UCL DEPARTMENT OF GEOGRAPHY

YEAR 2023-24

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COURSE PAPER TITLE:	**Undergraduate Individual Coursework Submission**
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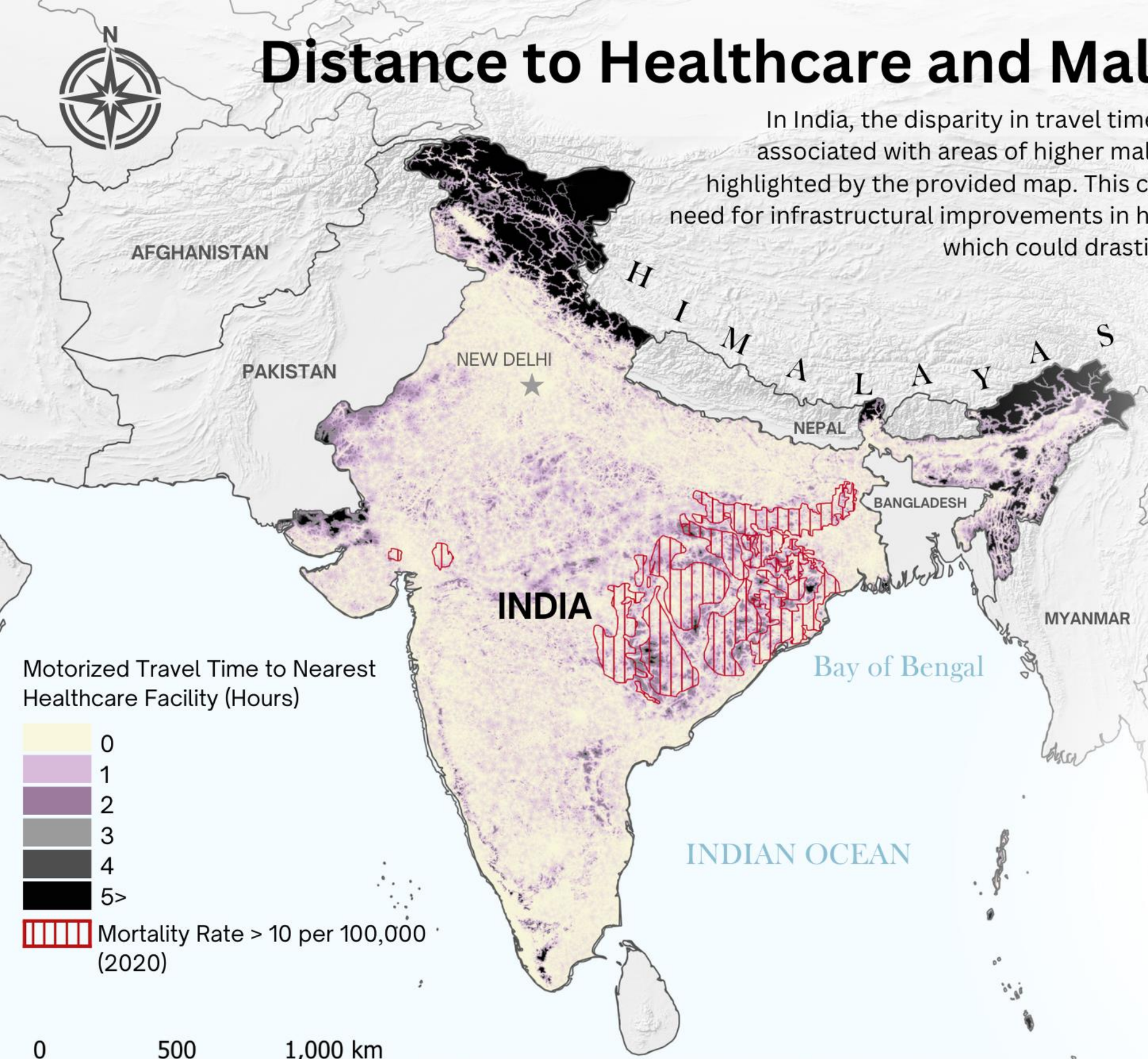
Introductory Paragraph:

