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5. Virology, Epidemiology, Pathophysiology and Prevention of Covid-19

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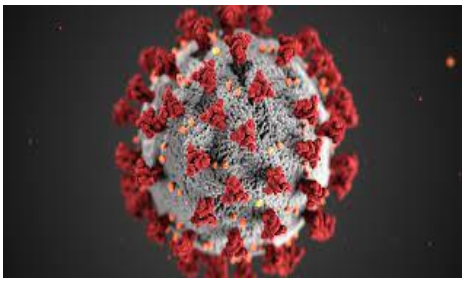
5.1 Topics Covered:

- Introduction to virus and coronavirus
- Virology of covid-19- genome, viral entry, replication of coronavirus into host.
- Epidemiology of covid-19
- Pathophysiology of covid-19- structure of coronavirus, life cycle, host response to coronavirus, symptoms, complications.
- Prevention and control of coronavirus.



Viruses have existed as long has life been on earth. The study of viruses is called VIROLOGY. Experiments on virology began with experiments of Jenner in 1798. He did not know the cause but found out that the individual exposed to cowpox did not suffer from small pox, to test this idea, he inoculated an 8- year old boy with fluid from a cowpox pustule and later intentionally infected the child with small pox. As predicted the child did not develop small pox.

Ref- kuby immunology 6th edition, news medical life science new-medical.net

5.2 Introduction/Classification of Virus:

The coronaviridae family of virus are enveloped, positive sense, single stranded RNA with helical capsids grouped into 4 genera: alpha-coronavirus, beta-coronavirus, gamma and delta-coronavirus that primarily infect birds and mammals, of which alpha and beta coronavirus are known to infect humans. Coronavirus have been studied for decade using the model beta coronavirus, murine hepatitis virus (HIV) and the human alpha coronavirus HCoV-2. Human coronavirus (HCoV-229E, -NL 63, -OC43, -HKU-1) contribute to seasonal cases of the “common cold” and sometimes linked to more severe respiratory

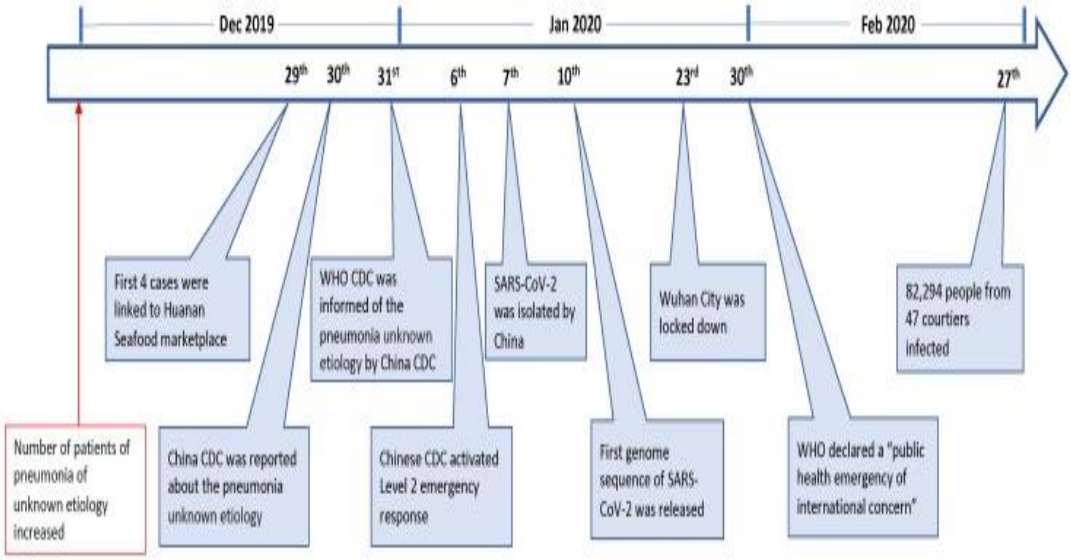
illness. Two beta coronavirus have previously been identified to cause more severe disease and outbreaks, SARS-CoV responsible for the SARS worldwide outbreak in 2002-2003 middle east respiratory syndrome (MERS- CoV) responsible for 2012 MERS outbreak and most recently severe acute respiratory syndrome coronavirus 2 (SARS- CoV-2) emerged in 2019.

5.3 Introduction to Coronavirus (SARS-CoV-2):

In December 2019, Wuhan- the Chinese city, new coronavirus SARS- CoV-2 was first identified and expanded across China and beyond. The outbreak of SARS-CoV-2 was considered to have originally started via a zoonotic transmission associated with the seafood market in Wuhan. What started as an epidemic mainly limited to China was declared a pandemic by the World Health Organization (WHO) on March 11, as it has been impacting a large number of people worldwide.

Coronavirus disease 2019 (Covid-19) is defined as illness caused by a novel coronavirus called Severe acute respiratory syndrome coronavirus 2 (SARS), it is known to infect both humans and animals, in humans causing respiratory illness (primarily affect respiratory system) other organ system are involved too. In initial cases symptoms found were fever, dry cough, headache, weakness, vomiting etc. studies have shown that mortalities are higher in elder patients or people who has existing health conditions.

As precautionary measures, a number of countries implemented social distancing and lockdown to mitigate further spread of virus. In early December 2020, nation began the race to secure vaccines as it perhaps the best hope for ending the pandemic, several drugs including remdesivir, hydrochloroquine and azithromycin etc have been tested in clinical trials yet none proves to be a definite therapy by now.



Ref: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7098030/

Currently two homegrown vaccines for the coronavirus- Covishield and Covaxin, also Russia's Sputnik V has been approved for use.

