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MALARIA VACCINE: A TOOL FOR TOTAL ERADICATION OF MALARIA IN NIGERIA

Author Info:

Otali Cyril Chinedu
Science Laboratory Technology Department, Federal Polytechnic, Orogun, Delta State, Nigeria.
otalicyrilc@gmail.com

Abstract
Fever, vomiting and a decrease in hunger are typical symptoms of malaria which may impact anyone, regardless of their background and age. In Nigeria, malaria is mainly caused by Plasmodium falciparum, a kind of parasite that infects people after female Anopheles mosquitoes have bitten them. There are many cases of malaria in Nigeria, continually leading to high numbers of sick people who report to hospitals. The variety in Nigeria is estimated at 100 million and over 300,000 deaths occur each year, contributing about 30% of the total malaria disease in Africa. It is estimated that malaria costs around $1.1bn each year through expenses for treatment, prevention and lost work time. Various prevention measures have been used, one of which is freely handing out insecticide treated nets. Because vaccination is an effective way to control infectious diseases such as malaria, many see this pilot vaccination in Bayelsa and Kebbi States as a positive step for the country's health system in Nigeria. In Kebbi State, more than 49% of progenies below five suffer from malaria and the area also reports the highest number of malaria demises. Yet, providing vaccinations can be tough in difficult communities, either because of geography or cultural barriers and we must all continue to be committed to this cause. This paper discusses the opportunities and potential of the Malaria vaccine in addressing malaria infection in Nigeria and how it could be run nationwide. Progenies in Nigeria are advised to get vaccinated against malaria using RTS/SAS01or RS21/Matrix-M.
Keywords: *Malaria, Vaccine, Nigeria, Bayelsa, Kebbi, Plasmodium falciparum.*

I. INTRODUCTION

Malaria can only be transmitted by mosquitoes (Anopheles mosquitoes) to humans and other vertebrates (Dahalan et al., 2019, Bhatt et al., 2015). Not all cases of malaria cause critical illness; some are mild. Fever, chills and headache are some of the mild symptoms. Signs of severe infection can include fatigue, confusion, having a seizure, and trouble breathing, according to the WHO (2025). Normally, symptoms of malaria appear within 10–15 days after being bitten by an disease-ridden mosquito, as reported by WHO. For some, symptoms may be milder if they have previously had malaria. Early testing for malaria is necessary since its symptoms are not conclusive.

Certain kinds of malaria may result in critical illness or even death. Progenies less than 5 years old, infants, pregnant women, foreign visitors, and those with HIV or AIDS are more at risk. Severe symptoms manifest as:

- Being very tired and worn out.
- Consciousness is weakened.
- Regular and intense muscle convulsions.
- Struggling with breathing.
- Your urine is dark red, almost brown.
- A symptom of jaundice is that the eyes and skin become yellow.
- Uncontrollable or excessive bleeding.

Yearly, malaria causes the demise of hundreds of thousands of progenies below the age of 5 in Nigeria/Africa (Thornton, 2020). Malaria is a big public health issue and a cause of pain and untimely demises in tropical and sub-tropical regions (Nwaorgu and Orajaka 2011). Malaria causes critical illness among Nigerians and leads to high hospitalisation rates.

The parasite Plasmodium falciparum found in disease-ridden female Anopheles mosquitoes is the main cause of malaria in Nigeria. Among these are, Anopheles gambiae, Anopheles funestus, Anopheles arabiensis, and Anopheles moucheti are principally involved in maintaining transmission all year. Plasmodium knowlesi, P. ovale, P. vivax, and P. malariae are similarly known species of the malaria parasite. The variety is highest in Kebbi, Zamfara, and Sokoto states in Nigeria. These figures proved that malaria occurrences are most prevalent in northern Nigeria.

Nigeria has made significant improvements in both how much malaria control interventions have advanced and how they are executed. There have been more interventions against malaria across the country, causing a reduction in the variety; such as, the rate dropped from 42% in 2010 to 27% in 2015 from Malaria Indicator Survey (MIS) results. Despite this, Malaria still leads to many illnesses and demises in Nigeria and vaccination should now be considered the final approach to ending Malaria as well-implemented with Polio (Nakkazi, 2021).

