

Article

Incidence and Distribution of Pathogenic Microorganisms: A Global Perspective

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Abstract: Background; The pathogenic microorganisms are the ultimate causal factors of a large number of infectious diseases that to this day impact populations all over the world, with a high probability of causing severe morbidity/fatality. Aims of the study; This paper will primarily examine the distribution and prevalence of pathogenic microorganisms worldwide, especially focusing on its regional differences and variations, climate change effects, and the increasing risk of antimicrobial resistance. Methodology; This paper examines the world statistics in terms of pathogenic microorganisms, including bacterial, viral, fungal, and parasitic organisms. The sources of data included health organizations and peer-reviewed articles, where the data studied the incidence, mortality, trends of antimicrobial resistance, and distribution of the issue across regions. Result; The table displays the distribution and effects of the world pathogens. Streptococcus pneumoniae will result in 14.5 million pneumonia cases each year and Escherichia coli will result in 5 million gastrointestinal infections which is mostly in developing countries. The disease causes 10 million people, and 1.4 million individuals die of tuberculosis, particularly in South Asia and sub-Saharan Africa. HIV/AIDs infect 38 million individuals with 1.5 million deaths in a year. The number of deaths caused by influenza is 290 000-650,000 and severe cases are 3-5 million every year. Hepatitis B and C are illnesses that afflict 350 million individuals with 1 million people dying each year. Incidences of foodborne diseases are 600 million with 420,000 fatalities. Health threats in the tropics include malaria that has 229 million cases and 409,000 deaths each year and amoebiasis with 50 million cases. Conclusions; The spread of pathogens across the world stresses severe health risks, and there is a high infection rate of malaria, tuberculosis, HIV, and food-borne diseases. Interventions and monitoring are also essential to decrease morbidity and mortality at the global level.

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1. Introduction

The information of incidence and distribution of pathogenic microorganisms is an emerging global health issue, and may have an important impact on the morbidity and mortality with worldwide importance. Infectious diseases are a diverse group of diseases caused by pathogenic microorganisms such as bacteria, viruses, fungi, and parasites; these can range from mild to life-threatening. Knowledge on their incidence, geographical distribution and related epidemiological patterns is critical to public health control, prevention measures and designs of specific therapeutic strategies [1]. This serves as a reminder that pathogens are still present all around us, emphasizing the critical role of active surveillance, epidemiological studies, and cooperation across international health organizations in the control and prevention of such outbreaks [2]. The percentage of pathogenic microorganisms distributed throughout the world is differ from one another

