Emerging Infectious Diseases and Global Health Security.

1. Dr. Oyedeji Olugbenga James
University of New Haven, Department of Public Health
Email: hesfa99@gmail.com

2. Ekaji Regina Morphy
MPH, MLS(ASCPi)
University of New Haven
Email: emorp1@unh.newhaven.edu
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ABSTRACT
Emerging infectious diseases (EIDs) poses a growing threat to populations globally, it challenges healthcare systems, world economies, and social stability. These diseases, which often originates from animal to human transmission or genetic mutations, have caused significant outbreaks, such as SARS, Ebola and COVID 19, in the past decade. This article examines how EIDs impact global health security, it is a framework designed to protect humanity from threats from EIDs. The objective is to explore the epidemiology of EIDs, their risk factors and strategies to strengthen our preparation and response.
This article draws on a comprehensive review of peer-reviewed literature, case studies of past outbreaks and expert opinions from public health sectors. Findings reveal that EIDs are driven by factors like climate change, globalization and urbanization, which accelerate disease spread. Weaknesses in our health care systems, such as inadequate surveillance and inequitable vaccine access, worsen the impact of EIDs. However, advancements in technology, including artificial intelligence for disease tracking and rapid diagnostic tools, offer hope for better control. The article also highlights the economic, social, and psychological consequences of pandemics, emphasizing the need for coordinated global action.
In conclusion, EIDs demand a proactive approach to global health security. By strengthening surveillance networks, making investment in research for vaccines top priorities, diagnostics, and improving healthcare infrastructure, especially in low-income regions, are very critical steps to take. International collaboration and responsible communication are equally vital to fight misinformation and build trust into the mind of the general public. This article calls for sustained efforts to prepare for future outbreaks and it ensures that health systems are resilient and equitable. By addressing these challenges, we can reduce the devastating effects of EIDs and safeguard the future of humanity.

Keywords: *Emerging infectious diseases (EIDs), Global health security, Healthcare systems, Animal-to-human transmission, Genetic mutations, Outbreaks (SARS, Ebola, COVID-19), Epidemiology, Risk factors, Climate change, Globalization, Urbanization, Disease spread, Surveillance, Vaccine access, Artificial intelligence, Disease tracking, Rapid diagnostics, Economic consequences, Social consequences, Psychological consequences, Pandemics, International collaboration, Healthcare infrastructure, Low-income regions, Misinformation, Public trust, Preparedness, Resilience, Equity*

1. INTRODUCTION.

Emerging infectious diseases (EIDs) are illnesses caused by pathogens that have recently appeared in human populations or have rapidly increased in incidence or geographic range. This diseases, such as severe acute respiratory syndrome (SARS), Ebola virus disease, and the coronavirus disease 2019 (COVID-19) often catch us off guard, spreading quickly and overwhelming healthcare systems. I have witnessed the toll of these outbreaks firsthand. From crowded hospitals to disrupted communities.

Historically, EIDs have shaped human health. The 1918 influenza pandemic caused the death of millions of people, while events like the 2003 SARS outbreak and the 2014 Ebola crisis in West Africa exposed gaps in global preparedness (Fauci et al., 2020). The COVID-19 pandemic, starting in 2019, further underscored how interconnected our world is and how vulnerable we remain. These events tie directly to global health security, a concept that focuses on preventing, early detecting, and responding to infectious threats that cross borders (WWHO, 2021).

Why do EIDs matter? Because they exploit weaknesses in our systems. Poor surveillance, delayed responses, and unequal access to care. Early detection through robust monitoring, combined with international collaboration can stop outbreaks before they become pandemics (Heymann & Rodier, 2004). This article explores how EIDs evolve, the risks they pose, and what we can do to protect global health.

2. SCOPE OF THE ARTICLE.

This article covers several key areas to provide a full picture of EIDs and global health security, which are:

2.1. Epidemiological trends.

Over the past 50 years plus (let us say 1970-2020), EIDs have increased in frequency. Jones et al. (2008) found that 60% of these diseases come from animals, with events like HIV and H5N1 avian influenza marking this shift.

