Forum:	World Health Organization
Issue:	Preventing the spread of diseases caused by climate change
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I. Introduction

Climate change is undoubtedly one of the greatest threats to humankind's existence. Hundreds of thousands of people are fleeing from or even dying to rising sea levels, natural disasters, and extreme weather. It is, however, rather neglected that climate change is exacerbating the spread of infectious diseases. The changes in temperatures, humidity, and ecosystems that come with climate change impact the survival of pathogens and how they are transmitted. An increase in average yearly temperatures, for example, affects where mosquitoes migrate to and thus where mosquito-borne diseases such as malaria are spread to. In times of COVID-19, the relationship between climate change and the spread of infectious diseases is a relevant matter. With the effect of climate change, pathogens evolve in new climates and are active in different parts of the world, which poses a danger to those who have had no previous contact. The reduction of greenhouse gas emissions and the preparation of humankind for the spread and potential resurgence of diseases must be pursued to prevent future pandemics.

II. Definition of Key Terms

a) Pathogens

The term "pathogen" refers to the cause of a disease and falls into four main categories: viruses, bacteria, parasites, and fungi. An example of a pathogen is the Mycobacterium tuberculosis, the bacteria that causes tuberculosis, or SARS-CoV-2, the virus that causes the disease COVID-19.

b) Hosts and vectors

A host is an organism that the pathogen resides in, such as the black rat, which hosted the pathogen that caused the bubonic plague. The host is often unharmed, such as in the case of the black rat. A vector is a living organism that transmits the pathogen. A typical example is the mosquito, which is a vector for malaria.

c) Transmission

There are five major routes of transmission of diseases.

i) Direct contact transmission

Direct contact transmission occurs when there is direct contact between the body of an uninfected human or animal and fluids or tissues of an infected organism. Examples include the transmission of HIV, a sexually transmitted disease.

ii) Airborne transmission

Airborne transmission occurs when an uninfected human or animal inhales pathogens, the pathogen comes in contact with mucous membrane, or the uninfected person comes in contact with pathogens residing on an environmental surface. Examples include the transmission of SARS-CoV-2.

iii) Fomite transmission

Fomite transmission occurs when an uninfected human or animal comes in contact with an object or surface contaminated with infectious pathogens. Examples include the influenza virus, which survives on certain substances for multiple hours.

iv) Oral transmission

Oral transmission occurs when an uninfected human or animal ingests pathogens by, for example, consuming contaminated food or drinking contaminated water. Examples include the transmission of the bacterias that cause cholera.

v) Vector-borne transmission

Vector-borne transmission occurs when vectors, typically blood-feeding arthropods such as mosquitoes and ticks, transmit pathogens to uninfected humans or animals. Examples of vector-borne diseases include malaria, Lyme disease, and the plague.

d) Diseases

A disease is a disorder in the functional state of humans, animals, or plants, caused by pathogens. Examples include COVID-19, which is caused by the virus SARS-CoV-2.

e) Climate Change

Climate change, as defined by the United Nations Framework Convention on Climate Change, is the "change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."[1]

III. General Overview

a) Climate change and the spread of diseases

i) The effect on pathogens

Climate change has a direct effect on pathogens. Changes in temperatures and precipitation affect their survival and lifecycle. It indirectly affects them by changing their environment and the available hosts. Pathogens, especially vector-borne ones, have a temperature range at which they can survive. The malaria parasite Plasmodium, for example, can only properly develop at temperatures at a temperature above 20°C.[2] Rising global temperatures mean that this pathogen will be able to reside in a

[1] "United Nations Framework Convention On Climate Change," UNFCCC (United Nations, 1992), https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf.

[2] "Climate Change and Vector-Borne Disease," Climate Change and Vector-Borne Disease | UCAR Center for Science Education, 2021, https://scied.ucar.edu/learning-zone/climate-change-impacts/vector-borne-disease.

greater variety of climates. Shifts in precipitation impact the development and spread of waterborne pathogens. In rainfall seasons, there is generally an increase in fecal pathogens. Changes in humidity also affect the responsiveness and spread of certain pathogens. Increased humidity was found to contribute to dengue fever outbreaks.

