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Disease X: Unveiling the Unknown Pathogen and Enhancing Global Preparedness

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Abstract

"The concept of "Disease X" was introduced to drive the creation and refinement of versatile technologies such as vaccines, therapeutic drugs, and diagnostic tests, which could be swiftly adapted and utilized in response to future infectious disease outbreaks with epidemic or pandemic potential. The aim was to establish a proactive approach to emerging health threats by developing platform technologies capable of addressing a broad spectrum of potential pathogens. The COVID-19 pandemic sparked significant discussion on whether it could be classified as an example of Disease X. Particularly, Shi Zhengli, a prominent Chinese virologist, proposed that the initial Disease X might emerge from a coronavirus. This hypothesis is grounded in the observation that a vast array of viruses circulating within wildlife populations poses a substantial risk. These wildlife reservoirs are considered prime sources of future infectious diseases due to their ability to spill over into other species, including humans. Such zoonotic transmissions could lead to the emergence of novel infections against which human populations lack preexisting immunity, thereby posing serious global health threats.

Keywords: Disease-X, COVID-19, epidemic, preparedness, immunity

INTRODUCTION

The term "Disease X" was coined to emphasize the unpredictable characteristics of emerging infectious diseases and the importance of proactive preparedness. It signifies a hypothetical yet highly likely unknown pathogen that could lead to a future epidemic or pandemic. The goal behind this idea is to encourage the development of adaptable platform technologies, such as vaccines, antiviral therapies, and diagnostic tools, that can be rapidly modified and deployed in response to a wide range of pathogens [1].

One of the major concerns is the vast reservoir of viruses circulating in wildlife, particularly in regions where human-wildlife interactions are frequent. These viruses have the capability to "spill over" from animals to humans, resulting in zoonotic infections. When this occurs, humans may face a novel pathogen against which they have no pre-existing immunity, making the spread of the disease more likely and severe [2].

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The "Disease X" framework emphasizes the importance of global collaboration in surveillance, research, and technological innovation to respond swiftly and effectively to future outbreaks, reducing the devastating impact on global health.

Definition

"Disease X" refers to a hypothetical illness caused by a currently unidentified but potentially serious microbial threat. It symbolizes the risk of a new infectious disease suddenly emerging and leading to widespread illness. In 2017, the World

Health Organization (WHO) added Disease X to its list of priority pathogens for research. This list includes some of the deadliest diseases known to humanity, such as severe acute respiratory syndrome (SARS) and Ebola. The inclusion of Disease X highlights the increasing recognition that an unknown pathogen could arise at any moment and trigger a global health crisis [3].

COVID-19, caused by the novel coronavirus SARS-CoV-2, serves as a real-world example of Disease X. When it emerged at the end of 2019, it rapidly spread across the globe, catching health systems off-guard and triggering a pandemic. The concern about Disease X stems largely from the vast reservoir of viruses that circulate in wildlife. These viruses can spill over into human populations, leading to infections for which humans have no natural immunity, making them highly dangerous. Global health experts believe that continued surveillance and research are essential to predict and prevent future Disease X events [4].

Incidence

The World Health Organization (WHO) developed a strategy to ensure early preparedness for emerging diseases, including those that are still unknown, through what it calls "cross-cutting R&D preparedness". This initiative gained urgency following the 2014–2016 Ebola outbreak in West Africa, which exposed significant gaps in global readiness to respond to health crises. Despite decades of Ebola research, no effective treatments or vaccines were available at the time to prevent the epidemic, resulting in over 11,000 deaths. This humanitarian disaster was a wake-up call for the global health community, highlighting the need for faster development of medical interventions [5].

In response, the WHO initiated the R&D Blueprint to expedite research for priority diseases. These include both known threats and potential future ones, ensuring that tools such as vaccines and treatments are available when needed.

Current List of Priority Diseases

- Covid-19.
- Crimean-Congo hemorrhagic fever.
- Ebola virus disease and Marburg virus disease.
- Lassa fever.
- Middle East Respiratory Syndrome (MERS) and SARS.
- Nipah and henipaviral diseases.
- Rift Valley fever.
- Zika.

