anyone who is clearly suffering from the flu and count the number of authorized staff. Companies should implement a quarantine measure with active surveillance of those who have had close contacts with people affected by COVID-19, and the provision of the obligation for those coming from areas at risk of epidemiology to communicate it to the prevention department of the competent health company, i.e., in the case of the presence of traveling staff, they should be prevented from traveling in countries which are sensitive to SARS-CoV-2, in the so-called red areas (Consiglio et al, 2020).

The actions that must be taken are:

• Preventing travel to and from any location designated as "red," where COVID-19 illnesses have previously been confirmed.

• A potential 14-day home quarantine for people who reside in, work in, or travel to certain regions.

• Strict monitoring and measurement of each supplier's and external collaborator's body temperature.

• Reducing the number of operators in each enclosed space.

• Prioritize working from home whenever possible (smart working).

• forming, if at all possible, two or more closed, independent working groups that will rotate every 14 days to operate within the organization or with smart working.

• A tendency to follow PPE dressing and undressing protocols to the fullest extent possible.

ECOLOGICAL MEASURES

Individuals who come into contact with contaminated goods, equipment, or surfaces found in the environment. A low or intermediate level of disinfection is ensured by using detergents and disinfectants frequently used in hospitals to inactivate viruses with similar biochemical and physical properties. Be sure to follow the manufacturer's instructions and the technical data sheet regarding dilution, contact time, and handling. Numerous studies have demonstrated that coronaviruses, such as those that cause SARS and MERS, can survive for up to 9 days on the inanimate surfaces of all shared spaces, particularly restrooms, locker rooms, canteens, rooms with distributors, smoking areas, and offices that are used by multiple people when working together. Therefore, even though it hasn't been shown, a role for contaminated surfaces in the spread of the SARS-CoV-2 infection should be taken into consideration (Otter et al, 2016).

The evidence that is currently available demonstrates that the aforementioned viruses are effectively rendered inactive by appropriate sanitization practices, such as the use of disinfectants based on sodium hypochlorite (0.1%–0.5%), ethanol (62%–71%), or hydrogen peroxide (0.5%), for an adequate contact time, with adequate ventilation of enclosed spaces, or through the use of physical methods like ultraviolet irradiation (UV). Therefore, extraordinary cleaning and sanitization processes must be used, amplifying the frequency with which these tasks are typically performed, while also employing the proper disinfectants/disinfectants and remembering to pay the utmost attention to the elimination of any organic residues (Otter et al, 2016).

TABLE 3: LIST OF DISINFECTANT ACTIVE ON VIRUSES AND THEIR RELATED AREAS OF APPLICATION

DISINFECTING SUBSTANCE	**APPLICATION SCOPE**
Alcohol	Cutaneous antisepsis Disinfection of small surfaces
Chlorine compounds (chloramine, hypochlorite)	Cutaneous and wound antisepsis Water treatment Surface disinfection
Glutaraldehyde	Disinfection of inanimate objects
Hydrogen peroxide	Cutaneous antisepsis
Iodophors	Skin and wound antisepsis

Acetic acid	Disinfection of inanimate objects

(Otter *et al*, 2016).

There are currently no studies on the effects of temperature and relative humidity on the viability of SARS-CoV2 in the literature, but, similar to the effects on SARS-CoV1, for which there are documents demonstrating these effects, we can suggest that it is useful keep the confined spaces very airy, ensuring inside them a temperature of over 20 degrees and with a degree of humidity higher than 60%.

- Reduce close contacts between work colleagues or other staff by applying these recommendations:
- Reduce direct physical contact (for example, shake hands);
- Avoid direct unprotected contact with secretions (esp. coughing, touching used paper tissues with bare hands);
- Avoid direct contact within 2 m and >15 min;
- Reduce contact with people in a closed environment (esp. classrooms, meeting rooms, hospital waiting rooms, etc.) beyond 15 min and at a distance of less than 2 m

Finally, a suitable isolation room must be identified and prepared to bring any suspicious cases pending verification by the NHS. This isolation room must be kept clean and ventilated, and, after its use, sanitized with the removal of all organic and inorganic residues through a suitable disposal procedure (Direzione *et al*, 2020).

