On Multiscale Modeling of Vector-Borne Diseases

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Abstract

The transmission of infectious diseases involves complex interactions across multiple biological scales, from within-host immunological processes to between-host transmission dynamics. We develop a multiscale epidemic model linking host–vector population-level transmission dynamics to within-host and within-vector pathogen dynamics. Our model captures key features of within-vector viral progression and allows bidirectional coupling between within-host and between-host processes. Our results underscore the importance of carefully selecting coupling functions and provide guidance on when multiscale modeling is essential for understanding and managing vector-borne diseases.

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