Article

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Journal of Development Economics and Management Research Studies (JDMS),
A Peer Reviewed Open Access International Journal
ISSN 2582 5119 (Online)
04(04), 47-51, April-June, 2020

http://www.cdes.org.in/
http://www.cdes.org.in/journal/

Medical history and impacts of notable pandemics

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Abstract

The outbreaks of infectious diseases display long-lasting effects on human throughout history. Pandemics are the diseases that break out on a global scale. These events have powerfully shaped the economic, political, ethical and social aspects of human civilization. The epidemic outbreaks led to the discovery of vaccination and modern medicine as well. It has also pushed forward the scientific community to develop principles of epidemiology, immunology, antimicrobial treatments and precautionary measures. This article outlines the information regarding the medical history and impacts of notable pandemics on the society such as Smallpox, cholera and COVID-19 disease conditions.

K**eywords**: Pandemic, epidemic, outbreak, global, population, vaccine

Introduction

In the context of infectious diseases, a pandemic is a worst-case scenario. When an epidemic spread beyond the country borders and affect the whole world, that's when the disease is officially called a pandemic. The major reason for the occurrence of these pandemics was the communicable diseases which existed during the early hunter-gather days and initially epidemics increased to a major extent due to the creation of several communities by agrarian life 10,000 years ago (Benedictow, 2005). Many diseases such as Smallpox, Plague, Cholera, Tuberculosis, and Influenza appeared world-wide. During the gradual civilisation of humans, infrastructural development took place which led to build of cities and expanding the trade routes to connect with other cities. All of this led to a great increase in pandemic rate all over the world (Littman, 2009)

This article attempts to study the medical history of various pandemics across the globe that has made a huge impact in the history. The first key factor to be noted is the major difference between a pandemic and an epidemic. An epidemic is defined as an outbreak of a disease that occurs over a wide geographic area and affects an exceptionally a very high proportion of population (Marr and Malloy,1996)

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In contrast with this, the term pandemic relates to geographical spread of a disease across the international borders that affects a whole country or the entire world. The pandemics have always affected the human civilization in the aspects of economics, politics, ethics and society causing thousands of deaths and millions of hospitalizations along with disruption in society all this has led to economical loss worldwide. With the increase in global transport and communication as well as settling urbanization, overcrowding conditions arose simultaneously. In ancient period, due to lack of advanced healthcare facilities and insufficient resources, it was more risky to deal with such infectious diseases which turned out to be pandemics.

Notable Pandemics in History

- The **Plague of Justinian** of 541 A.D. was attributed to the bubonic plague and wiped out 25 -50 million people in one year.
- The **Black plague** killed more than 75 million people from 1347 to 1351.
- The **Spanish flu pandemic** of 1918 killed well over 50 million people in one year.
- The **Cholera** pandemic killed more than 1 million people and was spread across Spain, Africa, Indonesia, China, Japan, Italy, Germany, America and India. A vaccine was created named Vaxchora in 1885 but the pandemics continued.
- The **Smallpox** pandemic of the 20th century claimed the declination of 300 to 500 million lives. Edward Jenner confirmed that cowpox provided protection against smallpox infection and introduced a vaccine called Vaccinia in 1798. In 1959, the World Health Organization (WHO) launched a huge campaign to globally eradicate smallpox. In 1980, smallpox was declared eradicated.
- The ongoing **Tuberculosis** pandemic continues to kill over 1.5 million people annually despite the availability of the effective treatments.
- The ongoing outbreak of novel coronavirus, which causes **COVID-19** has deleterious effects on human health as it has revealed vulnerabilities in the global community's response to outbreaks of viruses. On 11th March 2020, the WHO characterized the corona outbreak as a pandemic.

Smallpox

Smallpox ranks among the most devastating illnesses ever suffered by humankind. Smallpox was a contagious disease caused by the Variola virus. During the closing years of 18th century, the disease killed on an estimate 400,000 Europeans per year. During the 20th century, the Smallpox was responsible for 300-500 million deaths. During 1950s, an estimated 50 million cases of Smallpox occurred in the world each year. Later then the earliest written description of a disease that clearly resembled smallpox appeared in China in the 4th century CE (Common Era). A few early written descriptions also appeared in India in the 7th century and in Asia Minor in the 10th century. The global spread of smallpox started with the growth and spread of civilizations, exploration and expanding trade routes over the centuries. One of the first methods for controlling the spread of smallpox was the use of variolation named after the virus that causes smallpox (variola virus). Variolation is the process by which material from smallpox sores (pustules) was given to people who were never infected with smallpox. This was done either by scratching the material into the arm or inhaling it through the nose.

The discovery for vaccination of Smallpox began in 1796 when an English doctor named Edward Jenner conducted the first experiment to test this theory which involved

milkmaid Sarah Nelmes and James Phipps, the 9 year-old son of Jenner's gardener and he observed that milkmaids who suffered from cowpox did not show any symptoms of smallpox even after variolation. Dr. Jenner took the sample from a cowpox sore on Nelmes' hand and inoculated it into Phipps' arm. A few months later, Jenner exposed Phipps several times to variola virus, but Phipps never developed smallpox. Later, a few more experiments followed, and in the year 1801, Jenner published his treatise "On the Origin of the Vaccine Inoculation," in which he summarized his discoveries. Vaccination became widely accepted all over the world and gradually replaced the practice of variolation.

At some point in the 1800s the virus which was used to make the smallpox vaccine changed from cowpox to vaccinia virus which is still used as a live-virus vaccine against Smallpox. The Smallpox is caused by Variola virus which has two forms. The most dangerous form is Variola major that killed around 30% of people who were infected with it. In contrast, Variola minor was observed less deadly as it killed about 1% of population from those who were infected. The basic symptoms of Smallpox are small blisters that pop up on the face, arms and over the body which are filled up with pus. Other symptoms include flu-like fatigue, Headache, Body ache and in some cases even Vomiting. Small pox can be efficiently controlled through vaccination.

