Modeling on bacterial resistance to antibiotics caused by mutations and plasmids

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Bacterial resistance is one of the public health problems that most affects the mankind. Although the battle against some diseases such as Tuberculosis, Pneumonia or Malaria is being won, the acquisition of bacterial resistance continues increasing. In particular, antibiotics have been losing their effectiveness after decades of misuse and overuse, which has generated an emergency. We formulate and analyze a deterministic model for the population dynamics of sensitive and resistant bacteria to antibiotics, assuming that drug resistance is acquired through mutations and plasmid transmission. Qualitative analysis reveals the existence of a free-bacteria equilibrium, resistant bacteria equilibrium and a hopf bifurcation around of an endemic equilibrium where both bacteria coexist. The results suggest that to control bacterial growth, the fraction of resistant bacteria that evade the response of the immune system and the fraction of sensitive bacteria that do not present spontaneous mutations, and escape of both action of antibiotic and immune response must be controlled.

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