BIZCOMMUNITY

Killing mosquito larvae can contribute towards malaria elimination

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Malaria is a serious, complex and often fatal vector-borne disease caused by the parasite *Plasmodium* and transmitted when people are bitten by infected female *Anopheles* mosquitoes.

Vector control targeting the larval phase of the mosquito's life cycle can be successful. Shutterstock

The mainstay of most malaria control programmes are vector control methods. Vector control methods target mostly the adult mosquito vectors, and include indoor residual spraying as well as the use of long-lasting insecticide-treated nets. Integrated vector management is a key strategy recommended by the World Health Organisation, particularly for African countries.

The idea behind integrated vector management is to use a combination of different vector control methods to reduce human-vector contact.

The increase in the use of World Health Organisation approved vector control methods between 2000 and 2015 contributed to a large decline in the number of malaria cases globally. But progress against malaria has stalled. There was no significant reduction in global malaria between 2015 and 2017. An estimated 219 million malaria cases were reported in 2017 (versus 213 million in 2015). There were more than 435 000 deaths in 2017.

There are a number of theories about why progress has stalled and reported malaria cases have increased. These include that traditional vector control is becoming less effective due to certain challenges.

Challenges include increasing resistance to the insecticides used for indoor residual spraying. Mosquitoes are also adapting to control methods used inside homes by now feeding outside people's homes where it is more difficult to control the mosquito vectors.

This has led to the view that successes from methods targeting the adult mosquito need to be built on by targeting different mosquito stages.

One such approach is known as larviciding. This involves the use of insecticides that kill mosquitoes in their larval stage – before they develop into adult mosquitoes.

We tested larval control in parts of Botswana and Zimbabwe. It showed a high effect on the population of the mosquito larvae. It also led to a lower number of larvae surviving. We found that the reduction of the early and late mosquito larval stages can lead to reduced adult mosquito emergence and low adult mosquito densities.

The study

Mosquitoes, including malaria vectors, lay their eggs in bodies of water. The next stage in the mosquito life cycle is the larval stage where most larvae hang suspended to the water surface in order to breathe. The mosquito larvae are less mobile and feed on aquatic microorganisms during this stage. This makes the larval stage vulnerable to larviciding using oil-based larvicides that will starve the larvae of air, making them suffocate. Another approach involves using microorganisms they can feed on; these poison them and they die.

There are four larval stages – known as instars – before the last larval instar develops into a pupa. The adult mosquitoes emerge from the pupa and then fly away once their wings are dry.

Many of the challenges of vector control could be overcome by targeting the larval stage of the mosquito life cycle. This is also known as larval control.

There are different types of larvicides. These include contact poisons, stomach poisons, growth regulators and biological control agents. Biological control agents are, increasingly, the method of choice because of low toxicity to non-target agents and environmental concerns. They can be safely used for the control of insect pests of agricultural and horticultural crops as well as forests. They are also safe for use in aquatic environments including drinking-water reservoirs for the control of mosquito, black fly and nuisance insect larvae.

There's no evidence that they adversely affect birds, fish or any other non-target aquatic vertebrates tested in a large number of laboratory and field studies.

The use of larviciding for malaria control is not new. It is used in numerous countries globally. Despite this, the scale of larviciding isn't quantified. So it's not easy to determine the impact this method has on each country's malaria burden.

We studied this method in selected semi-arid rural areas of Botswana and Zimbabwe. We wanted to determine how effective winter larviciding could be as a complementary vector control intervention to indoor residual spraying and insecticide-treated nets.

We found that, on average, 86% of larval reduction was attributable to larviciding for the two countries combined (92% for Botswana and 65% for Zimbabwe). The reduction of the early and late mosquito larval stages could allow for a reduction in the emergence of adult mosquitoes and therefore low mosquito densities.

Future use

The inclusion of larviciding in an integrated malaria vector control approach could potentially help hinder malaria transmission and contribute to global malaria elimination. This could be particularly effective in urban areas because of rapidly growing urban centres.

Larviciding would also be a good control method to complement indoor residual spraying and insecticide-treated nets in semi-arid locations where breeding points a few, fixed and easy to find.

But larvaciding does have some challenges. It's not suitable in locations where some breeding habitats can't be identified; where environmental, economic and social activities lead to the creation of new breeding habitats; and where water bodies are too large to treat. Bio larvicides also have a short residual effect (average of two weeks). This makes the intervention labour intensive.

Scientists across the globe are continuously researching and building on existing methods to control malaria. A single malaria control method or strategy will lead to total malaria elimination. Both the malaria parasites and the mosquito vectors are highly adaptive and single approaches to control them can be thwarted. For example, a single vaccine on its own will not completely rid the world of malaria but it can play a part in controlling the disease.

Therefore, research must focus on identifying novel and innovative ways to contribute towards the global malaria elimination strategy.

Dr Mulamuli Mpofu, a regional technical advisor and member of the malaria technical expert network at the non-profit FHI360, contributed to this article.

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