

A Critical Study On COVID-19: Structure, Symptoms, Spread, Preventions and Role of Automation Technologies.

¹Nalin Somani, ²Nitin Kumar Gupta, ³Shishir Bisht

^{1,2}Assistant Professor, Department of Mechanical Engineering

³Research Scholar, Department of Mechanical Engineering

DIT University Dehradun, 248001, India

Corresponding author: **Nitin Kumar Gupta**

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ABSTRACT

As of September 21, 2020, a total of 31576422 cases of the coronavirus have been reported in India. Novel Coronavirus disease also called as COVID-19 is caused by severe acute respiratory syndrome (SARS)-COV2 has now become the globally public health concern. Wuhan city of China, where the large number of infected peoples were found, it was suggested that this could be the zoonotic origin of novel COVID-19. Studies reveals that this virus can transmit person to person so isolation is done prior to any treatment on the human being. At present no anti-drug or vaccine is available for the treatment of coronavirus. Extensive measures have been take to reduce the transmission of coronavirus like social distancing, wearing of masks etc. Studies also reveals that special attention is required to the children and elder peoples as their immune system could be weak. In this article we have highlighted the symptoms, structure, Phylogenetic Study, transmission and different ways to control the transmission and future directions for this novel disease. This work also indicates the importance of automation techniques like AR/RV, industry 4.0, Robotics in the field of medical.

Key Words: COVID-19, Symptoms, Structure, Phylogenetic Study, Transmission, Automation

Introduction: COVID-19 is an infectious disease which is caused by novel coronavirus which targets the respiratory system of the human being. The COVID-19 virus is mainly transmitted from the droplets which generates when an infected person exhales or sneezes. The density of these droplets is higher than air so it cannot hang in the air, and it quickly falls on the surface or wall or earth. By touching this kind of

infected surface and then eyes or mouth, can lead to the coronavirus infection. Infection can also be done by breathing the virus if we are in contact with the person who has already infected from coronavirus. In December 2019, huge number of patients were admitted to the hospital in Wuhan, China. These persons were epidemiologically connected to the wholesale market of seafood and wet animals of Wuhan [1]. On 11 February 2020, COVID-19 name was given by WHO. In last week of December 2019, first patient was died due to coronavirus infection [2]. On 2nd January 2020, one of the Chinese laboratory has confirmed that 41 patients were infected from COVID-19 and out of them 17 patients were having pre diseases like diabetes, liver problems and hypertension etc. [3]. Initially the testing was done for only those patients who were clinically sick so it was assumed that there could be many more patients who are infected by the coronavirus. By the end of January, a total of 7824 (7734 cases in China) cases were confirmed worldwide, and out of them 56 were died in China [4]. The other countries like United States, Australia, Malaysia, Sri Lanka, Thailand, Canada, France, Singapore, Germany, Vietnam, India, United Arab Emirates, Finland have also reported the coronavirus cases. 2.2 percent was the case fatality rate [5].

The first positive infected case of COVID-19 was confirmed in India on 30 January, 2020 from Kerala district. Diagnosis and clinical course was done which includes the mild symptoms of the coronavirus [6]. After two days again a positive case was reported and both the person has travelled from the Wuhan city of China. So far more than 4,25,000 positive cases of coronavirus have been reported in India and out of them more than 13,700 peoples have died and more than 2,37,000 peoples have recovered (<https://covid19.who.int/?gclid>). As of 21 June 2020, 83,396 positive cases have been reported in China and more than 4600 peoples have died. Currently 349 active cases are present in China. As of 21 June 2020, according to World Health Organization (WHO), globally there have been 87,08,008 confirmed cases of COVID-19 including 4,61,715 deaths. United States of America has the highest cases (7679644) followed by India (584680), Brazil (4940499), Russian Federation (1237504). India is now on the second number having total cases of 5640496 (<https://covid19.who.int/?gclid>). Figure 1 shows the cumulative data of infected and deaths due to the corona epidemic globally. The data has been taken from the WHO official website from 21 Jan 2020 till 21 Sept. 2020. Similarly figure 2 represents the cumulative data of the infected and deaths in India from the 21 Jan 2020 till 21 Sept 2020. On 21 Jan 2020 when the world wide cases were approximate 296, that time there were no case reported in India.

