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The Zika Threat: Why Now?

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Mostly innocuous and fairly unknown until a few weeks ago, the Zika virus is suddenly dominating the news for its putative link with a congenital birth defect that causes babies to be born with abnormally small heads and underdeveloped brains, or microcephaly.

Two recent publications [1,2] have documented finding the genome of the Zika virus in the amniotic fluid and brains of fetuses affected by microcephaly from three different mothers. These numbers are still too small to constitute a proof, and in fact, alternative theories are already cropping up: an organization of Argentinean doctors has published a report in which they claim that it’s not the virus, rather the insecticide used against the mosquitos, to cause the birth defect.

But what is Zika and, if the claims about microcephaly turn out to be true, how can it be harmless to most people yet so detrimental to a fetus? To answer these questions we have to take a step back and understand how viruses work and why some are endemic in the population, while others seem to come and go in waves.

The Zika virus was first isolated in 1947 from a rhesus monkey and from a pool of mosquitos in the Zika forest in Uganda. It belongs to the same family of viruses as dengue, yellow fever, and West Nile virus. However, unlike its close relatives, Zika was thought to be relatively harmless: most infected people experience no symptoms and a few have just a rash and mild fever. Originally confined to Africa, Zika started expanding to Asia in 2007. Since then the virus has spread exponentially.

Viruses like Zika are similar to Ebola in that they replicate in animal populations, where they are endemic. Ebola, for example, usually infects bats and jumps to humans who consume meat from infected animals. Zika is found in monkeys, and both monkeys and humans contract it through bites from mosquito carriers. To evade the host’s immune system, viruses evolve continuously: as organisms build immunity to fight them off, genetic changes enable viruses to escape the newly made defenses.

Most of the people who contract Zika don’t even realize they’ve been infected. They might just notice a pesky mosquito bite. But that pesky bite hints at the virus’s covert strength: once inside the mosquito, the virus becomes an invisible enemy, one that hides and migrates through a tiny insect. You can avoid infected people when you see them sniffing and sneezing, but how do you avoid a symptomless agent that spreads through a flying bug?

You don't. In areas where these mosquitos flourish, children get infected early in life, build immunity against the virus, and don't worry about it ever again.

Then why is Zika posing a threat now?

The problem arises when the virus moves to a new geographical area and encounters a population that has never been infected before. Pregnant women are particularly at risk: unless they've been infected earlier in life, in which case their immune system can clear the infection before it reaches the fetus, any disease agent that has the ability to cross the placenta is a potential threat. That's true of Zika. Despite its normally mild symptoms, when it reaches the completely naïve immune system of a fetus in the early stages of pregnancy it can potentially cause permanent damage.

Although the connection between microcephaly and Zika has yet to be confirmed, Los Alamos National Laboratory virologist and epidemiologist Brian Foley does not believe that pesticides are responsible, as hinted by the Argentinean report.

"Of course the insecticide application is slightly correlated," Foley says, "because Zika, dengue and other similar viruses are spread by mosquitoes. So, wherever you find one, you'll find the other, too. But the insecticide mentioned in the Argentinean report has been in use since before 2000 and was heavily tested for mammalian toxicity before being put into use. And it is used all over the world for mosquito control, not just in Argentina and Brazil."

"We can't exclude that Zika is responsible for microcephaly in areas where it has circulated longer. To detect such links it takes careful reporting and record keeping, and most countries do not have really accurate reporting to a central database."

The truth is, both the insecticide use and the virus are consequences of a global trend: over the past two decades, vector-borne viruses like Zika and yellow fever have spread globally at an increased rate. Why? That human behavior is once again responsible for this new spread comes as no surprise. Increased traveling between continents, an exponentially growing population and, last but not least, a rise in temperatures have created the perfect conditions for mosquitos—and hence the diseases they carry—to spread virtually unstopped. Humid, densely populated areas riddled with stagnant water become the ideal habitat for these bugs.

The race for a vaccine has started, and several companies have already announced a schedule to begin human trials in the near future. Unlike HIV, for which making a vaccine has turned out much more challenging than originally anticipated, the genome of the Zika virus is not very diverse. However, making *any* vaccine is regulated by strict government safety rules that require years of testing. "Under normal circumstances, it takes 10-20 years to make a vaccine," Foley explains. "In an emergency situation, they could push it to two to four years. That's still a long time in the event of an outbreak."

It's even longer if you think that Zika may only be the tip of the iceberg of a phenomenon we are bound to see over and over again in the near future.

"The distribution, transmission, and abundance of vectors that bear and transmit diseases are being enhanced by global warming," Foley and colleagues state in a recent publication [3]. "The mean global temperature increased approximately by 1° centigrade during the last several hundred years. However, during the next 20 years it is anticipated to increase by 2–3° centigrade."

Geographic areas once too cold for mosquito-borne diseases are now seeing an increase in encephalitic viruses, dengue, and West Nile. Similarly, Zimbabwe and Ethiopia are experiencing an increase in typhoid and cholera due to poor hygiene, stagnant water and climate change.

So yes, a vaccine can provide a solution. But if this is only the beginning, we need to think globally. It's not just one virus we're fighting but a global change that's happening too fast for the natural world to adapt on its own.

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