MUHAMMAD SHAFIQ

ONISILOS MSCA COFUND FELLOW

Πανεπιστήμιο Κύπρου
University of Cyprus

ONISILOS

The study addresses the urgent global threat of Antimicrobial Resistance (AMR) by utilizing Wastewater-Based Epidemiology (WBE) as a non-invasive, cost-effective sentinel for public health.

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Dr. Muhammad Shafiq is an ONISILOS Fellow (MSCA COFUND) at the Nireas-International Water Research Centre of the University of Cyprus. Muhammad's research expertise lies at the intersection of bioinformatics and environmental microbiology, with a specialized focus on the "One Health" framework. He received his PhD in Pharmacology and Toxicology from Nanjing Agricultural University, where he developed a strong foundation in characterizing microbial threats and antimicrobial resistance (AMR). His ONISILOS research career is dedicated to addressing global health challenges by developing advanced bioinformatic tools to monitor the dissemination of pathogens across the human-animal-environmental interface. The research project, titled "Bioinformatics for wastewater surveillance of communicable diseases / AMR pathogens and community wastewater treatment plants as an early alert system," is funded under the prestigious ONISILOS co-funding program. The study addresses the urgent global threat of Antimicrobial Resistance (AMR) by utilizing Wastewater-Based Epidemiology (WBE) as a non-invasive, cost-effective sentinel for public health. The project involves a comprehensive metagenomic surveillance of 28 wastewater samples collected from two major Mediterranean cities: Nicosia and Larnaca. The sampling strategy covers the entire urban water cycle and reuse continuum, including hospital influents, Wastewater Treatment Plant (WWTP) influents and effluents, and agricultural points of use (POU) where reclaimed water is used for irrigation. By comparing the efficiency of different treatment technologies—specifically Membrane Bioreactor (MBR) systems and the impact of distal distribution via chlorination—the project aims to identify the persistence of "last-resort" antibiotic resistance genes (LARGs) and high-priority ESKAPE pathogens. Using advanced bioinformatics, the project seeks to establish a correlation between the resistome found in urban wastewater and the pathogens that eventually reach the agro-ecosystem.

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The ultimate goal is to develop an "early alert system" that can detect shifts in community-level AMR signatures and communicable disease markers before they escalate into clinical outbreaks. This research provides critical evidence for policy-makers and water authorities to optimize treatment barriers and secure the safety of the reclaimed water-food interface. This interdisciplinary research is conducted at the Nireas-International Water Research Centre within the Department of Civil and Environmental Engineering at the University of Cyprus. The project is carried out under the supervision of Professor Despo Fatta-Kassinos, a world-renowned expert in wastewater treatment and antibiotic resistance. The team brings together a diverse group of researchers specializing in environmental engineering, microbiology, and bioinformatics, fostering a collaborative environment that bridges the gap between raw genomic data and practical public health solutions. The project also benefits from collaborations with the Plant and Environmental Biotechnology Laboratory at the University of Thessaly, ensuring a robust analytical approach to the complex metagenomic datasets.

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