



## Human Resilience-a study of pandemics

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### ABSTRACT

COVID 19 has changed the way people live and die. It has led to great uncertainty and stress. No one knows if and when they will be free from this pandemic. Lifestyles have changed a lot including the way people interact and their sense of security. Both the Plague and Spanish Flu left an impression on the world. It is believed that the disease will not be as fatal as the Black Death but how will coronavirus pandemic shape the course of human history is yet to be seen. Currently the society is in shock from the effects of the pandemic. When the Plague hit Europe, the society was used to fatality among children. When people thought that pandemics were interred in history, coronavirus struck. Pandemics have attacked us several times in the past but could not obliterate the resilient human spirit. We survived and will survive again. In this article we have attempted to explore past pandemics and COVID-19 along with their origin, incidence, consequences and survival.

**Keywords:** The Black Death, Small pox, Spanish flu, Influenza virus, COVID-19

### INTRODUCTION

A pandemic is an infectious disease that is prevalent over a whole country or the world affecting vast number of people. A disease that widespread but limited to a set of population or is not infectious is not a pandemic. It affects huge portions of the world or the whole world.

The history of mankind is fraught with pandemics like smallpox, plague, dengue, cholera, influenza, AIDS, SARS, tuberculosis and West Nile disease. These diseases affected the entire world. Influenza pandemics [1, 2, 3] are unpredictable but recurring events that can have severe consequences on societies worldwide. At a human life toll of 75 to 200 million, the Black Death (or the Plague) was the deadliest pandemic in human history that swept the world in the 14<sup>th</sup> century.

The influenza pandemics have a history of striking every 10 to 50 years. It attacked many times in every hundred years since the 16<sup>th</sup> century. There have been three major influenza pandemics- Spanish Flu (1918-1919), Asian Flue (1957-58) and Hong Kong Flu

(1968- 1969). These struck severe blow to human life and economic activities. Spanish Flu alone killed more than 50 million people worldwide and has been the most dangerous pandemic, [4, 5]

Recent years have seen several outbreaks- Hantavirus pulmonary syndrome, SARS, H1N1, H5N1, Middle East respiratory syndrome, and Ebola. These outbreaks have set off alarm bells for governments and researchers who fear Spanish Flu like damage.

Infectious disease disasters, including pandemics and emerging infectious disease outbreaks, have the potential to cause high morbidity and mortality in the world, and in fact they may account for a quarter to a third of global mortality, [6, 7, 8, 9, 10, 11, 12, 13]. In developing countries, both pandemics and infectious diseases have the potential to kill many lives, and the likelihood of deaths is within the range of 5 to 10 percent, [14]. Pandemics have infected millions of people, causing wide-spread serious illness in a large population and thousands of thousands of deaths.

Beyond the rising death toll these disease outbreaks have easily crossed borders to threaten economic and regional stability, [15]. Beyond the debilitating, sometimes fatal, consequences for those directly affected, pandemics have a range of negative social, economic and political consequences, [16]. The impact of pandemic is not just on mortality, but also on health-care systems, animal health, financial sector, agriculture, education, transport and tourism. In short, a pandemic event frightens all aspects of the economic and social aspect of human life. Life quality of families and communities has been reduced and all essential services are disturbed.

People travel between countries like they once did between villages. Our world is a much smaller place now with highly integrated economies and communities. Given this scenario, viruses travel with amazing speed putting us at higher risk. With increased pressure of population, cities have expanded and are densely packed, [17]. These are perfect conditions for spread of pandemics, [18, 19, 20, 21, 22].

Human behaviour leads to both spread and control of pandemics. Measures like covering the mouth while coughing or sneezing, hand hygiene, social distancing and vaccination contribute to control pandemics and lack of these leads to the spread. Here we give timeline of some of the deadliest pandemics that changed the history.

## 2. The Black Death: The Greatest Disaster Ever

“When the alive were insufficient to bury the dead”, [23]. The expression Black Death is itself ominous and points to some great disaster. This disastrous disease swept across Europe during the period 1346 to 1353. The freighting disease compelled most people to carry the burden of the dead. They would dig deep trenches in which the corpses would be bundled up and thrown and covered with some soil. The next group of bodies would then form the layer above the previous one. **Figure 1** shows the layering of skeletons.



