

# Multisector Health Policy Networks in 15 Large US Cities

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**Context:** Local health departments (LHDs) have historically not prioritized policy development, although it is one of the 3 core areas they address. One strategy that may influence policy in LHD jurisdictions is the formation of partnerships across sectors to work together on local public health policy. **Design:** We used a network approach to examine LHD local health policy partnerships across 15 large cities from the Big Cities Health Coalition. **Setting/Participants:** We surveyed the health departments and their partners about their working relationships in 5 policy areas: core local funding, tobacco control, obesity and chronic disease, violence and injury prevention, and infant mortality. **Outcome Measures:** Drawing on prior literature linking network structures with performance, we examined network density, transitivity, centralization and centrality, member diversity, and assortativity of ties. **Results:** Networks included an average of 21.8 organizations. Nonprofits and government agencies made up the largest proportions of the networks, with 28.8% and 21.7% of network members, whereas for-profits and foundations made up the smallest proportions in all of the networks, with just 1.2% and 2.4% on average. Mean values of density, transitivity, diversity, assortativity, centralization, and centrality showed similarity across policy areas and most LHDs. The tobacco control and obesity/chronic disease networks were densest and most diverse, whereas the infant mortality policy networks were the most centralized and had the highest assortativity. Core local funding policy networks had lower scores than other policy area networks by most network measures. **Conclusion:** Urban LHDs partner with organizations from diverse sectors to conduct local public health policy work. Network structures are similar across policy areas jurisdictions. Obesity and chronic disease, tobacco control, and

infant mortality networks had structures consistent with higher performing networks, whereas core local funding networks had structures consistent with lower performing networks.

**KEY WORDS:** health policy, local health departments, social network analysis, urban health

Policy development is one of the 3 core functions<sup>1-3</sup> assured by local health departments (LHDs) nationwide.<sup>4</sup> Evidence of effectiveness and cost-effectiveness of public health policy is strong in some areas of public health<sup>5-8</sup> and moderate or emerging in others.<sup>1-3</sup> Despite the potential of policy to improve public health, a survey of 315 LHDs between

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This project was funded by the de Beaumont Foundation and was conducted in partnership with the National Association of County & City Health Officials. The authors thank Vicky Bass and Chrissie Juliano of National Association of County & City Health Officials for their assistance with survey development other logistics and Shannon Carrillo for her excellent work in data collection and data management.

The authors declare no conflicts of interest.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (<http://www.JPHMP.com>).

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DOI: 10.1097/PHH.0000000000000401

1999 and 2001 found weak performance of policy development activities.<sup>9-11</sup> The Institute of Medicine subsequently called for more policy training and engagement for governmental public health.<sup>12</sup> However, LHD participation in policy development activities decreased significantly between 2006 and 2012, as did policy development activities of many of the sectors that partner with health departments.<sup>11,13</sup> While some health departments have had substantial public health policy success in recent years,<sup>14</sup> a 2014 survey of state and large LHDs found workers rated policy development as one of the top 5 skill gaps where skill is important but proficiency is low.<sup>15</sup>

Networks of organizations have advantages over single organizations when it comes to addressing complex problems, providing services, and using resources efficiently.<sup>16,17</sup> In recent years, evidence has been building about the structure and composition of the organizational networks that LHDs are embedded in<sup>18-21</sup> and how these networks influence local public health service delivery. Specifically, collaborating with more types of partners is associated with an increase in the number of services an LHD provides,<sup>22</sup> and local public health systems delivering comprehensive public health programming include more diverse partners (ie, partners from different sectors) than systems providing standard levels or limited programming.<sup>23,24</sup> Having well-connected or dense networks<sup>24-26</sup> and active partnerships<sup>27</sup> with outside organizations is also important to health department success. An LHD's position in its local network may be a key indicator of performance as well; 2 of the 3 most effective structures in a study of LHD networks nationwide were centralized around the LHD.<sup>24</sup>

Despite growing evidence on LHD networks and how these networks relate to performance and service provision, little work has been done to examine LHD local public health policy networks. Evidence that networks are key to successful development, adoption, and implementation of public health policy is growing.<sup>28</sup> For example, one study found that networks of individuals in worksites contributed to the successful development and implementation of worksite smoking policy.<sup>29</sup> Organizations collaborating on community-level alcohol policy influenced policy adoption,<sup>30</sup> whereas a comparison of tobacco policy networks in 2 Missouri cities found a denser policy network where policy adoption had been successful.<sup>31</sup> Finally, community partners working together on physical activity policy increased time for students in physical education classes<sup>32</sup> and increased intersectoral partnerships, improved policy engagement in a network aimed at reducing cancer disparities.<sup>33</sup>