Annually on 25 April, World Malaria Day is observed to appreciate global actions in addressing malaria. Worldwide, malaria threatens 3.3 billion people living in 106 countries. In 2012, about 627,000 people died from malaria, most of them being African progenies. No matter the use of drugs and other precautions, malaria is still a critical health problem (Otarigho, 2012).

A vaccine is a biological product that helps people develops protection against various diseases (CDC, 2022). Basically, vaccine is a special type of antigen given to someone to protect them from illness (Amanna and Slifka, 2016). A vaccine usually has part of the microbe that causes disease or a weakened version of it, and this helps protect the body. A vaccine helps the immune system fight a specific harmful agent by making it produce antibodies against it. By supplying antibodies or lymphocytes that have already been produced by an animal or human donor, a vaccine can also provide passive immunity. The agent triggers the immune system to identify the agent as a threat, eliminate it, and identify and eliminate any related microorganisms the body may come into contact with in the future.

A Brief History of Vaccine And Vaccination

In 1796, British physician Edward Jenner first used the cowpox virus to produce a vaccine helping people resist the closely related smallpox virus, as explained by Brunson 2025. The idea of using vaccination actually came from the historic practice in Asia of protecting progenies from smallpox by injecting them with materials from the illness. While some people were able to resist it, others got disease-ridden. This Physician pioneered a safer method of immunity, using a substance resembling though not as dangerous as smallpox. In this way, he took advantage of the fact that having immunity to a specific virus also helps against a different viral infection.

In 1881, anthrax immunization was introduced by Louis Pasteur, who injected sheep with a preparation that had weakened the bacillus causing the disease. Four years down the line, he managed to develop a defense against rabies.

After Pasteur's time, scientists focused on finding new vaccines, and created vaccines to fight bacteria, viruses, venoms, and toxins. Thanks to vaccination, the world reclaimed freedom from smallpox in 1980 and reduced polio cases by 99 percent. Mumps, measles, typhoid fever, cholera, plague, tuberculosis, tularemia, pneumococcal infection, tetanus, influenza, yellow fever, hepatitis A, hepatitis B, encephalitis, and typhus can be prevented by vaccines for some people, although their effectiveness is not always 100 percent. Since viral infections do not respond to antibiotics,

vaccines give especially strong protection against them.

An affordable and successful malaria vaccine could greatly reduce the problems caused by the disease. Vaccination has been a successful tool in combating many infectious childhood diseases in Nigeria and other African nations.

Malaria Pandemic

Nigeria is known to experience around 100 million malaria occurrences and 300,000 demises from the disease every year. Overall, the African region is strongly affected by malaria and bears about 30% of the burden, according to WHO in 2014. Close to 173 million people in Nigeria, which is about 97% of its population, may be at risk of infection. Malaria is responsible for nearly 60% of patient visits to hospitals, and it also kills many progenies and their mothers: 11% of mothers and 30% of progenies below the age of five (WHO, 2014). It has critical consequences for health and the economy.

About 214 million instances of malaria take place globally each year, and 3.2 billion individuals are at danger of getting it (WHO, 2015). About 438,000 people died from malaria in 2015, and around 90% of those demises were in sub-Saharan Africa, according to WHO (2015). At the World Health Assembly in 2005, an important goal was set to lower malaria infections and demises by 75% from 2005 to 2015 (WHO, 2005). This objective has guided medical practices by helping standardize placing medications to fight malaria worldwide.

According to the World Malaria Report 2022, Nigeria bears around 27% of all malaria occurrences worldwide. Malaria is still responsible for one million annual demises globally, with many demises occurring in Africa, at least 250,000 of which are in Sub-Saharan Africa (Adepoju, 2019).

