# Infectious human diseases: Regions, habitats, threats, and mitigation strategies: The actors—Part I

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Abstract

Infectious diseases are a significant burden on the global economy and public health. The major factors attributed to the rise in infectious diseases are thought to be the unstructured rise in the human population with expanding poverty, unplanned urbanization, fast urban migration, unplanned human habitats in thickly populated urban pockets that are the residence of poor people, insufficient healthcare infrastructure, inadequate vaccination, and neglect in effectively containing the zoonotic diseases, among others. Certain global regions such as China, India, Bangladesh, Pakistan, and Indonesia among the other Asian countries, sections of South America, and vast parts of Sub-Saharan Africa harbor more infectious human diseases. To contain the infectious disease burden, the health infrastructure especially in poor countries needs to be improved. With the assistance of rich countries monetarily as well as technologically, the situation can be improved. International institutions and large philanthropic organizations are working to improve human health globally. More monetary assistance to these organizations would positively contribute to the cause and would go a long way in diffusing the infectious agents.

**Keywords:** Anthropogenic factors, dense population, etiologic agents for infectious diseases, healthcare infrastructure, infectious human diseases, vaccines, zoonotic diseases

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#### **INTRODUCTION**

Infectious diseases are a significant burden on the global economy and public health.<sup>[1-3]</sup> COVID-19 is a flu, caused by infection from a virus known as SARS-CoV-2. The consequences of the COVID-19 outbreak<sup>[4,5]</sup> are the most recent examples. Pandemics and epidemics of infectious diseases have occurred throughout human history. While

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over the elapse of time, due to advances in medical sciences, people have been able to fight the disease outbreak more effectively, humankind continues experiencing new infections intermittently in some parts of the world as time elapses. Between years 1950 and 2000, it was thought by many that the battle against infectious diseases was won; however by the experience of immunodeficiency virus (HIV)<sup>[6]</sup> in 1981, the return of cholera in Senegal in 2005,<sup>[7]</sup> Ebola in Zaire in 1995,<sup>[8]</sup> and its return<sup>[9]</sup> in 2021 near the epicenter of the previous epidemic, it was realized that battle is not yet over and human population

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How to cite this article: Khandekar P, Ghosh PK. Infectious human diseases: Regions, habitats, threats, and mitigation strategies: The actors—Part I. MGM J Med Sci 2022;9:567-76. is far from victory over microbes; rather microbes have been continuously fooling human population. Mankind has entered the era in which emerging infections and established contagious diseases have increased much more in terms of severity and damage to the economy and loss of population. Emergence is thought to be drawn by much of anthropogenic factors such as emerging socioeconomic, ecological, or environmental factors. In addition, infectious diseases are also getting transformed into drug-resistant bacteria or parasites. The glaring examples are multidrugresistant tuberculosis (MDR TB) and chloroquine-resistant malaria.

The review is written in two parts. In the present Part I portion, the aims are at understanding which regions of human habitat, infectious diseases create maximum stress on human society, which are the broad areas where research should be intensely focused, and what major strategies are to be planned to contain the diseases as much as possible. The study probes into understanding the major infectious disease burden in the most populated regions of the world such as China and other highly populated regions of Asian countries including India, Bangladesh, Pakistan, and Indonesia; Brazil, Mexico, and Latin American countries; Nigeria and other African countries; Russia and other European countries; and the USA and North America.

In the second part (Part II), the infectious etiological agents causing human diseases, the vaccines available against fewer numbers, the importance of conducting more research in zoonotic diseases, and the need for carrying out developmental work jointly to enable the minimization of infections across the world, especially among poor people, have been highlighted.