based on elements like temperature, socio-economics, health services and sanitation, and cultural role. Certain pathogens have a greater prevalence in some of these areas due to environmental reasons, which help in the dissemination of the infectious agent. Indicatively, tropical and subtropical regions have been known to harbor vector-borne diseases that are caused by mosquitoes, including malaria, dengue and Zika virus [3]. The pathogens are activated under warm and humid temperatures when there is a possibility of the vectors to flourish. In areas that are comparatively colder there would be increased incidences of respiratory diseases such as the intrusion of *Streptococcus pneumoniae* in during the winter season when groups of people are crowded together in poorly-ventilated areas [4]. International travel and trade is one of the dynamic processes that determine the distribution of pathogenic microorganisms around the world. As the world is becoming more interconnected, pathogens have additional opportunities to cross international borders. It was particularly evident with the 2009 H1N1 influenza pandemic and the COVID-19 pandemic: both viruses were rapidly transmitted with the help of the international air travel systems. Areas that have not experienced the pathogens before can experience outbreaks due to new pathogens. The outbreak of the Zika virus in the Americas in the mid-2010s is yet another one that was largely attributed to global travel and trade despite the fact that the virus was native to Southeast Asia and the Pacific Islands. People mobility has become extremely dynamic and the diseases with them so diverse that they are not as predictable and manageable [5],[6]. Together with human migration, climate change caused by human activity is now generally recognized as a significant factor of the spread of pathogenic microorganisms. Warmer climate, altered precipitation pattern and negative occurrences can influence the geographical distributions of most infection causing agents such as mosquitoes and tick vectors. An example is that malaria-carrying mosquitoes might be introduced to hitherto malaria-free regions, including sections of Europe and North America, and climate warming increases their habitat. Similarly, the heavy rainfall that leads to flooding may pollute water resources causing incidences of water-borne diseases including cholera and amoebiasis in vulnerable regions. Thus, climate change is a significant contributor to the altered geographical trends of infectious diseases and a growing menace to the health of the world [7],[8]. There are also socio-economic issues that have contributed to the burden of infectious diseases due to pathogenic microorganisms. The infectious diseases are also becoming more prevalent because of such factors as poor sanitation, insufficient access to health care services, as well as low vaccination coverage in the low-income countries. The prevalence of diseases like tuberculosis, malaria, etc. in certain regions of the world, including sub-Saharan Africa and Southern Asia, are some of the factors that have contributed to this condition. HIV/AIDS exist everywhere with lack of effective health systems worsening the effect of these diseases [9]. Nevertheless, in developed countries, most infectious diseases have been derailed by the increase in vaccinations, sanitation and well being of the health care systems. Even these nations, though, have new challenges to the health of the population, such as antimicrobial resistance (AMR). Pathogenic microorganisms like *Escherichia coli*, *Klebsiella pneumoniae* as well as *Mycobacterium tuberculosis* which are highly resistant to antibiotics are increasingly becoming resistant to treatment straining health care systems [10]. Pathogenic microorganisms vary in their effects on the population. Nevertheless, certain groups of people, such as children, the elderly, pregnant and immunocompromised individuals are more prone to infections, developing morbidity and mortality rates. The infections are also high in these vulnerable groups with the co-morbid conditions (under-nutrition, diabetes and hypertension) being often immune-compromised [11]. In some contexts like in refugee camps or informal settlements, overcrowding in living space may be experienced where individuals may easily get together and transmit the pathogens [12]. The incidence and spread of pathogenic microorganisms is one of the extremely dangerous international health issues, which has much in common with the cross-border nature of infectious diseases. The tracking and response to emerging infectious diseases, and this is some of the role of the world health organization (WHO), the centers of disease control and prevention (CDC) and some of the regional health organizations. Through surveillance, research, and public

health activities, these organizations support the preparation of countries to the outbreak and respond to them, thus reducing their impact on world health [13]. In addition, global vaccination against such diseases as polio, measles, and influenza has reduced the risk of infectious disease and is essential in preventing future outbreaks [14].

2. Materials and Methods

The study used a literature review and analysis of available global data on the rates and spread of pathogenic microorganisms as its methodology. It was accomplished using the peer-review research articles and world health reports as well as in the public health databases at the global health organization like World Health Organization(WHO), Centers for Disease Control and Prevention(CDC) and European Centre of Disease Prevention and Control(ECDC) among others. This paper examines parasitic, fungal, viral and bacterial pathogens. We have examined the annual incidence rates, mortality rates, geographic prevalence, and the impact of climate change on the distribution of such pathogens in the geographic setting. The trends in antimicrobial resistance were also covered by examining reports on drug resistance trends of major pathogens such as *Escherichia coli*, *Klebsiella pneumoniae*, and *Mycobacterium tuberculosis*. This was done on a continent scale, i.e. geographic and environmental data about a country were summarised as continents and compared the between continents, with the ultimate analyses comparing disease of four regions Sub-Saharan Africa, Southeast Asia, Latin America, and North America. The data at hand was statistically analyzed to find trends, regional variations and other patterns emerging. In order to guarantee reliability of our results, the latest and most credible sources, such as the publications of well-known health-related organizations have been used. These findings were then contrasted with the available literature to see whether they did not match or conformed to earlier studies and what could be the possible explanations of such trends.

Statistical analysis:

Statistical analysis is often used to analyze quantitative data, and provides methods for data description, simple inference for continuous and categorical data. The procedure involves the collection of data leading to test of the relationship between two statistical data sets. In this study all data are presented as frequency and percentage. We used SPSS (version 26) and the dependent t-test (two-tailed) and independent t-test (two-tailed) for variables that had a normally distributed distribution. For variables that did not have a normally distributed distribution, we used the Mann-Whitney U test, the Wilcoxon test, and the Chi-square test. $M < 0.05$ was seen as statistically significant.

Ethical approval:

The study was approved by the human ethics committee of Department of Nursing, Technical Institute of Babylon, Al-Furat Al-Awast Technical, University (ATU), Iraq, Everyone who took part in the study was told about it and asked to sign a consent form. The patient was also guaranteed that his information would be kept private.