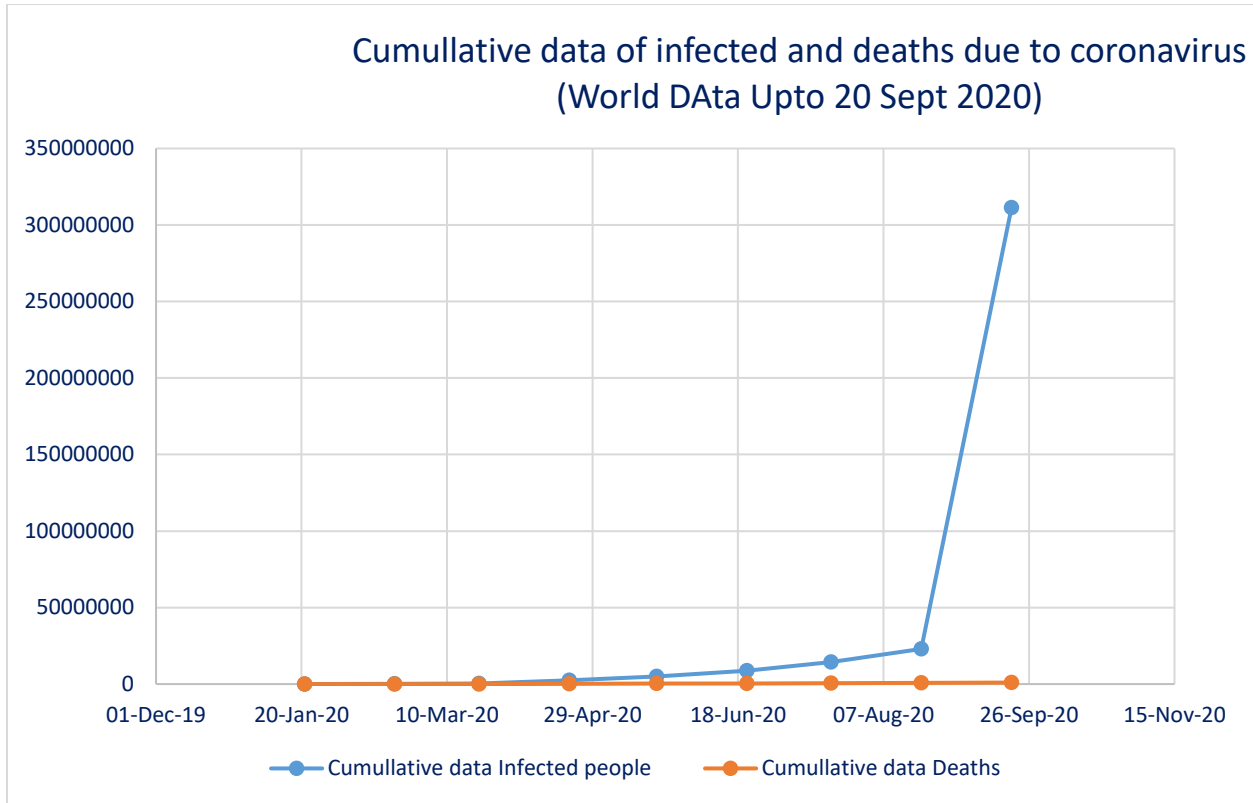


Figure 1: Cumulative Data of infected people and total deaths due to coronavirus worldwide till 20 Sept. 2020.

