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Towards understanding the correlations in epidemic dynamics on contact networks via the master equation

It is well-known that deterministic epidemic models such as mean-field or pair-approximation models can fail on contact networks because they ignore correlations that occur between populations. While there is a substantial amount of intuition about these correlations, the literature lacks a more analytic approach to these effects.

Here, by directly relating these epidemic models to the underlying master equations we can understand precisely where and why these models fail. In particular, common models such as mean-field and pair-approximation models are shown to contain implicit anomalous terms describing unbiological processes whereby individuals can be both susceptible and infectious at the same time. This contradicts the assumption of a compartmental model. It is these implicit terms which lead to the observed inaccuracies in the models.

Analysis of these terms enables us to gain a more analytic perspective on correlations in epidemic models and on the role of network clustering on epidemic propagation.