

Epidemiology in the Era of Globalization: From Local Outbreaks to World Threats

Andi Nurhalizah Tenriyola¹

¹Universitas Pejuang Republik Indonesia

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Corresponding Author:

Author Name*: Andi

Nurhalizah Tenriyola

Email*:

andinurhalizah90@gmail.com

Abstract: *Globalization has significantly reshaped the landscape of epidemiology by accelerating the spread of infectious diseases while simultaneously increasing the prevalence of non-communicable diseases. Local outbreaks that were once confined to specific regions can now rapidly evolve into global threats due to advances in transportation, trade, and human mobility. This study employs a qualitative descriptive-analytical approach, utilizing secondary data from scientific literature, WHO reports, and government publications to examine the relationship between globalization and epidemiological transitions. The findings reveal that globalization contributes to a double and even triple burden of disease, encompassing infectious, non-communicable, and environmentally driven health problems. Furthermore, global outbreaks such as SARS, Ebola, Zika, and COVID-19 demonstrate how weak health systems, political decisions, economic inequalities, and the infodemic phenomenon exacerbate the impact of epidemics. The study highlights the urgent need for cross-disciplinary approaches, equitable global health policies, and stronger international cooperation to enhance preparedness and resilience. In conclusion, modern epidemiology must not only focus on biological aspects but also integrate political, social, economic, and digital dimensions in order to protect global health security in the era of globalization.*

Keywords : *Epidemiology; Globalization; Infectious Diseases; Non-communicable Diseases; Global Health Security*

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INTRODUCTION

Globalization has fundamentally changed human lifestyles, mobility, and interactions between countries, thus affecting the way pathogens emerge and spread. In the last decade, epidemiology is no longer limited to local diseases; Plagues that were once confined to one region can now cross continents in a matter of days or even hours, due to advances in air transportation, urbanization, international trade, and interconnections between humans, animals, and the environment (Zimmermann et al., 2020). Perubahan Environments such as deforestation, agricultural intensification, climate change, and wildlife trade



exacerbate the risk of zoonotic spillover, which is the transmission of pathogens from animals to humans that can then quickly become a global threat (Nanda, 2021). A recent study found that public policies that include trade regulation, border quarantine, livestock biosecurity or animal markets, as well as public campaigns can reduce the risk of zoonotic spillover (Clifford Astbury et al., 2023).

History shows that disease outbreaks have long haunted humans. The Black Death epidemic in the 14th century, the Spanish influenza in 1918, and the various epidemics that emerged after that, illustrate how fragile humans are to the threat of infection. However, with the development of modern transportation, urbanization, and global interactions, the pattern of disease spread is becoming more and more complex. The SARS outbreak in 2003, the Influenza A H1N1 pandemic in 2009, the Ebola epidemic in Africa in 2014–2016, and the COVID-19 pandemic in 2019 are clear examples of how a disease that was initially local can quickly turn into a global threat. The COVID-19 pandemic has not only caused a health crisis, but has also triggered a multidimensional impact on the economy, politics, social, and education, showing the close link between health and global stability.

In addition to accelerating the spread of infectious diseases, globalization has also exacerbated the problem of non-communicable diseases. Lifestyle changes due to modernization and global trends, such as increased consumption of fast food, decreased physical activity, smoking habits, and exposure to air pollution, have contributed to the increasing prevalence of chronic diseases such as diabetes mellitus, hypertension, cancer, and heart disease (Calcaterra et al., 2023). According to the Global Burden of Disease (GBD) 2021, non-communicable diseases now account for more than 70% of global deaths per year. Even recent studies show that the burden of chronic kidney disease associated with high body mass index (BMI) has more than tripled since 1990. This data corroborates that modern epidemiology cannot only focus on infectious diseases, but must also include an understanding of chronic diseases and lifestyle risk factors that now dominate the global burden of disease.

