

Your Health ▶ It matters

Genetically altered mosquitoes to close gaps in malaria fight

As the world marks World Malaria Day today, gene drive technology interventions are expected to bring major breakthroughs in combating the disease. The technology looks at population alteration to reduce the vector's ability to transmit disease by preventing the malaria parasite from binding into the receptors

by **William Murigi**
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In 2020, nearly 6.9 million cases of malaria and about 742 deaths were confirmed in Kenya according to the Kenya Malaria Indicator Survey (KMIS) 2020.

Although the number of reported infections declined from 10.9 million in 2018, the disease is still one of the main health issues in the country despite being a largely preventable and treatable disease.

Kenya is not the only country suffering from the burden of this life-threatening disease. According to World Health Organisation (WHO) latest world malaria report, there were an estimated 241 million malaria cases and 627,000 malaria deaths worldwide in 2020. This represents about 14 million more cases in 2020 compared to 2019, and 69,000 more deaths.

The high number of malaria cases continues to be registered even though several efforts have been put in place towards malaria eradication. It is for this reason scientists and researchers are assessing the use of new tools to edit the genes of malaria-transmitting mosquitoes as they try to come up with a

long-lasting solution towards control and elimination of this disease.

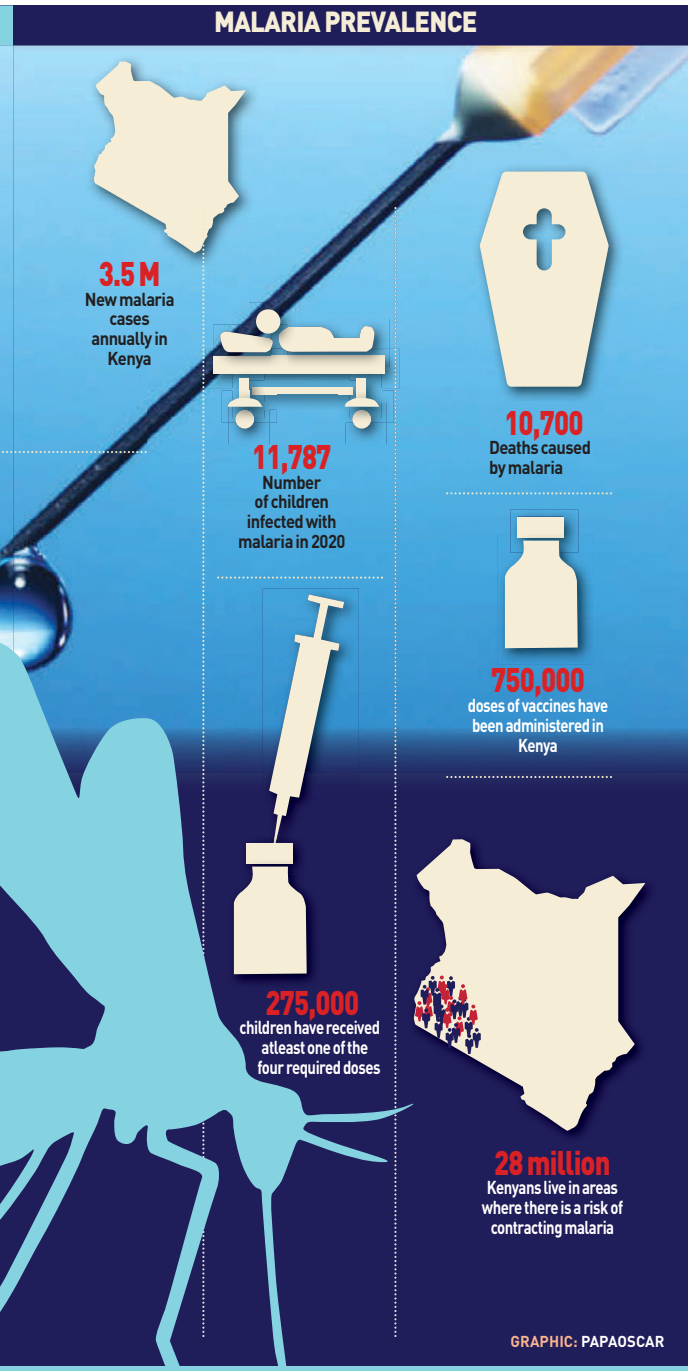
"The war against malaria has been ongoing for decades. It has led to the development of several interventions strategies, such as antimalarial drugs, insecticide-treated nets, and vaccines among others. However, despite all the interventions, the disease has not been eradicated because there are increased cases of insecticide resistance in mosquitoes, which pose a significant public health concern," says Dr Willy Kiprotich Tonui, EBS, the Chairman and Executive Director at the Environmental Health Safety (EHS) Consultancy Limited who also doubles up as the Founder and Head of Secretariat to African Genetic Biocontrol Consortium.

