

A Monthly e Magazine

ISSN:2583-2212

Oct, 2023; 3(10), 2711-2716

Popular Article

Pandemic Preparedness: Navigating Emerging Infectious Diseases for A Safer World

Ayushi Vaidhya*¹, Dhaval J Kamothi², Subhashree Parida³, Anshuk Sharma⁴ and Thakur Uttam Singh⁵

¹M.V.Sc. Scholar, Division of Pharmacology and Toxicology, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, U.P., India

²Ph.D. Scholar, Division of Pharmacology and Toxicology, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, U.P., India

³Senior Scientist, Division of Pharmacology and Toxicology, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, U.P., India

⁴Scientist, Division of Pharmacology and Toxicology, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, U.P., India

⁵Head, Division of Pharmacology and Toxicology, ICAR-Indian Veterinary Research Institute, Izatnagar, 243122, U.P., India

<https://doi.org/10.5281/zenodo.10059105>

Abstract

The present era has seen a series of significant infectious diseases outbreaks, including the devastating impact of the global pandemic like COVID-19. Additionally, there were outbreaks in the past such as the SARS coronavirus in 2003, the swine flu pandemic in 2009, the MERS coronavirus outbreak in 2012, the Ebola virus disease epidemic in West Africa from 2013 to 2016, and the Zika virus disease epidemic in 2015. These events led to substantial illness and death and crossed international borders, thus affecting the lives and livelihoods of many people across the globe. Simultaneously, recent decades have marked an extraordinary period characterized by remarkable advancements in technology, shifts in demographics, and evolving climate conditions. The ongoing developments in our current era are rendering humanity susceptible to future pandemics, anticipated to result from the melting of glaciers and polar ice caps. This thawing process could potentially unleash previously preserved viruses and bacteria from glacial ice and permafrost. Additionally, the warming climate is creating conditions where the habitats of these ancient viral pathogens increasingly overlap with those of humans, posing a significant threat to human well-being and safety. Thus, pandemic preparedness is not optional but rather an imperative in our interconnected global landscape.

Introduction

The term "emerging infectious diseases" (EIDs) refers to infectious ailments that have either manifested in a community or that have long existed but are now seeing a significant rise in incidence or geographic spread. As the causative agents of these ailments are novel or have undergone modifications that make them more virulent, transmissible, or otherwise challenging to control, these diseases frequently pose a serious risk to the public's health (Lederberg *et al.*, 1992). In the past 20 years, there has been a rising trend in the occurrence and magnitude of EIDs that could potentially lead to pandemics. The COVID-



19 pandemic has demonstrated that events where diseases jump from animals to humans (zoonotic spillover) pose a growing risk to global public health.

Starting in 2007, the WHO has officially declared six instances as Public Health Emergencies of International Concern (PHEIC). These include the swine flu pandemic in 2009, the Ebola virus disease outbreaks in West Africa from 2013 to 2015 and in the Democratic Republic of Congo from 2018 to 2020, the ongoing situation with poliomyelitis since 2014, the Zika virus outbreak in 2016, and the continuing COVID-19 pandemic, which began in 2020 and is still ongoing (WHO, 2019). Significant research efforts have been dedicated to these PHEICs, particularly in the context of COVID-19. However, the majority of this research has primarily focused on aspects such as disease origin, symptom identification, transmission chains, case rates, mortality, as well as preventive measures and treatments. There has been comparatively limited emphasis on addressing issues related to health disparity and exploring the connections between pre-existing socioeconomic disparities and the emergence, magnitude, and management of pandemics caused by EIDs (Farmer, 2016). Therefore, the complex interplay between socioeconomic disparities and EIDs, where existing inequalities interact with and worsen factors such as case rates, symptom severity, illness, and death, has not received sufficient attention or investigation (Bambra *et al.*, 2020) (Figure 1).