The epidemiological transition framework put forward by Abdel Omran in 1971 can explain this phenomenon. The theory states that the world community has shifted from the era of dominance of infectious diseases to the era of dominance of degenerative and chronic diseases. But in reality, globalization has created a situation of double burden of disease, where infectious diseases are not fully controlled, while non-communicable diseases are increasing. This situation poses a major challenge, especially for a developing country like Indonesia, which has to deal with two burdens of disease at once with limited health system capacity (Mboi et al., 2022).

Indonesia's condition illustrates this complexity. On the one hand, infectious diseases such as tuberculosis, malaria, and dengue hemorrhagic fever are still serious problems (Fauziyah et al., 2021). WHO data (2024) shows that tuberculosis is still a significant cause of death in Indonesia, while the extraordinary incidence of dengue fever occurs almost every year. On the other hand, non-communicable diseases have also increased sharply. Stroke, ischemic heart disease, and diabetes mellitus are now among the highest causes of death in Indonesia. WHO statistics note that the death rate from stroke reaches 168.9 per 100,000 population, while ischemic heart disease reaches 90.9 per 100,000 population. These figures show that Indonesia is now facing a double burden of disease, which is exacerbated by modern lifestyle risk factors such as obesity, lack of physical activity, and unhealthy food consumption.

The experience of dealing with the COVID-19 pandemic clearly shows how a local outbreak can turn into a global crisis (Timmis & Brussow, 2020). COVID-19 was first reported in Wuhan, China, in late 2019, but in less than three months it has spread to more than 190 countries. The WHO reports that the pandemic has caused more than 6.9 million deaths worldwide through 2023, with a much higher excess mortality rate when indirect impacts are taken into account (Chauhan, 2020). For Indonesia, this pandemic is a major test for the health system, highlighting weak preparedness, limitations in epidemiological surveillance, and challenges in cross-sector coordination. However, the pandemic has also provided valuable lessons about the importance of resilient health systems, strong laboratory capacity, and international cooperation in the face of global threats.

Based on this phenomenon, it is clear that epidemiology in the era of globalization faces various new challenges. Globalization has increased the mobility of people and goods which has accelerated the spread of disease, creating the potential for transformation from a local outbreak to a global pandemic. Changes in modern lifestyles have also exacerbated the prevalence of non-communicable diseases, which are now the leading contributor to deaths in the world (Upadhyay, 2022). On the other hand, epidemiological surveillance systems in many countries, including Indonesia, still have limitations in detecting and responding to outbreaks quickly and effectively. International collaboration in the health sector still needs to be strengthened in order to be able to face global health threats comprehensively.

From this background, several important questions arise: how exactly does globalization affect the pattern of disease spread from the local to the global level? What is the role of epidemiology in detecting, preventing, and controlling diseases in the era of globalization? What factors make a local outbreak develop into a global threat? And how is the relevance of epidemiological developments to the public health system, especially in Indonesia? These questions are the formulation of the problem of this study.

This study aims to describe the impact of globalization on the dynamics of disease spread, analyze the role of epidemiology in dealing with public health challenges, identify factors that make local outbreaks a global threat, and provide an overview of epidemiological implications for strengthening public health systems in Indonesia. With this goal, this research is expected to provide benefits both theoretically and practically. Theoretically, this study will enrich the scientific literature on the relationship between epidemiology and globalization, as well as serve as a basis for further research. Meanwhile, practically, the results of this study can provide input for policymakers, health workers, and the wider community in strengthening epidemiological surveillance, improving preparedness, and building international cooperation in dealing with global health threats. Thus, this introduction confirms that epidemiology in the era of globalization not only studies diseases at the local level, but also plays a vital role in protecting global health. The phenomenon of local outbreaks to global threats is clear evidence that health is no longer a mere domestic issue, but part of international security and stability.