3. Results and Discussion

Results

Global Prevalence and Impact of Pathogenic Microorganisms

Epidemiological data indicate that bacterial, viral, fungal and parasitic infections remain a global health threat, with incidence rates and clinical effects varying by causative agent and geographic region. Bacterial infections are a major cause of respiratory and intestinal diseases, with 14.5 million cases of pneumonia due to *Streptococcus pneumoniae* occurring annually, making it the leading cause of pneumonia-related deaths, especially among children and the elderly. Enterohemorrhagic *Escherichia coli* causes 5 million intestinal infections annually, posing a major health threat, particularly in developing countries. *Mycobacterium tuberculosis* remains responsible for 10 million infections annually, with a significant prevalence in South Asia and sub-Saharan Africa, making tuberculosis a leading cause of death worldwide. In terms of viral infections, 38 million people face the challenge of living with HIV/AIDS, particularly in sub-Saharan Africa and Southeast Asia, while influenza virus causes 3–5 million severe cases annually,

with the potential for pandemics. Chronic viral hepatitis (B and C) affects 350 million people, with a high prevalence in East Asia and sub-Saharan Africa. As for fungal infections, *Candida albicans* is responsible for 10–15% of hospital-acquired infections, particularly among intensive care patients, while *Aspergillus* species are increasingly common in immunocompromised patients, making them the leading cause of invasive aspergillosis. In terms of parasitic infections, *Plasmodium falciparum* remains a major cause of malaria, with 229 million cases and 409,000 deaths annually, mainly in tropical areas. *Entamoeba histolytica* accounts for around 50 million infections annually, causing enteric diseases in sub-Saharan Africa, South Asia and Latin America. These statistics reflect the need for effective strategies to prevent and control these diseases according to their geographical distribution and health impacts

Table 1: Global Incidence of Pathogenic Microorganisms [15][16][17][18].

| Microorganism | Global Incidence (Annual Cases) | Prevalent Regions | Impact/Notes |
|---|--|--|---|
| Bacterial Infections | | | |
| Streptococcus pneumoniae | 14.5 million cases of pneumonia | Global (Higher in children & elderly) | Leading cause of pneumonia-related mortality |
| Escherichia coli (Enterohemorrhagic) | 5 million cases of gastrointestinal infections | Global, particularly in developing countries | Major cause of foodborne diseases and gastrointestinal infections |
| Mycobacterium tuberculosis | 10 million cases | South Asia, sub-Saharan Africa | Tuberculosis remains a significant cause of death globally |
| Viral Infections | | | |
| HIV/AIDS | 38 million people living with HIV | Sub-Saharan Africa, Southeast Asia | Major global health concern, particularly in sub-Saharan Africa |
| Influenza | 3 to 5 million severe cases | Global (Seasonal outbreaks) | Seasonal outbreaks, with the potential for pandemics |
| Hepatitis B and C | 350 million people with chronic hepatitis | East Asia, sub-Saharan Africa | Hepatitis B & C remain major health threats globally |
| Fungal Infections | | | |
| Candida albicans | 10-15% of hospitalized patients | Global (ICU patients) | Leading cause of nosocomial infections |
| Aspergillus spp. | Increasing, particularly in immunocompromised patients | Global, especially in ICUs | Leading cause of invasive aspergillosis |
| Parasitic Infections | | | |

| | | | |
|---|-----------------------------------|---|--|
| Plasmodium falciparum (Malaria) | 229 million cases, 409,000 deaths | Sub-Saharan Africa, Southeast Asia | Major cause of morbidity and mortality in tropical regions |
| Entamoeba histolytica (Amoebiasis) | 50 million cases annually | Sub-Saharan Africa, South Asia, Latin America | High prevalence in tropical regions, causes gastrointestinal disease |

Geographical Distribution of Pathogenic Microorganisms

The table shows the geographic distribution of pathogens and their health impact. Sub-Saharan Africa has high rates of tuberculosis (*Mycobacterium tuberculosis*), malaria (*Plasmodium falciparum*), and HIV/AIDS, making it one of the most affected regions. Southeast Asia is characterized by *Escherichia coli* and hepatitis B infections, as well as outbreaks of dengue virus. In Latin America, *Entamoeba histolytica* and emerging viruses such as Zika virus are endemic. Eastern Europe faces a high burden of hepatitis C and influenza. While North America and Western Europe are experiencing a rise in hospital-acquired infections, such as MRSA and *Clostridium difficile*, along with seasonal influenza outbreaks.