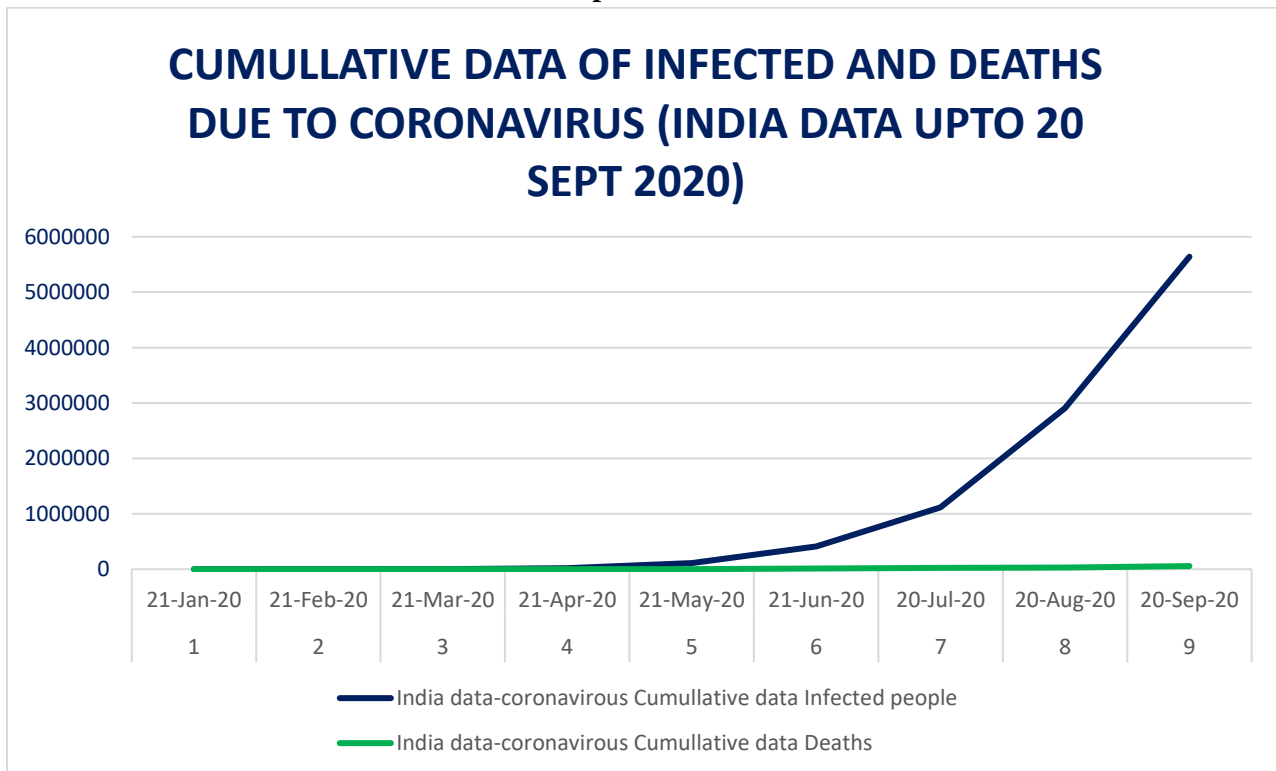


Figure 2: Cumulative Data of infected people and total deaths due to coronavirus India till 20 Sept. 2020.

Symptoms: On 11 Feb 2020, Covid -19 Name was given by WHO. 5.2 days incubation period is the approximately time after which the symptoms of COVID-19 infection appears [7]. The period from the start of symptoms of COVID-19 to death having range of 6 to 41 days. The median for this was 14 days [4]. This time period lies on the immune system and age of the patient. Researcher have reported that this time period was shorter for the patients having age more than 70 years as compared to the persons who were under the age of 70 years [4]. Cold, fever, diarrhoea, headache, body pain, dry cough and tiredness are reported as some of the common symptoms while chest pain, breathing difficulty and loss of speech are reported as serious symptoms of COVID-19. Sore throat, aches, loss of taste, loss of smell and rashes on skin are reported as very less common symptoms [4,8]. As per the guidelines of WHO, persons who are having mild symptoms are advised to stay at home and should manage their symptoms and the immediate medical attention is required for the persons who are having serious symptoms. Some clinical reports reveals that some abnormal features were seen when chest CT scan was done like RNAemia, acute cardiac injury and ground-glass opacities that leads to the cause of death [9]. However, some unique features of COVID-19 include that it targets the lower airway which is evident by the upper respiratory tract symptoms which includes sternutation, sore throat and rhinorrhea etc. [10,11].

The infected patients of COVID-19, who has shown gastrointestinal symptoms like diarrhoea, similar symptoms are experienced by some patients of SARS-COV. So, it is necessary to test the urine samples and faecal samples of the patients, health care workers like nurses, doctors, laboratory technicians, aides etc. Therefore, it is necessary to develop the methods which can identify the different forms of transmission of urine and faecal samples are immediately required to form the strategies or methods to minimize or to inhibit the transmission [10,11]. Figure 3 is the Schematics representation of the mild and sever symptoms on the different body parts due to the effect of COVID-19. This has been categories into mild and sever symptoms as per the instruction by WHO guideline.

