



## The Resistant Mosquito

### Video Transcript

#### Controlling mosquitoes through their ecology

Upon emergence from the pupa, female and male mosquitoes mate and search for a sugar meal. Then the female seeks an animal or a human host for its blood meal to support egg production. While some mosquito species prefer animals, others favour humans; and others still are less selective and may feed on both animals and humans, depending on their availability. Some mosquito species, such as *Anopheles gambiae*, preferentially feed indoors; and others, such as *Anopheles arabiensis*, are typically outdoor biters.

Upon blood feeding, the female mosquito rests in a cool, shady place to digest the blood. Resting may be indoors or outdoors, and again depends on the species-specific behaviour.

The key malaria vectors in sub-Saharan Africa feed and rest indoors. Therefore, the main interventions to control malaria vectors are based on long-lasting insecticidal nets and indoor residual spraying, exploiting mosquito behaviour.

Long-lasting insecticidal nets – or LLINs for short – have two functions. First, they represent a physical barrier between the host-seeking mosquito and the human host, preventing the person under the net from infectious mosquito bites. Second, upon contact with the net, the mosquito picks up insecticide. The insecticide kills the susceptible mosquito, which can then no longer transmit diseases. Therefore, LLINs also provide protection to the wider community, even if some people don't sleep under a mosquito net.

Indoor residual spraying – or IRS for short – kills mosquitoes that rest on treated surfaces and therefore provides protection for the whole community, even if some houses are not sprayed.

While LLINs and IRS have hugely contributed to reducing the malaria burden, they pose a strong selection pressure. Only mosquitoes that can either tolerate insecticides or change their behaviour to avoid contact with the insecticide will survive and have offspring.

Indeed, researchers have observed that mosquitoes have changed their biting time or changed from indoor to outdoor biters where LLINs or IRS are deployed.



Worryingly, insecticide resistance to the insecticides commonly used for LLINs and IRS is increasingly spreading, threatening the success of these important tools. Therefore, huge efforts are being made to repurpose or develop novel insecticides with new modes of action that overcome existing insecticide-resistance mechanisms.

In addition to LLINs and IRS, mosquitoes may also be targeted in different ways and at other stages during their life cycle. Larval breeding sites can be drained or treated with chemical or biological larvicides. Houses can be improved by installing window screens, plastering walls, or changing from thatch roofs to other roofing materials. People can protect themselves with long clothing and topical repellents.

Currently, several novel approaches are being evaluated to interrupt the mosquito life cycle. For example, modified or sterile mosquitoes can be released that suppress or replace wild populations. Spatial repellents could potentially stop mosquitoes from entering houses or places outdoors. A potential intervention could also be to use attractive toxic sugar baits that attract mosquitoes to feed on a sugar solution containing an insecticidal ingredient, or mosquitoes could be lured to odour-baited traps.

Mating swarms can be sprayed with insecticides. Once female mosquitoes search for a host, they can be lured by odour-baited traps and killed. Females seeking blood from an animal could be killed by treating livestock with antiparasitic drugs that act as systemic insecticides.

So, even with resistance to some insecticides developing, research into mosquitoes, their behaviour and ecology, is helping us to develop new and effective control interventions.