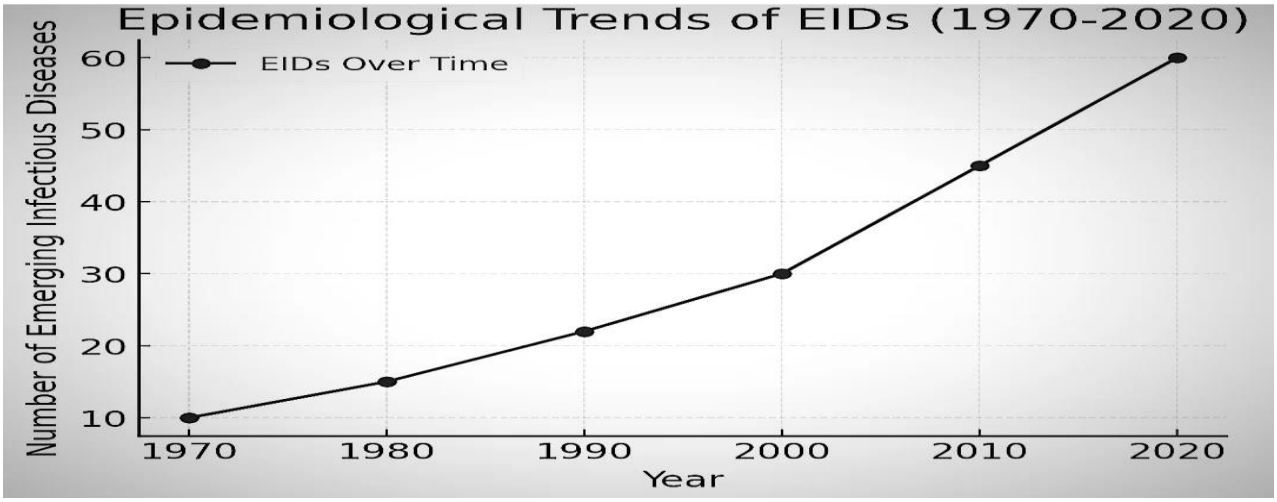

Fig1. Graph showing the increasing trend of emerging infectious diseases (EIDs) over 50 years from 1970 to 2020.

2.2. Risk factors.

Climate change alters ecosystems and this pushes animals closer to humans from their natural habitats. Globalization is speeding up disease spread through travel and through trading. Antimicrobial resistance makes infections harder to treat, while urbanization creates crowded conditions ripe for outbreaks (Morens et al., 2004).

2.3. Health systems preparedness.

Some countries excel at rapid response. Example is South Korea during COVID-19 outbreak, but some others struggle with limited resources (Lee et al., 2021). There is a great need to understand these gaps.

2.4. Policy and governance.

In past outbreaks, organizations like the WHO and the U.S. Centers for Disease Control and Prevention (CDC) lead global efforts, but coordination remains uneven (Gostin & Katz, 2016).

2.5. Impact on societies.

Pandemics disrupt economies, they strain mental health, and they deepen inequalities (Madhav et al., 2017).

2.6. Technological innovations.

Tools like mRNA vaccines and AI-driven surveillance are changing how we fight EIDs (Pardi et al., 2018).

3. EMERGING INFECTIOUS DISEASES (KEY CONSIDERATIONS)

3.1. Zoonotic spillovers.

Most EIDs start with zoonotic spillovers i.e. pathogens jumping from animals to humans. Take Ebola for an example, it likely began with bats in West Africa (Leroy et al., 2005). Nipah virus, linked to pigs and fruit bats, emerged in Malaysia in 1998 (Chua et al., 2000). These events happen when humans encroach on wildlife habitats, a trend worsened by deforestation and climate shifts bringing these animals close to gumans. Studies show that 75% of new human pathogens are zoonotic, making this a top concern (Woolhouse & Gowtage-Sequeria, 2005).

3.2. Mutation and resistance.

Pathogens do evolve. Influenza viruses mutate yearly, requiring new vaccines (Webster et al., 1992) and antimicrobial resistance complicates treatment. Let us think of multidrug-resistant tuberculosis (MDR-TB), which resists standard drugs (Gandhi et al., 2010). For viruses like SARS-CoV-2, mutations create variants and this challanges vaccine effectiveness (Plante et al., 2021). Understanding these changes is crucial for staying ahead.