The African Genetic Biocontrol Consortium is an interconnected network of organisations that strive to demonstrate the value of a regional forum centred on biocontrol dedicated to the development of genetic biocontrol strategies. Its main objective is to create awareness of how biocontrol developments impact our

lives. He says scientists are working day and night to see how genetic modification using gene drive technologies can be used to



Health CAS Rashid Aman with Rwandan Minister for Primary Health Care Tharcisse Mpunga and Ugandan Health Minister in charge of General Duties launch cross-border malaria control and prevention interventions ahead of World Malaria Day recently.



reduce malaria transmission in Africa by suppressing or modifying vector populations. This technology relies on the gene-editing tool CRISPR and some bits of RNA to alter or silence a specific gene or insert a new one. Once the new gene is inserted in one generation, in the next generation, the whole drive copies itself onto its partner chromosome so that the genome no longer has the natural version of the chosen gene, and instead has two copies of the gene drive. In this way, the change is passed on to up to 100 per cent of offspring. "Gene drive technology could be part of the answer that we have been waiting for malaria control and elimination. It is one of the newest approaches that is being tested as a potential strategy

for eliminating malaria," he said, adding, "The reason is that gene drive technologies will potentially reduce the incidence of mosquito-borne diseases, such as malaria in Africa and dengue fever in many parts of the world, resulting in healthier populations," he said.

"However, for malaria eradication (that is the disappearance of every malaria parasite from the face of this country and planet) there is a need for an integrated approach that incorporates several control methods, such as insecticide-treated nets, indoor residual spraying, environmental management, vaccines, and genetic biocontrol methods such as gene drives," he added.



TONUI

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Reduce malaria carrying mosquito

He reveals that the good thing about this technology when used for malaria control and elimination is that, its main aim is not to eliminate mosquitoes as many people have been saying since the modified population continues to exist and carries the drive gene at close to 100 per cent, but instead it reduces malaria carrying mosquito or unable to spread malaria.

However, in other areas, the tool is being used for suppression. For example, gene drive is a fundamentally new approach to invasive species control. The tool is currently being considered a humane, targeted way to wipe out alien pest species on Islands, such as mice, rats, and rabbits, by turning their own genes on themselves so they can no longer reproduce and their population collapses.

"With this tool, scientists are not looking into mosquito population suppression, which means knocking out the female fertility genes to prevent them from laying eggs or distort sex chromosome inheritance, because this will have some negative impacts on our ecosystem. Instead, they are looking into population alteration which entails a reduction of the vector's ability to transmit disease by preventing the malaria parasite from binding to the receptors within the vector."

He reveals that, apart from preventing diseases outbreaks, gene drive technologies in mosquitoes also envision several other possible uses, such as preventing transmission of malaria in Africa and other high incidence areas; preventing transmission of arboviruses, such as dengue or Zika in regions where they are prevalent, and controlling transmission of avian malaria that is threatening fragile native bird populations in island habitats.

"Although mosquito applications dominate the field of gene drives, scientists have also proposed ways to use the preferential inheritance that characterizes 'gene drive' to develop solutions for previously intractable threats to public health, food security, and biodiversity.

For example, gene drive technologies have been proposed to address problems in public health, such as the transmission of arthropod-borne pathogens, problems in agriculture caused by insect pests, weeds, and plant pathogens, and problems in conservation caused by invasive species. Therefore, we may see experiments being tried for ticks, fleas, and others in the future."

He says targeting malaria using gene drives is more cost-effective and feasible than traditional interventions, because gene drives only target specific species of mosquitoes that transmit malaria and not all species. Out of the 3,500 or so mosquito species that exist, only those within the Anopheles genus are capable of transmitting human malaria. Apart from that, if the insecticides resistance continues, there are risks that the malaria parasite will soon become resistant to drugs.

And will the release of GM mosquitoes to the wild stop the frequent malaria disease outbreaks? Dr Tonui says that gene drives will have the potential to limit the spread of malaria outbreaks to some extent, because the technology will ensure that in the long run there are reduced populations of mosquito species that can transmit human malaria.

Myths and misconceptions

However, studies are currently going on to establish whether genetically modified mosquitoes can achieve the ultimate goal of suppressing a wild population of potentially malaria-infected mosquitoes.

"What people need to know is that as of today, gene drive technologies are only being tested in the laboratory as part of ongoing research and development efforts, not outside, that is why most questions remain unanswered," he explains. To demystify some myths and misconceptions that have been there about the genetically modified organism, he says that people should stop fearing that gene introduced into mosquitoes would find its way into the human genome because this scenario has virtually no chance of happening in the foreseeable future.

Dr Tonui says most gene drive systems are constructed so that the gene drive is active in only certain cells of the repro-

ductive system and at a certain time that is either during the formation of sperm or eggs.

These temporal and spatial constraints are important and are achieved through the use of DNA sequences that exhibit these properties only in the species from which they were obtained. These molecular components of the gene drive are highly unlikely to function within a human cell as they do in mosquito cells. "The fact that each of these events individually has extremely low improbable means that taken together with the probability of a functional gene drive being transferred from the cells of mosquitoes to the cells of humans, other animals is exceedingly low," he offers.

However, determination of the ecological risks posed by GM mosquitoes, transboundary movement, and consequences to the entire ecosystem are issues of concern that are currently being studied.