PERSONAL MEASURES

Hand Washing:

- Proper hand washing is the essential measure to prevent the transmission of SARS-CoV-2.
- Hands should be washed with soap and water for at least 40–60 s; if soap and water are not available, a 62%–71% alcohol-based hand disinfectant can also be used. Hands must be washed:
- Before starting work, especially if this involves contact with the public;
- Frequently during the work shift, especially after contact with other staff or customers;
- After contact with secretions, excretions, biological liquids;
- After contact with potentially contaminated objects (gloves, clothing, masks, used tissues, waste);
- Immediately after removing gloves and other protective equipment.

Also remember to avoid close contact with people who suffer from acute respiratory infections by keeping at least one meter away, especially when they cough or sneeze or have fever.

Do not touch your eyes, nose, mouth or genitals, with your hands before having thoroughly washed and sanitized them. Although SARS-CoV-2 is mainly transmitted by the respiratory way, it can also enter the body through the mucous membranes; hands coming into contact with contaminated surfaces can act as a carrier.

Cover your mouth and nose if you sneeze or cough, remembering not to use the hand for this purpose but the crease of the forearm (Direzione *et al*, 2020).

Fig 6: Image showing various ways of hand washing (Direzione *et al*, 2020).

Use gloves categorized as third category personal protective equipment (PPE) for protection against germs that meet the requirements of technical standard EN 374 (a CE certification must have been obtained by the notification authority for the manufacturer) (Won et al, 2020).

The butadine and acrylonitrile-based composition used to make the disposable protective nitrile gloves gives them great levels of comfort, ergonomics, flexibility, and mechanical resistance to both perforation and contact with some chemicals. Finally, it is important to remember that they are hypoallergenic compared to latex gloves. Gloves should be used in certain situations:

• The gloves must be clean and adequately cover the wrist;

• Must be taken off as soon as the processes they were used for are finished; in particular, extreme caution must be exercised to avoid touching clean surfaces with contaminated gloves;

• If unclean or not entirely intact, it must be replaced immediately;

• Hypochlorite-based glove decontamination before hypochlorite removal, after each contact with a separate inanimate surface, and during doffing processes;

• Cannot be washed or reused.

Disposable respirators and masks

Based on the size of the particles, particularly in terms of their aerodynamic diameter, respiratory particles might be categorized as droplets or aerosols. The World Health Organization (WHO) and the Centers for Illness Control and Prevention (CDC) classify the spread of disease by droplets with particles bigger than 5 microns, and by aerosols with particles of 5 microns or smaller (Shiu *et al*, 2019).

Coughing, sneezing, speaking, or just exhaling produces both droplets and aerosols; whereas droplets settle rapidly, minute aerosols can stay suspended in the air and be carried over great distances by the air flow. Aerosols can spread disease farther than droplets, which can only do so at a distance of less than one meter, but at a ratio that is inversely proportional to the area covered and the dilution experienced (Shiu *et al*, 2019).

Filtration masks

The idea behind these masks is to filter the entering air and adhere to the face by creating a tiny negative pressure inside the mask (Lee *et al*, 2008).

Planning and carrying out a training program for their use is crucial if these devices are to truly protect individuals who use them. In accordance with American NIOSH requirements, N95 masks (with a filtering capacity of at least 95%, a leakage of 10%, and a bacterial filtration effectiveness of 99%) must be used in places that may be contaminated with SARS-CoV-2. However, the masks that come closest to these standards in terms of European law are FFP2 and FFP3. The average filtering power provided by respirators with a N95 facial filter against particles in the tested size range is approximately 8–12 times greater than that offered by disposable surgical masks, whose filtering powers varied greatly in the various studies based on the model and size of the aerosol particles (1.3 to 6.5 cm). This result is wildly inconsistent with that of other research, which assert that surgical masks only provide about a third as much protection as respirators with a N95 facial filter (Lee et al, 2008).

