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Implications for infectious disease models of heterogeneous mixing on control thresholds

Mixing among sub-populations, as well as heterogeneity in characteristics affecting their reproduction numbers, must be considered when evaluating public health interventions to prevent or control infectious disease outbreaks. In this talk, we model preferential within- and proportional among-group contacts in compartmental models of disease transmission and derive results for the overall effective reproduction number (Rv) assuming different levels of vaccination in the sub-populations. Specifically, we unpack the dependency of Rv on the fractions of contacts reserved for individuals within one's own subgroup and show that Rv increases as this fraction increases in a given sub-population. These considerations lead to our proposing the gradient of Rv with respect to subgroup vaccination fractions as a measure by which to evaluate interventions. Another significant result is that for general mixing schemes, both R0 and Rv are bounded below and above by their corresponding expressions when mixing is proportionate and isolated, respectively. This work is based on (1) Glasser et al., Lancet Infectious Diseases (2016) http://dx.doi.org/10.1016/S1473-3099(16)00004-9, (2) Feng et al., J. Theor. Biol. 386 (2015) 177–187, and (3) Poghotanyan et al. J. Math. Biol. (2018) https://doi.org/10.1007/s00285-018-1216-z.