#### Seats of concentration of infectious diseases

An in-depth analysis of the preponderance of infectious diseases reveals that such diseases are mostly among poor and extremely poor people. The World Bank blog in its narration had claimed<sup>[10]</sup> that based on the estimated world's 736 million extremely poor population in 2015, about half of the total lived in just five countries, which were (in decreasing numbers) India, Nigeria, Democratic Republic of Congo, Ethiopia, and Bangladesh. In a study<sup>[11]</sup> published in 2014, the burden of certain infectious diseases of poverty, which brings down the productivity of the infected, thereby reducing the earning capacity, was identified and flagged, including tuberculosis and MDR TB; malaria; HIV/AIDS; certain helminthiasis such as ascariasis, hookworm, and trichuriasis; schistosomiasis; lymphatic filariasis; onchocerciasis; dracunculiasis; dengue; Chagas disease; leishmaniasis; trachoma, leprosy, Buruli ulcers; and African trypanosomiasis. Interestingly, in a blog of a non-governmental organization (NGO),<sup>[12]</sup> it was claimed that the world had made visible progress since 1990 in improving the economic status of poor people, and more than 1.2 billion poor people have been able to increase their earnings, thereby getting out of extreme poverty and that presently only about 9.2% of the world population survives on less than \$1.90 a day (at 2011 prices), which population was nearly 36% of the total global population in 1990. The figure of US \$1.95 was arrived at in 2011 by World Bank researchers. They had defined,<sup>[13]</sup> based on 2011 prices, the international poverty line to be for individuals who lived on an income of \$1.90 a day or lower. The value of US \$1.95 in 2011 should be considered as US \$2.5338 in 2022 because the cumulative price change has resulted in US \$1 in 2011 becoming equivalent<sup>[14]</sup> to US \$1.2994 in 2022.

A research consortium by the name Global Burden of Disease (GBD) provides information, based on a scientific assessment of published information on 369 diseases and injuries, happening in 204 countries. GBD is a part of the Institute for Health Metrics and Evaluation<sup>[15]</sup> at the University of Washington, USA, and is funded by the Bill and Melinda Gates Foundation, USA. The GBD Report of 2019 indicates<sup>[16]</sup> that the age-standardized disability-adjusted life years (DALYs) have increased over the past decades (1990-2019) in poor countries with lower sociodemographic index (SDI), whereas in rich countries with higher SDI, the benefits have started to stabilize and stagnate at higher levels or have even come down. The results indicate socioeconomic progress in poor countries. The GBD Report advocates that regular reporting of population health and identifying the causes of poor performance through research endeavors would enable the governments to take appropriate measures for improving the deficiencies in the growth of poorer regions. GBD continuously publishes different kinds of scientific papers<sup>[17]</sup> on population health, which can be utilized for a better understanding of population health issues.

In another report, the disease escalation among the world's poorest population was studied and estimated and compared with those in high-income populations; the results highlighted noticeable disparities in communicable, maternal, neonatal, and nutritional diseases, although, over the years from 1990 to 2017, there had been a reduction in the above disease load, manifesting global progress<sup>[18]</sup> in health.

Because of poverty, multiple people in different societies, especially those residing in poor countries, do not have access to sound sanitation establishments. Consequently, because of poor sanitation conditions, several diseases linked with such situations such as dysentery, diarrheal diseases, cholera, typhoid, intestinal hookworm, etc., are more endemic to such regions.<sup>[19]</sup>

More research on diseases of poverty would hint, guide, and suggest newer methods of tackling the enormous global problem. The World Health Organization (WHO) in its Global Report for Infectious Diseases of Poverty<sup>[20]</sup> published in 2012 stated that stepping up research into the causes of infectious diseases that affect mostly the poor people all over the world, which advance and catalyze poverty and kill a sizable number of people globally annually, could enable finding clues to tackle the problem more effectively and would have an enormous impact on efforts to lift people out of poverty. The areas of research on infectious diseases were identified. Four specific themes in this context were identified, namely the environment, the existing health system, innovation required, and new technology to be developed. The landscape of funding for research as well as the high-level action plan required in research strategies was flagged. Adequate funding for research including collaborative research, establishing appropriate research infrastructure in developing countries, and involving collaborations with developed countries are anticipated to contribute enormously to uplifting the poor and stepping up the global development.

The above paragraphs advocate that if the world would develop in a manner that encourages and catalyzes overall human economic development, with more focus on the health of populations living in extreme poverty, then there would be more rationality in realizing the world as one.