Because nearly all Nigerians face a high risk of malaria, the vaccine is a vital addition to the country's defense strategies, including the use of insecticide-treated nets, indoor spraying, seasonal malaria medicines, and effective treatment of cases. Nigeria, the most populous nation in Africa, bears the greatest burden of malaria worldwide, contributing to about 27% of the disease's global burden and 31% of its fatalities. The 2023 World Malaria Report states that malaria claimed almost 200,000 lives in Nigeria. With a national prevalence rate of 22% in progenies aged 6-59 months as of 2021, pregnant women and progenies below five are the most affected. This rate can reach 49% in some areas, including Kebbi State.

Malaria Burden

Experts estimate that 263 million cases of malaria were recorded globally in 2023 while there were 252 million cases in the previous year. The estimated number of people who died from malaria in 2023 was 597 000 compared to the 600 000 recorded for 2022. Even today, Africa holds a major portion of the world's malaria occurrences. According to 2023 data, African countries hosted approximately 94% of all malaria occurrences and 95% of malaria demises. Malaria caused about 76% of demises among progenies younger than 5 in the same period.

Nigeria had the highest demise toll (30.9%), followed by the Democratic Republic of the Congo (11.3%), Niger (5.9%) and United Republic of Tanzania (4.3%). Nigeria, Africa's most populous country, is expected to reach a total population of around 205 million by 2018, growing at a rate of 3.2% each year. According to USAID (2016) and the WHO (2012), 97% of Nigeria's citizens are at risk of malaria, and the country accounts for 25% of the global cases. Nigeria has made progress in the fight against malaria due to the help of external donors, partners and the government. As an example, malaria was present in 42% of the population in 2010 but decreased to 27% by 2015 (MIS 2015).

Every year, progenies have around 2 to 4 episodes of fevers, and nationally, about 42% of cases and 25% of demises are due to malaria (National Malaria Indicator Survey, 2010). As of today, still many malaria demises are recorded all over the world. The disease greatly impacts the people of Africa and keeps hindering their economic progress in many areas, such as sub-Saharan countries like Nigeria. 60 percent of outpatient visits to Nigerian health facilities, 30

percent of childhood demises, 25 percent of infant demises, and 11 percent of maternal deaths are caused by the disease. According to government estimates, Nigeria loses $1.11 billion annually as a result of lost productivity and malaria-related medical costs (Okafor, 2024). The costs of treatment, prevention, lost man-hours, etc., are examples of the financial loss. However, it is a disease that can be treated and entirely avoided. Malaria's negative effects on the economy and human health prompted efforts to control, eradicate, and eventually eradicate the disease. Numerous interventions were implemented as a result of these efforts. Regretfully, the amount of money spent on malaria programs does not correspond with the current malaria indices. The lack of coordination and harmonization of malaria research is one of the main factors that have been found to contribute to this (Olufemi, 2022).

Current Treatment Regime

The earlier malaria is found and diagnosed, the better it can be controlled. The next steps involve treating the disease properly. Nigerians can purchase anti-malaria drugs across the counter without a prescription to treat malaria. Across time, the effectiveness of malaria medicine has been weakened by antimicrobial resistance. Based on the US Institute of Medicine in 2004, the main anti-malaria drug introduced in 1632 was quinine. In 1910, cases of quinine resistance began to be reported. Quinine is still important in the treatment of Malaria, despite some resistance, in Nigeria. Chloroquine was developed in 1945 and served as main antimalaria, but the first resistance was found in 1957. Just a year after its introduction, people began to see resistance to Sulfadoxine-Pyrimethamine. In addition, Mefloquine and Atovaquone have been introduced as frontline drugs for malaria treatment, along with reports of resistance. Artemisinin was discovered in 1967 and has been utilized intensively to treat Malaria in Nigeria, although resistance started appearing in 2001 and there have been a lot of cases of resistance since. The reasons for these changes are drug abuse, below average treatment doses, and the development of fake and low-quality drugs. Many Nigerians who live in rural areas turn to herbs as a means of treating malaria. In 2004, the Nigerian government adopted ACTs as the main treatment for malaria due to their effectiveness. The two primary ACT regimens are Artemether-lumefantrine (AL) and Artesunate-Amodiaquine (AS + AQ) (Kar et al., 2014). Still, this situation strains Nigeria's healthcare facilities and slowdowns its economic growth. The scale-up of ACTs was a major advance in the fight against malaria globally at the turn of the century.

