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## Epidemics and Pandemics: that changed the public health history

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## Epidemics and Pandemics: that changed the public health history

Cover Page Footnote

None

# Epidemics and pandemics that changed the public health history in India

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## Abstract

Currently, the world is experiencing one of the most disruptive pandemics in the modern history of disease and illness. As human beings became more civilized, started building cities, establishing trade routes between cities and countries, the conditions needed for these diseases to spread were greatly enhanced, and hence history has recorded many more epidemics and pandemics since the advent of global travel. Many of these epidemics and pandemics have disrupted the life of common human beings from BC 430 (Athens Plague) until date (COVID-19). Most of the recorded epidemics in history were originated in the western world like Athens, Romans, and Germans, etc. Sufferings of the human beings were enormous and the destruction of the population was innumerable. There are incidences where up to 25% of the total population was devastated. For the majority of the pandemics, the scientists succeeded in inventing vaccines, including COVID-19. Hence, pandemics and epidemics have helped human being to change their living pattern, adapt to changes, and accommodate healthy habits.

*Keywords:* COVID-19, epidemics, influenza, pandemics, plague.

## Introduction

Currently, the world is witnessing one of the most destructive pandemics in the modern era of disease and illness. Diseases have existed since the beginning of the human race; most of them were managed by home remedies. However, until relatively recently, the average member of the public in any country had very little use for the terms “pandemic, quarantine, triage,

isolation” etc. until March 2020, when the World Health Organization (WHO) announced that COVID-19 is a pandemic. By March 2021, almost every person on the planet was aware of these terminologies. Therefore, this review paper is intended to introduce the reader to the various epidemics and pandemics of the past.

The epidemic is defined as the occurrence of unusually high rates of disease in a community or region, specific health-related behaviour, or other health-related events exceeding “expected occurrence” (Park, 2015).

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Pandemics are the widespread transmission of infectious diseases that can significantly increase morbidity and mortality across wide geographic regions leading to great disruption on the economic, social, and political levels. Available data indicate that globalization, urbanization, changes in land use, and greater exploitation of natural resources have all contributed to an increase in the likelihood of pandemics over the past century (Jones et al., 2008). As human beings became more civilized, started building cities, establishing trade routes between cities and countries, the conditions needed for these

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diseases to spread were greatly enhanced, and hence history has recorded many more epidemics and pandemics since the advent of global travel.

This article will throw light on the important epidemics and pandemics that have ravaged human populations.

#### **430 BC: Athens plague**

During the Peloponnesian war, the oldest recorded pandemic was reported. The manifestations of the plague comprised fever, thirst, red skin and lesions, and a bloody throat. The disease was suspected to be like typhoid fever, which killed as many as 25% of the city's population; it devastated the city of Athens in Ancient Greece (Littman, 2009; Cunha, 2004).

#### **165 AD: Antonine plague**

It is believed that the Antonine plague is an early appearance of smallpox. Initially, it infected the Huns, followed by the Germans, and then it spread to the Romans. Manifestations included high temperature, sore throat, diarrhoea, and pus-filled sores over the long term. The plague lasted for 15 years and devastated the entire population of the Roman Empire and caused the death of five million people (Jones, 1996).

#### **250 AD: Cyprian plague**

Bishop Cyprian was the first victim to die from this plague, which was manifested by throat ulcers, vomiting, diarrhoea, and gangrenous hands and feet. Because of the limited resources and lack of medical knowledge, the cause of the plague was unknown. Speculations of the cause included smallpox, pandemic influenza, and viral haemorrhagic fever (filoviruses) like the Ebola virus (Wikipedia, 2021). It passed through northern Africa, Rome and continued to Egypt after possibly starting in Ethiopia. The estimates show that Roman cities' population was declined by 62% (5,00,000 to 1,90,000) with a recorded daily death rate of 5,000 (Harper, 2016; Kearns, 2018).

#### **541 AD: Justinian plague**

This contagious disease, identified as bubonic plague, resulted from *Yersinia pestis*. The disease was located in Europe and the Mediterranean region. It was believed that the Justinian plague was spread through fleas and featured enlarged lymphatic glands as symptoms. Recurrences of the disease during the following two

centuries killed about 25-50 million people, around 26% of the world's population. Hence, this plague brought the economic struggle to the entire world, specifically in the Roman Empire (Stathakopoulos, 2000; Mordechai, Eisenberg, Newfield, Izdebski, Kay, & Poinar, 2019).