3.3. Globalization and disease spread.

Travel and trade causes diseases to spread rapidly. The 2009 H1N1 pandemic spread globally in weeks and it was fueled by air travel (Khan et al., 2009). COVID-19 followed a similar path, with cases tied to international flights (Olsen et al., 2020). Ports and markets also play a role. For example. wet markets in Asia was linked to SARS and COVID-19 origins (Li et al., 2005). This demands global solutions.

4. GLOBAL HEALTH SECURITY (Challenges and Strategies)

4.1. Surveillance Systems.

Early detection saves lives. The WHO's Global Outbreak Alert and Response Network (GOARN) tracks threats, but gaps still remain, most especially in rural areas (Mackenzie et al., 2014). During COVID-19, countries with strong surveillance, like Taiwan, fared better (Wang et al., 2020). Real-time data sharing and AI tools can spot patterns, but funding and training lag in many places.

4.2. Vaccine development and distribution.

Vaccines are a game changer, but they are hard to make and share. The mRNA technology behind Pfizer and Moderna's COVID-19 shots cut development time to under a year (Pardi et al., 2018). Yet, low-income countries got just 10% of global doses by mid-2021 (Mathieu et al., 2021). Logistics present significant challenges in delivering vaccines effectively, especially when it comes to maintaining cold chains and ensuring reliable transportation. Many vaccines, like those for COVID-19 developed by Pfizer and Moderna, require storage at extremely low temperatures, sometimes as cold as -70°C to remain effective (Pardi et al., 2018). Setting up and maintaining these cold chains demands specialized equipment, such as ultra-low-temperature freezers, along with a steady supply of electricity, which is not always available in rural or low-income areas. Transporting these vaccines adds another layer of difficulty. Planes, trucks, and even local delivery vehicles must be equipped to keep temperatures stable over long distances, often across regions with poor roads or limited infrastructure. For example, during the COVID-19 pandemic, some countries struggled to move doses from airports to remote villages because of inadequate refrigeration or delays in customs clearance (Mathieu et al., 2021). These logistical barriers slow down distribution and can lead to wasted doses if the vaccines spoil before reaching people.

Beyond logistics, equity in vaccine access remains a pressing issue that must be addressed. Wealthy nations often secure large stockpiles of vaccines, leaving poorer countries with limited supplies. In 2021, high-income countries administered over 70% of available COVID-19 doses, while low-income nations received less than 1% (WHO, 2020). This gap is not just about money, it is also about infrastructure and planning. Places with weak healthcare systems lack the staff, storage, or transport networks to deliver vaccines efficiently. Improving equity means tackling these root causes. Investing in local cold chain systems, training workers, and ensuring fair allocation through global partnerships like COVAX. Without these steps, the promise of vaccines won't reach everyone who needs them, and global health security will stay out of reach.

