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Nigeria: Using BTI to improve Malaria rates

When diagnosed and correctly treated, Malaria is a curable disease with a low mortality rate. Out of the 249 million cases from 85 countries in 2022, there were around 608,000 deaths (Who.int, 2023), which amounts to around a 0.24% mortality rate among those who contract malaria. With that being said, those without access to medical treatment, or who do not get diagnosed fast enough, will likely die from the disease (Nhsinform.scot, 2023). This is often the case in Nigeria, which contains around 26.8% of the world's malaria, suffering from it the most out of any country (Who.int, 2023). Several factors may be contributing to this trend, such as unsanitary environments, humidity, and rainfall (Nature.com, 2024). Still, the common denominator is that all of these factors attract the vector of the disease: mosquitoes.

The population in Nigeria is currently about 227,478,173 (Worldometers.info, 2024). Of that, 54% is urban and 46% is rural. However, the urban population is rapidly increasing (Statista.com, 2024). 75.37% of Nigeria's terrain is cultivated for a variety of crops including cocoa, tea, feeds and fodder, cashew and tree nuts, and spices (Tradingeconomics.com, 2024). The average farm size is around 1-3 hectares, or 2.47105-7.41316 acres (Climatescorecard.org, 2023). The climate varies depending on the region of the country, but it is generally a tropical savannah climate (Britannica.com, ND).

The average family size as of 2020 is about 5.06 people overall, but typically rural families have more children with an average of 5.42 people, while urban families have 4.50 (Nigerianstat.gov.ng, 2024). The father is typically the head of the household, making the family's money and most of the decisions. The mother's responsibilities include taking care of the children and household chores. (Afsusa.org, 2024).

Unfortunately, many families are unable to access proper education for their children or choose not to send them to school beyond primary school, as Nigeria contains almost 20 million out-of-school children (Malala.org, 2024). This may tie into the gender roles of the country and their expectations of women, as more than half of the girls in Nigeria are not attending school (Dailytrust.com, 2023). Conflict can also contribute to the absence of education, one example being 600 schools shutting down in Sabo due to armed gangs and high kidnapping rates in 2022 (Voanews.com, 2022).

The lack of sanitary environments and clean water is another problem that Nigeria faces. Over 70% of Nigerians are living in unclean conditions as of 2021 (Tribuneonlineng.com, 2021). Shops and markets are extremely unsanitary, which is detrimental considering this is often the source of their food (Articles.nigeriahealthwatch.com, 2024). Clean water is an issue particularly prevalent in northern Nigeria, where only 30% of citizens have access to safe drinking water (Usaid.gov, ND). These conditions are contributing to several problems including a variety of diseases (Tribuneonlineng.com, 2021).

Healthcare is also a major issue for citizens of Nigeria. So much so that less than 5% of Nigerians are enrolled in the National Health Insurance Scheme (NHIS), and even those with insurance may not get the proper care needed, considering the current state of the system. Infrastructures are decaying and there is a need for modern facilities. Supplies are scarce and the overall quality of the care being provided is inadequate. The government is currently working on solutions to better the issue, but little has improved thus far (Trade.gov, 2023).

Malaria is one of the many diseases that burden the country. In the year 2021, there were 68 million cases of malaria in Nigeria alone, and 194,000 of those cases resulted in death (Sciencedirect.com, 2023).

Malaria is found throughout the country, but most frequently in north and north-east Nigeria. It is partially due to the tropical climate, which attracts mosquitoes. (Afro.int, 2023). Malaria is caused by a parasite called Plasmodium that is carried and transmitted through mosquitoes. When a mosquito bites a person infected with malaria, it will inject the parasite into another person, infecting them, and the cycle continues (Nih.gov, 2013). There are a few other ways it can be transmitted, however the vast majority of the time it's through mosquitoes. (Cdc.gov, 2023)

Those with malaria may experience symptoms that include (but are not limited to) fever, chills, headache, vomiting, and diarrhea. However, without being diagnosed or treated, the symptoms can become more severe, such as seizures, kidney failure, mental confusion, and even comas. When first infected with malaria, it may take days or months to experience these symptoms. Children, pregnant women, and travelers/migrants are at the highest risk due to a lack of immunity (Cdc.gov, 2023)

Furthermore, malaria can affect food production. When farmers fall ill with the disease, they are unable to harvest crops, meaning their livelihood is damaged and they are unable to receive income and provide for their families. Even more so, if farmers continue to contract the disease, less food is being harvested and produced, leading to overall food insecurity. Because the urban population is dominating, there are fewer and fewer people who pursue farming, which can only make matters worse (Peacecorps.gov, 2017).

The high rates of malaria in Nigeria can certainly be attributed to the lack of proper healthcare, especially taking into account the treatability of malaria. However, the problem runs deep and will take years to get rid of completely. While the government takes the next steps toward proper healthcare, Nigerian families continue to suffer and die from malaria. Until we can reach where we need to be, something else needs to be implemented.

