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A REVIEW AND STUDY ON EBOLA VIRUS, SARS, MERS AND COVID-19

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ABSTRACT
Super-spreading occurs when a single patient infects a disproportionate number of contacts. The 2015 MERS-CoV, 2003 SARS-CoV, and to a lesser extent 2014-15 Ebola virus outbreaks were driven by super-spreaders. We summarize documented super-spreading in these outbreaks, explore contributing factors, and suggest studies to better understand super-spreading. Emerging and re-emerging infectious viruses have always been a major threat to human health. In recent years in particular, the rise of Avian and Swine Influenza Viruses, Severe Acute Respiratory Syndrome- and Middle East Respiratory Syndrome-Coronavirus (SARS-CoV; MERS-CoV), Ebola virus, and most recently mosquito-borne Zika virus (Flavivirus), are becoming a global concern due to their pathogenicity, associated high mortality rate and socio-economical burden. These viruses mostly originate from animals but can cause disease and even death in humans (zoonoses). With frequent intercontinental travel and domestic living in high population density areas, the potential for these viruses to mutate, spread rapidly in human populations and because global pandemics is a major concern. Significant research efforts have led to the discoveries of complex intra- and extra-cellular signaling activation in host innate and adaptive immune responses to viral infection. Still, the immune system is often defeated by viral antagonistic proteins that suppress the host immune system resulting in immune evasion and diseases. Despite deeper understanding of the mechanisms of infection and of virus-host interactions, current therapeutic options remain limited. Furthermore, progress has been slow in the discovery of novel, next generation therapeutic options for many viral pathogens. This highlights the importance and urgency in the discovery and development of novel prevention and treatment strategies to combat ever mutating and emerging infectious viruses. Therefore, research in this area is of importance in preparation for sudden outbreaks and pandemics in the future. This topic aims to facilitate and strengthen our current understanding of the interactions between emerging infectious viruses and host immune responses, as well as insights into novel therapeutics that may be employed in the event of global pandemics.

KEYWORDS: Virion, Outbreak, Pandemic, Ebola, SARS, MERS, COVID.

EBOLA VIRUS
INTRODUCTION
1. Ebola first appeared in 1976 in 2 simultaneous outbreaks. In Nzara, Sudan, and in Yambuku, democratic republic of Congo.
2. The latter was a village situated near the Ebola river form which the diseases take its name.
3. Fruits bats of the pteropodidae family are considered to be the natural host of the Ebola viruses.
4. Ebola viruses causes a severe illness known as Ebola hemorrhagic fever that can be lethal to humans.

What is Ebola virus (Virology)?
Ebola is rare disease caused by one of five virus strains found in several African countries, and the largest Ebola outbreak in history is currently spinning Ebola out of control in West Africa. Increases human mobility and connectivity have radically changed the way in which emerging infectious diseases spread across regions and across the world. Some health care center caring for people with the diseases do not have running water.[1]

Virology: Ebolaviruses contain single-stranded, non-infectious RNA genomes. *Ebolavirus* genomes contain seven genes including 3'-UTR-*NP-VP35-VP40-GP-VP30-VP24-L*-5'-UTR. The genomes of the five different ebolaviruses (BDBV, EBOV, RESTV, SUDV and TAFV) differ in sequence and the number and location of gene overlaps. As with all filoviruses, ebolavirus virions are filamentous particles that may appear in the shape of a shepherd's crook, of a "U" or of a "6," and they may be coiled, toroid or branched. In general, Ebola virions are 80 nanometers (nm) in width and may be as long as 14,000 nm.

Incubation period: Ebola virus disease symptoms and

signs may appear from about 2 to 21 days after exposure (average incubation period is e8 to 10 days). It is unclear why some patients can survive and others die from this disease, but patients who die usually have a poor immune response to the virus. Patients who survive have symptoms that can be severe for a week or two, recovery is often slow (weeks to months) and some survivors have chronic problems such as fatigue and eye problems.[2]

Epidemiology: The disease typically occurs in outbreaks in tropical regions of Sub- Saharan Africa. From 1976 (when it was first identified) through 2013, the WHO reported 2,387 confirmed cases with 1,590 overall fatalities. The largest outbreak to date was the Ebola virus epidemic in West Africa, which caused a large number of deaths in Guinea, Sierra Leone, and Liberia.

Sudan (1976): The first known outbreak of EVD was identified only after the fact. It occurred between June and November 1976, in Nzara, South Sudan (then part of Sudan), and was caused by Sudan virus (SUDV). The Sudan outbreak infected 284 people and killed 151. The first identifiable case in Sudan occurred on 27 June in a storekeeper in a cotton factory in Nzara, who was hospitalised on 30 June and died on 6 July. Although the WHO medical staff involved in the Sudan outbreak knew that they were dealing with a heretofore unknown disease, the actual "positive identification" process and the naming of the virus did not occur until some months later in Zaire.

Zaire (1976): On 26 August 1976, a second outbreak of EVD began in Yambuku, a small rural village in Mongala District in northern Zaire (now known as the Democratic Republic of the Congo). This outbreak was caused by EBOV, formerly designated *Zaire ebolavirus*, a different member of the genus *Ebolavirus* than in the first Sudan outbreak. The first person infected with the disease was the village school's headmaster Mabalo Lokela, who began displaying symptoms on 26 August 1976. Lokela had returned from a trip to Northern Zaire near the border of the Central African Republic, after visiting the Ebola River between 12 and 22 August. He was originally believed to have malaria and given quinine. However, his symptoms continued to worsen, and he was admitted to Yambuku Mission Hospital on 5 September. Lokela died on 8 September, 14 days after he began displaying symptoms.

In 1995–2014 the second major outbreak occurred in Zaire (now the Democratic Republic of the Congo, DRC), in 1995, affecting 315 and killing 254. In 2000, Uganda had an outbreak infecting 425 and killing 224; in this case, the Sudan virus was found to be the Ebola species responsible for the outbreak. In 2003, an outbreak in the DRC infected 143 and killed 128, a 90% death rate, the highest of a genus *Ebolavirus* outbreak to date. In 2004, a Russian scientist died from Ebola after sticking herself with an infected needle. Between April and August 2007, a fever epidemic in a four-village region of the DRC was confirmed in September to have been cases of Ebola. Many people who attended the recent funeral of a local village chief died. The 2007 outbreak eventually infected 264 individuals and killed 187. On 30 November 2007, the Uganda Ministry of Health confirmed an outbreak of Ebola in the Bundibugyo District in Western Uganda. After confirming samples tested by the United States National Reference Laboratories and the Centers for Disease Control, the World Health Organization (WHO) confirmed the presence of a new species of genus *Ebolavirus*, which was tentatively named Bundibugyo. The WHO reported 149 cases of this new strain and 37 of those led to deaths.[3]

2013–2016 West Africa: In March 2014, the World Health Organization (WHO) reported a major Ebola outbreak in Guinea, a West African nation. Researchers traced the outbreak to a one-year-old child who died in December 2013. The disease rapidly spread to the neighbouring countries of Liberia and Sierra Leone. It was the largest Ebola outbreak ever documented, and the first recorded in the region. On 8 August 2014, the WHO declared the epidemic an international public health emergency. Urging the world to offer aid to the affected regions, its Director-General said, "Countries affected to date simply do not have the capacity to manage an outbreak of this size and complexity on their own. I urge the international community to provide this support on the most urgent basis possible." By mid-August 2014, Doctors Without Borders reported the situation in Liberia's capital, Monrovia, was "catastrophic" and "deteriorating daily". They reported that fears of Ebola among staff members and patients had shut down much of the city's health system, leaving many people without medical treatment for other conditions. In a 26 September statement, WHO said, "The Ebola epidemic ravaging parts of West Africa is the most severe acute public health emergency seen in modern times. Never before in recorded history has a biosafety level four pathogen infected so many people so quickly, over such a broad geographical area, for so long." Intense contact tracing and strict isolation largely prevented further spread of the disease in the countries that had imported cases. As of 8 May 2016, 28,646 suspected cases and 11,323 deaths were reported; however, the WHO said that these numbers may be underestimated. Because they work closely with the body fluids of infected patients, healthcare workers were especially vulnerable to infection; in August 2014, the WHO reported that 10% of the dead were healthcare workers.