**Figure 1: Pile of skeletons during Black Death pandemic**

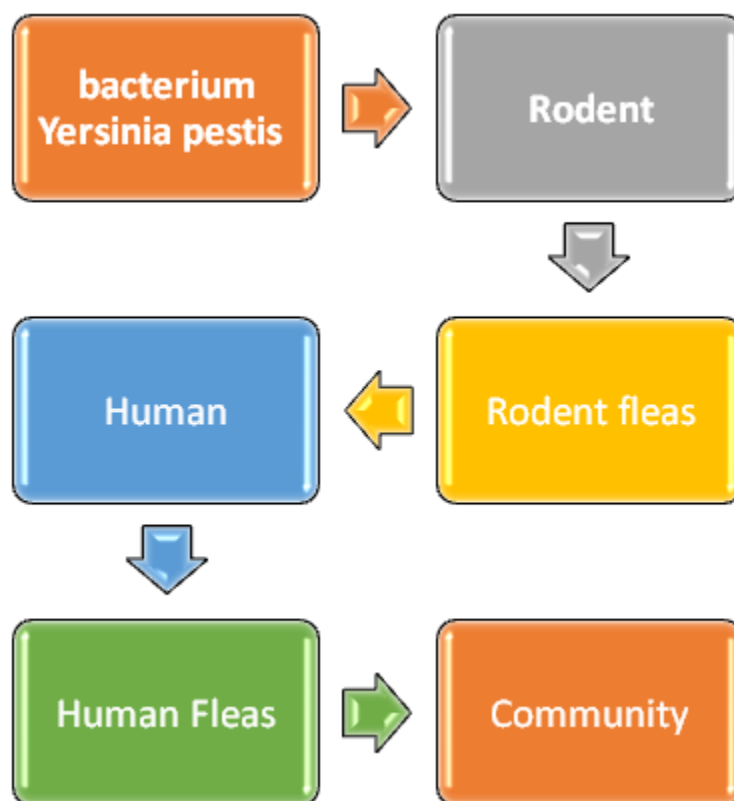
### 2.1 Cause and Transmission

The Black Death, one of the most catastrophic events in human history and was caused by the epidemic of bubonic plague. This disease is caused by the bacterium *Yersinia pastis* that is prevalent in large

colonies of wild rodents. Such an infected colony is called ‘plague focus’. The plague spread across oceans by ships infested by rats and rat fleas, [24, 25]. These fleas would take up new host rats at ports when the previous ones died. Not just that, these fleas ride the host rats as they move from house to house

infecting all that came in their way- from homes to clothing's to entire neighborhoods. This growth pattern resulted in fast and widespread distribution with humans, rats and fleas being the carriers. The escapee from a plague-stricken town or area arriving in various communities became carrier of plague in

other regions. This pattern of spread was called 'metastatic spread'. Thus, plague soon broke out in other urban and rural centres from where the disease spread into villages and townships of the surrounding districts by a similar process. **Figure 2** shows flow chart of Black Death:



**Figure 2: Flow chart of Black Death**

## 2.2 Symptoms

After the bite, the infection moved to a lymph node which developed as swelling and then into buboes mostly in the groin area, thighs, armpits or neck. Symptoms were mostly headaches, fever and vomiting. Hence the name bubonic plague. The incubation period was three to five days. In most cases death would occur in another three to five days.

## 2.3 Impact on Population

This Black Death pandemic finds its origin about 2000 years ago in China and from there it went to Mediterranean region including Europe killing as

much as 60% of the population. Consequently, the world population probably fell to 350 from 450 million.

The Black Death is thought have destroyed 30% to 60% of Europe's population. In the course of just a few months, 60 per cent of Florence's population died from the plague, and probably the same proportion in Siena. Approximately 50% of China's population perished, while Europe's went down by a third and Africa by an eighth. Figure 3 depicts approximate death toll of Black Death using Pie-chart:



Approximate Death % due to Black Death

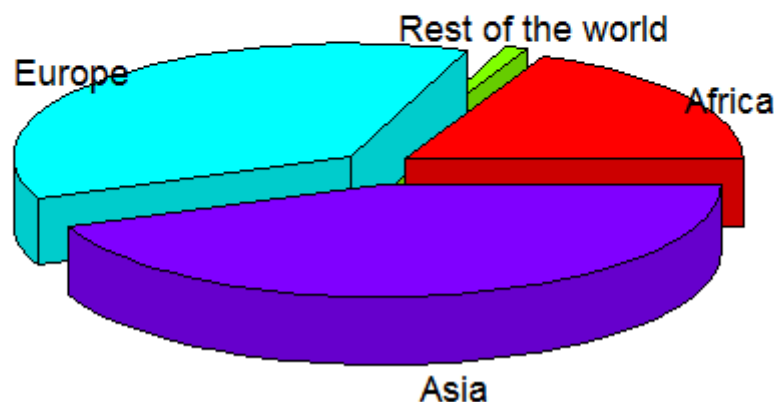


Figure 3: Pie-chart of approximate death toll of Black Death

## 2.4 End of Black Death

The implementation of quarantines played a major role for the end of plague. The uninfected persons stayed in their homes and only left when it was necessary. The people who could afford left the densely populated area and preferred to live in isolation.

Pandemic also forced improvements in personal hygiene. The practice of cremations rather than burials due to the sheer number of bodies was also done.

