



Review Article

A brief review on history, transmission and management of corona virus outbreaks

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ABSTRACT

Over the year's world had seen mainly viral outbreak, some of them became epidemic and others pandemic. Recent outbreak of COVID-19 is one of the examples. The present work is a review on the different viral outbreaks that took place in the history. Review mainly focuses on the outbreak caused by coronavirus family that comes under superfamily of Nidovirus. Here we have described in detail about the genetic composition of different corona viruses like Middle East Respiratory Syndrome-Corona-Virus (MERSCoV), severe acute respiratory syndrome-corona-virus (SARS-CoV) and Novel corona virus (COVID-19) along with their mode of spread and their effect on the human population. This work explains the about the research that either has been done or going on for the management and treatment of the disease. COVID-19 being the recent outbreak, a detail about its origin, cause, symptoms, transmission and its effect on the economy as well as environment has been explained here.

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1. Introduction

Coronaviruses family comes under the superfamily of Nidovirus. These viruses are categorized into three groups (1, 2, 3) based on their antigenic reactivity which is established by the genome sequencing pattern. Recently International Committee on Taxonomy of Viruses (2009) has personalized new taxonomic nomenclature.¹ According to new nomenclature these coronaviruses are again categorized into three genera (alpha, beta and gamma coronaviruses), which is a sub-division that comes under groups 1, 2, 3, of subfamily coronavirinae within coronaviridae family and order nidovirales. Coronaviruses causes disease in varieties of conjugal, wild animals and humans. Most of the studies on coronavirus has been carried out on betacoronavirus, murine coronavirus (MuCoV), mouse hepatitis virus (usually referred to as MHV) that has provided model systems for the study of central nervous system (CNS) and associated diseases like encephalitis and multiple sclerosis (MS) and acute hepatitis. Majority

coronavirus cause mainly the common cold in humans, but some corona virus is also known to produce severe acute respiratory syndrome (SARS). SARS is caused by SARS-associated coronavirus (SARS-CoV), which is also a betacoronavirus. This infection established the prospective that corona virus have additional significance in human diseases as far as coronavirus infections are concerned. SARS-associated human coronavirus (HCoV) were found out to be new corona virus that causes harsh infection in humans. In addition to this NL63 an alphacoronavirus is known to cause bronchiolitis in children, and HKU1, a betacoronavirus, associated were chronic respiratory disease in the elderly.²

2. Genetic sequencing pattern of Coronaviruses

Coronaviruses are positive strand RNA enveloped viruses that are regarded as the largest identified RNA genomes. Genomes Coronavirus are generally around 30–32 kb which are arranged equally where the replicase locus is encoded in the 50end at the 30 end structural proteins are encoded. Third After that the hemagglutinin esterase (HE)

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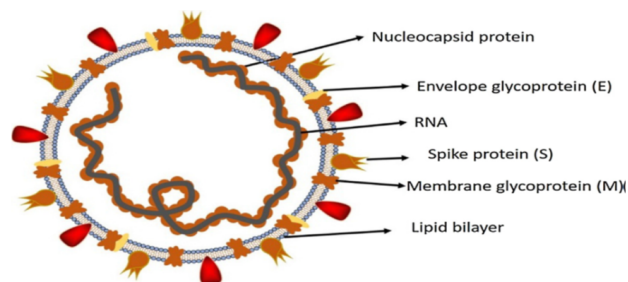


Fig. 1: Structure of respiratory syndrome causing human coronavirus.³

are arranged in the genome. HE is found only in some betacoronaviruses. Corona Virus further contains following parts namely the spike (S), a small membrane (E) along with a membrane (M) and nucleocapsid (N) and internal (I) protein, encoded within the N gene (Fig. 1). The nucleocapsid protein complexes with the genome RNA forms a helical capsid structure which is present inside viral envelope. The spike proteins are present on the surface and forms peplomers and these spikes give the corona virus a crown like structure. In number of coronavirus virions, the HE protein forms smaller spikes on the membrane. M and E, that are present in the virus are the transmembrane proteins involved in assembly of virus (Fig. 2). There is a difference in number, sequence and function of different corona viruses like MHV, SARS-CoV and Novel coronavirus.⁴

