PRESS RELEASE

26 JANUARY 2026 | FOR IMMEDIATE RELEASE

NUS Medicine study reveals how antimicrobial resistance spreads from gut bacteria to potentially dangerous hospital superbugs

Singapore, 26 January 2026 – Researchers from the Yong Loo Lin School of Medicine, National University of Singapore (NUS Medicine), have uncovered how a high-risk class of genetic vectors can efficiently spread antibiotic resistance within the gut, enabling even highly virulent bacteria to acquire drug resistance under real-world conditions. The findings shed new light on how so-called "superbugs", bacteria that are both highly virulent and antibiotic-resistant, can emerge and persist, particularly in healthcare settings.

Antimicrobial resistance (AMR) is a growing global health threat, driving increased patient mortality, prolonged hospital stays, and rising healthcare costs. Of particular concern is the increasing number of reports, especially across Asia, of hypervirulent bacteria gaining resistance to last-line antibiotics, creating infections that are both difficult to treat and more likely to cause severe disease.

Led by Associate Professor Gan Yunn Hwen, Department of Biochemistry, and Co-Chair of the Infectious Diseases Translational Research Programme (TRP), NUS Medicine, the study, which was published in *Nature Communications*, investigated how AMR genes are transmitted in the gut, which could be a major reservoir of resistance genes due to the vast number of bacteria living there. Using laboratory models which mimic conditions in the human intestine, the team examined how plasmids—mobile DNA molecules that act as vehicles for AMR transmission—move between common gut bacteria such as *Escherichia coli* (*E. coli*) and hypervirulent *Klebsiella pneumoniae* (hvKp), a pathogen responsible for severe infections worldwide.

The team discovered that a distinct group of plasmids, known as PTU-P2 plasmids, are particularly well adapted to the oxygen-poor (anaerobic) environment of the gut. These plasmids transferred resistance genes far more efficiently than closely related plasmids under gut-like conditions, mirroring their much higher prevalence in human and clinical bacterial isolates worldwide. Crucially, once these plasmids entered a new bacterial host, they could continue spreading even when the original donor bacteria were no longer present, allowing resistance to persist and amplify within the gut microbial community.

“Our findings show that not all resistance plasmids, even when they belong to the same category, behave the same way,” said Assoc Prof Gan. “Some plasmids are evolutionarily adapted to the mammalian gut, where they can quietly and efficiently spread antibiotic resistance. These gut-adapted plasmids represent a hidden but serious risk for the emergence of hard-to-treat infections.”

HvKp is known for its thick, sticky capsule, long thought to act as a physical barrier against genetic exchange. However, the study revealed that this capsule offers far less protection in the gut than previously assumed. Under oxygen-poor conditions similar to those in the intestine, the capsule became less viscous, allowing resistance plasmids to transfer more easily, which is a contrast to results seen under standard oxygen-rich laboratory conditions.

“In the lab, hvKp often appears relatively resistant to plasmid transfer,” explained Dr Melvin Yong, first author of the study, and research fellow at the Infectious Diseases TRP. “But in the intestine, where oxygen levels are very low, that barrier is weakened and makes it much easier for bacteria to pass genetic material to one another. This helps explain why we increasingly see hypervirulent strains acquiring antibiotic resistance in hospitals around the world.”

The study also showed that secondary transfer, where bacteria that have already acquired a plasmid go on to pass it to others, plays a dominant role in sustaining resistance spread in the gut. This means that even brief or rare exposure to resistant bacteria can seed long-lasting AMR transmission. By combining experimental work with large-scale genomic analysis of millions of bacterial genomes worldwide, the team showed that PTU-P2 plasmids are far more common in human-associated bacteria than their environmental counterparts. This suggests that current AMR surveillance efforts, which often focus on resistance genes alone, may miss high-risk plasmid backbones before they become widespread. The findings underscore the importance of studying AMR in biologically relevant environments and caution against relying solely on laboratory experiments to predict real-world risk.

