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RESEARCH ARTICLE

A BRIEF HISTORY OF PAST GLOBAL PANDEMICS: PHASING AND ORIGIN

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ABSTRACT

The term Pandemic has been used to describe the global spread of an infectious disease across multiple countries and involving multiple continents. Such an international health crisis may prove catastrophic for nations worldwide in terms of overburdening the healthcare system as well as causing economic stagnation. Halting & controlling the spread of a worldwide disease outbreak requires time bound strategic interventions from the authorities at National, sub national and international levels along with joint cooperative efforts from private and public sectors. Majority of pandemics arise from cross species transmission of pathogens, wherein the microorganism mutates or transforms itself to jump from animals to humans and then disease spreads via human to human transmission at an accelerated rate. The current paper outlines the history of major pandemic outbreaks starting from the Antonine Plague of 165 – 180 AD to the current COVID – 19 pandemic.

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INTRODUCTION

The terms 'outbreak' and 'epidemic' have often been used interchangeably in the past. They are both an indication of a widespread occurrence of an infectious disease in a community at a particular time. When such large-scale outbreaks of infectious disease spreads through human population affecting a large number of people, a major part of a nation or the entire nation, a continent or a part of the entire world, it is termed as a pandemic. [1] Pandemics have had profound and lasting effects on societies and are responsible for causing significant social, economic and political disruptions. Throughout human history, outbreaks of infectious diseases have shaped societies and cultures. Infectious diseases and illnesses have plagued humanity since the early ages, advancing the scientific codes of beliefs in modern medicine and helped develop various principles of epidemiology, prevention, immunization, and antimicrobial interventions. Despite such advancements and progress, there still exists significant gaps and challenges in global pandemic preparedness and response. [1,2] Throughout the era of civilization, the human population have suffered from many pandemics, be it the earlier form of small pox or tuberculosis or the recent incidence of coronavirus. The coronavirus pandemic also known as COVID 19 serves as a reminder to us of our global vulnerability to emergent threats to human health and our inability to predict or prevent such outbreaks. Even though the death toll of this recent pandemic is low in comparison to some of the other outbreaks in history, its impact has been catastrophic in various aspects. Advancements in healthcare and understanding the factors that contribute to the genesis of a pandemic have been instrumental in mitigating their impact. This is notable in the consistent trend of pandemics over time, i.e. the gradual reduction in the death toll of pandemics. Public health efforts often focus on minimizing the outbreak spread, once a pandemic begins. Curbing the spread of a pandemic can help reduce the total number of people who are infected and in turn help mollify its health and economic impact. Strategic preparedness and response interventions are classified based on various aspects of a pandemic's occurrence including the pandemic period, the spark period and the spread period. While the scope of influence of some of these interventions fall under a single authority, the responsibility to fulfil crucial aspects of pandemic response and preparedness planning is carried out by multiple authorities, which act as a balancing force. [1] The ascendancy and governance of a pandemic's response is complex and it is divided among national, subnational and

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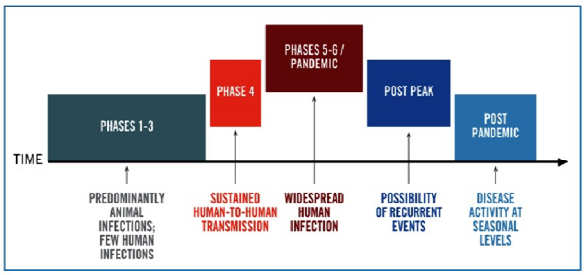
international institutions with each of them performing well designed responsibilities and tasks. Close coordination between public and private sectors are required for efficient pandemic preparedness. For example, vaccine development necessitated collaboration of the government and the vaccine producers. Even critical response measures such as managing quarantines requires a constant interface between relevant government agencies, public health authorities, hospitals, and impacted communities. Each one plays a significant role in leadership, governance and management at the ground level and it is imperative that their roles are not just clearly defined but there is accountability at each level.[3]



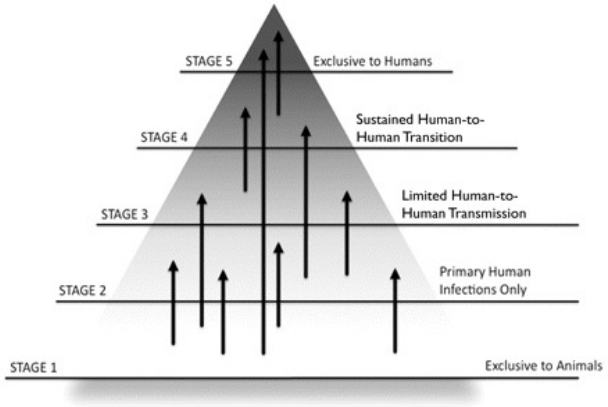
From: Pandemic Influenza Preparedness and Response: A WHO Guidance Document. Geneva: World Health Organization; 2009.