3. Challenges accessible by corona virus to global health

Various life threatening, viruses have emerged in current times. They have been responsible for causing large human mortality, and also promote various serious public health issues in worldwide. Wide-ranging travel of humans and goods, their rash anywhere in the world could potentially be a risk everywhere due to modern lifestyle. There are three types of corona viruses who are considered to be responsible for harsh acute illness in recent times, namely Middle East Respiratory Syndrome-Corona-Virus (MERS-CoV), severe acute respiratory syndrome-corona-virus (SARS-CoV),^{5,6} and Novel corona virus (Covid-19). These three viruses are causing acute and often fatal illness. Their fatality rate is ranges from 30 % to 90% .The reservoir of these viruses are considered to be animals such as bats, camels, or chimpanzees. These Viruses has spread from animal to human, and now it has been found to be spreading from human to human. As of now there is no specific treatment for controlling these diseases, though there are few supportive treatments to improve the health condition of patient. Steps are being taken for production of antiviral vaccines. It becomes quit a challenge for public health sector to control these kind of novel viruses and the

infection caused by them. To have a better control over these viruses there should be proper information about their reservoir, their spreading and the symptoms associated with them. The present articles explain about various parameters like transmission, safety and efficacy of therapies used on different patients who suffered from MERS-CoV and SARS infections. In addition to this the present work also take into account the recent pandemic of COVID-19 caused by corona virus. It is been seen that COVID-19 is caused by a virus that is related to virus that caused severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS).⁷ COVID-19 is caused by a betacoronavirus SARS-CoV-2 that mainly targets the lower respiratory tract and manifests as pneumonia in humans. In spite of rigorous global control and quarantine efforts, the incidence of COVID-19 continues to rise, with their numbers 8,786,592 laboratory-confirmed cases and over 463,156 deaths globally.



Fig. 2: Illustration of the geographical spread of confirmed COVID-19. Data accurate as of 3rd March 2020.⁸

4. SARS corona virus

In year 2002 a new viral disease emerged in China. The disease was termed as severe acute respiratory syndrome (SARS). SARS was regarded as global threat by WHO as it had a large morbidity or mortality. There were around 8273 confirmed cases from 37 countries with 775 deaths globally. Due to a high case fatality rate, accurate knowledge of the SARS-CoV remains a priority so that a number of fatality cases could drop down to 10%.⁹

4.1. Transmission of the SARS-CoV

SARS transmitted through respiratory aerosols, when the SARS patient coughed or sneezed, the droplets from an infected patient propelled to healthy individual through air. It was also found to enter human body through mouth, nose or eyes when the individual touched these parts after touching any infected surface.⁹

4.2. Signs and symptoms

By the various literatures survey indicated that incubation period of the SARS-CoV ranges from 2 to 10 days. And their signs and symptoms include: distress in respiration

track and body pains, high fever, migraine, slight respiratory problem, diarrhea (10–20%), and cough (after 2–7 days).¹⁰

4.3. Complications

Complications of many patients who were infected with SARS virus was development of pneumonia in most of the cases. There was a feeling of discomfort during breathing, to deal with it patient requires automatic respirator for the respiration. SARS was considered lethal in few cases due to respiratory failure. Along with that the associated problems were cardiac and liver failure. Investigation reports suggested that individual over 60 years of age having complications such as diabetes or hepatitis were at higher risk of severe complications.^{11,12}

4.4. Diagnosis of SARS-CoV

Diagnosis of SARS-CoV were done by the PCR testing as SARS was a new disease in humans back then and there were no anti-SARS-CoV antibodies are not found in populations. Many tests were developed in laboratory by the researcher like ELISA and immunofluorescent antibody (IFA) tests.¹³

4.5. Management

First line drug used for the disease were protease inhibitors (Retroviral) such as lopinavir/ritonavir along with ribavirin. Other antiviral therapy, RNA silencing, anti-monoclonal antibody, anti-viral peptides, and vaccines were under development and the role of interferon and general steroids in action of immune-mediated lung damages needed additional examination.¹⁴

4.6. Prevention

For the prevention various researcher and Scholars were working on different types of vaccines for the treatment of SARS, but till now these vaccines need to be official to test in humans.¹⁵

