

## REVIEW ARTICLE



# Emerging and Re-emerging Infectious Diseases: A Narrative Review.

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## Abstract

The past decade has witnessed a surge in emerging and re-emerging infectious diseases posing a significant threat to global health and social security. A review of emerging and re-emerging infectious diseases was conducted to determine their transmission dynamics and impact on public health. The literature review used major databases (google, PubMed, ScienceDirect, ResearchGate, among others). Articles published on emerging and re-emerging infectious diseases generated from the search terms and phrases were reviewed and relevant ones were included in the review. Our review found that COVID-19, Ebola, Zika, Lassa fever, Avian influenza and monkeypox were among the major emerging and re-emerging infectious diseases in the past decade. The emergence of Severe Acute respiratory syndrome Coronavirus (SARS-Cov-2) in 2019 stood out because of its pandemic level. COVID-19 had a profound global impact on individuals, communities, countries and health systems, especially in low- and middle-income countries. Some of the key factors found to have contributed to the emergence or re-emergence of these diseases were climate change, globalization, urbanization, increased animal-human interface, increased conflicts resulting in migration, and disruption of communities and health systems. Global collaboration in addressing the threats of emerging and re-emerging infectious diseases in the past decade highlighted the importance of proactive measures and emergency preparedness in mitigating the impact of future outbreaks of any infectious threat thus ensuring the maintenance of global health security.

**Keywords:** Emerging, Re-emerging, COVID-19, Zoonosis, Ebola.

## Introduction

Emerging and re-emerging diseases pose significant threats to public health, with implications ranging from economic burdens to global health security.<sup>1</sup> These diseases, often originating from zoonotic sources or due to changes in human behaviour and the environment, require constant vigilance and proactive measures to mitigate their impact.<sup>1</sup> The importance of understanding and addressing emerging and re-emerging diseases is highlighted by their potential to cause pandemics and devastate communities worldwide.<sup>2</sup> For instance, the COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, demonstrated how quickly a

previously unknown pathogen can spread globally, overwhelming healthcare systems and causing widespread illness and death.<sup>2</sup> Moreover, emerging infectious diseases (EIDs) and re-emerging infectious diseases (RIDs) have been linked to various factors such as globalization, urbanization, antimicrobial resistance, ecological changes, and climate change. These factors can create favourable conditions for the transmission of pathogens, facilitating their spread within and between populations.<sup>3</sup>

A study by Jones et al emphasized the interconnectedness of human, animal, and environmental health, highlighting the

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need for a One Health approach to disease surveillance and control.<sup>4</sup> This approach recognizes the interdependence of human health with the health of animals and ecosystems, underscoring the importance of collaboration across disciplines to prevent and respond to emerging and re-emerging diseases effectively. Furthermore, investing in research and development of vaccines, diagnostics, and therapeutics for emerging and re-emerging diseases is crucial for preparedness and response efforts.<sup>4</sup> For example, the development of vaccines against the Ebola virus and Middle East respiratory syndrome coronavirus (MERS-CoV) has been instrumental in controlling outbreaks and preventing further spread.<sup>4</sup>

Improving knowledge of emerging and re-emerging diseases is very crucial as these diseases can impact global health security, disrupt economic activities of nations and international trade and test the resilience of health systems.<sup>5,6</sup> The emergence of antimicrobial-resistant pathogens poses a significant threat to global health, rendering once-effective treatments ineffective and leading to prolonged illness and increased mortality.<sup>7</sup> Studies on emerging infectious diseases provide insights into the drivers of antimicrobial resistance, such as inappropriate antibiotic use in healthcare and agriculture, facilitating the development of antimicrobial stewardship programs and novel treatment strategies.<sup>7</sup>

**Factors contributing to the emergence and re-emergence of infectious disease:**

Several environmental factors such as the variability and shifts in the climate affect the geographic range of infectious diseases like dengue fever, malaria, and Lyme disease by affecting the distribution and abundance of vectors and reservoirs.<sup>8</sup> Temperature variations, altered precipitation patterns, and harsh weather can all contribute to the development of ideal circumstances for pathogen replication, vector reproduction, and transmission.<sup>8</sup>

Deforestation, urbanization, and agricultural expansion alter ecosystems and disturb natural habitats, which

increases contact between people and wildlife and raises the risk of zoonotic disease spillover.<sup>9</sup> By modifying the organization of host communities and vector behaviours, habitat fragmentation and biodiversity loss can also have an impact on the dynamics of disease.<sup>9</sup>

Globalization and travel are not left out as potential inducers of emerging and re-emerging factors. Trade, migration, and travel on a global scale enable infectious agents to move quickly across national borders, enabling diseases to infect new areas and become endemic.<sup>10</sup>