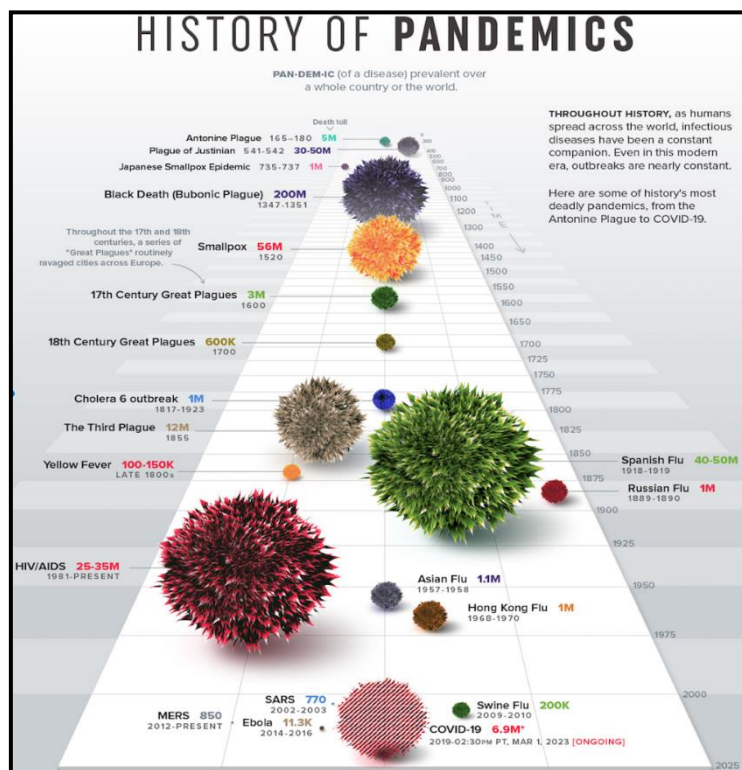


Figure-: 1 Timeline of Pandemics (<https://www.visualcapitalist.com/history-of-pandemics-deadliest/>).

Epidemiological Determinants Contributing to EIDs

1. Zoonotic Spillover: Many EIDs arise in animals and spread to people, including HIV, Ebola, and COVID-19.

2. Environmental Alterations: Deforestation, urbanization, and climate change are examples of environmental changes that could ruin ecosystems and increase human contact with disease vectors or reservoirs.
3. Globalization: Global trade and increased international travel can hasten the transmission of communicable ailments, posing a threat to the globe as a whole from small epidemics.
4. Antimicrobial Resistance: It is more challenging to combat and manage ailments as drug-resistant varieties of bacteria, viruses, and parasites arise.
5. Societal and Behavioral Impact: The genesis and transmission of infectious diseases can be attributed to societal habits such as inadequate hygiene, little emphasis on immunization, and reckless behaviors.
6. Microbial Evolution: Over time, pathogens can alter in terms of virulence, transmission, or susceptibility to treatments (Van Doorn, 2014).

EIDs and inequality

The three case studies highlighting Ebola virus disease (2015-16, 2018-20), Zika virus disease (2016), and COVID-19 (2020 to the present) have exhibited distinct reservoir hosts and vectors (including mosquitoes and bats), different primary methods of transmission (such as blood, contact, and airborne), and have affected a wide array of regions and countries (ranging from West Africa to the Americas to a global scale). Despite these differences, they all share a common outcome in terms of generating substantial disparities in terms of ailments and death rates across different social groups (Bambra, 2022).

The epidemiological study highlighted notable disparities in EIDs. To proactively address these variations, it's crucial to adopt a more comprehensive perspective. Drawing from several past case studies, it becomes evident that four major interlinked factors play a pivotal role in shaping these disparities: differing levels of exposure, variations in disease transmission, disparities in susceptibility, and inequalities in the provision of healthcare. Figure- 2

Pathways to inequality

1. Differing levels of exposure: - Due to disparities in their living and working circumstances, individuals with lower socioeconomic status are at a higher risk of being exposed to infections from EIDs. For instance, regarding Ebola, the poorest communities' dependence on consumption of bush meat may have raised their risk of exposure to the virus, just as increased deforestation and encroachment into forests did. With respect to COVID-19, individuals in lower-paying jobs faced a significantly greater likelihood of exposure, such as having to continue working even during lockdowns (Houéto, 2019).

2. Variations in disease transmission:- Community transmission, defined as the uneven diffusion of a pathogen within a community, is notably shaped by the social factors that determine health. For example, during the Zika epidemic, densely populated urban slums saw considerably higher infection rates due to extreme overcrowding. Likewise, the transmission of COVID-19 virus was more pronounced in economically disadvantaged areas marked by a higher prevalence of multi-occupancy housing, smaller living spaces, greater urbanization, and increased population densities (Souza *et al.*, 2018).



