MALARIA PREVENTION: INSECTICIDES

According to the World Health Organization, the most powerful and widely applied system of control for malaria-carrying insects is the use of insecticides, mostly in the form of insecticide-treated nets and indoor residual spraying.

Resistance

There are four class of insecticides currently used in the control of malaria carrying mosquitoes (vectors): organochlorines, organophosphates, carbamates and pyrethroids. The 12 insecticides in all four classes are recommended for use in indoor residual spraying (IRS), whereas only pyrethroids are currently recommended for use in long-lasting insecticidal nets (LLINs).

Unfortunately, there is evidence of insecticide resistance among major malaria vectors in various parts of Africa. If a mosquito develops resistance to one insecticide, in most cases it is immediately resistant to all other insecticides in the same class, which is increasingly limiting the available options for IRS. Resistance against pyrethroids is a particular cause for concern as no other insecticide class can be used for ITNs. Although pyrethroid resistance has been reported from several countries, it is not yet clear how this has affected the control of malaria in these regions.

It is of vital importance, therefore, that research continues to understand the impact of the problem and find ways of managing this growth in insecticide resistance. For IRS, several strategies have been proposed which might prevent or slow down resistance.

Insecticide Treated Nets

The *Anopheles* is one of the best known types of mosquito because of its role in the transmission of malaria. Since the *Anopheles* mosquito bites between dusk and dawn, sleeping under mosquito nets treated with insecticides provides critical protection against the spread of malaria. Insecticide treated nets (ITNs) can prevent around 50 percent of malaria cases and can reduce child deaths by an average 18 percent.

Long-lasting insecticidal nets (LLINs) are the most cost effective and sustainable method for protection against malaria. LLINs are treated in factories with insecticide and last for approximately three years. Besides protecting those sleeping from infected mosquitoes, LLINs help reduce the overall number of mosquitoes by killing those that come into contact with the treated net.

LLINs are increasingly being distributed in place of conventionally treated ITNs which need retreating with insecticide regularly.

Above: Preparing for IRS in Nigeria. Photo: Adam Nadel
Left: Anopheles mosquito feeding. Photo: James Gatheny/CDC

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Right: Net beneficiary in Northern Uganda
Below: Sprayers head for Gulu High School, Uganda
Photos: William Daniels

Large scale distributions of LLINs have been successful over recent years. However, distribution is not enough on its own. It is important that appropriate communication strategies are put into place to ensure that those who receive nets understand their importance and know how to use and maintain them. For this reason, net distributions should be combined with information and guidance strategies as well as local and national media campaigns.

Indoor Residual Spraying

Indoor residual spraying (IRS) is considered an effective means of mosquito (vector) control. IRS involves spraying internal walls and ceilings of dwellings using insecticides with residual action (i.e. insecticides that remain on the surface for a long time). The effectiveness of this control method depends to a large extent on the vector's sensitivity to the insecticide used and how much they like to rest indoors. Most vectors in Africa do prefer to rest indoors.

The aim of IRS is to kill potentially infected *Anopheles* mosquitoes before the parasite they carry develops into an infective stage. Mosquitoes spend at least two days on the wall after they have fed on blood before they are ready to lay eggs. The probability that an infected mosquito comes in contact with a sprayed surface at least once is, therefore, high during its frequent feeding-resting-egg-laying cycle which takes place every 2-3 days.

The parasite in the blood takes about 12 days at 25ºC (or longer in cooler environments) to develop before it is ready to be transmitted by the mosquito. During this period, the mosquito has to feed about 4-6 times. There is a high probability that the mosquito will rest on a sprayed wall during this time; if it dies then the parasite will not have been transmitted.

Spraying needs to take place before the malaria transmission season.

The residual life of the insecticide on sprayed surfaces varies between different chemicals, but it is usually between three and six months.

In areas where malaria epidemics are likely, using IRS can prevent seasonal increases in malaria transmission, or may help to prevent and control epidemics.

One of the main advantages of IRS is the ability to use a wide range of insecticide products. IRS can be expensive due to the high operational costs and the precautions that need to be followed to ensure its effectiveness, and that it meets environmental and safety compliance requirements.

IRS sprayers require full training to maintain safety standards. It is therefore important to manage any IRS programme effectively to prevent unauthorised use of public health insecticides.

The effectiveness of the combined use of different malaria control methods, such as IRS and long-lasting insecticidal nets, is currently the subject of discussions within the malaria control community, and particularly within the World Health Organization, around growing insecticide resistance.

Re-treating ITNs on the Thai-Cambodian border Photo: Adam Nadel

Space Spraying

Space spraying is applied mostly as a control measure during malaria epidemics and not very commonly used. It requires specialist equipment and is expensive to implement on a routine basis. The insecticide used has no residual action. It is a rapid method of control and is often used as an occasional emergency intervention. As it has a short term effect, frequent re-application is necessary for substantial impact.

What Malaria Consortium is Doing

Malaria Consortium focuses much of its work on prevention and control of malaria by implementing proven strategies and conducting research around innovative and sustainable approaches.

We have a great deal of experience in the process of mass net distributions and between 2003-2010 distributed over 14 million LLINs to those who are most at risk. We are also working in many malaria endemic countries promoting the use of indoor residual spraying and increasing its reach.

Research into pyrethroid resistance is important and we are key players in shaping the view of the malaria community on the steps needed to tackle such resistance. We are also working on the implementation of effective interventions in close partnership with health services in endemic countries and global and local organisations involved in malaria control.

Malaria Consortium's aim is the relief of sickness among poor people suffering from communicable diseases, particularly malaria, and the protection of people at risk from such diseases.

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