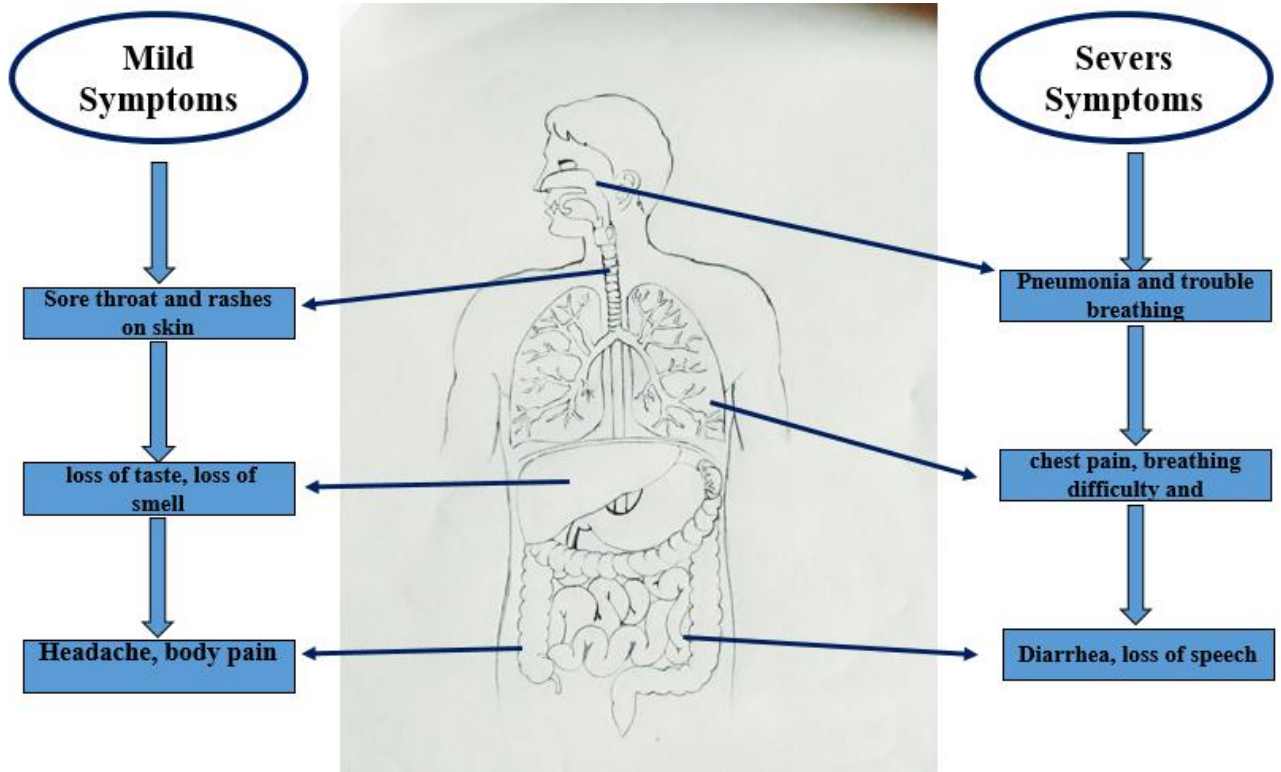


Figure 3: Schematics representation of human body consisting of the mild and sever symptoms of COVID-19.

Structure of coronavirus: In December 2019, first positive case of coronavirus was reported from Wuhan city of China. Later on WHO declared this disease as a public health emergency. Till the time of writing this article, the coronavirus now named as SARS-COV-2 has infected more than 87 lakh persons and out of them 4.61 lakh peoples had died (<https://covid19.who.int/?gclid>). Research reveals that the shape of SARS-COV-2 virus is spherical in nature and the surface projections are bulbous. 0.125 μm is the average diameter of this virus with 20 nm long spikes. The envelope diameter is 85 nm and it appears as a pair of electron dense shells. The envelope has lipid bilayer which is anchored with Envelope (E), Spike (S) and Membrane (M) in the ratio of 1:20:300 (E:S:M). On an average 74 surface spikes are observed on coronavirus particle [12-14]. These spike makes a membrane on human cells, and after it their structure changes which allows to fuse the viral membrane to the cell membrane and then it can enter it into host cell and can produce more number of viruses [15]. Figure 4 shows the C-S model of the coronavirus.