Mode of Transmission: It is believed that between people, Ebola disease spreads only by direct contact with the blood or other body fluids of a person who has developed symptoms of the disease. Body fluids that may contain Ebola viruses include saliva, mucus, vomit, feces, sweat, tears, breast milk, urine and semen. The WHO states that only people who are very sick are able to spread Ebola disease in saliva, and whole virus has not

been reported to be transmitted through sweat. Most people spread the virus through blood, feces and vomit. Entry points for abrasions. Ebola may be spread through large droplets; however, this is believed to occur only when a person is very sick. This contamination can happen if a person is splashed with droplets. Contact with surfaces or objects contaminated by the virus, particularly needles and syringes, may also transmit the infection. The virus is able to survive on objects for a few hours in a dried state, and can survive for a few days within body fluids outside of a person. The Ebola virus may be able to persist for more than three months in the semen after recovery, which could lead to infections via sexual intercourse. Virus persistence in semen for over a year has been recorded in a national screening programme. Ebola may also occur in the breast milk of women after recovery, and it is not known when it is safe to breastfeed again. The virus was also found in the eye of one patient in 2014, two months after it was cleared from his blood. Otherwise, people who have recovered are not infectious. Correct medical isolation procedures is considered low. Usually when someone has symptoms of the disease, they are unable to travel without assistance. The risk increases when they do not have appropriate protective clothing such as masks, gowns, gloves and eye protection; do not wear it prope Dead bodies remain infectious; thus, people handling human remains in practices such as traditional burial rituals or more modern processes such as embalming are at risk. 69% of the cases of Ebola infections in Guinea during the 2014 outbreak. There has been transmission in hospitals in some African countries that reuse hypodermic needles. Some health-care centres caring for people with the disease do not have running water. In the United States the spread to two medical workers treating infected patients prompted criticism of inadequate training and procedures. Human-to-human transmission of EBOV through the air has not been reported to occur during EVD outbreaks, and airborne transmission has only been demonstrated in very strict laboratory conditions, and then only from pigs to primates, but not from primates to primates. Spread of EBOV by water, or food other than bushmeat, has not been observed. No spread by mosquitos or other insects has been reported. Other possible methods of transmission are being *STUDIED* Airborne transmission among humans is theoretically possible due to the presence of Ebola virus particles in saliva, which can be discharged into the air with a cough or sneeze, but observational data from previous epidemics suggests the actual risk of airborne transmission is low. A number of studies examining airborne transmission broadly concluded that transmission from pigs to primates could happen without direct contact because, unlike humans and primates, pigs with EVD get very high ebolavirus concentrations in their lungs, and not their bloodstream.

Therefore, pigs with EVD can spread the disease through droplets in the air or on the ground when they sneeze or cough. By contrast, humans and other primates accumulate the virus throughout their body and specifically in their blood, but not very much in their lungs. It is believed that this is the reason researchers have observed pig to primate transmission without physical contact, but no evidence has been found of primates being infected without actual contact, even in experiments where infected and uninfected primates shared the same air.[4]

Ebola Symptoms & Signs: Symptoms of Ebola virus infection are similar to those produced by other hemorrhagic fever viruses and include

- Fever
- Fatigue
- Malaise
- Weakness
- Reddened eyes
- Joint and muscle pain
- Headache
- Nausea and vomiting.

Additional Ebola symptoms may include:

- Diarrhea
- Stomach pain and loss of appetite
- Cough, sore throat, and difficulty swallowing
- Rash
- Hiccups
- Chest pain
- Breathing problems.

As the disease worsens in severity, symptoms can include bleeding at various sites within or outside of the body.

Diagnosis: Diagnosing Ebola virus disease (EVD) shortly after infection can be difficult. Early symptoms of EVD such as fever, headache, and weakness are not specific to Ebola virus infection and often are seen in patients with other more common diseases, like malaria and typhoid fever. To determine whether EVD is a possible diagnosis, there must be a combination of symptoms suggestive of EVD AND a possible exposure to EVD within 21 days before the onset of symptoms. An exposure may include contact with.

- blood or body fluids from a person sick with or who died from EVD,
- objects contaminated with blood or body fluids of a person sick with or who died from EVD,
- infected fruit bats and nonhuman primates (apes or monkeys), or
- semen from a man who has recovered from EVD.

If a person shows signs of EVD and has had a possible exposure, he or she should be isolated (separated from other people) and public health authorities notified. Blood samples from the patient should be collected and tested to confirm infection. Ebola virus can be detected in blood after onset of symptoms. It may take up to three days after symptoms start for the virus to reach

detectable levels. Polymerase chain reaction (PCR) is one of the most commonly used diagnostic methods because of its ability to detect low levels of Ebola virus. PCR methods can detect the presence of a few virus particles in small amounts of blood, but the ability to detect the virus increases as the amount of virus increases during an active infection. When the virus is no longer present in great enough numbers in a patient's blood, PCR methods will no longer be effective. Other methods, based on the detection of antibodies an EVD case produces to an infection, can then be used to confirm a patient's exposure and infection by Ebola virus. A positive laboratory test means that Ebola infection is confirmed. Public health authorities will conduct a public health investigation, including identifying and monitoring all possibly exposed contacts.[5]

Treatment: Symptoms of Ebola virus disease (EVD) are treated as they appear. When used early, basic interventions can significantly improve the chances of survival. These include:

- Providing fluids and electrolytes (body salts) through infusion into the vein (intravenously).
- Offering oxygen therapy to maintain oxygen status.
- Using medication to support blood pressure, reduce vomiting and diarrhea and to manage fever and pain.
- Treating other infections, if they occur.

Prevention and Vaccine: In the United States, Ebola virus disease (EVD) is a very rare disease that has only occurred because of cases that were acquired in other countries, eventually followed by person-to-person transmission. EVD is most common in parts of sub-Saharan Africa, with occasional outbreaks occurring in people. In these areas, Ebola virus is believed to circulate at low rates in certain animal populations (enzootic). Occasionally people become sick with Ebola after coming into contact with these infected animals, which can then lead to Ebola outbreaks where the virus spreads between people. When living in or traveling to a region where Ebola virus is present, there are a number of ways to protect yourself and prevent the spread of EVD:

- Contact with blood and body fluids (such as urine, feces, saliva, sweat, vomit, breast milk, semen, and vaginal fluids) of persons who are ill.
- Contact with semen from a man who has recovered from EVD, until testing verifies the virus is gone from the semen.
- Items that may have come in contact with an infected person's blood or body fluids (such as clothes, bedding, needles, and medical equipment).
- Funeral or burial rituals that require handling the body of someone who died from EVD.
- Contact with bats and nonhuman primates' blood, fluids, or raw meat prepared from these animals (bushmeat).
- Contact with the raw meat of an unknown source. These same prevention methods apply when living in or traveling to an area affected by an Ebola outbreak. After returning from an area affected by Ebola, monitor your health for 21 days and seek medical care immediately if you develop symptoms of EVD.

Ebola Vaccine: The U.S. Food and Drug Administration (FDA) approved the Ebola vaccine rVSV-ZEBOV (tradename "Ervebo") on December 19, 2019. The rVSV-ZEBOV vaccine is a single dose vaccine regimen that has been found to be safe and protective against only the *ZAIRE EBOLAVIRUS* species of ebolavirus. This is the first FDA approval of a vaccine for Ebola. Another investigational vaccine was developed and introduced under a research protocol in 2019 to combat an Ebola outbreak in the Democratic Republic of the Congo. This vaccine leverages two different vaccine components (Ad26.ZEBOV and MVA -BN-Filo) and requires two doses with an initial dose followed by a second "booster" dose 56 days later. The second vaccine is also designed to protect against only the *ZAIRE EBOLAVIRUS* species of Ebola.[6]

What India Can Do: India, too, can contribute to global efforts to quell the Ebola crisis. It has a large cadre of epidemiologists, laboratory scientists, doctors and nurses who are experienced in epidemic control and can help support diagnosis, the training of health workers, or clinical services in Ebola treatment units. It also has a large number of social mobilizes who have proved their abilities in health campaigns such as the polio eradication campaign. They could contribute their experiences in community empowerment (one of the cornerstones of the Ebola response), address rumors and fears and help communities regain trust in the humanitarian response. These resources are waiting to be mobilized, both to help contain the crisis in West Africa and to ensure that India is prepared for a possible Ebola emergency in the near future. By stepping decisively into the fray, India will signal that it stands with other world powers in the front line of the global fight against Ebola as well as other emerging infectious diseases. It is only when the outbreak is controlled in West Africa that nations will have done all they could to protect their own citizens from a possible outbreak of Ebola on their shores.

