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Social Network Analysis: A Novel Approach to Legal Research on Emergency Public Health Systems

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The public health system (PHS) involves many agencies and organizations working together.[1] Systems function to connect, coordinate, and provide feedback among separate agents to fulfill specific purposes.[2] On the basis of previous consensus reporting[3] and research,[4] the PHS is made up of governmental public health agencies, hospitals, community-based health care providers, law enforcement, faith institutions, emergency medical services, and others. A critical purpose of the PHS is to prevent, protect against, quickly respond to, and recover from emergencies with public health consequences. Statutes, regulations, plans, and protocols define emergency PHSs— for example, by outlining scopes of authority for governmental agencies, mandating mutual responsibilities (such as, communication and reporting) among agencies and community organizations, and establishing when emergency conditions warrant the departure from routine practices.

In the effort to understand how laws and policies define the PHS for emergency purposes, traditional legal researchers can borrow from the methods of social network analysts. Previous studies have applied network analysis to communication patterns of workers within local health departments and interrelationships within public health agencies,[5,6] cooccurrence of words and citation patterns in the US Code,[7] and citation patterns in French legal codes.[8] The network analysis tool might equally well provide a way to analyze the qualities of emergency PHS networks.

In preliminary studies, we have combined legal analysis of statutes and policies with network analysis to explore the relationships among agents in state PHSs for emergency purposes. Eleven states were selected for national geographic diversity, variation of population density, and risk profile variation: Alaska, California, Florida, Kansas, Maryland, New York, North Dakota, Pennsylvania, Rhode Island, Texas, and Wisconsin. The texts of emergency laws (4917 statutes and regulations) from these states were translated into numeric codes representing a directive or statement: acting agent (entity being directed), partner agent (entity receiving directed action), prescription (ie, must, may), action (ie,

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vaccinate, plan, enact), goal (object or result of action), purpose (preparedness, response, or recovery), emergency type, timeframe (recurring or bounded period of action), and condition (trigger or circumstance for action). Posted in Excel spreadsheets, these codes became the data source for network diagrams generated by NetDraw[9] and Pajek.[10] The network properties were analyzed by using social network software including Igraph[11] and UCINET.[12]

To date, this method has produced network diagrams of emergency laws for individual states, for all 3 emergency purposes, and for various emergency types. Full texts of coded statutes, regulations, and policies are posted on a searchable database (see http://www.phasys.pitt.edu/default.aspx) and accessible from the LEgal Network Analyzer (LENA) applet (see http://www.phdl.pitt.edu/LENA/).

In the accompanying Figure, a network diagram produced by LENA shows PHS *agents* (acting and partner) as nodes connected by edges (lines that correspond to *actions*) as directed by NewYork State's emergency laws for the *goal* of infectious disease surveillance. Acting and partner agents connected by heavy (thick) edges have more frequent directives in state law. Arrowed lines represent directionality of legal mandates: unidirectional statements are represented by blue lines; bidirectional statements are represented by red lines. Agents central to infectious disease surveillance are central in the network map with connections to many other agents that together form the core of the network. Agents peripheral to the surveillance function have fewer connections to other agents, and the special force-based algorithm used in this visualization puts these less relevant agents at the periphery. The list of agents in the upper left corner of the network map—called isolated agents—have no statements naming them in this set of laws.

Visualizations of this kind show patterns of relationship within systems in ways that allow the researcher to explore strengths and vulnerabilities. How robust and inclusive are the legally defined emergency systems, compared to the actual practice of emergency responders? Do the emergency laws of a given state adequately define the mutual roles and responsibilities of PHS organizations and agencies, relative to the state's risk profile, resources, and demographics? Can comparisons of states' emergency laws focus attention on optimizing performance outcomes as opposed to stakeholders' personal or organizational interests?

Thus, answers and insights from network analysis of laws and policies can complement traditional legal analysis in useful ways for policy makers and emergency planners. Linking network maps with legal texts can be a resource for legislators and regulators.

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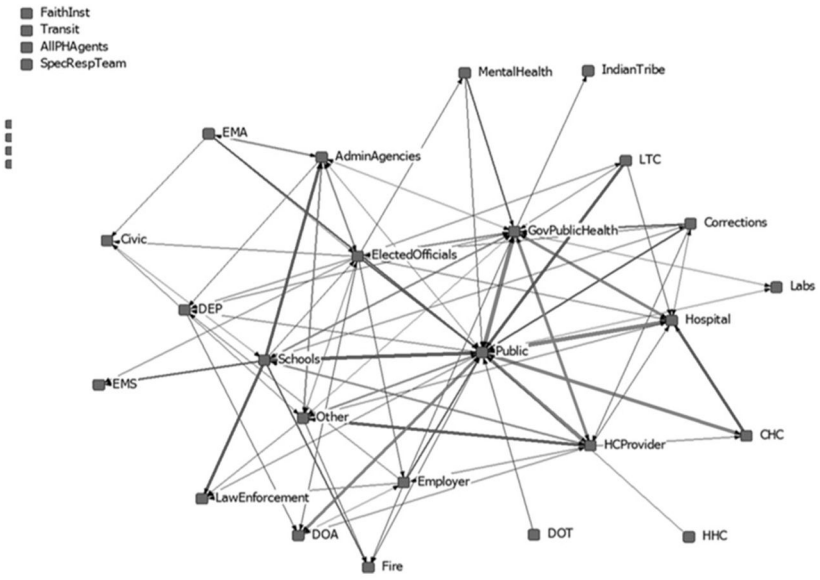

FIGURE.

Legally Directed Agents for Infectious Disease Surveillance in New York State