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Exposing the diversity of multiple infection patterns

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Abstract

Natural populations often have to cope with genetically distinct parasites that can coexist, or not, within the same hosts. Theoretical models addressing the evolution of virulence have considered two within host infection outcomes, namely superinfection and coinfection. The field somehow became limited by this dichotomy that does not correspond to an empirical reality, as other infection patterns, namely sets of within-host infection outcomes, are possible. We indeed formally prove there are over one hundred different infection patterns solely for recoverable chronic infections caused by two genetically distinct horizontally-transmitted microparasites. We afterwards highlight eight infection patterns using an explicit modelling of within-host dynamics that captures a large range of ecological interactions, five of which have been neglected so far. To clarify the terminology related to multiple infections, we introduce terms describing these new relevant patterns and illustrate them with existing biological systems. These infection patterns constitute a new framework for linking within-host and between-host dynamics, which is a requirement to forward our understanding of the epidemiology and the evolution of parasites.

Keywords: superinfection; coinfection; within-host interactions; cooperation; public goods; spite; epidemiology; infection pattern.