Pharmacy researcher developing nicotine vaccine, novel drug

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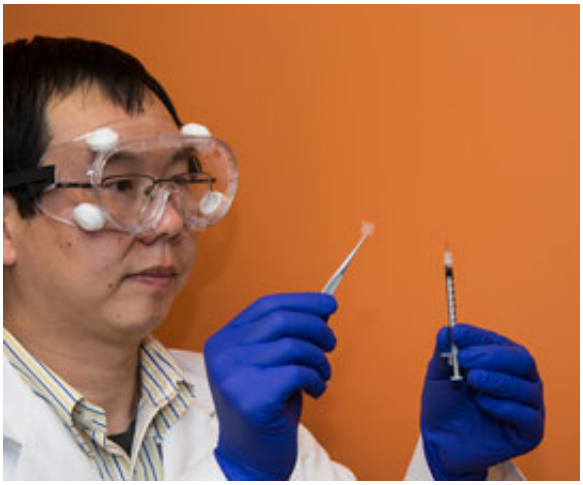

Xinyuan Chen, an assistant professor of biomedical and pharmaceutical sciences at URI's College of Pharmacy, holds the patch he developed to deliver a powdered nicotine vaccine next to a traditional hypodermic needle.

A University of Rhode Island researcher in its College of Pharmacy is developing a nicotine vaccine and accompanying drug delivery system that he believes could lead to one of the most effective methods of combating cigarette smoking and other tobacco use.

Xinyuan Chen, an assistant professor of biomedical and pharmaceutical sciences, joined URI's College of Pharmacy after seven years at Massachusetts General Hospital in Boston, bringing with him a $1.08 million career development grant from the National Institute of Drug

Abuse and a $432,000 grant from the National Institute of Allergy and Infectious Disease.

"My laboratory at URI is developing a laser-based delivery system for a powdered vaccine to improve nicotine vaccine effectiveness," Chen said. "There is no vaccine approved by the U.S. Food and Drug Administration for smoking."

Nicotine vaccines have been studied by other researchers, but none are in use yet.

Typical vaccines fight diseases, but Chen's vaccine and delivery system fight addictive behavior by blocking nicotine's entry into the brain.

"This will induce nicotine antibodies in the body," Chen said.

Described as "a laser-based epidermal (skin) powder delivery" system for improved nicotine vaccination, the laser treatment generates micro-channel arrays, or micro-pores in the skin, through which a powdered vaccine is delivered from a patch applied onto the skin.

This is a close-up of Xinyuan Chen's powdered nicotine vaccine and the patch used to deliver the medicine through micro-channel arrays made by a laser. Also in the photo is a traditional hypodermic syringe. The URI biomedical scientist

believes the drug delivery system he is developing might someday eliminate the need for painful shots. Credit: Nora Lewis.

"Generally, vaccines are liquid, but powdered vaccines are more convenient and they have a longer shelf-life," Chen said.

One of the critical parts of the research involves adjuvants—ingredients added to vaccines to enhance effectiveness. Aluminum gels or salts are adjuvants used safely in a number of childhood and adult vaccines to improve their effectiveness. But some vaccine adjuvants can be toxic.

The adjuvants used in Chen's system, known as MPL and CpG are very powerful and can cause reactions.

"Normally, with a standard vaccine injection, all of the vaccine and all of the adjuvant are delivered all at once at the same location," Chen said. "This approach can be very difficult to handle by the skin and body overall."

Chen said epidermal powder delivery is a novel skin delivery technology capable of minimizing vaccine/adjuvant-induced skin reactions through the delivery of vaccine and powerful additives into hundreds or thousands of separated micro-channels surrounded by normal healthy skin. In other words, the vaccine and its additives are administered in small doses across many sites on the skin, resulting in less potent reactions.

In his lab, Chen displayed a small (6 by 6 millimeter) patch made of contact lens material and a small vial of powdered nicotine vaccine. That tiny patch, with 81 channels, can deliver 810 micrograms of medicine. The typical flu shot contains 45 micrograms of medicine.

The method also allows the incorporation of potent nano-encapsuated adjuvants to safely boost skin vaccination without significant local reactions.

"This system is expected to safely and profoundly boost nicotine antibody production and completely block nicotine entry into the brain," Chen said.

"We want to help those who are already addicted to nicotine, to help them quit smoking," the researcher added. "We also believe for other vaccines, that we could put multiple vaccines in one patch, thereby eliminating the need for multiple injections."

One of his goals is to eventually use the pain-free, needle-free system to eliminate the 30 to 40 needle injections babies receive in their early years.

Only on the job a few months at URI, Chen said he sees the University as a great place to build his research capacity.

"URI's strong College of Pharmacy allows me to pursue this novel vaccine delivery system, and I also see this as being an effective method for the delivery of other drugs."

Provided by University of Rhode Island