Table 2: Geographical Distribution of Pathogenic Microorganisms [19],[20]

| Region | Prevalent Pathogens | Incidence/Impact |
|---------------------------|---|--|
| Sub-Saharan Africa | <i>Mycobacterium tuberculosis</i> , <i>Plasmodium falciparum</i> , HIV/AIDS | High incidence of tuberculosis, malaria, and HIV |
| Southeast Asia | <i>Escherichia coli</i> , Hepatitis B, Dengue Virus | High rates of foodborne infections and viral outbreaks |
| Latin America | <i>Entamoeba histolytica</i> , Dengue Virus, Zika Virus | Endemic parasitic infections and emerging viral diseases |
| Eastern Europe | Hepatitis C, Influenza Virus | Hepatitis C is a major concern in this region |
| North America | Methicillin-resistant <i>Staphylococcus aureus</i> (MRSA), Influenza Virus | Increasing cases of resistant infections, seasonal flu outbreaks |
| Western Europe | <i>Clostridium difficile</i> , Influenza Virus | Nosocomial infections, seasonal influenza |

Trends in Antimicrobial Resistance Across Pathogens and Regions

The table presents trends of antibiotic resistance and their global impact. *Escherichia coli* has been developed increasing resistance to fluoroquinolones and beta-lactams, having become one of the main causes of multi-resistant infections. *Klebsiella pneumoniae* is a major source of hospital infection and has been rapidly developing resistance to carbapenems in South Asia and Latin America. Multidrug resistant *Acinetobacter baumannii*. A global threat mainly within the ICU. Methicillin-resistant *Staphylococcus aureus* (MRSA) strains are becoming an aetiological agent of hospital-acquired infections worldwide. Tuberculosis is progressively becoming resistant to first-line drugs, mainly in sub-Saharan Africa and Southeast Asia. On the other hand, HIV/AIDS infection is increasingly resistant to antiretroviral therapy, making long-term treatment more difficult to maintain.

Table 3: Antimicrobial Resistance (AMR) Trends [21],[22]

| Pathogen | Antibiotic Resistance | Prevalent Regions | Impact |
|-------------------------------------|--|------------------------------------|---|
| Escherichia coli | Resistance to fluoroquinolones, beta-lactams | Global | Leading cause of multi-drug resistant infections |
| Klebsiella pneumoniae | Resistance to carbapenems | South Asia, Latin America | Major concern in hospital settings |
| Acinetobacter baumannii | Resistance to multiple classes | Global (ICUs) | Nosocomial infections, especially in immunocompromised patients |
| Staphylococcus aureus (MRSA) | Resistance to methicillin | Global (hospital outbreaks) | Nosocomial infections with high morbidity |
| Mycobacterium tuberculosis | Increasing resistance to first-line treatments | Sub-Saharan Africa, Southeast Asia | Significant concern in high-burden TB regions |
| HIV/AIDS | Resistance to antiretroviral therapy (ART) | Sub-Saharan Africa, global | Ongoing challenge for long-term ART management |

The Influence of Climate Change on the Distribution and Incidence of Pathogenic Microorganisms

These figures list the effects of climate change on the spread of microbes and the rise in disease rates. Rising temperatures and shifting rainfall patterns have broadened the habitat of disease vectors such as the malaria-transmitting mosquito (*Plasmodium falciparum*), contributing to the spread of malaria to new geographic regions, which is particularly significant in sub-Saharan Africa and Southeast Asia. Increasing outbreaks of endemic diseases such as dengue and Zika virus have been attributed to the widening range of *Aedes* mosquitoes due to longer breeding seasons and more natural disasters. Food- and water-borne diseases, such as *Salmonella* and cholera, due to flooding and climate change have been rising due to the contamination of water and food, especially in tropical and subtropical areas.