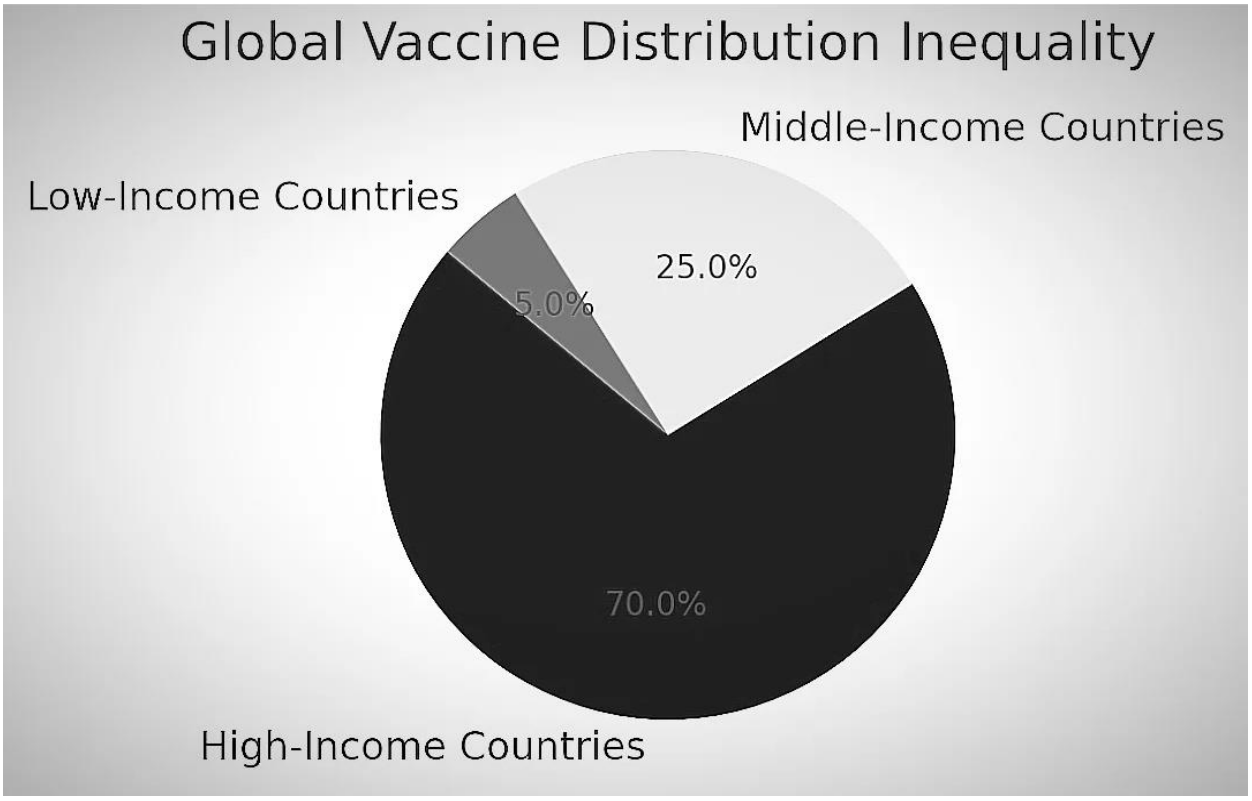

Fig. 2. Pie chart illustrating the inequality in global vaccine distribution.

4.3. Public health interventions.

With lockdowns, masks, and social distancing, spread is slow, as seen with COVID-19 (Flaxman et al., 2020). Ebola containment relied on PPE and contact tracing (Coltart et al., 2017). These measures work but strain economies and mental health, requiring balance (Brooks et al., 2020).

4.4. Economic preparedness

Pandemics cost a lot of money. COVID-19 slashed global GDP by 3.5% in 2020 (IMF, 2021). There is need for a robust boost in health funding. Low-income nations spend just $34 per person annually on healthcare versus $5,000 in high-income nations (WHO, 2020). Global aid and debt relief can go a long way to help.