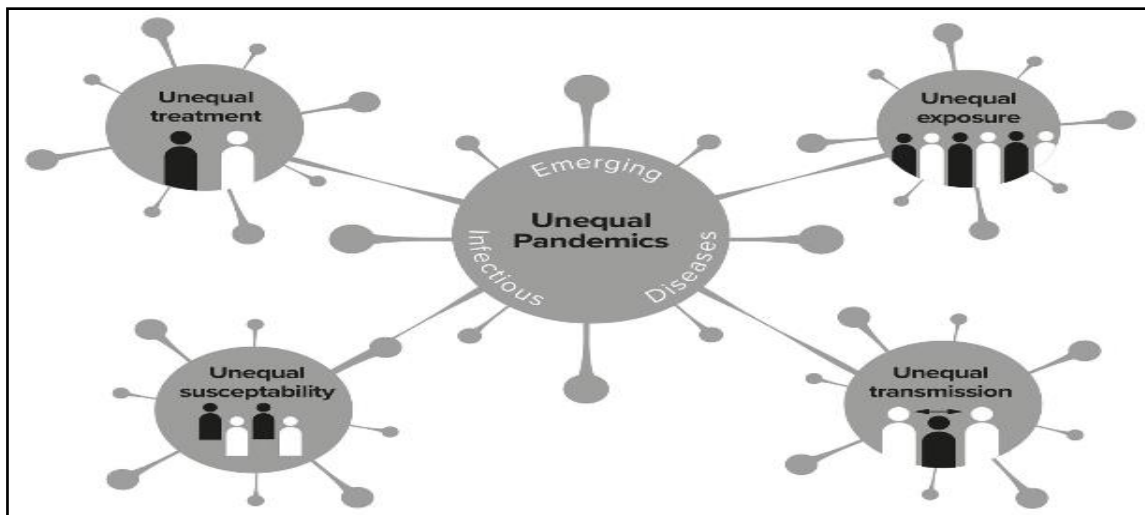


Figure-: 2 Pathways to Inequalities in Emerging Infectious Diseases Pandemics (Bambra, 2022) (Figure 2).

3. Disparities in susceptibility-: This factor presents a dual facet. First, susceptibility to EIDs is heightened by pre-existing medical conditions such as diabetes, heart disease, obesity, tuberculosis, and HIV. Additionally, individuals from lower income brackets are more prone to EIDs due to factors like malnutrition and chronic stress stemming from psychological conditions. Previous research has shown that economically disadvantaged groups with pre-existing health issues and limited access to healthcare facilities are at a higher risk of contracting diseases like Zika and Ebola (Fallah *et al.*, 2015).

4. Inequalities in the provision of healthcare-: A key element contributing to disparities in EIDs lies in the accessibility of healthcare treatment and preventive services. This issue was particularly pronounced during the Ebola outbreak, as the intentionally neglected healthcare infrastructure in West Africa, stemming from historical colonial legacies and persistent healthcare system deficiencies, led to limited access to healthcare facilities. In the case of COVID-19, there's growing evidence that even in developed countries with universal healthcare, disparities exist in the availability vaccines. The pandemic has also revealed inequalities in access to personal protective equipment and disparities in testing for the disease (Todd and Bambra, 2021).

Future Pandemics

Numerous research findings have highlighted the potential for future pandemics to be linked to climate change, as rising temperatures result in the thawing of glaciers and polar ice caps. This thawing process, in turn, may contribute to the resurgence of viruses and bacteria that have been preserved in glacial ice and permafrost. The revival of these microorganisms poses a risk of infecting local wildlife, particularly as these animals migrate toward polar regions in response to the increasing temperatures. A study involving genetic analysis of soil and sediment samples from Lake Hazen, the world's largest high Arctic freshwater lake, has revealed that the risk of viral spill over, where a virus infects a host species for the first time, could be elevated in proximity to melting glaciers (Lemieux *et al.*, 2022) (Figure 3).



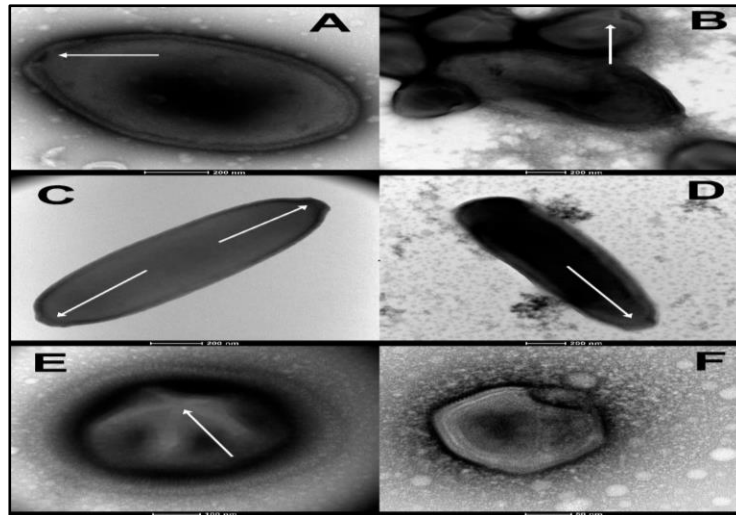


Figure-:3 Morphological features guiding the preliminary identification of newly isolated viruses (negative staining, TEM) (Alempic *et al.*, 2023).