This project examines the local networks of 15 large urban health departments (members of the Big Cities

Health Coalition [BCHC]) for 5 health policy areas. The BCHC is a group of large LHDs from across the country that together serve 51 million people in the United States (<http://www.bigcitieshealth.org/>). The BCHC was formed by the National Association of County & City Health Officials and is supported by the de Beaumont Foundation and the Robert Wood Johnson Foundation with the goals of playing a national leadership role in the public health system and facilitating the exchange of ideas and identification of priority issues among LHDs. In this leadership role, the BCHC has the opportunity to influence how LHDs nationwide view and do policy work. Four of the health policy areas examined are traditional policy categories: tobacco control, obesity and chronic disease, violence and injury prevention, and infant mortality. The fifth area, core local funding, refers to the allocation of funds for LHDs, which is dictated by policy. We sought to characterize the structure and composition of local health policy networks across (1) policy area and (2) LHD jurisdiction. In addition, we sought to identify characteristics of existing public health policy networks that are consistent (or inconsistent) with evidence on effective LHD networks and health policy networks.

## ● Methods

### Data collection

Fifteen BCHC health departments participated. In each participating jurisdiction, we identified the local public health policy network members through a 2-stage process before soliciting participation for a network survey. First, we worked with the senior official responsible for policy (eg, chief of policy) to identify up to 10 local partners for each of the 5 policy areas. In addition, we asked the senior officials to indicate up to 2 "key leaders" in each policy area who could supply names for additional partners. Next, we reached out to key leaders to identify up to 10 additional local policy partners in each area not listed by the LHD policy official. Finally, a full roster of partners was then compiled for each jurisdiction and presented to participants for the questions in the network survey. We sent a Web-based survey to each organization identified as a member of the policy network. Drawing on prior interorganizational network research,<sup>20,31,34</sup> we asked questions about links among the organizations, including the following:

1. *Contact:* On average, how often have you had direct contact (eg, meetings, phone calls, e-mails, faxes, or letters) with each of the following organizations within the last 12 months? [unaware, aware but never contact, yearly, quarterly, monthly, weekly, daily]

2. *Policy*: Indicate the organizations you have worked with in the last 12 months and the policy areas you worked with them on [tobacco control, obesity and chronic disease, violence and injury prevention, infant mortality, core local funding]. (Only organizations where yearly or more contact was indicated were displayed.)

Participants classified their organization as one of the 8 organization types: government agencies, nonprofits, for-profits, schools/universities, hospitals/clinics, coalition organizations, foundations, and voluntary/advocacy organizations.

### Data management

Six networks were constructed for each jurisdiction: one contact network and one network for each policy area. In the contact networks, we considered a link to exist between 2 organizations if contact was monthly or more frequent as indicated by at least one of the organizations. For the policy networks, the pair was considered linked if one or both of the organizations indicated working together on a particular policy. To evaluate whether the ties forming the networks were reliable, we also computed the percentage of the pairs of organizations in each network where the 2 organizations agreed that there was (or was not) a tie between the 2. Finally, for those organizations not responding to the survey, organization type was determined through examination of the organization Web site.

### Analysis

Several network characteristics have been associated with performance of LHD networks<sup>22-24</sup> and policy networks.<sup>31,33,35</sup> Specifically, diverse membership, assortative ties, network density, centralization, and transitivity have all been associated with network performance.<sup>22-24,31,33,35</sup> We focused on these 6 whole network characteristics: density, transitivity, degree centralization, betweenness centralization, diversity of organization types, and assortativity. In addition, given the importance of LHD centrality in LHD networks, we measured degree and betweenness centrality for the LHD in each network. We compared network structures by policy area and LHD jurisdiction.

### Network diversity

Diversity of actors was measured using the index of dispersion. The index of dispersion quantifies the extent to which characteristics are distributed among members of a group. In the BCHC networks, we used the index of dispersion to quantify the extent to which network

members were distributed across the 8 organization types. The index ranges from 0 (all members fall in the same category) to 1 (members are equally distributed across all categories).