The exhalation valve-equipped N95 respirators are made to make breathing easier. According to the findings of the literature review we conducted, the N95 facial filter and exhalation valve respirator retains its ability to shield its user from exposure to airborne particles with bacterial and viral dimensions. For negative pressure respirators, the aerosol penetration via the exhalation valve was also investigated. The results showed that the values were approximately 0.03%-0.04% with no valve defect (Chellamani *et al*, 2013).

Temporary surgical masks (Facemasks)

Facemasks (surgical masks), whether made of disposable fabric or not, are composed of four layers (type II or IIR): an external layer that serves as a filter; a central layer that is impermeable to liquids but permeable to air; and an internal layer that comes into contact with hypoallergenic skin. The internal layer also includes an upper deformable nose bar that allows the face mask to perfectly fit the wearer's face and a fastening system made of ties or elastic They shield the nose and mouth from 4.5 m-diameter particles that could irritate them. Even though they were created to protect the patient (via surgical procedures or aseptic techniques), they function as an efficient barrier system for potentially infectious liquids (Grant *et al*, 2020).

It is advised to use a surgical mask:

• For those who work with people who may have an airborne illness (measles, chicken pox, flu symptoms);

• When engaging in activities that could result in blood or other bodily fluids splashing or splattering;

• in administrative and technical support roles;

• By medical professionals such as doctors, nurses, biologists, midwives, and others;

• By the personnel of contractual companies (such as in cleaning);

• By workers in public assistance.

Depending on the mask's design, data show that a surgical mask reduces virus exposure by 1.1 to 55 times (on average six times). The subject who may be infected is currently said to be wearing them.

Disposable surgical masks can provide great protection, although they are not as effective as

Masked FFP2. Surgical masks don't require additional funding to manufacture in big quantities, hence they are less affected by supply shortages. Although surgical masks are unlikely to offer much protection against the spread of microscopic particles like droplet nuclei, a partial decrease in the virus's transmissibility may be enough to significantly lower the number of infected people and, as a result, stop the pandemic (Furukwa *et al*, 2020).

Instructions for using facemasks:

Of course, no mask, whether a snugly fitted N95 respirator mask that has received approval from NIOSH or a loosely worn surgical mask, offers perfect (100%) protection. However, inadequate defense does not equate to "utterly useless."

All workers should be given access to FFP2 and FFP3 filtering masks, which will be issued and utilized after a training session. Accordingly, the personnel must:

· Examine the facial filter's proper adherence by reading the manufacturer's directions;

· Wear the mask, being careful to prevent structural changes;

• Examine the adhesion by exhaling through the mask (if it has one) or inhaling through it (if it doesn't), looking for any aberrant airflow.

In the event that the filter masks mentioned above are not readily available, surgical disposable masks may be used. Despite the drawbacks associated with the imperfect adherence to the face, depending on the various models on the market, these devices are to some extent protective, especially in preventing close contact with droplets, and are even more effective when used in conjunction with other PPE (nitrile disposable gloves, protective glasses) (Decaro *et al*, 2011).

SPLASH GUARD VISOR AND SAFETY GLASSES:

Microorganisms can enter the conjunctiva with ease. This makes it crucial to shield the eyes from SARS-CoV-2 exposure while in close proximity to an infected person.

According to the specifications of the technical standard EN 166, which was developed for this purpose, these PPE must have the certification provided by the notification authority for the producer as regards the CE marking as PPE for the "protection against splashing liquids" (Won et al, 2020).

