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A History of Global Pandemic from 20th Century to Novel Emerging Human Corona Virus SARS-CoV-2

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Abstract

The novel corona virus SARS-CoV-2 is the seventh coronavirus known to infect humans. Severe Acute Respiratory Syndrome Corona Virus (SARS-CoV), Middle East Respiratory Syndrome Corona Virus (MERS-CoV), novel emerging corona virus and Severe Acute Respiratory Syndrome 2 (SARS-CoV-2) are highly transmissible and pathogenic viruses that emerged in humans in the 21st century. Corona viruses pose a serious threat to global health as evidenced by Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS), and corona virus disease 2019 (COVID-19) disease outbreaks caused by the causative agents SARS-CoV, MERS-CoV, and the novel SARS-CoV-2 respectively. The World Health Organization (WHO) has declared the novel corona virus outbreak a pandemic to spread a new disease worldwide. The current novel COVID-19 pneumonia pandemic, caused by the SARS-CoV-2 virus, is spreading inter-continental at an accelerated rate, with a basic reproduction number (R0) of 2-2.5, indicating that 2 persons-3 persons will be infected from an index patient. As of September 15, 2020, there are more than 28918900 confirmed cases of COVID-19 worldwide, with over 922252 related deaths and more than 4846427 corona virus confirmed cases in India, with over 79722 deaths. In this review, we offer a perspective on the notable features of the current knowledge on highly transmissible emerging pathogenic corona viruses in 21st century and historical pandemic outbreak in 20th century. As this information, can help counter measures against future spillover and pathogenic infections in humans with novel corona viruses.

Keywords: Corona virus; SARS-CoV-2; COVID-19; Pandemic; Human corona virus

Introduction

The word “virus” comes from a Latin word simply meaning “slimy fluid”. They were first described only in the 1890’s. It is a sub-microscopic pathogen that replicates only inside the living cells of an organism [1]. It cannot grow or reproduce apart from a living cell. Viruses, an extremely small piece of organic material can infect all types of life forms that cause disease in humans, animals, and plants. Viruses are found in almost every ecosystem on earth [2]. Viruses nearly about 0.02 µm-0.2 µm, the recent corona virus outbreak has triggered panic across the globe, prompting travel bans, visa restrictions and large-scale quarantines. Before the corona virus, the human race has to deal with various epidemics and pandemics across the 20th century. Throughout history many disease outbreak due to the pandemic. Herein, we have summarized major occurrences of those across history.

Case Presentation

Spanish flu (H1N1, 1918)

The history’s one of the destructive infectious disease outbreak of the Spanish flu occurred in 1918 [3]. The Spain was one of the earliest countries, where Spanish flu was identified and confirmed [4]. In fact, it seems generally accepted that the pandemic virus originated in the United States, possibly in a military camp, and was then taken *via* infected personnel travelling by troop transport, to France by April 1918. The virus spread quickly across Europe, and *via* army unit transports again to northern Russia, North Africa and India. Further spread then occurred, to China, New Zealand and The Philippines, all by June 1918. It infected about 500 million people, and killed over 50 million people across the globe.

Asian flu (H2N2, 1957)

The Asian flu pandemic of 1957 or 1957 flu pandemic was history’s second major deadliest infectious disease outbreak occurred in 1957. The 1957 outbreak of influenza pandemic caused by virus influenza a subtype H2N2 was first detected in Singapore in the same year [5]. Then virus quickly spread to China, Hong Kong, United Kingdom and later it had reached coastal areas of the United States. The rapid development of a vaccine against H2N2 virus and the availability of antibiotics to treat secondary infections limited the spread and mortality of the pandemic [6]. The Asian flu pandemic caused an estimated two million deaths across the globe.