METHODOLOGY

This study uses a qualitative approach with an analytical descriptive method. The selection of this method is based on the objectives of research that focuses on understanding, interpreting, and criticizing epidemiological dynamics in the era of globalization, especially how local outbreaks can develop into global health threats. The main data sources come from secondary literature in the form of books, scientific articles, reports of the World Health Organization, as well as official publications of relevant governments



and international institutions. Data collection was carried out through literature studies by browsing online and print databases to obtain the latest information on infectious disease trends, mechanisms of their spread, and related global policies.

The data analysis stage is carried out using content analysis techniques, namely identifying the main themes, comparing findings between sources, and compiling a synthesis that describes the relationship between globalization and disease epidemiological patterns. The validity of the data is maintained through the process of triangulating sources, by comparing information from various literature to ensure consistency and reduce interpretation bias. Furthermore, the results of the analysis are presented in the form of a structured descriptive narrative, starting from an overview of epidemiological phenomena, globalization factors that influence, to implications for the world health system.

RESULTS AND DISCUSSION

The Dynamics of the Spread of Disease in the Era of Globalization

Globalization not only accelerates the spread of diseases, but also changes epidemiological patterns that previously tended to be local to global (Zhou & Coleman, 2018). In the past, endemic diseases were usually limited to certain areas due to geographical barriers and lack of interaction between populations. However, now the pattern is shifting: diseases that were once only found in the tropics can appear in subtropical or even transcontinental countries. For example, dengue fever cases that are identical to Southeast Asia are now also found in Latin America and even parts of Europe due to climate change and international mobility. This shift in epidemiological patterns suggests that state boundaries are increasingly irrelevant in the context of public health.

In addition, globalization also poses new challenges in the form of the emergence of new infectious diseases (emerging diseases) and the return of old diseases (re-emerging diseases) with a more complex character (Green, 2020). HIV/AIDS, which has been spreading since the end of the 20th century, is a clear example of how new diseases can spread massively through global social, economic, and migration networks. Meanwhile, old diseases such as tuberculosis are now again a global threat due to the presence of drug-resistant strains (MDR-TB) that spread rapidly between countries. This condition shows that epidemiology can no longer be understood solely in the local framework, but must adapt to global dynamics involving cross-cultural, cross-border, and cross-health system interactions.

No less important, globalization also widens the gap in public health. Developed countries with strong health systems are relatively better prepared to face the threat of epidemics than developing countries with limited resources. This is evident during the COVID-19 pandemic, where access to vaccines and health facilities is uneven in different parts of the world. As a result, while developed countries are able to suppress case numbers faster, many developing countries are still grappling with high waves of transmission (Bolcato et al., 2021). This difference in readiness confirms that the pattern of modern epidemiology is now determined not only by biological factors, but also by global social, economic, and political factors that are greatly influenced by the flow of globalization.

Globalization and Changing Epidemiological Patterns

Changes in epidemiological patterns in the era of globalization show a phenomenon that is often referred to as the double burden of disease (Nyabani, 2021). Developing countries are not only facing a high prevalence of infectious diseases that have long been endemic, but also an increase in non-communicable diseases due to lifestyle modernization. For example, in Indonesia the prevalence of



tuberculosis is still relatively high, while at the same time cases of diabetes, hypertension, and obesity are increasing sharply. This poses a major challenge for the health system, as limited resources must be divided to tackle two groups of diseases with different characteristics (Roncarolo et al., 2017). In the context of globalization, this condition is further exacerbated by the interconnectedness between countries that makes infectious diseases can quickly cross borders, while degenerative diseases are influenced by the globalization of the fast food industry, urban lifestyle, and consumptive culture.

In addition to the double burden, globalization also causes the phenomenon of triple burden of disease. In addition to infectious and non-communicable diseases, there is now also a threat of diseases due to the environment and climate change, such as respiratory disorders due to air pollution, skin diseases due to exposure to industrial chemicals, to zoonotic diseases that are increasing due to ecosystem degradation. This requires modern epidemiology to integrate cross-sectoral analysis: health, environmental, economic, and social. In other words, the current epidemiological transition can no longer be mapped only with linear models as Omran argues, but must be understood as a dynamic process influenced by the interaction of various global factors.