5. MERS corona virus

In January, 2012 another virus had been seen in various countries in the gulf region, Korea and European region. As per the reports of the WHO there had been 1638 human cases, including 587 deaths. The virus was MERS-CoV that caused the disease Middle East Respiratory Syndrome (MERS co-V).^{16,17} WHO announced MERS as a lethal disease caused by corona virus which was considered a threat to entire globe.^{17–20} MERS-CoV was found to be a single strand RNA according to various reports.^{21,22} MERS-CoV was taxonomically similar to the SARS-CoV and had also been associated with serious respiratory disease along with nosocomial transmission in hospital areas. The first case was reported in human was in year 2012 from

Saudi Arabia. Later on various cases were reported from Egypt and nearby 22 countries include UAE, Kuwait, Qatar, Indonesia, Thailand, UK, Korea, China and USA.^{19,20}

In 2nd May, 2014 the first case of MERS-CoV was identified in USA in a tourist who came from the Kingdom of Saudi Arabia. The Republic of Korea reported its first case on 20 May 2015, in total there were 185 cases from that region and 36 deaths were reported. After this the reports of WHO and King Saud University (KSU) experts came together to work on this disease. They isolated MERS virus from nasal swabs of camels and verified that the whole genome order that were obtained from human and camel were identical.²³ It was found that the transmission from person-to-person was low. Also transmission from patients to the health care workers and close relatives were also found to be low. But even today, there is no definite vaccine or treatment for this disease.

5.1. Transmission and Reservoir of MERS-CoV

According to various published research articles the normal reservoirs of infection were “camels”. Initial cases of MERS (especially primary or in first cases) were found in the persons who were in close contact with camels or they were found to be drinking camel’s milk. As per the reports camels were considered to be the animal sources of MERS-co V.²⁴ in human to human transmission of MERS-CoV occurred from patients to health care workers through droplet infection, through touching contaminated surfaces.^{21,25}

5.2. Epidemiology and Incubation period of MERS-CoV

Investigation suggested that incubation period of MERS-Co V ranges from 2 to 14 days.^{21,26} In 2012, during the summer season in Jeddah, a Saudi Arabian city, an anonymous coronavirus (CoV) was identified from the saliva of a patient with acute pneumonia and renal failure. A similar form of virus, named human coronavirus, was isolated from a patient with harsh respiratory infection who traveled from the Middle East to London, United Kingdom on 15th September 2012. Similar kind cases had also been reported in other Eastern Mediterranean countries as: Kuwait, Yemen, Oman, Iran, Lebanon, Tunisia, Algeria, Southeast Asian countries as: Bangladesh, Malaysia, as well as European countries as: France, Italy, Germany, Netherlands, United Kingdom, Greece, Italy, in addition to the United States.^{26–29}

In first 9 days Saudi Arabia confirmed eight MERS-CoV and that number finally came out to be 833 confirmed cases, including 358 deaths, with a case-fatality rate of 43%.

5.3. Signs and symptoms of MERS-CoV

Common signs and symptoms include: rigidity, feeling cold along with trembling, migraine, cough, sore throat,

and trouble in breathing and also muscular rheumatism, chest pain, kidney failure, pneumonia, giddiness, nausea and vomiting, dysentery, and stomach pain. It was found that unusual symptoms comprising slight respiratory infection without pyrexia and diarrhea used to happen before the development of pneumonia. According to reports immune-compromised people were at high risk to get infected by MERS-CoV.⁷

5.4. Diagnosis of MERS-CoV

For the diagnosis of MERS-CoV commonly PCR diagnosis method were used and confirmation was done by collecting sputum or any other sample from the patient. Blood sample test were also used to decide whether a person had been previously infected.³⁰ In the year 2015 high fatality rate was observed that was around 30% to 40%. It was quite clear that secondary cases comprises a larger proportion of patients; many of them were health professionals engaged in provision of healthcare for the major cases of MERS-CoV.⁷

5.5. Management of MERS

As far as reports are considered there is no accurate treatment or prophylaxis exists for MERS-CoV. An Enhanced diagnosis and therapy remains the basis of patient management.⁷

5.6. Infection control

To protect the health care employees and patients a successful disease control method is key. To ensure better management of patient infected with MERS-CoV Convalescent plasma, lopinavir and interferon (IFN) were prescribed. Interferon and lopinavir were the drugs that were used for initial treatment. The exact use role of steroids on viral infection control in MERS were not well known. Though systemic administration of corticosteroid delayed clearance of viruses like SARS CoV. MERS CoV were associated with delayed replication of other respiratory infections. That was the reason that sequential sampling, diagnosis with PCR were must for every patient who had received steroids for any symptoms. Combination therapy of Ribavirin and interferon had shown many beneficial effects.³¹ Cyclosporin A (CsA), cycloheximide, mycophenolate, IFN- β , omacetaxine mepesuccinate, anisomycin, and emetine dihydrochloride hydrate were also known to extend better protection against MERS-CoV.³²