Figure 1. Phases of pandemic

WHO Guidelines and Phases of Pandemic

The World Health Organization developed a six-phase approach for pandemics in 1999 which was later revised in 2005. This approach provides a global agenda to help countries in pandemic response planning. As is evident in the figure given below, Phases 1-3 are associated with preparedness, including capacity development and response planning activities, while Phases 4-6 clearly indicate the necessity for response and mitigation efforts. Periods after the first pandemic wave are elaborated to facilitate post pandemic recovery activities. [3] This six phase approach was evolved to provide a framework in planning, preparedness and mitigation. While the first three phases have had no proven substantive risk to life, the later phases are directly linked to large scale loss of human life. The possibility of infections existing in the first three phases which do not result in a pandemic is very much possible even though the risk thereon is inherent. [3,4] Despite enhanced surveillance and improved public health systems, pandemics may escape the vigilant eyes of epidemiologists before it is too late. The movement from phase 3 to subsequent phases may be rapid and virulent but it is absolutely possible to prevent its scale and reach by proper management and containment. [4]

Origin and History of Pandemics: Evidence suggests that a major proportion of all pandemics originated due to Zoonosis or zoonotic diseases, i.e. cross species transmission of microorganisms/pathogens (Infectious agents including bacteria, viruses, parasites, prions etc.) from non-human animals to humans. For successful cross transmissions, animal pathogens evolve into specialized pathogens that not only infect humans but also without having to renter from original animal host, they maintain long term human to human transmission leading to be a much larger and challenging threat to the human population. [2] There are 5 stages leading to the transmission of major human infectious diseases. Stage 1 includes animal pathogens that are not present in humans under normal and natural conditions. As soon as this pathogens evolves in a way that it can be transmitted to humans under natural conditions, the pathogen is said to be in stage 2. Rabies, West Nile viruses, Tularemia bacilli, Nipah etc. are some examples of such pathogens. Secondary transmission between humans defines the transition of the pathogen from stage 2 to stage 3. Pathogens that endure only a few cycles of secondary transmission are included in stage 3 whereas those pathogens that are able to withstand long and multiple such human to human transmission cycles without involvement from animal hosts are said to be in stage 4. Examples of some stage 3 pathogens are Ebola, Marburg, and human monkeypox viruses whereas influenza A, *Vibrio cholerae*, and dengue virus contribute to stage 4 pathogens. Stage 5 pathogens represent infectious diseases that solely transmit from humans. These agents are responsible for causing some of the most devastating pandemics in the history of mankind such as human immunodeficiency virus (HIV) infection, smallpox, and tuberculosis.[2,4]



From: Clin Infect Dis. 2010 Jun 15; 50(12): 1636–1640. Published online 2010 Jun 15. doi: 10.1086/652860

Figure 2. Zoonotic disease emergence model outlining the 5 stages of pathogen emergence from animals to humans

There have been a number of significant pandemics in the past starting from the Antonine Plague of 165 – 180 AD to the current COVID – 19 pandemic. Death tolls ranging from 770 people due to the SARS pandemic in 2002-3 to a massive death toll of over 200 million human deaths due to the Bubonic Plague also known as Black death. A brief outline of the major pandemic outbreaks recorded throughout history is given as follows. [5]

The Antonine Plague of 165 to 180 AD: Also known as the Plague of Galen named after the physician who documented and recorded it. This plague occurred in the Roman Empire and it's cause was thought to be smallpox. The plague destroyed as much as one-third of the population in some areas, also leading to the death of the Roman army. It's impact was severe which led to the decline of the roman military and its economic supremacy. [7]

The Justinian Plague: Originated in mid-sixth century AD which was the first 'real plague' pandemic cause by a bacterial pathogen named - Yersinia Pestis. It was the first recorded outbreak of the bubonic plague that started in Egypt. The plague led to the elimination of a quarter to half the human population of the known world at that time. [8]

