Core Dimensions of Connectivity in Public Health Collaboratives

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A major challenge facing state and local public health agencies is how to partner with other organizations, agencies, and groups to collaboratively address goals in population health while effectively maximizing resource sharing of the partners involved. Today's public health efforts require multiagency partnerships between both governmental and nongovernmental sectors to achieve this mission. However, the frequent reconfiguration of partnerships among government and nongovernmental agencies has left many public health managers struggling to find ways to both develop public health collaboratives and evaluate their success. In this article, we use network theory and social network analysis to outline the core dimensions of connectivity used to measure progress in public health collaboratives. *Connectivity* is defined as the measured interactions between partners in a collaborative such as the amount and quality of interactions and how these relationships might change over time. We also articulate how these measures fit into the overall process of measuring progress in public health collaboratives and end the article with suggestions for future research and development.

KEY WORDS: connectivity, constituency building, health system mobilization, measurement, networks, performance, public health collaborative, public health partnerships, social network analysis

A major challenge facing state and local public health agencies is how to partner with other organizations to collaboratively address goals in population health while effectively maximizing resource sharing of the partners involved. Today's public health efforts require multiagency partnerships between both governmental and nongovernmental sectors to achieve this mission.[1–4] These partnerships are created by an understanding that the antecedents of poor health are multifactorial and thus require a multisystemic approach.[5] The need for effective and efficient partnerships spans many domains of public health from chronic disease prevention (eg, diabetes) to public health preparedness (eg, natural disasters).[6] Public health now includes not only healthcare providers, insurers, purchasers, public health departments, community-based organizations, and academic institutions, but also entities that operate outside the traditional sphere of healthcare, such as faith-based and other nonhealth community-based organizations, schools, businesses, and other nonhealth governmental agencies. Today, public health collaboratives (PHCs) are frequently established to leverage resources and maximize the synergies that many agencies bring to the table.

In this article, we use network theory and social network analysis (SNA) methodology[7,8] to operationalize a set of measurable dimensions, to evaluate the strength of PHCs, and the connections (or connectivity) among partner organizations. *Connectivity* is defined as the measured interactions between partners in a collaborative such as the amount and quality of interactions and how these relationships might change over time. We also articulate how these measures fit into the overall process of measuring progress in PHCs and end the article with suggestions for practical uses of such measurement.

In this work, we operationalize PHCs as "networks" of three or more organizations. This approach allows us to consider methodology such as SNA and apply

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network theories used in other fields to identify how organizations are positioned within a network and to evaluate the quality and impact of the exchanges among them. Although using network analysis is relatively new to the field of public health systems research, other areas of public health (eg, disease transmission) have successfully employed these approaches.[6,9,10] Luke and Harris[7] distill networking in public health into three broad categories: (1) transmission networks, (2) social support networks, and (3) organizational networks. Although the study of transmission and social support networks has become more common, the study of organizational networks in the field of public health systems research has been relatively uncharted territory.

Why Current Efforts Are Not Sufficient

Engaging in partnerships with multiple community systems is intrinsic to improving a public health systsem.[11] However, the process by which public health departments have engaged partners in PHCs to address the multiple influences of these systems has varied, with few ways to measure the success of these partnerships. Public health leaders are eager to understand how to analyze the collaboratives in which they are involved so that they may determine whether efforts to focus resources on partnership or collaborative development are working. For example, a key question concerns how to assess the quality and value of convening many partners together to form a PHC. It is important to understand how PHCs are linked to health outcomes, how public health departments (HDs) can maximize resources to develop these collaboratives, how networks are used to build public health constituencies, and how they can remain accountable to their funders and stakeholders. A deeper understanding of how to assess the strength of a collaborative, what motivates and moves constituents to action on public health issues, and benefits from particular relationships in a collaborative is required.[12]

Efforts to evaluate PHCs to date include several existing frameworks and tools,[12–15] each offering a broad-based assessment of partnerships and the benefits by asking questions about activities within the collaborative at an aggregate level (eg, Do partnerships exist in the community to ensure coordination of public health activities?). However, they do not delineate between specific interorganizational interactions and the individual contributions of each organization. These assessment questions fall short of providing the types of data that can inform dimensions of connectivity. Thus, it may be difficult for organizations to identify agencies that are not well connected to the overall system, target those that are viewed as critical to the success of the net-

work, or identify ways to improve overall trust and resource exchange. The goals of our approach to measure connectivity in PHCs are twofold: (1) to help HDs better identify community partners and the resources, expertise, and staff they bring to the collaborative, and (2) to better assess how collaborative relationships change over time.

