Nanotech improves cystic fibrosis antibiotic by 100,000-fold

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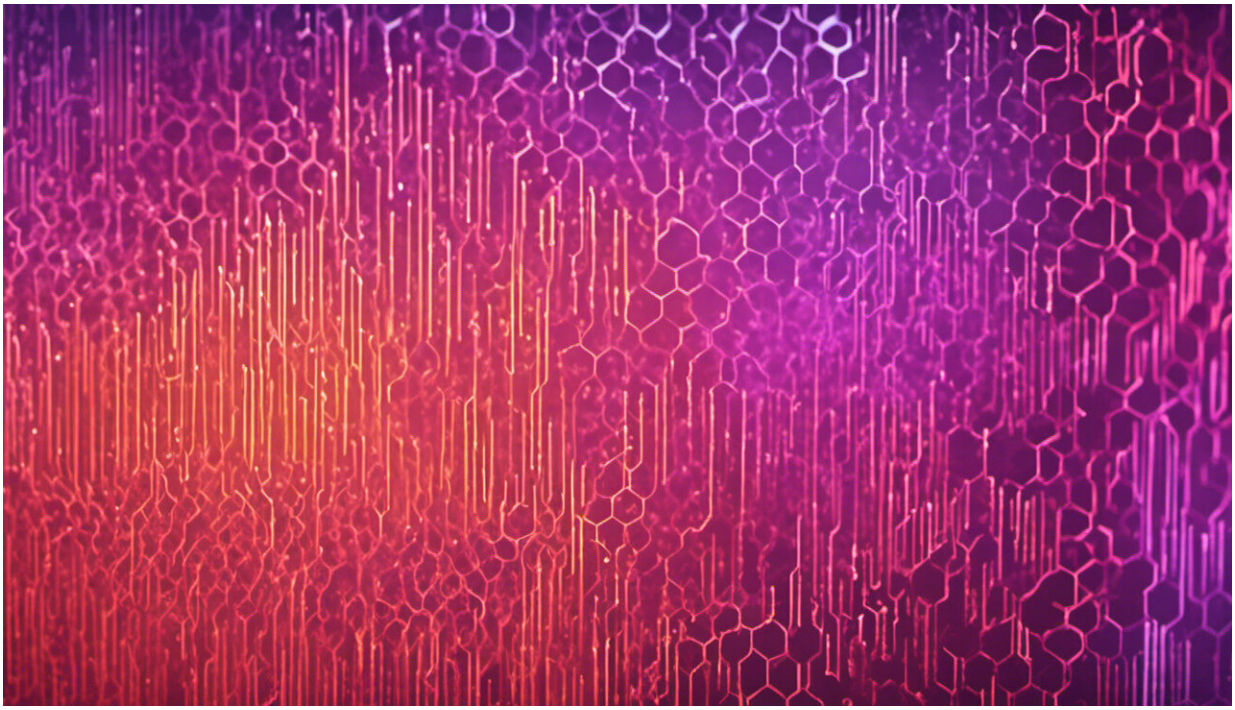

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World-first nanotechnology developed by the University of South Australia could change the lives of thousands of people living with cystic fibrosis (CF) as shows it can improve the effectiveness of the CF antibiotic Tobramycin, increasing its efficacy by up to 100,000-fold.

The new technology uses a biomimetic nanostructured material to augment Tobramycin—the antibiotic prescribed to treat chronic Pseudomonas aeruginosa lung infections in severe cases of CF—eradicating the infection in as little as two doses.

In Australia, cystic fibrosis (CF) affects one in 2500 babies—or one baby born every four days—causing severe impairments to a person's lungs, airways and digestive system, trapping bacteria and leading to recurrent infections. Lung failure is the major cause of death for people with CF.

The UniSA research team, which includes Professor Clive Prestidge, Dr. Nicky Thomas, and Ph.D. candidate, Chelsea Thorn, says the discovery could transform the lives of people living with CF.

"CF is a progressive, genetic disease that causes persistent, chronic lung infections and limits a person's ability to breathe," Thorn says.

"The disease causes thick, sticky mucus to clog a person's airways, attracting germs and bacteria, such as Pseudomonas aeruginosa, which leads to recurring infections and blockages.

"Tobramycin is commonly used to treat these infections but increasingly antibiotics are failing to make any significant difference to lung infections, leaving sufferers requiring life-long antibiotic therapy administered every month.

"Our research successfully treats advanced human cell culture lung infections using nano-enhanced Tobramycin and shows how it can eradicate serious and persistent infections after only two doses.

"This could be a real game-changer for people living with CF."

Researchers enhanced the Tobramycin with a biometric, nanostructured, lipid liquid crystal nanoparticle (LCNP)-based material, testing it on a new lung infection model to showcase its unique ability to penetrate the dense surface of the bacteria and kill the infection.

Dr. Nicky Thomas, who is supported by a Mid-Career Fellowship from The Hospital Research Foundation Group, says the discovery continues the global battle to eradicate and prevent Pseudomonas aeruginosa.

Tobramycin works by inhibiting the synthesis of bacteria and causing cell membrane damage. Yet, as it's a concentration-dependent antibiotic, achieving a sufficiently high concentration is critical," Dr. Thomas says.

"Our technology improves the performance of Tobramycin without increasing the toxicity of the drug, so what we're doing is a far more effective and efficient treatment for chronic lung infections."

The technology is currently entering pre-clinical trials and hopes to be on the market in the next five years.

More information: Chelsea R. Thorn et al. Tobramycin Liquid Crystal Nanoparticles Eradicate Cystic Fibrosis-Related Pseudomonas aeruginosa Biofilms, *Small* (2021). DOI: 10.1002/smll.202100531

Chelsea R. Thorn et al. Protective Liquid Crystal Nanoparticles for Targeted Delivery of PslG: A Biofilm Dispersing Enzyme, *ACS Infectious Diseases* (2021). DOI: 10.1021/acsinfecdis.1c00014

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