Hong kong flu (H3N2, 1968)

The Hong Kong flu also familiar as 1968 flu pandemic was third influenza pandemic of the 20th century [7]. The flu of 1968 was a global outbreak of influenza virus that originated in China in July 1968 and lasted until 1969-1970. The virus was highly contagious, spread quickly in Hong Kong, Southeast Asia, Panama Canal Zone, United States, Vietnam, United Kingdom and countries in Western Europe. Australia, Japan, Africa, Eastern Europe and Central and South America were also affected. The pandemic was caused by the emergence of virus influenza a subtype H3N2. It is suspected that H3N2 virus evolved from a previous influenza outbreak in 1957. The Hong Kong flu 1968 pandemic was less severe than the influenza pandemic of 1918 and 1957. This is because of the persons exposed to the H2N2 virus in particular apparently retained immune protection against the H3N2 virus [8]. The Hong Kong flu pandemic caused an estimated one million deaths worldwide. The human H3N2 virus was isolated from pigs in 1990's, which may reveal symptoms of Swine flu [9].

AIDS (HIV, 1981)

Acquired Immuno Deficiency Syndrome (AIDS) is an auto-immune disease, caused by the Human Immunodeficiency Virus (HIV) that was first identified in the democratic republic of Congo in 1980's [10]. The HIV causes AIDS and interferes with the body's ability to fight infections. The virus can be transmitted through contact with infected blood, semen or vaginal fluids. The sexually transmitted virus has killed over 35 million people in the decades of its existence [11]. There is no cure exists for AIDS, but it is treatable with medicine Antiretroviral regimens (ARV's) can dramatically slow the disease's progress as well as prevent secondary infections and complications. HIV, a pandemic that is still with us and still lacks a vaccine, has killed an estimated 35 million people and infected 75 million, with more added every day.

Swine flu (Influenza virus, 2009)

The Swine flu 2009 pandemic was a recapitulate of the "Spanish flu" pandemic from 1918, but with far less devastating consequences [12]. Swine flu is caused by several types of Swine Influenza Virus (SIV) or Swine-Origin Influenza Virus (S-OIV) is any strain of influenza family of viruses as H1N1, H1N2, H2N1, H3N1, H3N2 and H2N3 virus strain, which transmitted from swine/pigs to human [13]. It started in Mexico and US in April of 2009. Later, swine flu was reported in India with over 31,156 confirmed positive cases and 1841 deaths up to March 2015. Swine flu caused an estimated that varying from 20,000 to over 500,000 deaths globally [14]. There is vaccine available to protect against swine flu [15]. The WHO declared the swine flu pandemic officially over in August 2010.

Ebola (EBOV, 2014)

The Ebola Virus Disease (EVD), commonly known as "Ebola" outbreak caused by Ebola Virus (EBOV) in late 2013. The first outbreak of Ebola was reported that 18-month-old boy from a small village in Guinea is believed to have been infected by bats [16]. After five additional cases of fatal diarrhea occurred in that area, an official medical alert was issued on January 24, 2014, to the district health officials. Later, the disease spread to neighbouring countries Liberia and Sierra Leone. The impact this epidemic had on the world, and particularly West Africa, is significant. A total of 28,616 cases of EVD and 11,310 deaths were reported in Guinea, Liberia, and Sierra Leone. There were an additional 36 cases and 15 deaths that occurred when the outbreak spread outside of these three countries. The epidemic also had a great impact on children. Nearly 20% of all EVD cases occurred in children under 15 years of age, and an estimated 30,000 children became orphans during this epidemic [17].

ZIKA (ZIKV, 2015)

Zika virus was a little known, dormant virus found in rhesus monkeys in Uganda. Zika virus (ZIKV) is a member of the virus family Flaviviridae [18]. The Zika virus, first identified in Uganda in 1947, is transmitted by Aedes mosquitoes, the same type of mosquito that carries dengue fever, yellow fever, and chikungunya virus [19]. A mosquito bites an infected person and then passes those viruses to other people it bites. Outbreaks did not occur outside of Africa until 2007, when it spread to the South Pacific. From 2007 to 2016, the virus spread eastward, across the Pacific Ocean to the Americas, leading to the 2015-2016 Zika virus epidemic. The WHO declared the end of the Zika epidemic in November 2016 [20].

Human corona virus

The name "corona virus" is derived from the Ancient Greek "korone" meaning crown, which refers to the characteristic appearance of the virus particles (virions). Corona viruses belong to the sub-family Coronavirinae (Orthocoronavirinae) in the family Coronaviridae [21]. They can be classified into four genera: Alpha (α), Beta (β), Gamma (γ), and Delta (δ) corona virus [22]. Among them, α and β-corona viruses infect mammals, γ-corona viruses infect avian species, and δ-corona viruses infect both mammalian and avian species. Scientists currently recognize seven types of corona virus that can infect humans, which alpha corona viruses include human corona virus 229E and NL63; beta corona viruses OC43, HKU1, SARS-CoV and MERS-CoV [23]. Based on nucleic acid sequence similarity, the newly identified SARS-CoV-2 is a beta corona virus (**Table 1**) [24].