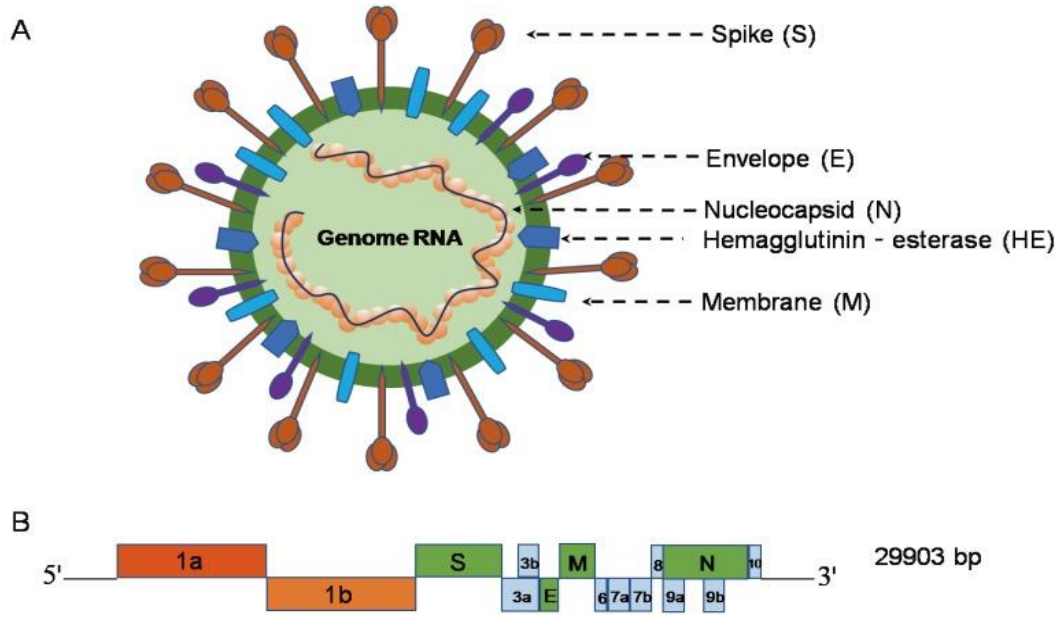
Now we will consider the underlying mechanism to explain the viruses epidemiology, virology, pathophysiology through our current knowledge of Covid-19.

5.3.1 Virology of Covid.

a. **Genome:** Covid-19 belongs to genera beta-coronavirus, it has the largest genome of all ribonucleic acid (RNA) virus infecting humans, it consist of a positive sense single stranded RNA roughly 300kb in size that is 5'-capped and 3'-polyadenylated, associated with a nucleoprotein within a capsid comprised of matrix proteins. This envelope bears club-shaped glycoprotein projections, which plays a essential role in binding to receptors on the host cell, spike protein of coronavirus is functionally divided into the S1 domain, responsible for receptor binding and S2 domain responsible for cell membrane fusion.

Spike (S) glycoprotein is responsible for the characteristic feature of the coronavirus because it forms crown-like structure on the outer surface of the virus.

Other major structural proteins are- HE (hemagglutinin-esterase) in some beta-coronavirus, membrane (M) and envelope (E) all located on membrane envelope and nucleocapsid (N) protein found in core. This covid-19 (SARS-CoV-2) has genetic polymorphism in the S protein which distinguish it from SARS and MERS-CoV.



Ref: curriculum.covidstudentresponse.org

Image ref: ncbi.nIm.nih.gov

b. **Viral Entry:** In general the life cycle of virus within the host consist of 5 following steps:

- Attachment: virus binding to receptor
- Penetration: enter host cell through endocytosis/membrane fusion.
- Biosynthesis: making of new viral proteins/particles.
- Maturation
- release

specific proteins which cell carry on their surface that allow the virus to infect human cell, is called Angiotensin-converting enzyme(ACE-2), it is present in every organism but the quantity can vary among individuals and in different tissues, cells throughout body. ACE2 expression found high in lungs, heart, ileum, kidney and bladder.

A viral genomic RNA, along with the nucleocapsid, enters the host cell cytoplasm through either receptor-mediated endocytosis or directly through the host cell membrane after binding and fusion of 'S' protein.

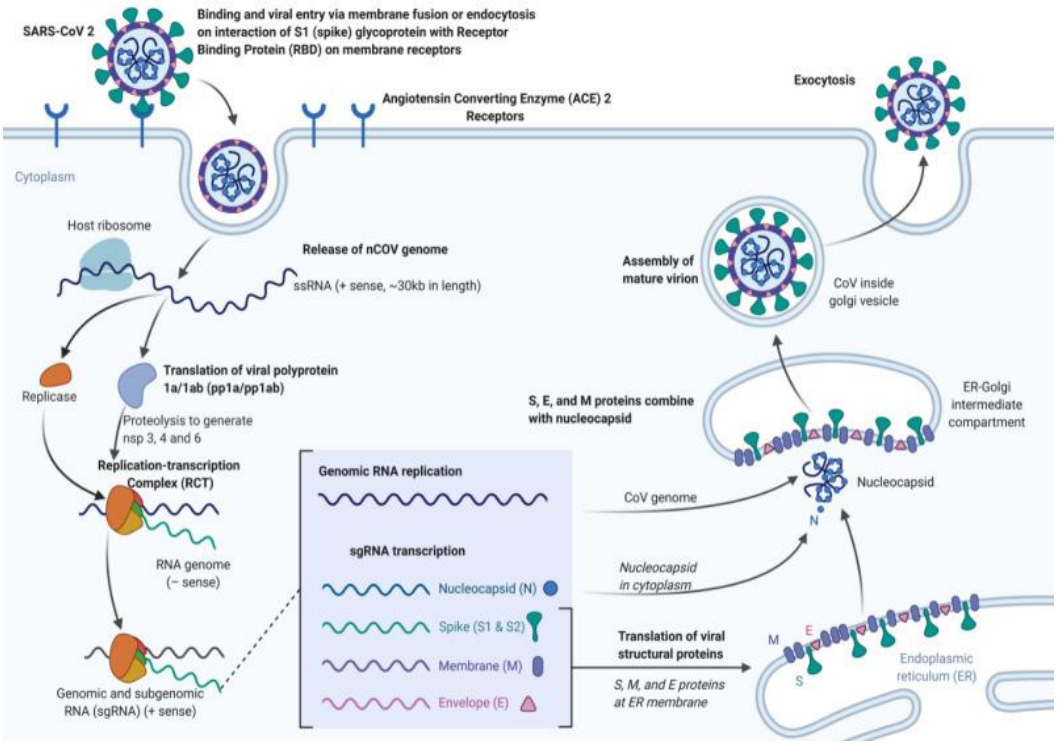
Following binding of SARS-CoV-2 to the host protein, the spike protein undergoes protease cleavage. A two-step sequential protease cleavage to activate spike protein of SARS-CoV-2 consisting of cleavage at the S1/S2 cleavage site for priming and a cleavage for activation at the S'2 site, a position adjacent to a fusion peptide within the S2 subunit.

