Research Brief

NCPERRC
North Carolina Preparedness and Emergency Response Research Center

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Addressing Public Health Issues with Social Network Analysis

Social network analysis (SNA) refers to the study of interactions among a set of actors, organizations, or other social entities.[1] Researchers use SNA to understand individual actions within the context of structured relationships, or the structures themselves.[1] A network-based analysis is ideally suited to visualizing, describing, and analyzing public health systems.

This brief introduces social network analysis and highlights its use in current projects of North Carolina Preparedness and Emergency Response Research Center (NCPERRC).

Social Network Analysis in Public Health

The introduction and application of SNA to public health systems and services research is relatively new. Ongoing questions and demands associated with measurement, assessment, and evaluation of public health systems and services have increased with concerns related to performance assessment, program evaluation, and improvements from local to federal levels. It is important not only to assess performance and capacity, but also to understand the structural components that contribute to system characteristics. SNA is one approach that assesses interactions among public health organizations to support analysis of the structure of public health systems.

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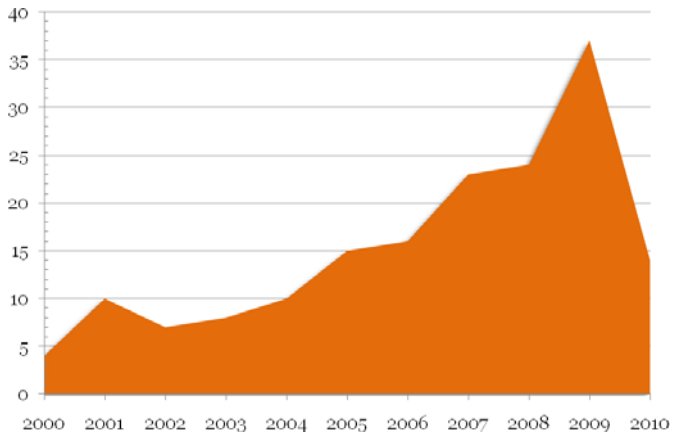
In the past ten years, the growth of publications on social network analysis has been dramatic: 37 peer-reviewed articles directly examined social networks related to public health issues in 2009. Luke and Harris may be credited with bringing increased attention to SNA for public health.[2] More recently, Van Wave and colleagues argue that "research on the attributes, functions, and effects of local, state, and federal public health systems and networks promises to hasten development and translation of evidence to practice and accountability concerning the efficacy, effectiveness, and equity of public health investments."[3]



Source: PubMed.gov/MEDLINE

Figure 1: Growth of Social Network Publications in Public Health

Network analysis offers public health a new and innovative approach to framing and answering important health questions.[2] Rather than focus on the characteristics of an individual, organization, or system, SNA examines the relationship among these units. These relationships are visually depicted through a

sociogram, or a drawing of points (representing individuals or organizations) connected by lines (indicating relationships). In addition to connecting the dots, the color and size of the points, also referred to as *nodes*, may also be used to depict the individual characteristics or roles within a network. The analysis of networks thereby allows the whole system to be examined in its entirety, which may reveal useful information about network position, properties of different groups, or characteristics of the complete network.

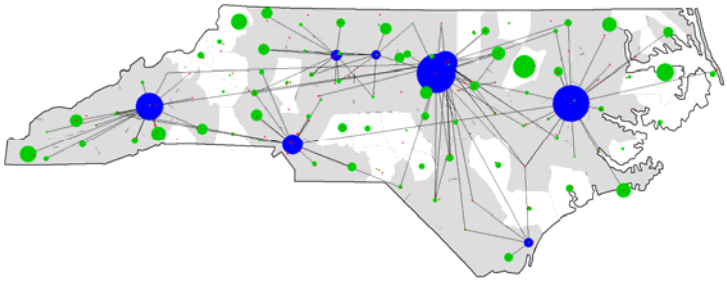
Use of SNA in PERRC Research

NCPERRC is using SNA in two areas of research: 1) a regional study of PHEP-funded workforce infrastructure programs; and 2) a pilot project looking at communication among public health professionals in North Carolina. In each of these projects, NCPERRC is using SNA to address questions that it might not otherwise be able to answer using more traditional research methodologies.

Fulfilling the Liaison Role

NCPERRC is using SNA to help systematically examine the organization, function, and capacity of regional preparedness programs in North Carolina and their impact on the state's ability to respond to potential public health threats and hazards.

One program being studied is the hospital-based public health epidemiologist (PHE) program, established in 2003 by the North Carolina Division of Public Health (NC DPH) to enhance state and local preparedness and response. NC DPH placed PHEs in each of the state's 11 largest hospitals and tasked them with the responsibilities of surveillance, detection, and monitoring; assisting local health departments (LHDs); educating clinicians; enhancing communication; and conducting special studies. The project examines PHEs' roles and responsibilities, as well as the range of services provided to host hospitals, NC DPH, and LHDs.



Size of nodes indicates frequency of liaison role in network

Figure 2: PHE Interactions with LHDs & Hospitals

A key objective of this research has been to identify and determine key actors and critical partnerships in the PHE network to understand how these relationships impact the flow of information and communication around surveillance, reporting, and investigation of communicable diseases and potential bioterrorism events. SNA not only allows the differentiation of distinct structural roles within an inter-organizational network, but helps to validate the PHE program's intended liaison role within the inter-organizational network across the state.