Table 1: Classification of human corona virus.

Virus	229E	OC43	NL63	HKU1	SARS-CoV	MERS-CoV	SARS-CoV-2
Realm	Riboviria	Riboviria	Riboviria	Riboviria	Riboviria	Riboviria	Riboviria
Phylum	incertae sedis	incertae sedis	incertae sedis	incertae sedis	incertae sedis	incertae sedis	incertae sedis
Order	Nidovirales	Nidovirales	Nidovirales	Nidovirales	Nidovirales	Nidovirales	Nidovirales
Family	Coronaviridae	Coronaviridae	Coronaviridae	Coronaviridae	Coronaviridae	Coronaviridae	Coronaviridae
Genus	*Alpha coronavirus*	*Beta coronavirus*	*Alpha coronavirus*	*Beta coronavirus*	*Beta coronavirus*	*Beta coronavirus*	*Beta coronavirus*
Subgenus	Duvinacovirus	Beta-coronavirus 1	Setracovirus	Embecovirus	Sarbecovirus	Merbecovirus	Sarbecovirus
Species	Human corona virus 229E	Human corona virus OC43	Human corona virus NL63	Human corona virus HKU1	Severe Acute Respiratory Syndrome Corona virus	Middle East Respiratory Syndrome - related Corona virus	Severe Acute Respiratory Syndrome Corona virus 2

Human corona virus SARS (SARS-CoV, 2002)

SARS corona virus was the first outbreak in the 21st century that managed to get public attention. SARS is a severe, acute respiratory illness caused by the SARS corona virus (SARS-CoV). SARS-CoV is thought to be an animal virus from an animal reservoir, perhaps bats, that spread to other animals (civet cats) [25]. It was first infected humans in the Guangdong province of southern China in 2002 [26]. It started in China and affected fewer than 10,000 individuals, mainly in China and Hong Kong, but also in other 26 countries, including 251 cases in Canada [27].

Human corona virus MERS (MERS-CoV, 2012)

Middle East Respiratory Syndrome (MERS) is a viral severe, acute respiratory illness caused by a novel corona virus MERS-CoV was first discovered in Saudi Arabia in 2012. MERS-CoV is a zoonotic species of corona virus which infects human, bats and camel. MERS-CoV infections have been attributed to human-to-human infections, but scientific evidence suggests that Camels were a reservoir host for it. The first confirmed case was found in Saudi Arabia in 2012 [28]. MERS pandemic outbreaks have occurred in several countries, with the largest outbreaks seen in Saudi Arabia, United Arab Emirates and the Republic of Korea. The impact of this epidemic had on the world, a total of 2279 infected confirmed cases and 806 deaths across the globe according to a WHO report. Both viruses likely originated in bats, and genetically diverse corona viruses that are related to SARS-CoV and MERS-CoV were discovered in bats worldwide [29].

Human corona virus HKU1 (HCoV-HKU1, 2005)

Human corona virus HKU1 (HCoV-HKU1) is a species of corona virus which originated from infected mice. In humans, infection results in an upper respiratory disease with symptoms of the common cold, but can advance to pneumonia and bronchiolitis [30]. HCoV-HKU1 was first identified in January 2005, in a 71-year-old man who was hospitalized with an acute respiratory distress and radiolographically confirmed bilateral pneumonia [31]. The man had recently returned to Hong Kong from Shenzhen, China. Subsequent research revealed it has global distribution and earlier genesis.

Human corona virus NL63 (HCoV-NL63, 2004)

Human corona virus NL63 or HCoV-NL63 is a species of coronavirus. It was identified in late 2004 in a seven-month-old child with bronchiolitis in the Netherlands [32]. The virus originated from infected palm civets and bats. Infection with the virus has been confirmed worldwide, and has an association with many common symptoms and diseases. Associated diseases include mild to moderate upper respiratory tract infections, severe lower respiratory tract infection, croup and bronchiolitis [33]. A study performed in Amsterdam estimated the presence of HCoV-NL63 in approximately 4.7% of common respiratory illnesses. Further studies confirmed that the virus is not an emerging virus, but rather one that continually circulates in the human population.

