Scientists use computer algorithms to develop seasonal flu vaccines

July 9 2010

Defeating the flu is challenging because the virus responsible for the disease undergoes frequent changes of its genetic code, making it difficult for scientists to manufacture effective vaccines for the seasonal flu in a timely manner. Now, a University of Miami (UM) computer scientist, Dimitris Papamichail, and a team of researchers from Stony Brook University have developed a rapid and effective approach to produce vaccines for new strains of influenza viruses. The researchers hope to develop the new technology and provide an efficient method to confront the threat of seasonal epidemics.

The novel approach uses computer algorithms created by Papamichail and scientists from Stony Brook University to design viruses that serve as live vaccines, which are then synthesized to specification. The new method is called Synthetic Attenuated Virus Engineering (SAVE). The findings are available in a study titled "Live attenuated influenza virus vaccines by computer-aided rational design," now available as an advance online publication by Nature Biotechnology.

"We have been able to produce an entirely novel method to systematically design vaccines using computer algorithms," says Papamichail, assistant professor of Computer Science in the College of Arts and Sciences at UM and co-author of the study. "Our approach is not only useful for influenza; it is also applicable to a wide range of viruses."

One way to make an anti-viral vaccine is to weaken a virus to the point

where it cannot cause sickness, and then use the weakened virus as a live vaccine. Although such weakened viruses often make very effective vaccines, they suffer from the possibility that the virus can sometimes mutate to regain virulence.

In this study, the researchers used a novel approach to weaken the influenza virus: they made a synthetic genome of the virus containing hundreds of changes to its genetic code. The computer algorithms indicate the best places in the genome to make the changes, such that the new synthetic genome encodes exactly the same proteins as the wild-type genome, but in lesser quantities.

This process allows a wide margin of safety, explains Papamichail. "The probability of all the changes reverting themselves to produce a virulent strain is extremely unlikely," he says.

Although the new sequence and the original sequence both direct the synthesis of exactly the same proteins, the new sequence gives a weakened version of the virus; for that reason the live vaccine is capable of eliciting an immune reaction against the wild-type virus, but is not strong enough to cause disease symptoms. This method used to weaken the influenza virus is a general one, and may allow the creation of safe, effective vaccines against many different types of viruses.

In the future, the researchers would like to explore the applicability of their techniques, with the ultimate goal of methodically and computationally design from scratch synthetic organisms with predetermined functions and controlled properties, with broad applications in medicine.

Provided by University of Miami