#### **11th-century leprosy**

Leprosy is a hereditary and contagious bacterial infection that causes sores and deformities. It was believed at that time to be a punishment of God. In extreme cases, a patient loses their fingers and toes, loses their eyesight, collapses their nose, develops ulcers and lesions, and their skeletal system can weaken. It could be fatal if not treated with antibiotics. The disease was spread all over the world, but it became a pandemic in Europe. This disease came to be known as the "living death" because leprosy victims were treated as if they were already dead. Funeral services were performed to proclaim those with the disease "dead" and allow their family to request their inheritance. Its most important victim was Baldwin IV, the "leper king" of Jerusalem (Kearns & Nash, 2021).

#### **1350: The Black death**

This outbreak of bubonic plague was the second largest of its kind originating from China in 1334, spreading across Central Asia to northern India, and ultimately reaching Europe through the renowned Silk Trade route in 1347. In less than five years, the plague had ravaged almost the totality of the European continent, spreading further into Russia and the Middle East. Although the most severe effect of this pandemic occurred between 1343 and 1356, its effects lingered in a milder form during the 1400s and decreased the world population from 450 million to less than 300 million making it the culprit for the death of one-third of the world's population. According to literature, 60% of the population of Europe was killed at that time. This was often known as pneumonic plague. The symptoms of this plague were lumps in the groin and armpits followed by dark black spots appearing on the arms and thighs and some other parts of the body, as explained by Boccaccio (1343). England and France were the two countries most affected, and the feudal system of England collapsed due to the corresponding economic

crisis and changes in demographics (Benedictow & Benedictow, 2004; Dols, 2019; Bowsky, 1964).

### **1665: The great plague of London**

This was one of the major epidemics of bubonic plague to occur in England. A total of 20% of London's population lost their lives during this epidemic in only 18 months. This was the last in a long series of plague epidemics that commenced in 1499 in London (James, 2004).

### **1720: The Great plague of Marseille**

In Western Europe, the last major outbreak of bubonic plague occurred in Marseille, France. A total of 1,20,000 people were killed, and it took 45 years for the population to return to its 1720 level. It was recorded that the *Yersinia pestis* reached the port of Marseille via the merchant ship *Grand Saint Antoine* arriving from the Levant. This pandemic transmitted a legacy of fear and a deep imprint in the European minds that the plague may reappear anywhere and at any time (Devaux, 2013; Varlık, 2020).

### **Cholera pandemic**

Over the past 200 years, seven cholera pandemics have occurred. Cholera is one of the deadliest diseases known to man and a threat to global public health. Worldwide there are 21,000 to 143,000 deaths and 1.3 to four million cases reported every year (World Health Organization, 2021). Today, cholera is endemic in many countries, but it poses a challenge to developing countries where there is a lack of safe and clean drinking water and proper sanitation (Glass & Black, 1992). During the 19th century, the cholera pandemic became highlighted when an outbreak of the deadly disease started in the Ganges Delta in India. Millions of people across every continent were killed due to seven cholera pandemics (History, 2017; Siddique & Cash, 2013). Cholera is a water-borne disease caused by the bacterium *Vibrio cholerae*. Despite hundreds of different strains of cholera bacteria, only two strains of bacteria (Serotype 01 and 0139) can cause a cholera outbreak. Cholera-like illnesses were reported by Sushruta Samhita in the 5th century BC and the 1st century AD by Aretaeus of Cappadocia. Initially, the disease was called “moryxy” because of its very high fatality rate (History, 2017; Reidl & Klose, 2002).

### ***History of Cholera pandemic***

**1817-1924 (1st cholera pandemic).** The first Asiatic cholera originated in India from the Ganges Delta. It was believed that the disease spread globally through a Hindu pilgrimage, the Kumbh Mela, on the upper phase of the river Ganges. In 1817, cholera started spreading outside the country to places like Myanmar and Sri Lanka. In 1820, the disease had spread to Indonesia, Thailand, and the Philippines. Through contact with people, it reached China in 1821, and in 1822 was found in Japan (Macnamara, 1876; Wikipedia, 2021).