### Network assortativity

While diversity is about the network members, assortativity is about the ties among them. A diverse network has many different types of members. Diverse networks can have higher homophily of ties, or connections between the same types of organizations, or higher assortativity where connections are between organizations of different types. The assortativity coefficient measures the extent to which organizations partner with others who are the different on some characteristic, in this case organization type. Assortativity ranges from  $-1$  to  $1$ . Positive values indicate that network members tend to connect with other network members that are the same (ie, homophily), whereas negative values indicate that network members connect with network members who differ on the characteristic of interest (ie, assortativity). So, negative values that are larger in magnitude indicate higher assortativity.

### Network density

Density is an indicator of how connected a network is. Density is computed by dividing the number of connections in a network by the total possible number of connections. In observed networks, larger networks tend to have lower density, suggesting comparisons based on density across networks that vary in size may be problematic. We examined the correlation between density and network size across the 89 networks and found a weak negative nonsignificant correlation ( $r = -0.12$ ;  $P = .28$ ). Given this result, we compared networks using network densities.

### Network transitivity

Transitivity is the existence of triangle structures in networks and is another measure of network cohesion, like density. Specifically, if network member A is connected to B and B is connected to C, then A would be connected to C to form a triangle structure. The metric used to capture transitivity is the probability that A and C are linked, given that A is linked to B and B is linked to C.

### Network centralization

There are several different measures of centralization. We examined degree centralization and betweenness centralization. Degree centralization represents the

extent to which a single network member or a few network members are well connected, whereas other network members have few connections. Centralization has also been associated with network size. We examined the correlation between centralization and network size and found a weak positive nonsignificant correlation between the 2 ( $r = 0.05$ ;  $P = .63$ ). Given this finding, we compared network centralization using degree centralization. Although there was no significant correlation with size, we used the standardized degree centralization metric to account for the theoretical maximum degree being different across networks of different sizes. The standardized degree centralization ranges from 0 (every network member has the same number of connections) to 1 (a single network member is connected to all other network members and no other ties exist).

### LHD centrality

Degree centrality for a network member is the number of connections the member has. We measured degree centrality for the LHD in each network to determine the extent to which LHDs play central roles in their local policy networks. Because the number of possible connections varies by network size, we standardized this measure by dividing the number of ties an LHD had by the number of possible ties for an LHD. For example, an LHD in a network with 10 members that was connected to 6 others would have degree centrality of 6 divided by 9, or 0.67. Betweenness centrality is the extent to which a network member connects other network members who are not directly connected to each other. We measured the extent to which LHDs acted as bridges in the policy networks using the betweenness centrality score.

## ● Results

Participation rates ranged from 63% to 100% of invited organizations. The 89 BCHC public health policy networks ranged in size from 5 to 54 organizations, with an average network size of 21.81 (standard deviation [SD] = 9.72). One city did not identify any policy partners in the area of infant mortality but did have partners in the other policy areas. We found reliability of tie reporting to be universally high, with a mean of 88% (SD = 7.3%) of pairs of organizations agreeing that there was (or was not) a tie between them.

Networks were composed of 8 organization types: coalitions, foundations, for-profits, government agencies, schools/universities, hospitals/clinics, nonprofits, and voluntary/advocacy organizations (see Supplemental Digital Content 1, available at: <http://links.lww.com/JPHMP/A206>),

which shows the composition of 89 BCHC local public health networks by organization type). On average, nonprofits and government agencies made up the largest proportions of the networks, with 28.8% and 21.7% of network members, respectively, coming from these 2 categories on average across all networks. For-profits and foundations made up the smallest proportions in all of the networks, with just 1.2% and 2.4% on average, respectively. Network diversity was high in nearly all of the networks, with an average of 0.85 (SD = 0.09) and a range of 0.37 to 0.97 (Table). Assortativity was also consistently high; organizations in the networks tended to connect with organizations of different types (eg, nonprofits with coalitions) rather than connecting with the same types (eg, nonprofits with nonprofits). Mean assortativity was between  $-0.05$  and  $-0.13$  in the policy areas; across all networks, assortativity ranged from 0.20 to  $-0.60$ .

There was similar consistency across policy areas for mean density 0.28 (SD = 0.14) and transitivity 0.42 (SD = 0.15); however, a few networks with very low and very high scores resulted in wide ranges for these 2 measures (5%-98% for density; 0%-98% for transitivity). Mean degree and betweenness centralization were also similar across the 5 policy areas, with a few networks with very high or low centralization resulting in a wide range of 0.02 to 0.87 for degree and 0 to 0.93 for betweenness centralization.

