Can genetically-modified mosquitoes wipe out malaria?

1 Current prevention methods for malaria do their best but fail miserably. There's no vaccine. There is pre-exposure prevention treatment and post-exposure medical care, both of which are too expensive for the people most affected by the disease. To date, the prevention method that seems to work best -- and is the cheapest to implement on a wide scale -- is mosquito netting doused in repellant. And still, in sub-Saharan Africa, a young child dies of malaria every 30 seconds. So the sudden, possible viability of a cheap, gene-based prevention method is big news.

2 The mosquito-transfer method of spreading malaria is an effective one. It works something like this:

When a female **Anopheles mosquito** is laying eggs, she needs extra protein, which she gets by sucking blood from vertebrate animals like birds, reptiles or mammals. If the animal she feeds on is carrying a **malaria parasite**, the mosquito picks it up. The next time she feeds on an animal, she transfers the parasite to that animal's blood stream. This transfer method infects about 300 million people every year.

3 The idea of using genetically modified (GM) mosquitoes to help wipe out malaria has been around for a while. Theoretically, if you could create a "better," stronger mosquito that happens to be unable to spread malaria parasites, and you were to release tens of thousands of those better mosquitoes into the wild, they would eventually win the survival game and replace the mosquitoes that are able to spread malaria. In this theoretical solution, once malaria were eradicated from a particular area, it wouldn't come back because the mosquitoes couldn't carry it back. But there has always been a glitch.

4 It's not difficult to activate a gene that makes a mosquito immune to any particular malaria parasite (there are a lot of them) and lose the ability to pass it on. It's a relatively cheap laboratory procedure. In this case, the scientists turned on a gene in the mosquito's gut that controls SM1 peptide**.** SM1 peptide, a type of protein, appears to stop the development of the malaria parasite while it's living in the mosquito, rendering it harmless. So making mosquitoes immune to malaria isn't the problem. It's the "better mosquito" qualification that has been eluding science. Genetically modifying a mosquito has always appeared to make it weaker. And a weaker, malaria-resistant mosquito won't win the survival game, so there's no point in releasing it into the wild. It'll just die off. The big deal about the findings published in March 2007 by a group of Johns Hopkins researchers in the journal Proceedings of the National Academy of Sciences is that they seem to disprove previous studies regarding the fitness of GM mosquitoes.

5 When the scientists put 1,200 GM mosquitoes and 1,200 "wild" mosquitoes in a cage with malaria-infected mice, they began to feed. So at the start of the experiment, the mix of GM and wild was 50/50. (The scientists also triggered a gene to make the eyes of the GM mosquitoes glow in the dark so they could easily identify which was which.) After nine egg-laying cycles, the mix of GM and wild had changed to 70/30. The GM mosquitoes were slowly out-surviving the wild mosquitoes. The researchers believe that the genetic modification probably still weakened the malaria-resistant mosquitoes in general, but that

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they gained a survival advantage because the parasite couldn't develop in their gut. This seems to have caused them to live longer, allowing them to lay more eggs than their malaria-infected counterparts.

6 But it's not time to release swarms of malaria-resistant mosquitoes into the wild. There are several issues that make the findings, while promising, very preliminary and really only the tip of the iceberg in terms of actually using GM mosquitoes to stem the spread of malaria. First, the Johns Hopkins team found that when the two groups of mosquitoes fed on uninfected mice, they survived equally well. That would seem like good news, but it's not. The GM mosquitoes only had an advantage when the malaria parasite entered the picture, and they needed to be "better" under non-malaria circumstances, too. Most female Anopheles mosquitoes never pick up the parasite. So in order for the GM mosquitoes to replace current mosquitoes and have any real effect on malaria transmission, they'd have to outsurvive them even when the parasites weren't present. Also, the latest research only addressed a type of parasite that infects mice with malaria, and that parasite is different from the parasites that infect humans, so some scientists say that these results really only show that it may be possible to stop the spread of malaria in mice.

7 Under the best of circumstances -- with many more studies showing similar results, with the successful introduction of human-malaria parasites into the equation, and with the discovery of a way to make GM mosquitoes generally more fit than wild mosquitoes -- it'll be at least another 10 years before malaria-resistant mosquitoes would ever be released into the wild. There are significant concerns about releasing tens of thousands of genetically modified animals into a natural setting. Nothing on that scale has ever been done, and there's no way to know what the long-term, widespread ecological implications might be. Other animals populations might be affected. The mosquito population might grow to unmanageable levels, develop intelligence and take over the world. Or, more likely, the malaria parasites might adapt to the genetic makeup of their new hosts, keeping the disease alive but in a form for which we have no treatment at all.

8 Still, that mosquitoes modified to be malaria-resistant could outsurvive normal mosquitoes under any circumstances is a tremendous finding, and it may be the proof-of-concept needed to keep this line of research moving forward. At the very least, it's a possible step toward a financially manageable, large-scale approach to eradicating malaria.

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