Devices that have "protection from droplets" certificates in addition to certifications of compliance with the aforementioned technical standard are preferred. When an FFP2 mask is worn, visors cannot be worn. Goggles that ensure protection from droplets must therefore be given in the processes that entail splashes. When a suspect case could potentially come into close contact with someone, certain precautionary measures must be taken, especially if the suspect case is not donning a surgical mask that could slow the spread of viruses. After being utilized, it is crucial to disinfect them because they may serve as a SARS-CoV-2 transmission vector themselves. The wearer is responsible for removing and properly disposing of all of the PPE mentioned above. Correct removal is necessary to avoid

recontaminating the wearer's hands or clothes (Won et al, 2020). The suggested procedure for securely removing PPE is as follows:

• Rolling the gloves down from the wrist without contacting the flesh to remove them;

• Taking off the protective garment, folding it with the contaminated outside inside, and discarding it in a lidded container;

• Washing hands;

• Removing the splash guard eyewear or safety goggles;

• Disposing of the facemask/respirator in a container with a lid after removing it, being careful to only touch the strings and avoid touching the contaminated surface.

The following actions must be taken in the case that a potentially infected person is identified while waiting for medical help:

• Refrain from making close physical contact with the ill person; if at all feasible, accompany the subject in the carefully prepared isolation chamber;

• If possible, provide the patient a surgical facemask and a pair of self-applicating disposable nitrile gloves;

• Clearly wash your hands;

• Pay close attention to any bodily surfaces where the patient's fluids (urine, feces, or respiratory secretions) may have come into touch;

• Ask the subject to discard any used paper tissues, masks, and gloves right away in a waterproof bag. The bag will then be properly disposed of along with the contaminated supplies used throughout the medical aid procedure provided by the healthcare professionals (Won et al, 2020).

GOWNS FOR ISOLATION:

Disposable (single-use) isolation gowns are made of nonwoven fabrics alone or in combination with substances that provide further protection against liquid penetration, such as plastic films. They are intended to be thrown away after a single usage. Instead of the interlocking geometries found in

woven and knitted materials, they can be created utilizing a variety of nonwoven fiber-bonding processes (thermal, chemical, or mechanical) to offer integrity and strength (Kilinc *et al*, 2015).

CORONA VIRUS VACCINE'S MECHANISM OF ACTION AND IMPACT

THE BODY'S DEFENSE AGAINST INFECTION IS THE IMMUNE SYSTEM

It helps to first consider how our systems fight disease in order to comprehend how COVID-19 vaccinations function. When germs penetrate our bodies, like the virus that causes COVID-19, they attack and reproduce. Illness is brought on by this invasion, sometimes known as an infection. To fight infection, our immune system employs a variety of methods. White or immune cells, which fight infection, are found in blood along with red cells, which deliver oxygen to tissues and organs. Different white blood cell subtypes fight infection in various ways:

• White blood cells called macrophages ingest and digest pathogens as well as dead or dying cells. Antigens are pieces of the invaders' bacteria that the macrophages leave behind. Antibodies are triggered to assault antigens when the body recognizes them as being hazardous.

White blood cells that are on guard, called B-lymphocytes. They generate antibodies that target the viral fragments that the macrophages leave behind.

Another sort of protective white blood cell is the T lymphocyte. They target already-infected bodily cells for attack (Tang *et al*, 2020).

When a person contracts the virus that causes COVID-19 for the first time, it may take many days or weeks for their body to produce and activate all the germ-fighting mechanisms required to recover from the illness. The immune system retains the information it gained on how to defend the body against that disease after the infection. When the same virus resurfaces, the body retains a small number of memory T-lymphocytes that act fast. B-lymphocytes create antibodies to fight off the recognized antigens when they are found. How long these memory cells shield a person from the virus that causes COVID-19 is still unknown to experts. The world is only partially prepared for the significant obstacles that the COVID-19 pandemic poses. High infectivity and significant pathogenicity are characteristics of SARS-CoV-2. The latter is made better by the fact that, in contrast to SARS-CoV-1 and MERS-CoV, which were spread by symptomatic patients and could be contained more effectively, asymptomatic and pre-symptomatic persons can transmit the virus. The fundamental objective of COVID-19 damage control is confinement, together with physical separation and numerous additional infection-prevention measures. Numerous studies are currently

being conducted to determine the best ways to prevent the spread of viruses while still allowing for social and commercial activity (Anderson et al, 2020). The biological mechanics of the virus and its capacity for propagation must be understood from a scientific perspective. Based on this knowledge, practical strategies may prioritize at least three things: first, maintaining hygiene practices and physical separation; second, maximizing viral monitoring across space and time; third, concentrating viral containment locally and preventing transmission whenever and wherever it is possible (Tirotta *et al*, 2015).

