Summarize the Etiology and Epidemiology Characteristics of the New Coronavirus

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ABSTRACT

Until May 16th, there are more than four million people who have been confirmed of the Covid-19 virus in the whole world and 311,739 of total deaths. The virus caused disastrous effects in the economy around the whole world, destroying small businesses and the stock market, ruining international transportation, devastating the morale of the people and prohibiting people from interacting and socializing. Considering these huge impacts that the virus made, on March, 12, 2020, the World Health Organization (WHO) characterized the Covid-19 caused by the Sars-CoV-2 virus as a global pandemic. There is not an effective vaccination or specific medicine to cure the disease. The most effective way to slow down the transmission is early detection, isolation of new carriers and operating proper treatment to patients. Thus, the research on the physical properties and clinical characteristics of the Covid-19 become significantly important. To prepare for the future prevention, this paper summarizes the overall treatment of the virus, mainly through the virus's origin, etiology, epidemiology, and clinical symptoms to inform readers more about the Covid-19, eliminate misunderstanding and bias to the virus, invoke the sense of self-protection and finally use scientific and logical methods to overcome this world-wide pandemic.

CCS Concept

Applied computing→Life and medical sciences→Health informatics

Keywords

Sars-CoV2; etiology; epidemiology; disease

1. INTRODUCTION

Until May 16th, there are more than four million people who have been confirmed of the Covid-19 virus in the whole world and 311,739 of total deaths. The virus caused disastrous effects in the economy around the whole world, destroying small businesses and the stock market, ruining international transportation, devastating the morale of the people and prohibiting people from interacting and socializing. Considering these huge impacts that the virus made, on March, 11, 2020, the World Health Organization (WHO) characterized the Covid-19 caused by the Sars-CoV-2 virus as a global pandemic [1]. Till now, there is not an effective vaccination or specific medicine to cure the disease. The most effective way to slow down the transmission is early detection, isolation of new carriers and operating proper treatment to patients [2]. Thus, the research on the physical properties and clinical characteristics of the Covid-19 become significantly important. To prepare for the future prevention, this paper summarizes the overall treatment of the virus, mainly through the virus's origin, etiology, epidemiology, and clinical symptoms to inform readers more about the Covid-19, eliminate misunderstanding and bias to the virus, invoke the sense of self-protection and finally use scientific and logical methods to analyze this world-wide pandemic.

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The new coronavirus lung disease (named Covid-19 by the World Health Organization on February, 11, 2020), has spread rapidly across the whole world since December. First exploded in the Huanan Seafood Wholesale market in Wuhan, Covid-19, till May 18th, has spread throughout China causing 84063 total cases in the country. The Chinese government closed down the city, public transportation and required citizens to stay at home and keep social distancing [3]. Not only China suffers from Covid-19, the virus spread all around the world. The United States, Russia and Brazil are the top three countries that have the most cases recently. There were 1,556,749 in the United States, and 4,858,850 cases in the whole world (John Hopkins, Data till 8PM. On May 18th), causing millions of people suffering from lung disease and the risk of death. The strongly contagious virus draws people's attention. It is necessary to find out the epidemiology of coronavirus and discover the solution to prevent the spread of the new pandemic destroying the world right now.

Coronavirus, named after the crown shape of its structure, appears as a common type of virus among the environment, usually carried by wild animals such as bats and pangolins [4]. First separated from mice, the coronavirus only spread through domestic animals, mainly causing damage in agricultural and animal husbandry [5]. However, as the coronavirus mutates and evolves, it can achieve Cross-species transmission that causes the appearance of coronavirus in humans, like HCoV-229E and OC43 [6]. Such human coronavirus only slightly infected the respiratory system, so that people did not take many precautions to prevent spreading [7]. However, as the coronavirus started to evolve, the coronavirus became very infectious and deadly. In 2003, the severe acute respiratory syndrome (SARS) caused more than 8000 cases in twenty countries with a ten percent death rate. Covid-19, as the relative of SARS, shows its extremely high transmission rate, already causing close to five million cases around the whole world [8]. The new coronavirus, due to its high infectiousness and

severe symptoms, becomes one of the most difficult viruses to deal with during the 21th century.