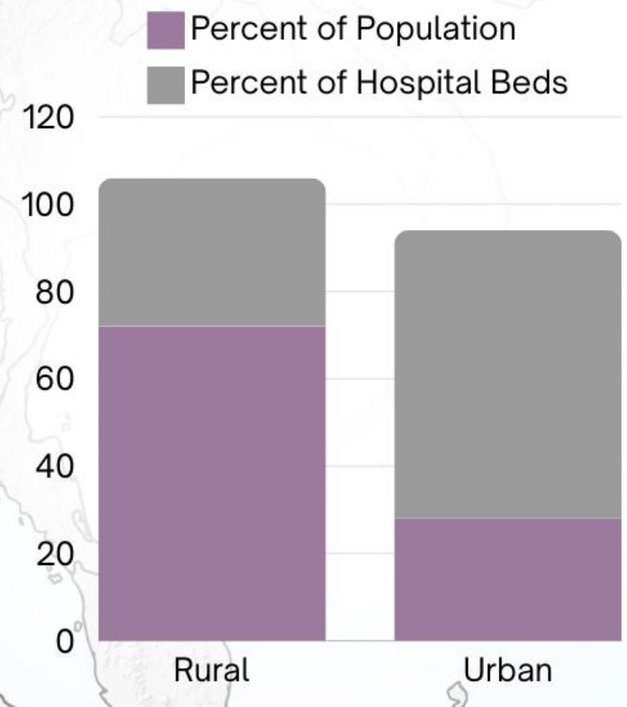
This series of five visualizations explores the relationships between environmental factors, healthcare accessibility, migration patterns, and the spread and management of malaria globally. Intended for policymakers, public health officials, researchers, and non-governmental organisations involved in malaria prevention and control, these maps provide valuable insights into the geographic and demographic patterns influencing malaria transmission and treatment effectiveness. By highlighting trends such as the impact of stagnant water on malaria cases, the global reach of antimalarial case management, the impact of rainfall on mosquito occurrence, historical and current migration patterns of malaria, and rural access to healthcare, this series aims to inform and guide strategic decisions aimed at reducing the incidence and impact of malaria worldwide.

Distance to Healthcare and Malaria Mortality

In India, the disparity in travel time to the nearest healthcare facility is associated with areas of higher malaria mortality rates, a pressing issue highlighted by the provided map. This critical insight emphasizes the urgent need for infrastructural improvements in healthcare accessibility in rural India, which could drastically reduce malaria-related deaths.

Addressing this issue requires focusing on enhancing road connectivity, increasing healthcare facilities, and ensuring the availability of malaria prevention and treatment resources in remote areas. Such interventions are essential to mitigate the high mortality rates associated with malaria in India's underserved regions.





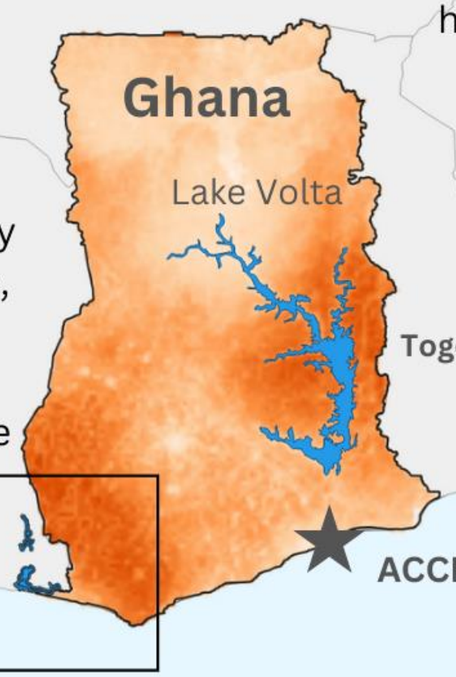
Map Data: *Malaria Atlas Project,* **Boundaries and Earth Data:** *Natural Earth,* **Chart Data:** *Yadav K, Jarhyan P, Gupta V, Pandav CS. Revitalizing Rural Health Care Delivery: Can Rural Health Practitioners be the Answer? Indian J Community Med. 2009*