After the cleavage at S1/S2 site, S1 and S2 subunits remain non-covalently bound and the distal S1 subunit contributes to the stabilization of the membrane-anchored S2 subunit at the prefusion state. Subsequent cleavage at S'2 site presumably activates the spike for membrane fusion via irreversible, conformational changes.

The coronavirus spike is unusual among viruses because a range of different protease can cleave and activate it. The characteristics unique to SARS-CoV-2 among coronaviruses is the existence of furin cleavage site ("RPPA" sequence) at the S1/S2 site.

The furin cleavage sites facilitate a very strong binding of the S-glycoprotein with the hACE-2 receptor of SARS-CoV-2.

c. Replication of Coronavirus in Host Cell:



Covid 19, Corona Replication. Contributed by Rohan Bir Singh, MD

Ref: https://www.ncbi.nlm.nih.gov/books/NBK554776/figure/article-52171.image.f1/

Replication of the virus in host cell. SARS-CoV-2 enters into the host cell by binding with specific cell surface receptors like a human angiotensin-converting enzyme (hACE). S1 and S2 subunit of spike glycoproteins facilitate the process of entry and fusion between the host and the viral cell membrane.

Followed by uncoating, Viral genomic mRNA is entered into the host cell cytoplasm. Two-third portion of the genomic RNA contains two ORFs mainly ORF1a and ORF1b which gets translated into two polypeptides namely pp1a and pp1ab which further gives rise to 16 no of NSPs through the proteolysis process. All these NSP proteins are involving in the replication and transcription process. One-third of the remaining viral genome transcribed into antisense RNA (3′ to 5′), further, it will replicate and formed to a full-length positive strand of genomic RNA with the help of replicase activity of viral RNA dependent RNA polymerase. On the other hand, antisense RNA is also able to synthesize several different small sizes nested (subgenomic) mRNA via discontinuous transcription and further translated into structural proteins like envelope protein (E), membrane protein (M), nucleocapsid (N) and spike proteins (S). Theses structural proteins are assembled into the nucleocapsid and viral envelope at the ER or ERGIC, followed by release of virus by exocytosis or by fusing with the plasma membrane.

5.3.2 Epidemiology of Covid-19:

Epidemiology is the study of the determinants, occurrence, and distribution of health and disease in a defined population.

A large number of studies so far are reports based on experiences in China. Initial reports showed that , its origin was Bat. It transmitted human to human by droplets and contact routes. At the beginning of the outbreak, COVID-19 cases were mostly observed among elderly people . as the outbreak continued, the number of cases among people aged 65 years and older increased further, but also some increase among children (<18 years) was observed.

Following the outbreak in China, SARS-CoV-2 has spread worldwide. As of early April 2020, the reported number of covid-19 patients were highest in the U.S followed by Spain, Italy, Germany, France and China. Italy was significantly affected after the outbreak of China. The report from Italy showed the case-fatality rate of 7.2% which was three times as high as the one in China. The high case-fatality in Italy was somewhat explained by the demographic chracterstics.

The first two cases of the new coronavirus (COVID-19) in Italy were recorded between the end of January and the beginning of February 2020. Since then, the number of cases in Italy increased steadily, surpassing 4.3 million as of August 5, 2021.

(https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.statista.com%2Fchart%2F21346%2Fcoronavirus-in-italy-update%2F&psig=AOvVaw0YNfyEq9U1ZyrWmKL1KfHf&ust=1628420404620000&source=images&cd=vfe&ved=0CAgQjRxqFwoTCOiHkfHgnvICFQAAAAAdAAAAABAD)

Ref: https://www.statista.com/statistics/1101690/coronavirus-new-cases-development-italy/

www.elsevier.com/locate/yclim

A systematic review and meta-analysis was conducted to provide an overview of the epidemiological chracteristics of COVID-19. Findings suggested that COVID-19 has an average incubation period of 5.68 days and there is a lag of 4..92 days from onset of symptoms to the first clinical visit. On average, symptoms of the patients lasts less than 20 days before recovery is achieved. Fever, dry cough, shortness of breath and fatigue are common symptoms among the patients in the included studies. The longer incubation period of the COVID-19 may be one of the major factors that helps explain its rapid spread in comparison with previous respiratory infection viruses.

Ref: ncbi.nIm.nih.gov

from the beginning of this outbreak, the percentage of children within the total COVID-19 patients was small. According to the data of the Chinese Center for Disease Control and

Prevention (China CDC) from February 2020, children younger than 10 years of age and within the age of 11-19 years occupied 1% each of the total cases. Considering this age group represents 20% of the total population, however, this may be underestimation of actual incidence in pediatric population if less tests were undertaken in children due to less symptoms. In the report of 2134 pediatric patients with COVID-19 from the China CDC, 4.4%, 50.9%, 38.8% and 5.9% of patients were diagnosed as asymptomatic, mild, moderate or severe respectively.

(asymptomatic: covid test is positive, without any clinical symptoms and signs.

Moderate: frequent fever, cough with no obvious hypoxemia.