Socioeconomic factors for the spread of disease, such as cramped living quarters, starvation, and restricted access to healthcare especially immunizations and mosquito nets, can all be made worse by poverty.<sup>11</sup> On the other hand, urbanization and informal settlements are social pointers to emerging and re-emerging infections.<sup>12</sup> These conditions are exacerbated by the lack of infrastructure for waste management, sanitation, and healthcare provision.<sup>12</sup> Marginalized communities face obstacles to prompt diagnosis, treatment, and preventative care, which lead to unequal illness outcomes.<sup>13</sup> Moreso, migration and displacement can trigger the transmission of infectious illnesses across borders and regions can be aided by population movements brought on by environmental displacement, economic migration, or conflict.<sup>13,14</sup>

The role of microbial factors in the emergence and re-emergence of diseases is of great concern to public health. One important factor is that pathogens, like viruses and bacteria, are constantly evolving and adapting, which results in the formation of new strains that may effectively disseminate and elude human protection.<sup>15</sup> For example, the appearance of SARS-CoV-2 variations of concern (VOCs), such as the Delta variant, highlights the dynamic character of microbial evolution and its consequences for the transmission of disease.<sup>16</sup> The selection and spread of antimicrobial-resistant bacteria and genes is facilitated by environmental contamination with antimicrobial agents, such as antibiotics and disinfectants.<sup>17</sup> Antimicrobial misuse

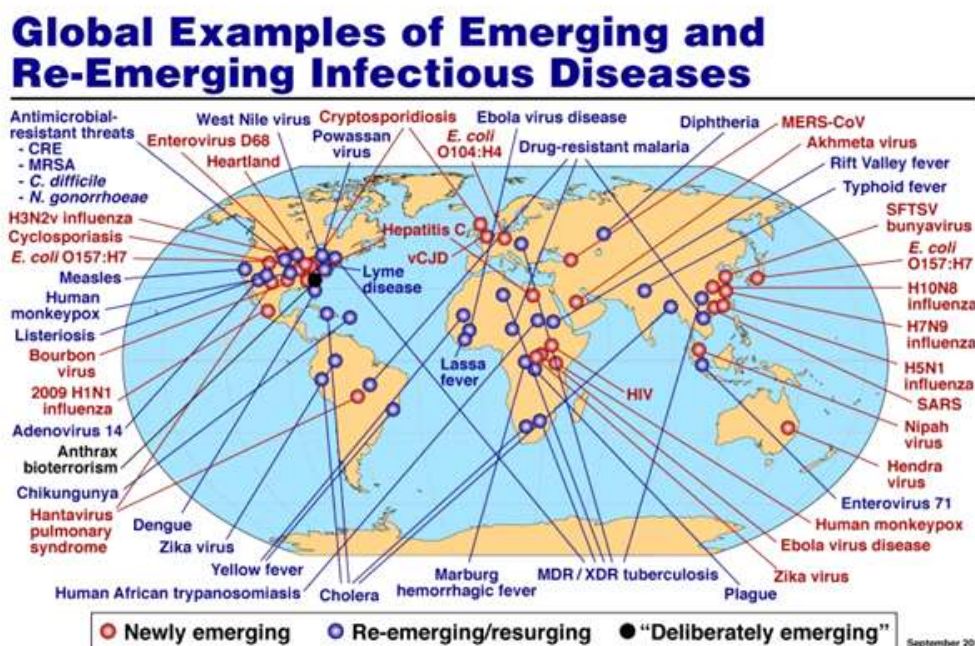


Figure 1: Examples of emerging and re-emerging infectious diseases.<sup>18</sup>

is contributing to the spread of resistant pathogens in human and environmental reservoirs.<sup>17</sup>

### Some Emerging and Re-emerging Infectious Diseases in the last 10 years:

Several infectious diseases have re-emerged in the last decade, some with very devastating impacts.<sup>18</sup>

Coronavirus disease 2019 (COVID-19) was first reported in 2019. The first cases were reported to have originated from Wuhan in China.<sup>19,20</sup> COVID-19 is caused by a coronavirus called severe acute respiratory syndrome coronavirus-2 (SARS-COV-2). It is a new strain of coronaviruses that has been known to infect humans and animals for a long time. The origin is reported to be zoonotic with the initial cases linked to a wet market in Wuhan China where fresh animal produce and meat are sold.<sup>19,21,22</sup>

Following the first reported cases of COVID-19 in late 2019, cases quickly spread to many countries around the world through international air travel routes. The disease was declared a pandemic in March 2020 by the World Health Organization.<sup>20,23</sup>