Currently, WHO recommends using 6 different artemisinin-based combination therapies (ACTs) for both the first- and second-line treatment of uncomplicated P. falciparum malaria? Grown from the plant Artemisia annua, artemisinin and its derivatives are widely known for quickly reducing malaria parasites in a patient's blood. ACTs drugs are made from combining artemisinin derivatives with other medications. Artemisinin reduces the number of parasites during the early days of treatment, while the other drug kills off the rest of the parasites and leads to recovery.

Malaria causes a huge loss financially, with about 132 billion Naira ($700 million USD) being spent each year for treatment, prevention, and other costs (WHO, 2012). During the last decade, there has been a major increase in efforts to combat malaria by developing new diagnostic methods, medicines, and control methods that aim to end the disease (Korenromp et al., 2013). As a result, there was a decrease of 30% in malaria occurrences around the world and 34% in Africa from 2000 to 2013 (Murray et al., 2014).

Potentials of Malaria Vaccine in Nigeria

The trial of the malaria vaccine in Nigeria was started in 2024 using Kebbi and Bayelsa states as pilot locations. The introduction of the malaria vaccine could help the country reach its goal of eliminating the disease. Vaccination is often affected by societal and cultural issues in most countries, especially in Nigeria. In the past, this system of beliefs has hindered the success of vaccination

programmes. For instance, just before the COVID-19 vaccination programme began in Nigeria, there were rumors about those vaccines, such as claims that they were developed to make men infertile, contain microchips, or be harmful to anyone who receives them in Africa (Asishana, 2021; Schönbauer, 2022). There have been similar myths in the past when the polio vaccine was introduced in Northern Nigeria (Renne, 2014), so they may also happen during the release of a malaria vaccine. The vaccination staff and rural leaders, including those in traditional and religious roles, worked together to solve these issues (Effiong et al., 2021; Elebesunu and Ubani, 2021). So, a successful vaccination program for malaria in Nigeria depends greatly on involving members of the community who support it. A strong program to monitor and correct misinformation regarding the malaria vaccine should be established in all Local Government Areas of Nigerian.

The Battle is Gradually Being Worn

A promising weapon in the fight against the malaria pandemic appears to be the malaria vaccine. Compared to just 13 countries in 2000, 35 countries reported fewer than 1000 indigenous cases of the disease in 2023 (WHO, 2025). It is noteworthy that certain endemic nations have experienced at least three years in a row with no native cases of malaria. Numerous nations with a low malaria burden are still making steady progress toward the goal of eradication, and the WHO has certified 45 countries and 1 territory as malaria-free to date. Azerbaijan (2023), Tajikistan (2023), Belize (2023), Egypt (2024), Argentina (2019), Algeria (2019), China (2021), El Salvador (2021), Sri Lanka (2016), Kyrgyzstan (2016), Paraguay (2018), Uzbekistan (2018), and the Maldives (2015) are among them. This is a significant step toward the global eradication of malaria.

"Receiving a malaria vaccine is a great achievement for us in our efforts to control malaria occurrences and demises," explained Professor Muhammad Ali Pate, the Coordinating Minister of Health and Social Welfare. With the backing of UNICEF, Gavi, and WHO, our ambition is to eliminate malaria from Nigeria.

Opportunities of Malaria Vaccine

The new malaria vaccine offers a plethora of benefits and opportunities. First, the majority of parents are willing to accept the malaria vaccine, just as they have accepted the vaccines for polio and other diseases. The government's and its agencies' quick response, along with the N1 billion that was made available to repair the cold chain, comes in second. In addition, a new National Health Bill was passed to support the new vaccine against malaria. Furthermore, there has been a recent uptick in the advocacy for malaria, which includes, among others, in-country donors and malaria ambassadors.