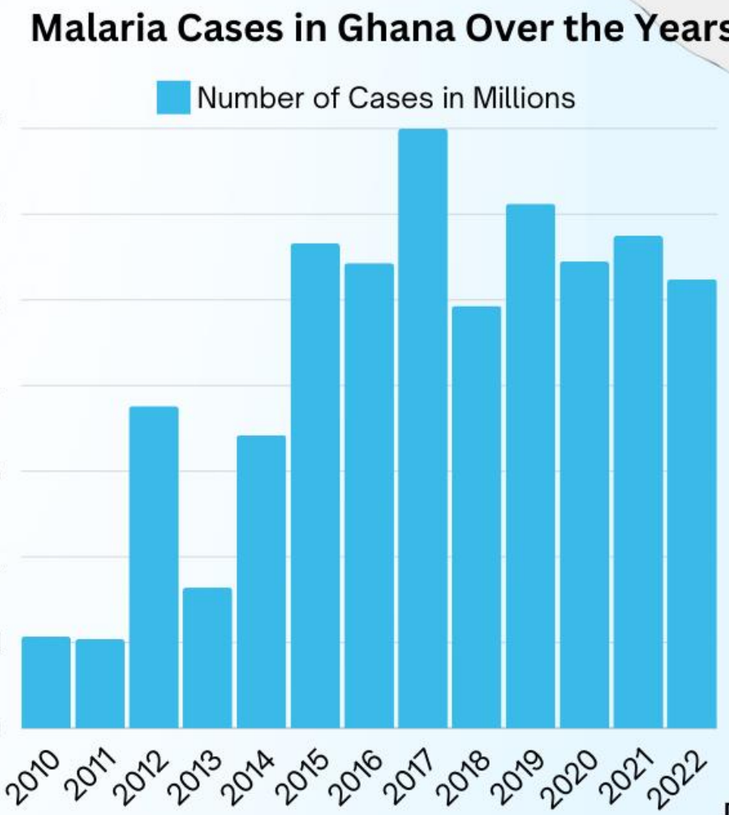
Stagnant Water as Breeding Ground for Malaria

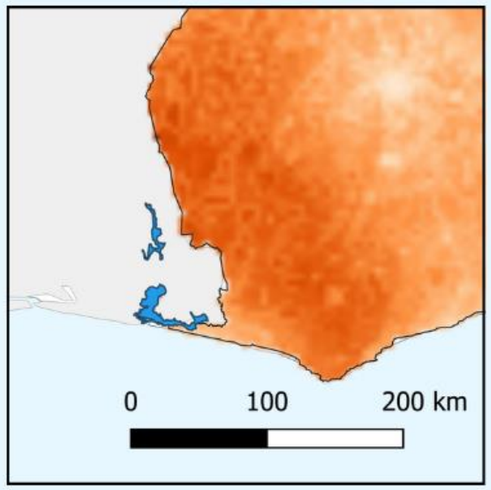
This visualisation illustrates the correlation between stagnant water bodies and the incidence of malaria in Ghana. This comprehensive map and accompanying bar graph detail the geographic distribution of stagnant water sources and the malaria cases diagnosed across different regions, providing a clear depiction of the relationship between environmental conditions and health outcomes.

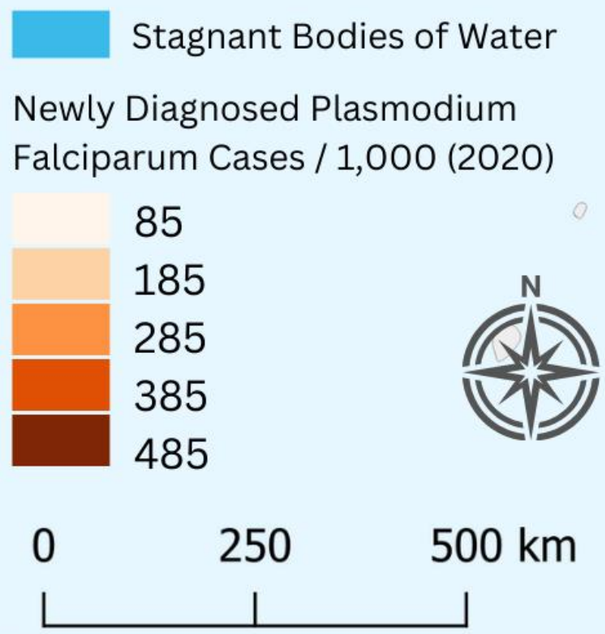
The primary map highlights Lake Volta, a large body of stagnant water in Ghana. Large bodies of still water such as these create suitable breeding habitats for mosquitoes and their larval habitat. The intensity of the color red correlates with the number of cases per 1,000 people, vividly indicating regions where malaria is most prevalent. The map also zooms into a large body of stagnant water in nearby Ivory Coast, underscoring the proximity of stagnant water bodies to high-incidence malaria zones.

This visual tells a story of cause and effect, highlighting the critical need for effective water management and mosquito control strategies in malaria-prone regions. By focusing on Ghana, the visualization advocates for targeted public health interventions, including the clearing of stagnant water sources and the implementation of community education programs on the risks of standing water.