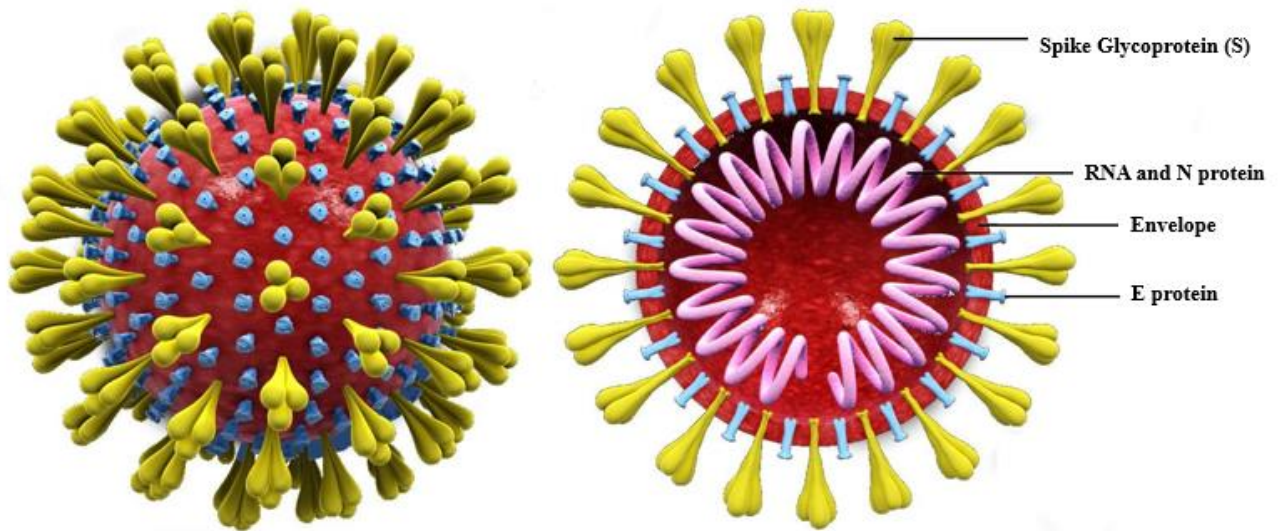


Figure 4. C-S model of the novel coronavirus [15]

In earlier 2020, the scientists of China have released the genome sequence of this virus. This virus contains a single stranded RNA genome and the size of the genome ranges from 26.4-31.7 kilobases. Scientists from University of Texas, have used cryo-electron microscopy to take the detailed picture of atomic level structure of SARS-COV-2 spike. Figure 5 shows the image taken by McLellan's lab, University of Texas, Austin [15].

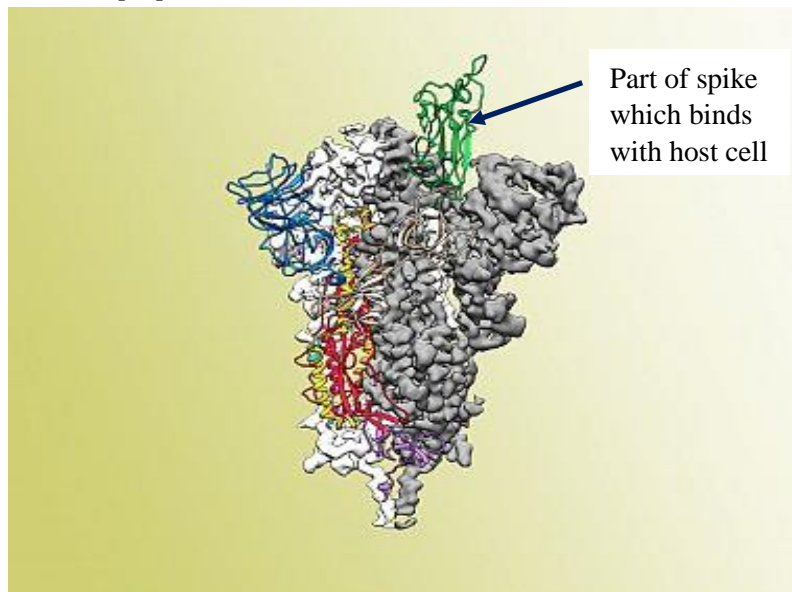


Figure 5. Atomic structure of SARS-COV-2 spike [13]

Transmission of coronavirus: Origin of the coronavirus was from Wuhan city of China where large number of peoples were infected. Efforts has been done to find out the intermediate carriers by which the transmission of the infection takes place to the humans. Research shows that human to human transmission can be a root for spreading the virus or infection. This is supported by the infected cases who have not travelled to the Wuhan city but any how they came in contact with the infected person and got

infected. This human transmission of virus could be either due to direct contact or due to spread of droplets of cough of the infected person (within 1 m). According to WHO, the droplets can be of different sizes. If the diameter of droplet is more than 5-10 μm then they are called as respiratory droplets and if the diameter of droplet is less than 5 μm then they are termed as nuclei [16-20]. As per the clinical reports, the transmission of this virus is due to respiratory droplets and due to contact routes. Person to person transmission can also be due to fomites in the environment nearer to the infected person (<https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf>). So transmission of the coronavirus can occur either due to direct contact with the infected person or it can occur indirectly by coming in contact with the objects used by infected person or by touching the infected surfaces. Figure 6 shows the graphical representation of the most common cause for spreading the coronavirus.