On the issue of whether it would have been better to spend all the time and money developing a vaccine against malaria instead of such as solution, he says that though vaccines are important tools against several infectious diseases, unfortunately, despite decades of effort, it has not been possible to come up with a vaccine for malaria and dengue.

The reason is, that the two are very challenging diseases to control and there is little doubt that successful control and/or elimination will require multiple different tools, with vector control remaining important with or without available vaccines. That is why there is need for an integrated approach.

And are there countries that have released genetically modified mosquitoes to the wild since research has been ongoing for quite some time? Though gene-drive research is moving fast, Dr Tonui notes that only one country, the United States, has been able to approve release of GM mosquitoes into the wild. This is after the Environmental Protection Agency recently gave a green light to Oxitec, a US-owned company, to release over 2 million genetically modified mosquitoes in Florida and California as part of an expanded effort to combat the transmission of diseases such as Zika and Dengue fever.

BRIEF

Child jab tracking system launched

by Mwangi Mumbo
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The Kenya Medical Research Institute (KEMRI) has launched a cloud-based vaccination tracking system, which will enable digitally storage of baby's and mother's information, including vaccination schedules and complete medical history.

Launched in collaboration with the Nipon Electric Company (NEC), the innovation uses fingerprints, voice and face recognition and taking into consideration a wide scope of people, including those with disabilities.

The tracking system is part of an ongoing study in Kwale and Kisumu Counties on the feasibility of a cloud-based vaccination tracking system for health information systems coupled with biometrics through registration of pregnant women and infants.

The research finding will help to convert the usual mother-child booklet into an electronic version that nurses and clinicians can use to enter medical records. "Using this technology, we will set up computers with the special web-based program in hospital facilities and register mothers and infants as they receive services in mother and child health clinics,"

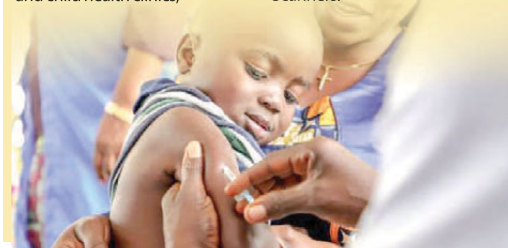
observed Dr Nzou Muuo, the principal investigator at Kemri.

During a mothers or child visit to the clinic, nurses will enter the treatment and vaccinations received by the mother and child into the system and continue to update the information on the subsequent visits. "With further testing, improvements and widespread use, the system will ultimately be able to accurately retrieve important summary statistics, such as vaccination coverage that are useful for planning health services," said Dr Muuo.

Kemri officials say the use of electronic medical records and biometrics is gaining momentum in healthcare settings, because of the value addition and easier access to patient data, improved workflow, better, improved coordination of patient, secure records, care among other benefits.

In an effort to improve service delivery in health care settings, it is becoming increasingly important to adopt new technologies and further use them for monitoring and evaluation of service delivery.

Participating health facilities will be issued with Notebook PCs connected to USB Finger Vein Biometric Scanners.



NUTRITION
WITH WINNIE WANGARE

How alcohol impacts absorption of nutrients

A glass of wine or two is not a big deal, but once alcohol consumption becomes a routine or greater than four or five times a week, clinical symptoms and nutritional deficiencies may occur. Alcohol is a psychoactive substance produced through the fermentation and distillation of natural sugars and starches. It affects mood, mental health and if abused or consumed in excess it interferes with absorption and utilisation of various nutrients in the body.

Alcohol interferes with brain's communication pathways, makes the brain unable to learn new information and affects memory. It also causes liver inflammation and damage, makes the pancreatic vessels swell preventing proper digestion and weakens the immune system making the body an easy target for diseases, such as Pneumonia and Tuberculosis. Additionally, some types of cancer like Liver, Colorectal and Esophageal cancer have been linked to excessive alcohol consumption.

Alcoholics frequently experience deficiencies

in essential nutrients, such as Carbohydrates, Proteins and Vitamins. As a result, they suffer from malnutrition, which can present itself in two forms; primary malnutrition, which occurs when alcohol replaces other nutrients in the diet and results in reduced nutrient intake or as secondary malnutrition where one consumes adequate nutrition, but alcohol interferes with the absorption of the nutrients in the intestines. More so, severe malnutrition occurs in alcoholics who are hospitalised for medical complications of alcoholism and is normally accompanied by a significant reduction of muscle mass and weight loss.

The main nutrients mostly affected by alcohol consumption are the Amino Acids, the B complex Vitamins, Vitamin A and C, Magnesium, Calcium, Manganese, Zinc, Iron, Chromium, Potassium and Omega 3. Alcohol decreases the production Albumin, a protein found in blood, which may lead to accumulation of fluid in the abdomen and bloating. It also triggers depression, anxiety,



cardiac and neurological disorders, increases fatigue and affects neurotransmitters as a result of Vitamin and mineral deficiencies.

Therefore, to prevent the effects of alcohol on the body, it is advisable to reduce alcohol consumption, eat healthy, avoid high sugar and fat foods, eat a wide range of fruits and vegetables, avoid caffeine and any sources of nicotine, drink plenty of water to flush out toxins from your body and take at least three meals a day.