## Population increase and regions of intense infectious diseases

The world population<sup>[21]</sup> was reported as 7.96 billion as of June 2022. Top 10 countries having more population (recorded in decreasing numbers as % of total world population) were China (18.5%), India (17.7%), USA (4.2%), Indonesia (3.5%), Pakistan (2.8%), Brazil (2.7%), Nigeria (2.6%), Bangladesh (2.1%), Russia (1.9%), and Mexico (1.7%), representing in total 57.7% of the world population. These regions and many others have caused the development of multiple pockets of thickly populated human habitats. The region-wise population density, measured in terms of the number of people per square kilometer, was Asia (150), Africa (45), Europe (34), Latin America and the Caribbean countries (32), and North America (20). Infectious diseases in highly populated countries and densely inhabited regions may pose greater risks of causing adverse results if appropriate preventive

measures are not in place and if the health infrastructure is not strong. However, because of intense international travel for various reasons, especially for commerce and trade reasons, diseases from remote corners can easily travel to totally nonendemic regions and can cause disaster.

The annual expenses<sup>[22]</sup> on the health budget in the above 10 countries as the percentage of gross domestic product (GDP) during 2019 were China (5.35%), India (3.01%), USA (16.77%), Indonesia (2.90%), Pakistan (3.38%), Brazil (9.59%), Nigeria (3.03%), Bangladesh (2.48%), Russian Federation (5.65%), and Mexico (5.43%). More expenditure on the health budget is thought to be an indicator of better public health infrastructure in that country, which means a better capacity to tackle issues relating to per capita public health.

It is anticipated that the infectious diseases manifested especially in the above 10 countries would adequately represent the established infectious diseases globally. Through vigilance and collection of appropriate information, well-planned strategies could be evolved for planning better strategies to contain the emergence and reemergence of infectious diseases.

The recent pandemic created and caused by COVID-19 flu had taught many lessons and encouraged globally multifaceted collaboration among the academic institutions, the private sector, and the government instrument (especially the regulatory infrastructure), to come out with products and services for use among the people for containing the disease and becoming safe. As a result, multiple procedures and products were invented in a short time, which include the development of protective equipment, several types of testing kits, respiratory devices for the treatment of critically ill patients, and the trial of multiple therapeutic substances for treatment. New vaccines were invented in a record short time, and their applications on the citizens brought considerable respite to people all over the world. Besides medical intervention to tackle the pandemic, multiple nonmedical and nontherapeutic interventions to prevent the spread of infectious diseases were also drawn out and implemented.

Learned from the COVID-19 pandemic, there is a need for reviewing all the other existing major infectious disease loads in the world, to ascertain which diseases are more potential for causing a future pandemic and to evolve effective, doable strategies in a short time, in situations that might be causing stress.

The infectious diseases in the most populated parts of the world and other closer terrain have been collated and grouped into six regions: (1) China; (2) other Asian countries including India, Bangladesh, Pakistan, and Indonesia; (3) Brazil, Mexico, and Latin America; (4) Nigeria and other African countries; (5) Russia and other European countries; and (6) the USA and North America.

#### China

In China, there are some 40 notifiable infectious diseases, of which certain of such diseases affect more people.<sup>[23]</sup> Infectious diseases causing more infection among people include gastrointestinal or enteroviral diseases such as hand foot and mouth disease, infectious diarrhea, bacterial dysentery, acute respiratory diseases such as seasonal influenza, tuberculosis, mumps, scarlet fever, pertussis, rubella, etc.; hemorrhagic conjunctivitis, multiple viral infections causing enteroviral diseases such as hepatitis-A, hepatitis-E, typhoid and paratyphoid, amebic dysentery; sexually transmitted blood-borne diseases such as hepatitis-B, hepatitis-C, syphilis, HIV/AIDS, gonorrhea, etc.; and vector-borne diseases such as dengue, malaria, schistosomiasis, typhus, Japanese encephalitis, brucellosis, and hemorrhagic fever with renal syndrome. Certain hydatid diseases such as Echinococcus granulosus tapeworm; animal bites causing rabies; anthrax; and leptospirosis are also causes of concern, among infectious diseases. Zoonotic schistosomiasis japonica, also called "snail fever," causing chronic liver and intestinal fibrosis is also a disease of concern. As mentioned earlier, China spent about 5.35% of its GDP in 2019 on health care, which is more than many other countries, which is an indicator of the commitment of the government toward people for their health. China is trying to bring about a reform in the healthcare system and in 2009 launched a new healthcare system with increased health insurance coverage. Although this reform has brought in several benefits to the people, the demand for quality services has increased, but expensive medical services have not been adequately available to low-income individuals and are thought to have generated a negative impact<sup>[24]</sup> on the healthcare system on an overall basis. More research is consequently needed to evolve improved policies to increase the overall efficiency and to benefit the poorer people more.

