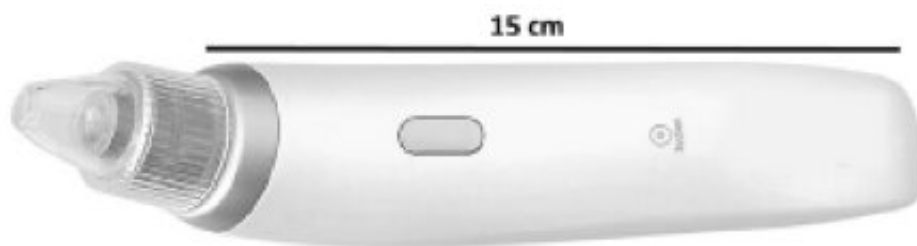


# Combining ancient and modern medicine, scientists use cupping to deliver COVID-19 vaccine in lab tests

November 5 2021

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A portable, battery-powered suction device for human clinical trials. Credit: Rutgers University

Rutgers researchers studying COVID-19 have created a new way to deliver DNA molecules into skin cells, using a suction technique similar to the ancient healing practice of cupping.

The study appears in the journal *Science Advances*.

In laboratory tests with rodents, the team used the suction method to deliver a SARS-CoV-2 DNA vaccine, which generated a strong immune response—about 100 times stronger than an injected vaccine alone. Based on the results, the study's funder, biopharmaceutical company GeneOne Life Science, Inc., has licensed the technology for human clinical trials of a COVID vaccine. A human clinical trial has advanced

to Phase II based on the high level of the technology's safety and immunogenicity.

"This suction-based technique is implemented by applying a moderate negative pressure to the skin after nucleic acid injection in a totally non-invasive manner," said the study's senior author Hao Lin, a professor in the Department of Mechanical and Aerospace Engineering at Rutgers-New Brunswick. "This method enables an easy-to-use, cost-effective and highly-scalable platform for both laboratory and clinical applications for nucleic-acid-based therapeutics and vaccines."

Cupping is a traditional practice in which heated cups are placed on the skin to create negative pressure, increasing blood circulation to the area in an effort to promote healing. Nucleic-acid medicine is a next-generation technology using DNA, RNA and other biomolecules that control genetic information. It has grown extensively over the past two decades due to its promise in treatments and vaccines for various diseases. Most recently, several nucleic-acid-based vaccines have been rapidly designed, manufactured and mass-distributed to fight the COVID pandemic.

Nucleic-acid medicine works when synthetic or engineered nucleic acids enter host cells and, using the cellular machinery, direct the production of encoded proteins to prompt an immune response in case of a vaccine. A key step in this process is transfection, or the delivery of purified nucleic acids across the cell-membrane barriers into the cytoplasm (RNA) and nucleus (DNA) of host cells.

If DNA and RNA molecules are injected into tissue, they do not automatically enter the host cells and most will rapidly degrade unless they are protected. For example, in mRNA-based COVID vaccines, lipid nanoparticles are used to enclose the mRNAs to protect and help deliver them across the [host cell](#) membrane, so that the coded protein is

produced and an immune response provoked. Alternately, an electrical field is often used to deliver DNA to cells, but this method commonly causes adverse effects, including inflammation, pain and tissue damage.

But in the new study, after the injection of pure DNA, the researchers applied suction directly to the site to create negative pressure atop the skin. The suction produced strain and relaxation in the layers of skin, triggering uptake of the DNA molecules by [skin cells](#). The new method is simple, painless and has no known side effects, Lin said.

"Development of enhanced delivery technologies plays an instrumental role in bringing nucleic-acid based biologics to broad use and clinical relevance, and world-wide [vaccine](#) distribution is just one example," he said. "We have demonstrated an alternative, safe and effective transfection platform that yields high levels of transgene expression. The advantages also include device cost-effectiveness and manufacturing scalability and minimal requirements for user training. Because of the inherent advantages of DNA, not least of which is avoiding cold-chain requirements of other vaccines, this technology facilitates vaccination programs into remote regions of the world where resources are limited."

The study was a collaborative venture between Rutgers' School of Engineering and GeneOne Life Science. The Rutgers team was led by professors Hao Lin, Jonathan Singer, Jerry Shan, Jeffrey Zahn and David Shreiber and graduate students Emran Lallow, Nandita Jhumur, Juliet Melnik and Sarah Park.

**More information:** Emran O. Lallow et al, Novel suction-based in vivo cutaneous DNA transfection platform, *Science Advances* (2021). [DOI: 10.1126/sciadv.abj0611](https://doi.org/10.1126/sciadv.abj0611).  
[www.science.org/doi/10.1126/sciadv.abj0611](https://www.science.org/doi/10.1126/sciadv.abj0611)

Provided by Rutgers University

Citation: Combining ancient and modern medicine, scientists use cupping to deliver COVID-19 vaccine in lab tests (2021, November 5) retrieved 2 May 2024 from

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