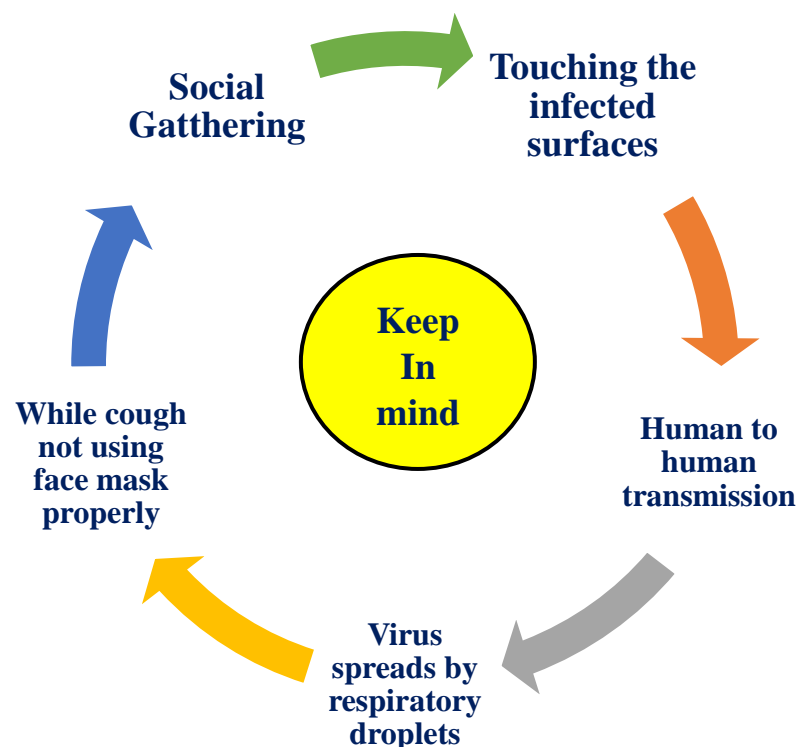


Figure 6: Most common cause for spreading infections from human to human.

Phylogenetic Study: WHO has termed coronavirus as beta-coronavirus of group 2B [21]. The clinical reports regarding the genetic sequence of coronavirus shows that around 80% identity belongs to SARS-COV and around 50% identity belongs to MERS-COV, and both these categories originate in bats [22-23]. So the phylogenetic analysis evidence shows that this novel coronavirus belongs to β -coronavirus and it includes SARS-COV which can infect to the human beings, animals and bats.

Based on the phylogenetic study and genetic sequential identity, it is concluded that both COVID-19 and SARS-COV are quite different so the COVID-19 can be considered as β -coronavirus which infects the human beings. Research shows that the COVID-19 is most likely to be developed from the bat origin COVs. Reports also shows that the coronaviruses are having single intact open reading frame on genes 8, which also indicates that these viruses are bat origin coronaviruses [24].

Treatment: COVID-19 which spread from fish market of Wuhan city, China has infected millions of people worldwide and the cases in the countries like India are still rising. The major problem is that the

treatment of this novel virus is only supportive. Vaccines or anti-drugs are not available to cure this disease. They are under developmental phase. The only option which is available is to use several anti-viral drugs such as Nucleoside analogues, Favipiravir, Lopinavir, Ritonavir, HIV-protease inhibitors to reduce the effect of the virus [25]. Some of the reports shows that antiviral drugs such as remdesivir, chloroquine are also effective to control the COVID-19 infection. So, these antiviral drugs may be considered for the treatment of the COVID-19 infection. EIDD-2801 compound which is used against seasonal influenza virus infection, has potential to be used as antiviral drug for COVID-19 infection [26]. So, it is clear from the study that more research and clinical trials are required to develop the drug and vaccine that can be used for treatment of the COVID-19 infection.

Preventions and Future guidelines:As per the guidelines of WHO, the infected person or the person who has initial symptoms of COVID-19, should be under isolation for at least 14 days so that chances of spread of virus will be less. It is also recommended that each and every person has to clean his/her hands with alcohol based hand soap or sanitizers. Mask should be weared and at least 3 feet distance should be maintained so that the droplets of infected person's cough, sneeze etc. will not be transmitted to the other person. If not necessary than avoid to go to the crowded area or public place. As the hand touches to the many surfaces, so avoid to touch the eyes and nose, as the virus can transmit to the body from eyes or nose. WHO strongly recommends that it is necessary to consult a doctor when a person have symptoms like dry cough, fever, difficulty in breathing etc. So, it is clear that this novel coronavirus for which no specific treatment or drug is available till yet, the only way to be safe is that every person has to follow the guidelines of the WHO so that the human to human transmission of this virus will be minimize [<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>].