Sunshine also has a direct effect on pathogens. The reproduction of the vibrio cholerae, a bacteria of which some strains cause cholera, is more favorable under sunshine. Climate change worsens droughts, which breeds convenient conditions for cholera pathogens, for example.

These direct effects of climate change lead to more favorable conditions for certain pathogens, especially waterborne and vector-borne pathogens.

ii) The effect on hosts, vectors, and transmissions

Changes in temperatures affect the distribution of hosts and vectors. The habitats of mosquitoes and ticks, for example, have expanded due to this. Studies have found that vector-borne diseases such as malaria, Lyme disease, yellow fever, dengue fever, and tick-borne encephalitis are transmitted in an increasingly wider range, as conditions are becoming more favorable for the vectors.[3] An increase in the spread of some of these vector-borne diseases may also be correlated with changes in precipitation. Stronger winds may also extend mosquitoes' flight range and thus extend where they transmit vector-borne diseases. These changes in climate do not always promote the development of these vectors. Excessive rainfall damages the reproduction of mosquitoes, for example, and strong winds may reduce biting opportunities for blood-feeding arthropods.

b) Diseases influenced by climate change

Climate change both directly and indirectly influences the spread of many diseases, mostly water-borne, air-borne, and vector-borne ones.

[3] Xiaoxu Wu et al., "Impact of Climate Change on Human Infectious Diseases: Empirical Evidence and Human Adaptation," Environment International (Pergamon, October 18, 2015), https://www.sciencedirect.com/science/article/pii/S0160412015300489.

i) Cholera

Vibrio cholerae, the cholera pathogen, are bacteria that thrive in warm waters. Cholera is especially prevalent in areas with inadequate sanitation and poor hygiene, mostly LEDCs. The disease spreads through eating or drinking food or water contaminated by feces. Considering the the lack of clean water and the climate vulnerability of these areas, cholera epidemics are expected to worsen if no progress is made in improving the infrastructures.

ii) Ebola

A 2018 model suggests that there is a link between increasing average temperatures and Ebola outbreaks.[4] Animals such as bats which are suspected of transmitting Ebola will migrate to new areas and bring the disease with them. The Ebola virus itself is less susceptible to climate change. The connection between Ebola and climate changes rests mainly on the migration of the bats, who directly transmit to it other hosts, such as humans. In the past, there have been Ebola outbreaks in the Democratic Republic of Congo (DRC), Sudan, Gabon, Uganda, and Western Africa, and they are ongoing in the DRC and Guinea. As developing countries, they are vulnerable to both climate change and the spread of infectious diseases.

iii) Malaria

Climate change affects the malaria pathogen Plasmodium as well as how and where the vector transmits the disease. The pathogen, a parasite, is transmitted through bites from the female Anopheles mosquito. The parasite cannot properly develop in temperatures below 20°C, so a rise in average temperatures expands the range of the pathogen. Higher temperatures and precipitation are also agreeable to mosquitoes. As these increase with greenhouse gas emissions, mosquitoes can spread malaria in more areas. In 2019 alone, more than 400 000 people died of malaria, making it one of the deadliest diseases. Nigeria, the Democratic Republic of Congo, Burkina Faso,

[4] Josh Gabbatiss, “Ebola Epidemics Will 'Increase with Greenhouse Gas Concentrations', Study Finds,” Carbon Brief, October 15, 2019, https://www.carbonbrief.org/ebola-epidemics-will-increase-with-greenhouse-gas-concentrations-study-finds.