As a result, public health strategies can no longer focus only on one type of disease. Both developed and developing countries must adopt a dual approach: strengthening infectious disease surveillance systems while building capacity to prevent degenerative diseases through the promotion of healthy lifestyles. At the global level, this requires closer international cooperation, both in the exchange of epidemiological data, strengthening laboratory capacity, and coordinating cross-border health policies. Thus, globalization is not only seen as a risk factor, but can also be an opportunity to build global health solidarity in the face of the complexity of the contemporary epidemiological transition.

Global Outbreak Cases as a Mirror of the World's Threat

A number of major outbreaks of the 21st century are a real mirror of how local epidemics can become global threats. SARS in 2003, which started in Guangdong, China, managed to spread to nearly 30 countries. MERS in 2012 caused international anxiety despite being relatively under control, while the 2014–2016 Ebola epidemic in West Africa showed severe public health and socio-economic impacts due to delays in detection and treatment. The Zika case in 2015–2016 posed unique challenges due to its impact on reproductive health, particularly microcephaly in infants. At its peak, the COVID-19 pandemic is the most obvious evidence that in a global world, new diseases can paralyze almost all aspects of international life (Noor et al., 2025). The pattern that emerged from such cases was similar: starting with local clusters, then quickly spreading through global transport routes, and exacerbated by delays in international reporting or coordination. Interestingly, the development of digital technology also affects the dynamics of information dissemination. On the one hand, fast information helps the global response, but on the other hand, it also gives birth to the infodemic phenomenon, which is a flood of information that is not always true, which exacerbates public panic. All of this shows that the threat of outbreaks in the era of globalization is not only biological, but also social and digital.

The series of cases of the global outbreak shows that the world is currently in a condition of shared vulnerability, namely shared vulnerability to the threat of infectious diseases (Poli et al., 2021). No country can completely shut itself off from risk, as global mobility makes geographical borders even more fragile. For example, SARS and MERS highlight how quickly the coronavirus can cross continents, even when its origins stem from limited zoonotic interactions. Ebola underscores that weak health systems in one region can have a major impact on international stability, especially because it creates fear, disrupts trade, and

reduces trust in global health institutions. In addition, the cases of Zika and COVID-19 open a new chapter in global epidemiology, namely how outbreaks not only cause health burdens, but also have implications for demographic, reproductive, and even geopolitical dimensions. Zika raises concerns for future generations through its impact on fetuses, while COVID-19 forces countries to change social, economic, and social governance patterns in global society (Hirawan, 2020). This pandemic confirms that the threat of outbreaks is multidimensional, not only medical matters, but also closely related to global social and political resilience.

When compared, each global outbreak has different patterns and characteristics that can be a source of reflection. SARS (2003) showed how quickly new viruses can spread via air transport, but with a mortality rate of about 10%, a rapid public health response was eventually able to suppress further spread. MERS (2012), although having a higher fatality rate, is relatively limited in its spread because transmission is more difficult to occur between humans, so control is easier to achieve. Ebola (2014–2016) exposed the fundamental weaknesses of the local health system in West Africa (Omoleke et al., 2016). The outbreak has not only caused a large number of casualties, but has also shaken public trust in health services, worsened economic conditions, and created a deep stigma for survivors.