6. COVID-19

Coronavirus is one of the major pathogens that solely affect human respiratory system. Two previous outbreaks of coronaviruses (CoVs) were the severe acute respiratory syndrome (SARS)-CoV and the Middle East respiratory

syndrome (MERS)-CoV. In December 2019 a new outbreak starts to emerge when a group of patients were admitted to hospitals with an early diagnosis of pneumonia of an unidentified etiology in Hubei Province, China. The patients were found to be in close association to the seafood and wet animal wholesale market in Wuhan.^{33,34}

On diagnosis it was found that a new strain of corona virus has infected humans and it was predicted to cause potential Coronavirus outbreak. The virus was given a name 2019 Novel (New) Coronavirus, later the name changed to COVID-19 by WHO on Feb 11, 2020. The chronology of spread of COVID-19 infections was very interesting. It started in December 2019 when the initial cases were reported.³⁵ After that within the time span of December 18, 2019 to December 29, 2019 five more patients were found to be suffering from acute respiratory distress syndrome and were hospitalized, out of them one patient died and registered first death due to this.³⁶ Then on January 2, 2020, 41 more patients were admitted who were confirmed by laboratory of COVID-19 infection, Half of these patient were found to be suffering from diseases like diabetes, hypertension, and cardiovascular disease.³⁷ These patients were found to be infected in hospital may be due to nosocomial infection. It confirmed that COVID-19 gets transmitted from patient to patient. On January 22, 2020, sum of 571 patients were found to be infected by 2019-new coronavirus (COVID-19) from 25 provinces (districts and cities) in China.³⁸ As per China National Health Commission till January 22, 2020 the number of death reported were found to be 17 deaths up to. The number of infected person from mainland China increased to 1975 and number of death increased to 56 by January 25, 2020.³⁹ According to a report on January 24, 2020, the cumulative incidences in China were predicted to be 5502.⁴⁰ Till January 30, 2020, a total of 7734 cases had been found only in China. In addition to this 90 other cases had also been reported from different countries like Taiwan, Thailand, Vietnam, Malaysia, Nepal, Sri Lanka, Cambodia, Japan, Singapore, Republic of Korea, United Arab Emirates, United States, The Philippines, India, Australia, Canada, Finland, France, and Germany. Considering number of reported cases, the fatal outcome rate was calculated, that came around 2.2% (170/7824).⁴¹ With every passing day the spread of infection has increased exponentially till March 28, 2020 the death toll in Italy only rose to 7,503, with total of 74,386 infections. Spain recorded around 769 deaths on daily basis with increasing the total number of cases to 4,858. In United States number of confirmed coronavirus cases has surpassed **1 3,953,786*** and around more than **592,791*** deaths were reported. According to reports of Johns Hopkins University almost whole of the world is infected due to which WHO has declared COVID-19 as world pandemic.⁴²

6.1. Symptoms

From all the updates that came from doctors and researchers it was confirmed that the symptoms associated with COVID-19 appears after an incubation period that is between 2 days to 14 days.⁴³ The duration of death of patient suffering from COVID-19 was found out to be 6 to 41 days. Although the duration of death may vary depending upon the immune system and age of the patient.³⁹ The most common symptoms that were seen at onset of COVID-19 illness were fever, cough, and fatigue, while other symptoms include sputum production, headache, haemoptysis, diarrhoea, dyspnoea, and lymphopenia.^{36,37,39,44}

As per a recent report of doctors even a sudden loss of a sense of smell could be a sign of a COVID-19 infection. By the recent research Clinical features exposed by a chest CT scan presented as pneumonia, however, there were atypical features such as RNAemia, acute respiratory distress syndrome, acute cardiac injury, and numbers of grand-glass opacities that led to death.³⁷ The multiple peripheral ground-glass opacities were observed in some cases.⁴⁵ (Fig. 2). COVID-19 have similar symptom as betacoronavirus is noted most importantly fever, dry cough, dyspnea, and bilateral ground-glass opacities reported by chest CT scans⁽⁴⁴⁾. Whereas patients infected with COVID-19 also develops gastrointestinal symptoms like diarrhoea, a low percentage as comparison of MERS-CoV or SARS-CoV patients showing similar GI distress.^{46,47}