Mozambique, and Niger account for more than half of all malaria deaths.[5] Yellow fever, Lyme disease, and dengue fever are affected by climate change in a similar way.

iv) COVID-19

No direct link has been found between climate change and the transmission of SARS-CoV-2. However, there may be an indirect connection. The novel coronavirus is zoonotic, meaning the virus passed from animals to humans. The damage climate change has done to ecosystems is related to the spread of zoonotic diseases. 31% of disease outbreaks are related to deforestation,[6] for example. According to the United Nations Environment Programme, "[the] most fundamental way to protect ourselves from zoonotic diseases is to prevent destruction of nature. Where ecosystems are healthy and biodiverse, they are resilient, adaptable and help to regulate diseases."[7] Climate change leads to the migration of animals and therefore causes more interaction between different animals, increasing the likelihood of diseases spreading. As animal populations shrink, there is less genetic diversity, which enables new diseases to develop and be spread. One study suggests that changes in the distribution and richness of bats, which are likely the origin of SARS-CoV-2, in eastern China facilitated the spread of the virus.[8]

IV. Major Parties Involved & Their Views

a) World Health Organization (WHO)

The WHO is a specialized agency of the UN concerned with international public health. The organization expects climate change to cause around 250 000 between 2030 and 2050 from diseases sensitive to climate change such as malaria

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[5] "Fact Sheet about Malaria," World Health Organization (World Health Organization, 2020), https://www.who.int/news-room/fact-sheets/detail/malaria.
[6] Sandrine Boukerche and Rianna Mohammed-Roberts, "Fighting Infectious Diseases: The Connection to Climate Change," World Bank Blogs, May 19, 2020, https://blogs.worldbank.org/climatechange/fighting-infectious-diseases-connection-climate-change.
[7] "Science Points to Causes of COVID-19," UNEP (United Nations, May 22, 2020), https://www.unep.org/news-and-stories/story/science-points-causes-covid-19.
[8] Robert M. Beyer, Andrea Manica, and Camilo Mora, "Shifts in Global Bat Diversity Suggest a Possible Role of Climate Change in the Emergence of SARS-CoV-1 and SARS-CoV-2," Science of The Total Environment (Elsevier, January 26, 2021), https://www.sciencedirect.com/science/article/pii/S0048969721004812?via%3Dihub.

and dengue fever. The health infrastructure of certain areas plays a crucial role in the spread of diseases. Especially developing countries, many of which already struggle with disease, will be unprepared to address the rapid spread of diseases caused or exacerbated by climate change. The WHO supports countries' efforts in building "climate-resilient health systems."[9] They underline three main goals: cooperating with other UN agencies to ensure health is discussed in the climate change agenda, reviewing the scientific link between climate change and the spread of diseases, supporting countries in strengthening health systems vulnerable to the effects of climate change. Concerning COVID-19, the WHO has said that they have found no direct link between climate change and the spread of COVID-19.

b) The Philippines

In the last decades, the Philippines has worked on controlling and eradicating malaria. While 20 years ago 75 000 thousands of cases of malaria were reported every year in the Philippines, malaria cases and deaths dropped by over 80% from 2005 to 2017.[10] The Filipino Department of Health developed a plan for malaria control, which includes the distribution of mosquito nets and sprays across endemic areas. The WHO supported the Philippines in their efforts, which have proven effective.

c) Nigeria

Nigeria was one of the only countries that successfully dealt with Ebola in the West African Ebola virus epidemic from 2013-2016. The virus entered Nigeria's biggest city, Lagos, on July 20, 2014. An emergency operations center was established, and funds were allocated to efficiently and quickly diagnose cases of Ebola. Isolation facilities were constructed and GPS systems were used to track the transmission of Ebola, as they are currently being used in some countries to track the spread of COVID-19. With the support of the WHO, Nigeria was able to keep the total number of cases at 19 and the number of deaths at 7.

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[9] "Climate Change," World Health Organization (World Health Organization, 2021), https://www.who.int/health-topics/climate-change#tab=tab_1.

[10] "Successfully Controlling and Eliminating Malaria in the Philippines," World Health Organization (World Health Organization, July 12, 2017), https://www.who.int/philippines/news/feature-stories/detail/successfully-controlling-and-eliminating-malaria-in-the-philippines.