WORKINGS OF THE COVID-19 VACCINE

The COVID-19 vaccination aids in preventing the disease by assisting our bodies in building immunity to the COVID-19 virus. All vaccines leave the body with a supply of "memory" T-lymphocytes and B-lymphocytes that will remember how to fight that virus in the future, albeit different vaccine types act differently to confer protection. After immunization, the body normally produces T- and B-lymphocytes over the course of a few weeks. Because "the vaccine did not have enough time to offer protection, it is possible for a person to contract the virus that causes COVID-19 just before or just after vaccination and then become ill. Following vaccination, the process of developing immunity may occasionally result in symptoms like fever. These signs of immunity-building in the body are normal symptoms (Lee *et al*, 2015)".

Development of Vaccines

Soon after the SARS-CoV-2 outbreak started, vaccine development got underway at a significantly faster speed. There are now more than twenty vaccinations undergoing clinical trials as we finish this review. The WHO frequently updates its list of vaccinations under development. As a leader in the development of epidemic vaccines, CEPI set up a worldwide consultation committee that assisted in the establishment of the COVID-19 Vaccine Development Taskforce, which is working with GAVI and the World Bank to focus on vaccine manufacturing and finance. The scientific literature constantly publishes very beneficial comments on COVID-19 vaccinations (Callaway, 2020). The understanding obtained from earlier coronavirus outbreaks offers a strong scientific foundation for vaccine creation, for example, by assisting in the identification of potentially protective epitopes, which are a virus' Achilles' heel. The spontaneous eradication of SARS-CoV-1 from the human population and the substantial control of MERS-CoV without the need for extensive pharmaceutical interventions, however, resulted in a sharp decline in research funding over the past ten years,

severely restricting further study and vaccine development. As a result, there is currently little knowledge of coronavirus vaccination, and the first coronavirus vaccine for humans has not been authorized. One must prioritize vaccines that can be produced in large quantities, for which the production know-how and infrastructure are already available or can be constructed quickly, given the urgency of making vaccines available to billions of people (Amanat *et al*, 2020). Viruses in their entirety (live-attenuated or inactivated), viral vectors, nanoparticles, virus-like particles, subunit components, proteins/peptides, RNA, DNA, or live cells can all be used as the basis for vaccines. On February 15, 2020, a vaccine study against COVID-19 was launched in China using dendritic cells that had been genetically altered to express structural and enzymatic components from SARS-CoV-2. A second experiment using the same vaccine and the addition of T cells specific to the antigen was conducted, also in China. While the majority of other vaccines are tested on healthy volunteers, both of these vaccines are therapeutically tested on COVID-19 patients. The first trial, sponsored by Moderna and the National Institutes of Health, began in the US in March 2020 and used lipid nano-particle-encapsulated mRNA expressing the spike (S) protein (Nakayama, 2019). A DNA vaccine experiment using a plasmid expressing the S protein was started in early April 2020 and was funded by Inovio Pharmaceuticals and CEPI. Several vaccines made on inactivated SARS-CoV-2 virus have being tested in China from mid-April 2020. At the University of Oxford in the UK, the first COVID-19 vaccine using a viral vector was created. It is now through phase 2/3 testing and based on a chimpanzee adenovirus, and encodes the S protein. Adenovirus-5 is the basis of a similar vaccine. Phase 1 outcomes in Wuhan, China, showed encouraging signs. To identify the best vaccine dose and timing, as well as whether repeated booster shots are necessary, clinical trials are now urgently needed to investigate the COVID-19 vaccine candidates. Sequential vaccinations typically result in stronger, longer-lasting immunity; this is perhaps necessary for people who are expected to have weak immune responses, such as the elderly or people with immune deficiencies. Clinical trials should show whether the potential vaccines cause any unintended side effects, such as local skin toxicity or flu-like symptoms like fever. Additionally, autoimmune responses might manifest hematologically or neurologically. Fortunately, serious unfavorable side effects are extremely rare with the majority of vaccines. Nevertheless, all safety issues must be carefully studied before a vaccine is used widely (Lotfi et al, 2020).