Severe: pneumonia with hypoxemia(Spo2<92%)

Critical: Acute Respiratory Distress Syndrome (ARDS) may have shock, encephalopathy, myocardial injury, heart failure etc.)

In contrast, 18.5% of adult patients had severe diseases. Infants were most vulnerable to severe type of infections; the proportion of severe and critical cases was 10.6%, 7.3%, 4.2%, 4.1% and 3.0% for the age group of 1, 1-5, 6-10, 11-15 and > 16 years respectively.

Overall, the data suggested that children were less asymptomatic than adults as in Chinese reports. Among the children for whom complete information was available, only 73% developed fever, cough or shortness of breath. That's compared to 93% of adults reported in the same time frame, between the ages of 18 and 64 years. Regarding the severity of COVID-19, there is a growing interest in relationship between the severity of disease and gender. Although the Chinese series showed equal number of cases between males and females, data suggested that more men than women suffered from severe disease and died. The data from other countries demonstrated similar results. Adverse outcomes of COVID-19 were associated with comorbidities, including hypertension, cardiovascular disease and lung disease. These conditions are more prevalent in male and linked to smoking and drinking alcohol. Sex based immunological differences were pointed out as another potential explanation. Within the context of pandemics, found that women were about 50% more likely to practice non-pharmaceutical behaviors, such as hand washing, face mask use and avoiding crowds as compared to men, which may be in part responsible.

Ref: science direct, www.elsevier.com/locate/yclim

5.4 Pathophysiology of Corona Virus:

The convergence of pathology with physiology or the study of the disordered physiological processes that cause result from or are otherwise, associated with a disease or injury is termed pathophysiology. A lot has been discovered about the novel Corona Virus, about how it spreads, its transmission and how fatal it can be but very less is known about the pathophysiology of this virus. In the pathophysiology we will discuss about the Life Cycle of the virus, how it invades the host cell and its transmission.

Corona Virus also known as Covid – 19 or SARS Cov-2 is believed to emerge from Wuhan, Hubei Province, China. The novel Corona Virus belongs to the family Coronaviridae. It affects the human by causing mild fever to major respiratory tract infection and may even lead to death.

The novel Corona Virus was earlier named 2019-n CoV and later named SARS- CoV- 2 (Severe Acute Respiratory Syndrome Corona Virus 2 and now it is termed as COVID – 19 i.e. Corona Virus Disease -2019 (as referred by WHO). The disease caused by this virus has spread like a fire across the world and has been termed fatal by WHO on March11, 2020.

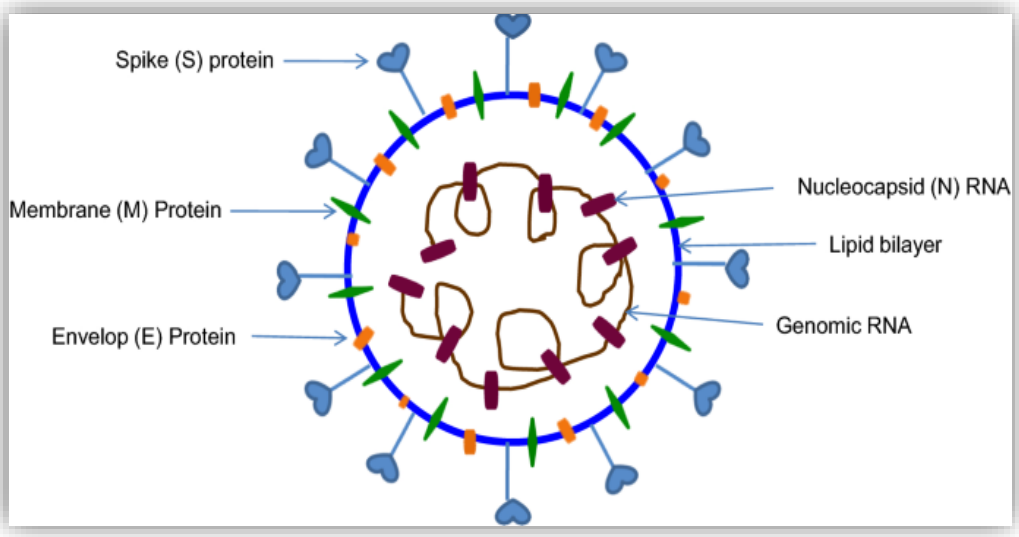


Fig. Structure of corona virus (https://link.springer.com/article/10.1007/s12291-020-00919-0)

- **Transmission of Infection:**

The principal mode by which people are infected with SARS-CoV-2 is through exposure to respiratory fluids carrying infectious virus.

1. Inhalation of very fine respiratory droplets and aerosol particl
2. Deposition of respiratory droplets and particles on exposed mucous membrane in the mouth, nose, or eye by direct splashes and sprays,
3. Touching mucous membranes with hands that have been soiled either directly by virus-containing respiratory fluids or indirectly by touching surfaces with virus on them.

The presence of the virus has been confirmed in sputum, pharyngeal swabs and faeces . Vertical transmission of SARS-CoV-2 has been reported and confirmed by positive nasopharyngeal swab for COVID-19.

5.5 Structure of Corona Virus:

Animal and plant viruses generally fall into two basic categories. Those in which genetic material is long DNA molecule and those in which genetic material is stranded RNA.

Adenoviruses, wart viruses, Herpes fall under the first category and Corona Virus, HIV, rhinovirus, influenza viruses fall under the second category.

The particles of the novel Corona Virus consist of long RNA polymers that are tightly packed into the center of the particle and are surrounded by coats or capsid proteins that consist of repeated protein molecules. In case of the novel Corona Virus the proteins are referred to as nucleocapsid designated by N.

The nucleocapsid proteins form the capsid outside the genome and the genome is packed by an envelope that is associated to link with three structural proteins namely – Membrane proteins designated by M, spike proteins designated by S and envelope proteins designate by E.