V. Timeline of Key Events

Date	Event
June 3-14, 1992	United Nations Framework Convention on Climate Change (UNFCCC), first UN convention on climate change
Dec. 11, 1997	Kyoto Protocol to the UNFCCC is signed, goals to reduce CO2 emissions
Feb. 16, 2005	Kyoto Protocol to the UNFCCC comes into force
Oct. 2010	Cholera outbreak in Haiti after earthquake
Dec. 2013	Begin of the Ebola epidemic in Western Africa
April 22, 2015	Paris Agreement is signed, global agreement to combat climate change
Aug. 2016	Thawing permafrost in Siberia leads to Anthrax outbreak
Nov. 4, 2016	Paris Agreement comes into force
Oct. 8, 2018	Intergovernmental Panel on Climate Change (IPCC) reports the immediate need for greenhouse gas emission reductions to prevent increase of 2°C above pre-industrial levels
January 2020	Begin of the COVID-19 pandemic

VI. Relevant United Nations Documents & Other Sources

- Health, environment, and climate change

  This is a detailed report on the World Health Organization's strategy to combat the spread of diseases exacerbated by climate change. It outlines the problem and the WHO's objectives.
- Protecting health from climate change

  This report explains how climate change affects health and the spread of diseases, exploring the issue in various parts of the world.
- Impact of climate change on human infectious diseases: Empirical evidence and human adaptation

  This report goes into great detail on the effect of climate change on pathogens, hosts and vectors, and transmission.

VII. Previous and Possible Solutions

The solutions to preventing the spread of diseases caused by climate change either tackle the issue of climate change itself, a long-term solution, or directly deal with the spread of diseases.

The Paris Agreement and other climate accords have so far failed in reducing greenhouse gas emissions, although carbon emissions have decreased since the beginning of the COVID-19 pandemic. The UN reports, however, that the world health crisis is doing little in the fight against climate change.[11] The United Nations Environment Programme reported in 2019 that, to prevent global average temperatures from rising 1.5°C since the beginning of the Industrial Age, emissions need to be cut by 7.6% every year for the next decade.[12] A slowdown like the one during the current pandemic would be needed every year until 2030 to accomplish the goals of the Paris Agreement. Greenhouse gas emissions in certain countries, however, are decreasing. In Germany, for example, they have declined by more than 35% since 1990.[13] Member states must construct or continue to construct green infrastructure and further pursue the use of clean energy, to prevent the exacerbation of epidemics and the resurgence of certain diseases.

To directly prevent the spread of diseases caused or worsened by climate change, health infrastructure and health education need to be heavily improved, especially in developing countries. For example, in the Democratic Republic of Congo, where, in 2019 alone, 13 000 people died of malaria,[14] long-lasting insecticide-treated nets (LLINs) were used by less than 50% of the populace that had access to them, according to one study.[15] Access to healthcare facilities is also limited in many LEDCs, particularly in rural areas. Allocating funds and resources

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[11] “United in Science 2020,” World Meteorological Organization, October 25, 2020, https://public.wmo.int/en/resources/united_in_science.

[12] “Cut Global Emissions by 7.6 Percent Every Year for Next Decade to Meet 1.5°C Paris Target - UN Report,” UNFCCC (United Nations, November 26, 2019), https://unfccc.int/news/cut-global-emissions-by-76-percent-every-year-for-next-decade-to-meet-15degc-paris-target-un-report.

[13] Kerstine Appunn, Freja Eriksen, and Julian Wettengel, “Germany's Greenhouse Gas Emissions and Energy Transition Targets,” Clean Energy Wire, March 16, 2021, https://www.cleanenergywire.org/factsheets/germanys-greenhouse-gas-emissions-and-climate-targets.

[14] James Tasamba, “Malaria Remains Leading Cause of Death in DR Congo,” Anadolu Ajansı, April 26, 202AD, https://www.aa.com.tr/en/africa/malaria-remains-leading-cause-of-death-in-dr-congo/1818732.