## 3. Smallpox

Smallpox [26,27] has been the one of the deadliest diseases of all times that annihilated civilizations and changed the world killing vast population. The disease no longer exists but when it raged it killed 30% of the infected people many of whom were children. The survivors were usually left with scars for life, [28] and in some cases even blindness but got lifelong immunity. English physician Edward Jenner was responsible for the small pox vaccination making it the first disease that was controlled by vaccination.

### 3.1 Cause and Transmission

Smallpox was a severe contagious disease that was caused by variola virus part of the Orthopoxvirus family. There has been no evidence of any natural carriers in animals or natural spreading outside the human body. It spreads by direct contact with infected people, body fluids, or contaminated objects. The disease was of two types- Variola Major and Variola minor. The first was more common and more dangerous and resulted in more deaths. Variola Minor resulted in a milder condition resulting in fatality of less than 1 % of cases.

### 3.2 Symptoms

Smallpox or variola major was an acute infectious disease that started with high grade fever, headache, and back ache. It then resulted in eruptions on the skin that left face and limbs covered with pockmarks or pox. The incubation period lasted 12 to 14 days followed by sudden onset of influenza type symptoms like fever, malaise, headache, prostration, severe back ache and sometimes abdominal pain and vomiting. Two to three days later rashes appeared on face and limbs and also on the trunk after a few days. Lesions also appeared in the mucous membranes of nose and mouth followed by ulcerates releasing large amounts of virus into the mouth and throat.

### 3.3 Impact on Population

Smallpox, which is believed to have originated over 3000 years ago in India or Egypt, was one of the deadliest diseases known to mankind. The first evidence of smallpox can be found during the time of Egyptian Pharaoh Ramses V who died in 1157 B.C [29]. His mummified body indicate pockmarks on his skin. Smallpox appeared in almost in century. The patterns of transmission usually followed the migration routes of the people. During the middle age's smallpox spread to Europe from Asia and Africa. From there it went to the Americas with Spanish colonists in the fifteenth and sixteenth centuries. It is believed that more Aztec and Inca population was killed by smallpox than the Spanish conquerors thereby eliminated those empires (Smallpox national). Smallpox continued to create havoc in Europe, Asia, and Africa for centuries. Towards the end of the eighteenth century, almost 400,000 people succumbed to the disease every year in Europe alone and that included five kings. One-third of the survivors were blinded. The worldwide death numbers were massive and the situation continued into the twentieth century.

### 3.4 End of Smallpox

Small pox has a unique place in medicine history. It is one of the deadliest diseases annihilated by vaccination. Before vaccination several techniques were used to cure people. A healthy person was made immune to smallpox by being injected with pus taken from the sores of an infected person for centuries in Southwestern Asia. Grinding the scabs of a smallpox victim and blowing the powder through a tube into the nose of a healthy person was another plan of attack on this virus practiced in China. People immunized in this way suffered a fleeting illness themselves and were contaminated for a period. Few persons got serious infection and died; but this for sure affected the risk of dying in a smallpox epidemic by reducing mortality approximately 2 percent, as compared with 20 to 30 percent. In the late 18th-century, a British doctor Edward Jenner observed that milkmaids infected with a milder virus called cowpox seemed immune to smallpox and he was right. His discovery almost took two more centuries to benefit mankind. Following a successful vaccination program Smallpox virus was declared eradicated in 1980 after a final outbreak in the

United States in 1949. It was one of the greatest achievements of medical science, [30, 31].

### 4. The Influenza Pandemic of 1918

The other pandemic that traumatized the entire world was Influenza, also known as Spanish flu. "Spanish Flu" or "La Grippe" the influenza of 1918-1919 was a global disaster and cited as the most desolating pandemic in world history. Somewhere about 50 million people were killed by this pandemic, which were more than the World War I (WWI). It is being said that this pandemic took more lives in a single year than in four-years of the Black Death from 1347 to 1351.

Spain was not origin of this disastrous pandemic, in fact was the only country that covered the outbreak from the beginning. Spanish media was given liberty. During World War I Allied countries and the Central Powers had wartime censors who hid news of the flu for their self-esteem. Spain was the only country reporting on the flu that time therefore it is believed that the Influenza came into existence here.

The increasing number of corpses flooded beyond the capacity of coffin makers, gravediggers and undertakers, [32]. It was gruelling task to bury the dead, where cremation was an uncommon practice. Not only lives suffered, dead humans could not gain last homage. Ban on public gatherings for funeral compounded the pain of many families who could not even mourn their loved ones. Rising death toll became burden for graveyards. Gravediggers either had contracted the flu or were afraid that they would, resulted in their deficit. Mourning families dug tombs for their loved ones.

### 4.1 Cause and Transmission

Influenza (Flu) is infectious respiratory illnesses. It was caused by an H1N1 virus with genes of avian origin. In the fall of 1918, the highly contagious wave of influenza appeared. However, during the second wave the disease was with vengeance by much more power, convoluted by bacterial pneumonia, which was the main cause of death. Before the doctors could understand or treat the victims, they died within hours or days while developing symptoms. The average life expectancy in America dropped by a dozen

years in just a single year. The medical science was scandalized and helpless against this powerful agent of influenza.