### India, Bangladesh, Pakistan, Indonesia, and other Asian regions

India is burdened with multiple infectious diseases. For the control and eradication of infectious diseases, the Indian government in its Indian National Health Mission<sup>[25]</sup> runs several national health programs such as National Vector Borne Disease Control Programme (NVBDCP), Revised National TB Control Programme, and National Leprosy Eradication Programme. The NVBDCP is an umbrella

program for the prevention and control of several vectorborne diseases such as malaria, dengue, chikungunya, kala-azar, or visceral leishmaniasis (caused by *Leishmania donovani*), Japanese encephalitis, and lymphatic filariasis. The NVBDCP provides technical assistance, makes policies, and assists the Indian states in the form of cash and commodity support for the implementation of the mission. The disease burden is ascertained from the incidence of the diseases across the country. Assistance is provided for early diagnosis, and wherever treatment options are available, actions for treatment are initiated.

For Japanese encephalitis, vaccination is also intensified in the endemic area. More surveillance is kept on the notified diseases,<sup>[26]</sup> among which are tuberculosis, leprosy, malaria, cholera, typhoid fever, dengue fever, rabies, tetanus, diphtheria, whooping cough (pertussis), chicken pox, smallpox, influenza, measles, polio, HIV/AIDS, hepatitis-A, hepatitis-B, scarlet fever, Japanese encephalitis, and other viral encephalitis and plague. The expenditure on health care in 2019 as a percentage of GDP was only 3.01%. To make public healthcare infrastructure more poor-people-friendly, more investment is required. More investment will also strengthen the disease surveillance infrastructure, including infectious diseases.

The infectious diseases in Bangladesh are similar to those found in India. Bangladesh has its health infrastructures, which are not adequate to keep high vigilance and take measures to effectively contain infectious diseases. Bangladesh teamed up with the United States-based Centers for Disease Control and Prevention (CDC) for the last 50 years to strengthen the country's capacity to detect emerging infectious diseases. The Institute of Epidemiology Disease Control and Research, Bangladesh, within the Bangladesh Ministry of Health and Family Welfare has a strong collative endeavor with the CDC to strengthen the capacity of Bangladesh to detect emerging infectious diseases.<sup>[27,28]</sup> Bangladesh has immensely benefitted from the collaboration. In 2012, CDC designated Bangladesh as a CDC Global Center to rapidly direct and respond to various infectious diseases in the country. These supports empowered Bangladesh to identify and respond to infection caused by Naegleria fowleri (commonly referred to as the "brain-eating amoeba"). The collaboration has also helped to tackle and treat encephalitis in several communities by quickly identifying the pathogen Nipah virus, causing the outbreaks. CDC provided a key support to the Bangladesh government to work on encephalitis in the country and to quickly identify the disease-causing Nipah virus. CDC and Bangladesh had been conducting surveillance on the disease. Pteropus bats are the natural

hosts, carrying the virus, and pigs serve as an amplifier. Nipah virus transmission from bats to humans is associated with drinking fresh date palm sap as also the traditional liquor made from date palm sap. Fresh date palm sap is contaminated with Nipah virus causing encephalitis in humans with a high fatality rate. Species of fruit bats in the *Pteropus* genus are the natural reservoirs of the Nipah virus, and such bats have been identified to contaminate date palm sap at night, thereby contaminating the sap and causing human infection.<sup>[29,30]</sup> The annual health expenditure in Bangladesh as a percentage of their GDP was 2.48% only in 2019.

The infectious diseases in Pakistan are similar to those found in India and Bangladesh. The spending by Pakistan on healthcare is low; Pakistan spent 3.38% of its GDP on healthcare in 2019. Consequently, the public healthcare infrastructure needs to be strengthened to more effectively benefit the poor population of the country. Tuberculosis, diarrheal diseases, respiratory infections, typhoid fever, viral hepatitis (A, B, and C), measles, rabies from dog bites, and mosquito-borne diseases such as malaria, dengue fever, and chikungunya have been widespread. Multiple adverse factors such as poverty, a lack of basic health education, overpopulation, a lack of effective preventive strategies, unorganized urbanization, migration, and associated problems linked with displaced persons are some of the causes of the presence and, at times, rise in the infectious diseases.<sup>[31]</sup> Like in Bangladesh, CDC has also been working<sup>[32]</sup> with the Pakistan government to strengthen several of its key public health issues through capacitybuilding enhancement and infrastructure development. The collaborative programs include jointly working on a couple of infectious diseases such as polio eradication, viral hepatitis (A, B, C, E) surveillance, and measures to control the spread, viral influenza detection and surveillance, and study of HIV outbreaks and surveillance. CDC also assists the Pakistani government in field epidemiology and lab training programs on several diseases. CDC also has a strong linkage with Aga Khan University to foster research in vaccinations and neonatal infections.