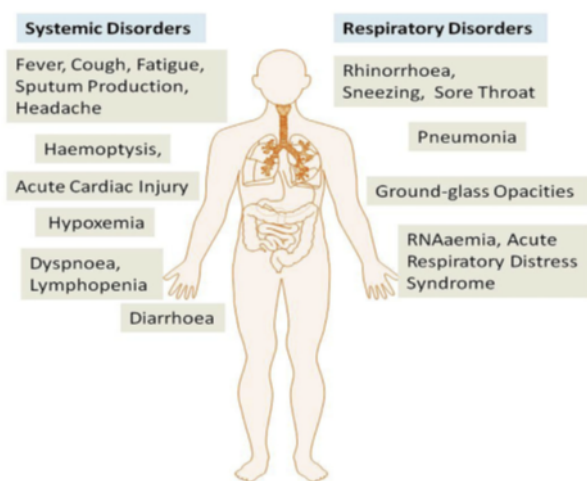


Fig. 3: The systemic and respiratory disorders caused by COVID-19 infection.⁴¹

6.2. Pathogenesis

COVID-19 infection has affected many people around the globe and due the number of COVID-19 infection cases and the number of fatalities associated with it, it has

become a global pandemic. If China is considered where the disease emerged as epidemic, then On January 22, 2020, the China National Health Commission reported the details about initially 17 death, whereas the number had reached 56 by 25, 2020.³⁹ COVID-19 patients displays characteristics like higher leukocyte numbers, abnormal respiratory findings, and increase in the numbers of plasma pro-inflammatory cytokines. As per reports COVID-19 patients shows symptoms such as 5 days of fever presented with a cough, coarse breathing sounds of both lungs, and a body temperature of 39.0 °C. When sputum of these patients was carried through real-time polymerase chain reaction then it shows positive results and thereby confirms the infection.⁴⁵ The laboratory finding of COVID-19 patient shows conditions like leucopenia with leukocyte counts of 2.91×10^9 cells/L out which neutrophils comprises 70.0%. In addition to this the level of C-reactive protein was found out to be on the higher side where normal range of it is 0–10 mg/L.¹⁶ The major pathogenic characteristic of COVID-19 infection are severe pneumonia as it primarily target respiratory system, RNA aemia, along with the incidence of ground-glass opacities and acute cardiac injury. The increase in level of cytokines are evident in COVID-19 infection and the most common cytokines are found to be IL1- β , IL1RA, IL7, IL8, IL9, IL10, basic FGF2, GCSF, GMCSF, IFN γ , IP10, MCP1, MIP1 α , MIP1 β , PDGFB, TNF α , and VEGFA. In some patients with severe disease condition cytokines such as IL2, IL7, IL10, GCSF, IP10, MCP1, MIP1 α , and TNF α are found in higher numbers.³⁷

6.3. Transmission

Transmission of COVID 19 is seen as a zoonotic spillover as the initial cases were found to be linked to wet animal market in Wuhan City, which is well known for selling of live animals for consumption of humans. Proper work had been done to find out the animal reservoir of the disease and few initial studies also reported that the possible reservoir could be two species of snakes. Though till emergence of COVID 19 infection, the reservoirs of all the previous infection were mammals or birds.^{48,49} COVID-19 genomic sequence analysis was found to be 88% identical with two bat-derived severe acute respiratory syndrome (SARS)-like corona viruses.^{50,51} According to a work published on 27 march 2020 in the reputed journal Nature, it had been reported that pangolins have showed the presence of SARS-CoV-2-related coronaviruses in them. Pangolins are mammals, who basically feed on ants for survival, are found in Africa and Asia. They are among the most trafficked wildlife around the world and are poached for their meat and scales (used in traditional Chinese medicines). Though scientists clears that study does not indicate that the SARS-CoV-2 had spread from pangolins to humans but it confirms pangolin as carrier of viruses very similar to SARS-CoV-2.⁵² Reports also confirms the spread of disease also occurs

from human to human as few people who never visited animal market in Wuhan city were also found to be infected from the virus.⁵³ Mode of transmission from person to person is through droplet infection, when an infected person transfers his droplets to a healthy individual while sneezing or coughing. As pregnant women's are more susceptible to respiratory infections, so studies were conducted on women who were in their third trimester of pregnancy whether the virus get transmitted to the new born child. Whereas as far as reports are concerned no such evidence were found in women who went through cesarean section but cases of vaginal birth are still under scanner.⁵⁴