SARS-COV-2 is primarily a respiratory pathogen. The disease manifests with constitutional symptoms including fever, headaches, and respiratory symptoms like cough and shortness of breath.<sup>20,24</sup> COVID-19 exerted a heavy impact on health systems around the world with a heavy financial burden on every sector of the economy and life generally. This was because of the impact of the disease on health causing serious morbidity and case fatalities due to poor health infrastructures and resources, especially in low- and middle-income countries.<sup>23</sup> Fatalities associated with the disease were also high in many developed countries, especially among the vulnerable population such as the elderly and those with co-morbidities.<sup>23</sup>

COVID-19 had a devastating impact on the lives of people due to the strict lockdown imposed as a control measure. This disruption affected every aspect of life, including daily income-generating activities, industrial production, and education, with widespread school closures. These challenges had devastating consequences for individuals, families, and communities, profoundly impacting their psychosocial, physical, and mental health.<sup>25</sup> Many people today are living with the complications of the COVID-19 pandemic such as Long COVID, and the psychological trauma of the events surrounding the peak of the pandemic.<sup>24</sup> Ebola disease is caused by a group of viruses, known as orthoebolaviruses (formally known as Ebola virus), named after the river Ebola in former Zaire, now known as the Democratic Republic of Congo (DRC). These viruses are zoonotic pathogens known to cause disease in non-human primates and pigs. It has also been found in bats.<sup>26</sup> Ebola disease was first described in 1976 near Ebola River in the DRC from where the virus got its name. Several outbreaks of Ebola disease have been reported in the past 10 years in Africa. In 2014, an outbreak of Ebola disease started in Guinea, West Africa and spread to several countries including Sierra Leone, Liberia, Nigeria, Mali, Italy and the United States.<sup>27</sup> Other outbreaks of Ebola within the last 10 years include outbreaks in DRC in 2018, Guinea and DRC in 2012 and Uganda and DRC in 2022.<sup>26-28</sup>

The resurgence of Ebola disease in Eastern Africa in the past 10 years is a serious problem, especially in the DRC and

Uganda which have witnessed several outbreaks. The problem is further compounded by weak health systems and conflicts in the region.<sup>28</sup> Ebola outbreaks in the DRC and Uganda are also reported to pose a significant threat to the health and socio-economic well-being of East Africa due to frequent international travel in the region. The outbreaks disrupt economic activities like agriculture, trade and tourism.<sup>28</sup> Reports also suggest that Ebola disease epidemics are traumatic events having not only socioeconomic impact but also leading to mental breakdowns and reduced quality of life for those affected.<sup>29</sup>

Zika Virus disease is a mosquito-borne disease that is transmitted by the mosquito *Aedes aegypti*. The virus is a member of the genus flavivirus and related to other vector-borne flaviviruses like Dengue virus.<sup>30</sup> Zika virus was first identified in Rhesus macaque monkeys in Africa and human disease outbreaks have been reported since 2007. In the past decade, there have been three reported outbreaks of Zika virus disease.<sup>31</sup> A large outbreak of Zika virus disease was also reported to have occurred in Brazil in 2015. The epidemic extended into 2016 and 2017 with over 200,000 cases reported and an outbreak was also reported in Europe in 2019 and another in India in 2021.<sup>30,31</sup>

Avian influenza is a disease caused by a serotype of Influenza virus type A. Avian influenza includes the H7N9 serotype and affects birds. It is transmitted to humans through contact with infected, sick or dead birds.<sup>31</sup> First reported in China in 2013 where over 1500 cases of human infections were recorded with many deaths, Avian influenza is now known to cause human infections in other countries with several cases reported from Africa, Europe and the Americas.<sup>30</sup> Avian influenza has recently been reported in dairy cows in the United States with multiple states reporting outbreaks of the disease attributed to the H5N1 serotype.<sup>31,32</sup>

The impact of Avian Influenza outbreaks is usually linked to the massive culling of birds as part of control measures.<sup>33</sup> A report found that an estimated 40 million birds are lost during outbreaks with an associated cost of between \$2.5 billion to \$3 billion. This can have a devastating impact on the food sector and global trade and economy.<sup>33</sup>

Chikungunya virus (CHIKV) is an arbovirus from the genus Flavivirus. It is a vector-borne virus transmitted by the mosquitoes *Aedes aegypti* and *Aedes albopictus*. Chikungunya virus, like Zika virus, is endemic to Africa.<sup>34</sup> It is a re-emerging pathogen of zoonotic origin. It is found in non-human primates and transmitted to humans by mosquitoes through their bites.<sup>34</sup> Chikungunya occurs in sporadic outbreaks which have been reported in many countries across Africa, Asia, the Caribbean, and Latin America.<sup>34</sup> In Nigeria, Chikungunya was reported to be endemic, and outbreaks tend to be associated with periods of heavy rainfall.<sup>35</sup> Many outbreaks of CHIKV have been reported in Africa and countries in Asia, and Latin America over the last decade.<sup>35</sup>