Similarly, a study conducted by a research group has revealed that increasing temperatures could release ancient pathogens previously trapped in polar regions. They identified thirteen viral strains from seven different Siberian permafrost samples (Alempic *et al.*, 2023), with one of them being nearly 50,000 years old and still capable of causing infections. The warming climate is promoting the overlap of habitats between these ancient viral pathogens and humans, thereby presenting a risk to human health and safety (Carson *et al.*, 2022).

Conclusion and Future perspectives

Pandemic preparedness is not optional but rather an imperative in our interconnected global landscape. While the COVID-19 pandemic revealed vulnerabilities in our global response, it also highlighted the potential of human innovation and collaboration. To ensure a safer world for present and future generations, we must allocate resources towards enhancing surveillance, research, healthcare infrastructure, public health education, and global cooperation. The insights gained from this pandemic should lead us to adopt a more proactive and robust strategy for addressing EIDs. We must take action promptly because the next pandemic may loom on the horizon.

On April 23, 2023, the WHO introduced a new program called the "Preparedness and Resilience for Emerging Threats Initiative," abbreviated as PRET. This initiative builds on the lessons and methods developed during the COVID-19 pandemic and other recent health crises, with the goal of enhancing global readiness for pandemics. Using a transmission-based approach, WHO will provide guidance to nations in their pandemic planning efforts, recognizing that many skills and resources can be applied across various infectious agents. PRET responds to the need for technical assistance and support in advancing and reinforcing comprehensive preparedness and response, in line with resolutions from the World Health Assembly.

References

Alempic, J. M., Lartigue, A., Goncharov, A. E., Grosse, G., Strauss, J., Tikhonov, A. N., ... & Claverie, J. M. (2023). An update on eukaryotic viruses revived from ancient permafrost. *Viruses*, 15(2), 564.



- Bambra, C. (2022). Pandemic inequalities: emerging infectious diseases and health equity. *International Journal for Equity in Health*, 21(1), 6.
- Bambra, C., Riordan, R., Ford, J., & Matthews, F. (2020). The COVID-19 pandemic and health inequalities. *J Epidemiol Community Health*, 74(11), 964-968.
- Carlson, C. J., Albery, G. F., Merow, C., Trisos, C. H., Zipfel, C. M., Eskew, E. A., ... & Bansal, S. (2022). Climate change increases cross-species viral transmission risk. *Nature*, 607(7919), 555-562.
- Fallah, M. P., Skrip, L. A., Gertler, S., Yamin, D., & Galvani, A. P. (2015). Quantifying poverty as a driver of Ebola transmission. *PLoS neglected tropical diseases*, 9(12), e0004260.
- Farmer, P. (2016). Social inequalities and emerging infectious diseases. *Understanding and applying medical anthropology*, 118-126.
- Houéto, D. (2019). The social determinants of emerging infectious diseases in Africa. *MOJ Public Health*, 8(2), 57-63.
- <https://www.who.int/news-room/questions-and-answers/item/emergencies-international-health-regulations-and-emergency-committees>
- <https://www.who.int/news/item/26-04-2023-who-launches-new-initiative-to-improve-pandemic-preparedness>
- Lederberg, J., Shope, R. E., & Oaks Jr, S. C. (1992). Emerging infections: microbial threats to health in the United States.
- Lemieux, A., Colby, G. A., Poulain, A. J., & Aris-Brosou, S. (2022). Viral spillover risk increases with climate change in High Arctic Lake sediments. *Proceedings of the Royal Society B*, 289(1985), 20221073.
- Souza, W. V. D., Albuquerque, M. D. F. P. M. D., Vazquez, E., Bezerra, L. C. A., Mendes, A. D. C. G., Lyra, T. M., ... & Martelli, C. M. T. (2018). Microcephaly epidemic related to the Zika virus and living conditions in Recife, Northeast Brazil. *BMC public health*, 18, 1-7
- Todd, A., & Bambra, C. (2021). Learning from past mistakes? The COVID-19 vaccine and the inverse equity hypothesis. *European journal of public health*, 31(1), 2-2.
- Van Doorn, H. R. (2014). Emerging infectious diseases. *Medicine*, 42(1), 60-63.