There are several different causes of the high malaria rates in Nigeria, so what kind of solution should be implemented? There are numerous different ways to go about it, some smaller scale, some bigger, and some already being worked on currently. Multiple actions need to be executed in the coming years to help solve malaria, but something needs to be done quickly. The quickest solution here lies not in curing the existing malaria (though that should continue to be improved upon), but in cutting it at its roots. The easiest way to bring change is to wipe out mosquitoes. With fewer mosquitoes transmitting the disease, malaria rates will decrease rapidly.

There are different components that contribute to high mosquito populations. As previously mentioned, warmer climates house more mosquitoes and they tend to have a high metabolism and bite more often when the air temperature is higher. Not only this but larval growth happens faster in the heat. (Moultriehealth.org, 2024). Mosquitoes also tend to be drawn to bodies of water because they can lay their eggs in them (Cdc.gov, 2022). Heavy rainfall usually will deter them as they will die out and get washed away. Cleanliness and soil contents also come into play. Certain bacteria may encourage or discourage a breeding ground for them or kill them off (Nature.com, 2024).

Bacillus thuringiensis israelensis (BTI) is a naturally occurring bacterium that can sometimes be found in soil and is considered an effective mosquito repellent. It is only effective at killing feeding larvae, not adult mosquitoes. It produces toxins that specifically harm mosquito larvae (as well as black flies and fungus gnats) by causing them to quit eating and die (Doh.wa.gov, ND). It is not harmful in any way to humans, animals, the environment, or the soil it is used in (epa.gov, 2023). This could significantly help Nigerians become less exposed to the risk of malaria by successfully getting rid of the vessel itself. It is easy to use, although it may need to be replaced after a certain amount of time (Ipm.ucanr.edu, ND).

A 1992 study conducted by N. Becker et al. concluded that factors such as sunlight, larvae density, and water temperature may influence the effectiveness of BTI. It is critical that these factors are considered

when deciding the necessary BTI dosage and how often it needs to be replaced. This might vary depending on the environment (biodiversitylibrary.org, 1992).

This plan can be funded by The World Health Organization (WHO). The WHO has been dedicated to solving public health issues since 1948, malaria being one of their top priorities. (un.org, 2023). Volunteers could help put the project into place. The volunteers would work with community members and help them get started but the project would be continued and held out primarily by the community members. It would be best to start with the places most in need (northern and northeastern Nigeria, areas near bodies of water, etc) and expand from there. The UN must take the necessary measures to keep volunteers safe and protected, as Nigeria can often be a dangerous country with high crime rates, particularly in terms of street violence (Gov.uk, ND).

There is no indication that BTI can not be sourced in Nigeria, as it is used globally across all continents (valentbiosciences.com, 2016). Nigeria should be able to produce and apply BTI independently. The application process is simple and quick. A common method is putting the BTI in the form of powder into water that will then be used to water the plants/crops. It can also be put directly into water that contains larvae (doh.wa.gov, ND). Over time farmers/community members would need to be continuously supplied with BTI (funded by the UN). If after a year, there's a noticeable difference in malaria rates in the areas that the BTI has implemented, the project can continue in various other regions of the country.

A crucial aspect to take into consideration when putting this plan into action is respect for the citizens' homes, properties, and communities. While the plan is designed to help them, it may be easy for them to feel invaded or exposed. Their crops and vegetation should be handled kindly and should not be damaged in any way. Especially for people whose crops are their source of finance. It is important to put their livelihood first and make that known to them. It may be good to have policies put in place to help ensure their privacy and comfort.

Additionally, mosquito-repellent plants could also be a useful solution. Specifically, citronella, which has proven to be effective in deterring mosquitoes. Along with the BTI, it can be planted in crops across Nigeria. While citronella does not directly kill mosquitoes, its oil has repellent attributes that successfully work on the skin (Bonnieplants.com, 2024). It grows well in tropical climates, so it should flourish in most parts of Nigeria (Nhb.gov.in, ND). So, if enough is planted it could be sold in large quantities for a cheap price.

Aside from focusing on getting rid of mosquitoes in particular, it is also essential to consider cleaning communities in Nigeria. Unsanitary conditions are partially to blame for the high mosquito population. Volunteers can help clean certain areas that are heavily affected. This may not be a realistic solution as of right now, but it's something to keep in mind going forward. Cleaner conditions are vital and could create a significant difference for citizens.

All in all, there is a great deal to be done in terms of malaria and other diseases that are widespread in Nigeria. BTI may not completely clear up the issue, but it might assist in taking a major step forward in lowering malaria rates. Working towards clean and sanitary environments will also help with a world of issues. Not just malaria, but several other infectious diseases, and will overall improve the quality of life for citizens. Working together with the WHO and volunteers this project is doable and will ultimately prove to be worth doing. This project could also go beyond Nigeria and extend to other countries that suffer from malaria. But for now, we can start it on a smaller scale with the areas affected the most, in hopes that we can bring change.

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