Human corona virus OC43 (HCoV-OC43, 2006)

Human corona virus OC43 (HCoV-OC43) is a member of the species β-corona virus, which infects humans and cattle [34]. It has, like other corona viruses from genus Betacoronavirus, sub-genus Embecovirus, an additional shorter spike-like surface protein called Hemagglutinin Esterase (HE) [35]. The infecting corona virus is an enveloped, positive-sense, single-stranded RNA virus which enters its host cell by binding to the N-acetyl-9-O-acetylneuraminic acid receptor.

Human corona virus 229E (HCoV-229E)

Human corona virus 229E (HCoV-229E) is a species of corona virus which infects humans and bats [36]. The infecting virus is an enveloped, positive-sense, single-stranded RNA virus which enters its host cell by binding to the Alanine Aminopeptidase (APN) receptor. Along with Human coronavirus OC43, it is one of the viruses responsible for the common cold. The species is a member of the genus α-corona virus and sub-genus HCoV-229E transmits *via* droplet-respiration and fomites [37]. HCoV-299E is also among the corona viruses most frequently detected with other respiratory viruses, particularly with Human Respiratory Syncytial Virus (HRSV) (**Table 2 and Figure 1**).

Table 2: History of diseases and deaths from its worldwide.

Virus	Year	Disease	Infected cases	Deaths
SARS-CoV-2	2019	COVID-19	28918900	922252
SARS-CoV	2003	-	8098	774
MERS-CoV	2012	-	2519	866
HCoV-229E	1960	-	8089	774
H1N1	2009	Swine flu	1, 63, 271	18449
H2N2	1957	Asian Flu		1.1 million
H3N2	1968	Human Flu	180000	1 million
ZIKV	1947	Zika	174667	18
EBOV	1976	Ebola	286616	11325
HIV	1959	Aids	37.9 million	7, 70, 000

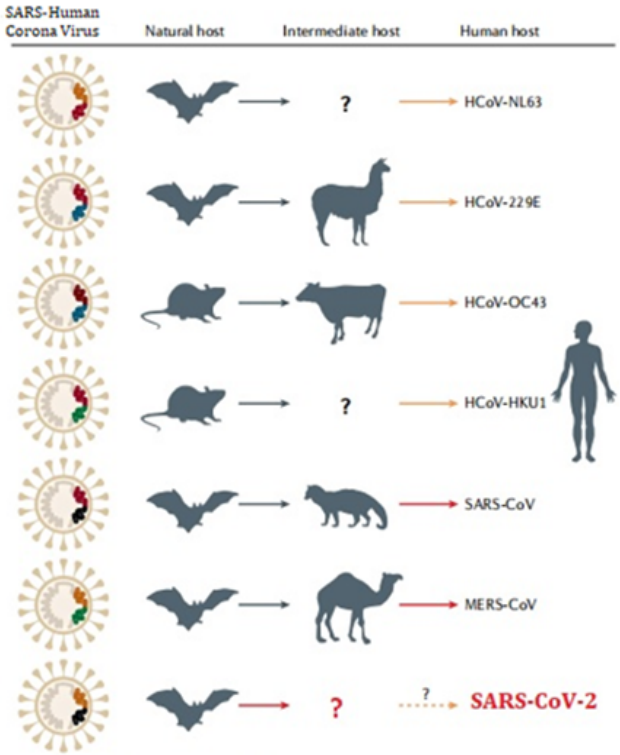

Figure 1: Animal origin of human coronaviruses.

