

The Scientist: NewsBlog:

Breaking the mucus barrier

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Step aside sound barrier: Chemical engineers at Johns Hopkins University have broken the mucus barrier, a long-standing adversary to drug delivery in diseases such as cystic fibrosis, lung cancer, and cervical cancer.

"We get asked all the time, 'Why on Earth do you want to study mucus?'" said Samuel Lai, a postdoc at Hopkins who presented the work yesterday (August 20) at the annual American Chemical Society meeting in Philadelphia. Lai has an easy answer to that question: Mucus has evolved over thousands of years to remove foreign particles, he said, so it blocks not only germs but drugs, especially those targeted to mucus-coated areas of the body such as the lungs and cervix.

At the meeting, Lai presented a new strategy for transmitting drug-toting nanoparticles through mucus and preliminary in vivo data describing the therapeutic potential of the engineered particles.

To figure out how to overcome the sticky barrier with synthetic particles, Lai and [Justin Hanes](#), lead investigator of the study, looked to natural invaders who already manage the feat -- viruses. If particles engineered to carry the drugs had a hydrophilic and uncharged surface, like viruses, they might be able to pass through mucus. The biochemists looked to polyethylene glycol, or PEG, a hydrophilic, uncharged, and already FDA-approved polymer. PEG has been widely used in drug delivery, as well as in products such as skin cream, laxatives, and lubricants. "We couldn't have come up with a more appropriate particle," Lai told *The Scientist*.

The team published a paper [last year](#) describing the efficacy of PEG-coated nanoparticles. Surprisingly, large particles, 200 and 500 nm in diameter, moved through mucus as if it were water. Since then, they have determined the optimal PEG coating -- high densities of low molecular weight of the polymer -- and tested their delivery system in a variety of types of human mucus, including [cystic fibrosis](#) sputum, known to be a thick, tough mucosal barrier.

At the ACS meeting, Lai presented preliminary findings from animal studies that showed PEG-coated nanoparticles containing drugs for small cell lung cancer and [cervical cancer](#) are effective against tumor growth in respective mouse models.

The researchers plan to form a company based around the mucus-penetrating technology later this year, but continue to work with animal models of various diseases to prove efficacy.