## 4.2 Symptoms

During the first wave, the typical flu symptoms of headache, sore throat and fever were experienced by the patients. In second wave it was complicated by bacterial pneumonia, which was the main cause of death. This more serious type caused heliotrope cyanosis to develop, whereby the skin first developed two mahogany spots over the cheekbones which then spread to colour the entire face blue in few hours, followed by black coloration first in the extremities and then further spreading to the limbs and the torso. After this, lungs were filled with fluids followed by death within hours or days. Spontaneous mouth and nosebleeds, a peculiar smell, delirium, dizziness, insomnia, teeth and hair falling, loss of hearing or smell, blurred vision, and impaired colour vision, miscarriages for pregnant women were other symptoms reported. The most dangerous complication was haemorrhage from mucous membranes, especially from the nose, stomach, and intestine. Bleeding from the ears and petechial haemorrhages in the skin also occurred.

## 4.3 Impact on Population

There is no authentication for where the Spanish Flu originated. Theories point to France, China, Britain, or the United States, where the first known case was reported at Camp Funston in Fort Riley, Kansas, on March 11, 1918, [33]. It is believed that some infected soldiers spread the disease to other military camps across the country, then brought it overseas. In March 1918, 84,000 American soldiers went across the Atlantic and were accompanied by 1,18,000 more the following month. It was fall of 1918, the Great War in Europe was curving down and peace was taking place. The Americans had helped in the fight, bringing the Allies closer to victory against the Germans. Nothing could be worse than that these soldiers lived deep within the trenches through some of the most brutal conditions of life. In the spring of 1918, the “War to End All Wars”. At the same time, a new global threat emerged and became one of the most devastating global health crises in recorded history, [34]. This common cold stirred the entire

globe. The influenza of that season, however, was far more than a cold. This viral disease [35] ruined the earth within a year. A fifth of the world's population was infected. The flu was more dangerous for people ages 20 to 40. This pattern of distress was unusual for influenza which is usually a killer of the young children and elder persons. It poisoned 28% of Americans. Approximately 6,75,000 Americans died of influenza during the pandemic, this figure was ten times as many as in the world war. Of the U.S. soldiers who died in Europe were not killed only by enemy, in fact half of them became victims of the influenza virus. Around 43,000 servicemen mobilized for WWI died of influenza. In total 1918 was a year of misfortune, sufferings and deaths.

## 4.4 End of Influenza

The flu pandemic came to an end by the summer of 1919. Infected persons either died or developed immunity. Social distancing played major role in flattening curve. In 1918, the studies found, the key to flattening the curve was social distancing. Researchers and health workers in the United States and Europe were confidently coming up with vaccines and immunizing hundreds of thousands of people in what amounted to a medical experiment on the grandest scale.

## 5. HN Variants

Hunger of Spanish flu was not over. With many convoluted variants influenza shocked the entire world almost in every 10 to 50 years and still spreading its terror. Russian flu had already targeted mankind in 1889-1890. After destroying the world in 1918 by Spanish flu influenza came in the form of Asian flu [36], Hong Kong Flu, Bird flu [37] and Swine flu [38]. Flu pandemics usually came in waves. These pandemics killed tens of millions and sickened hundreds of millions. The loss of many people in the population caused turbulence and psychological damage to many people. In that time there were not enough doctors, hospital rooms, or medical supplies for the living as they contracted the disease. Dead bodies were often left unattended and ignored as few people were available to deal with them. Psychologically people were so disappointed that they lost the credibility of those in authority, they believed that they had no one to turn on, no one to rely on.

## 5.1 Cause and Transmission

Influenza virus subtypes are labelled HN based upon the antigenic properties of two surface glycoproteins: hemagglutinin (H) and neuraminidase (N), which promote and coordinate host cell entry and exit, respectively. 18 H subtypes and 11 N subtypes for a theoretical total of 198 strain variations are identified by The United States Centers for Disease Control and Prevention. However, only H1, H2, and H3 are known to have achieved substantial human-to-human transmission. H4 to H9 represents for bird to human transmission which is possible in case of bird flu and its variants.

Within the past 150 years, six pandemics have resulted from the emergence of a novel influenza strain for which humans possessed little or no immunity: possibly H2N2 Russian flu (1989), the H1N1 Spanish flu (1918), the H2N2 Asian flu (1957), the H3N2 Hong Kong flu (1968), the H5N1 bird flu (1997) and the H1N1 swine flu (2009).

Influenza virus may be transmitted among humans in three ways: (1) by direct contact with infected person; (2) by contact with contaminated objects; and (3) by inhalation of virus-laden aerosols. The actual mode of transmission of influenza of these is still not known or confirmed.