Special efforts are required to prevent the transmission between children and the elder peoples. The earlier reports of death cases of elder peoples due to COVID-19 reveals that due to weak immune system, faster progression of this virus in body takes place which becomes the reason for death. Guidelines have published for the health-workers, medical staffs, researchers who are directly or indirectly involved or interested in COVID-19 [27]. Countries like China, US, India have implemented many prevention measures like social distancing, use of mask and travel screening to control the spread of the coronavirus [8]. Figure 7 indicate the schematic representation of the instructions given by the WHO to avoid the spread of the coronavirus.

Some major questions that needs to be addressed like how many persons has tested, how many of them tested positive, is the positive test rate is constant or fluctuating [28]. Countries like India having more than 130 crore population, so far very less paediatric cases have been reported; is this due to less availability of testing kits or due to lack of susceptibility? So far the persons who have been tested for COVID-19, how many of them has developed severe disease? How many of positive tested person has shown no symptoms or any sign of disease? For these kind of questions more intensive study is required and also the specific health measures should be implemented.

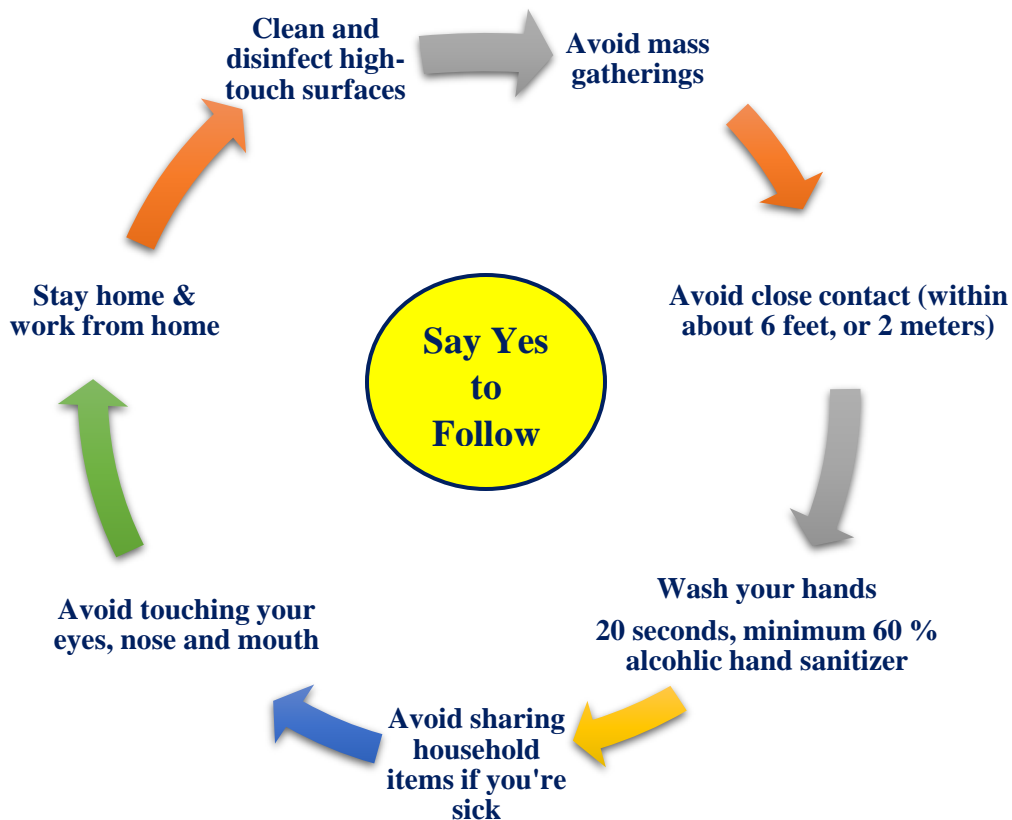


Figure 7: Different measures to prevent spread of covid-19.

Many researchers around the globe are working to create the standards procedure and technologies' so that they can take preventive measure to control the spread of the virus epidemic in future. Keeping the social distancing in mind, industrial automation may play critical role. Industrial automation is using the sensors, control system, drives to stimulate the machine elements, help in automated materials handling, avoid the direct human contact. Now a day many new filed of automation are come into the healthcare industry like industry 4.0, virtual reality, automated reality, robotics, robotics process automation etc.