SARS VIRUS (Severe Acute Respiratory Syndrome)

Introduction: Severe acute respiratory syndrome (SARS) coronavirus (SARS-CoV) is a novel virus that caused the first major pandemic of the new millennium. The rapid economic growth in southern China has led to an increasing demand for animal proteins including those from exotic game food animals such as civets. Large numbers and varieties of these wild game mammals in overcrowded cages and the lack of biosecurity measures in wet markets allowed the jumping of this novel virus from animals to human. Its capacity for human-to-human transmission, the lack of awareness in hospital infection control, and international air travel facilitated the rapid global dissemination of this agent. Over 8,000 people

were affected, with a crude fatality rate of 10%. The acute and dramatic impact on health care systems, economies, and societies of affected countries within just a few months of early 2003 was unparalleled since the last plague. The small reemergence of SARS in late 2003 after the resumption of the wildlife market in southern China and the recent discovery of a very similar virus in horseshoe bats, bat SARS-CoV, suggested that SARS can return if conditions are fit for the introduction, mutation, amplification, and transmission of this dangerous virus. Here, we review the biology of the virus in relation to the epidemiology, clinical presentation, pathogenesis, laboratory diagnosis, animal models or hosts, and options for treatment, immunization, and infection control.[7]

What Is SARS: Severe acute respiratory syndrome (SARS) is a serious form of viral pneumonia caused by the SARS coronavirus. The virus that causes SARS was first identified in 2003. The emergence of SARS-CoV-2 has resulted in >90,000 infections and >3,000 deaths. Coronavirus spike (S) glycoproteins promote entry into cells and are the main target of antibodies. We show that SARS-CoV-2 S uses ACE2 to enter cells and that the receptor-binding domains of SARS-CoV-2 S and SARS-CoV S bind with similar affinities to human ACE2, correlating with the efficient spread of SARS-CoV-2 among humans. We found that the SARS-CoV-2 S glycoprotein harbors a furin cleavage site at the boundary between the S_1/S_2 subunits, which is processed during biogenesis and sets this virus apart from SARS-CoV and SARS-related CoVs. We determined cryo-EM structures of the SARS-CoV-2 S ectodomain trimer, providing a blueprint for the design of vaccines and inhibitors of viral entry. Finally, we demonstrate that SARS-CoV S murine polyclonal antibodies potently inhibited SARS-CoV-2 S mediated entry into cells, indicating that cross- neutralizing antibodies targeting conserved S epitopes can be elicited upon vaccination.

Causes: SARS is caused by a virus that takes over your body's cells and uses them to make copies of itself. The SARS virus is from a group known as coronaviruses, which also cause the common cold. SARS can spread when people who have it cough or sneeze, spraying tiny droplets of liquid with the virus to other people within 2-3 feet. Other people may get the virus by touching something those droplets hit, then touching their nose, eyes, or mouth.[8]

Mode of Transmission: The origin of SARS-CoV is, at present, thought to be the Himalayan palm civet (*Paguma larvata*) found in Guangdong province in south China, from which coronaviruses very similar to SARS-CoV isolated from humans have been detected. The fact that a much higher seroprevalence of SARS-CoV was found among wild animal handlers in Guangdong also supports its animal origin. Although it is still a mystery how SARS-CoV has crossed the species barrier, a number of reports have provided detailed descriptions on the transmission of SARS-CoV among humans. The transmission of most respiratory viruses is a combination of direct contact (touch), short-range (large droplet; within 1 m) and long- range (droplet nuclei; beyond 1 m and further). There are several infectious agents that are recognized to be spread by all three routes with equal importance, e.g. tuberculosis, measles and chicken pox [49], but most are transmitted mainly by direct contact and short-range routes, with occasional instances where long-range transmission can be the only explanation, e.g. influenza. The source for such transmission events is normally the infected patient's upper respiratory tract, and not via the haematogenous or fecal–oral routes. The transmission of SARS-CoV is similar to other respiratory viruses, but with several important differences. A brief summary of the early stage of the SARS epidemic in Hong Kong will highlight this. The first international dissemination of SARS-CoV was related to a 'superspreader', a 64-year-old physician from southern China. He visited Hong Kong on 21 February 2003 and stayed in Hotel M. He died 10 days later of severe pneumonia. He spread the infection to at least 16 hotel guests or visitors who had visited the floor where he stayed. The infection was spread subsequently to other parts of Hong Kong, Vietnam, Singapore and Canada within a short period of time. The high infectivity of this viral illness is supported by the fact that 138 patients (many of whom were healthcare workers) were infected with SARS-CoV within 2 weeks after the admission of this single index case from Hotel M. This super spreading event is thought to be related to the administration of a nebulized bronchodilator to the index case, together with overcrowding and poor ventilation in the hospital ward. Many cases of nosocomial SARS-CoV transmission between healthcare workers and patients occurred in intensive care units, where there is particularly close contact between healthcare workers and patients. Next, there was evidence to suggest that SARS might have spread by long- range airborne transmission in a major community outbreak in a private residential complex in Hong Kong. There are several other hypotheses for this major outbreak, including passive carriage of viruses by pests, drying up of U-shaped bathroom floor drain which allowed the backflow of contaminated sewage or its aerosolized particles and creation of infectious aerosol current by the se of residential exhaust fans in the toilet. Other circumstantial evidence is also in line with the airborne transmission hypothesis for SARS-CoV. For instances, air samples obtained from a room occupied by a SARS patient, and swabs taken from frequently touched surfaces in rooms and at a nurse station, were positive for SARS- CoV by PCR. The temporal–spatial spread of SARS among patients in a medical ward where there was a SARS outbreak, at the Prince of Wales Hospital in Hong Kong, was also consistent with airborne transmission. Hence, from this account, one of the main difficulties in controlling SARS transmission during the early stages of the worldwide epidemic is the readiness with which the

virus could spread between healthcare workers and their patients (mainly direct or short-range transmission), but also the existence of 'super spreaders' who generate a far greater than average number of secondary cases. The reasons for this are still not known for certain, but may be a combination of host and viral factors.[9]

The basic R0 (reproductive number) of an infectious agent generally gives an indication of transmissibility of the agent and can also estimate the vaccine coverage required in an otherwise susceptible population, to prevent person-to-person spread of the agent and an ensuing epidemic. Estimates for the R0 of SARS-CoV have been reported by several authors, but in each case, the super spreaders were left out of the estimates, so as not to skew the results for the majority of SARS-CoV-infected individuals. The R0 for SARS-CoV has been estimated to be between 2 and 3. These two analyses excluded super spreading events in their final value of R0, because the transmission route for these events were almost certainly atypical of the disease in most cases and may have been assisted in some way. This value of R0 puts SARS-CoV quite low down on the scale of transmissibility.

Symptoms of SARS: SARS symptoms are similar to those of the flu, including.

- fever over 100.4°F
- dry cough
- sore throat
- problems breathing, including shortness of breath
- headache
- body aches
- loss of appetite
- malaise
- night sweats and chills
- confusion
- rash
- diarrhea

Diagnosis: Various lab tests have been developed to detect the SARS virus. During the first outbreak of SARS, there were no laboratory tests for the disease. Diagnosis was made primarily through symptoms and medical history. Now, laboratory tests can be performed on nasal and throat swabs or blood samples. A chest X-ray or CT scan may also reveal signs of pneumonia characteristic of SARS.

