



**Erin E. Gorsich**  
**Department of Biology**  
Colorado State University, Fort Collins CO 80521  
Tel: 330-204-1686 | e-mail: eringorsich@gmail.com

Dear Sir/ Madam,

19 January 2019

Please find attached a manuscript titled, "Interactions between chronic infections: opposite outcomes of co-infection at individual and population scales" for submission as an article in Proceedings of the National Academy of Sciences.

Co-infecting parasites and pathogens remain a leading challenge for global public health. Recent and exciting work has quantified the importance of secondary infections for individual-level infection risk and the clinical outcomes of infection. Interactions between co-infecting pathogens may also influence the spread of infections at the population level. Understanding the effects of co-infection at both levels may, therefore, be fundamental to the success of integrated control programs that target multiple infections. In this study, we bridge these individual and population scales by synthesizing multiple, individual-level processes across natural demographic and environmental variation. As a result, this is one of the first studies to provide a cross-scale investigation of co-infection dynamics.

Our results are broadly relevant for two reasons. First, we provide a data-driven example of competition between pathogens in a natural population. This work improves our understanding of the consequences of co-infection for chronic pathogen dynamics. Second, our results describe a novel mechanism driving competition between co-infecting pathogens. In this study, competition occurs because one pathogen facilitates both the transmission and progression of the second pathogen. This mechanism of competition is unique compared to previously described mechanisms and occurs without cross-immunity, resource competition within the host, or a period of convalescence. Although this is the first data-driven description of this mechanism, it has the potential to be occurring in other important persistent infections such as HIV or TB.

This work has not been published or accepted for publication, and is not under consideration for publication in another journal or book; its submission for publication has been approved by all relevant authors and institutions; and all persons entitled to authorship have been so named.

Thank you for your consideration.

Yours sincerely,

Erin E. Gorsich