**1826-1837 (2nd cholera pandemic).** This outbreak began around 1829 in India, and then passed along trade and military routes to reach Europe, the Americas, and Great Britain. This pandemic was significant in Europe (from 1829 to 1849) due to its geographic extent and high morbidity and mortality rate were reported (Imperaro, Imperato, & Imperato, 2015). For nearly two decades, the pandemic re-emerged in many countries and finally subsided in 1851 (Chan, Tuite, & Fisman, 2013).

**1852-1859 (3rd cholera pandemic).** Asia, Europe, North America, and Africa were affected during this pandemic. This disease killed around 23,000 Britons in 1854 and was called the worst year of cholera (Swedha, 2020). During this period, one of the founders of modern epidemiology, British physician John Snow, was fascinated by the causes of a cholera outbreak in the Soho area of London. He found that during the mid-1800s, there was no adequate provision of wastewater disposal. Sewage was dumped into open pits or disposed directly into the River Thames without treatment. This water was used for consumption and a plethora of different purposes. Hence, John Snow suspected that sewage could be the reason for the cholera outbreak in and around the city. In 1854, there was another severe outbreak of cholera in the Soho area of London. Again, he accepted the challenge to confirm that water contaminated by sewage was the cause of cholera. Those people, who used the water from wells in town and the Broad Street pump, which was contaminated by the open pits (“cesspools”), or the river Thames, were far more likely to contract the

disease. It was confirmed that a single street pump was the sole cause for the outbreak of cholera in London. Later, he persuaded the officials to detach the handle from the pump to avoid drawing water. As a result, there was a decline in cholera cases (Stanwell-Smith, 2015; Newsom, 2006).

**1863-1875 (4th cholera pandemic).** The fourth cholera outbreak lasted from 1863 to 1875 and spread from the Ganges Delta of the Bengal region to Mecca and throughout the Middle East through Muslim pilgrims (Azizi, Azizi, & Azizi, 2010; History, 2017).

**1881-1896 (5th cholera pandemic).** The fifth pandemic was one of the most significant international outbreaks. It started in India and spread throughout Asia, Europe, and South America. This pandemic did not touch the United States and Great Britain due to their advanced public health systems and superior sanitation. The death rate was high in Russia and Japan. This fifth pandemic was the last serious outbreak in European countries during this century (Briggs, 1961; Wikipedia, 2021).

**1899-1923 (6th cholera pandemic).** This pandemic began in 1899, it did not affect Western Europe and North America due to their advanced public health systems, but it devastated India, Russia, the Middle East, and Northern Africa. In 1923, gradually the cholera pandemic disappeared, except in India. Half a million Indian people were killed between 1918 and 1919 (History, 2017).

**1961-1975 (7th cholera pandemic).** The seventh cholera pandemic occurred between the years 1961 and 1975. It originated in Indonesia and was caused by the biotype El Tor lineage strain. It reached East Pakistan in 1963, India in 1964, and the Soviet Union in 1966, later in 1973 it spread to Italy.

During the outbreak of cholera in 1991, 3488 people were killed in Africa and 2618 in Latin America. Outbreaks of cholera happen even now, but they are more easily managed with modern medicine and their severity has been diminished. The application of antibiotics and fluid therapy has reduced the mortality rate in developing countries (Azizi, 2010; Sigman, & Luchette, 2012).

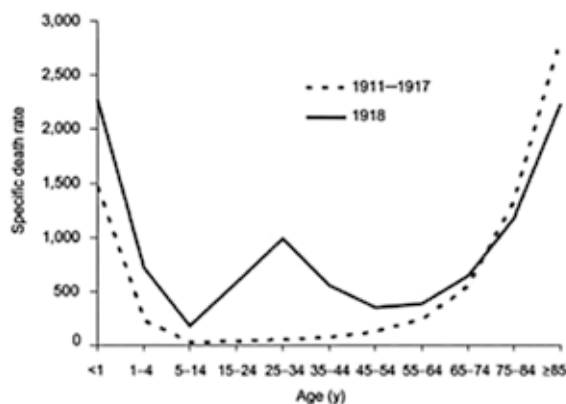
### **Spanish Flu pandemic (1918 Influenza)**