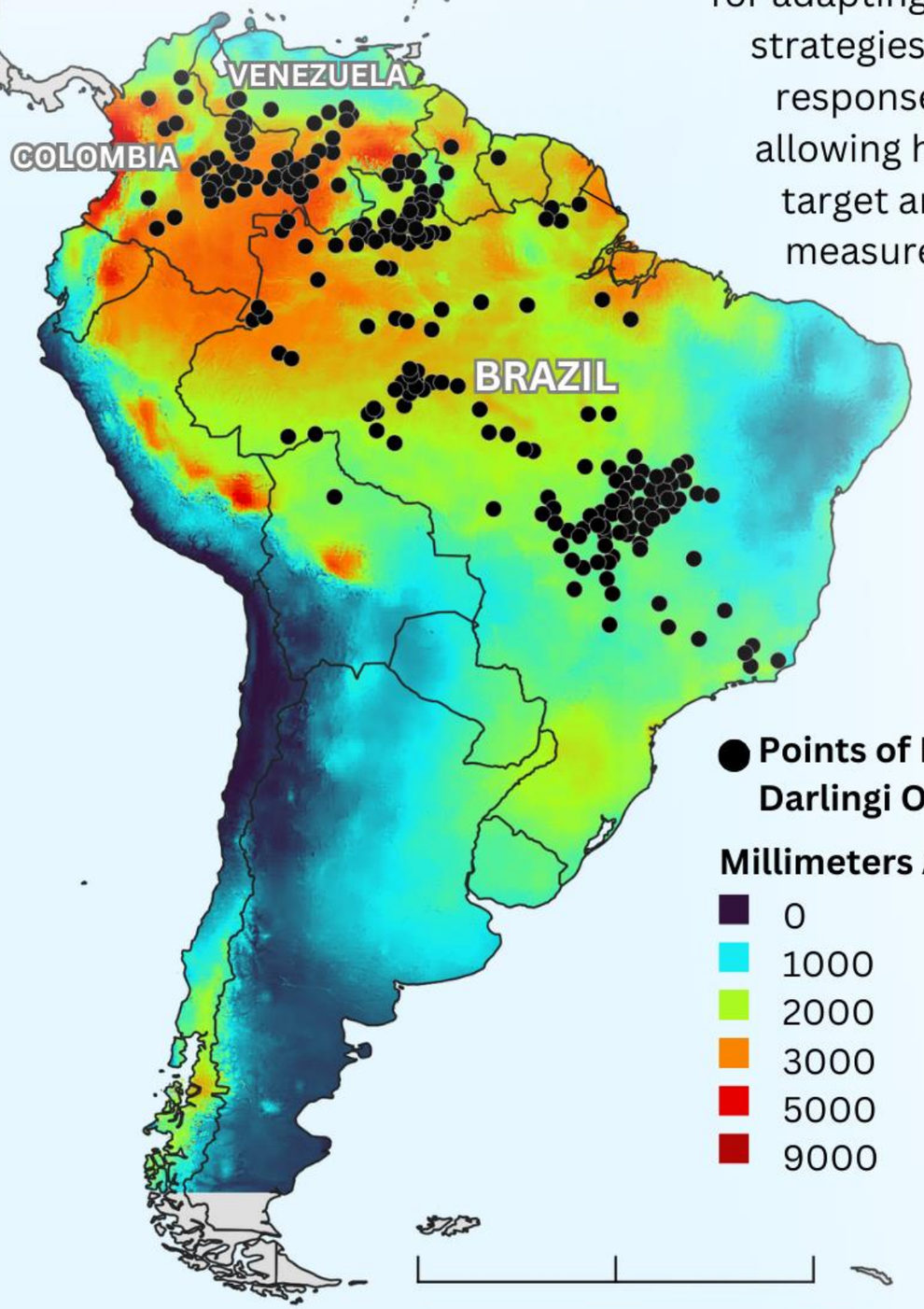
Data: *Malaria Atlas Project* **Boundaries:** *Natural Earth* **Chart Data:** *World Data Bank*