SARS-CoV-2 contains four structural proteins and sixteen non structural proteins. SARS-CoV2 particles are spherical and contain proteins known as spikes that protrude from the surface. These spikes latch into the human cells causing viral membrane to fuse with the cell membrane. The viral genes then undergo replication and produce more viruses.

- **Host Response to Corona Virus:**

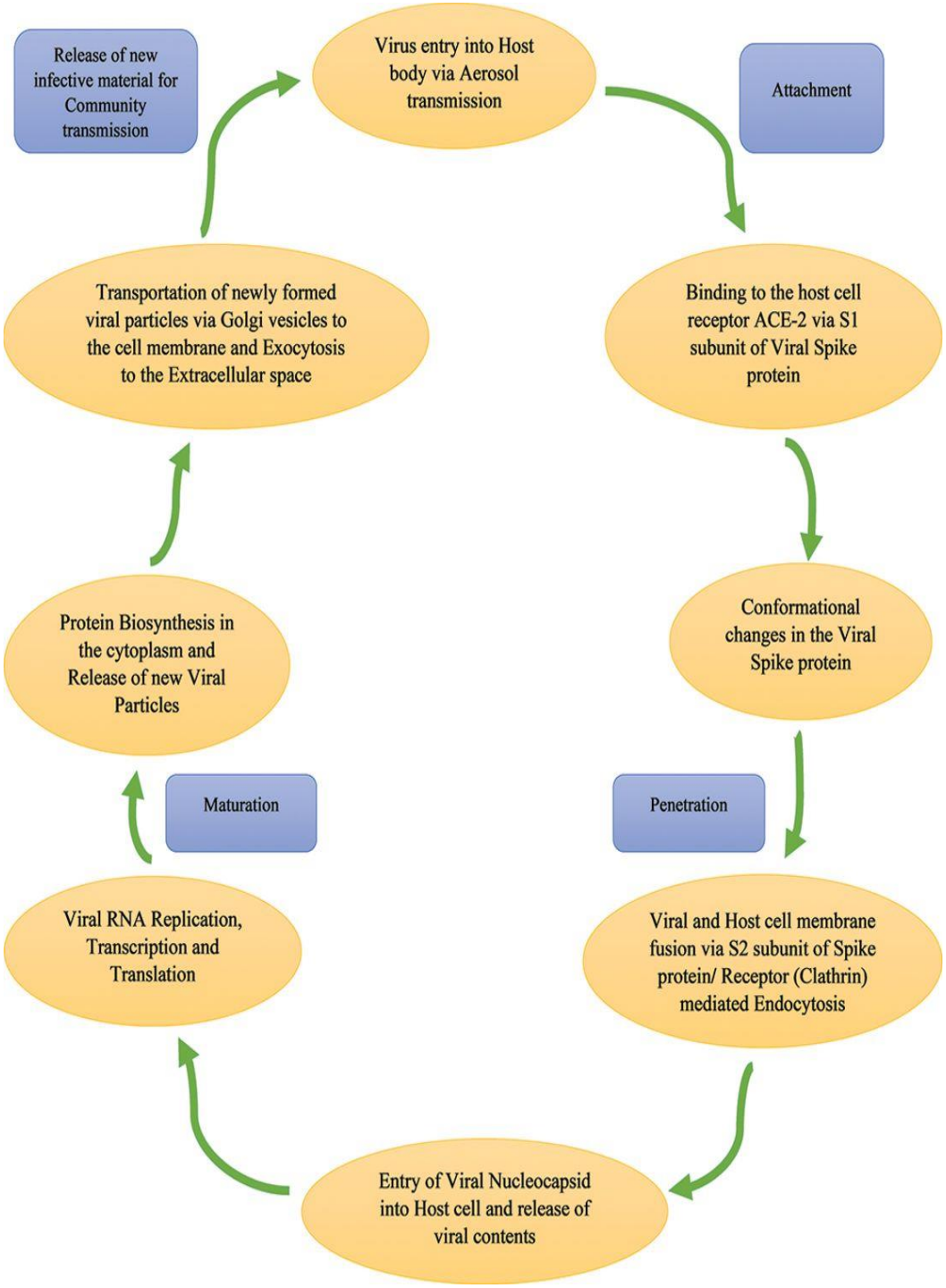
The symptoms of patients infected with Corona Virus ranges from minimal symptoms to severe respiratory failure with multiple organ failure or may even lead to the lead of an individual. Mostly the elderly and the ones suffering from diseases like diabetes are more prone of getting the Virus.

As we all know that Corona Virus transmits the respiratory droplet that comes as a result from coughing or sneezing. It enters our nasal system by inhaling and then the viral genes starts to replicate and hence multiply and cause severe effects on the individual's body.

