

Adding heterogeneity in models of infectious diseases

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Classic models in mathematical epidemiology rely on several simplifying assumptions, such as non-evolving pathogens and constant, homogeneous populations. Various models have been proposed to overcome these limitations. In this mini-symposium, we present examples of such novel modeling approaches.

One important extension involves accounting for multiple co-circulating strains [4], each with its own transmission and recovery rates. While models with a finite number of strains use a system of ODEs, this number can be extended to infinity, resulting in a single PDE describing the disease dynamics. This generalization is the subject of the first talk.

Another prominent direction for increasing model precision is the inclusion of behavioral responses among individuals aware of an ongoing outbreak. This field is expanding rapidly (see, for instance, recent meta-analyses [3, 1, 2]). The two other talks follow this trend : one examines a model of voluntary isolation using both ODE and network approaches, while the other considers the evolution of virulence and its impact on vaccine acceptance.

A final presentation will complete this mini-symposium. The speaker is to be confirmed, with a topic designed to complement those currently scheduled.

The prospective speakers are :

- Eriq DEBRABANT
- Hugo MARTIN
- Clément MONAURY
- Fourth speaker to be confirmed

- [1] A. Hamilton, F. Haghpanah, A. Tulchinsky, N. Kipshidze, S. Poleon, G. Lin, H. Du, L. Gardner, E. Klein. *Incorporating endogenous human behavior in models of covid-19 transmission : A systematic scoping review*. *Dialogues in Health*, **4**, 100179, 2024. doi :10.1016/j.dialog.2024.100179.
- [2] L. LeJeune, N. Ghaffarzadegan, L. M. Childs, O. Saucedo. *Formulating human risk response in epidemic models : Exogenous vs endogenous approaches*. *European Journal of Operational Research*, 2025. doi :10.1016/j.ejor.2025.01.004.
- [3] A. Reitenbach, F. Sartori, S. Banisch, A. Golovin, A. Calero Valdez, M. Kretzschmar, V. Priesemann, M. Mäs. *Coupled infectious disease and behavior dynamics. a review of model assumptions*. *Reports on Progress in Physics*, **88(1)**, 016601, 2024. doi :10.1088/1361-6633/ad90ef.
- [4] K. E. Shaw, J. K. Peterson, N. Jalali, S. Ratnavale, M. Alkuzweny, C. Barbera, A. Costello, L. Emerick, G. Espana, A. Meyer, S. Mowry, M. Poterek, C. de Souza Moreira, E. L. Morgan, S. Moore, A. Perkins. *Co-circulating pathogens of humans : a systematic review of mechanistic transmission models*. *Proceedings of the Royal Society B : Biological Sciences*, **292(2055)**, 20251453, 2025. doi :10.1098/rspb.2025.1453.

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