Annual Rainfall And Predicted Anopheles Mosquito Occurrence in South America

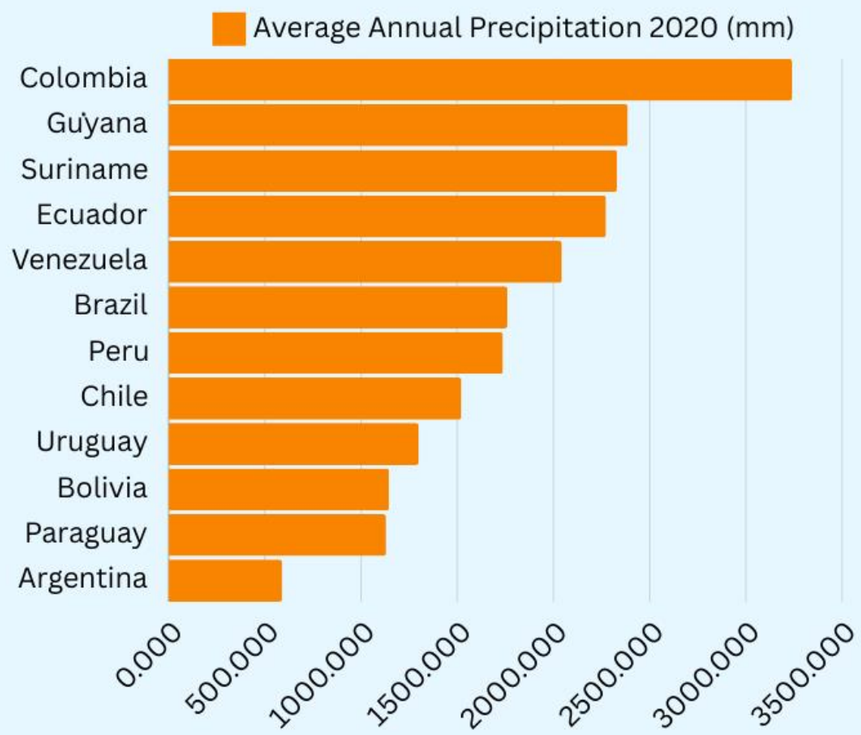
Anopheles darlingi, a key malaria vector in the Anopheles genus, is predominantly found in South America's tropical and subtropical regions, especially the Amazon basin.

Climate factors like temperature and rainfall significantly influence mosquito longevity and malaria parasite development. High mosquito occurrences, indicated by dense black dots on maps, align with regions of heavy rainfall, particularly in Colombia, Venezuela, and northern Brazil.

This detailed mapping is crucial for adapting malaria prevention strategies, especially those in response to climate change, allowing health authorities to target and prioritize control measures in high-risk areas.