## 5.2 Symptoms

It is a contagious viral infection that attacks respiratory system. In all of the flues, it is common that the infection takes three–five days to incubate in people before they fall ill, and another three–five days before, in 80 per cent of the cases, the victims die. Common symptoms of infection can be confused with other conditions. While in some milder cases the flu can resolve on its own without significant symptoms, severe cases of influenza can be life-threatening. Unlike a common cold, the flu typically occurs with a sudden onset of symptoms. Various flues had their own symptoms.

### 5.2.1 Russian flu symptoms

Symptoms are fever /chills, cough or sore throat, runny or stuffy nose, headache, feeling very tired, sore or aching muscles, vomiting, diarrhoea etc.

### 5.2.2 Asian flu symptoms

Asian flu symptoms are similar to many other strains of influenza, like fever, body aches, chills, cough,

weakness, and loss of appetite. It causes many of the symptoms commonly reported in an influenza virus.

### 5.2.3 Hong Kong flu symptoms

In this flu symptoms lasted four to five days, and in some cases up to two weeks. The infection caused upper respiratory symptoms typical of influenza, including chills, fever, muscle pain and weakness.

### 5.2.4 Bird flu symptoms

The main symptoms of bird flu appeared very quickly. Very high temperature or feeling hot or shivery, aching muscles, headache, cough is early noticeable.

### 5.2.5 Swine flu symptoms

The signs and symptoms of swine flu are similar to those of infections caused by other flu strains. It includes fever (but not always), chills, cough, sore throat, runny or stuffy nose, watery, red eyes, body ache and headache.

## 5.3 Impact on Population

Pandemics have given a huge loss in human lives and frequent waves of HN variants flu have major contribution in it. In the winter of 1889, Russian flu started from Russia and spread by rail and sea across Europe and North America. As per [39], nearly everybody was sick and the disease was almost universal. With an estimated fatality rate in the range of 0.1%–0.28%, the outbreak killed about one million people globally that time.

In 1957 [40] all seemed initially quiet on the UK influenza front. In February 1957, a new influenza strain alarmed the Yunnan Province of China. Humans had no immunity to this H2N2 strain. This Asian flu virus first attacked Hong Kong in April, then spread to Singapore, Taiwan, and Japan before infecting globally throughout the summer of 1957(CDC). Around 2 million people died due to this virus.

After a decade, the Asian flu strain underwent an antigenic shift. Reassorting to H3N2 it emerged as a new pandemic known as the Hong Kong flu. The strain was milder than the Asian flu but was highly transmissible. It was first reported in Hong Kong in July 1968, its spread was driven in part by Vietnam War veterans returning to the United States. The infection affected the United States and Japan in



August; England, Wales, and Australia in September; Canada in December; and France in January 1969. Around 1 million casualties happened due to this pandemic worldwide.

Then this virus shifted to animals specially birds. In 1997, world faced the problem of bird flu (H5N1) and its variant are still coming regularly. It has killed 50,000 people worldwide till now.

Swine flu caused by the novel H1N1 virus, likely emerged from Mexico in April 2009. It was first

recorded in almost simultaneous outbreaks in Mexico and the United States. The disease had spread across 30 countries within a week. On 11 June 2009, the WHO declared a global influenza pandemic. More global trading and travelling allowed swine flu to spread as widely in six weeks as past pandemics had in six months. By July, infection was reported in 122 countries. Total death recorded till pandemic stop (vaccine discovered) was more than 1,51,700.

The type of influenza virus, type and death comparison has been given below in tabulated form, see **table 1**.

SI. NO.	PANDEMIC INFLUENZA	OUTBREAK-FINISH TIME	DEATH TOLL	SUBTYPE INVOLVED
1	Russian Flu	1889–1890	1 million	possibly H2N2
2	Spanish Flu	1918–1920	50 million	H1N1
3	Asian Flu	1957–1958	1.5 to 2 million	H2N2
4	Hong Kong Flu	1968–1969	1 million	H3N2
5	Bird Flu	1997-Continue	over 50,000	H5N1 other variants also available
5	Swine Flu	2009–2010	over 1,51,700	novel H1N1

**Table 1: Table for types of influenza and death toll**

#### 5.4 End of HN Variants

A vaccine probably was not available in the initial stages of population infection. Then people were encouraged to maintain social distancing, focusing on personal hygiene, frequent hand wash and wearing mask. All flu epidemics disappeared or changed its type or transmitted in animals when the vaccines were available for world society. The influenza virus continuously mutated, passing through humans, pigs and other mammals. The pandemic-level virus turned

into just another seasonal flu. Still the world is facing challenges with the many HN variants.