The Spanish flu pandemic took hold in the midst of World War I. Even though it was not the first pandemic of the modern world, it remains one of the gravest warnings to public health because of the devastating effects it had worldwide. The cause of this pandemic was the H1N1 strain of the influenza virus. Since then, all the pandemics caused by influenza viruses emerged from this strain, including 'drifted' H1N1 viruses, followed by H3N2 viruses. Despite the subsequent advancements in epidemiology and public health, the real source of the Spanish flu remains unidentified. Potential roots of its source could be from the United States of America, China, Spain, France, and Austria. The influenza virus, through its deadly H1N1 strain, ravaged Europe very quickly due to the wide military activities that were taking place back then. The virus spread to Africa, Asia, the United States of America, and the Pacific Islands (Oxford, Sefton, Jackson, Innes, Daniels, & Johnson, 2002). An estimated one-third of the world's population were infected with the virus and had a clinically apparent illness during 1918-1919 (Holtenius & Gillman, 2014). The death toll was predicted to be somewhere between 50-100 million (Guest, 2021).

It was recorded that the Spanish flu pandemic had three waves. From spring 1918, the first wave started and spread across the world. The second wave was between September and November 1918, and the third wave was in the early months of 1919. By the end of World War I, the third wave, which was present in fewer countries, was exacerbated because soldiers were returning home. Epidemiologically, it is difficult to explain the sudden drop in the cases of the first and second waves and then the sharp rises in the cases of the second and third waves; assuming even transient post infection immunity (Taubenberger & Morens, 2006).

Young adults were mostly affected by the Spanish flu. For at least 150 years, the curve of influenza deaths by age at death has been U-shaped, showing high mortality rates in infants and old people, with relatively few numbers of deaths at all ages in between. However, the curve took a "W" shape during the 1918

pandemic, where in addition to the very young and very old, there was a third-rate peak in the 20-45 age groups (Taubenberger, & Morens, 2006; Viboud, Eisenstein, Reid, Janczewski, Morens, & Taubenberger, 2013). (Figure 1).



**Figure 1.** “U” And “W” shaped combined Influenza and Pneumonia mortality, by age at death, per 100,000 persons in each age group, United States, 1911–1918. Influenza and Pneumonia specific death rates are plotted for the inter pandemic years 1911–1917 and the pandemic year 1918 (Ref: Taubenberger & Morens, 2006).

### **Impact of Spanish flu on society**

This pandemic hit the world during World War I. Most countries were diverting their budgets to the welfare of the soldiers and the war; hence, the economic crunch and the death toll were neglected. Compared to today’s pandemic, economists did not pay attention to the economic effects of the pandemic or it was retrospectively discussed anywhere. That is why this pandemic is considered as “forgotten pandemic” (Boianovsky & Erreygers, 2021).

### **Smallpox 1974**

One of the worst smallpox epidemics of the 20th century was witnessed in India in 1974, three years before the announcement of smallpox eradication. Between January and May 1974, more than 15,000 people contracted and died from smallpox. The most affected states were Bihar, Orissa, and West Bengal. India had over 86% of the world’s smallpox cases in 1974. Those who survived smallpox became blind or disfigured. Even though the government of India initiated the smallpox eradication program in 1962, it was not able to achieve the desired benefit (Wikipedia, 2020).

### **COVID-19 pandemic**

Once again since December 2019, the world is facing a significant threat to humanity from the COVID-19 pandemic, which presumably emerged in Wuhan, Hubei, China, where there were a series of pneumonia cases with unknown history caused by the novel coronavirus (2019 nCoV) (Guan et al., 2020). The disease originated in bats, and it spread throughout China originating from a Wuhan Seafood market, in December 2019. COVID-19 is often developed among those who have had severe respiratory disease.

Since the start of the 21<sup>st</sup> century, the world has been devastated by three epidemics from the same group of novel coronavirus. The first epidemic began in 2003, named severe acute respiratory syndrome coronavirus (SARS-CoV), in Guangdong, China. The second epidemic emerged in Saudi Arabia in 2012. A novel coronavirus, the disease is known as the Middle East Respiratory Syndrome Coronavirus (MERS- CoV) which had a great mortality rate.