The Japanese Smallpox Epidemic claimed up to 25%-35% of Japan's entire population in the years 735–737 AD, with some areas experiencing much higher rates. The epidemic had significant social, economic, and religious repercussions throughout the country. [5]

The Black Death: Also known as the Bubonic Plague was a global outbreak originating in China in 1331 but following the Silk route, it reached Europe in 1347. The plague originated in rats and spread to humans via infected fleas. It was responsible for wiping about 30 – 50 percent of Europe's population which took 200 years to recover from it. In the following centuries the plagues made repeated rounds but of lesser intensity as compared to the black death. These plagues were termed as the second plague pandemic also called 17th and 18th century great plagues [5,9]

Smallpox: Was a highly contagious disease for which the world's first ever vaccine was developed in 1798. Caused by the major variola virus, it's main symptoms included fever, vomiting and the formation of prominent pustules which resulted hundreds of million fatalities in the 20th century alone. World Health organisation (WHO) certified the global eradication of the disease in 1980. [6]

Cholera: A water borne infectious disease caused by the bacterial pathogen Vibrio Cholera became widespread in the 19th century leading to seven cholera pandemics with the first one originating in India in 1817 with additional reported pandemics in between the 1990s. It lead to major scientific breakthroughs including the first immunization by Pasteur and the development of the first cholera vaccine. [10]

Influenza pandemics: Caused by the influenza virus spread on a worldwide scale and led to the transmission of infection among large scale populations. Some of the major influenza pandemics recorded include the 1918 Spanish flu pandemic, being one of the worst pandemics in history, responsible for the mortality of around estimated 40 – 50 million. This led to the six stage classification of transmission of influenza virus by The World Health Organization (WHO). Other major influenza pandemics include the Asian flu in 1957 – 1958, the Hong Kong flu in 1968 – 1969 and the most recent 2009 swine flu pandemic. [5]

HIV Pandemic: Also known as AIDS is a slow progressing global pandemic has a prevalence of about 0.79%. It has led to approximately 25-35 million deaths and more than 30 million people are still living with HIV infection. The efficiency of transmission of HIV-1 depends mainly on the concentration of the virus in the infectious host. As it is considered to be a slowly spreading pandemic, it has received a large amount of attention from the public health sector leading to advancements in treatment protocols in such a manner that HIV has turned into a chronic condition that be managed with anti-retroviral and protease inhibitor medications. [11]

Severe Acute Respiratory Syndrome (SARS): Caused by the SARS Corona virus (SARS-CoV), it started in China and affected fewer than 10,000 individuals, mainly in China and Hong Kong but rapidly let to infect individuals in some 37 countries around the world. With primarily respiratory symptoms, it has a mortality rate of about 10% which led to major public health concern in the early 2000s. This pandemic was also known to be the first outbreak to focus on mental health aspects in its aftermath. [12]

Ebola outbreak: Was first reported in remote villages of Africa in the 1970s, and was originally believed to be transmitted to humans from wild animals. Ebolavirus lead to the frequent fatal haemorrhagic syndrome in humans and has led to more than 20 Ebola outbreaks since the 1970s with the largest being in 2014, declared as a Public Health Emergency of International Concern (PHEIC) by the World Health Organization (WHO). [13]

The 2019 – 2020 Coronavirus Pandemic/ COVID – 19: Was characterized as a pandemic by the Director-General of WHO on March 11, 2020 on the basis of "alarming levels of spread and severity, and by the alarming levels of inaction". It is currently an ongoing pandemic caused by the SARS Corona virus (SARS-CoV) identified in Wuhan, China, in December 2019. With common flu like symptoms including fever, cough, shortness of breath, fatigue etc., COVID – 19 has spikes to more than 3 million cases with over 200 thousand deaths. The pandemic has led to one of the largest global socioeconomic disruptions in the history including the largest global recession since the great depression. On 3rd February 2020 WHO released the international community's Strategic Preparedness and Response Plan to help protect states with weaker health systems. [14]

Conclusion

Similar to a natural calamity, an uncontrolled large scale infectious illness has the capacity to wreak havoc on the stability of even the most powerful and developed nations. Literature provides us enough accounts of massive social, economic and political impact of such an event on previous civilisations. After witnessing the aftermath of the ongoing COVID-19 crisis, it is prudent to mention that there's a pressing need for global governing institutions to develop a detailed protocol for pandemic preparedness and timely response. Only then can we assure the safety of our future generations against an enemy unknown.

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