This initiative aims to prevent another large-scale health crisis.

REASONS BEHIND DISEASE X PANDEMIC

In recent years, the world has faced a series of contagious disease outbreaks, including Monkeypox, Crimean-Congo hemorrhagic fever, and the ongoing threat of COVID-19. These events have heightened global concerns about the potential for another epidemic looming on the horizon. One of the key factors fueling this concern is climate change.

Climate change plays a crucial role in the potential emergence of new diseases, including the feared "Disease X". As global temperatures rise, ecosystems are disrupted, forcing wildlife to migrate to areas closer to human populations. This displacement heightens the risk of zoonotic spillovers, where pathogens are transmitted from animals to humans. This process has been responsible for the emergence of many past infectious diseases, and experts warn that it could lead to future outbreaks as well [6, 7].

Additionally, climate change is altering the dynamics of how infectious diseases are spread. Warmer climates and changing habitats can create ideal conditions for disease vectors like mosquitoes to flourish,

thereby raising the likelihood of transmission. This makes the emergence of new and more frequent infectious diseases more likely [8].

Forcible Animal Relocation

Climate change is causing the destruction and fragmentation of natural habitats, forcing many animal species to move into new areas in search of food and shelter. As wildlife intrudes into human habitats, the closer proximity elevates the risk of zoonotic spillover, allowing pathogens to transfer from animals to humans. This heightened interaction creates ideal conditions for the emergence of new infectious diseases [9].

Mortal Impact

Increased urbanization, deforestation, and encroachment into preliminarily untouched natural territories amplify the chances of humans meeting new and potentially dangerous pathogens. Implicit Sources of Disease X Pandemic.

The World Health Organization (WHO) introduced the conception of Disease X in 2018, emphasizing its potential to crop from different sources.

Zoonotic Contagions

Sources of emerging infectious diseases include hemorrhagic complications and recent non-polio enteroviruses, but the most concerning pathway remains zoonotic transmission. This occurs when animal pathogens jump to humans, often resulting in severe outbreaks. According to Professor John-Arne Røttingen, this natural process represents one of the greatest threats to global health, underscoring the importance of vigilance and preparedness.

WHO special advisor, Professor Marion Koopmans, also highlighted the increasing risk posed by zoonotic diseases. She emphasized that as human-animal interactions intensify – driven by factors like globalization and habitat destruction – it becomes more likely that new zoonotic diseases will emerge and spread worldwide. This growing risk calls for enhanced global surveillance and research [10].

H7N9(2018)

In 2018, a new strain of the H7N9 influenza virus, colloquially referred to as the “raspberry flu”, emerged, capturing the attention of global health authorities due to its alarming characteristics. This strain had a notably high mortality rate of 38%, prompting concerns among health experts and leading some to speculate that it could represent a potential “Disease X”. Despite these fears, the World Health Organization (WHO) and the R&D Blueprint team did not officially recognize it as such.

China’s initial reluctance to share samples of the new H7N9 strain exacerbated international concerns, as limited data hindered global efforts to understand and control the virus. Nevertheless, with coordinated efforts and improved public health measures, the outbreak was ultimately brought under control. This incident highlighted the critical need for transparent data sharing and global cooperation to effectively manage emerging infectious threats.

COVID-19 (2019 – present)

The COVID-19 pandemic sparked significant debate about whether it fits the criteria for what is known as Disease X. Chinese virologist Shi Zhengli proposed that the first Disease X could potentially arise from a coronavirus, given the virus’s similarities to those known to cause serious respiratory illnesses. This hypothesis gained traction as COVID-19 unfolded, exhibiting rapid and widespread global transmission, which aligned with many of the characteristics associated with Disease X.

Marion Koopmans, a member of the WHO’s R&D Blueprint Special Advisory Group, noted that the pandemic’s swift international spread and the novel nature of the virus made COVID-19 resemble a

Disease X scenario. Peter Daszak, another member of the R&D Blueprint, also supported this view, describing COVID-19 as fitting the Disease X profile due to its emergence as an unexpected, high-impact pathogen. The pandemic highlighted the necessity of being ready for unpredictable and potentially devastating infectious threats.

