Anti-microbial 'paint' kills flu, bacteria

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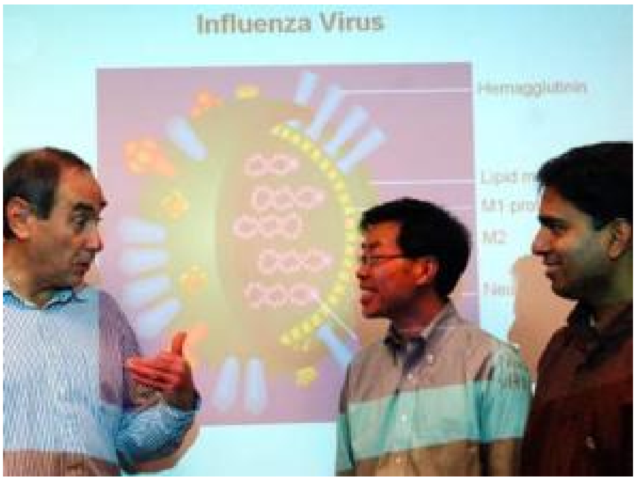

Professors Alexander Klibanov, left, Jianzhu Chen and MIT researcher Jayanta Haldar discuss the 'antimicrobial paint' they have developed. Photo / Donna Coveney

A new "antimicrobial paint" developed at MIT can kill influenza viruses that land on surfaces coated with it, potentially offering a new weapon in the battle against a disease that kills nearly 40,000 Americans per year.

If applied to doorknobs or other surfaces where germs tend to accumulate, the new substance could help fight the spread of the flu, says Jianzhu Chen, MIT professor of biology.

"Because of the limited efficacies with existing (flu) vaccines and antivirals, there's room for other, complementary approaches," said Chen, one of the authors of a report on the new material that appeared Nov. 13 in the online edition of the *Proceedings of the National Academy of Sciences*.

In a typical year, 200,000 people in the United States are hospitalized from influenza virus infection, and 36,000 of them die, according to the Centers for Disease Control. If an avian flu pandemic broke out, as many experts fear, the death toll could be in the millions.

Most fatal flu cases occur in the elderly or in people with weakened immune systems. Available flu vaccines are only 30 to 40 percent effective among those groups, and only 70 to 80 percent effective among healthy adults.

Influenza is spread when viruses released by an infected person accumulate on surfaces, where other people pick them up. Stopping the viruses before they infect people could prevent some flu cases, says Chen.

The new substance can do just that, by killing influenza viruses before they infect new hosts. The "antimicrobial paint," which can be sprayed or brushed onto surfaces, consists of spiky polymers that poke holes in the membranes that surround influenza viruses.

Influenza viruses exposed to the polymer coating were essentially wiped out. The researchers observed a more than 10,000-fold drop in the number of viruses on surfaces coated with the substance, according to Alexander Klibanov, MIT professor of chemistry and bioengineering and the senior author of the paper.

Combating E. coli, too

The polymers are also effective against many types of bacteria, including human pathogens Escherichia coli and Staphylococcus aureus, deadly strains of which are often resistant to antibiotics. For example, S. aureus causes serious problems in hospitals, where it can spread among patients and health care workers.

"In the U.S., more people die in hospitals of diseases they didn't have when they got to the hospital than from the disease that prompted them to go to the hospital in the first place," said Klibanov, who anticipates the new material would be useful in a hospital setting, as well as others where people congregate.

The new coating acts in a very different way from the many antibacterial products--such as soaps, sponges, cutting boards, pillows, mattresses and even toys--that are now on the market.

Those products--which kill bacteria but not viruses--depend on a timed release of antibiotics, heavy metal ions or other biocides, a system that has many drawbacks, says Klibanov. Once all of the biocide has been released, the antimicrobial activity disappears. Also, it can be harmful to release all of these biocides into the environment.

One of the benefits of the new polymer coating is that it is highly unlikely that bacteria will develop resistance to it, Klibanov said. Bacteria can become resistant to traditional antibiotics by adjusting the biochemical pathways targeted by antibiotics, but it would be difficult for bacteria to evolve a way to stop the polymer spikes from tearing holes in their membranes.

"It's hard to develop resistance to someone sticking a knife in your body," Klibanov said.

In a prior experiment designed to test for resistance, 99 percent of bacteria that were exposed to a polymer-coated surface died. The researchers then took the surviving one percent, let them multiply and again exposed them to the surface. They repeated the cycle 12 times, and each time, approximately 99 percent of the bacteria were killed, suggesting that the microbes were not becoming resistant.

The MIT researchers are working with industrial and military partners such as Boeing and the Natick Army Research Center to develop the coatings for practical use.

Once the polymer coating is applied to a surface, it should last about as long as a regular coat of paint, Klibanov said. Accumulation of dead bacteria and viruses diminishes the effectiveness of the nanometer-sized polymer spikes, so the surface would need to be washed with soapy water every once in a while to remove dead microbes, he said.

Other authors of the paper are Jayanta Haldar, a postdoctoral associate in chemistry, and former MIT affiliates Deqiang An and Luis Alvarez de Cienfuegos.

Source: MIT