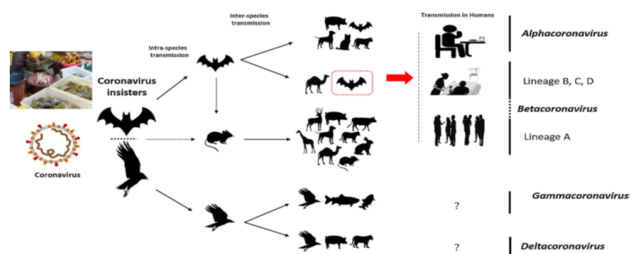


Fig. 4: The Schematic representation of reservoirs and mode of transmission of³

Viral infection starts with binding of virus with the receptors in the host cell. According to reports as SARS-CoV basically affect the respiratory system, it was found that the angiotensin- converting enzyme 2 (ACE2) receptor that are present in lungs were the target receptor for spike proteins of the virus.⁵⁵ As there is similarity of sequence of the receptor-binding domain in COVID-19 spikes and SARS-CoV, it can be suggested that entry of virus is through ACE2 receptor.⁵¹

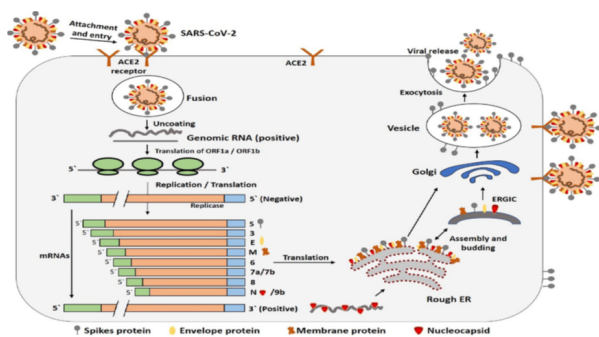


Fig. 5: The life cycle of SARS-CoV-2 in host cells; (67)

6.4. Phylogenetic analysis

COVID-19 has classified COVID-19 as a β CoV of group 2B by World Health Organisation.⁵⁶ Ten genome sequences which were obtained from patients shows 99.98% identical sequence. According to another study there was

99.8–99.9% nucleotide similarity and sequence revealed about a new new beta-CoV strain. The similarity of genetic sequence of the COVID- 19 with that of SARS-CoV was found to be 80% and with MERSCoV it is 50%^{6,21}, and both these viruses were found in bats.⁵⁷ Therefore, the phylogenetic analysis reveals that COVID-19 is from genus betacoronavirus that affects humans, bats, and many wild animals.⁵⁸ COVID-19 is seventh member belonging to coronavirus family that is pathogenic to humans and comes under the subfamily of orthocoronavirinae. Phylogenetic reports also suggest that COVID-19 is quite different from SARS-CoV and so it is considered to be a new betacoronavirus that is pathogenic to humans. It is assumed that COVID 19 most likely originated corona viruses found in bats. A high degree of homology of ACE2 receptor found in different kind of animals also indicates the presence of an intermediate host for COVID-19 infection. Moreover, these viruses were found to have similar genetic frame as of bat-origin CoVs. In addition to this the amino acid sequence related to receptor binding of the virus is found to be similar with SARS-CoV, which justifies that the virus uses same receptor for imparting action.³⁶

6.5. Therapeutics/treatment options

Increase in the person to person transmission of COVID-19 infection forced the medical authorities to isolate the patients. Presently there is no specific treatment for COVID-19 infection. Patients were given a range of drugs to counteract the disease. Antiviral drug that possess a broad therapeutic range such as Nucleoside analogues and drugs such as HIV-protease inhibitors are used for treatment till any specific drug arrives.⁹ The therapy that has been provided to patients includes a twice a day oral dose of 75 mg oseltamivir along with 500 mg lopinavir and 500 mg ritonavir . Moreover therapy also includes intravenous administration of 0.25 g ganciclovir for a duration of 3–14 days.⁵⁹ According to a report broad-spectrum antiviral drugs remdesivir and chloroquine are found to be highly effective against of 2019- nCoV infection in vitro. The patients were given these drugs with keeping a track of the safety. Therefore these drugs can be considered for the therapy of COVID-19 infection.⁶⁰