Methods

First, a systematic *literature review* summarized network theories that include dimensions for measuring PHC connectivity. A brief summary of the literature review is presented below. Next, an *advisory panel* (to maintain promised confidentiality, no public health department or partners are reported) consisting of members representing six health departments (respected for their exemplary track records in creating and sustaining PHCs) reviewed our initial list of relevant network theories and measures to assist in prioritizing their relevance as the core dimensions of connectivity in PHCs. They shared their perspectives of existing collaborative evaluation tools and provided input about how to measure network connectivity activity along a set of core dimensions. Finally, we conducted *key informant interviews* ($N = 20$) to operationalize core dimensions of connectivity and identify specific measurable variables related to working successfully in a collaborative. Criteria for selecting key informants included (1) engagement in an existing PHC and/(2) representation of a non-HD organization. Interview responses were entered into a database and coded by emerging themes by three coders. Reviews of coding consistency ensured inter-rater reliability.[16] We interviewed key informants until responses became redundant as identified by a modified consensus analysis. We used the coded responses to develop a final set of measurable dimensions of connectivity and to operationalize these for future data gathering, particularly when using SNA methodology.

Results

Literature review summary: Examining potential dimensions of connectivity

The literature review resulted in three primary findings: (1) SNA is a useful method to evaluate PHCs, (2) operationalizing PHCs as networks can help identify new ways to evaluate them, and (3) network theory guides the measurement of PHC connectivity. The following is a summary of these findings.

The desire to improve the performance of PHCs is strong.[15,17–27] However, the frequent reconfiguration of partnerships among government and nongovernmental agencies has left many public health managers

struggling to find ways to both develop PHCs and evaluate their success. Many have worked on improving partnerships and their connectivity in public health settings; however, "measurement issues associated with network data have not been thoroughly examined within the context of community-based health promotion."[28(p809)] Applying SNA methodology to evaluate PHCs is one way to measure, monitor, and manage such activity over time. Social network analysis[8] is a methodology used for gathering and analyzing data that explain how people and organizations connect to one another. Recent studies illustrate how network interactions can increase community capacity to deal with public health issues, how different kinds of interactions affect relationship building and network management, how trust and reciprocity can influence various organizational structures (eg, hierarchical, bureaucratic), and why organizations collaborate.[29–31]

Quantitative processes, such as algorithmic computations that inform network analysis, are continuously being developed to measure connectivity. However, these types of computations are limited in their measurement of connectivity.[32,33] Common measures of connectivity include combinations of measurement of the density and intensity of networks (often based on "counts" of communication activities),[31,28] particularly across different stages of collaboration. However, some have asserted that these types of computations are elementary and leave gaping holes in the accuracy of measurement and evaluation of connectivity.[32,33] Therefore, there is a need for a more thorough look into how SNA and related network theories can inform PHC measurement.

The creation and maintenance of PHCs take the commitment of valuable yet scarce resources, including time and energy. The costs and efforts for collaboration are rarely accounted for in budgets.[34] Rather than investing in ad hoc collaborative relationships, members

of PHCs might be well-advised to think about these collaborations strategically and to manage them by focusing on the quality of the connections between participants rather than the notion that "more is better." Network theory can inform this strategic direction by focusing on measures of quality and structural connections leading to a process of "relationship budgeting."