#### 6. Coronavirus (COVID-19)

The COVID-19 pandemic is among the deadliest infectious diseases to have emerged in recent time. The current coronavirus disease 2019 (COVID-19) outbreak strongly shows the burden that respiratory infectious diseases force in an intimately connected world. Unprecedented containment and mitigation policies have been implemented in an effort to limit



the spread of COVID-19. Travel restrictions, screening and testing of travellers, isolation and quarantine, and school closures have changed day to day life. This newly emerged CoV is giving a high threat to global public health. The current emergence of COVID-19 is the third CoV outbreak in humans over the past 20 years. It is the time of global health crisis and the greatest challenge the current era is facing. The continuously increasing number of confirmed cases globally indicating higher transmission competence. Novel coronavirus pandemic has not only affected health and economy but also triggered the final journey of humans. This is the time of misfortune that there is no dignity even in death for COVID-19 victims. While losing a loved one to the disease caused by the pandemic is tragic enough, it is even more heart wrenching for the family and relatives are not being able to give the dead a dignified farewell. The accelerating death toll of COVID-19 is also facing the problem of overcrowding at the city's crematoriums, with grieving families waiting for hours in long queues outside crematoriums, at times only to be asked to return. The second wave of the pandemic came as a deadly blow to India. Elsewhere in the world it was not that bad. The medical infrastructure has been unable to cope with the gravity of the situation. Severe shortage of hospital beds and oxygen has been seen throughout the country. Experts have predicted that a third wave is not far. The entire world is buzzing with uncertainty and questions: How long will the pandemic last? What will people's lives look like once the pandemic is over [41]?

### 6.1 Cause and Transmission

Coronaviruses is large, enveloped, single-stranded positive-sense RNA viruses named after their corona or crown-like surface projections observed on electron microscopy that correspond to large surface spike proteins [42]. It is found in humans and other mammals, such as dogs, cats, chicken, cattle, pigs, and birds. Coronavirus attacks respiratory system and also causes gastrointestinal, and neurological disease. With a diameter of 60 nm to 140 nm SARS-CoV2 has distinctive spikes, ranging from 9 nm to 12 nm, giving the virions the appearance of a solar corona. We have not overcome of this situation till now. A new study has suggested that the SARS-CoV2, the virus that causes COVID-9, might have originated from a recombination of coronavirus in bats and

pangolins. The findings strengthen the theory that pangolins could be the intermediate host for transmission of SARS-CoV2 to humans. Pangolin and bat are both night time animals. They eat insects, and share overlapping ecological niches which make pangolins the ideal intermediate host for some SARS related coronaviruses.

Study indicates that droplets expelled during face-to-face exposure during talking, coughing, or sneezing is the most common mode of transmission. Prolonged exposure to an infected person being within 6 feet for at least 15 minutes and briefer exposures to individuals who are symptomatic are associated with higher risk for transmission, while brief exposures to asymptomatic contacts are less likely to result in transmission. Contact surface spread as touching a surface with virus on it, is another possible mode of transmission. The second wave of the pandemic has shown that transmission also occurs via aerosols (smaller droplets that remain suspended in air).

### 6.2 Symptoms

Coronaviruses vary significantly in risk factor. Some can kill more than 30% of those infected, such as MERS-CoV, and some are relatively harmless, such as the common cold. Coronaviruses can cause colds with major symptoms like chills, cough, fever, shortness of breath or difficulty breathing, sore throat, congestion or a runny nose, fatigue, headache, muscle pain, loss of taste or smell, nausea or vomiting, diarrhoea. Although this pandemic is not showing mercy to any particular age group but at its first peak people aged 65 years or older, people living in nursing homes or care facilities, people of any age who have serious underlying medical conditions, including chronic lung disease, serious heart conditions, severe obesity, a compromised immune system, or diabetes had a higher risk of developing serious illness. At the second wave in India the pandemic started affecting younger people. It is predicted that the third wave could result in complications in young children.

### 6.3 Impact on Population

The new coronavirus was first reported in Wuhan, China, in the month of December 2019. The infectious respiratory disease has spread rapidly within China and to neighboring countries and beyond. The first confirmed coronavirus cases

outside China occurred on January 2020, in Japan, Thailand and South Korea. On January 21, 2020 the first case in the U.S. was identified in Washington State. On January 24, the first two European cases were confirmed in France. By February 1, eight European nations had confirmed cases of COVID-19, and a month later that count had risen to 24 countries with at least 2,200 cases, most of them in Italy. On March 11, Italy eclipsed 10,000 cases and the World Health Organization declared the outbreak a pandemic — the first since H1N1 in 2009. That is also when China, the original epicenter, began seeing drops in daily counts of new cases. 235 Countries and Territories around the world have reported a total 157897763 of confirmed cases of the coronavirus that originated from Wuhan, China, and a death toll of 3287082, [5].

#### 6.4 End of COVID-19

Doctors and scientists are scrambling to find treatments and drugs that can save the lives of infected people and perhaps prevent infection. Due to the urgency posed by the pandemic, vaccines were developed urgently make them available as soon as possible. Vaccines are the best hope for ending COVID-19. It is not accurately known what level of protection can be reached with the vaccines in development. All over the world drug makers and research centres are working on COVID-19 vaccines. Several vaccines have been developed in a few countries and many are in clinical trials. India has also developed two vaccines and testing more. Several countries have authorised emergency use of these vaccines. Evidence shows that these vaccines are safe and effective. Reasonably effective vaccines, together with other public health measures and therapeutic treatments, will be a key component in overcoming COVID-19.