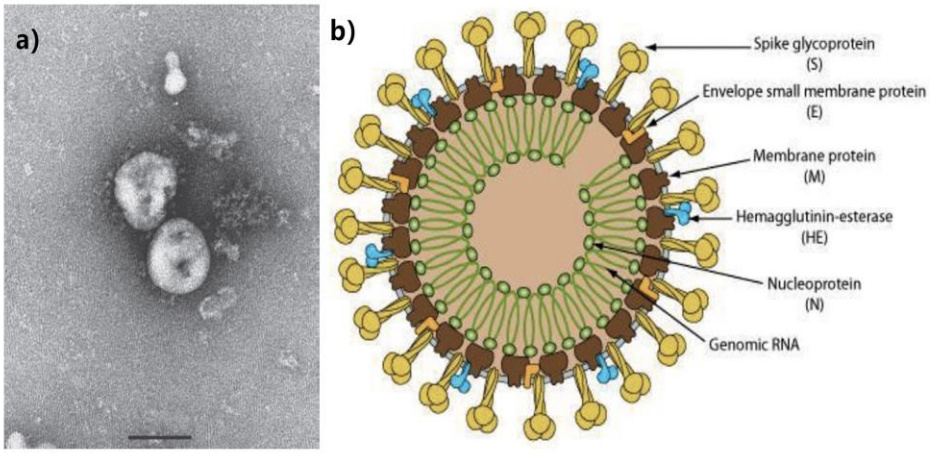

Figure 1(a). The structure of the Sars-CoV2 under electron microscope 9]

Figure1 (b) animated inner structure of Sars-CoV2 [10]

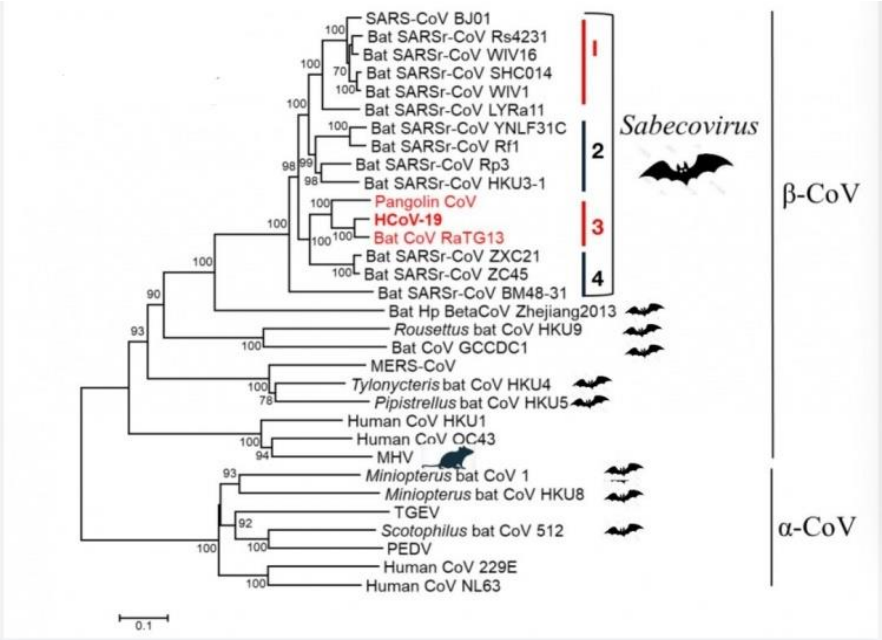

Figure 2. [13] Lineage of coronavirus graph, which the letters marked as red represent the cluster that the new Coronavirus belongs to

2. Etiology

Figure 1 (a) shows Covid-19's structure under the electronic macroscope. Under the scope, the virus is in a relatively circular shape. Figure 1(b) shows a diagram of the virus' inner structure. The virus is an enveloped, multi-shaped or round shaped single RNA virus with a radius usually ranging from 150 to 160nm. The virus contains positive-sense single-stranded RNA, unsegmented capsid, matrix, Nucleoproteins, and S proteins [11]. By tracing its ancestry and relatives, scientists discovered that Sars-CoV2 belongs to cluster three of the sabecovirus subgenus as figure 2 describes [12]

