Analysis and an NSFD method of a model of bacterial competition in the presence of a plasmid

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The rise of antibiotic-resistant bacteria is a major threat to public health across the world. Despite the decline in incidence of many infectious illnesses, bacterial resistance is on the increase. Antibiotics are no longer effective to treat many diseases since they have been overused for decades. In this work, we construct and examine a new mathematical model of the population dynamics of antibiotic-resistant and antibiotic-nonresistant bacteria in a chemostat, where the non-resistant bacteria are infected by a homogenous plasmid that causes them to become resistant to antibiotics. The coexistence of resistant and nonresistant bacteria is possible, despite the fact that nonresistant bacteria keep entering the system. We employ a new nonstandard finite difference (NSFD) numerical method that maintains the model's positivity and its elementary stability in order to verify the theoretical conclusion. The new NSFD method is also second-order accurate.

References

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