VACCINE ANTIGENS

B Cell/Antibody Targets

“The Protection induced by currently available vaccines against viruses is primarily based on virus-neutralizing antibodies. Such antibodies usually block the interaction of the virus with its cellular receptor or prevent conformational changes required for fusion of the virus with the cell membrane.

The SARS-CoV-1 virus has been studied in substantial detail. Recent investigations have shown that the new SARS-CoV-2 virus uses a similar strategy for cell entry" (Hoffmann et al, 2020). "Attachment to host cells takes place via binding of the viral S protein to the angiotensin-converting enzyme 2 (ACE2), the viral receptor on host cells. Subsequently, the S protein is primed by host cell proteases, by furin and the serine proteases TMPRSS2 and TMPRSS4, enabling the fusion of viral and cellular membranes and the consequent entry of viral RNA into the host cell" (Zang et al, 2020). "S protein interaction with ACE2 is well described for both SARS-CoV-1 and -2 and relies on a particular domain within the S protein, the so-called receptor binding domain (RBD). Indeed, most antibodies capable of neutralizing coronaviruses are directed against RBD. Hence, the primary immune mechanism of avoiding infection is through blocking viral attachment to ACE2. Therefore, generating a vaccine inducing antibodies against RBD is the strategy used by the majority of COVID-19 vaccine candidates. It has recently been shown that RBD is glycosylated and methylated. Generally, such posttranslational modifications are difficult to reproduce in vaccines, meaning that vaccines may display (slightly) different epitopes than the virus. Consequently, the antibodies induced by the vaccines may potentially be cross-reactive and non-protective. Interestingly, however, the receptor interaction site (RIS) directly binding to ACE2 is not glycosylated, indicating that this RIS may potentially be an ideal vaccine candidate" (Grant et al, 2020). "The second most frequent choice is to use the whole S1 subunit. Other vaccine manufacturers use the full-length S protein and/or the fusion peptide (FP), which is part of the S2 unit and fuses with the cell membrane and therefore also has neutralizing epitopes" (Tang et al, 2020). "The latter is not the case for the N-terminal domain (NTD) of the S protein and the membrane (M), envelope (E) and nucleocapsid (N) proteins, all of which are not directly targeted by the current vaccine candidates, also because of the risk of inducing disease enhancing antibodies. Vaccine antigens may be used in the form of protein or peptides. A recent study has shown that a SARS-CoV-2 S1-Fc fusion protein readily induced neutralizing antibodies in non-human primates" (Ren et al, 2020). "Proteins and peptides may be rendered more immunogenic by formulating them with strong adjuvants. Another strategy is to display vaccine antigens on VLPs, which are often highly immunogenic. Have shown that RBD-VLPs, efficiently induced SARS-CoV-2-neutralizing antibodies in mice. Further options are to insert RBD into viral vectors or DNA or RNA. A potential challenge is that the induction of neutralizing antibodies depends on antigen display in the correct conformation, which is not guaranteed when a protein or peptide is expressed and displayed in isolation at the site of injection. This may be easier to achieve with the full S protein. However, S protein vaccination may induce non-wanted antibodies in addition to the neutralizing ones directed against RBD. Therefore, provided that one succeeds in constructing a vaccine displaying RBD or even only the RIS in the proper conformation, RBD or RIS may be preferable to the whole S protein. The most obvious isotype to be induced by a COVID-19 vaccine is IgG, preferably the more protective IgG1 and IgG3 subclasses. However, IgA may also be of importance to reduce infection of mucosa and epithelial cells in the respiratory tract, as well as