Average Annual Precipitation in South America

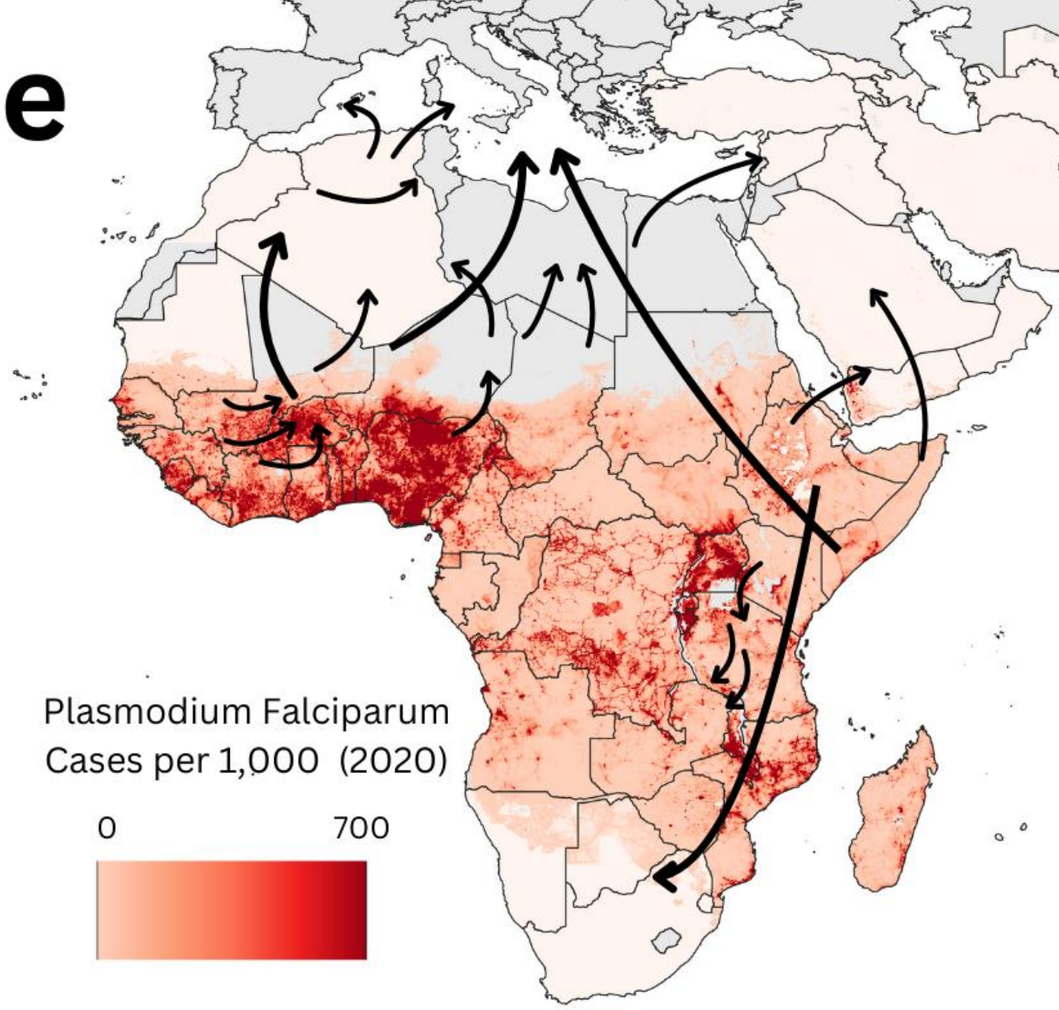


Data: *National Weather Service* **Boundaries:** *Natural Earth* **Chart Data:** *Our World in Data*

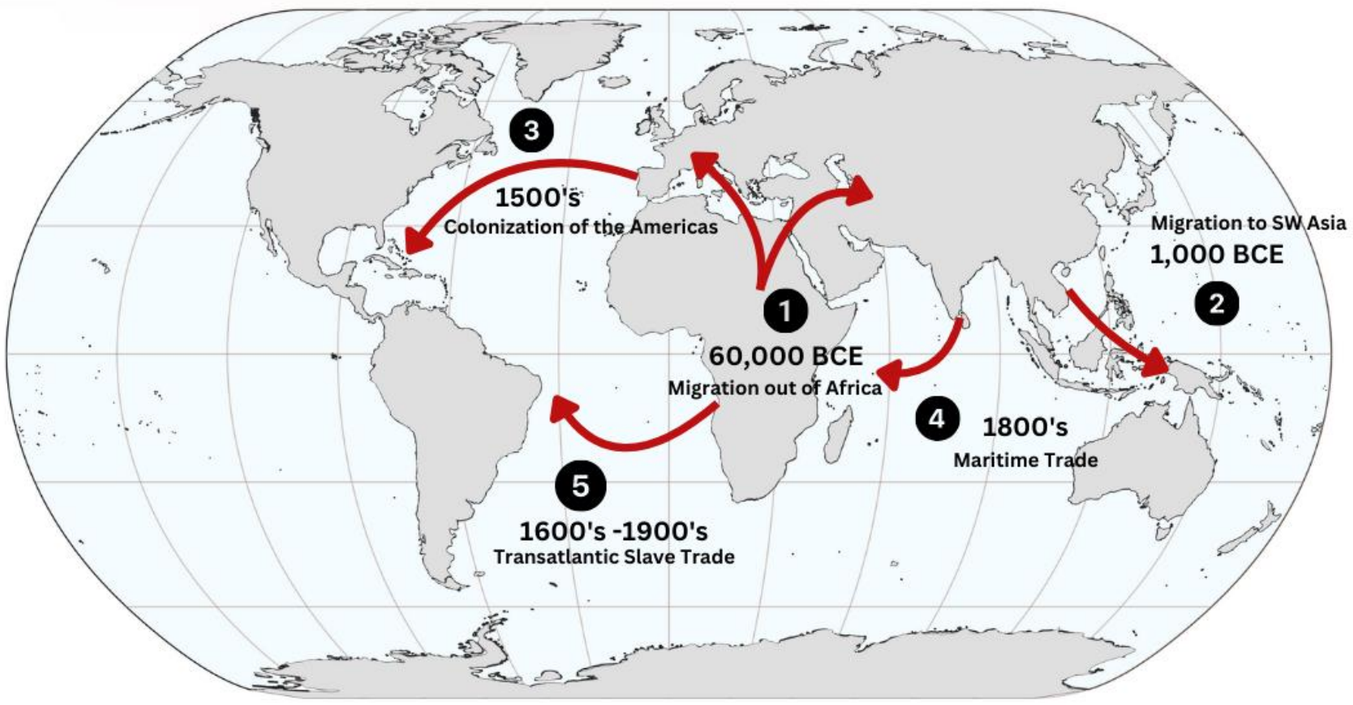
Migration Patterns and the Spread of Malaria

To the right, the map illustrates the major migration routes of the Plasmodium Falciparum parasite Malaria across Africa, emphasized by black arrows traversing the continent. The heatmap shades in red the intensity of malaria's prevalence, giving a visual representation of its concentration and severity. This demonstrates the risk associated with migration flows out of areas with high incidence into areas of low incidence, as well as its spread across continents.