Synthetic Contagions Bioweapons

In 2018, concerns emerged about the potential for future Disease X to be intentionally created as a bioweapon, especially advancements in gene-editing technologies. These technologies have the potential to create synthetic pathogens that could be weaponized for mass destruction. While Professor John-Arne Røttingen expressed skepticism about the likelihood of such an event, he acknowledged the serious risks associated with synthetic biology. The ability to design and produce highly dangerous pathogens underscores the need for robust biosecurity measures and international regulations to prevent misuse of these powerful technologies.

Bacterial Infection

In September 2019, Public Health England (PHE) sounded alarms about the growing issue of antibiotic resistance in bacteria. The effectiveness of even last-resort antibiotics, such as carbapenems and colistin, was dwindling, raising significant concerns among health experts. This resistance is exemplified by conditions like antibiotic-resistant gonorrhea, which poses a serious threat to public health. If unchecked, the rise of such resistant infections could evolve into a Disease X scenario, where previously treatable bacterial infections become untreatable and potentially lead to widespread health crises Table 1.

Table 1. Comparison of COVID-19 and hypothetical Disease X characteristics

S. N.	Aspect	Covid-19	Disease-X
1	Nature	Real-world pandemic with known characteristics	Hypothetical scenario with undefined characteristics
2	Contagiousness	Highly contagious, leading to rapid spread	Unknown contagiousness
3	Severity	Can cause severe illness and fatalities	Severity undefined
4	Healthcare Impact	Overwhelmed healthcare systems globally	Potential to strain healthcare systems
5	Asymptomatic Transmission	Significant role in spreading the virus	Presence and role uncertain
6	Initial Vaccine	No vaccine available during initial stages	Vaccine availability uncertain
7	Preparedness	Lessons learned for preparedness and response	Preparation based on hypothetical scenarios.

PREPAREDNESS FOR DISEASE X PANDEMIC

Enhancing Healthcare Structure

To effectively prepare for a potential Disease X pandemic, India must prioritize enhancing its healthcare infrastructure. This involves investing in the growth and modernization of hospitals, enhancing individual laboratories, and reinforcing research facilities. A well-developed healthcare system is crucial for responding efficiently to future outbreaks. By ensuring that adequate resources and capacities are in place, India can improve its ability to manage and contain new infectious threats, ultimately safeguarding public health and minimizing the impact of potential pandemics.

Improving Surveillance

Enhancing surveillance and early detection systems is crucial for managing emerging diseases. Developing robust surveillance infrastructure and effective early warning mechanisms allows for the timely identification and containment of new outbreaks, thereby mitigating their spread. Moreover, public awareness campaigns are crucial to this process. By educating the population about the signs and symptoms of emerging diseases, these campaigns can facilitate quicker reporting and response, ultimately helping to prevent widespread transmission and improve overall public health resilience.

Promoting Research and Development

India should leverage its strong pharmaceutical industry and scientific expertise to drive research and development in infectious diseases, including the creation of vaccines and treatments.

Investing in these areas will improve the country's capacity to respond swiftly and efficiently to emerging threats. Additionally, building a skilled healthcare workforce is essential for managing outbreaks efficiently. India must focus on training and equipping healthcare professionals with the necessary skills and resources, ensuring they are well-prepared to handle emergencies and provide high-quality care during crises.

Fostering Transnational Collaboration

Recognizing that Disease X poses a global threat, India should actively participate in international collaborations and cooperative efforts. Engaging with global organizations and sharing information, expertise, and resources on an international scale is essential for enhancing preparedness and response capabilities. By working together with other countries and health agencies, India can contribute to a collective approach to global health security. This collaboration not only strengthens individual countries' responses but also builds a unified strategy to address emerging infectious threats effectively.

CONCLUSION

Disease X highlights the urgent need for proactive health measures against unknown pathogens. The COVID-19 pandemic has highlighted the significance of having rapid response capabilities and strong global preparedness. To effectively address future outbreaks, it is crucial to invest in healthcare infrastructure, improve surveillance systems, support research, and encourage international collaboration. By preparing for the unknown, we can better safeguard public health and reduce the effects of future pandemics.

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