The third and current epidemic, COVID-19, evolved in China and later appeared in outlying provinces of China, Japan, and Thailand (Alanagreh, Alzoughool, & Atoum, 2020; Cui, Li, & Shi, 2019). In February 2020, globally 80,000 confirmed cases have been recorded, and the WHO declared the COVID-19 outbreak a Public Health Emergency of International concern. Nearly 114 countries had been affected by the pandemic and more than 4,000 people were killed. Due to the severity and rapid spread of the disease throughout the globe, the WHO declared COVID-19 a pandemic on 11 March 2020 (Cucinotta & Vanelli, 2020; World Health Organization, 2020).

### **COVID-19 in India**

The infection that developed in China spread across the world, leaving devastation in its wake. Indeed, its effect was felt far beyond India. The first COVID-19 case in India was detected on 30 January 2020 in Trissur, Kerala. Day-by-day, Covid cases were increasing as a result of travel to affected countries, and in India, the pandemic reached its peak in October 2020 (Arnold, 2020; Wikipedia, 2020).

Coronavirus influences everyone in various ways. Most of the infected cases exhibit mild to moderate symptoms and the patient will recuperate without hospitalization. Very often, Covid patients develop symptoms like fever, weakness, and a dry cough. Other symptoms like a sore throat, headache, loss of taste or smell, aches and pains, conjunctivitis, and diarrhoea are less common among Covid infected people (World Health Organization, 2020). COVID-19 can affect any age group of people, and it may cause serious illness or death. However, people with co-morbidities like high blood pressure, heart problems, cancer, and diabetes, and who are above 60 years old, are at higher risk of developing this serious illness (Jordan, Adab, & Cheng, 2020; Gjerstad & Molle, 2020).

The virus spreads rapidly from infected persons through different modes of transmission, like close contact with an infected person, or through fomites (infected respiratory droplets projected when sneezing, coughing, or even breathing) and in overcrowded or less ventilated places (Struyf *et al.*, 2020).

**The severity of COVID-19 in India.** The COVID-19 pandemic has touched every sphere of human life. Worldwide, millions of deaths have been directly caused by this deadly disease. The management of patients with COVID-19 has become challenging for health care sectors due to a lack of definitive treatment for critically ill patients. (Kontis *et al.*, 2020).

**The severity of COVID-19 in the World.** Covid patients are treated based on the severity of symptoms. The infected person with mild symptoms like myalgia, fever, sore throat, and fatigue can recover with home isolation and appropriate treatment. However, severe cases with tachypnea, oxygen saturation of less than 93% at rest, PaO<sub>2</sub>/FiO<sub>2</sub> less than 300 mgHg, critical organ failure, and respiratory failure requiring mechanical ventilation and septic shock need hospitalization in an intensive care unit (Verity *et al.*, 2020).

The pandemic also brought the rapid transition to social, economic, environmental, and health care systems. Indeed, it has indirectly affected education, family life, religious belief, political system, production and supply, purchasing power, and so on (Douglas,

Katikireddi, Taulbut, McKee & McCartney, 2020; Kontis *et al.*, 2020; Karunathilake, 2020).

**COVID-19 first wave.** There are two wave patterns of COVID-19 reported in many countries. The first wave began in spring 2020, and a second wave in late summer and fall (Iftimie *et al.*, 2021).

In India, the first wave started in late January 2020 and a surge in cases was reported in September 2020. In May-June 2020, about 0.7% of people in India had been infected; in January 2021, the infection rate has increased to 20%. In August 2020, a total of 3,621,245 cases and 64,469 deaths were reported (Song *et al.*, 2021). The viruses that cause COVID-19 mutate all the time and produce different versions or variants of themselves. The variant of SARS-CoV-2 officially known as Lineage B. 1. 617, was first detected in India on 5 October 2020. During the first wave, local mutations of the virus did not play a major contributing role (Menon, 2021; Peacock, 2021).

However, the Government, has taken extensive measures to control the first wave through lockdowns, social distancing, mask-wearing, and avoiding social gatherings. With these measures, the first wave of COVID-19 in India slowed down in October 2020.

**COVID-19 second wave.** The prediction that the Indian community would develop the herd immunity needed to control the second wave was unsubstantiated. The second wave in India began in March 2021 and became the world's worst coronavirus crisis. In late April 2021, India recorded the highest number of new cases previously recorded in the world with 400,000 cases in a day (The Hindu, 2021).

