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Penn Researchers Develop Experimental mRNA Avian Flu Vaccine

Penn Medicine

Promising preclinical results suggest mRNA vaccine platform could limit the impact of avian flu pandemics.

An experimental mRNA vaccine against avian influenza virus H5N1 is highly effective in preventing severe illness and death in preclinical models. The vaccine could potentially help manage the outbreak of the H5N1 virus currently circulating in birds and cattle in the United States, and prevent human infections with the virus, according to research from the Perelman School of Medicine at the University of Pennsylvania, published in Nature Communications.

“The mRNA technology allows us to be much more agile in developing vaccines; we can start creating a mRNA vaccine within hours of sequencing a new viral strain with pandemic potential,” said Scott Hensley, PhD, a professor of Microbiology at the Perelman School of Medicine. “During previous influenza pandemics, like the 2009 H1N1 pandemic, vaccines were difficult to manufacture and did not become available until after the initial pandemic waves subsided.”

Hensley and his laboratory collaborated in the study with the laboratory of mRNA vaccine pioneer and Nobel Prize winner, Drew Weissman, MD, PhD, the Roberts Family Professor in Vaccine Research and Director of Vaccine Research at Penn Medicine.

“Before 2020, experts thought the influenza virus posed the greatest risk of causing a pandemic, and we had limited options for creating a vaccine if that had happened,” said Weissman. “COVID-19 showed us the power of mRNA-based vaccines as tool to protect humans from emerging viruses quickly, and we are better prepared now to respond to a variety of viruses with pandemic potential, including influenza”

Most influenza vaccines are egg-based, where experts inject fertilized chicken eggs with what they predict will be the dominant viral strain, let it replicate, and then inactivate the virus to use in the flu shots distributed globally. However, viruses must first be adapted to replicate in fertilized eggs before these conventional vaccines can be produced, which can take up to six months, presenting potential problems for quickly producing vaccine when it’s needed most during the first few months of a pandemic. mRNA vaccines are easily and quickly adapted to protect against different strains of influenza viruses, and don’t require eggs for their development.

The Penn researchers developed an mRNA vaccine targeting a specific subtype of the H5N1 virus that is circulating widely in birds and cattle. While it rarely infects humans, some fear that the virus may evolve and cause a human pandemic. The researchers found that the vaccine elicited a strong antibody and T cell response in mice and ferrets. What’s more, the animals maintained high levels of antibodies even a year after vaccination. Additionally, the researchers found that vaccinated animals who were subsequently infected with H5N1 cleared the virus more rapidly and displayed fewer symptoms than unvaccinated controls. The researchers also note that all of the vaccinated animals survived following H5N1 infection, whereas all the unvaccinated animals died.

Finally, researchers compared the mRNA vaccine response in mice to their response to a traditional egg-based vaccine and found that the mRNA vaccine was just as effective; both vaccines elicited strong antibody responses, regardless of prior seasonal flu exposures.

The Hunter Laboratory at the University of Pennsylvania School of Veterinary Medicine, the Webby Lab at St. Jude, and Steven Fan at Acuitas also contributed to this research.

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