endothelial cells, which may be widely targeted by the virus. While mucosal immunization at a large scale in a rapid fashion might be difficult, the use of an adjuvant that triggers the production of IgA might be an important consideration. TLR7/8 and TLR9 ligands are good candidates as they potently promote IgA responses" (Meiler et al, 2008).

T-Cell Targets

CD-4 and CD-8 T cells recognize and react to SARS-CoV-2 antigens, contributing to immune protection, particularly by reducing disease severity. To some extent, this may also be the case for cross-reactive T cells induced by seasonal coronaviruses. For disease prevention, T cells alone are probably less potent than neutralizing antibodies. Preventive anti-viral vaccines are successful because they induce antibodies that neutralize viral particles in the extracellular space, immediately after body entry and before viruses infect the host's cells. Importantly, B cell responses and antibody production are strongly promoted by CD-4 T helper cells. Therefore, vaccines should simultaneously induce both B cells and T cells. T cell antigens must be presented by HLA molecules on the surface of antigen-presenting cells and infected cells. As HLA molecules differ in most people due to the huge genetic HLA polymorphism, viral recognition by T cells is based on a very large diversity of antigenic peptide/HLA complexes. Each person has her/his own T cell specificities for those antigenic peptides that bind to her/his HLA molecules. Vaccines containing short antigenic peptides or mini-genes will not work for most people, i.e., for those whose HLA molecules cannot present the respective antigenic peptides. In contrast, immunization with lengthy peptides or full-length viral proteins and matching DNA/RNA are possibly helpful for many or all individuals. CD8 cytotoxic T cells predominantly identify viral peptides that are produced within the infected cell. In contrast, protein antigens that are taken up from the extracellular space are poorly presented to CD8 T cells. Small percentages of dendritic cells, which are capable of "cross-presentation," which involves cellular uptake of external protein (particularly particulate antigens) and presentation of processed peptides on HLA class I molecules to CD8 T cells, are the only exception to this norm (Colbert et al, 2020). Full-length protein vaccinations are ineffective at eliciting CD8 T cell responses because cross-presentation is somewhat sluggish and frequently rate limiting. It is typically more difficult to elicit long-term T cell responses through vaccination compared to antibody induction. The majority of vaccines are either dead or manufactured substances that do not multiply in vivo, or attenuated infections. However, for the activation of potent T cell reactions, significant microbial multiplication in vivo is typically necessary (Johansen et al, 2008). Therefore, using currently known vaccination methods to produce persistent CD8 T cells is very challenging. Given that CD8 T cells are not specifically designed to fight diseases, this may not present a significant issue for preventive

vaccination. Instead, after host cells have been infected, CD8 T cells are crucial. Therefore, persons with established infections are where these cells play their main role. Because there are already enough low numbers of CD4 T cells to sustain antibody generation, the stimulation of these cells is frequently not rate limiting during vaccination. Nevertheless, non-responsive CD4 T cells could cause immunization to fail. "A sensible strategy is to complement vaccines by adding microbial antigens against which most persons are already vaccinated since T cell aid can be provided by CD4 T cells with other specificities by intermolecular help" (Zeltins *et al*, 2017). Because boosting established and previously primed CD4 T cells is more effective than priming, the resulting immunological response will be stronger.