More than 20.2 million cases and 2,22,000 deaths were reported in May 2021. Multiple factors have contributed to the massive surge in cases and deaths in India (WHO, 2021).

Despite knowing the magnitude of the second wave, the Indian Government has failed to prepare in advance to tackle the COVID catastrophe in the country. Rather, the Government has allowed political rallies, religious festivals and has delayed the vaccine campaign (less than 2% vaccine coverage) (Lancet, 2021). Another major



challenge to controlling the second wave in the country was the mutation of the SARS- CoV-2 virus (Lineage B. 1. 617). Three sub lineages have been detected in India, as of May 2021. The sub lineage B.1.617.1 is called variant Kappa, and B.1.617.2 is known as variant Delta, both were detected in December 2020. The first sub lineage, B.1.617.3, was found in October 2020. In February 2021, new cases of variant B. 1. 617 (all sub lineages) increased rapidly (WHO, 2021).

The best way to contain the spread of the virus is to follow the Covid rules and precautionary measures like maintaining social distance, wearing masks, washing and sanitizing hands regularly, staying in well-ventilated places, getting tested when symptoms develop, and crucially, getting vaccinated. Without a doubt, these measures help the public to protect themselves from new variants.

Amidst the COVID-19 pandemic, there is a ray of hope from vaccination. Vaccines give effective protection against the new variant. In India, a vaccination program was initiated in January 2021, India has approved the use of Indian BBV152 (Covaxin), the British oxford-Astra Zeneca vaccine (Covishield), and the Russian Sputnik V vaccine (Ranjan, Sharma, & Verma, 2021; Song et al., 2021; Kannan, Gurusriram, Banerjee, Bhattacharjee, & Varadwaj, 2021). Over 74 cores of vaccine doses have been distributed until 12 September 2021. The recovery rate from infection in India currently is 97.51% and the weekly positivity rate remains below 5% and the daily positivity rate on 12 September was 1.87% (PIB's daily bulletin, 2021).

India's health care system was shaken during both the waves of the COVID-19 pandemic. Governing bodies of all the private health sectors joined their hands to support the public health care system in diagnosing and treating the cases as per the need of the society, which helped to control the pandemic. Even though there was a scarcity of hospitals, manpower, oxygen supply, life-saving medicine, PPE, and infrastructure during the first wave; the central and the different state governments were proactive to plan actions to tackle the pandemic by setting up dedicated COVID-19 hospitals, isolation centres and tech-enabled mapping of resources before the commencement of the second wave. Various

technology and applications were developed by central and state governments, e.g., Arogya Setu, CoWIN app. Tele-consultation, bed management, and reporting of active cases daily helped the government to manage the positive patients effectively. Several in-service and on-the-job training were organized to equip the health care workers with essential knowledge and skill. INR 2,23,846 crore was allocated in the budget during 2021-2022 by the government for health and well-being, an increase of 137 percent from the previous year, with INR 35,000 crore earmarked for COVID-19 vaccine in the coming fiscal year (Mistry, 2021).

In the Indian health care system, the grass-root level workers are called Accredited Social Health Activists (ASHA) chosen from the same village. During the pandemic, ASHA workers have done a tremendous job by visiting the remotest corners of the country by doing door to door surveys, screening people for COVID-19 symptoms, motivating them for vaccination, educating them for Covid appropriate behaviour, and directing them to the health centres in case found with symptoms (Awasthi, 2020).

The WHO supported all its member countries with essential technical and logistic assistance for the management of the COVID-19 pandemic. To provide information to the public, the headquarters held several media briefings, released several audio and video recordings. WHO conducted a series of international teleconferences on the topics such as clinical management, laboratory, and virology, infection prevention and control, Mathematical modelling, seroepidemiology, research and development for diagnostics, therapeutics, and vaccines (WHO, 2021).

The pandemic era has changed the way we think and go about our daily lives. The entire world has been ravaged by the first and second waves of COVID-19. It has spread from cities to rural areas and affected people of all age groups. Tragically, the ones who suffer most are the millions of impoverished people in the world. Moreover, the third wave is inevitable, so the country has to rebuild its health care system to handle the crisis. We need to provide comprehensive care to the public, there should be a robust health system in India. This can be achieved through the collective effort of

policymakers, business leaders, health care providers, and technology providers.

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