

# Malaria and Vector Control Question and Answers

## What role do mosquitoes play in malaria?

Mosquitoes – specifically, females of the genus *Anopheles* – are the vector that carries the malaria parasite. It is through the mosquito bite that the parasite enters the human bloodstream. There are five types of parasite that cause malaria. One of these – *Plasmodium falciparum* – is responsible for 99% of the half a million malaria deaths each year.

It takes up to two weeks for the symptoms of malaria to appear. The fever that commonly accompanies malaria is a result of the body's natural immunity trying to fight the disease. If left untreated malaria can quickly become fatal, particularly in people with little natural immunity such as children or travellers from non-endemic regions.

## What does vector control mean?

The mosquito is the vector that carries the malaria parasite: Infected mosquitoes transmit the parasite through their bite when they feed on human blood. The mosquitoes themselves are infected when they feed on people who carry parasites in their blood. If an infected mosquito lives long enough, it will again transmit the parasite to other humans when it feeds.

Vector control means controlling mosquitoes so they cannot transmit malaria. The main tools for vector control tools are insecticides that kill mosquitoes, typically sprayed on the walls of dwellings, or soaked into bed nets. These chemicals are fatal to the mosquitoes that land on them.

## What is Indoor Residual Spraying and what are its advantages and disadvantages?

Indoor Residual Spraying is spraying the interior walls and the roof eaves of a dwelling with an insecticide. The product kills mosquitoes that land on the sprayed surface. National malaria-control programmes decide where to spray based on a countrywide plan, and send professionals to treat entire villages.

One advantage of Indoor Residual spraying is that a single spraying can protect a home for up to 9 months. Another is that spraying requires no behavioural change – after spraying teams have treated a dwelling, the occupiers can continue as before. However, homes must be regularly resprayed for the treatment to remain effective over longer periods.

By contrast, insecticide-treated bed nets – another key tool in protecting people from malaria - can last up to 5 years but do require behavioural change: people have to sleep under their nets.

## What are pyrethroid insecticides and why are they not working?

Pyrethroids are a group of insecticides approved by the World Health Organisation to be used on bed nets. As bed nets touch the human body and young children often suck them, products used on nets must not be harmful to humans. With only one class of insecticide available today and with its repeated use, mosquito populations are adapting and resistance to the insecticide is growing.

If resistance becomes widespread, the gains made in the last decade against malaria will be lost, as it is no longer possible to keep mosquito populations under control and the transmission of malaria will increase.

One way to preserve the efficacy of pyrethroid on nets is not to use it in spraying, to limit the exposure mosquitoes get to the product. Until a new insecticide is found for bed nets, the international community must do all it can to protect the use of pyrethroid.

## How do mosquitoes develop resistance to insecticides and why is this a problem?

Mosquitoes develop insecticide resistance by natural selection: though many mosquitos are killed by a given insecticide, after repeated exposure the most resistant ones survive and pass on their resistant genetic traits to their offspring. Over generations, the proportion of resistant individuals in the population increases.

One way to combat this is to rotate the active ingredients. A mosquito is less able to develop resistance to one insecticide, if it is exposed to a variety of different insecticides. In medicine, doctors combine different active ingredients in drugs, to make it harder for viruses or bacteria to adapt.

In the insecticide world each product is unique, so products are rotated. That way the mosquito is exposed to a different insecticide each year and is less able to develop resistance to any of the products.

## What are the implications for malaria if insecticides are not deployed, or if they stop working altogether?

The last 15 years have seen the number of cases and deaths from malaria halved. No single intervention is responsible for this success - it is a combined effort involving prevention, diagnosis and treatment. Estimates say that vector control (nets and spraying) could be responsible for the decline in cases of malaria by as much as 70%. Each tool in the fight against malaria needs to be managed responsibly to avoid resistance issues which currently pose the greatest threat to the gains made to date.

## How can insecticide resistance be managed?

We need a range of different insecticidal products, used yearly in rotation. New products are on the way, but they need some help to get to market.

Evidence-based WHO recommendations guide malaria-control programmes in many countries. Developing the market and building a body of scientific evidence of the effectiveness of vector control methods will ensure that new products come to market. Healthy competition between products in turn will lead to affordable prices and a good range of alternative products for spraying so that the chances of resistance are minimised.

## To what extent is *Aedes aegypti*, the mosquito that is spreading Zika virus in Latin America, susceptible to pyrethroid insecticides?

*Aedes aegypti* is subject to the same resistance issues as other mosquitoes – if exposed to a given insecticide, it will develop resistance over time. The problem is that *Aedes aegypti* has a varied lifestyle which is not so focused on people's homes. As a result spraying is not a silver bullet and needs to be part of a broader package of measures.

Attempts to stop the spread of Zika virus – currently a priority for the global health community – could increase demand for new insecticide formulations for Indoor Residual Spraying.

## What next in vector control?

Today some of the older products don't last long on the walls and so people are not protected for the whole of the rainy season. There is a new generation of insecticide that is making its way to market. These products aim to work longer and be more effective. One such product is already available but the cost makes it prohibitive for governments and countries to afford. Reducing the price of this new generation of insecticides and getting other such products on the market will be key in vector control in the coming years.