#### 7. Discussion

There are numerous records of pandemics in history that have left devastating impact on health, security and economy. With pandemics and epidemics there have been seemingly endless wars, [43]. Despite that the term “pandemic” is not a well-defined medical concept and it keeps on changing and evolving. We are, however, clear about these key features of pandemics- wide geographic spread, severity, novelty, high incidence of infection, explosive attacks and almost no human immunity.

The consequences of the pandemic have been disastrous characterised by millions of infections, serious illness and more than a million deaths till date. This has also led to serious threat to the world economy. Economic activities came to an almost stand still as the pandemic raged across the world. The immediate consequences were shutting down of business, loss of jobs and earnings and increase in direct and indirect costs. The impact of this would be felt even in the long run as economies try to recover lost ground. Then there are social consequences which are manifest in the interactions among the society, travel restrictions, and lockdowns leading to school and market closures. A pandemic with high morbidity and mortality has exponential consequences in almost all walks of life.

Drastic situations call for drastic measures. Increased development in healthcare systems has made us better equipped to fight such hazards. There has been lot of investment in medical research and development which has resulted in vaccines and medicines that aim at keeping pace with new diseases. Well managed and efficient response can lessen the risk of avoidable mortality. Governments across the globe are in firefighting mode in their efforts to control the pandemic. Their strategies will play a crucial role in checking such outbreaks in the future. History tells us that pandemics descend every hundred years and yet the human spirit fights back and we survive.

#### References

1. MacKellar, L. Pandemic influenza: a review. Population Council, 2007; 33(3): 429-451.
2. Taubenberger, J K, & Morens, D M. Pandemic influenza - including a risk assessment of H5N1. Rev. Sci. Tech., 2009; 28(1): 187-202.
3. Fangriya, R. Pandemic Influenza Threat. World Scientific News, 2015; 11: 120-137.
4. WHO. The classical definition of a pandemic is not elusive. Bull. World Health Organization. 2011a; 89(7): 540-541. doi: 10.2471/blt.11.088815
5. WHO. Comparative Analysis of National Pandemic Influenza Preparedness Plans.pdf WHO, Coronavirus disease (COVID-19)

- pandemic, 2011b; <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>.
6. Verikios, G, Sullivan, M, Stojanovski, P, Giesecke, J, Woo, G. Assessing Regional Risks from Pandemic Influenza: A Scenario Analysis. *The World Economy*, 2015; 39(8). <https://doi.org/10.1111/twec.12296>.
7. Bootsma, M C J, Ferguson, N M. The effect of public health measures on the 1918 influenza pandemic in U.S. cities. *Proceedings of the National Academy of Sciences*, 2007; 104(18): 7588-7593.
8. Barrelet, C, Bourrier, M, Burton-Jeangros, C, Schindler, M. Unresolved issues in risk communication research: the case of the H1N1 pandemic (2009-2011). *Influenza and Other Respiratory Viruses*, 2013; 7(2): 114-119. doi: 10.1111/irv.12090.
9. Bhandari, R, Hartley, T A, Lindsley, W G, Fisher, M A, Palmer, J E. Assessing Healthcare Utilization for Influenza-like Illness at an Emergency Department and a Student Health Service during the 2009-2010 H1N1 Pandemic. *Infectious Diseases (Auckl)*, 2013; 6: 15-23. doi: 10.4137/IDRT.S11315.
10. Cauchemez, S, Ferguson, NM, Wachtel, C, Tegnell, A, Saour, G, Duncan, B, Nicoll, A. Closure of schools during an influenza pandemic. *The Lancet Infectious Diseases*, 2009; 9(8): 473-481.
11. Chen, W C, Huang, A S, Chuang, J H, Chiu, C C, Kuo, H S. Social and economic impact of school closure resulting from pandemic influenza A/H1N1. *Journal Infection*, 2011; 62(3), 200-203.
12. Donaldson, L J, Rutter, P D, Ellis, B M, Greaves, F E, Mytton, O T, Pebody, R G, Yardley, I E. Mortality from pandemic A/H1N1 2009 influenza in England: public health surveillance study. *BMJ*, 2009; 339: b5213.
13. Drake, T L, Chalabi, Z, Coker, R. Cost-effectiveness analysis of pandemic influenza preparedness: what's missing? *Bull World Health Organization*, 2012; 90(12): 940-941. doi: 10.2471/BLT.12.109025.
14. Kern, M J. *Global Epidemics, Pandemics, Terrorism: Risk Assessment and European Responses*; 2016.
15. Qiu, W, Rutherford, S, Mao, A, Chu, C. The Pandemic and its Impacts. *Health culture society*, 2017; 9-10: 1-11. DOI 10.5195/hcs.2017.221| <http://hcs.pitt.edu> 11.
16. Davies, S E. *National Security and Pandemics*. *UN Chronicle*, 2013; 50: 20-24.
17. Ross, A G, Crowe, S M, & Tyndall, M W. Planning for the Next Global Pandemic. *International Journal of Infectious Diseases*, 2015; 38: 89-94.
18. Enemark, C. Is Pandemic Flu a Security Threat? *Survival*, 2009; 51(1): 191-214. doi: Pii 908599172 Doi 10.1080/00396330902749798.
19. Fan, EX. *SARS: economic impacts and implications*, 2003.
20. Harris, S S. *A Dictionary of Epidemiology*, Fourth Edition, Oxford University Press, London; 2000.
21. Honigsbaum, M. Historical keyword Pandemic. *The Lancet*, 2009; 373: 1939.
22. 1957-1958 Pandemic (H2N2 virus). Center for disease control and Prevention, National center for Immunization and Respiratory diseases, <https://www.cdc.gov/flu/pandemic-resources/1957-1958-pandemic.html>.
23. Benedictow O J. *The Black Death: The Greatest Catastrophe Ever*, History today, 2005; 55(3): 42-49.
24. Gottfried, R S. *Black Death*. Simon and Schuster. New York; 1983.
25. Byrne, J P. *The Black Death*. London: Greenwood Publishing Group. London; 2004.
26. Small pox <https://www.nationalgeographic.com/science/health-and-human-body/human-diseases/smallpox/>

