Could a Single Vaccine Prevent Multiple Diseases Spread by Mosquitoes?

By Alex Berezow, PhD — June 12, 2018

The reason there is no universal flu vaccine is because the influenza virus constantly changes. That's why we get jabbed with a new vaccine every season; the vaccine from the previous year is unlikely to work against the strains of flu circulating this year.

The hunt for a universal influenza vaccine is based on targeting parts of the virus that don't change. In theory, antibodies generated against these portions of the virus should confer protection against all influenza viruses. Whoever develops and successfully demonstrates such a vaccine should win a Nobel Prize.

But this may not be the only strategy for the creation of universal vaccines. Indeed, a team of researchers who are concerned by mosquito-borne illnesses has described a very clever idea for the development of universal vaccines in the *Journal of Infectious Diseases*.

One Shot to Cure Them All?

Mosquitoes transmit a wide variety of nasty microbes, from viruses like dengue, yellow fever, and Zika to parasites like malaria. The sheer number and diversity of diseases transmitted by mosquitoes makes vaccine development a challenge. But what if a vaccine could target the mosquito, instead? That's the idea presented by the NIH's Dr. Jessica Manning and her colleagues.
When a mosquito "bites," it's not merely drinking blood like through a straw. The mosquito first injects a cocktail of salivary proteins into your body, which are meant to facilitate the blood-drinking. This triggers the body's innate immune response. (See figure, Panel A.) If the mosquito also happens to inject a pathogen, like a virus, cells can become infected. This triggers the arrival of neutrophils (cells that are sort of like the immune system's version of the SWAT team), and that's when things get even worse. The neutrophils encourage other cells to arrive on the scene, and when these also become infected, they travel to their local lymph node, eventually spreading the infection throughout the whole body.
The authors imagine that it may be possible to subvert this process. (See figure, Panel B.) If people are vaccinated against mosquito saliva, they will generate a different kind of immune response when bitten. Instead of neutrophils (the sort of cells that shoot first and ask questions later), T-cells are recruited to the site of a mosquito bite. These cells are like intelligence officers, and they facilitate the production of antibodies, which is a more sophisticated, targeted immune response.

If a vaccinated person is bitten by a mosquito (see figure, panel C), the authors predict that, which now involves T-cells and macrophages, will not only destroy the mosquito saliva but all the other nasty stuff in the neighborhood, including viruses. Now, the virus never even makes it to the lymph node.

**Theory Is Nice, But Does It Work?**

On paper, this is a pretty good idea. But is there evidence it could work? Yes. Sandflies transmit a parasite called *Leishmania*, and researchers have shown that inoculating various animals with sandfly saliva helps prevent them from being infected by the parasite. Likewise, vaccination with tick saliva may prevent the spread of Lyme disease.

If the authors’ machinations are correct, this could represent a breakthrough in ridding humanity of all types of nasty viruses and parasites.