Treatment for SARS: Patients with SARS often require oxygen therapy, and severe cases require tracheal intubation and mechanical ventilation to support life until recovery begins. Severely ill patients should be admitted to the intensive- care unit. No medication has been proven to treat SARS effectively, and treatment is supportive and directed by the patient's clinical condition. Medical caregivers need to follow strict policies on gloves, masks, gowns, and other protocols to avoid becoming infected.[10]

Prevention: There is no vaccine for SARS, although doctor Anthony Fauci mentioned that the CDC developed one and placed it in the US national stockpile. That vaccine, however, is a prototype and not field-ready as of March, 2020. Clinical isolation and quarantine remain the most effective means to prevent the spread of SARS. Other preventive measures include.

- Hand-washing with soap and water, or use of alcohol-based hand sanitizer.
- Disinfection of surfaces of fomites to remove viruses.
- Avoiding contact with bodily fluids.
- Washing the personal items of someone with SARS in hot, soapy water (eating utensils, dishes, bedding, etc.)
- Keeping children with symptoms home from school.
- Simple hygiene measures.
- Isolating oneself as much as possible to minimize the chances of transmission of the virus.

Many public health interventions were made to try to control the spread of the disease, which is mainly spread through respiratory droplets in the air. These interventions included earlier detection of the disease; isolation of people who are infected; droplet and contact precautions; and the use of personal protective equipment (PPE), including masks and isolation gowns. Studies done during the outbreak found that for medical professionals, wearing any type of mask compared to none could reduce the chances of getting sick by about 80%. A screening process was also put in place at airports to monitor air travel to and from affected countries.

SARS-CoV is most infectious in severely ill patients, which usually occurs during the second week of illness. This delayed infectious period meant that quarantine was highly effective; people who were isolated before day five of their illness rarely transmitted the disease to others. Although no cases have been identified since 2004, the CDC was still working to make federal and local rapid response guidelines and recommendations in the event of a reappearance of the virus as of 2017.

Epidemiology: SARS is a new disease which has its origins in Guangdong Province, China. The earliest known cases were identified in mid-November 2002. Since then, probable cases of SARS have been reported in 17 countries.

- WHO is constantly investigating and, where appropriate, verifying rumours about SARS coming in from a wide range of sources?
- The current cumulative number of cases of SARS is 2781 cases with 111 deaths, officially notified by ministries of health. The global case- fatality rate for probable SARS is 4%.
- Most SARS cases to date have occurred in young adults. This transmission pattern largely reflects the age of health care workers, their family members and social contacts, and international travellers. On

the basis of present data, children appear to be less likely to present with SARS than adults.

- SARS appears to be spread most commonly by close person-to- person contact involving exposure to infectious droplets, and possibly by direct contact with infected body fluids.
- China continues to see new cases of SARS although the numbers are decreasing following a peak in cases in February. To date, 1290 cases and 55 deaths have been reported from mainland China.
- Hong Kong is experiencing the second largest outbreak of SARS with 998 cases and 30 deaths. A significant outbreak at the Amoy Gardens apartment block between 27 March to 1 April resulted in a peak in cases. Stringent public health measures appear to have controlled the Amoy Gardens outbreak. However, cases continue to be reported in health care workers, and Hong Kong health authorities are strengthening their infection control and community-based public health measures accordingly.[11]
- Canada has experienced an outbreak of 97 probable SARS cases and 10 deaths. Up to now, the outbreak has been largely confined to Toronto. All cases have been epidemiologically linked to transmission related to a health care setting and transmission among close contacts of known SARS cases. In the Canadian outbreak, the higher case-fatality ratio appears to be linked to the older age of the patients, who frequently have underlying chronic disease.
- Infection control and other public health measures implemented in Viet Nam have effectively controlled the outbreak in Hanoi. Very low levels of transmission have been reported after 24 March. Since the outbreak began on 26 February, 4 deaths have been reported.
- Although Singapore continues to see new cases, including clusters in hospital staff, inpatients, and visitors at two hospitals, the daily increase in numbers has decreased since a peak in mid-March. As of 10 April, a cumulative total of 126 cases with 9 deaths has been reported. Singapore is currently investigating a new cluster at the Singapore General Hospital affecting 52 persons in Wards 57 and 58, comprising 19 probable and 33 suspect SARS cases. The index case was admitted to this hospital on 24 March for the management of unrelated chronic illness, did not show characteristic SARS symptoms initially, and therefore was not placed in isolation and managed according to the principles of strict infection control.
- Cases continue to increase in the United States with 154 persons under investigation. US figures include probable and suspect cases. The US now reports limited transmission from patients to health care workers. No deaths have so far been reported from the US.

Areas defined as "affected" are updated each day according to the latest data on cases and evidence of patterns of transmission.

Epidemiological data indicate that SARS cases occurring in all other countries became infected while present in one of the affected areas or by direct contact with known cases of SARS.

Outbreak in South China: The viral outbreak can be genetically traced to a colony of cave-dwelling horseshoe bats in China's Yunnan province. The SARS epidemic appears to have started in Guangdong Province, China, in November 2002 where the first case was reported that same month. The patient, a farmer from Shunde, Foshan, Guangdong, was treated in the First People's Hospital of Foshan. The patient died soon after, and no definite diagnosis was made on his cause of death. Despite taking some action to control it, Chinese government officials did not inform the World Health Organization of the outbreak until February 2003. This lack of openness caused delays in efforts to control the epidemic, resulting in criticism of the People's Republic of China from the international community. China officially apologized for early slowness in dealing with the SARS epidemic.

The outbreak first appeared on 27 November 2002, when Canada's Global Public Health Intelligence Network (GPHIN), an electronic warning system that is part of the World Health Organization's Global Outbreak Alert and Response Network (GOARN), picked up reports of a "flu outbreak" in China through Internet media monitoring and analysis and sent them to the WHO. While GPHIN's capability had recently been upgraded to enable Arabic, Chinese, English, French, Russian, and Spanish translation, the system was limited to English or French in presenting this information.

Thus, while the first reports of an unusual outbreak were in Chinese, an English report was not generated until 21 January 2003. The first super- spreader was admitted to the Sun Yat-sen Memorial Hospital in Guangzhou on 31 January, which soon spread the disease to nearby hospitals.[12]

MERS VIRUS (Middle East respiratory syndrome)

Introduction: Middle East respiratory syndrome coronavirus (MERS-CoV) is a novel human coronavirus that was previously called “novel human coronavirus Erasmus Medical Center” (HCoV-EMC). The virus was discovered for the first time in Saudi Arabia in 2012 by Zaki et al. The World Health Organization (WHO) has confirmed 2279 cases of human infections with MERS-CoV in 27 countries since 2012; (35%) infected patients have died as of Feb. 13, 2019. However, Saudi Arabia still has the highest reported MERS-CoV mortality rate. Approximately 80% of the cases have been reported to occur there. MERS- CoV belongs to the family *CORONAVIRIDAE*, order *NIDOVIRALES*. It is one of the recently reported zoonotic viruses. The family *CORONAVIRIDAE* is classified into four genera (α, β, γ, and δ). Each genus is divided into linage subgroups.

MERS-CoV belongs to lineage-C of the β coronaviruses. Although bats are the main reservoir for most coronaviruses, dromedary camels are considered the only known reservoir for MERS-CoV to date. Additionally, MERS-CoV isolated from dromedary camels is relatively closely related to some bat coronaviruses. According to the WHO, MERS-CoV transmission between humans is possible and occurs in Middle East countries and the Republic of Korea. Viral spread has been observed among health-care workers and among individuals visiting MERS-CoV-positive patients. The control of some of these outbreaks has been achieved by the local center of disease control and prevention (CDC). Immunocompromised individuals as well as patients with comorbidities are the groups most prone to severe MERS-CoV infection, which may lead to death of these infected patients in many cases.[13]

Three MERS-CoV proteins are expressed on the envelope of the virus: the surface spike protein (S), the membrane glycoprotein (M), and the envelope protein (E). The S protein is responsible for viral entry via attachment to and fusion with the host cell membrane. MERS-CoV host cell receptors were identified to be cluster of differentiation 26, also known as dipeptidyl peptidase-4. The interaction of MERS-CoV S proteins with the DPP4 receptor not only facilitates viral access into the host cell but also triggers signals that induce the immunosuppression of infected patients, enabling viral replication and spread. Despite ongoing research on the development of specific therapies or vaccines against MERS-CoV, there is currently no effective prophylaxis or therapy for MERS-CoV, which hinders the treatment or control of the viral infection. Understanding the mechanism of the immune response against MERS-CoV infection will make the development of effective vaccine candidates achievable, especially if the vaccine candidates are strong enhancers for both cellular and humoral immunity. In this review, we will discuss how innate immunity and acquired immunity respond to MERS-CoV infections in light of the most up-to-date literature in this field of research. Moreover, we highlight the most recent advances in the field of MERS-CoV vaccines.

