NEWS RELEASE

Singapore, 17 Jan 2026

NTU Singapore scientists find new way to disarm antibiotic-resistant bacteria and restore healing in chronic wounds

An international team of scientists, led by **Nanyang Technological University, Singapore (NTU Singapore),** has discovered a new way that could speed up the healing of chronic wounds infected by antibiotic-resistant bacteria.

Worldwide, chronic wounds represent a major health challenge, with an estimated 18.6 million people developing diabetic foot ulcers[1] each year. Up to one in three people with diabetes are at risk of developing a foot ulcer during their lifetime.

These wounds are a leading cause of lower-limb amputations and are frequently complicated by persistent infections that prevent healing.

In Singapore, chronic wounds such as diabetic foot ulcers, pressure injuries and venous leg ulcers are increasingly common, with over 16,000 cases annually, particularly among older adults and people with diabetes[2].

Published in *Science Advances*, the study done with collaborators at the University of Geneva, Switzerland, shows how a common bacterium, *Enterococcus faecalis (E. faecalis)*, actively prevents wound healing. The team also demonstrated how neutralising this biological process can allow skin cells to recover and close wounds.

E. faecalis is an opportunistic pathogen frequently found in chronic infections such as diabetic foot ulcers. These wounds are difficult to treat and often fail to heal, increasing the risk of complications and amputation.

Antibiotic resistance is also an increasing concern in *E. faecalis*, with some strains resistant to several commonly used antibiotics, making certain infections difficult to treat.

While such infections are known to delay healing, the biological mechanism behind this disruption has remained unclear to doctors and scientists.

---

[1] Armstrong, D. G. (2023). *Diabetic Foot Ulcers: A Review*. PubMed. Retrieved from https://pubmed.ncbi.nlm.nih.gov/37395769/

[2] Goh, O. Q., et al. (2023). *Chronic wounds in a multiethnic Asian population: a cost of illness study* [Abstract]. *BMJ Open*. Retrieved from https://pmc.ncbi.nlm.nih.gov/articles/PMC10510887/

The study is jointly led by **NTU Associate Professor Guillaume Thibault** from the **School of Biological Sciences** and **Professor Kimberly Kline** from the **University of Geneva**, who is a visiting professor at **SCELSE – Singapore Centre for Environmental Life Sciences and Engineering**, at NTU.

The team discovered that unlike other bacteria, which produce toxins when they infect wounds, *E. faecalis* produces a metabolic product called reactive oxygen species (ROS) that impairs the healing process of human skin cells.

Mechanism that disrupts wound healing

First author of the paper, **NTU Research Fellow Dr Aaron Tan**, found that *E. faecalis* uses a metabolic process known as extracellular electron transport (EET), which continuously produces hydrogen peroxide, a highly reactive oxygen species that can damage living tissue.

When present in infected wounds, this bacterium produces hydrogen peroxide, which damages human skin cells through oxidative stress.

Laboratory experiments showed that oxidative stress triggers a cellular defence mechanism known as the “unfolded protein response” in skin cells called keratinocytes, which are responsible for skin repair.

This unfolded protein response is normally used by cells to cope with damage by slowing down protein production and other vital activities, so that they can recover.

Once activated, the stress response effectively paralyses the cells, preventing them from moving to close the wound, a process known as migration.

When the researchers used a genetically modified strain of *E. faecalis* that lacked the EET pathway, the bacteria produced significantly less hydrogen peroxide and were unable to block wound healing.

This confirmed that the metabolic pathway was central to the bacterium’s ability to disrupt skin repair. The team then tested whether neutralising the hydrogen peroxide could reverse the damage.

Potential solution that bypasses antibiotic-resistance

By treating affected skin cells with catalase, a naturally occurring antioxidant enzyme that breaks down hydrogen peroxide, the researchers reduced cellular stress and thus restored the cells’ ability to migrate and heal.

This offers another solution to tackle antibiotic-resistant *E. faecalis* strains rather than trying to kill or inhibit them with antibiotics.

“Our findings show that the bacteria’s metabolism itself is the weapon, which was a surprise finding previously unknown to scientists,” said Assoc Prof Thibault, who is also the Assistant Dean (International Engagement) at the College of Science.

“Instead of focusing on killing the bacteria with antibiotics, which is becoming increasingly difficult and leads to future antibiotic resistance, we can now neutralise it by blocking the harmful products it generates and restoring wound healing. Instead of targeting the source, we neutralise the actual cause of the chronic wounds – the reactive oxygen species.”

The study establishes a direct link between bacterial metabolism and host cell dysfunction, offering a new therapeutic strategy for chronic wounds.

The researchers suggest that wound dressings infused with antioxidants, such as catalase, could be an effective treatment in the future.

Because antioxidants like catalase are already widely used and well understood, the researchers believe this strategy could shorten the path from laboratory research to clinical application, compared with developing a new drug.

As the study used human skin cells to demonstrate the mechanism, the findings are relevant to human physiology and may pave the way for new treatments for patients with non-healing wounds.

Giving an independent expert comment, **Adj Associate Professor Timothy Mark Sebastian Barkham, Senior Consultant, Department of Laboratory Medicine, Tan Tock Seng Hospital,** said: “While this basic research does not yet translate into an immediate therapy, it opens a promising new direction for investigation. With antibiotic resistance making chronic wound infections increasingly difficult to treat, exploring alternative approaches beyond antibiotics is both timely and necessary. Such novel approaches warrant further follow-ups to determine their safety and effectiveness.”

The NTU team aims to move towards human clinical trials after determining the most effective way to deliver antioxidants through ongoing studies in animal models.

###

*Paper titled: “**Enterococcus faecalis redox metabolism activates the unfolded protein 4 response to impair wound healing**”, published in Nature Electronics, 16 Jan 2026. DOI:* 10.1126/sciadv.aeb5297

Media contact:

Lester Kok
Senior Assistant Director
Corporate Communications Office
Nanyang Technological University, Singapore
Tel: +65 6790 6804
Email: lesterkok@ntu.edu.sg

About Nanyang Technological University, Singapore

A research-intensive public university, Nanyang Technological University, Singapore (NTU Singapore) has 35,000 undergraduate and postgraduate students in the Business, Computing & Data Science, Engineering, Humanities, Arts, & Social Sciences, Medicine, Science, and Graduate colleges.

NTU is also home to world-renowned autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies and Singapore Centre for Environmental Life Sciences Engineering – and various leading research centres such as the Earth Observatory of Singapore, Nanyang Environment & Water Research Institute and Energy Research Institute @ NTU (ERI@N).

Under the NTU Smart Campus vision, the University harnesses the power of digital technology and tech-enabled solutions to support better learning and living experiences, the discovery of new knowledge, and the sustainability of resources.
Ranked amongst the world's top universities, the University's main campus is also frequently listed among the world's most beautiful. Known for its sustainability, NTU has achieved 100% Green Mark Platinum certification for all its eligible building projects. Apart from its main campus, NTU also has a medical campus in Novena, Singapore's healthcare district.

For more information, visit www.ntu.edu.sg