Two network theories are relevant to the evaluation of PHC connectivity: (1) the strength of weak ties and (2) structural holes. The strength of weak ties theory[35] asserts that there is a benefit to increasing the number of "weak ties" in our network or relationships to those that are less close and therefore extend us to people beyond our own close tie networks. Weak ties also often require less resource intensive interactions and are thought to be easier to maintain. This is also known as "bridging social capital." The structural holes theory[36] is the idea that any individual organization in a network can act as a connector between two different networks that are otherwise unconnected (filling a structural hole). This connecting organization acts as a boundary spanner between actors in networks. Therefore, to reduce redundancy, any single organization could aim to partner with a boundary spanning organization to maintain the least number of ties without becoming disconnected from any one subgroup of partners. Together, reducing redundancy within the network while increasing the number of weak ties may allow the group to work more efficiently and effectively. See Figure 1 for an illustrative example of these two strategies.

Identifying core dimensions of connectivity

The literature review identified a number of dimensions of connectivity appropriate for evaluation of PHCs. We narrowed these dimensions of connectivity to seven areas on the basis of advisory group input and developed questions to match each dimension (see

FIGURE 1 ● Network Strategy Comparisons.

Strategy 1: Increase in Strength of weak ties theory: Increase in **weak ties** leading to possible higher levels of diversity. Requires an increase of resources, but less frequent communication.
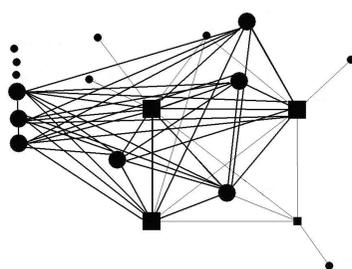
Strategy 2: Structural holes theory: Reduce **redundancy** to work more efficiently and effectively. Add subsequent weak ties to other new subgroups.
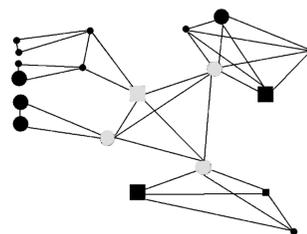
TABLE 1 ● **Core dimensions of connectivity in public health collaboratives**

Dimension
Network membership
Network interaction
Role of health department
Frequency of interaction
Strategic value
Trust
Reciprocity

Table 1). We used these questions as a guide for the key informant interviews.

Interview findings: Operationalizing measures of connectivity

The interview responses were analyzed, leading to the following operationalization of the dimensions of connectivity.

Network membership: diversity in organizational membership is key for PHCS

Interview findings reveal that three types of partners appear to dominate PHCs: community-based organizations (including health/nonhealth and faith-based nonprofits); public health departments; and direct service healthcare providers. A fourth group that seems to be actively engaged is colleges/universities (includes medical schools and schools of public health). Business was rarely mentioned as a partner; however, several respondents said that they would like to see an increase in participation from the business sector.

Network interaction: Creating subgroups within a collaborative is efficient

Although some members took the stance that PHCs should be as inclusive as possible, most felt that the decision for how many organizations to include and at what level should be considered strategically (vs simply recruiting as many partners as possible). The general consensus was that it is difficult to maintain interactions between all members of a collaborative and that if this was achievable, it probably was not sustainable. If we continue to simply count the number of partners as a method for measuring connectivity, we neglect other options to demonstrate successful collaboration based on strategic network interactions.

The role of health departments: HDs often play the role of convener, facilitator, and funder

The dominant view of the key informants is that HDs should play a strong coordinating function in PHCs.

The interviewees felt strongly that HDs should not be expected to stay in the coordinating position forever. Many felt that the role of HDs is not static, and that over time they eventually should be able to assume a role as an equal partner so that the collaborative can function with a more decentralized configuration.

Frequency of interactions—frequent interaction is not always necessary for good connectivity

Although most research to date concludes that frequent interactions among organizations improve collaboration, we thought it important to ask respondents whether they agree, given a scarce amount of available resources for collaboration and network theories that suggest otherwise. Most interviewees responded that the required level of communication among members depends on varying factors. The simple assumption that more frequent interaction makes for better collaboration is not adequate. Therefore, when thinking about measuring connectivity in PHCs, it is important to consider how different types of relationships between members warrant varying levels of interaction. For example, as a relationship becomes more trusted, less communication may be necessary to maintain successful levels of interaction.