Indonesia, which is officially the Republic of Indonesia, is a country in Southeast Asia and Oceania and is spread over an estimated total of 17,504 islands. The country is densely populated and belongs to a middle-income economy. Among the infectious diseases, the government machinery takes special interest in addressing and implementing programs to combat diseases such as tuberculosis, malaria, dengue, avian influenza, and HIV/AIDS. Other infectious diseases found in the Asian region are also found in the country. There exists active surveillance and outbreak response system to monitor the key aspects of the health of the citizens.[33] Indonesia spends smaller amounts on its healthcare system; the 2019 spending of the country on health systems was only 2.90% of the GDP. Consequently, several important components of healthcare have become expensive, and availing of those requires expenditure from out-of-pocket savings. The government-supported immunization program in the country for the prevention of communicable childhood diseases is not adequate yet, resulting in insufficient vaccination among the poor population.<sup>[34]</sup> Indonesia has teamed up with the USA for collaborations to strengthen its health systems to strengthen its infrastructure in preventing, detecting, and responding to health challenges in the country. The USA through its United States Agency for International Development (USAID) partners with the Government, Indonesian businessmen, and healthcare providers. USAID inputs include strengthening the ability of Indonesia to plan, finance, and implement multiple priority public health initiatives.[35]

In all these countries, namely India, Bangladesh, Pakistan, and Indonesia, the annual expenditure on healthcare budget as a percentage of their GDP has remained low.

Infectious diseases in other Asian countries are anticipated to be similar to the diseases in the above region.

#### Brazil, Mexico, and Latin America

Brazil is the largest country in South America and is the fifth largest country in the world. The largest Portuguesespeaking population resides in this country. The urban population is high and is about 85% of the total population. The country has several kinds of infectious diseases, which include vaccine-preventable diseases such as viral hepatitis-A, hepatitis-B, typhoid, and paratyphoid fever, as well as childhood preventable diseases such as diphtheria, tetanus, pertussis, and others. Yellow fever is also another vaccine-preventable disease, found in Brazil. Several vectorborne diseases are present in many areas of Brazil, which include malaria, yellow fever, dengue, chikungunya, and Zika; tick and flea-borne diseases such as *Rickettsia rickettsii*, Febre maculosa; several diarrheal and food-borne diseases emanating from infection with Salmonella enterica, Shigella spp., Escherichia coli, Campylobacter spp., Cyclospora cayetanensis, Entamoeba histolytica, Taenia solium (cysticercosis), Brucella spp., Listeria monocytogenes, etc.; respiratory diseases including tuberculosis and viral influenza; bat-borne viral diseases; leptospirosis; several parasitic infections; rabies from animal bites; and several sexually transmitted infections.[36]

Mexico is the second most populous country in Latin America after Brazil. Nearly 78% of Mexicans live in urban areas. Throughout its 32 states, Mexico has diverse geographic features. The disease pattern<sup>[37]</sup> of Mexico is similar to that found in Brazil.

Latin America, including Brazil and Mexico, is understood as a group of 33 countries and dependencies, which cover parts of North America and entire South America as well as the Caribbean region. Several infectious diseases cause distress to the people of this region. The top vectorborne diseases in all regions<sup>[38]</sup> are malaria, dengue fever, chikungunya viral infection, leishmaniasis, Chagas disease, and schistosomiasis. Several infectious viruses having their genome as ribonucleic acids (RNA) such as arena, alpha, and flaviviruses are endemic in South America; these can adapt easily to new hosts, thereby creating zoonotic threats. Endemic and emerging infectious diseases unique to Latin America are multiple. The risks for infectious disease outbreaks have greatly increased in recent times, which are embedded in geopolitical, socioeconomic, and environmental factors including climate change and human migration.<sup>[39]</sup> For the entire Latin America, there exists infectious disease surveillance and reporting systems through the Pan American Health Organization (PAHO), which is the specialized health agency<sup>[40]</sup> of the Inter-American System. PAHO also serves as the Regional Office of the WHO for the Americas. However, with the fast change in the global infectious disease because of turbulence created by man-made disturbances in the environment, social system, urbanization, conflicts, and others, there is an urgent need to invest more at the local large country level in infectious disease surveillance and reporting systems. The pandemic created by the COVID-19 flu has alarmed the global community to invest liberally in such issues.