Automation /Artificial intelligence/ Virtual reality: In 20th century multidisciplinary engineering approach are solving many issue in Medical as well healthcare industry. Surgical Robotics are being used in fully automated operations due to their advantages of precision and the possibility of performing minimallyinvasive operations and, furthermore, their ability toaccess all the anatomical areas of the patient, thusproviding a high degree of versatility in the operating conditions[29]. 3D printing technologies helping to create the model, which can gives the actual feeling of the body parts. In the situation of the epidemic to identify the exact disease is challenging task. Fast Diagnosis of the disease can give opportunity for the critical patient to survive.

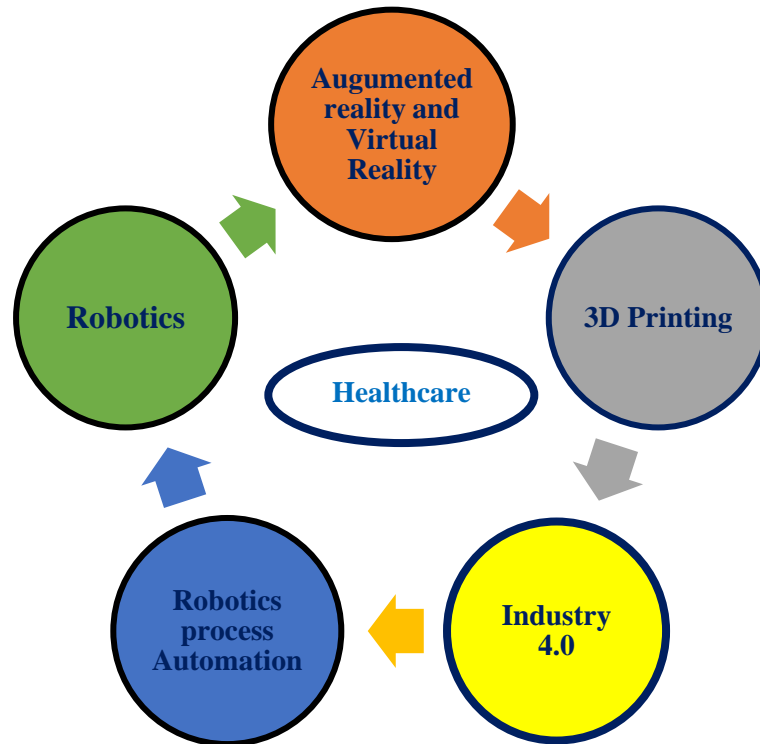


Figure 8: Important role of Automation Technology in healthcare industry.

Virtual reality, augmented reality provides a simulated environment to interact with the 3D world. Medical professionals are developing and implementing this technology for training, diagnosis and virtual treatment during a critical situation.[30]

Industry 4.0, virtual reality, augmented reality, and artificial intelligence have contributed to an improvement in the diagnosis of patients timely. Figure 8 shows the various advanced technology that are being used to create the application in the field of healthcare. Automated equipment may play a vital role to avoid the direct contact with patients having dangerous disease. Also the automated materials handling system can be used in the medical waste. In the COVID-19 scenario various sector of automation can play a critical role to help the healthcare workers

Conclusion: COVID-19 also called as novel coronavirus originated from fish market of Wuhan, China has infected more than 87 lakh persons and still the cases are rising. COVID19 is caused by SARS-COV2 which attacks on the respiratory system of the human being. COVID-19 can be considered as β -coronavirus which infects the human beings. Research data shows that the shape this virus is spherical in nature and the surface projections are bulbous. The envelope has lipid bilayer which is anchored with Envelope (E), Spike (S) and Membrane (M) in the ratio of 1:20:300 (E:S:M). Atomic structure of COVID-19 shows that this virus contains a single stranded RNA genome and the sizes ranges from 26.4-31.7 kilobases. Clinical report shows that this virus can transmit person to person. This human transmission of virus could be either due to direct contact or due to spread of droplets of cough of the infected person within 1 meter of radius or could be due to touching the infected surface. At present no anti-drug or vaccine is available for the treatment of coronavirus. Several anti-viral drugs such as Nucleoside analogues, Favipiravir, Lopinavir, Ritonavir, remdesivir, HIV-protease inhibitors, chloroquine are used to reduce the effect of the coronavirus. Special attention is required to the children and elder peoples as their immune system could be weak. Extensive measures have been take to reduce the transmission of coronavirus like social distancing, travel screening, wearing of masks etc. Timely

sanitization, avoiding unnecessary travel, isolation, consultation with doctor if person having symptoms like dry cough, fever, difficulty in breathing etc. are some of the major guidelines of WHO to reduce the transmission of this virus. Automation can also play a major role to prevent the spread and control this type of epidemic.

Conflict of interest: Authors has no conflicts of interest for this review work.

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