[15] “The Importance of Education to Increase the Use of Bed Nets in Villages Outside of Kinshasa, Democratic Republic of the Congo,” ResearchGate, October 2010, https://www.researchgate.net/publication/47394986_The_importance_of_education_to_increase_the_use_of_bed_nets_in_villages_outside_of_Kinshasa_Democratic_Republic_of_the_Congo.

towards the improvement of education and health infrastructures would lessen the vulnerability to diseases like malaria, Lyme disease, dengue fever, and other vector-borne diseases. Ebola, which is believed to be partly transmitted through infected animals like fruit bats and chimpanzees, is sometimes contracted through the handling of infected bushmeat. Cholera, on the other hand, is contracted through the drinking of water contaminated by feces. Those living in poor socio-economic conditions are more likely to consume contaminated foods and not have access to clean drinking water. As with vector-borne diseases, the spread of orally transmitted diseases can be prevented through proper health education and better infrastructures. In the case of cholera, improved sanitation systems and awareness about cholera contraction are measures to avoid epidemics. Ebola contraction can also be avoided through education and increased awareness of bushmeat consumption. However, when tackling the problem of the Ebola virus, direct contact transmission appears to be an issue too. COVID-19, for example, is transmitted through direct contact or fomites. Quarantines and lockdown were and still are being introduced to prevent the spread of the novel coronavirus. Quarantining infected persons limits the possibilities for a disease to spread. The effectiveness of certain lockdowns has been put in question, however. The Chair of Global Public Health at the University of Edinburgh argues that “a robust system for testing, tracing and isolating, where test results are returned within 24 hours, at least 80% of people’s contacts are reached and there is high adherence to a rule of 14 days’ isolation for those exposed to the virus” is crucial in defeating COVID-19.[16] As mentioned before, Nigeria is an example of a country that handled the West African Ebola virus epidemic of 2013-2016 well, by quickly responding to the danger through tracking infections and constructing isolation facilities. As has been done with COVID-19, the development of vaccines is absolutely crucial in defeating diseases. This research obviously funding. Member states must determine their spendings and decide what should be left to the public and what to the private sectors.

[16] Devi Sridhar, “Continual Lockdowns Are Not the Answer to Bringing Covid under Control,” The Guardian (Guardian News and Media, October 10, 2020), https://www.theguardian.com/commentisfree/2020/oct/10/continual-local-lockdowns-answer-covid-control.

VIII. Questions to Consider

- How can health infrastructures in developing nations be improved to protect people from diseases susceptible to climate change?
- What steps must be taken to prevent the human-to-human transmission of diseases?
- Can research on the relationship between climate change and the spread of certain diseases help tackle the issue?
- What responsibility do MEDCs have in preventing the spread of climate-susceptible diseases in LEDCs?
- How can medical research contribute towards solving the issue?
- How can future pandemics exacerbated by climate change be prevented?
- What is needed to achieve the goals of past climate agreements?

IX. Conclusion

With the COVID-19 global pandemic, people in both developed and developing countries have become aware of the threats infectious diseases pose. This increasing spread of diseases is evidently connected to climate change. Rising sea levels, precipitation, temperatures, longer droughts, and faster winds affect the development and survival of pathogens and the transmission from vectors and hosts to humans. This means that diseases susceptible to climate change will have a wider range of infection. Developing countries are especially vulnerable due to lacking health infrastructures and awareness, such as inadequate sanitation or an insufficient amount of healthcare centers. The worst polluters, generally developed countries, are not facing all consequences of their emissions as health crises in developing countries worsen.

The spread of diseases caused by climate change cannot only be countered through measures to decrease the risk of people becoming infected with infectious diseases but also through detailed plans to fight climate change which promote the use of clean energy over fossil fuels. The coronavirus pandemic has proven that member states must cooperate on health issues and will have to do so in the future.

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