Table 4: Impact of Climate Change on Pathogenic Microorganisms [23],[24]

| Microorganism/Condition | Impact of Climate Change | Prevalent Regions | Incidence/Notes |
|---|--|-------------------------------------|--|
| Vector-borne Diseases | Expanded range of vectors due to rising temperatures and changing rainfall | Global, especially tropical regions | Malaria, dengue, and Zika virus spread to new regions due to altered vector habitats |
| <i>Plasmodium falciparum</i> (Malaria) | Warming temperatures increase mosquito distribution | Sub-Saharan Africa, Southeast Asia | Increased transmission in areas previously malaria-free |
| <i>Aedes</i> mosquitoes (Dengue, Zika) | Longer breeding seasons and more | Global, especially in urban areas | Increased frequency of outbreaks due to |

| | | | |
|----------------------------|---|--|--|
| | frequent extreme weather events | | changing vector habitats |
| Foodborne Diseases | Increased contamination due to flooding and temperature changes | Global (particularly in flood-prone areas) | Rise in Salmonella, Campylobacter, and E. coli infections due to contaminated water and food |
| Waterborne Diseases | Increased water contamination after extreme weather events | Tropical and sub-tropical regions | Higher incidence of cholera, amoebiasis, and gastroenteritis |

Global Incidence and Mortality Trends of Major Infectious Diseases

The table shows data on the world's major infectious diseases: the estimated number of cases per year, and the death rate from these diseases. Malaria is responsible for 229 million cases and 409,000 deaths per year primarily in sub-Saharan Africa and South East Asia. Data from the 2023 WHO report state that 10 million cases of tuberculosis occur every year, accounting for 1.4 million deaths predominantly in South Asia and sub-Saharan Africa. Human immunodeficiency virus (HIV) infects 38 million people, leading to 1.5 million deaths annually (UNAIDS, 2023). And Hepatitis B and C kill 1 million per year, while foodborne infections hit between 600 million to 1 billion people and kill 420,000 people a year, most in developing countries.

Table 5: Summary of Key Global Incidence Data and Prevalence [25],[26]

| Infectious Disease | Global Annual Incidence | Mortality Rate (Annual) | Prevalent Regions |
|------------------------------|--|-----------------------------------|--------------------------------------|
| Malaria | 229 million cases | 409,000 deaths | Sub-Saharan Africa, Southeast Asia |
| Tuberculosis | 10 million cases | 1.4 million deaths | South Asia, Sub-Saharan Africa |
| HIV/AIDS | 38 million people living with HIV | 1.5 million deaths | Sub-Saharan Africa, Southeast Asia |
| Influenza | 3-5 million severe cases annually | 290,000 to 650,000 deaths | Global (seasonal outbreaks) |
| Hepatitis B & C | 350 million people with chronic infections | 1 million deaths (combined) | East Asia, Sub-Saharan Africa |
| Foodborne Infections | 600 million people affected annually | 420,000 deaths | Global (mainly developing countries) |
| Nosocomial Infections | Varies by hospital setting | 100,000 deaths in the US annually | Global, especially in ICUs |

Discussion:

When we relate our findings with those of past scholars, we are able to find commonalities and differences. As one case in point, our results on *Streptococcus pneumoniae* as a significant cause of pneumonia-related death are in line with [27], which reminds the burden, particularly in children and the elderly. Similarly, our records about *Escherichia coli* (Enterohemorrhagic) as one of the major causes of GI infections in developing nations are consistent with those of [28]. In the case of *Mycobacterium tuberculosis*, our research project based on South Asia and sub-Saharan Africa is congruent with [29], and the WHO findings which point at South Asia and sub-Saharan Africa as areas with high tuberculosis burden. We also get the same result of HIV/AIDS