WHAT IS MERS?: MERS-CoV was first reported in Saudi Arabia. Since then, it's been reported in other countries in the Middle East and in Africa, Europe, Asia and the United States. Most cases outside of the Middle East have been reported by people who recently traveled there.[14]

Virology: Middle East respiratory syndrome is caused by the MERS coronavirus (MERS-CoV), a species with single-stranded RNA belonging to the genus beta-coronavirus which is distinct from SARS coronavirus and the common-cold coronavirus. Its genomes are phylogenetically. A novel human coronavirus, Middle East respiratory syndrome coronavirus (MERS-CoV), has caused outbreaks of a SARS-like illness with high case fatality rate. The reports of its person-to-person transmission through close contacts have raised a global concern about its pandemic potential. Here we characterize the six-helix bundle fusion core structure of MERS- CoV spike protein S2 subunit by X-ray crystallography and biophysical analysis. We find that two peptides, HR1P and HR2P, spanning residues 998-1039 in HR1 and 1251-1286 in HR2 domains, respectively, can form a stable six-helix bundle fusion core structure, suggesting that MERS-CoV enters into the host cell mainly through membrane fusion mechanism. HR2P can effectively inhibit MERS-CoV replication and its spike protein- mediated cell-cell fusion. Introduction of hydrophilic residues into HR2P results in significant improvement of its stability, solubility and antiviral activity. Therefore, the HR2P analogues have good potential to be further developed into effective viral fusion inhibitors for treating MERS-CoV infection.[15]

Causes: Research suggests that MERS-CoV originated in bats. It then likely spread from infected dromedary camels to humans. According to the World Health Organization (WHO), most cases of MERS in humans have been transmitted by people in healthcare environments. However, evidence suggests that dromedary camels could also be a source of infection in humans. The virus does not seem to pass easily from person to person unless there is close contact, as in a healthcare setting. Researchers do not yet know how exactly camels are involved in transmitting this virus. They have identified MERS-CoV in camels in several countries in the Middle East, Africa, and South Asia.

Mode of Transmission: Non-human to human transmission: The route of transmission from animals to humans is not fully understood, but dromedary camels are the major reservoir host for MERS-CoV and an animal source of infection in humans. Strains of MERS-CoV that are identical to human strains have been isolated from dromedaries in several countries, including Egypt, Oman Saudi Arabia.

Human-to-human transmission: The virus does not pass easily from person to person unless there is close contact, such as providing unprotected care to an infected patient. There have been clusters of cases in healthcare facilities, where human-to-human transmission appears to have occurred, especially when infection prevention and control practices are inadequate or inappropriate. Human to human transmission has been limited to date, and has been identified among family members, patients, and health care workers. While the majority of MERS cases have occurred in health care settings, thus far, no sustained human to human transmission has been documented anywhere in the world.

Since 2012, 27 countries have reported cases of MERS including Algeria, Austria, Bahrain, China, Egypt, France, Germany, Greece, Islamic Republic of Iran,

Italy, Jordan, Kuwait, Lebanon, Malaysia, the Netherlands, Oman, Philippines, Qatar, Republic of Korea, Kingdom of Saudi Arabia, Thailand, Tunisia, Turkey, United Arab Emirates, United Kingdom, United States, and Yemen. Approximately 80% of human cases have been reported by Saudi Arabia. What we know is that people get infected there through unprotected contact with infected dromedary camels or infected people. Cases identified outside the Middle East are usually traveling people who were infected in the Middle East and then travelled to areas outside the Middle East. On rare occasions, outbreaks have occurred in areas outside the Middle East.[16]

Symptoms: The clinical spectrum of MERS-CoV infection ranges from no symptoms (asymptomatic) or mild respiratory symptoms to severe acute respiratory disease and death. A typical presentation of MERS-CoV disease is fever, cough and shortness of breath. Pneumonia is a common finding, but not always present. Gastrointestinal symptoms, including diarrhoea, have also been reported. Severe illness can cause respiratory failure that requires mechanical ventilation and support in an intensive care unit. The virus appears to cause more severe disease in older people, people with weakened immune systems, and those with chronic diseases such as renal disease, cancer, chronic lung disease, and diabetes. Approximately 35% of patients with MERS have died, but this may be an overestimate of the true mortality rate, as mild cases of MERS may be missed by existing surveillance systems and until more is known about the disease, the case fatality rates are counted only amongst the laboratory-confirmed cases.

Prevention and treatment: No vaccine or specific treatment is currently available, however several MERS-CoV specific vaccines and treatments are in development. Treatment is supportive and based on the patient's clinical condition.

As a general precaution, anyone visiting farms, markets, barns, or other places where dromedary camels and other animals are present should practice general hygiene measures, including regular hand washing before and after touching animals, and should avoid contact with sick animals. The consumption of raw or undercooked animal products, including milk and meat, carries a high risk of infection from a variety of organisms that might cause disease in humans. Animal products that are processed appropriately through cooking or pasteurization are safe for consumption, but should also be handled with care to avoid cross contamination with uncooked foods. Camel meat and camel milk are nutritious products that can continue to be consumed after pasteurization, cooking, or other heat treatments. Until more is understood about MERS-CoV, people with diabetes, renal failure, chronic lung disease, and immunocompromised persons are considered to be at high risk of severe disease from MERS-CoV infection. These people should avoid contact with camels, drinking raw camel milk or camel urine, or eating meat that has not been properly cooked.

Diagnosis: During the appointment, the doctor will ask about symptoms and recent activities, including travel.[17]

To check for an active MERS-CoV infection, a doctor takes a sample from the person's respiratory tract. Laboratory tests, including polymerase chain reaction tests, can confirm the presence of the virus. Scientists can also tell whether a person has previously had a MERS-CoV infection by using blood tests to check for antibodies developed to combat the virus. Traveler to Middle Eastern countries where MERS-CoV virus is believed to be circulating in the 14 days before onset of illness. A person with an acute febrile respiratory illness of any severity, an inconclusive MERS-CoV laboratory test (that is, a positive screening test without confirmation), and a direct epidemiologic link with a confirmed MERS-CoV case.

Epidemiology: Total laboratory-confirmed cases of MERS world-wide per year have been as follows.

2012	2013	2014	2015	2016	2017	2018	2019
14	100	381	492	249	250	147	212 (as of 12 Dec)

Saudi Arabia: MERS was also implicated in an outbreak in April 2014 in Saudi Arabia, where MERS has infected 688 people and 282 MERS-related deaths have been reported since 2012. In response to newly reported cases and deaths, and the resignation of four doctors at Jeddah's King Fahd Hospital who refused to treat MERS patients for fear of infection, the government removed the Minister of Health and set up three MERS treatment centers. Eighteen more cases were reported in early May. In June 2014, Saudi Arabia announced 113 previously unreported cases of MERS, revising the death toll to 282.

United States: On 2 May 2014, the Centers for Disease Control and Prevention (CDC) confirmed the first diagnosis of MERS in the United States at Community Hospital in Munster, Indiana. The man diagnosed was a health care worker who had been in Saudi Arabia a week earlier, and was reported to be in good condition. A second patient who also traveled from Saudi Arabia was reported in Orlando, Florida on 12 May 2014.