Inside of the Virus is the helix shaped nucleoproteins formed by RNA and N-proteins. The RNA of the protein contains 29891 nucleotides with the order of 5', Spikes protein, envelope, Glycoprotein, nucleocapsid and 3'. The combination of gene of the Covid-19 is much different from its relatives: Sars-CoV and Mers-CoV. However, it has a 85 percent homology compared to the coronavirus found on bats(bat-SL-CoVZC45) [14] . The Spike protein of the Covid-19 contains two protein domains, S1 and S2. Subunits of S1 mainly control the virus ability to identify the receptor binding domain RBD, which is the zone for the combination of the viruses and the receptor cells. Subunits of S2 contain all of the materials needed for the membrane fusion of the virus and the cell, and S2 subunits have 99 percent homology with

the subunits of the Sars-CoV in the 2004 pandemic [15]. However, compared to Sars-CoV, Covid-19 contains longer spike proteins made by S1 and S2 which are essential for the virus to confirm the host's target and transmission ability [16]. Thus the complex spike proteins can help Covid-19 to find the best host that can transmit the virus quickly. Covid-19 viruses are fragile to ultraviolet and high temperatures. It can be destroyed by exposure of 56 Celsius degrees for thirty minutes. Also some solutions such as ether, 75 percent ethanol, disinfectant containing Chlorine, peracetic acid can all kill the virus effectively [17].

3. Epidemiological Characteristics

3.1 Introduce to R0

R0, the basic reproduction number, usually recognized by the scientists to measure the transmission ability of a certain disease by measuring a variable using a well-designed equation. If R0 is smaller than 1, which means the disease would disappear slowly. If R0 equals to 1, the disease would become a regional pandemic that does not transmit to other places. If R0 is larger than 1, the disease would transmit exponentially and become a global pandemic [18]. The R0 of the Covid-19 is between 2.2 to 3.8, which exceeds the 1 line of R0 by 1.2 to 2.8 proving its high transmission ability [19]. However, the coronavirus is not very contagious compared to the measles and diphtheria, which have Ro numbers between 12-18, and 6-7 [20], [21]. However, scientists have already developed effective medicine and vaccines to cure such diseases and the government have made several regulations to control the spread of such diseases. The Covid-19, on the other hand, does not have an effective way to control its spread due to its complicated transportation.

3.2 Difficulties to Detect the Virus

One of the difficulties to control the spread of the Covid-19 is its trick ability to infect others when the patients cannot completely recognize it. The incubation period of the Covid-19 is usually one to fourteen days, and sometimes three to seven days applying to different people [22]. During the virus's incubation period, the patients cannot feel any symptoms caused by the virus. Thus the doctors cannot find the patients as fast as possible to limit the spread of the virus. The incubation period of the virus is also relatively long, causing the patients exponentially infecting people surrounded by them when they go to work or join parties. Asymptomatic infection may also become a source of transmission of the virus, which means that some patients, due to their special body traits, do not show obvious clinical symptoms due to their weak immune system stress response or their own physical characteristics, but they carry the virus and can infect others and cause other people having the symptoms that they don't have [23]. Asymptomatic infection is not easy to find, because they don't show any traits that can warn them to do a diagnosed test. The patients themselves do not know. Because of this, it is difficult to control and isolate in time, causing large-scale transmission, which also brings up the importance of social-distancing, section prevention and control work [24]. Thus the government has to implement coronavirus testing for everybody to diagnose those asymptomatic patients to erase the risks of further transmission. Also, some studies have suggested that patients in the recovery period carry pathogens, but they have not been widely confirmed and need further study.

3.3 Transmission of the virus

Covid-19 entered the body through the ACE2 enzyme located on the lung. ACE2 is a new found Metalloproteinase maintaining located on the alveoli cell, belonging to the I Transmembrane protein playing a significant role in regulating respiratory system, kidney function and blood pressure control [25]. When the virus attaches to the ACE2 in the alveoli cell, the immune system reacts to the contagious cell which causes lung inflammation [26]. The main route of transmission of the virus is through respiratory droplets and close contact. Sometimes Under the condition of long-term exposure to high concentration aerosols in a relatively closed environment, it is possible to propagate through aerosols [27]. Thus the possibility of aerosol propagation increases under certain conditions.