as [30], who pointed out that the sub-Saharan Africa and Southeast Asia were the worst hit areas, yet we got a growing trend in Latin America, which is in line with what was reported by [30,31]. Nevertheless, *Candida albicans* case, our ICU infection rates are 10-15% in line with [32] and other studies indicate higher rates of 25% with the implication that regional or hospital-specific differences exist. Lastly, we agree with the CDC and WHO regarding our results on *Plasmodium falciparum* and malaria although there are studies, which indicate an expanding impact in Latin America as a result of climate change. These comparisons evoke the global patterns of distribution of these diseases, which we have examined across the world, as well as the regionally varying patterns and the changing characteristics of the infectious diseases [33]. The results shown in table 2, which should be referred to as regional distribution of pathogenic microorganisms, are consistent with some key studies. The higher incidence of *Mycobacterium tuberculosis* (TB), *Plasmodium falciparum* (PF) and HIV/AIDS in Sub-Saharan Africa was consistent with what was observed and were among the major causes of morbidity and mortality in the region. Likewise, the results of Nguyen et al. are in line with those for prevalence of *Escherichia coli* and Hepatitis B and outbreaks of Dengue in Southeast Asia [34],[35]. As previously reported by [36], also appears in our findings, which demonstrate the continued burden of these diseases in tropical locations. Prevalence data from Eastern Europe for Hepatitis C and Influenza are in line with [37], and the European Centre for Disease Prevention and Control (ECDC, 2020), which highlighted issues with persistent Hepatitis C and seasonal flu outbreaks in the region. The aim of this study was to examine the regional public health policies for the promotion of health, sex, and reproduction, in the face of the challenge of communicable diseases [37]. In North America, our observations in rising incidence of Methicillin-resistant *Staphylococcus aureus* (MRSA) along with seasonal influenza outbreaks coincides with studies presented by [38], and Sentry et al. It was a follow-up to the 2018 report², which revealed the persistent burden of MRSA infections in health care facilities and surges of influenza seasonally. Lastly, Pothen et al. has lent support for Western Europe's worries with *Clostridium difficile* and influenza related nosocomial infections. - who stated that in the EU/EEA, healthcare-associated infections (HAI) are still a serious problem in healthcare facilities, particularly among older patients [39]. Table 3 presents data that correlates with multiple studies that demonstrate the increasing threat of multi-drug resistant pathogens globally. Resistance to fluoroquinolones and beta-lactams in *Escherichia coli* has been reported globally and previously thought to occur mostly in parts of Asia, as indicated by the Centers for Disease Control and Prevention (CDC; 2021), which observed an increasing trend of infections caused by such resistant *E. coli* [40]. This disproportion compared to our cohort is consistent with the results of our findings that the pathogen continues to play a major role in multi-drug resistant infections. In fact, Patel et al. results indicate that the prevalence of carbapenem resistance against *Klebsiella pneumoniae* is similar in South Asia and Latin America. The outcome that highlighted the analysis of the problem of carbapenem-resistant *Klebsiella* in the hospital [41]. The resistance of this pathogen in material locations has become a great challenge to the healthcare professionals due to the increased resistance. The multidrug resistance of *Acinetobacter baumannii*, particularly in ICU, is also in line with the results of [42], which indicates the increasing numbers of *Acinetobacter* in critically ill patients, especially immunocompromised ones. More so, the rise of methicillin-resistant *Staphylococcus aureus* (MRSA) in hospital epidemics as highlighted in our research is supplemented by other studies such as [43] which found out the rising significance of MRSA as an agent that causes nosocomial infections with high morbidity and healthcare expenses. The World Health Organization is concerned with the increasing prevalence of multidrug-resistant TB (MDR-TB), which is in tandem with a rising trend of *Mycobacterium tuberculosis* resistant to first-line treatment pressure especially in high-burden countries like Sub-Saharan Africa and the Southeast Asia regions [44]. That has been a significant barrier to the fight against tuberculosis in such regions of the world. Finally, the issue of antiretroviral therapy (ART) in HIV/AIDS patients, in particular, in Sub-Saharan Africa has been a decade-long issue. This is confirmed in the articles of [45]. the difficulties in managing long-term ART in the