Assessing the strategic value of partners

There was strong consensus around three dimensions for assessing the value of partners. (1) *Power and Influence*: Collaborative members bring value to their PHC largely through their power and influence in the community. Such members hold prominent positions in the community, have influence as a change agent, and/or exhibit leadership. Respondents described these types of valuable members as *people with influence who can get action to happen* and those that have credibility and authority within the community. (2) *Active Involvement*: Actively involved members not only participate in scheduled meetings but actually accomplish tasks. The value of active involvement was described as *knowing the job that needs to get done and the best strategy for achieving it*. (3) *Resources*: Valued partners bring resources to the collaborative, such as money, food, and physical space for meetings, staff time, data, and educational materials. Some of the more intangible resources valued include knowledge, information, and feedback.

Overall, the most valuable member is considered by key informants to be one that has a credible, well-connected presence in the community, can devote resources (time and money), and contributes the effort to make things happen.

Assessing trust among partners: Trust is considered the key to good collaboration

Respondents described a trusted partner as (1) being reliable and following through, (2) sharing a common mission with the group, and (3) willing to engage in open, frank discussion, even when disagreement exists (mentioned most often by respondents). Interviewees described this aspect of trust as *an expectation that people will be talking together, versus talking at each other* and a *willingness to listen to another perspective, maybe allowing your opinion to be changed*. In the words of one interviewee, trust is *when you can speak frankly but still come to consensus to move forward. In other words, non-adversarial disagreements when everyone can be heard*.

Reciprocity: Reciprocity is an important dimension of the success and sustainability of a PHC

One-way interactions do not suffice as "collaboration," and the importance of reciprocity (often noted by resource exchange) between organizations should not be underestimated. In fact, one of the general expectations regarding the effects of interaction is that cooperative behavior will ordinarily be made more likely by the other's cooperation. Although one interviewee thought that *some say they are engaged in collaboration, but it is unidirectional—it's really just community outreach*, most people felt that *people do need to participate and be involved* and that without this kind of interaction people will be unmotivated and might leave the group. Most respondents noted that often the act of *being at the table* was in itself *giving something* that should be included as reciprocal to the larger group. In conflict at times are mismatched expectations among members regarding what level of give and take is appropriate.

These findings enabled us to operationalize a set of measures to evaluate connectivity within PHCs. These are listed in Table 2.

● Discussion

The practice of strategically managing the cost of collaboration (eg, "relationship budgeting") is impossible without developing measures of collaboration that account for the specific interactions among participating network members. By adding future "connectivity" tools to the suite of tools available to HDs, we believe a gap in performance measurement for PHCs will begin to close. By systematically measuring connectivity over time, not only can users better understand how resource expenditures are linked to collaboration (thereby providing better accountability to funders) they can also strategize ways to improve collaboration.

**TABLE 2** ● **Operationalized measures of connectivity in public health collaboratives**

Dimension	Measures
Membership	Organizational identification by name, type, and other organizational characteristics (eg, size, mission of organization)
Network interaction	Network patterns and positions identified by subgroups, key players, etc
Role of health department	Convener/facilitator vs equal member
Frequency of interaction	Types and levels of communications among members
Organizational value to the collaborative	Power, involvement, and resources
Trust	Reliability, shared belief in mission, and opportunity for frank discussion
Reciprocity	Evidence of mutual exchange of resources

The measurement of connectivity fits into a larger process of implementing a PHC. The larger process (see Figure 2) includes identifying the community's health needs, identifying barriers and opportunities to meet the identified needs, identifying internal and external resources, mobilizing a PHC of partners from both within and outside the health sector, evaluating the PHC (including *measuring connectivity*), and making strategic decisions to improve the collaborative on the basis of the results of the evaluation.

● Conclusion

The creation and maintenance of multisectoral PHCs take the commitment of scarce resources, such as time and energy. Although support for PHCs is growing, evidence of the impact of such an approach is not keeping pace, resulting in a gap between the practice of collaboration and the subsequent health impact. The lack of connection between the cost of collaboration and evidence of its benefit presents an opportunity for measurement, innovation, and improvement. The measurement approach suggested in this article provides two possible innovative approaches for improving PHCs—strategic decision making around connectivity and linking network processes to health impacts.

