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Review article

Connectome: Graph theory application in functional brain network architecture

Fabrizio Vecchio [a,*], Francesca Mira

[a] Brain Connectivity Laboratory, IRCCS San Raffaele Pisana,
[b] Institute of Neurology, Dept. Geriatrics, Neuroscience &

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CONCEPTS & SYNTHESIS
EMPHASIZING NEW IDEAS TO STIMULATE RESEARCH IN ECOLOGY

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LANDSCAPE CONNECTIVITY: A GRAPH-THEORETIC PERSPECTIVE

[1]*Nicholas Schoo*
[2]*National Center*

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REVIEW

Networks and epidemic models

Matt J. Keeling[1,†] and Ken T. D. Eames[2]

[1]*Department of Biological Sciences & Mathematics Institute, University of Warwick, Gibbet Hill Road, Coventry CV4 7AL, UK*
[2]*Department of Zoology, Downing Street, Cambridge CB2 3EJ, UK*

Networks and the epidemiology of directly transmitted infectious diseases are fundamentally linked. The foundations of epidemiology and early epidemiological models were based on population wide random-mixing, but in practice each individual has a finite set of contacts to whom they can pass infection; the ensemble of all such contacts forms a 'mixing network'. Knowledge of the structure of the network allows models to compute the epidemic dynamics at the population scale from the individual-level behaviour of infections. Therefore, characteristics of mixing networks—and how these deviate from the random-mixing norm—have become important applied concerns that may enhance the understanding and prediction of epidemic patterns and intervention measures.

Here, we review the basis of epidemiological theory (based on random-mixing models) and network theory (based on work from the social sciences and graph theory). We then describe a variety of methods that allow the mixing network, or an approximation to the network, to be ascertained. It is often the case that time and resources limit our ability to accurately find all connections within a network, and hence a generic understanding of the relationship between network structure and disease dynamics is needed. Therefore, we review some of the variety of idealized network types and approximation techniques that have been utilized to elucidate this link. Finally, we look to the future to suggest how the two fields of network theory and epidemiological modelling can deliver an improved understanding of disease dynamics and better public health through effective disease control.

Keywords: transmission; infection; contact-tracing; random network; small-world network; scale-free network