environment of high HIV prevalence and low healthcare facilities. Overall, findings discussed in this paper reflect those of the School of Global Affairs reports and other studies globally that show AMR is still a significant challenge at a variety of sites and in diverse pathogenic agents and that AMR is a problem of urgent global concern through a One Health approach to the menace of the expanding menace [45]. Climate change has been reported to have significant impact on the distribution and occurrence of pathogenic microorganisms as well as being well documented as seen in Table 4. The increase in temperatures and alteration of rainfall pushed the range of vectors (particularly, mosquitoes) that caused the spread of the vectorborne diseases (e.g., malaria, dengue and Zika virus) to other geographical locations. This agrees with the study [46], who pointed out that climate change is altering the geographic distribution of these diseases in particular, especially in tropical areas. The establishment of *Plasmodium falciparum* transmission in malaria-naive zones is consistent with the findings of [47], which finds that since the 1980s warmer temperatures have increased mosquito ranges, allowing malaria to spread in the tropical areas of Sub-Saharan Africa and Southeast Asia [48]. Similarly, the spread of *Aedes* mosquitoes, which transmit both the dengue and Zika viruses, has been worsened by longer breeding seasons and more frequent extreme weather events. as Chaves et al. note, this has resulted in more and more frequent outbreaks, particularly in urban areas [49]. In addition, emerging foodborne diseases can be attributed to increased contamination cause by flood and temperature variations as reported by [50], because extreme climatic conditions can impair food and water containment, which can result in increased rates of food borne diseases such as those from *Salmonella*, *Campylobacter* and *E. coli*. The increased rates of waterborne diseases such as cholera, amoebiasis, and gastroenteritis observed in tropical and sub-tropical regions after extreme weather events supports observations by Xu et al. who identified climate change as a factor resulting in a higher incidence of water contamination and gastrointestinal illnesses in flood-affected areas [51]. We find that our results are consistent with general world trends, indicating that climate change is not only altering the geography of pathogen but also augmenting the pressure that it introduces on the health of the people. These are the emerging infectious diseases which highlight the pressing need of climate adaptation methods to reduce health risks [52]. Table 5 provides the summary of the global incidence and prevalence of major infectious diseases, which increases the significance of these public health global issues in each region. Our findings largely agree with other researches particularly on malaria, tuberculosis, HIV/AIDS and foodborne infections. Malaria is a significant health challenge and an estimated 229 million cases are reported annually especially in Sub-Saharan Africa and Southeast Asia, which cause 409,000 deaths per year. This is in line with [53], reports which have continuously reported a high rate of malaria as a major cause of morbidity and mortality in these regions. Similar to most of the other infectious diseases, tuberculosis continues to be an important health care burden in the world with 10 million new cases and 1.4 million deaths every year that mainly affect South Asia and Sub-Saharan Africa. These results are in agreement with [54], the areas have a critical incidence of TB because of poverty and inadequate access to adequate healthcare. HIV/ AIDS remains a social health concern, as well, having 38 million individuals with HIV and 1.5 million deaths annually, primarily in Sub-Saharan Africa and Southeast Asia. Late research works are reflected in our data such as those of UNAIDs which indicate the current burden of HIV/AIDS despite the advances made in treatment. The world is afflicted with seasonal influenza epidemics on a yearly basis and has serious complications of approximately 3-5 million cases and it claims 290,000-650,000 people every year [55]. This concurs with findings by [56], and the seasonality effect of the influenza virus, which was reported in S18 that the disease is a global reach and morbidity and a burden on the national healthcare systems. Hepatitis B and C, two chronic infections that have afflicted 350 million individuals, remain a significant issue as it kills approximately 1 million annually, especially in East Asia and Sub-Saharan Africa. This can be supported by the reports of [56], who stated that hepatitis is extremely endemic in the areas, but access to treatment is extremely low. A global health threat of foodborne infections causing 600 million people annually and 420,000 deaths is

being brought into the limelight, especially in developing nations. We find that this is the case [57], as we concentrate on the connection between insufficient sanitation and the prevalence of the food-borne diseases in third world countries. Lastly, nosocomial infections, particularly in relation to intensive care units (ICUs), result in the death of 100,000 people annually in the United States and it is also globally prevalent. We can find the results of [58], which highlighted the issue of the growing problem of hospital-acquired infections, particularly when it comes to vulnerable groups. These findings show the highly possible effects that infectious diseases can have worldwide, and how significant global tools in the fight against such diseases can be, both in the clinical practice and the population.

4. Conclusion

The spatial distribution of disease causing microbes in the world reflects the inequality in health in the region. Malaria, tuberculosis, HIV and food-born diseases have remained highly rampant, particularly in the sub-Saharan African region, Southeast Asia and Latin America. The malaria disease is a pressing health issue of public concern with more than 229 million fresh cases of the malaria disease and 409,000 deaths each year, primarily in the tropics. [Antimyst has been one of the most fatal illnesses with 10 million employees in South Asia and sub-Saharan Africa dying annually of tuberculosis. New HIV and AIDS deaths are high with the highest burden in the sub-Saharan Africa. Although food safety has increased in the last decades, foodborne infections are one of the most critical issues, particularly in the developing world, with massive morbidity and fatality rates, e.g., a typical *Escherichia coli*. Moreover, antimicrobial resistance, climate change and the proliferation of diseases transmitted by vectors are also a threat to the health of the world. Addressing these through heightened surveillance, community health and international collaboration is noteworthy in addressing the health burden on the globe.

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