Building on this work, the researchers aim to identify strategies to block plasmid transmission in the gut and improve early detection of high-risk AMR vectors in clinical settings. These efforts will be supported through the establishment of the Centre for AMR Microbiome Research & Innovations (CAMBRI) at NUS Medicine, which will focus on understanding how complex gut microbiomes, both the healthy and antibiotic-perturbed ones, shape the spread of antimicrobial resistance.

This research was supported by the National Research Foundation, Singapore under the National Medical Research Council (NMRC) Open Fund-Individual Research Grant (MOH-000642) administered by the Singapore Ministry of Health through the NMRC Office, MOH Holdings Pte Ltd.

For media enquiries, please contact:

Shaun YEE
Communications Executive,
Yong Loo Lin School of Medicine,
National University of Singapore

DID: +65 9012 1928
Email: medv3719@nus.edu.sg

About National University of Singapore (NUS)

The National University of Singapore (NUS) is Singapore's flagship university, which offers a global approach to education, research, and entrepreneurship, with a focus on Asian perspectives and expertise. We have 15 colleges, faculties and schools across three campuses in Singapore, with more than 40,000 students from 100 countries enriching our vibrant and diverse campus community. We have also established our NUS Overseas Colleges programme in more than 15 cities around the world.

Our multidisciplinary and real-world approach to education, research, and entrepreneurship enables us to work closely with industry, governments and academia to address crucial and complex issues relevant to Asia and the world. Researchers in our faculties, 30 university-level research institutes, research centres of excellence and corporate labs focus on themes that include energy; environmental and urban sustainability; treatment and prevention of diseases; active ageing; advanced materials; risk management and resilience of financial systems; Asian studies; and Smart Nation capabilities such as artificial intelligence, data science, operations research and cybersecurity.

For more information on NUS, please visit www.nus.edu.sg.

About the NUS Yong Loo Lin School of Medicine (NUS Medicine)

The NUS Yong Loo Lin School of Medicine is Singapore's first and largest medical school. Our enduring mission centres on nurturing highly competent, values-driven, and inspired healthcare professionals to transform the practice of medicine and improve health around the world.

Through a dynamic and future-oriented five-year curriculum that is inter-disciplinary and inter-professional in nature, our students undergo a holistic learning experience that exposes them to multiple facets of healthcare and prepares them to become visionary leaders and compassionate doctors and nurses of tomorrow. Since the School's founding in 1905, more than 12,0000 graduates have passed through our doors.

In our pursuit of health for all, our strategic research programmes focus in innovative, cutting-edge biomedical research with collaborators around the world to deliver high impact solutions to benefit human lives.

The School is the oldest institution of higher learning in the National University Health System. It is one of the leading medical schools in Asia and ranks among the best in the world (Times Higher World University Rankings 2026 by subject and the Quacquarelli Symonds (QS) World University Rankings by Subject 2025).

For more information about NUS Medicine, please visit https://medicine.nus.edu.sg/

About the National Medical Research Council (NMRC)

The NMRC was established in 1994 to oversee research funding from the Ministry of Health and support the development and advancement of biomedical research in Singapore, particularly in the public healthcare clusters and medical schools. NMRC engages in research strategy and planning, provides funding to support competitive research grants and core research enablers, and is responsible for the development of clinician scientists through awards and fellowships. The council's work is supported by the NMRC Office which is part of MOH Holdings Pte Ltd. Through its management of the various funding initiatives, NMRC promotes healthcare research in Singapore, for better health and economic outcomes.

About the National Research Foundation (NRF)

The National Research Foundation, Singapore (NRF), set up on 1 January 2006, is a department within the Prime Minister's Office. The NRF sets the national direction for research and development (R&D) by developing policies, plans and strategies for research, innovation and enterprise. It also funds strategic initiatives and builds up R&D capabilities by nurturing research talent. Learn more about the NRF at www.nrf.gov.sg.