

New ASU research hunts down drug-resistant microbes

Project pioneers new genomic surveillance tools for antibiotic resistance in animals, the environment

By Richard Harth, ASU News
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Antibiotics are one of the greatest triumphs in the history of medical science — but these lifesaving tools have a dark side.

Their persistent use can produce "superbugs" — drug-resistant microbes that pose a danger to humans, animals and the environment.

In a first-of-its-kind pilot project, researchers from the Food and Agriculture Organization of the United Nations, Indonesia's Ministry of Agriculture and Arizona State University tested the novel integration of a handheld DNA sequencing device within Indonesia's national antibiotic resistance surveillance system across six chicken slaughterhouses in the Greater Jakarta area. They collected samples from both wastewater and surrounding rivers.

The goal: to determine whether portable DNA sequencing could improve national efforts to track drug-resistant *E. coli*, a key indicator of antibiotic resistance.

The study found signs that antibiotic-resistant bacteria from slaughterhouse wastewater may be reaching nearby rivers. In many cases, downstream sites had higher levels of resistant *E. coli* than upstream, pointing to a possible route for resistance to spread from animal waste into the environment.

However, the study also showed how portable DNA sequencing can strengthen national surveillance efforts — making it easier to detect antibiotic resistance hotspots and paving the way for more targeted, cost-effective solutions to reduce its spread. Resistant *E. coli* strains can cause a range of illnesses, including diarrhea, especially in children, older adults and immunocompromised individuals.

"In certain settings, diarrhea isn't just uncomfortable — it's life-threatening," said senior author [Lee Voth-Gaeddert](#), a researcher with the ASU [Biodesign Center for Health Through Microbiomes](#). He is joined by his Biodesign Institute colleagues and international collaborators.

The mobile sequencing approach could be expanded to farms and wet markets, or adapted to track other pathogens such as bird flu.

The research appears in the journal [Antibiotics](#).

Bringing lab tests to the front lines

Antibiotic resistance is a growing global crisis. It occurs when bacteria evolve to survive the drugs meant to kill them. When people are infected with these bacteria, the usual antibiotics won't help. In 2021 alone, antibiotic resistance was linked to nearly 5 million deaths. That number is expected to double by 2050.

Traditional monitoring relies on culture-based techniques. This requires transporting samples to a lab. For a nation like Indonesia, home to more than 14,000 islands, that presents a challenge.

The new project tested a device called MinION, which uses portable nanopore DNA sequencing to rapidly analyze genetic material at the point of collection. The device is small enough to fit in the palm of a hand and powered by a laptop. It delivered results comparable to high-cost laboratory systems.

The project monitored a strain of bacteria that is resistant to a broad class of antibiotics and recognized by the Centers for Disease Control and Prevention as a significant threat. This strain of *E. coli* is often used as a proxy for detecting the presence and spread of other dangerous resistant bacteria.

"It's not the nastiest one, but it is on the CDC list of pathogens of concern," said Voth-Gaeddert, who is also a senior Global Futures scientist with the [Julie Ann Wrigley Global Futures Laboratory](#). "We often use it as a primary indicator of antibiotic resistance."

Samples were taken from slaughterhouse wastewater, as well as upstream and downstream river sites. Most of the *E. coli* found in wastewater was antibiotic resistant. That same resistance pattern was seen downstream but not upstream, suggesting that slaughterhouse waste was the source.

"This wasn't overly surprising," Voth-Gaeddert said. "A lot of these slaughterhouses are positioned right next to rivers. You need water for the slaughtering process, but it also makes waste disposal easier — especially when it's liquid waste."

A spectrum of waste treatment and risk

The study documented large differences in how facilities managed their waste. Some had treatment systems in place, while others released their waste without treating it.

Although the researchers did not assess how effective the treatment systems were, they detected antibiotic-resistant bacteria in both treated and untreated samples. This raises concerns not only about gaps in infrastructure, but also about the maintenance, regulation and oversight of existing systems.

Globally, wastewater from households, hospitals and agricultural runoff is a major source of antibiotic residues in rivers — especially in Southeast Asia, according to [a recent study](#). When antibiotics linger in the environment, they create conditions that allow bacteria to develop new ways to resist them, making high-quality surveillance even more urgent.

To better understand the risk, the team went beyond simply identifying bacteria — they also sequenced their genetic material. Many of the resistance genes they found were located on plasmids — small mobile pieces of DNA that can move between bacteria and spread resistance across species.

Using the MinION device, the researchers identified these genes as well as virulence factors and specific bacterial strains with up to 100% agreement compared with traditional lab methods. The findings show that high-resolution genomic surveillance is feasible even outside elite research settings.

One Health, many fronts

This project is rooted in the [One Health framework](#), which recognizes that human, animal and environmental health are deeply interconnected.

“If we only use a narrow lens, we miss a lot of potential leverage points to control the spread of antibiotic resistance,” Voth-Gaeddert said. “There’s a lot of opportunity here. That’s why there’s been such a big push to promote One Health.”

Indonesia’s environmental diversity and experience with antibiotic resistance surveillance made it an ideal location for piloting new tools. But the insights are globally relevant as antibiotic resistance spreads across borders and ecosystems.

Fast, affordable and locally accessible tools like the MinION may significantly advance our efforts to track and control a broad range of microbial threats.

Why this research matters

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Main image



In a first-of-its-kind pilot project, researchers from the Food and Agriculture Organization of the United Nations, Indonesia's Ministry of Agriculture and Arizona State University tested the novel integration of a handheld DNA sequencing device to improve national efforts to track drug-resistant *E. coli*, a key indicator of antibiotic resistance. Graphic by Jason Drees

Text image(s)



Lee Voth-Gaeddert