Novel pneumonia COVID-19 (SARS-CoV-2, 2019)

At the end of 2019, a novel corona virus was identified as the cause of a cluster of pneumonia cases in Wuhan, a city in the Hubei Province of China [38]. It rapidly spread, resulting in an epidemic throughout China, followed by an increasing number of cases in other countries throughout the world. The World Health Organization (WHO) has declared the novel corona virus outbreak a pandemic, causes corona virus disease (COVID-19), a Public Health Emergency of International Concern. COVID-19 is an acute, sometimes severe respiratory illness caused by a novel corona virus Severe Acute Respiratory Syndrome Corona Virus-2 (SARS-CoV-2). The pathogen responsible for this pandemic is a new corona virus designated earlier 2019-nCoV and later SARS-CoV-2 by the WHO. The clinical manifestations of COVID-19 are protean, which include asymptomatic carrier, ARD, and pneumonia of varying degrees of severity. A mysterious pneumonia illness (COVID-19) was first reported in late December 2019 in Wuhan, Hubei province of Central China and has extensively spread in China, Italy, Spain, USA, France, United Kingdom, India and worldwide [39]. These corona viruses that cause severe respiratory infections are zoonotic pathogens, which begin in infected animals and are transmitted from animals to people. Scientists have isolated the virus from patients and determined its genetic code. SARS-CoV-2 belongs to the same family of viruses as the well-known corona virus SARS CoV and MERS CoV, which have killed thousands of people in the past 18 years [40].

Epidemiological data indicate that the virus can cause a wide spectrum of clinical disease (mild-to-severe illness), including death, and spreads through direct contact and droplets. It is estimated that 5 days-6 days (range 2 days-14 days) for the incubation period and 2.2-3.6 for the reproduction rate. In the World Health Organization, European Region, Rome, Paris, London, Istanbul, and Moscow have direct flights to Wuhan, China, and the risk for importation was considered high. SARS-CoV-2 was reported to have been introduced into Europe by a person from France who had traveled to Wuhan, China, for work, became ill on January 16, and returned ill to France on January 22. We report a cluster of illness in a tour group from Wuhan that predates this case detection and led to subsequent transmission in Europe. SARS-CoV-2 was reported to have been introduced into Europe by a person from France who had traveled to Wuhan, China, for work. It infected more than 16,00,000 people worldwide and killed at least 95,100.

Structure and family

Like other corona viruses, SARS-CoV-2 particles are spherical to pleomorphic enveloped particles and have proteins called spikes protruding from their surface. These spikes latch onto human cells, then undergo a structural change that allows the viral membrane to fuse with the cell membrane [41]. The viral genes can then enter the host cell to be copied, producing more viruses. Recent work shows that, like the virus that caused the 2002 SARS outbreak, SARS-CoV-2 spikes bind to receptors on the human cell surface called Angiotensin-Converting Enzyme 2 (ACE2). The subfamily Coronavirinae is subdivided into four genera on the basis of genetic and serologic properties. The subfamily Coronavirinae is subdivided into four genera on the basis of genetic and serologic properties.

How corona virus spreads

Many viruses cause diseases in human beings. Corona viruses invade the respiratory tract *via* the nose. After an incubation period of about 3 days, they cause the symptoms of a common cold, including nasal obstruction, sneezing, runny nose, and occasionally cough [42]. Droplets resulting from cough or sneezes of an infected person are either inhaled directly or transmitted through contaminated objects such as pens, books, cups, doorknobs, computer keyboard or mouse, etc., and cause infection in a healthy person. It also spread through by touching a contaminated surface (blanket or doorknob), saliva (kissing or shared drinks), and skin-to-skin contact (handshakes or hugs).

Early COVID-19 cases were linked to a live animal market in Wuhan, China, suggesting that the virus was initially transmitted from animals to humans. Person-to-person spread occurs through contact with infected secretions, mainly *via* contact with large respiratory droplets, but it could also occur *via* contact with a surface contaminated by respiratory droplets. Super-spreaders played an extraordinary role in driving the 2003 SARS outbreak and may also play a significant role in the current COVID-19 outbreak [43]. A super-spreader is an individual who transmits an infection to a significantly greater number of other people than the average infected person.

With the corona virus spreading rapidly around the world, people have raised concern about whether it can pass from pets to people. The investigation in cat, dog, pig, chickens and ducks identified no viral RNA in animals deliberately inoculated with the virus, or in those exposed to the inoculated animals [44]. These findings suggest that none of the species plays a part in the epidemiology of COVID-19. But, US centers for Disease Control and Prevention recommends that precautionary advised to the people with COVID-19 limit contact with their pets.