The health expenditure across Latin America and the Caribbean countries in 2020 was<sup>[41]</sup> about 6.6% of their GDP.

#### Nigeria and other African countries

The Federal Republic of Nigeria,<sup>[42]</sup> in short Nigeria, is an African country, situated in West Africa. Nigeria covers an area of 923,769 square kilometers (356,669 sq. miles). Nigeria is the most populous country in Africa. The country has 36 states and the largest city is Lagos. Major infectious diseases<sup>[43]</sup> in Nigeria are malaria caused by *Plasmodium falciparum*; tuberculosis and tuberculosis with HIV/AIDS; schistosomiasis; diarrheal and water-borne diseases such as amebiasis, cholera, giardiasis, and typhoid fever; viral hepatitis including A, B, C, and E; yellow fever; leishmaniasis; onchocerciasis; lymphatic filariasis, etc. Malaria happens to be a major cause of death in Africa,<sup>[44]</sup> and Nigeria accounted for about 31.9% of global deaths. Nigeria accounts for about 245,000 deaths annually from tuberculosis, and about 590,000 new cases occur every year (of these, around 140,000 are also HIV-positive). Tuberculosis accounts for more than 10% of all deaths in Nigeria despite effective treatments being available.<sup>[45]</sup> Schistosomiasis is another major disease, caused by some species of blood trematodes (flukes) in the genus Schistosoma. The prevalence of the disease is highest among schoolchildren, adolescents, and young adults. Urogenital schistosomiasis is caused by Schistosoma haematobium. The disease is characterized by hematuria, dysuria, bladder wall pathology, genital ulcers, and other complications and can even lead to squamous cell carcinoma. Intestinal schistosomiasis is caused by Schistosoma mansoni. The infection may be manifested as bloody diarrhea and bowel ulceration and can lead to periportal liver fibrosis, portal hypertension, and hematemesis. It is estimated that over 90% of the global infection from schistosomiasis is in Sub-Saharan Africa with almost 300,000 deaths annually, and Niger<sup>[46]</sup> has the greatest number of cases of this disease in the world.

Like many other countries in the world, Nigeria has teamed up with CDC, and the USA. Through the Nigerian Ministry of Health and the State ministries of health, the CDC works to prevent diseases such as HIV, tuberculosis, malaria, and vaccine-preventable diseases. CDC also supports disease surveillance, setting up of labs, and training of the workforce including the field epidemiologists. Collaboration with CDC, USA has helped the country considerably<sup>[47]</sup> in fighting tuberculosis, HIV/AIDS, malaria, and vaccinepreventable diseases more effectively.

