

[Announcer] This podcast is presented by the Centers for Disease Control and Prevention. CDC – safer, healthier people.

[Peter Drotman] I'm Peter Drotman, editor in chief of Emerging Infectious Diseases and your host for today. I'm speaking with Dr. John Gimnig, a member of our peer review panel and an entomologist with the Division of Parasitic Diseases at the CDC.

John, the February issue of Emerging Infectious Diseases has an article about the reduced efficacy of insecticide treated nets and indoor residual spraying for malaria control in an area with insecticide resistance. Now since malaria remains one of the most important public health problems in the world, any evidence of decreased prevention effectiveness carries substantial implications. And since this is not the first time insecticide resistance has been reported in a malaria vector in Africa, what makes this article especially worrisome?

[John Gimnig] Thanks Peter. You're right that there have been numerous reports of insecticide resistance in the mosquito *Anopheles gambiae*, one of the primary malaria vectors in Africa. As control programs become increasingly reliant on insecticide-based strategies for the prevention of malaria, any reports of insecticide resistance are worrisome. However, most of these previous reports are based upon laboratory assays of resistance. These laboratory methods are important tools for monitoring the effectiveness of any insecticide based intervention. However, they are imperfect tools. In truth, we really don't have a good correlation between insecticide resistance as measured in our laboratory measures and control failure in the field. This is one of the few studies which shows direct evidence that insecticide resistance, as measured in the laboratory, could compromise the effectiveness of malaria prevention measures in the field.

[Peter Drotman] So what did these researchers do that is different from what others have done previously?

[John Gimnig] Well Peter, they used an experimental hut system to measure the efficacy of two malaria prevention tools: insecticide treated nets and indoor residual spraying. They constructed huts in two areas of Benin. One area is known to have populations of mosquitoes susceptible to pyrethroids, which are a class of insecticides including lambda-cyhalothrin. In the other area, mosquitoes have a resistance factor to pyrethroids of at least 10 fold compared to a susceptible strain, meaning that when exposed to the same chemical dose as a susceptible strain, it takes at least 10 times as long to kill them. In each site, there were four huts: one hut was provided with an untreated mosquito net, one was provided with a lambda-cyhalothrin treated net, one hut was sprayed with water, and one was sprayed with lambda-cyhalothrin. Over the course of 8 weeks, a volunteer slept in each hut. Each morning, the researchers counted the number of mosquitoes that had entered each hut, how many managed to successfully blood feed, and how many died. What they found was that in the area with a susceptible population, the number of mosquitoes that fed on people sleeping in huts with treated nets or treated walls was 96% less than in huts with untreated nets or untreated walls. Additionally, of those mosquitoes that came into the treated huts, 98% of them died. However, in huts in the area with pyrethroid resistance, there was no reduction in blood feeding and only a 30% mortality rate in the mosquitoes.

[Peter Drotman] So does this mean that pyrethroid treated mosquito nets and indoor residual spraying with pyrethroids are no longer effective?

[John Gimnig] Not necessarily. First, it should be pointed out that the researchers intentionally made 80 holes in the nets they used. The idea was to simulate worn nets that are often found in the field. However, control programs could purchase stronger nets that might reduce the number of holes and tears. The insecticide might have limited efficacy, but the net would still serve as a physical barrier. Second, there are other outcomes that were not measured in this study that may indicate those interventions are still working. For example, the researchers measured mortality of the mosquitoes for only 24 hours after they were collected. However, a mosquito needs to live 10 to 14 days after picking up malaria parasites from one person before it can transmit the parasite to another person; therefore, reducing the overall lifespan of a mosquito could have a significant impact on malaria transmission. Repeated exposures to insecticide over the life of a “resistant” mosquito may have that effect. There is a study from Ivory Coast that lambda-cyhalothrin treated bed nets are still effective in reducing the incidence of clinical malaria by over 50%, despite high levels of insecticide resistance. Nevertheless, these findings from Benin are very sobering.

[Peter Drotman] So what will our options be for malaria prevention in an era where pyrethroids are no longer effective?

[John Gimnig] Well, unfortunately, our options right now are pretty limited. There are really only two main strategies for the prevention of malaria: insecticide treated nets and indoor residual spraying. For the treatment of nets, only pyrethroids are recommended because they have long residual activity on the nets and are very safe to humans. There is some work on alternative insecticides for netting but it may be several years before those are ready for use in programmatic settings. For indoor residual spraying, we have the option of using several other classes of insecticides including organophosphates, organochlorines, and carbamates. However, many of these insecticides are often more costly and more toxic to humans than pyrethroids. Furthermore, there are reports of carbamate resistance in some of these same areas of West Africa. DDT is another option that would be safe and inexpensive. But, there is some concern that there’s cross-resistance between pyrethroids and DDT. We are hopeful that with the new infusion of funding from the Global Fund and the President’s Malaria Initiative there will be increasing interest in developing alternative insecticides for malaria prevention and control.

[Peter Drotman] Thank you for your comments, John. We appreciate your perspective on these findings.

Our discussion with Dr Gimnig was prompted by the publication of an article on two approaches to malaria control and pyrethroid resistance in Benin. This article and others on emerging bacterial and viral diseases are available online from [www.cdc.gov/eid](http://www.cdc.gov/eid)

Comments on this interview may be sent to [eideditor@cdc.gov](mailto:eideditor@cdc.gov). That’s eideditor, all one word, at cdc.gov

For Emerging Infectious Diseases, I’m Peter Drotman.

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