Transmission of Smallpox

Before Smallpox was eradicated, it was transmitted through face to face contact between people. Smallpox patients became contagious as the first sign of soars appear in their mouth and throat which is an early rash stage. The virus was spread when the infected person coughed or sneezed, the droplets from mouth or nose spread to healthy person. Smallpox has rarely spread through air through airborne route. Smallpox can be spread by humans only and not by inects or animals.

Cholera

Cholera is an infectious disease caused by a bacterium called *Vibrio cholerae*. The bacteria typically live in salty and warm water, such as estuaries and coastal areas. There are hundreds of strains of the cholera bacteria in which only two i.e., *V. cholerae* strain O1 and O139 are well known to cause outbreaks and epidemics. These strains produce the cholera toxin that cause intestinal cells to release increased amount of water leading to diarrhoea and rapid loss of fluids and electrolytes (salts). The origin of cholera is not clear still, but early traces were found from India (by Sushruta Samhita in the 5th century B.C.), Greece (Hippocrates in the 4th century B.C. and Aretaeus of Cappadocia in the 1st century A.D.).

Cholera pandemic

Cholera became a disease of global importance in 1817. In that year a particularly lethal outbreak occurred in Jessore, India, midway between Calcutta (Kolkata) and Dhaka (now in Bangladesh) and then spread throughout India, Burma (Myanmar) and Ceylon (Sri Lanka). It devastated Asia, Europe, North America and Africa by killing 23,000 people in Great Britain alone in 1854, the worst single year of cholera.

Efforts of various scientists against Cholera

In 1854 John snow a British Physician (Father of Modern Epidemiology) identified the source of the disease was contaminated water from the public well pump and convinced

the officials to remove the water pump which decreased the spread in the small area of London. In 1883, German microbiologist Robert Koch, the founder of modern bacteriology, studied cholera in Egypt and Calcutta. His study has shown the presence of the bacterium in intestines cause cholera. Later on in the same year an Italian microbiologist Filippo Pacini had actually identified the cholera bacterium naming it cholerigenic vibrio in 1854. The bacteria are transmitted between humans through the faecal-oral route or via a bite of contaminated food / a sip of contaminated water could cause infection.

Development of vaccine against Cholera

Earlier observations by Koch and colleagues in the 1880s revealed that people who had cholera were protected against subsequent infections during the same epidemic suggested that some form of naturally acquired immunity had developed. The first cholera vaccine was developed by Ferran in 1885 and used in mass vaccination campaigns in Spain (Pariona, 2019).

Sawtschenko and Sabolotny developed the first OCV (oral cholera vaccines) in 1893. In the 1920s–1930s, field trials were conducted in India on the use of Bilivaccine, a commercially prepared tablet containing 70 billion dried *V. cholerae* organisms. Three doses were given on three successive days that shown to provide protection against cholera (Cait Hartwyk, 2017).Currently, three oral cholera vaccines (OCV) such as Dukoral®, Shanchol™, and Euvichol® are available.

Corona virus

Coronaviruses are a group of single stranded RNA viruses that cause diseases in mammals and birds. In humans, these viruses cause respiratory tract infections that can range from mild to lethal. Coronaviruses are a big family of different viruses. Some of them cause the common cold in people. Others infect animals, including bats, camels, and cattle. Coronaviruses belongs to family Coronaviridae, subfamily Orthocoronavirinae, and order Nidovirales.

Scientists first identified a human Coronavirus in 1965. It caused a common cold. Later that decade, researchers found a group of similar human and animal viruses and named them after their crown-like appearance. The one that causes SARS emerged in southern China in 2002 that quickly spread to 28 other countries. More than 8,000 people were infected by July 2003, and 774 individuals were died. This coronavirus causes fever, headache, and respiratory problems such as cough and shortness of breath (Joel et al., 2013). Corona virus is morphologically related by their distinctive club-like spikes (Li, 2006).

COVID-19- a pandemic

The World Health Organization declared COVID-19 outbreak as a Public Health Emergency of International Concern on 30 January, and a pandemic on 11 March 2020. As of 10 May 2020, more than 4.02 million cases of COVID-19 have been reported in over 187 countries and territories resulting in more than 279,000 deaths. However, more than 1.37 million people have recovered from this disease. The pandemic has caused severe global socioeconomic disruption world-wide. It has led to the postponement or cancellation of sporting, religious, political and cultural events, widespread supply shortages. Fortunately, it has decreased emissions of pollutants and greenhouse gases due to sudden lockdown. According to recent evidence, coronavirus is primarily transmitted between people through respiratory droplets and contact routes (Lu et al., 2020). Most common symptoms are fever, dry cough, tiredness, cold. Less common symptoms are aches and pain, sore throat,

diarrhea, conjunctivitis, headache, rash on skin or discoloration of fingers or toes. Chronic symptoms include difficulty breathing or shortness of breath, chest pain or pressure, loss of speech or movement and multi-organ failure.

Conclusion

Medical history of pandemics outlines some of the history of most deadly infectious diseases counting from Antonine plague to the current COVID-19 event. These pandemics have affected the humankind since the period they started spreading. Due to lack of resources and healthcare facilities it was difficult and took time to control the pandemics across the globe. Many medical practices such has vaccination, immunization, sanitation were being carried out in order to control the spread of various infectious diseases. Successful prevention from the deadly infections depends upon adequate control measures including rapid and accurate microbial diagnosis, prompt treatment, patient isolation and preventative education. These strategies help in decreasing the risks factors of any pandemic disease.

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