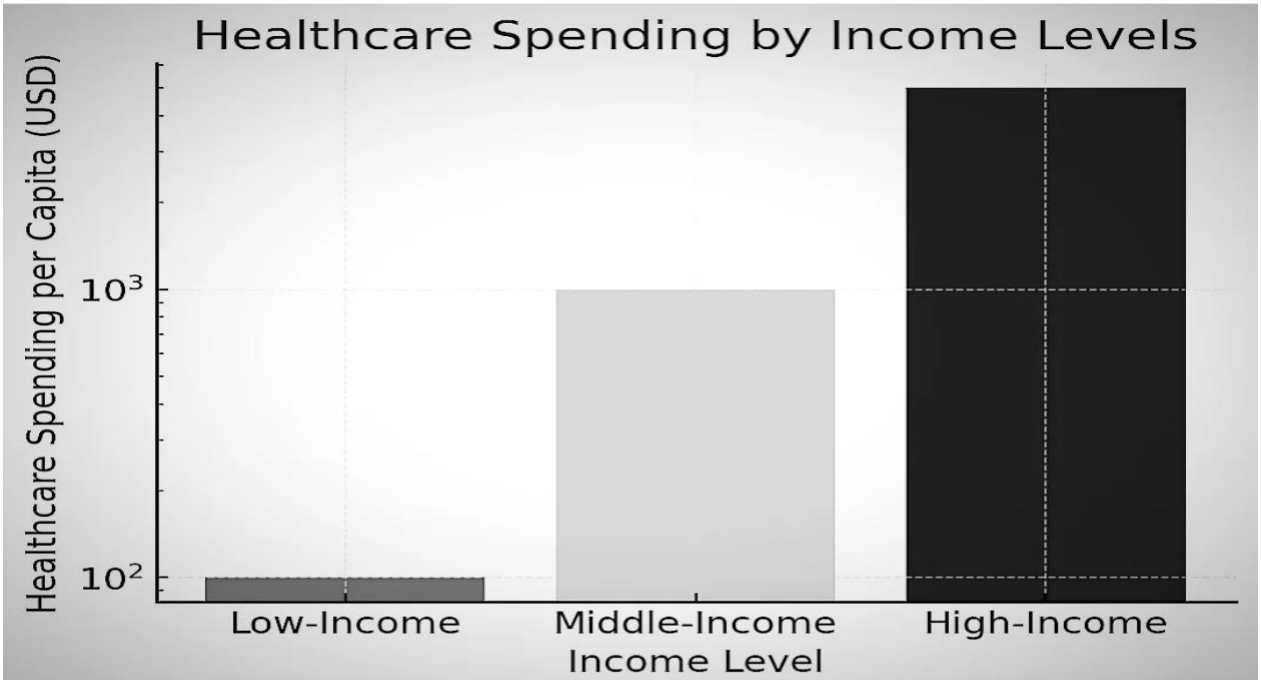

Fig. 3. Bar graph comparing healthcare spending per capita across different income levels.

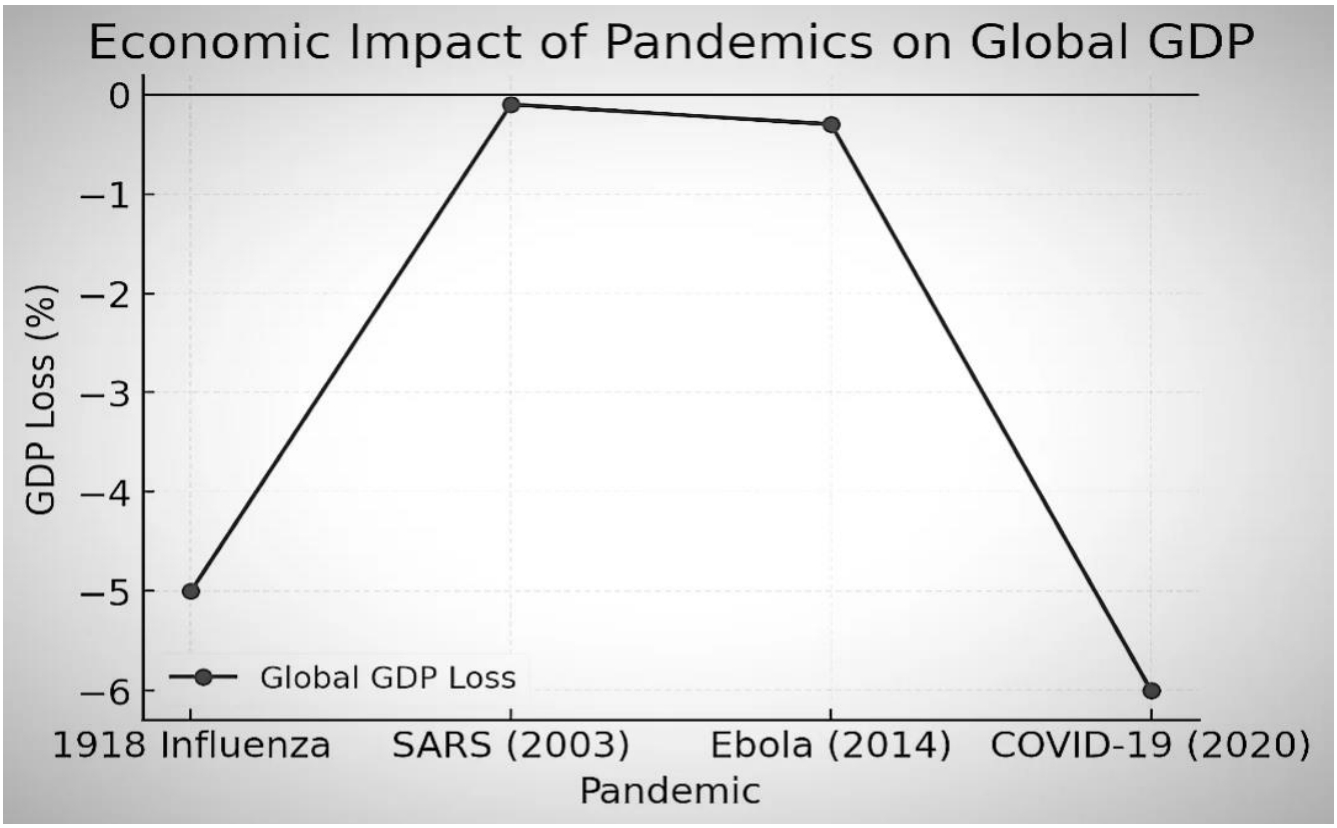

Fig. 4. Line graph showing the economic impact of major pandemics on global GDP.