Mode of action

SARS-CoV-2 shares between 80% and 90% of its genetic material with the virus that caused SARS. Both consist of a strip Ribonucleic Acid (RNA) inside a spherical protein capsule that is covered in spikes [45]. The spikes lock on to receptors on the surface of cells lining the human lung. The same type of receptor in both cases allowing the virus to break into the cell. Once inside, it hijacks the cell's reproductive machinery to produce more copies of itself, before breaking out of the cell again and killing it in the process.

Symptoms and signs

People with COVID-19 may have few to no symptoms, although some become severely ill and die. Symptoms can include fever, cough, and shortness of breath. Those with more severe disease may have lymphopenia and chest imaging findings consistent with pneumonia. Clinicians should use their judgment as to whether a patient's symptoms and signs are compatible with COVID-19 and whether they should be tested. Decision to test should also take into account the local epidemiology of COVID-19, the course of illness, and the patient's epidemiologic factors such as close contact with a confirmed COVID-19 case within 14 days of symptom onset or history of travel to an affected geographic area within 14 days of symptom onset.

Discussion

Diagnosis and treatment: Control and prevention

Quarantine and isolation measures are being applied in an attempt to limit the local, regional, and global spread of this outbreak. The COVID-19 virus infects people of all ages. However, evidence to date suggests that two groups of people are at a higher risk of getting severe COVID-19 disease. These are older people; and those with underlying medical conditions. The WHO emphasizes that all must protect themselves from COVID-19 in order to protect others. Treatment of COVID-19 is supportive. There is no specific antiviral drug treatment has been confirmed to be effective against COVID-19. To help prevent spread from suspected cases, health care practitioners should use standard, contact, and airborne precautions with eye protection [46]. There are six clinical trials registered in both the International Clinical Trials Registry platform and the Chinese Clinical Trial Registry to evaluate the efficacy or safety of targeted medicine in the treatment or prognosis of COVID-19. A series of measures have been suggested to reduce nosocomial infection, including knowledge training for prevention and control, isolation, disinfection, classified protections at different degrees in infection areas, and protection of confirmed cases. Concerning psychological health, some suggested psychological intervention for confirmed cases, suspected cases, and medical staff. The best prevention is to avoid being exposed to the virus airborne precautions and other protective measures have been discussed and proposed for prevention. Infection Preventive and Control (IPC) measures that may reduce the risk of exposure include the following: Use of face masks; covering coughs and sneezes with tissues that are then safely disposed of (or, if no tissues are available, use a flexed elbow to cover the cough or sneeze); regular hand washing with soap or disinfection with hand sanitizer containing at least 60% alcohol (if soap and water are not available); avoidance of contact with infected people and maintaining an appropriate distance as much as possible; and refraining from touching eyes, nose, and mouth with unwashed hands. According to the WHO guideline, on the use of face

masks in the community, individuals with respiratory symptoms are advised to use medical masks certified N95 or FFP2 both in health care and home care settings properly following the infection prevention guidelines. An individual without respiratory symptoms is not required to wear a medical mask when in public. Proper use and disposal of masks is important to avoid any increase in risk of transmission.

Conclusion

In late 2019, the first reports of an unknown respiratory infection in some cases fatal emerged from Wuhan, China. The source of that infection was quickly identified as a novel corona virus, related to those that had caused outbreaks of Severe Acute Respiratory Syndrome (SARS) from 2002-2004 and Middle East Respiratory Syndrome (MERS) in 2012. Corona virus is one of the deadliest transmissible viruses in recent history. There are no specific treatments for corona viruses, but symptoms can be treated. Every day lost in effective response means the looming danger of a surge in infections. India spends a paltry 1.28% of its GDP on health care, and that may begin to bite if there's a full-blown outbreak. The corona viruses typically cause respiratory symptoms. So we recommend basic hand hygiene, such as washing your hands with soap and water and respiratory hygiene, such as when you sneeze, sneezing into your elbow. Ways to protect yourself against a potential animal source would be to avoid unnecessary unprotected contact with live animals and to make sure that you wash your hands thoroughly after contact with animals and also to make sure your meat is cooked thoroughly before consuming. Lessons learned from past outbreaks can be applied to prevent or minimize the impact of future outbreaks locally and globally.

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