Population Ghost Effect Prolongs Plasmid Carriage Following Antibiotic Misuse

Andrea Weiss*, Zhengqing Zhou*, Zhixiang Yao, Hye-in Son, Anokh Ambadipudi, Rohan Maddamsetti, Yuanchi Ha, Lingchong You

Department of Biomedical Engineering, Center for Quantitative BioDesign, Duke University

*These authors contribute equally to the work.

Antibiotic misuse leads to prolonged persistence of antibiotic resistance within microbial communities, significantly compromising clinical interventions. Due to the crucial role of plasmids in carrying antibiotic resistance, efforts have been made to quantitatively predict their steady state behavior. However, the temporal dynamics of plasmids remain inadequately understood. In this work we combine mathematical modelling and quantitative experiments to unravel the mystery of the extended plasmid carriage following antibiotic misuse. Our findings reveal that antibiotics induce purifying selection on the bacterial populations, pushing them into a ghost-effect zone, where plasmid decay is decelerated due to the slow process of plasmid segregation loss. This result highlights the effect of transient antibiotic misuse on compromising the collective effort of antibiotic stewardship.