Netherlands: On 14 May 2014, officials in the Netherlands reported the first case had appeared.

South Korea: In May 2015, the first case in South Korea was confirmed in a man who had visited Saudi Arabia, United Arab Emirates and Bahrain. Another man from South Korea, who was travelling to China, was diagnosed as the first case in China. So far, no Chinese

citizen has been found infected. As of 27 June 2015, 19 people in South Korea have died from this outbreak, with 184 confirmed cases of infection. There have been at least 6508 quarantined. In 2018 a case was found in South Korea; the patient had recently returned from Kuwait (via Dubai). One study found that severe cases of illness had higher viral loads than milder cases, and that concentrations peaked in the second week of illness.

Philippines: In April 2014, MERS emerged in the Philippines with a suspected case of a home-bound Overseas Filipino Worker (OFW). Several suspected cases involving individuals who were on the same flight as the initial suspected case are being tracked but are believed to have dispersed throughout the country. Another suspected MERS-involved death in

Sultan: Kudarat province caused the Department of Health (DOH) to put out an alert. On 6 July 2015 the DOH confirmed the second case of MERS in the Philippines. A 36-year-old male foreigner from the Middle East was tested positive.

United Kingdom: On 27 July 2015, the accident and emergency department at Manchester Royal Infirmary closed after two patients were treated for suspected MERS virus. The facility was reopened later that evening, and it was later confirmed by Public Health England that the two patients had in fact tested negative for the disease.

Kenya: In January 2016, a larger outbreak of MERS among camels in Kenya was reported. As of 5 February2016 more than 500 camels were said to have died of the disease. On 12 February 2016, the disease was reported to be MERS. As of 12 February 2016, there were no known human cases. Antibodies though were found in healthy humans in Kenya according to one study.[18]

COVID-19 (Novel Coronavirus)

Introduction: Coronaviruses are important human and animal pathogens. During epidemics, they are the cause of up to one-third of community-acquired upper respiratory tract infections in adults and probably also play a role in severe respiratory infections in both children and adults. In addition, it is possible that certain coronaviruses cause diarrhea in infants and children. Their role in central nervous system diseases, except for a single case report of encephalitis in a severely immunocompromised infant, has been suggested but not proven. The microbiology, epidemiology, clinical manifestations, diagnosis, treatment, and prevention of community-acquired coronaviruses will be discussed here. Severe acute respiratory syndrome coronavirus (SARSCoV), Middle East respiratory syndrome coronavirus (MERS-CoV), and coronavirus disease 2019 (COVID-19) are reviewed separately.[19]

What is coronavirus: Coronaviruses are a large family of viruses which may cause illness in animals or humans. In humans, several coronaviruses are known to cause respiratory infections ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). The most recently discovered coronavirus causes coronavirus disease COVID-19.

Outbreak: The FDA issued an emergency use authorization for Roche's COVID-19 antibody test, the Swiss drug company announced Sunday. The new Elecsys Anti-SARS-CoV-2 antibody test is designed to determine if a patient has been exposed to the SARS-CoV-2 virus that causes COVID- 19 and whether the person has developed antibodies, according to the news release. Roche has already begun shipping the test to laboratories around the world, the company said, and will increase production to the "high double-digit millions per month." By the end of the year, Roche will double production from 50 million per month to 100 million per month, according to Reuters. The blood test has a 99.8% specificity, the company said, and a sensitivity rating of 100%, which means few false positive and false negatives, the news wire reported. The test requires a blood draw, which provides higher accuracy, instead of a finger prick. "I am in particular pleased about the high specificity and sensitivity of our test, which is crucial to support health care systems around the world with a reliable tool to better manage the COVID-19 health crisis," Roche Group CEO Severin Schwan said in the news release. Other companies have developed antibody tests as well, including Abbott Laboratories, Becton Dickinson and DiaSorin. Abbott has said its test has 99.5% specificity and 100% sensitivity, and Diasorin has said its tests has 98.5% specificity and 97.4% sensitivity, according to Reuters. FDA emergency use authorizations differ from typical FDA approval. The FDA is authorizing certain diagnostic and therapeutic solutions to test and treat COVID-19 and will continue to study other options.

Economic impact of the COVID-19 pandemic in India: The economic impact of the 2019–20 coronavirus pandemic in India has been hugely disruptive. World Bank and credit rating agencies have downgraded India's growth for fiscal year 2021 with the lowest figures India has seen in three decades since India's economic liberalization in the 1990s. The former Chief Economic Advisor to the Government of India has said that India should prepare for a negative growth rate in FY21 and that the country would need a 720 lakh crore (US$10 trillion) stimulus to overcome the contraction. However, the International Monetary Fund projection for India for the Financial Year 2021-22 of 1.9% GDP growth is the highest among G-20 nations. Within a month unemployment rose from 6.7% on 15 March to 26% on 19 April. During the lockdown, an estimated 140 million (140 million) people lost employment. More than 45% of households across the nation have reported an income drop as compared to the previous year. The Indian

economy is expected to lose over 32,000 crore (US$4.5 billion) every day during the first 21-days of complete lockdown which was declared following the coronavirus outbreak. Under complete lockdown less than a quarter of India's $2.8 trillion economy is functional. Up to 53% of businesses in the country will be significantly affected. Supply chains have been put under stress with the lockdown restrictions in place; initially there was a lack of clarity in streamlining what is an "essential" and what isn't. Those in the informal sectors and daily wage groups are the most at risk. A large number of farmers around the country who grow perishables are also facing uncertainty. Various businesses such as hotels and airlines are cutting salaries and laying off employees. Major companies in India such as Larsen and Toubro, Bharat Forge, UltraTech Cement, Grasim Industries, Aditya Birla Group and Tata Motors have temporarily suspended or significantly reduced operations. Young startups have been impacted as funding has fallen. Fast-moving consumer goods companies in the country have significantly reduced operations and are focusing on essentials. Some defense deals have been affected/delayed due to the pandemic such as the delivery of Dassault Rafale fighter jets. Stock markets in India posted their worst loses in history on 23 March 2020. However, on 25 March, one day after a complete 21-day lockdown was announced by the Prime Minister, SENSEX and NIFTY posted their biggest gains in 11 years, adding a value of 4.7 lakh crore (US$66 billion) crore to investor wealth. The Government of India has announced a variety of measures to tackle the situation, from food security and extra funds for healthcare, to sector related incentives and tax deadline extensions. On 27 March the Reserve Bank of India also announced a number of measures which would make available 374,000 crore (US$52 billion) to the country's financial system. On 29 March the government allowed the movement of all essential as well as non-essential goods during the lockdown. On 3 April the central government released more funds to the states for tackling the coronavirus totaling to 28,379 crores (US$4.0 billion). The World Bank and Asian Development Bank have approved support to India to tackle the coronavirus pandemic. On 14 April 2020, the Prime Minister of India extended the lockdown to 3 May. A new set of guidelines for the calibrated opening of the economy and relaxation of the lockdown were also set in place which would take effect from 20 April. On 17 April, the RBI Governor announced more measures to counter the economic impact of the pandemic including 50,000 crores (US$7.0 billion) special finance to NABARD, SIDBI, and NHB. On 18 April, to protect Indian companies during the pandemic, the government changed India's foreign direct investment policy. The Department of Military Affairs has put on hold all capital acquisitions for the beginning of the financial year. *The Press Information Bureau brought out a fact check that stories about a financial emergency being imposed in India are fake. A financial emergency has never been imposed in the history of India as yet. On 4 April, former RBI chief Raghuram Rajan said that the coronavirus pandemic in India may just be* the "greatest emergency since Independence". On 28 April, former CEA Arvind Subramanian said that India would need a ≠720 lakh crore (US$10 trillion) stimulus to overcome the contraction caused due to the pandemic.[20]

Lockdown: On 22 March, the Government of India decided to completely lockdown 82 districts in 22 states and Union Territories of country where confirmed cases have been reported till 31 March. At 6 am on 23 March Delhi was put under lockdown till at least 31 March. Essential services and commodities were to continue. 80 cities including major cities such as Bengaluru, Chennai, Mumbai, Chandigarh and Kolkata were also put under lockdown. Inter-state movements are allowed during the lockdown period. However, some states have closed their borders. On 23 March, union and state governments announced the lockdown of 75 districts where cases were reported. On 24 March, PM Narendra Modi announced a complete nationwide lockdown, starting from midnight for 21 days. By 6 April, the growth rate of the pandemic had slowed to one of doubling every six days, from a rate of doubling every three days earlier. As the end of the lockdown period approached, several state governments recommended extending the lockdown. The governments Odisha, Punjab, Maharashtra, and West Bengal governments have extended the state lockdowns to 30 April. On 14 April, PM Narendra Modi extended nationwide lockdown till 3 May, with a conditional relaxation from 20 April for the areas that have been able to contain the spread. On 29 April, Punjab government announced for extension of curfew till 17 May. On 1 May, the Government of India extended nationwide lockdown further by two weeks until 17 May. On 5 May, Telangana government announced for extension of lockdown till 29 May in their state.