Meanwhile, Zika (2015–2016) showed a new face of global epidemiology. It is not the mortality rate that is the main highlight, but the impact on the reproductive health and development of the baby (Syakhsyah, 2021). This proves that outbreaks can have long-term implications that are generational, not just acute. In contrast, COVID-19 is present as a combination of all previous lessons: highly contagious, long-term, involving all aspects of life, and showing that the world still does not have a truly effective global health coordination system. This pandemic shows the close interconnectedness between health, politics, economics, and the digital environment, making it the first "multidimensional outbreak" in modern history. From this comparison, a common thread can be drawn that the threat of a global epidemic cannot be understood uniformly. Each outbreak carries a different message: SARS and MERS emphasize the importance of transportation readiness and airport surveillance systems; Ebola highlights the urgency of strengthening primary health systems in developing countries; Zika reminds the world of the importance of research on reproductive health impacts; and COVID-19 underscores the need for cross-sectoral integration and adaptive global governance. This means that epidemiology in the era of globalization must be flexible, cross-disciplinary, and always open to learning from previous outbreak experiences.

Non-medical factors in Global Epidemiology

Political factors in global epidemiology are evident in various cases of major outbreaks. The delay in reporting by state authorities not only slows down the flow of information, but also creates international distrust (Worsnop, 2019). A clear example can be seen in the early phases of SARS and COVID-19, when delays in information transparency exacerbated the rate of global spread. This shows that health policy cannot be separated from political governance. The decision to open or close transportation access, limit the movement of the population, and establish a health emergency status are all political decisions that have a direct impact on the success or failure of outbreak control (Wilkinson et al., 2020). On the other hand, the economic aspect is often a limiting factor that is no less decisive. Countries with low health funding often struggle to provide adequate laboratory facilities, trained medical personnel, and surveillance infrastructure. This makes early detection too late, so the epidemic quickly spreads. Even in developed countries, economic considerations affect control strategies, as seen in the lockdown policy, which is always faced

with the dilemma between saving lives and keeping the wheels of the economy running. Thus, the global outbreak is not only a health issue, but also a test of a country's economic resilience.

The socio-cultural dimension also has a significant influence. Local norms, traditions, and beliefs often influence people's behavior in dealing with outbreaks (Friendler, 2021). For example, stigma against HIV/AIDS patients or Ebola survivors makes some people reluctant to report or seek medical help. In the case of COVID-19, the communal culture in some countries makes social restrictions difficult to implement, thus accelerating the spread. Meanwhile, in the digital era, the infodemic phenomenon adds complexity. The public not only faces biological viruses, but also "information viruses" in the form of hoaxes, conspiracy theories, or misinformation that weaken compliance with health protocols. All of these non-medical factors confirm that global epidemiology requires a cross-disciplinary approach. Political science plays a role in studying governance and transparency; economics highlights the sustainability of health funding; Communication science examines how public information can be effectively channeled; While anthropology and sociology help understand people's behavior in the context of local culture. With this cross-field collaboration, modern epidemiology can evolve from just a biomedical science to a comprehensive framework that is able to answer the challenges of global outbreaks more fully.

Global Health Inequality and Justice Challenges

The global health inequalities that have been exposed during the COVID-19 pandemic show that the epidemic is not only a test for the medical system, but also for international solidarity (Ho & Dascalu, 2021). The gap in access to vaccines, personal protective equipment, and ventilators shows that developed countries tend to be better prepared to face crises, while developing countries have to struggle hard with limited resources. This reality confirms that structural inequities in the global health system exacerbate the impact of the outbreak on the most vulnerable groups of people. In an epidemiological framework, this condition shifts the focus of analysis from simply the spread of disease to a more fundamental question: who gets protection and who is left behind.

In addition, inequality is also seen in the capacity of the health system. Developed countries with strong medical infrastructure are able to conduct mass testing, genomic research, and vaccine development in a short period of time (Sanders, 2023). On the other hand, low- and middle-income countries often rely on foreign aid to simply conduct policy surveillance. This has direct implications for the speed of detection and the effectiveness of the epidemic response. From the perspective of dependency theory, this situation shows how the dominance of developed countries and multinational pharmaceutical companies is shaping an unequal global healthcare architecture. Ideal global epidemiology should not only map the distribution of disease, but also map the distribution of power and resources that determine who is most vulnerable to the impact of outbreaks.