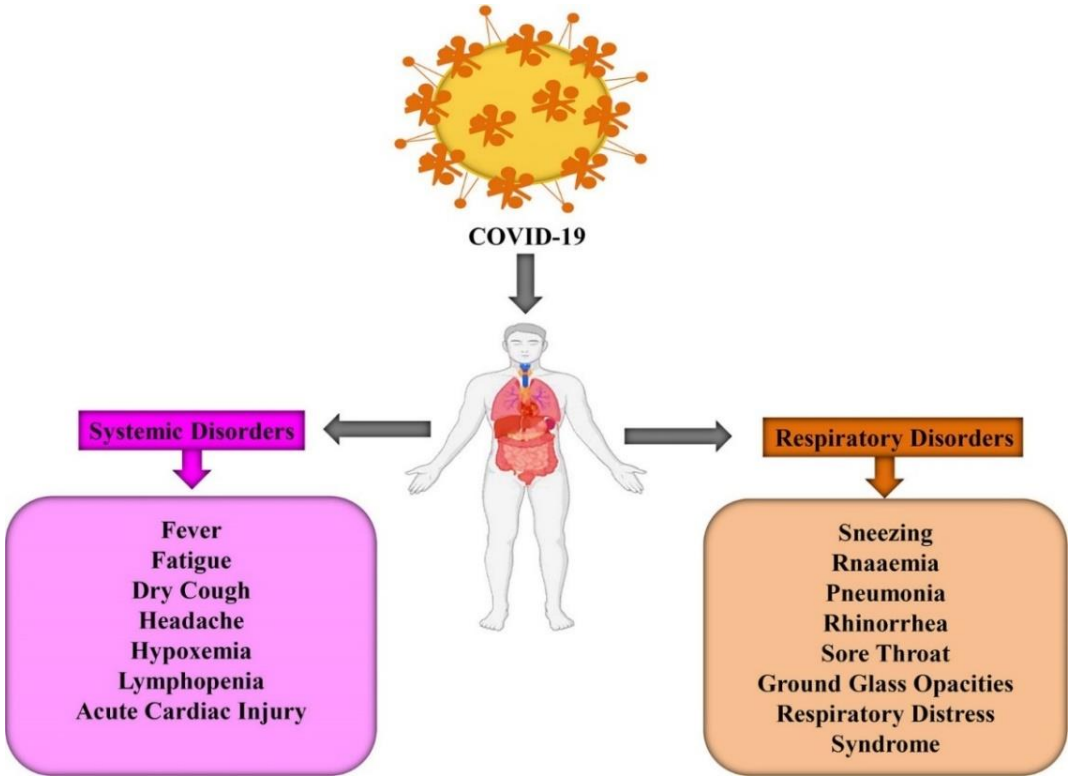
The main receptor for the novel Corona Virus is the ACE2. The enzyme Furin plays an important role for allowing the viral genes to enter the host body.

The spike protein of the Corona Virus is pinched inside the host cell binding to the ACE2. The virus starts replicating and multiplying in number. It then reaches the respiratory tract where it faces more innate immunity response.

The disease is mild for almost 80% of the infected individuals and mostly affects the upper airways and hence, these individuals can be monitored and hence treated. The rest 20% infected individuals suffer from pulmonary infiltrates and may develop severe disease, many of which can be fatal.



https://www.frontiersin.org/articles/10.3389/fphar.2020.563478/full



A. Symptoms:

Signs and symptoms may appear after 2 to 14 days of exposure. Most common symptoms include Fever, Cold, Cough, and Tiredness. Early symptoms may also include loss of taste and smell. Other symptoms include soar throat, chest pain, chills, body aches, headache, difficulty in breathing, nausea, vomiting, diarrhoea, rashes and so on. The symptoms start becoming worse as the virus starts multiplying.

Symptoms vary from person to person and in some cases there might be no symptoms at all whereas others might have severe symptoms. Elderly people have higher chances of suffering from COVID-19. There are certain health conditions that increase the chances of getting diseases or getting affected from corona virus. Some these conditions include pregnancy, heart diseases, diabetes, obesity, high blood pressure, smoking, chronic kidney disease, brain and nervous system conditions, dementia and many other serious conditions.

B. Asymptomatic Phase:

The SARS-CoV-2 which is received via respiratory aerosols binds to the nasal epithelial cells in the upper respiratory tract. The main host receptor for viral entry into cells is the ACE-2, which is seen to be highly expressed in adult nasal epithelial cells.

The virus undergoes local replication and propagation, along with the infection of ciliated cells in the conducting airways. This stage lasts a couple of days and the immune response generated during this phase is a limited one. In spite of having a low viral load at this time, the individuals are highly infectious, and the virus can be detected via nasal swab testing.

Invasion and Infection of The Upper Respiratory Tract:

In this stage, there is migration of the virus from the nasal epithelium to the upper respiratory tract via the conducting airways. Due to the involvement of the upper airways, the disease manifests with symptoms of fever, malaise and dry cough. There is a greater immune response during this phase involving the release of C-X-C motif chemokine ligand 10 (CXCL-10) and interferons (IFN-β and IFN-λ) from the virus-infected cells. The majority of patients do not progress beyond this phase as the mounted immune response is sufficient to contain the spread of infection.

Involvement of the Lower Respiratory Tract and Progression to Acute Respiratory Distress Syndrome (ARDS):

About one-fifth of all infected patients progress to this stage of disease and develop severe symptoms. The virus invades and enters the type 2 alveolar epithelial cells via the host receptor ACE-2 and starts to undergo replication to produce more viral Nucleocapsids. The virus-laden pneumocytes now release many different cytokines and inflammatory markers such as interleukins (IL-1, IL-6, IL-8, IL-120 and IL-12), tumour necrosis factor-α (TNF-α), IFN-λ and IFN-β, CXCL-10, monocyte chemoattractant protein-1 (MCP-1) and macrophage inflammatory protein-1α (MIP-1α). This 'cytokine storm' acts as a chemoattractant for neutrophils, CD4 helper T cells and CD8 cytotoxic T cells, which then begin to get sequestered in the lung tissue. These cells are responsible for fighting off the virus, but in doing so are responsible for the subsequent inflammation and lung injury. The host cell undergoes apoptosis with the release of new viral particles, which then infect the adjacent type 2 alveolar epithelial cells in the same manner. Due to the persistent injury caused by the sequestered inflammatory cells and viral replication leading to loss of both type 1 and type 2 pneumocytes, there is diffuse alveolar damage eventually culminating in an acute respiratory distress syndrome.

Ref: https://pmj.bmj.com/content/97/1147/312

5.6 Complications:

There are many complications that one can suffer due to corona virus. These complications include blood clotting, difficulty in breathing, pneumonia, fatigue and tiredness, organ failures, heart problems, acute respiratory distress syndrome, kidney injury or even failure, dizziness, anxiety, problem in sleeping

5.7 Reference:

1. https://www.biophysics.org/blog/coronavirus-structure-vaccine-and-therapy-development

2. https://www.mayoclinic.org/diseases-conditions/coronavirus/symptoms-causes/syc-20479963#:~:text=Coronavirus%20is%20a%20family%20of,East%20respiratory%20syndrome%20(MERS)
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7169933/
4. https://www.frontiersin.org/articles/10.3389/fcimb.2020.587269/full

5.8 Prevention of Covid-19:

Before understanding the prevention of covid -19 let us first understand how it spreads.