Zonal classification: The Government Divided the entire nation into three zones – Green Zone, Red Zone, Orange Zone, relaxation will be allowed accordingly.

- Red zone (Hotspots) – districts with high doubling rate and high number of active cases.
- Orange zone (Non-hotspots) – districts with fewer cases.
- Green zone – districts without confirmed cases or without new cases in last 21 days.

Mode of Transmission

Modes of transmission of the COVID-19 virus: Respiratory infections can be transmitted through droplets of different sizes: when the droplet particles are >5-10 µm in diameter they are referred to as respiratory droplets, and when then are <5µm in diameter, they are referred to as droplet nuclei.1 According to current evidence, COVID-19 virus is primarily transmitted between people through respiratory droplets and contact routes. In an analysis of 75,465 COVID-19 cases in China, airborne transmission was not reported Droplet transmission occurs when a person is in in close contact

(within 1 m) with someone who has respiratory symptoms (e.g., coughing or sneezing) and is therefore at risk of having his/her mucosae (mouth and nose) or conjunctiva (eyes) exposed to potentially infective respiratory droplets. Transmission may also occur through fomites in the immediate environment around the infected person.8 Therefore, transmission of the COVID-19 virus can occur by direct contact with infected people and indirect contact with surfaces in the immediate environment or with objects used on the infected person (e.g., stethoscope or thermometer).[21]

Airborne transmission is different from droplet transmission as it refers to the presence of microbes within droplet nuclei, which are generally considered to be particles <5μm in diameter, can remain in the air for long periods of time and be transmitted to others over distances greater than 1 m. In the context of COVID-19, airborne transmission may be possible in specific circumstances and settings in which procedures or support treatments that generate aerosols are performed; i.e., endotracheal intubation, bronchoscopy, open suctioning, administration of nebulized treatment, manual ventilation before intubation, turning the patient to the prone position, disconnecting the patient from the ventilator, non-invasive positive-pressure ventilation, tracheostomy, and cardiopulmonary resuscitation. There is some evidence that COVID-19 infection may lead to intestinal infection and be present in faeces. However, to date only one study has cultured the COVID-19 virus from a single stool specimen. There have been no reports of faecal–oral transmission of the COVID-19 virus to date. Implications of recent findings of detection of COVID-19 virus from air sampling: To date, some scientific publications provide initial evidence on whether the COVID-19 virus can be detected in the air and thus, some news outlets have suggested that there has been airborne transmission. These initial findings need to be interpreted carefully. A recent publication in the New England Journal of Medicine has evaluated virus persistence of the COVID-19 virus.10 In this experimental study, aerosols were generated using a three-jet Collison nebulizer and fed into a Goldberg drum under controlled laboratory conditions. This is a high-powered machine that does not reflect normal human cough conditions. Further, the finding of COVID-19 virus in aerosol particles up to 3 hours does not reflect a clinical setting in which aerosol-generating procedures are performed—that is, this was an experimentally induced aerosol generating procedure.

There are reports from settings where symptomatic COVID-19 patients have been admitted and in which no COVID-19 RNA was detected in air samples. WHO is aware of other studies which have evaluated the presence of COVID-19 RNA in air samples, but which are not yet published in peer-reviewed journals. It is important to note that the detection of RNA in environmental samples based on PCR-based assays is not indicative of viable virus that could be transmissible. Further studies are needed to determine whether it is possible to detect COVID-19 virus in air samples from patient rooms where no procedures or support treatments that generate aerosols are ongoing. As evidence emerges, it is important to know whether viable virus is found and what role it may play in *transmission.*[22]

Prevention

Take these steps

- Wash your hands often with soap and water or clean them with an alcohol-based sanitizer. This kills viruses on your hands.
- Practice social distancing. Because you can have and spread the virus without knowing it, you should stay home as much as possible. If you do have to go out, stay at least 6 feet away from others.
- Cover your nose and mouth in public. If you have COVID-19, you can spread it even if you don't feel sick. Wear a cloth face covering to protect others. This isn't a replacement for social distancing. You still need to keep a 6-foot distance between yourself and those around you. Don't use a face mask meant for health care workers. And don't put a face covering on anyone who is: o Under 2 years old o Having trouble breathing o Unconscious or can't remove the mask on their own for other reasons
- Don't touch your face. Coronaviruses can live on surfaces you touch for several hours. If they get on your hands and you touch your eyes, nose, or mouth, they can get into your body.
- Clean and disinfect. You can clean first with soap and water, but disinfect surfaces you touch often, like tables, doorknobs, light switches, toilets, faucets, and sinks. Use a mix of household bleach and water (1/3 cup bleach per gallon of water, or 4 teaspoons bleach per quart of water) or a household cleaner that's approved to treat SARS-CoV-2. You can check the Environmental Protection Agency (EPA) website to see if yours made the list. Wear gloves when you clean and throw them away when you're done. There's no proof that herbal therapies and teas can prevent infection. COVID-19 preparation tips

In addition to practicing the prevention tips listed above, you can.

- Meet as a household or larger family to talk about who.
- If you have people at a higher risk, ask their doctor what to do.
- Talk to your neighbors about emergency planning. Join your neighborhood chat group or website to stay in touch.
- Find community aid organizations that can help with health care, food delivery, and other supplies.
- Make an emergency contact list. Include family, friends, neighbors, carpool drivers, doctors, teachers, employers, and the local health department. Choose

a room (or rooms) where you can keep someone who's sick or who's been exposed separate from the rest of you.

- Talk to your child's school about keeping up with assignments.
- Set yourself up to work from home if your office is closed.
- Reach out friends or family if you live alone. Make plans for them to check on you by phone or email.

Vaccine or specific medicine is not yet discovered.[23]

Diagnosis

Call your doctor or local health department if you think you've been exposed and have symptoms like:

- Fever of 100ºF or higher
- Cough
- Trouble breathing

In most states, decisions about who gets tested for COVID-19 are made at the state or local level. A swab test looks for signs of the virus in your upper respiratory tract. The person giving the test puts a swab up your nose to get a sample from the back of your nose and throat. That sample goes to a lab that looks for viral material. If it's there, the test is positive. A negative test could mean there is no virus or there wasn't enough to measure. That can happen early in an infection. It usually takes 24 hours to get results, but the tests must be collected, stored, shipped to a lab, and processed. The FDA is working with laboratories nationwide to develop more tests. The agency is also granting emergency use authorizations to let doctors' use tests it has yet to approve. These include tests that check your blood for things called antibodies. Your immune system makes antibodies in response to an infection. A swab test can only tell whether you have the virus in your body at that moment. But an antibody test can show whether you've ever been exposed to the virus, even if you didn't have symptoms. This is important in officials' efforts to learn how widespread COVID-19 is. In time, it might also help them figure out who's immune to the virus.