CORONA VIRUS VACCINE TYPES

Three main COVID-19 vaccine versions are currently undergoing or soon will be undergoing extensive (Phase 3) clinical studies in the United States. The mechanisms by which each type of vaccine encourages human bodies to identify and defend against the virus that causes COVID-19 are described below. These vaccinations cannot cause COVID-19 (Amanat and Krammer, 2020).

mRNA Vaccinations

"These include genetic material from the COVID-19 virus that instructs our cells to produce an un-harmful protein that is specific to the virus. The genetic material from the vaccine is destroyed when our cells duplicate the protein. Our systems create T- and B-lymphocytes that will remember how to fight the COVID-19 virus if we become infected in the future because they know that the protein shouldn't be there" (Zhonghua et al, 2020).

Vaccines for Protein Subunits

Instead of the full virus infection, they utilize harmless fragments (proteins) that produce COVID-19. Following vaccination, our immune system starts producing T-lymphocytes and antibodies because it detects that the proteins don't belong in the body. Memory cells will detect and combat the virus if we become infected in the future (Ceraolo and Giorgi, 2020).

Vaccines for Vectors:

"These contain genetic material from the virus that causes COVID-19 put into a weaker variant of a live virus that is distinct from the virus that causes COVID-19 (this is called a viral vector). The genetic material inside the viral vector instructs cells to produce a protein that is specific to the virus that causes COVID-19 once it has entered our cells. These instructions are used by our cells to produce duplicates of the protein. As a result, our bodies begin to produce T-Cells and B-lymphocytes that will prepare to fight the virus if we become infected again in the future" (Batlle *et al*, 2020).

The COVID-19 vaccines that are currently undergoing Phase 3 clinical trials in the United States all require two shots, with one exception. Building defense starts with the opening shot. To receive the maximum level of protection provided by the vaccine, a second shot is required a few weeks later. One shot is required for one vaccine in Phase 3 clinical trials (Colbert *et al*, 2022)

CONCLUSION

One of many actions you may take to safeguard yourself and others from COVID-19 is being immunized. Because COVID-19 can result in severe sickness or death in certain people, protection from it is crucial. Utilizing all of the available instruments is necessary to stop a pandemic. In order for your body to be prepared to combat the virus if you are exposed to it, vaccines work with your immune system. Other measures, such as masks and social seclusion, assist in lowering your risk of contracting the illness or passing it on to others. The greatest defense against COVID-19 is a combination of COVID-19 immunization and adhering to the CDC's instructions for protecting both you and other people. In Wuhan, China, a corona virus outbreak was identified in the first few days of January 2020. At least 180 additional countries have acquired this virus since it was exported from China, where it has been circulating for at least two months (Grant et al, 2020). The illness is known as COVID-19, and the virus is known as SARS-CoV-2. After reviewing the most recent publications on SARS-CoV-2, the other coronaviruses, and the prevention of respiratory diseases, our objective was to develop a guide on the application of preventive and protective measures, useful in the workplace, for all activities that involve a relationship with both customers and colleagues. This was done in light of the lack of knowledge regarding how and by whom SARS-CoV-2 is transmitted. The control of physical conditions, by monitoring the temperature, and of flu-like symptoms among the workforce, taking into account that the period of maximum infectivity is the symptomatic one, is a rule that can also be used in the future as an effective preventive measure for any subsequent endemic, as shown in Table 3. CoV-2 SARS waves. composition, where it is feasible to switch between two or more closed, independent work groups every 14 days. Working within the organization or utilizing smart working could assist the business in isolating only one group in the event of an infection and quarantine. We did the same for PPE, taking into account how its use prevents the main viral transmission routes—through the large droplets released during speaking, coughing, and sneezing, as well as through inanimate objects—even in the absence of scientific evidence.

For this reason, wearing a respiratory mask, a protective visor, and gloves together creates a useful mechanical barrier that can be used during work activities when maintaining the advised safety distances isn't always possible. Following the CDC's doffing recommendations, single-step glove and

gown removal, double-gloving, spoken instructions during doffing, and the use of hypochlorite-based glove disinfection may lessen contamination and boost compliance.

Emergency management can be improved by implementing these organizational, environmental, and individual strategies. This will ensure that regular operations continue and will ultimately help to lower the risk of contamination among the workers and the general population.

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