Progress of Malaria Vaccination Trials in African Countries

The results of years of investment in the creation and application of novel malaria vaccines and cutting-edge instruments for malaria prevention and control are beginning to show. The complicated life cycle, morphological changes, and multiple antigenic sites of the malaria parasite Plasmodium falciparum present difficulties in the ongoing research and development of a malaria vaccine (Arama and Troye-Blomberg, 2014). As stated by Effiong et al., 2022, the malaria vaccine candidates focus on particular phases of the parasite's life cycle and primarily consist of Blood-Stage Vaccines (BSVs), Pre-Erythrocytic Vaccines (PEVs), which are typical of RTS, S, and R21, and Transmission-Blocking Vaccines (TBVs).

The R21/Matrix-MTM Malaria Vaccine

Matrix-M1 50µg as an adjuvant and R21 Malaria antigen 5µg make up a dose of 0.5ml, which is a ready-to-use liquid formulation for intramuscular injection that comes in a vial. The vaccine is recommended for children aged five to thirty-six months in order to prevent clinical malaria. The vaccine should be stored between 2 and 8°C. According to data from current malaria vaccine trials, the vaccine is effective in protecting trial participants, primarily children with severe malaria or high susceptibility to the disease, and in generating an immune response.

Seven African nations, including Kenya, Burkina Faso, Malawi, Ghana, and Mali, have successfully conducted malaria vaccine trials. Introduced to children aged five to fifteen months, the R21/Matrix-M vaccine is the second to be approved by the World Health Organization (WHO) (Okafor, 2024). The Jenner Institute at Oxford University created the R21/Matrix-M, which consists of three doses spaced four weeks apart and a booster dose given a year later (Okafor, 2024). Ivory Coast and the Democratic Republic of the Congo also started utilizing the vaccine.

Phase III clinical trials for the previously approved RTS,S malaria vaccine have been completed, and results show efficacies of 55% within 12 months and 39% cumulatively over 4 years (Nakkazi, 2021). Additionally, phase III clinical trials for the R21 malaria vaccine have begun after earlier trials in Burkina Faso demonstrated an efficacy of 77%, exceeding the WHO standard of 75% for malaria vaccine efficacy (Hill, 2021). All things considered, the RTS,S vaccine has effectively decreased the risk of contracting malaria and provided more than a million African progenies with immunological protection (WHO, 2022). With Gavi, the Vaccine Alliance, investing more than US$150 million in the purchase and delivery of the malaria vaccine to multiple Sub-Saharan African nations, funding for the vaccines' widespread distribution has begun (Kuehn, 2022). With the WHO 2030 target of a 90 percent reduction in malaria mortality appearing much more achievable, the reality of access to malaria vaccines has given malaria control efforts a new windfall (Patouillard et al. (2017).

Malaria Vaccine Rollout Plan in Nigeria

The Nigeria government is part of the global malaria vaccine initiative. It was believed that vaccinating children less than a year old with four doses of the malaria vaccine should become a common practice in Nigeria. On 26 November 2024, the first vaccinations were given for malaria in Kebbi and Bayelsa States, the sites most affected by malaria. The pilot was carried out in Bayelsa and Kebbi since they were included in the group of the nation's worst-affected states and by 2025, the government hopes to extend it to all Nigerian states (Okafor, 2024).

The population in Kebbi State is 6,260,592 in 2025 and malaria affects children below five years old there on a high scale. Studies have revealed that most cases of malaria involving children under five are in the state, with 49% being reported by Abubakar, 2025. It is revealed by studies that several diseases in Kebbi, caused by malaria parasites, are symptomless in progeny, thus making it challenging to tackle the disease.

Results of a study indicate that Bayelsa State's malaria parasite rate is very high at 89.73%, making it endemic. A different report notes that Sagbama LGA experiences malaria in almost every case, so there should be swift steps against asymptomatic malaria there. According to a study, out of all cases in primary school students in Angiama, 63.3% were confirmed to be caused by Plasmodium falciparum malaria.