Simultaneously, the lower globe traces the historical spread of the Plasmodium vivax parasite, marked by red lines that connect the dots of initial outbreaks to subsequent areas of impact. Plasmodium Vivax is of the oldest parasites, and is thought to have evolved in tropical Africa around 30 million years ago. These paths tell a historical narrative of human and mosquito movement, tying together the geographic and human spread of the disease.



Major Routes of Migration in Africa and Incidence of Malaria Cases



History of the Migration of Plasmodium Vivax Parasite

By integrating these two perspectives, the visualization captures both the macro and micro aspects of disease transmission, presenting not only the paths that the disease takes but also the intensity of its impact. It serves as a crucial tool for understanding how historical migration patterns potentially mirror current disease movement, providing a foundation for predicting future trends and preparing strategic responses.

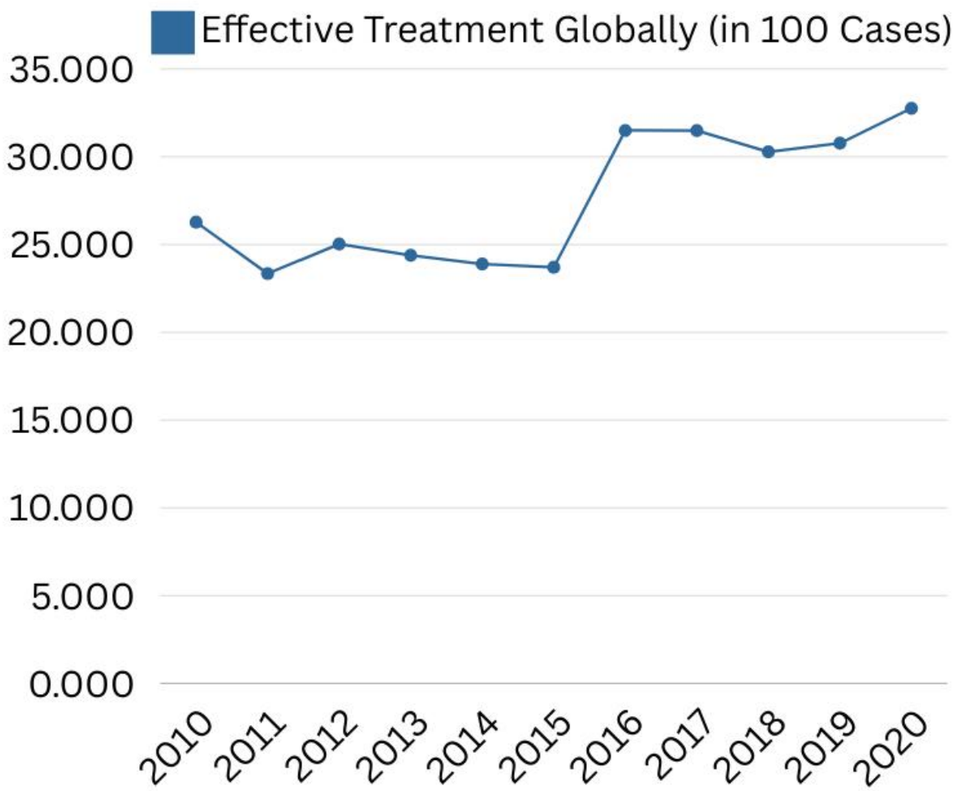
Globe Map Data: *Walter and Eliza Hall,* **Africa Map Data:** *Malaria Atlas Project,* **Boundaries:** *Natural Earth*