The re-emergence of Mpox in various parts of the world has raised concern among public health authorities worldwide.<sup>36</sup> The World Health Organization declared outbreaks of Mpox in some countries of Africa including Nigeria and the DRC from 2017 to 2018.<sup>37</sup> Europe, Asia and the Americas have also seen outbreaks of monkeypox primarily affecting



disease.<sup>44</sup> The two approved vaccines are Ad26.ZEBOV/MVA-BN-Filo, produced by Janssen, and rVSV-ZEBOV, a single-dose vaccination made by Merck, which is anti-EBOV.<sup>45</sup> The surface glycoprotein is the target antigen of the rVSV-ZEBOV, a recombinant vesicular stomatitis vector (rVSV) that is essential for eliciting a protective humoral immune response. In the most affected areas, ring vaccination with rVSV-ZEBOV-GP was implemented during the latest outbreak in the Democratic Republic of Congo.<sup>46</sup>

The first Dengue vaccine (CYD-TDV "Dengvaxia") was licensed in 2015 and is now used in a few nations, particularly in countries where DENV infection is quite common.<sup>47</sup> This vaccine contains a 17D reserve of the yellow fever virus and is tetravalent, and attenuated.<sup>49</sup> Nevertheless, the use of Dengvaxia is restricted to individuals who test positive for Dengue and are older than nine.<sup>48</sup> Numerous vaccination approaches have been examined for Zika virus (ZIKV). Several are now in the preclinical stage, while others are in the clinical stage.<sup>49-51</sup> Although the cases of ZIKV are low, vaccine development for the disease is ongoing due to the possibility of large-scale outbreaks in the future and the severity of complications associated with ZIKV infections in pregnant women such as congenital malformations.<sup>52</sup>

The COVID-19 pandemic demonstrated that the nations with the lowest incomes and greatest vulnerability suffered the greatest loss of life. Furthermore, public policies must be addressed for immunizations to reach places that are inaccessible owing to dangerous natural circumstances, violence, war, and other risks, as well as populations like prisoners, expectant mothers, and those with comorbidities.<sup>48</sup>

### Public health interventions in the prevention and control of EID

Public health initiatives have been essential in combating emerging and re-emerging infectious illnesses over the years.<sup>53</sup> Early outbreak detection and response have been made easier by enhanced surveillance systems, such as those that use syndromic surveillance and improved molecular diagnostics.<sup>53,54</sup> Building public trust and encouraging collaboration in outbreak response have been made possible by transparent risk communication tactics combined with community engagement initiatives.<sup>55</sup> By raising immunization rates in susceptible groups, targeted vaccination campaigns have proven crucial in containing outbreaks.<sup>56,57</sup> Travel advisories and screening procedures, among other border health interventions, have contributed to the reduction of infectious disease transmission across international borders.<sup>58, 59</sup> Additionally, improvements in epidemic preparedness and response skills have resulted from investments in health system strengthening and capacity building.<sup>60,61</sup> Over the past 10 years, public health strategies have changed dramatically to address the complicated problems brought on by emerging and re-emerging infectious diseases. Governments and health organizations may effectively reduce the impact of future epidemics and protect global health security by placing a high priority on surveillance, communication, immunization, border health measures, and improving the health system.<sup>61</sup> As targeted vaccination programs successfully lower disease burden and transmission in high-

risk populations, preventive vaccination continues to be a cornerstone.<sup>56</sup> Furthermore, the implementation of current campaigns has shown to be crucial in raising vaccination rates and averting epidemics.<sup>57</sup> Additionally, marginalized populations now have better access to vaccines due to the development of creative vaccine delivery strategies such as integrated healthcare services and mobile vaccination clinics.<sup>62</sup> These tactics highlight how crucial immunization campaigns are to reducing the effects of emerging infectious illnesses and attaining the objectives of global health security.

### Conclusion:

The importance of addressing emerging and re-emerging diseases cannot be overstated. By understanding the underlying factors driving their emergence and re-emergence and implementing proactive measures, we can mitigate their impact on public health and global stability. Improving our knowledge of emerging and re-emerging infectious diseases is essential for safeguarding global health security, mitigating economic losses, strengthening healthcare systems, and addressing the threat of antimicrobial resistance. By integrating findings from epidemiological, ecological, and social research, policymakers and healthcare practitioners can develop evidence-based strategies to prevent, detect, and respond to outbreaks and ultimately protect populations from the devastating consequences of infectious diseases

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