Moreover there are few compounds which are under the process of development. One of the candidate is EIDD-2801 compound that has potential to treat diseases such as seasonal and pandemic viral infection caused by the influenza virus is under consideration for the treatment of COVID-19 infection.⁶¹ Few more drugs that can be considered till any specific drug emerges are Lopinavir/Ritonavir, Neuraminidase inhibitors, peptide (EK1), RNA synthesis inhibitors. But it is evident that a urgent and dedicated research is required for identification of drug that can specifically treat COVID-19 infections. For the development of pre-and post-exposure prophylactic

therapy against COVID-19, an animal model is required to replicate the currently observed disease in human. Although a groups of scientists are working for development of a nonhuman primate model to study COVID-19 infection. So that it will help to establish fast track novel therapeutics and for the testing of potential vaccines and also provide a better understanding of virus-host interactions.⁶²

7. Comparison between SARS, MERS AND COVID-19³

8. Life Span of corona virus on different surface

The coronavirus can live for hours to days on surfaces like countertops and doorknobs. How long it survives depends on the material the surface is made from. Here's a guide to how long coronaviruses – the family of viruses that includes the one that causes COVID-19 – can live on some of the surfaces you probably touch on a daily basis. Keep in mind that researchers still have a lot to learn about the new coronavirus that causes COVID-19. For example, they don't know whether exposure to heat, cold, or sunlight affects how long it lives on surfaces. They also don't know how much of the virus it takes to cause an infection. But you're probably more likely to catch it from being around someone who has it than from touching a contaminated surface.⁶³

9. Effect of covid-19 infection on economy

COVID-19 has not only affected the human race medically but also it has created a great impact on the world economy. The economy of the world is globally connected by the means of flow of goods, services, people, financial investment, foreign investments, international banking across the border. The economic aspect of the world is more connected by the belief system rather than physically. All these things can act as a propagator of economic shock that the world is witnessing.⁶⁴ As mentioned by Torsten Beck in his ebook banks will not likely to act as an vector for the economic contagion because of tightening of regulation capital buffers are higher and the banking system are generally seen as safer. But all other financial organization other than banks is risk of bankruptcy as it will be difficult for them to pay any debt taken for their usual business. The said scenario can already be seen in UK airline, Flybe, which is unable to meet debt obligations due to dramatic drop in air travel due COVID-19 infection as reported on 5 March 2020. Non-banking sectors are at a greater risk due to COVID-19 infection as due to lockdown the demand of product has decreased and the factories may shut down, whereas they have to pay their debt along with the wages of the workers. This will bring an addition toll to them financially. Trade will be affected severely due to COVID-19 infection. Due to the infection the borders are closed due to which the goods prepared in one country cannot be supplied to another country which

has a demand for it.⁶⁵ This will lead to shutting of the companies and thereby in turn will bring economic crisis. Moreover due to closer of border there will be ban on travel, that will immensely impact the travel industry and ultimate will lead to job losses. Export from China had already been hit by the virus. Japan has also been affected by the COVID-19 infection economically as most of the company instructed their employees to work from home, so the rush hour commuters like trains showed a diminished output. Countries like China, South Korea, and Japan are hit hard as they account for around 25% in US import and the percentage is around 50 if we consider the import of computers and electronics. In addition to these the footwear companies are also feeling the heat of economic crisis due to COVID-19. In East Asia, automobile sector has also been affected due to interruption in supply chain across the border. A Japanese company has closed factory in Japan due to shortage of stocks.⁶⁶