27. History of Vaccines Smallpox Timeline, The College of Physicians of Philadelphia. [https://www.historyofvaccines.org/timeline#EVT\\_2](https://www.historyofvaccines.org/timeline#EVT_2); 2018.
28. Henderson D. Smallpox: the death of a disease. Prometheus Books, New York; 2009.
29. Epidemics of the Past: Smallpox, Smallpox: 12,000 Years of Terror <https://www.infoplease.com/math-science/health/diseases/epidemics-of-the-past-smallpox-12000-years-of-terror>.
30. Henderson D A. The eradication of smallpox – an overview of the past, present, and future, Vaccine., 2011; 29(4): D7-9. Doi:10.1016/j.vaccine.2011.06.080. PMID 22188929.
31. Shchelkunov S N. Emergence and Re-emergence of smallpox: the need for development of a new generation smallpox vaccine. Vaccine., 2011; 29(4): D49–53. Doi:10.1016/j.vaccine.2011.05.037. PMID 22185833.
32. Klein, C. How America struggled to bury the Dead during the 1918 Flu Pandemic, <https://www.history.com/news/spanish-flu-pandemic-dead>; 2020.
33. Spinney, L, Rider, P: the Spanish flu of 1918 and how it changed the world. Random House, New York; 2018.
34. Michaela NE, Kindrachuk, J. A year of terror and a century of reflection: perspectives on the great influenza pandemic of 1918–1919". BMC Infect. Dis., 2019; 19(1): 117. doi:10.1186/s12879-019-3750-8. ISSN 1471-2334.
35. Hilleman MR. Realities and enigmas of human viral influenza: pathogenesis, epidemiology and control. Vaccine. 2002; 20(25–26): 3068–87.
36. Strahan, LM. An oriental scourge: Australia and the Asian flu epidemic of 1957. Austr. Hist. Studi. 1994; 26 (103): 182–201. doi:10.1080/10314619408595959.
37. Wong, G W K, Leung, T F. Bird flu: lessons from SARS. Paediatric Respiratory Reviews, 2007; 8(2): 171-176. doi: 10.1016/j.prrv.2007.04.003.
38. Tanner, W D, Toth, D, Gundlapalli, A V. The pandemic potential of avian influenza A (H7N9) virus: a review. Epidemiology and Infection., 2015; 143(16), 3359-3374.
39. Ewing, E T. La Grippe or Russian influenza: Mortality statistics during the 1890 Epidemic in Indiana, Wiley Online Library, , <https://doi.org/10.1111/irv.12632>; 2019.
40. Jackson, C. History lessons: the Asian flu pandemic. British Journal of General Practice., 2009; 59(565): 622–623. doi:10.3399/bjgp09X453882.
41. Cohut, M. COVID-19 global impact: How the coronavirus is affecting the world, <https://www.medicalnewstoday.com/articles/covid-19-global-impact-how-the-coronavirus-is-affecting-the-world>; 2020.
42. Joseph, R, Hageman, M D. The Coronavirus Disease 2019 (COVID-19). Pediatric Annals, 2020; 49(3): e99-e100 <https://doi.org/10.3928/19382359-20200219-01>.
43. Aberth J. From the brink of the apocalypse: confronting famine, war, plague, and death in the later Middle Ages, first ed., Routledge, New York; 2001.