First, with results from a network analysis, members of the collaborative can facilitate more strategic connections that may improve the way the network functions. Instead of expecting *everyone* to interact with *everyone else* in the collaborative (eg, more is better), perhaps a select number of connections (as many that can be "budgeted" for) can be fostered, allowing full connectivity among the network, while placing less burden

FIGURE 2 ● Process Framework for Public Health Collaboratives: Inception to Measurable Outcomes.
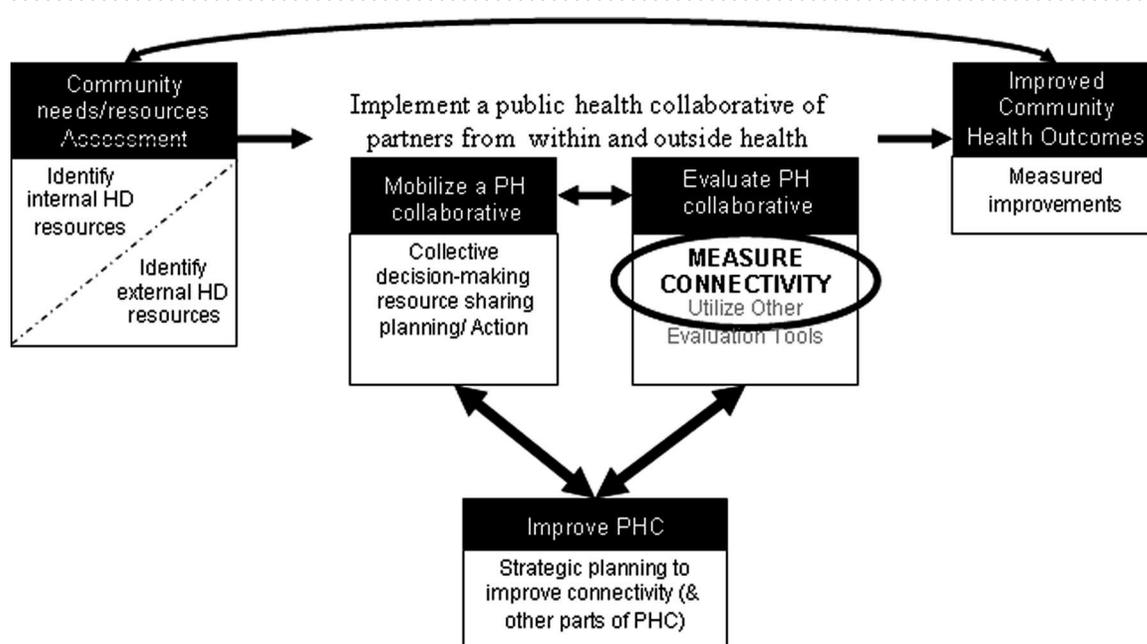
on each individual or organization. Additional strategic decisions might include improving overall trust among members by incorporating trust-building activities into the process, making efforts to increase the strength of connections to those members considered most valuable for a certain goal, or structuring the network so that less people are required to attend meetings while ensuring that adequate boundary-spanning members are well-connected as points of information diffusion. The specific strategy chosen depend on the analysis and the specific needs of that PHC.

Second, such an approach can better enable members to link their collaborative activity with desired health impacts. While measuring PHCs as networks does not provide a measure of "outcome" or "impact," it does provide a measure of the process that organizations are engaged in to achieve those outcomes. In other words, the collaborative process itself is not the end result, but rather the pathway to achieve a positive health impact. This process needs to be correlated with the collaborative's health impacts over time (Figure 2).

The measurement of network activity and the associated collaboratives is one aspect of improving management of constituency and stakeholder PHCs. Certainly this is not the only aspect of measurement that can contribute to health impacts; however, the lack of such a measure is currently a gap in the evaluation approach in place. Further enhancement and the practical implementation of such an approach will provide further support for this approach.

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