It is believed that by the year 2025, there will be about 2.7 million people living in Bayelsa State in Nigeria. For this reason, the state is not very populated when compared to other states in the country. Although, the population in the state has grown, but it is still lower than those found in other states in Nigeria (Ikein. 2004).

Nigeria was supported by Gavi, the Vaccine Alliance, UNICEF and the World Health Organization (WHO) to receive the first million doses of the malaria vaccine in October 2024. The campaign began in early December, and the vaccine was first added to the routine immunization schedules of Kebbi and Bayelsa states, which have the highest malaria rates in Nigeria (Okafor, 2024).

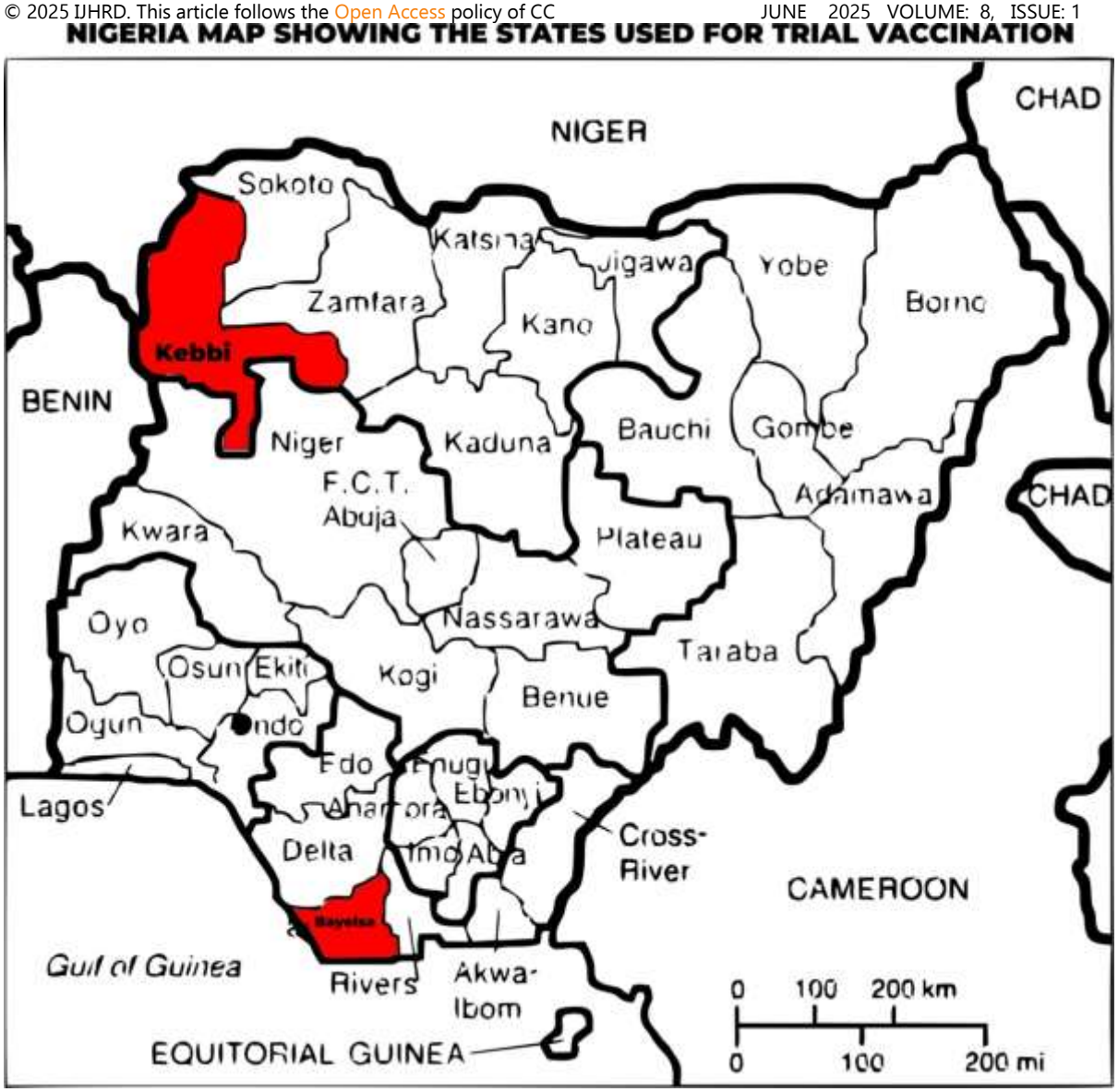

Figure 1: Nigerian map showing Kebbi and Bayelsa States (in red colour) that received the malaria vaccine in 2024.