Snapshots of a Public Health Event

In addition to the regional project, NCPERRC is also applying SNA in a pilot study of communication among public health preparedness officials. The study describes communication and information sharing patterns among North Carolina public health professionals during the 2009 H1N1 outbreak. Using network data derived from a partner NCPERRC study,[5] this study sought to answer the following questions:

- How do public health personnel generally learn about outbreaks and ongoing situations?
- Was there anything different about the H1N1 outbreak?
- With whom did public health officials communicate during the H1N1 event?

The following sociograms illustrate the differences between where public health officials first learn about public health events in general and where they first learned about H1N1.

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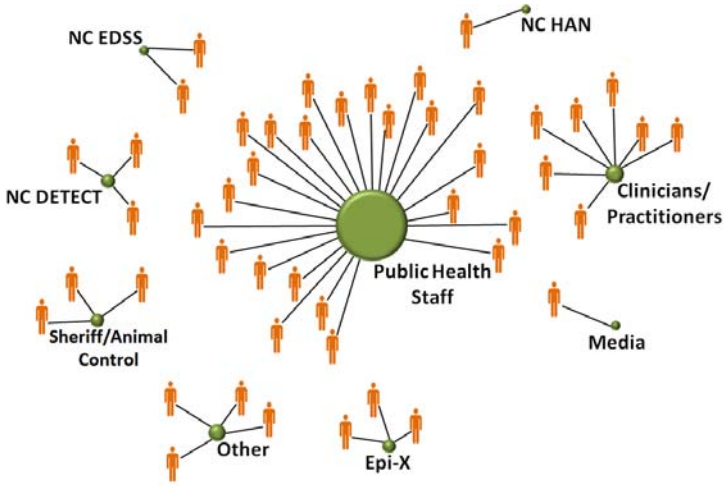

Figure 3: Where Public Health Professionals First Learn about Public Health Events in General

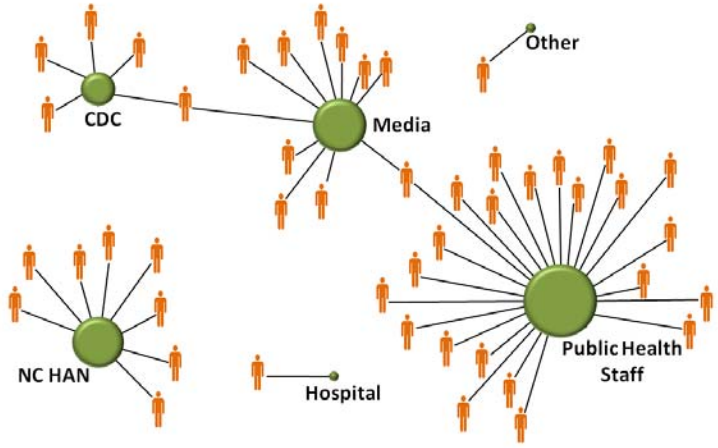

Figure 4: Where Public Health Professionals First Learned about H1N1

This comparison helps identify patterns in how public health professionals in North Carolina communicate about events and outbreaks, such as H1N1. Triangulating communication patterns with other descriptions and measures of performance will help identify successful structures. These findings can lead to interventions to improve communication inefficiencies that impede the management of public health response within the state.

Discussion

The public health preparedness infrastructure consists of a complex arrangement of organizations, associations, and patterns. Together, they represent a delivery network of public health services, including surveillance, education, and communication. SNA models help to identify and differentiate structural roles within an inter-organizational network, especially in systems associated with public health information and communication. These methods can be applied to measure and evaluate public health systems and services. Network-based studies, like those featured here, help to expand and move public health beyond the limitations of frequency and descriptive statistics.

References

1. Wasserman S, Faust K. *Social Network Analysis: Methods and Applications*. Cambridge University Press: New York, NY. 1994.
2. Luke DA, Harris JK. Network analysis in public health: History, methods, and applications. *Annual Review of Public Health*. 28:69-93. 2007.
3. Van Wave TW, Scutchfield FD, Honoré PA. Recent advances in public health systems research in the United States. *Annual Review of Public Health*. 31:283-95. 2010.
4. Samoff E, Soeters HM, Davis M, Park M, Fleischauer AP, Ising A, Haas SW, Waller A, MacDonald PDM. Public Health Surveillance Project: Summary of Year 1. Research Brief. URL: http://cphp.sph.unc.edu/ncperrc/research/SurvProjectResearchBriefMay2010.pdf

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Additional Recommended Readings

In addition to the references, the following writings are also recommended.

Carrington PJ, Scott J, Wasserman S. *Models and Methods in Social Network Analysis*. Cambridge University Press: New York, NY. 2005.

Freeman LC. *The Development of Social Network Analysis*. Empirical Press: Vancouver, BC. 2004.

Kilduff M, Tsai W. *Social Networks and Organizations*. Sage Publications: Thousand Oaks, CA. 2003.

Varda DM, Chandra A, Stern SA, Lurie N. Core dimensions of connectivity in public health collaboratives. *J Public Health Management Practice*, 14(5):E1-E7. 2008.

Social Network Software Packages

Here are a few recommendations for social network software packages, ranked by ease of use.

PARTNER.
Program to Analyze, Record, and Track Networks to Enhance Relationships is a tool designed to measure and monitor collaboration among people/organizations over time.
http://www.partnertool.net/

UCINet and *NetDraw*.
A comprehensive package for the analysis of social network data, works in tandem with freeware program called NETDRAW for visualizing networks.
http://www.analytictech.com/ucinet/

Pajek.
A Windows-based program for the analysis and visualization of large networks.
http://pajek.imfm.si/doku.php?id=pajek

statnet and *sna* packages, *R*.
A suite of software packages for network analysis in R
http://csde.washington.edu/statnet/

Note: Software is subject to development.

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