This highly pandemic Corona Virus spreads through close contact (within 6 feet) during person to person contact through respiratory droplets. According to Dr David Goldberg, Corona Virus spreads through respiratory droplets produced when a person sneezes, coughs or when a person comes in direct contact with an infected person like while shaking hands.

Corona virus can also spread by Airborne transmission. There are less chances of transmission by this process.

It can spread when infected air particles linger in the form of air particles or droplets and remain there for few minutes to few hours.

It can spread when the transmissions occurred within enclosed places with less ventilation. In such places, the virus can spread from person who is already infected whether he or she is even at a distance of 6 feet or it can spread from person who was infected with the virus but would have recently left the place.

The corona virus can spread through contaminated surfaces or areas. The chances by spreading of Corona Virus through this means is very less. In this case when a person touches the contaminated surface or any article or thing that has virus on it and later on touches their nose, hands, eyes, mouth, etc. or even come in contact with other people through handshake, it can spread. However, the chances of spread through this means is very less.

- **Prevention of Corona Virus:**

There are various means by which we can control the spread of Corona Virus and hence, lead to its end. Various measures can be adopted like social distancing, washing hands properly, wearing mask, restricting travel, watching for symptoms, treatment of infected person, education and creating awareness.

Prevention and Control of Corona Virus can be done at three levels:

- National Level
- Case- related population level
- General population level

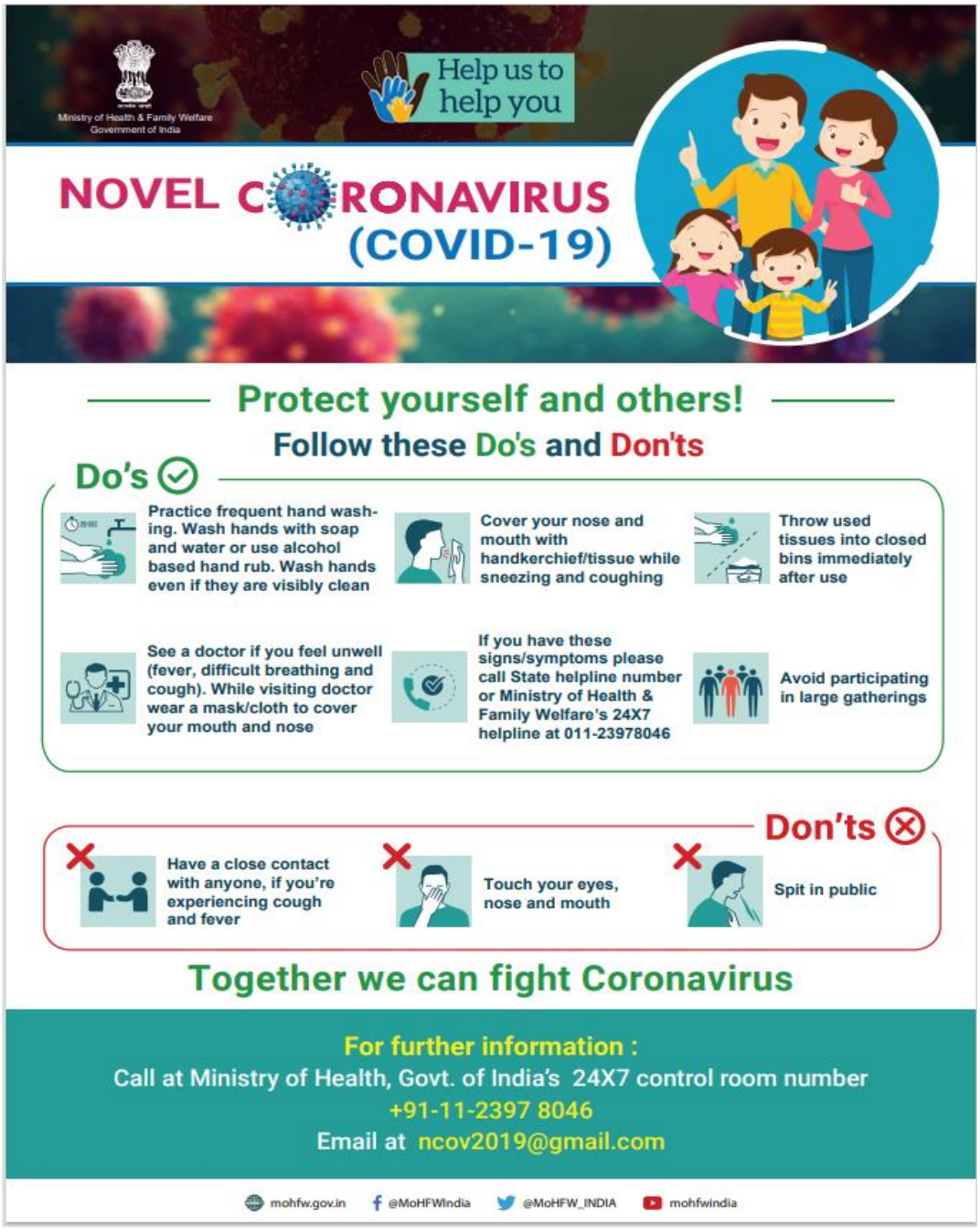


Illustration (1) Poster regarding hand washing, prepared by Indian Ministry of Health https://www.mohfw.gov.in/pdf/Poster_Corona_ad_Eng.pdf

Steps Taken by The Government of India to Stop the Spread of Corona Virus:

1. The Government introduced an app named AarogyaSetu so as to educate the citizens about the deadly Corona Virus and help to create awareness among the people so that they can take preventive measures accordingly.
2. The Oil ministry spokesperson told that the poor households that use 5kg cooking gas cylinders will be provided for free eight refills in three months during the lockdown.
3. The Government set up chains of shops named 'SURAKSHA STORES' which will help the citizens to get daily essentials while maintaining the strict safety rules.
4. Ramesh Pokhriyal (Union Human Resource Development Minister) launched a web portal named YUKTI to monitor and record the initiative by the ministry.
5. The Government provided free LPG refills to over 8.3 crore poor women for 3v months during the lockdown.
6. The government doubled the collateral free loan amount for women in self help groups.
7. Over 6 crore farmers have been benefitted during the lockdown under the PM KISSAN Scheme.
8. For the workers the wages were hiked from Rs. 182 to Rs. 202 under the MGNREGA.
9. The last date for filling the income tax returns for the financial year 2018 to 2019 was also extended to June 30, 2020.
10. Under the Building and Construction Workers Fund over 2 crore construction workers received almost Rs 3,066 crore as financial support.
11. Even the deadline for filling the GST was extended to JUNE 30,2020.
12. The government provided medical insurance cover of almost Rs. 50 lakh per person to health workers fighting during the corona virus pandemic

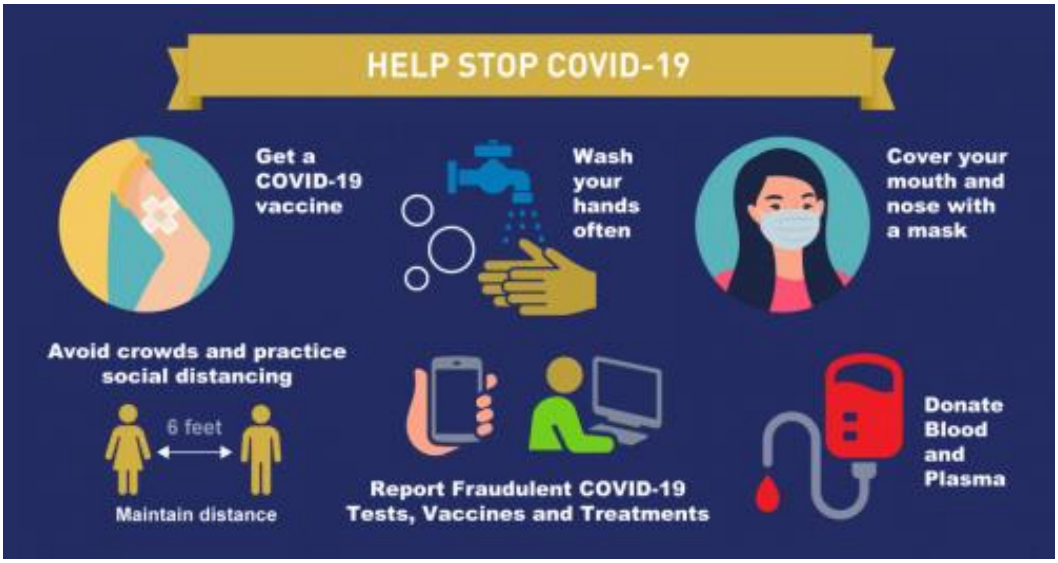
This is not the end. The government did all that it could. It helped the society in a number of unexplainable ways. Some of which got published and other did not.

Measures To Control Corona Virus:

- Wash hands most often. One can use soap and water or an alcohol- based hand rub.
- Wear a mask whenever outside.
- Maintain physical distance from someone who is sneezing or coughing.
- Don't touch your eyes, nose or mouth.
- Cover your nose and mouth with bent elbow or carry an handkerchief or a tissue.
- Stay home whenever you feel unwell.
- If you have fever,cough or sneezing take immediate medical help.
- Use hand sanitizer after touching the surfaces or even after shaking hands.
- Refrain from smoking and other activities that makes your lungs weak.
- Avoid large gatherings.
- Get vaccinated as soon as you are eligible.
- Wash fruits and vegetables properly before consuming.
- Low carb diet will help slow down diabetes and focus on protein rich diet.
- Fruits and vegetables rich in beta carotene, ascorbic acid and other essential vitamins should be consumed.
- Some natural immunity boosters like turmeric, ginger,gooseberries (amla) can be taken.
- Herbs like Garlic, basil leaves and black cumin also increase immunity.

- Certains nuts and seeds like sunflowers seeds, flax seeds,pumpkin seeds and melon seeds, etc. are rich in proteins.
- Take proper sleep.
- Stay hydrated.
- Do not skip exercise.
- Consume supplements or food that boosts immunity like vitamin C, Vitamin D, Zinc, Elderberry,Turmeric and Garlic.

Reference (https://www.redcross.org/about-us/news-and-events/news/2020/coronavirus-safety-and-readiness-tips-for-you.html)



Ref (https://www.fda.gov/consumers/consumer-updates/help-stop-spread-coronavirus-and-protect-your-family)

5.9 Cleaning and Disinfection:

High-touch areas such as bedside tables and door handles should be disinfected daily with regular household disinfectant containing a diluted bleach solution (that is, 1-part bleach to 99 parts water). For surfaces that cannot be cleaned with bleach, 70% ethanol can be used. Toilets and bathrooms should be cleaned and disinfected with a diluted bleach solution (one part bleach to 9 parts water to make a 0.5% sodium hypochlorite solution). Disposable gloves should be used when cleaning or handling surfaces, clothing, or linen soiled with body fluids. All used disposable contaminated items should be placed in a lined container before disposing of them with other household waste. Clothes, bed linens, and bath and hand towels should be cleaned using regular laundry soap and water or machine washed at 60–90°C with common laundry detergent. Disposable gloves should be used when cleaning or handling surfaces, clothing, or linen soiled with body fluids. All used disposable contaminated items should be placed in a lined container before disposing of them with other household waste.

Useful website: https://www.ncbi.nlm.nih.gov/books/NBK554776/