Global Antimalarial Case Management

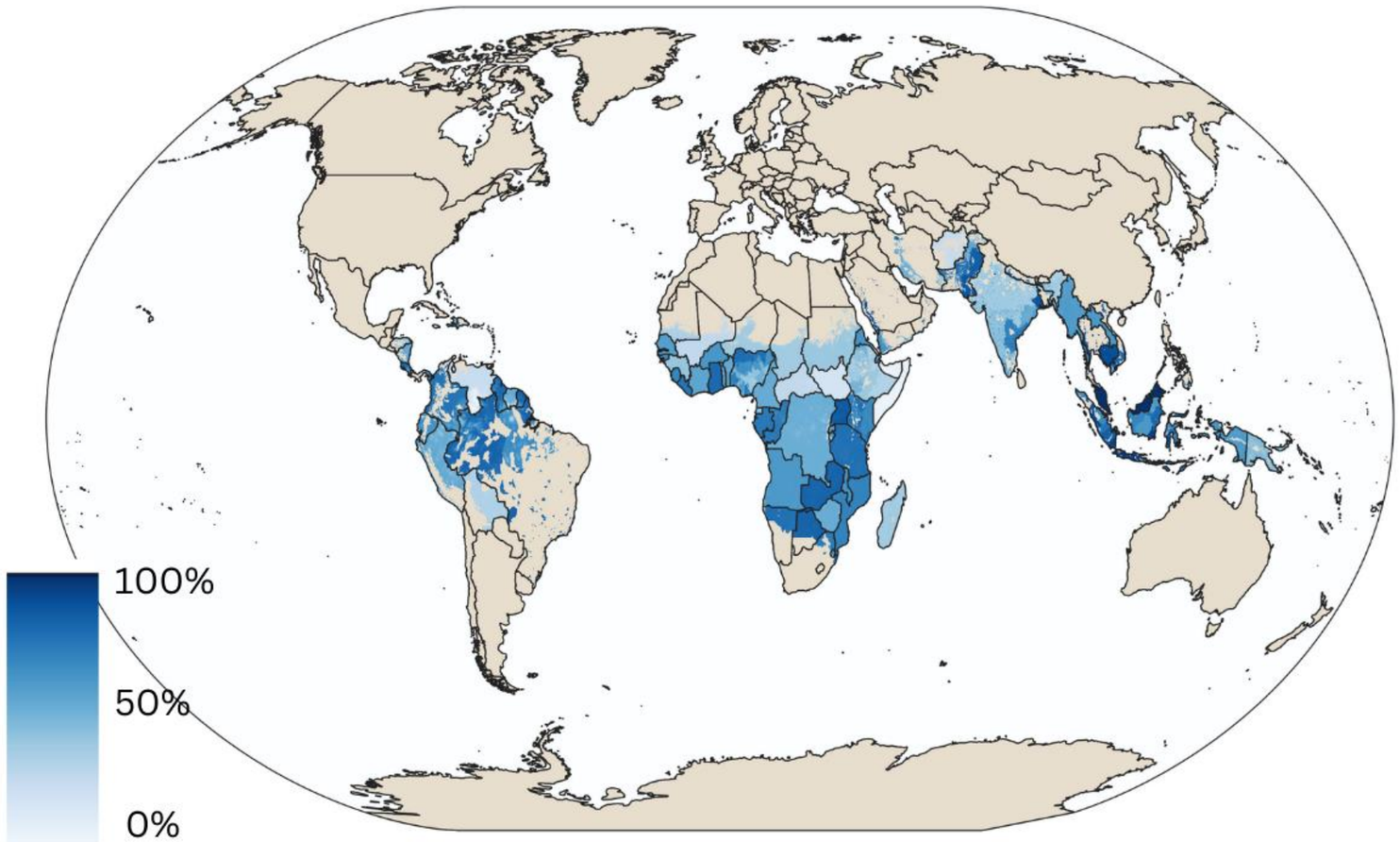
Antimalarials are crucial in the fight against malaria. These medications, when effectively distributed and administered, can significantly reduce mortality and morbidity associated with the disease. However, barriers to access, such as logistical challenges in remote areas, lack of healthcare infrastructure, economic constraints, and drug resistance, often hinder the widespread and timely distribution of these lifesaving treatments.

The map and accompanying graph showcase the significant strides and remaining challenges in global antimalarial efforts, highlighting the critical need for enhanced access to effective treatments, particularly in regions most burdened by the disease. This visualization highlights both areas where success but also areas of unmet need. Addressing these obstacles is essential for enhancing the efficacy of malaria control programs and ensuring that vulnerable populations receive the care they need.

Global Efficacy Rate of Antimalarial Treatments



Proportion of Malaria Cases that Receive Effective Treatment with an Antimalarial Medicine 2020



Map Data: *Malaria Atlas Project* **Boundaries:** *Natural Earth* **Chart Data:** *World Data Bank*

Reflection:

I am particularly proud of how I was able to learn QGIS, despite having no prior experience with the software. It has been both challenging and rewarding, allowing me to channel my creativity into visualising complex data related to infectious diseases, a key area of my academic and professional work. This newfound skill not only enhances my ability to analyse and interpret geographical data but also opens new avenues for applying these insights in the field of public health. One aspect I would aim to improve would be my time management skills, especially when learning new mapping techniques. The trial-and-error process, while invaluable, was time-consuming. Looking forward, I will apply this to learning new skills in the future. Overall, this experience has significantly enhanced my capabilities as a cartographer, providing me with powerful tools to turn raw data into actionable knowledge, which I will be immensely useful in my future endeavours.