Symptoms of COVID-19

- **Fever**
- **Coughing**
- **Shortness of breath**
- **Fatigue**
- **Chills, sometimes with shaking**
- **Body aches**
- **Headache**
- **Sore throat**
- **Loss of smell or taste**
- **Nausea**
- **Diarrhea**

Treatment: There's no specific treatment for COVID-19. People who get a mild case need care to ease their symptoms, like rest, fluids, and fever control. Take over-the-counter medicine for a sore throat, body aches, and fever. But don't give aspirin to children or teens younger than 19. You might have heard that you shouldn't take ibuprofen to treat COVID-19 symptoms -- the World Health Organization made that statement in March 2020. But they reversed it soon after and said there's no proof that taking it causes any harm. Antibiotics won't help because they treat bacteria, not viruses. If you hear about people with COVID-19 getting antibiotics, it's for an infection that came along with the disease. People with severe symptoms need to be cared for in the hospital. Many clinical trials are under way to explore treatments used for other conditions that could fight COVID-19 and to develop new ones.

• Several studies are focused on an antiviral medication called remdesivir, which was created to fight Ebola.

Testing and counter measurement

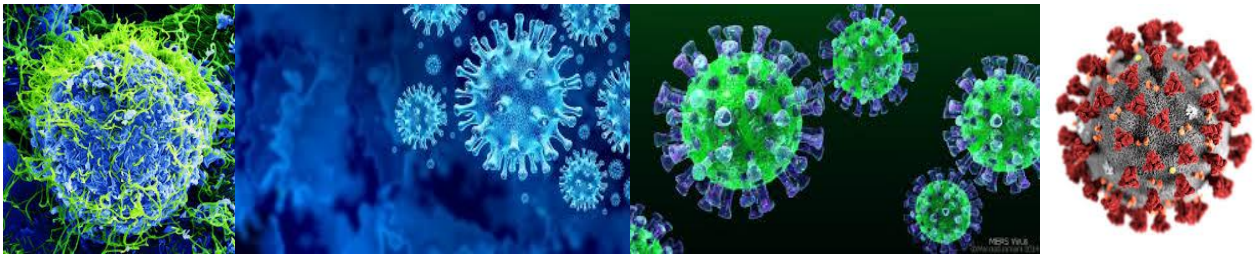
Testing: The Union Health Ministry's war room and policy making team in New Delhi consists of the ministry's Emergency Medical Response Unit, the Central Surveillance Unit (IDSP)**,** the National Centre for Disease Control (NCDC) and experts from three government hospitals. They are part of policy decisions to decide how coronavirus should be tackled in the country. A cluster-containment strategy is mainly being adopted, similar to how India contained previous epidemics, as well as "breaking the chain of transmission". 15 labs across India led by the National Institute of Virology (NIV), Pune, are testing for the virus, with more labs being trained. On 14 March 65 labs were named capable for testing for the virus (though as of 17 March not all are fully functional). On 14 March, scientists at the National Institute of Virology isolated a strain of the novel coronavirus. By doing so, India became the fifth country to successfully obtain a pure sample of the virus after China, Japan, Thailand and the US. The Indian Council of Medical Research (ICMR) said that isolation of the virus will help towards expediting the development of drugs, vaccines and rapid diagnostic kits in the country. NIV has shared two SARS-CoV-2 genome sequences with GISAID. On 16 April, China sent 650,000 Corona virus medical kits to India to help fight with global epidemic.[24]

Initial testing: Initially, the labs tested samples only from those with a travel history to 12 countries designated as high-risk, or those who have come in contact with anyone testing positive for the coronavirus, or showing symptoms as per the government guidelines. On 20 March, the government decided to also include all pneumonia cases, regardless of travel or contact history after the country saw a sharp increase in the number of cases. The first and second confirmatory tests for the virus has been made free by the government. On 9 April, ICMR further revised the testing strategy and allowed testing of the people showing symptoms for a week in the hotspot areas of the country, regardless of travel history or local contact to a patient. As of 14 March, the

National Institute of Virology (NIV) has tested around 5,900 samples from individuals across the country. The number of tests per million in the country was 5 as of 14 March. In comparison, it is 26 in US, 76 in Japan, 1,005 in Italy and 4,099 in South Korea. There are concerns that testing for the virus in India is being inadequately conducted and the need for ramping up the scale of testing is a necessity to understand the real scope of the number of people affected.

Coronavirus Risk Factors: Anyone can get COVID-19, and most infections are usually mild, especially in children and young adults. But if you aren't in an area where COVID-19 is spreading, haven't traveled from an area where it's spreading, and haven't been in contact with someone who has it, your risk of infection is low People over 65 are most likely to get a serious illness, as are those who live in nursing homes or long-term care facilities, who have weakened immune systems, or who have medical conditions including:

- **High blood pressure**
- **Heart disease**
- **Lung disease**
- **Kidney disease that needs dialysis**
- **Severe obesity**
- **Diabetes**
- **Cancer**



Figures of Ebola virus, SARS, MERS & COVID

CONCLUSION

WHO is supporting the national authorities in the response to an outbreak of Ebola virus disease (EVD; formerly known as Ebola Hemorrhagic fever). The outbreak is now confirmed to be caused by a strain of Ebola virus with very close homology (98%) to the Zaire Ebola virus. This is the first time the disease has been detected in West Africa, though it has not been detected in India. The current outbreak is sure to subside, though unfortunately only after consuming many lives. At the same time, it is bound to reappear somewhere, sometime, and mostly for man-made reasons. Unfortunately, it might happen before long. Would the world have learnt from the present deadly out-break? If and when Ebola strikes again, would it be able to deal with it better? Hopefully during the lull, scientists, researchers, and the industry would treat Ebola as a common enemy that must be defended with modern medicine and better health-care infrastructure.

In a population-based study in Iceland, children under 10 years of age and females had a lower incidence of SARS-CoV-2 infection than adolescents or adults and males. The proportion of infected persons identified through population screening did not change substantially during the screening period, which was consistent with a beneficial effect of containment.

Our experience with MERS-CoV is of zoonotic nature, transmitted to humans from infected dromedary camels. The origin of MERS-CoV viral infection is not very well understood. It could have originated in bats and transmitted to dromedary camels at some unknown time in the past. The virus seems to be well maintained in dromedaries, which serve as a reservoir with a spill over human infections. Sporadic human cases in areas where MERS-CoV is endemic in dromedary camels are likely to continue to happen. The awareness of the disease and the easy access to a more developed health care system could explain the higher incidence of MERS-CoV. Diagnosis in Saudi Arabia compared to other countries in Africa where the disease is likely to be overlooked. Larger scale serological screening of human populations in areas where MERS-CoV is endemic in dromedary camels should be considered. More extensive screening of bats in Saudi Arabia and East Africa, especially the Egyptian tomb bat, needs to be considered. Screening dromedary camel populations in Africa (Sahara Desert and surrounding areas), and East Asia (Pakistan, Afghanistan, and Iran) will help better delineate the geographical distribution of dromedaries' involvement. Experimental MERS-CoV inoculation of other domestic animals will help define predisposed groups and should be considered so as to guide screening efforts for other potential reservoirs.

There are hundreds of coronaviruses, most of which circulate in animals. Only seven of these viruses infect humans and four of them cause symptoms of the common cold. But, three times in the last 20 years, a coronavirus has jumped from animals to humans to cause severe disease. SARS, a beta coronavirus emerged in 2002 and was controlled mainly by aggressive public health measures. There have been no new cases since 2004. MERS emerged in 2012, still exists in camels, and can infect people who have close contact with them. COVID-19, a new and sometimes deadly respiratory illness that is believed to have originated in a live animal market (Wuhan Sea Food Market) in China, has spread rapidly throughout that country and the world. The new

coronavirus was first detected in Wuhan, China in December 2019. Tens of thousands of people were infected in China, with the virus spreading easily from person-to-person in many parts of that country. The novel coronavirus infections were at first associated with travel from Wuhan, but the virus has now established itself in 177 countries and territories around the world in a rapidly expanding pandemic. Health officials in the United States and around the world are working to contain the spread of the virus through public health measures such as social distancing, contact tracing, testing, quarantines and travel restrictions. Scientists are working to find medications to treat the disease and to develop a vaccine. Now it is a challenge for India to combat the disease by providing unlock1 and by imposing lockdown to the containment zone with a view to regain the economical paralytic condition.

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