10. Effect of lockdown On the Environment

Although COVID-19 has created havoc all over the globe for the human race but there a beneficial side to it also if the condition of the environment is considered. As there is complete lockdown in different countries around the world so it has reduced the pollution level. According to reports clear skies are seen during the lockdown period. According to few articles during lockdown some of the endangered species were seen roaming on the streets. In Noida, a Nilgai was seen walking on the road. On the similar line in Kozhikode Kerala, a endangered animal like Malabar civet was seen on the street. According to the latest reports issued by World Health Organisation globally 8.5 lakh cases has been reported with around 42000 deaths. To stop the spread of disease almost everything has been shut. This has helped in dropping of pollution level, improvement in the activity of marine life. According to a research carried out by Columbia University level of carbon monoxide and carbon-dioxide emissions has fallen by around 50 percent and 10 percent, respectively, in the bustling city of New York. According to a report there is 25 % decrease in emission across China as use of coal has been reduced. Furthermore there is also decrease in the level of nitrogen oxide as well. In India, Delhi showed an Air Quality Index (AQI) around 93 which was around 161 in March 2019. Nationwide lockdown also helped the marine life as well. The olive ridley turtles to laid eggs in Odisha's Gahirmatha beach and Rushikulya's rookery, which usually lays egg in the sea due to human interruption. Pandemic has helped the environment to rejuvenate.⁶⁷

11. Lessons learned from the COVID-19 outbreak

The international response to COVID-19 had been more transparent and efficient when we compare it the response

Table 1: Comparison of different corona virus species in accordance to their fatality rate and rate of transmission

S.No	Middle East Respiratory Syndrome (MERS)	Severe Acute Respiratory Syndrome (SARS)	Covid-19
Identified in	Saudi Arabia in 2012	Southern China (Guangdong) in 2002	Wuhan, China in December 2019
Spread	27 countries	30 countries	185 countries
Confirmed cases:	2494	8473	1, 174 652 cases
Deaths:	858	813	64 400 deaths
Fatality rate:	34%	9.5%	3.4%

Table 2: List describing the life span of corona virus on different surfaces

Surface	Life of virus
Air	3hr
Copper	4hr
Cardbord	24hr
Stainless steel	2-3 days
Polypropylene	3 days
Aluminum	2-8hr
Glass	5days
Paper	5days

Table 3: 3 : Learnings from COVID-19 Pandemic

Issues with the current response	Response	Event Consequence Key	learning points
Lack of transparency	Clinicians were intimidated when they identified COVID-19	That leads to delayed release of information pertaining to COVID-19 cases	Establishment of strong policies for future global health emergencies
Travel control delay	Aviation services continued to operate for more than a month even after initial outbreak with no proper health screening at international borders	People from high-risk areas were freely passing through large airports without health screening	Earlier implementation of Precautions such as screening of citizens returning from high-risk countries should be done
Why Quarantine delay	On 31st December 2019, the first case of COVID-19 was reported but Wuhan began to quarantine after almost 1 month i.e. on 23rd January 2020,	That lead to spread of infection both nationally and internationally	High-risk areas should be quarantine Duas soon as a possible health threat is identified
Public propaganda	Due to Lack of transparency leads to rumours, speculation and misinformation to be spread amongst the public	Unwanted Racism, incorrect public precautions, and unprecedented fear surrounding COVID- 19 was seen	Transparency to all information is essential for avoidance of misinformation

that had been taken against the SARS outbreak. Whereas we can take some learning away from COVID-19 to tackle such future outbreaks. Chinese Government should have issued viral response guidelines 13 days before. This may be the cause of delayed implementation of containment strategies that could have help to dampened viral spread.⁸

12. Conclusion

The different viral outbreaks that took place due to corona viruses have been because of zoonotic spillover. The origin had always been from an animal source, which got

transferred to human. MERS that happened in Saudi Arabia had camels as the animal that leads to its spread, whereas in case of SARS the animal involved was bat and now in COVID-19 the animal that is involved is thought to be pangolins. All these outbreaks created havoc in the world because of the rate at which it spread. As we don't have any particular treatment for these diseases so some previously available antiviral drugs are employed for their treatment. Research is in progress for development of right medication to tackle these diseases. In case of COVID-19, it has not only affected the human population health-wise but also it has created severe impact on the economy of the whole

world due to lockdown. The only positive of COVID-19 that can be seen is that, due to the lockdown, the nature has rejuvenated itself. It has been seen that the spread of COVID-19 is due to mismanagement of the patients and the information related to the outbreak. If proper steps had been taken earlier by the government of China in the initial stages, then picture would have been something else. Moreover we as a society must focus on the developing research facilities so that when something like this occurs in future we should be in a position to face it. It can be concluded that, it is the need of the hour that we must learn from the mistakes we had committed during these outbreaks, so that in future no such mistakes would be further repeated and eventually that will keep the humanity in a safer space during these kind of outbreaks.

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14. Conflict of Interest

None.

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