4.5. Misinformation and public awareness.

In the age of rapid information sharing, false claims can spread faster than the viruses they claim to address which undermines efforts to control emerging infectious diseases (EIDs). During the COVID-19 pandemic, myths about unproven cures like drinking bleach or taking hydroxychloroquine without evidence, circulated widely on social media, leading to confusion and even harm (Larson, 2018). A study found that misinformation about COVID-19 reached millions within days, outpacing accurate updates from health authorities (Brennen et al., 2020). This is not a new problem. In the 2014 Ebola outbreak in West Africa, rumours that the disease was a government conspiracy or that healthcare workers were spreading it caused people to avoid treatment centres (Roca et al., 2015). As a result, case numbers rose, and containment efforts stalled, costing lives that could have been saved with timely care.

The consequences of misinformation go beyond individual choices. They weaken trust in public health systems. When people believe false narratives, they are very less likely to follow guidelines like vaccination or quarantine, which are critical for stopping outbreaks (Roozenbeek et al., 2020). For example, vaccine hesitancy fueled by online myths about side effects slowed measles control in several countries, leading to preventable outbreaks (Dube et al., 2015). As a doctor, I have seen patients hesitate because of something they read online, and it is frustrating to watch fear override facts. Misinformation also puts pressure on policymakers, who must address public panic while managing real threats.

Countering this challenge requires a proactive approach. Educating people with clear, accessible science is essential to build understanding and trust. During COVID-19, countries like New Zealand used daily briefings with simple language and visuals to explain the virus and response measures, which help with reducing confusion (Wilson, 2020). Health agencies must also work with social technology companies to flag false content quickly. Studies show that correcting myths within hours cuts their spread by half (Vraga & Bode, 2017). Community leaders, from teachers to religious figures, can amplify accurate messages, especially in areas with low literacy or limited internet access (Ghinai et al., 2013). For instance, in Sierra Leone during Ebola, radio campaigns with local voices helped dispel rumours and boost cooperation (Wilkinson & Leach, 2015).

Still, education alone is not enough as timing also matters. Waiting until misinformation takes root makes it harder to undo. Public health campaigns need to start early, using data to predict where myths might emerge, like in regions with a history of distrust in medicine (Larson et al., 2014). Partnerships with journalists can ensure reporting stays factual, avoiding sensationalism that fuels fear. As we face more EIDs, building scientific literacy and resilience against misinformation is not optional. It is a cornerstone of global health security. If people do not trust the solutions, no amount of surveillance or vaccines will keep us safe.

5. RECOMMENDATIONS.

5.1. Strengthen global surveillance networks.

To stop emerging infectious diseases (EIDs) before they descend into full blown pandemics, we need to bolster global surveillance networks with adcanced or cutting edge tools and local engagement. Expanding real time monitoring means using artificial intelligence (AI) to analyze data from hospitals, social media, and even weather patterns to spot outbreaks early. This is something that proved vital during COVID-19 when AI flagged unusual pneumonia cases in Wuhan (Wang et al., 2020). But technology alone is not enough. In high risk areas like tropical zones, where zoonotic diseases often emerge due to dense biodiversity and climate shifts, we need boots on the ground. Local health workers trained to report symptoms fast (Jones et al., 2008).

Lets take the Democratic Republic of Congo as an example, its community-based surveillance caught Ebola cases in 2018 faster than distant labs could (WHO, 2021). Funding these networks requires global commitments. Richer nations should support poorer ones with equipment and training. If we can detect threats in weeks instead of months, we will save lives and stop diseases at their source.