The challenge ahead is how to build a more equitable and inclusive global health system. The principle of equity must be integrated into international policies, for example by strengthening more equitable vaccine distribution mechanisms, encouraging health technology transfer, and reducing the dependence of developing countries on dominant actors. If this principle is ignored, then each new epidemic will continue to leave deeper wounds for low-capacity countries, while widening the global gap. Thus, one of the most important agendas of contemporary epidemiology is to make health justice a key pillar in epidemic management strategies.

International Efforts to Deal with Global Outbreaks

The COVAX program was initially expected to be able to bridge the vaccine gap between developed and developing countries (Eccleston et al., 2021). However, its implementation shows that global solidarity is still weak. High-income countries tend to secure excess vaccine supplies for domestic interests, while low-income countries have to rely on leftover distribution that arrives late. This injustice not only slows down immunization programs, but also widens the gap between economic and health recovery between regions. This situation confirms that despite the existence of an international cooperation mechanism, national interests and the dominance of a strong state remain an obstacle. Global epidemiology therefore cannot stop at medical analysis alone, but must encourage a more equitable and sustainable policy of distribution of health resources.

Transparency of epidemiological data is another important pillar in dealing with global outbreaks. Rapid case reporting, sharing of viral genome information, and publication of the results of medical interventions can accelerate mitigation measures (World Health Organization, 2023). However, there are still many obstacles in the form of technological limitations, data security concerns, and the closed attitude of some countries in order to maintain political or economic stability. Global outbreaks are increasingly complicated by external factors such as climate change, rapid urbanization, and high intensity of human mobility across countries. For this reason, the concept of One Health must be integrated in a real way by emphasizing the relationship between human, animal, and environmental health. Collaboration across government sectors, international institutions, academia, industry, and civil society is an absolute requirement for the world to be better prepared to face the threat of future pandemics.

Implications for Future Epidemiology

Future epidemiological developments will also be determined by the extent to which this science is able to answer global health ethical and justice issues. The vaccine distribution gap during the COVID-19 pandemic shows that science and technology without the value of solidarity will only perpetuate inequality. Therefore, modern epidemiology needs to integrate the principles of equity and health justice in every policy and intervention. The concept of global health security must not only prioritize the protection of developed countries, but must ensure the collective protection of all humanity. With this kind of approach, epidemiology will be the vanguard that fights not only the disease, but also the structural injustices that accompany it.

Another crucial implication is the need to strengthen public health literacy globally. The digital era brings new challenges in the form of a rapid flow of information that is at the same time vulnerable to abuse, such as the spread of hoaxes or conspiracy theories that have been proven to weaken the public response. Epidemiology in the future must collaborate with the fields of communication, psychology, and anthropology to build a collective consciousness based on scientific knowledge. Thus, epidemic prevention relies not only on medical interventions, but also on strong social awareness. It is this transformation that will determine whether the world is able to face the next pandemic with better preparedness and more real solidarity.

CONCLUSIONS

Epidemiology in the era of globalization reflects a profound transformation in the way diseases emerge, spread, and impact societies worldwide. Globalization not only accelerates the spread of infectious diseases across borders but also contributes to the growing prevalence of chronic and lifestyle-related



illnesses, creating a double or even triple burden of disease. Major global outbreaks such as SARS, Ebola, Zika, and COVID-19 illustrate how local epidemics can rapidly escalate into international crises, influenced by mobility, weak surveillance, political factors, and global inequalities. The findings emphasize that modern epidemiology must evolve into a multidisciplinary field, integrating health sciences with political, social, economic, and digital dimensions. To face future pandemics, equitable health systems, resilient surveillance, and stronger international collaboration are essential. Ultimately, epidemiology should not only aim to control disease but also to promote global solidarity and health justice as fundamental pillars of public health security.

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