In this context, it is relevant to briefly discuss major infectious diseases in the African subcontinent. Africa, including Nigeria, comprises 54 countries as per the United Nations official statistics. Africa is the second-largest and the second-most populous continent, after Asia. Africa is spread over about 30.3 million km<sup>2</sup> (11.7 million square miles); the continent covers 6% of Earth's total surface area and 20% of its land area. The continent is the home of about 1.4 billion people (as of 2021), which is about 18% of the global population. The per capita income of Africans on average is the lowest in the world. Although the continent is endowed with a wide range of natural resources, human factors such as a lack of democracy, corruption, colonialism, neocolonialism, tribalism and social fractionalization, violence, Cold War, abject poverty, underutilized agriculture, poor infrastructure, poor health facilities, poor education, etc., and natural adverse factors such as unfriendly climate in certain regions, geographical factors such as a lack of access to the sea, and tropical climate, etc., are thought<sup>[48]</sup> to be responsible for slower growth of the continent. In the African continent, diseases such as malaria, tuberculosis, acute respiratory infections, diarrheal diseases, and HIV/AIDS cause high mortality annually. Malaria, tuberculosis, acute respiratory infections, diarrheal diseases, and HIV/AIDS are assessed to be causing over six million deaths annually in the region.<sup>[49]</sup> A multitude of diseases such as lymphatic filariasis, leishmaniasis, schistosomiasis, sleeping sickness, and several others cause a loss of productivity through disabilities and deformities. Millions of people in African nations live with less than \$1 a day and on fragile and often remote rural ecosystems. With the public healthcare system being inadequate and the level of poverty being high, most African countries are unable to cope with the burden of disease. The life expectancy in many African countries is reducing because of infectious diseases. The SARS-CoV-2 viral pandemic has more than awakened the African national institutional healthcare infrastructure to be able to cope with the current and future disease threats, including infectious diseases. New policy and orders<sup>[50]</sup> would require not only strengthening capabilities for the manufacture of effective diagnostic devices, vaccines, and therapeutics but also developing a large pool of trained manpower of various kinds for working on health issues, as also to promote multiple types of collaborations and partnerships with able institutions and agencies. In such as large endeavor, public-private partnerships at national and international levels would go a long way to tackle the gigantic problem.

The health expenditure across Sub-Saharan Africa,<sup>[51]</sup> measured as a percentage of GDP, has remained low.

#### Russia and European countries

Compared to infectious diseases in the developing and poor countries, the infectious disease load in Russia is considerably low.<sup>[52]</sup> In August 2021, in Russia, the acute respiratory infection was comparatively high, with about 2.268 million cases, followed by acute intestinal infection of 0.043 million cases, further followed by other infectious diseases such as HIV/AIDS, pediculosis, tuberculosis, salmonella infection, syphilis, gonorrhea, hepatitis, whooping cough, and epidemic parotitis (mumps). Of late, the COVID-19 infection has caused considerable devastation in the country. Tuberculosis is also endemic in Russia. Several emerging and reemerging infections<sup>[53]</sup> such as tick-borne encephalitis, ixodid tick-borne borreliosis, hemorrhagic fever with renal syndrome, Crimean–Congo hemorrhagic fever, West Nile fever, Astrakhan spotted fever, leptospirosis, and tularemia have been surfacing in Russia, probably because of globalization and increased international travel to and from Russia.

The incidence of infectious diseases in the European Union (EU) and European Economic Area (EEA) countries and regions has remained low. In 2014, according to the executive summary of the annual report of EU and EEA, five infectious diseases Chlamydia infection, campylobacteriosis, salmonellosis, gonorrhea, and tuberculosis were the most commonly reported infectious diseases in these regions.<sup>[54]</sup> Later, for 31 selected diseases in the EU and EEA, another study was carried out to calculate the burden of DALYs for these diseases. Of all the diseases selected, it was revealed that influenza had the highest burden (about 30% of the total burden), followed by tuberculosis, human HIV/AIDS infection, and invasive pneumococcal disease. Such studies provide results of baseline estimates for evaluating infectious disease prevention and control strategies. The very narrow range of only four diseases indicates the low levels of infectious disease load in the entire region.<sup>[55]</sup>

The annual expenses on the health budget for  $EU^{[56]}$  were 9.92% of GDP in 2019, whereas that for Russia was only 5.56%, which are indicators of comparatively better health status in the EU than in Russia.

The war between Russia and Ukraine started on February 24, 2022, when Russia invaded Ukraine, and on September 30, 2022, Russia annexed Luhansk and the three partially occupied Ukrainian oblasts of Donetsk, Zaporizhzhia, and Kherson. The war severely affected the economy of both Russia and Ukraine. The sufferings of the people in the war-affected regions must have increased with lesser or non-availability of essentials like electricity, gas, safe drinking water, and proper shelters, which may have been manifested in increased respiratory diseases, diarrhea and intestinal disorders, and other ailments, especially among the old people and the children in the war-affected regions. Russia is also anticipated to suffer and would be handicapped to extend adequate medical assistance to its people. It is anticipated that the war has been bringing unprecedented suffering to poor people all over the world, besides the population residing in the war-affected regions. The prices of most essential commodities have increased, and the supply chain of raw materials, components, and other goods have got seriously disrupted by an increase in prices, which has resulted in the closure of several small units and the laying off of workers from jobs in many countries.