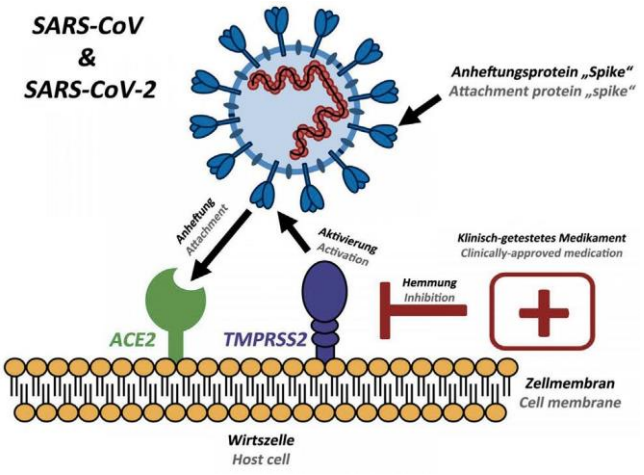

Figure 3. [28] animated graph showing the infection of the Sars-CoV2 attaching to ACE2 proteins

Recently, a novel coronavirus was detected in the feces of many patients during an experiment that tried to figure out the transmission order of the coronavirus. The experiment shows that there is a possibility of one mouth fecal transmission [28]. Although in the study of other kinds of coronaviruses, such as horse coronavirus and swine flu, they can be transmitted through fecal oral route, but common human coronaviruses, such as SARS and mers related coronavirus, have no clear case report of fecal oral route. Up to now, there is no conclusive evidence that covid-19 can cause disease by ingesting contaminated food or water [29]. Scientists still cannot rule out the possibility that covid-19 can spread in the form of aerosol or contact under certain conditions after excretion of feces. Recent studies have shown that there may be mother to child vertical transmission of the new coronavirus, but preliminary evidence shows that infection in late pregnancy will not cause vertical transmission, which other studies have found that the urinary system [30].

3.4 Susceptible Population

During recent experiments, scientists believed that people are generally susceptible, due to the emergence of a new virus, in which people generally have no resistance and cannot produce antibodies. According to the sample taken in Hunan China, the data showing the percentage of male infection and women infection 1.09:1, 0.8:1, which does not show a statistically significance for this data [31]. In terms of age, there is no difference in the ability to resist the virus among all age groups, and they are susceptible to the virus under suitable conditions. However, the infection rate of the elderly and those with basic diseases increases compared to the infection rate of the adults. Most of the elderly have relatively weak immune function. As a result, they are more dangerous exposed under the virus and are

more susceptible and high-risk groups of infectious diseases. The majority of the population that are critically infected in this pandemic usually have high ages such as sixty or older. The novel coronavirus is susceptible to pneumonia in children and pregnant women as well, since they also have relatively weak immunity ability compared to a health adult [32].

4. Conclusion and Concern

The World has already exposed three major pandemics involved in coronavirus: the Sars-CoV in 2002, Mers-CoV in 2012 and the SARs-CoV-2 in 2020. Even though the new Coronavirus has seventy five percent similarity with the SARs-CoV, the new virus actually contains a lot of new traits that scientists still cannot solve, like its epidemiological and etiology traits. Recently, the implementation of herd immunity became popular among some countries. As a high school student, I am very disappointed with the idea of herd immunity following the old trend of social Darwinism, the indifference of the government in the herds and I hope people can find a way altogether solving the pandemic issue. Scientists already experienced the previous two pandemics and accumulated a lot of relative information about the control and cure of the pandemic. Based on the successful clinical trial for the Sars-CoV diseases, scientists have already made significant progress for developing treatments for the new coronavirus. As a result, I hope that the research on the virus can effectively limit the outbreak of the pandemic and we can finally overcome the virus and embrace our success.

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