

HBKU Thematic Research Grant 3rd Cycle– Project Highlight

Project Title: *Investigating the pervasiveness and distribution of known and unknown antimicrobial resistance genes, coupled with toxic metabolite production, in Qatar: A comprehensive study across various sectors for AI modeling.*



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Executive Summary (limit to 200 words)

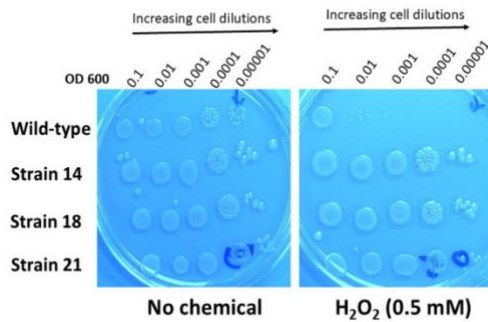
Antimicrobial resistance (AMR) will cause at least another 100 million deaths by 2030. Newer antibiotics are limited, and thus, we must find alternative approaches to stop the spread of drug-resistant bacteria. To combat AMR, the antibiotic **colistin** has been repurposed to treat patients with bacterial infections. However, the misuse of colistin as a growth promoter in animal husbandry has led to the emergence of new microbial resistance mechanisms towards the antibiotic, and one such mechanism involves acquiring the gene *mcr-1*. We hypothesize that selection pressures from the misuse of colistin in various sectors can lead to bacteria with elevated resistance to colistin. We isolated *E. coli* from wastewater showing escalated resistance to colistin. We expect these bacteria to harbour new genetic factors contributing to the enhanced colistin resistance. Our findings will be used to assemble a multimodal dataset by training AI models to predict AMR-gene prevalence, map hotspots across wastewater networks, and run simulations to guide stewardship that curtails spread of AMR in remedial and pristine sites in Qatar. The AI models would be critical for stakeholders, such as MoPH, CDC, and Baladna, to institute policy changes that would save humans and the animal, poultry, fish, and agriculture industries from infectious bacteria.

Expected Outcome (limit to 100 words)

- Advance our understanding of AMR in environmental settings, with a specific focus on Qatar's water systems, including industrial effluents and TSE.
- Provide critical insights into the prevalence, distribution, and potential transmission pathways of resistance genes in these systems.
- Developing effective AMR surveillance strategies using AI and informing public health policies to regulate the overuse of antibiotics in Qatar.
- Mitigate the risks associated with antimicrobial resistance in water environments and improve food safety by eliminating antibiotic-resistant bacteria in recycled water to reach agricultural land.
- Maintaining national priorities such as health, food security, and sustainability of the environment.

Collaborating HBKU entities: CHLS, CSE, and QEERI

Photos –relevant to the project



The data show extreme resistance of *E. coli* strains to a chemical used for treating wastewater. Overnight culture of the Wild-type *E. coli* and three *E. coli* strains (14, 18. and 21) isolated from wastewater were serially diluted 10,000- fold from the starting OD 600 of 0.1. The undiluted and diluted cells were spotted onto plates without and containing the chemical hydrogen peroxide (H₂O₂). Plates were incubated overnight at 37 °C and photographed with a mobile phone.