SOCIAL NETWORK ANALYSIS AND AGENT-BASED MODELING IN SOCIAL EPIDEMOLOGY

Adapted from the work of Abdulrahman M El-Sayed, Peter Scarborough, Lars Seemann* and Sandro Galea: "Social Network Analysis and Agent-Based Modeling in Social Epidemology"

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Abstract

- The paper is about the implementation of Social network analysis and agent-based models (ABMs) in social epidemiologic research
- Social network analysis involves the characterization of social networks to yield inference about:
  ~ how network structures may influence risk exposures among those in the network. (ideal for understanding the influences of social interaction on population health.)
  BUT - requires network data and - causal inference from current network analytic methods is limited
- ABMs can promote population-level inference from explicitly programmed, micro-level rules in simulated populations over time and space: exploration of feedback and reciprocity between exposures and outcomes in the etiology of complex diseases.
- Social network and agent-based approaches are promising in social epidemiology, but continued development of each approach is needed.

Social epidemiology

*This branch of epidemiology is fundamentally interested in the influences of social factors such as:
- individual attributes (i.e., social class and ethnicity),
- behaviors (i.e., diet and physical activity),
- contextual influences (i.e., neighborhoods and regions)

on the distribution of health and disease in populations

* Change in disease risk is not always proportional to the change in exposure. There are 2 epistemological approaches:

* "reductionism", which suggests that systems are best understood by aggregating information gathered via the independent study of their components.

* systems approach implies that the dynamics and behavior of a system are different, qualitatively, from those of the sum of its parts. A systems approach, therefore, emphasizes the dynamics of relationships between components of a system, rather than the characteristics of those components themselves

Social network analysis

* In the context of social epidemiology, social network analysis involves the characterization of the structures of social networks or subsets of networks so as to understand the flow of health-relevant factors (i.e., disease, information, social support, etc.) between network nodes.

* Network characterization involves analyses directed toward understanding the roles played by individual actors, subgroups of actors, or overall network structures in characterizing the flow of factors of interest within networks.

For example, at the level of the individual, analyses might address:

- the number of connections a particular actor has within a network
- the degree to which the actor bridges between other actors in the network
- the social distance (measured in relationships) between an actor and other actors, or the degree of connectedness of an actor relative to others.

By contrast, analyses of full networks may address degrees of connectivity between actors, the degree of centralization or hierarchy in a network, or lengths of paths between particular actors of interest.

* Another Method: inferential analysis

~ These methods, still in development, include stochastic, and longitudinal network analytic techniques.

~ Longitudinal network analysis allows investigators to study temporal changes in networks, their characteristics and dynamics, and/or the characteristics of their constituent parts, while stochastic analytic techniques allow for the construction of network models for use in simulations

Application

* Social network analysis is particularly useful for studying how social phenomena spread through social networks and influence health in this manner.

Using social network analysis, several studies have demonstrated the spread of non-infectious conditions through social networks, including obesity, smoking, alcohol, back pain, and general well- being.

* However, the current literature that has employed social network approaches to understand the communicability of non-infectious health outcomes has only scratched the surface of the applicability of these approaches.

~ For example, while it has been suggested that obesity may be communicable via network ties, little is known about heterogeneity: why might some contacts of obese individuals become obese while others may not? Maybe the answer is linked with characteristics of the obese contacts, the characteristics of those exposed, or in characteristics of the relationships they share

* Also, we know that differences in social network structure among ethnic majority and minority groups may influence the spread of obesity among them.

Agent-based models

* ABMs are stochastic computer simulations of simulated "agents", or individuals, in simulated space, over simulated time. Useful for complex function of agent attributes

* Agent-based modeling requires the investigator to explicitly describe and program agent characteristics and updating rules during implementation.

Application

- We can use data from other communities and infer from them to model the network of the community of our research: Move beyond reductionism
- Understand causal inference in social epidemiology