#### United States of America and North America

Several most common infectious diseases in the United States of America (USA) have been identified,<sup>[57]</sup> which include Chlamydia, a sexually transmitted disease affecting men and women; influenza A and B; common cold caused by other viral infections; Staph infections caused by Staphylococcus bacteria such as Staphylococcus aureus; Escherichia coli (E. coli) infection caused usually by eating contaminated raw vegetables or undercooked meat; Shigellosis from the use of contaminated water or food or with an infected person's poop; Salmonella infection from raw or undercooked meat, poultry, eggs, or egg products; food poisoning syndromes especially by Norovirus, caused through the intake of contaminated food or water or from the touch of contaminated surfaces, or objects; pneumonia caused by microbes such as bacteria, viruses, and fungi; infection from herpes simplex 1 (HSV-1) and/or herpes simplex 2 (HSV-2); syphilis; gonorrhea; HIV/AIDS; and hepatitis C, caused contact with infected blood. The incidence of such diseases is however within manageable limits, and several of these diseases are treatable, for which health infrastructure exists. A couple of infectious diseases causing concern in the USA in 2018 were cases of Salmonella infection, Lyme disease, tuberculosis, and meningococcal disease cases, although the number of cases reported was not very high.<sup>[58]</sup> The infecting bacteria, Salmonella, typically lives in animal and human intestines, and people become infected through contaminated food and water intake. Lyme disease is transmitted to humans through the bite of infected black-legged ticks. The illness caused by the bacteria Neisseria meningitides is the genesis of meningococcal disease. A couple of tick-borne infections also cause concern<sup>[59]</sup> in certain circumstances. The extent of infectious diseases in the USA is considerably low when compared with such disorders in poor countries.

In Canada over the years, there has been a fast decline in infectious disease not only by improving the living conditions of people but also by deploying vaccination to the eligible population including newborns and children, as also by using appropriate therapeutic substances. Though the research spending of Canada on infectious diseases is much less than that of the USA, the country has been able to maintain high-class research capacity in its academic and private sectors. The country has created its Public Health Agency of Canada, through which it can take fast steps for maximizing need-based research and actions against endemic and infectious diseases.<sup>[60]</sup> The major threats from infectious diseases in Canada are similar to or even lesser than those in the USA. The annual expenses on the health budget in the USA as a percentage of GDP were 16.77%, whereas that in Canada<sup>[61]</sup> was 11.6%, both countries during 2019.

#### **DISCUSSION AND CONCLUSION**

The world is in the midst of fast transition and change, especially in the regions where the population density is high. The change is driven by the intent of people to be wealthier and more economically comfortable. The changes are guided by economic, political, and social factors and are driven by planned and unplanned urbanization and demographic factors. The changes arising from intense competition between the factors of survival and prosperity generate spots and regions of imbalances. The imbalances result in stress and chaos, following which health conditions get the beating and are manifested in the emergence and reemergence of infectious diseases.

Human dwellings in thickly populated pockets that are the residence of poor people suffer more than people residing in healthier regions. During the last century in 1918, in the influenza pandemic, known as the Spanish Flu pandemic when many people died, it was found that transmission of infection, as well as death, was more<sup>[62]</sup> among the people living in inept poverty, inequality, living in densely populated and environmentally more polluted areas. Mortality rates were relatively lower in the medium- and high-income population group.

Although, because of economic growth in many poorer regions, the percentage of middle-income populations is rising, there is yet a high percentage of poor people in such regions, and their absolute numbers are yet very high. Government investment in the healthcare system in developing countries has been small, though the quantum is increasing over the years. However, the proportion of investment compared to what is needed for maintaining the better health of the majority of the population remains insufficient. As a result, communicable diseases have persisted and problems of maternal as well as child health have remained inadequately addressed, especially in poor settings. The majority of the disease burden and also its intensity are attributed consequently to poor countries.

To effect faster global development, each poor country needs to improve upon its health infrastructure and health needs. With the assistance of rich countries monetarily as well as technologically, the situation can be improved. International organizations such as the WHO, the World Bank, and others including large philanthropic organizations are working to improve human health globally. More monetary assistance to these organizations would positively contribute to the cause.

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#### **Conflicts of interest**

There are no conflicts of interest.

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