# New antibiotic for multidrug resistant superbug

**Researchers from the universities in Konstanz and Vienna discover a new class of antibiotic that selectively targets Neisseria gonorrhoeae, the bacterium that causes gonorrhoea. These substances trigger a self-destruction program, which also operates in multi-resistant variants of the pathogen. The novel findings are published in the current issue of Nature Microbiology.**

In recent years, the World Health Organization (WHO) has repeatedly warned of the increase in microbes resistant to antibiotics. Especially multi-resistant bacteria threaten the global healthcare system and can deprive modern medicine of one of its most important curative tools. A team of researchers at the University of Konstanz and the University of Vienna, along with their collaboration partners, have now identified a highly effective substance that uses a new mechanism to target one particularly problematic pathogen. The astonishing findings of the research team led by Christof Hauck, professor of cell biology at the University of Konstanz, and Thomas Böttcher, professor of microbial biochemistry at the University of Vienna, have now been published in Nature Microbiology.

Last year, the WHO compiled a list of particularly problematic bacterial pathogens *(Bacterial Priority Pathogens List*). It names15 types of bacteria that are resistant to antibiotics and classifies them into categories such as "critical", "high" and "medium" priority. The WHO has called upon science and industry to focus their efforts on developing drugs that fight these microbes. One bacterium on the list is *Neisseria gonorrhoeae*, the microbe that causes the sexually transmitted disease gonorrhoea.

## Superbug gonococci

*Neisseria gonorrhoeae*, also referred to as gonococcus, is a highly specialized type of bacteria only found in humans. The pathogen primarily colonizes mucous membranes in the genital tract and can be transmitted from person to person during unprotected sex. During birth, these pathogens can also be transmitted from an infected mother to her child, causing the baby's eyes to become infected. Especially before antibiotics were available, this was a common cause of blindness in newborns.

"Gonococci are notorious for quickly becoming resistant to antibiotics", says chemist Thomas Böttcher. This is because gonococci have the special ability to pick up genetic material from other microbes – including antibiotic resistance genes. Böttcher adds: "This is one of the reasons why gonococcal strains have recently emerged that are resistant to all antibiotics currently in use – such *superbugs* can no longer be treated with antibiotics."

## Interdisciplinary research approach enables breakthrough

Hauck and Böttcher's teams have now been able to identify new substances from the group of alkyl quinolones (AQs) that are even effective against multidrug resistant gonococci. AQs are substances produced naturally by some bacteria to ward off other naturally occurring bacteria. Building on the idea that "the enemy of my enemy is my friend", the researchers recreated these natural substances in the lab and synthesized slightly modified variants. "One of these new AQ molecules actually did have a unique effect: The chemical compound was able to kill gonococci without having a negative impact on other microorganisms or human cells", says cell biologist Hauck. The team elucidated the nature of this astonishing effect using an interdisciplinary research approach that combines synthetic and organic chemistry with genetic and biochemical analyses as well as complex preclinical animal models.

It turns out that this novel antibiotic activates an existing "suicide" mechanism in gonococci. "From other microorganisms, we know about such self-destruction programmes based on toxin-antitoxin systems, and our AQ substance seems to precisely target this Achilles heel of gonococci", explains Ann-Kathrin Mix, first author of the study and a doctoral researcher in Hauck's team. The new antibiotic causes the breakdown of an antitoxin in gonococci, so that the toxin part is released and kills the bacteria. Importantly, the AQ substance can even eliminate multi-resistant gonococcal variants. However, since the respective toxin-antitoxin system is exclusive to gonococci, the antibiotic does not harm other bacteria.

Toxin-antitoxin systems are also present in other infectious microorganisms. The researchers thus expect that this type of treatment could be adapted for use against other bacterial pathogens. "The recently published findings open up a new and innovative way to fight pathogenic microbes before our arsenal of antibiotics is drained", Hauck concludes.

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Mix, A.-K., Nguyen, T.H.N., Schuhmacher, T., Szamosvári, D., Muenzner, P., Haas, P., Heeb, L., Wami, H.T., Dobrindt, U., Delikkafa, Y.Ö., Mayer, T.U., Böttcher, T., Hauck, C.R. (2025) A quinolone N-oxide antibiotic selectively targets *Neisseria gonorrhoeae* via its toxin-antitoxin system. Nature Microbiology, DOI: 10.1038/s41564-025-01968-y

## Press release

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## Further information

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