The Impact of Pilot Malaria Vaccination

The malaria vaccination carried out in Bayelsa and Kebbi States in Nigeria is a great achievement for malaria eradication there. Just as we discussed, more youngsters between zero and five in Kebbi State have recently suffered from malaria, making it the hardest-hit state in Nigeria. Because of this, the indigenous people believed that malaria vaccine would protect the next generation and greatly reduce both cases and deaths from malaria. Fighting malaria in Nigeria has become much easier thanks to the vaccine. Those who live in the indigenous communities of Kebbi and Bayelsa are happy their states were chosen to be part of the pilot vaccination program. Having drones in the program made it easier to distribute vaccines in inaccessible regions. Samuel (2025) says that 20,000 progenies in Bayelsa state's remote settlements have received malaria vaccines because of drone deliveries. Investigations reveal that parents and local health workers in these states are in favor of the vaccine.

Challenging Issues with Malaria Vaccine in Nigeria

Social, cultural, biological, political and educational factors work together to make malaria something difficult to treat in Nigeria. The big profits earned from treating malaria are

among the problems that are predicted. Those making medications for malaria have apparently slowed down the progress of a malaria vaccine development.

There are over 31 million children below five in Nigeria, so vaccinating them will be very important. This huge population of this age bracket is threatened by lack of adequate infrastructure to carry out nation-wide vaccination exercise.

Another delicate issue is the lack of trained personnel, especially at the local government level, and the weak health system and structure (such as the nation's inadequate cold chain and storage supply). This is on top of the resistance to change displayed by workers in the local government and/or medical professionals. According to Effiong et al., 2022, the complex interplay of social, cultural, biological, political, and educational factors makes the fight against malaria more challenging.

A Glimpse into the Future

During its meeting in 2015, the World Health Assembly adopted the new Global technical strategy for malaria for the years 2016 to 2030. It advises countries to help them progress much faster in getting rid of malaria. The purpose of technical strategy is to assist malaria-affected regions and countries to reach their aims of controlling and eliminating malaria. According to WHO, 2025b, The strategy set seems ambitious but achievable global targets, including:

Plan to reduce the number of malaria cases by 90% by the year 2030.

Reduce malaria deaths by at least 90% between 2015 and 2030.

Elimination of malaria in at least 35 countries by 2030

Keeping malaria from returning in those countries where it has been eliminated.

II. RECOMMENDATION

Use of a cold chain is required to transport and store the RTS,S malaria vaccine at special temperatures (Asante et al., 2016). At the moment, the vaccines for malaria should be kept at a temperature between 2 and 8 degrees Celsius, but the good supply of power and sufficient cold storage needed for them is hard to maintain in Nigeria which could result in the vaccine losing its quality and potency. How the cold chain for vaccine storage is powered by the sun must be explored.

Religious and traditional leaders must team up with officials in public health sector to explain the need for vaccinations to the masses.

III. CONCLUSION

Using the malaria vaccine can aid in the mission to eliminate malaria in Nigeria. During trials in Bayelsa and Kebbi, challenges and improvements have been noticed in the vaccine administration programme. It is necessary to overcome these hurdles to ensure that the vaccination program works in Nigeria. At both national and regional levels, different parties are admonished to join forces. Handling these matters and organizing a good malaria vaccination plan in Nigeria will require a careful consideration of ethno-religious levels. This will guarantee notable advancements in the effective management and eradication of malaria in Nigeria.

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