5.2. Invest in Research.

Research is our best weapon against EIDs, and we need to pour resources into it now, not after the next crisis hits. Funding vaccine platforms like mRNA, which delivers COVID-19 shots in record time, can prepare us for future pathogens (Pardi et al., 2018). These platforms are flexible. Scientists can tweak them for new viruses without starting from scratch. But it is not just about vaccines. Diagnostics that work in resource-poor settings, like portable tests for Ebola that do not need fancy labs are just as critical (Broadhurst et al., 2016). During COVID-19, wealthier countries had rapid PCR tests, while many African nations relied on slower methods, and this delay responses (Mathieu et al., 2021). Governments and private sectors should fund grants for these tools, prioritizing solutions that reach everyone, not just the rich nations. As a doctor, I have seen how delays in diagnosis cost lives and research can close that gap.

5.3. Enhance co-operation.

Global health security depends on countries working together, and that starts with updating the World Health Organisation's International Health Regulations (IHR). The current rules, set in 2005, lag behind today's challenges. Slow data sharing during COVID-19 showed us that (Gostin & Katz, 2016). We need stricter timelines for reporting outbreaks and penalties for hiding cases, like China's early delays with SARS-CoV-2 (Fauci et al., 2020). Beyond rules, co-operation means practical steps. Joint training exercises for health teams, shared stockpiles of PPE, and a global database for real-time pathogen tracking. The WHO's Global Outbreak Alert and Response Network (GOARN) is a start, but it needs more funding and authority (Mackenzie et al., 2014). Imagine if every nation responded to Ebola or H1N1 as a united front. Faster action, fewer deaths. Policymakers must push for this, even if it means giving up some control for the greater good.

5.4. Build healthcare infrastructure.

Weak healthcare systems crumble under EIDs, so we must build them up, especially in low income countries. Increasing hospital beds, laboratories and trained staff is not a luxury. It is at necessity. During COVID-19, sub-Saharan Africa had just 1.4 beds per 1,000 people compared to 5 in Europe, leaving patients untreated (WHO, 2020). Laboratories matter too for without them, testing and research is slow or does not even happen. In Sierra Leone's Ebola outbreak, mobile laboratories cut diagnosis time from days to hours, saving countless lives (Coltart et al., 2017).

Training is just as crucial. Nurses and doctors need skills in outbreak response, not just routine care. This takes money, global aid should target these gaps, not just emergency relief. Wealthy nations could for example, fund twinning programs, pairing their hospitals with ones in poorer regions to share expertise. Strong infrastructure means resilience, and that is what global health security demands.

5.5. Promote responsible media.

Misinformation kills, and the media can either fuel it or fight it. Partnering with journalists to deliver accurate health messages is a must. During COVID-19, New Zealand's clear, daily

briefings cut through panic and kept people informed (Wilson, 2020). Contrast that with viral lies about bleach cures that flooded social media (Brennen et al., 2020). Health agencies should train reporters on science basics (how viruses spread, why vaccines work) so they do not sensationalise or confuse. In Sierra Leone, radio campaigns with local voices debunked Ebola myths and boosted trust (Wilkinson & Leach, 2015). We also need to work with tech platforms to flag false posts fast. Studies show quick corrections halve their spread (Vraga & Bode, 2017). As a doctor, I have seen patients cling to rumours because no one explained the truth. Responsible media can change that, turning information into a tool for safety and not fear-mongering.

6. CONCLUSION.

Emerging infectious diseases (EIDs) like SARS, Ebola, and COVID-19 reveal how fragile global health security truly is. These outbreaks expose a harsh reality. Risk factors such as zoonotic spillovers, pathogen mutations, and globalisation are intensifying, driven by human activity and environmental change, while health systems and policies struggle to adapt (Jones et al., 2008). As a doctor, I have seen the chaos of unpreparedness. Overflowing wards, delayed vaccines, and communities gripped by fear. The need for action is urgent, and waiting for the next crisis is not an option. Robust surveillance can catch threats early, vaccines can protect us, and international co-operation can ensure no country is left behind. But these tools work only if we invest in them now (WHO, 2021). We must shift from a reactive mindset to a proactive one, building resilient systems that prioritise equity and readiness. This means funding labs in rural Africa, training health workers in Asia, and linking nations through shared goals. Our health's future hinges on this pivot. If we act decisively, we can face the next EID not as victims, but as a united, prepared world.

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