### Network structures by policy area

#### Core local funding

Core local funding policy networks included more coalitions and fewer hospitals/clinics and schools/universities than other policy areas (see Supplemental Digital Content 1, available at: <http://links.lww.com/JPHMP/A206>) which shows the composition of 89 BCHC local public health networks by organization type). Core local funding networks also had the lowest density, transitivity, diversity, degree centralization, and average LHD degree centrality of the policy areas (Table). Size, assortativity, betweenness centralization, and average LHD betweenness were moderate compared with other networks. None of the metrics for the core local funding networks were high compared with the networks in the 4 other policy areas. Supplemental Digital Content 2 (available at <http://links.lww.com/JPHMP/A207>) shows a network from each policy area that is near the mean on all metrics shown in the Table for the policy area indicated; note the noncentral location of the LHD and the limited diversity in partner types for the core local funding, with 13 of the 21 organizations in the network being from the nonprofit (orange) and school/university

**TABLE ● Characteristics of 89 BCHC Policy Networks**

|  | Overall Mean (SD) | Contact Mean (SD) | Core Local Funding Mean (SD) | Infant Mortality Mean (SD) | Obesity and Chronic Disease Mean (SD) | Tobacco Control Mean (SD) | Violence and Injury Prevention Mean (SD) |
|--|-------------------|-------------------|------------------------------|----------------------------|---------------------------------------|---------------------------|--|
| Size                                       | 21.81 (9.72)      | 29.93 (9.26)      | 19.60 (8.88)                 | 16.71 (7.68)               | 24.33 (7.71)                          | 18.53 (7.54)              | 21.40 (9.18)                             |
| Cohesiveness                               |                   |                   |                              |                            |                                       |                           |  |
| Density                                    | 0.28 (0.14)       | 0.34 (0.15)       | 0.21 (0.08)                  | 0.26 (0.07)                | 0.32 (0.07)                           | 0.32 (0.12)               | 0.23 (0.08)                              |
| Transitivity                               | 0.42 (0.18)       | 0.52 (0.17)       | 0.26 (0.13)                  | 0.32 (0.20)                | 0.52 (0.11)                           | 0.47 (0.17)               | 0.40 (0.13)                              |
| Heterogeneity                              |                   |                   |                              |                            |                                       |                           |  |
| Diversity                                  | 0.85 (0.09)       | 0.87 (0.05)       | 0.83 (0.06)                  | 0.84 (0.10)                | 0.87 (0.05)                           | 0.87 (0.05)               | 0.84 (0.07)                              |
| Assortativity                              | −0.07 (0.11)      | −0.01 (0.07)      | −0.06 (0.10)                 | −0.13 (0.11)               | −0.07 (0.04)                          | −0.09 (0.10)              | −0.05 (0.06)                             |
| Centralization                             |                   |                   |                              |                            |                                       |                           |  |
| Degree                                     | 0.48 (0.15)       | 0.44 (0.12)       | 0.41 (0.13)                  | 0.57 (0.17)                | 0.51 (0.10)                           | 0.52 (0.13)               | 0.45 (0.18)                              |
| Betweenness                                | 0.33 (0.18)       | 0.20 (0.14)       | 0.39 (0.17)                  | 0.47 (0.20)                | 0.28 (0.13)                           | 0.38 (0.20)               | 0.28 (0.15)                              |
| LHD centrality                             |                   |                   |                              |                            |                                       |                           |  |
| Degree                                     | 0.54 (0.23)       | 0.69 (0.18)       | 0.39 (0.19)                  | 0.48 (0.25)                | 0.61 (0.18)                           | 0.57 (0.23)               | 0.48 (0.25)                              |
| Betweenness                                | 0.007 (0.004)     | 0.005 (0.002)     | 0.008 (0.005)                | 0.010 (0.006)              | 0.006 (0.003)                         | 0.008 (0.004)             | 0.007 (0.004)                            |
| Most central to network—degree, n (%)      | 30 (33)           | 9 (67)            | 3 (20)                       | 4 (27)                     | 5 (33)                                | 4 (27)                    | 5 (33)                                   |
| Most central to network—betweenness, n (%) | 26 (29)           | 9 (60)            | 5 (33)                       | 4 (27)                     | 2 (13)                                | 3 (20)                    | 3 (20)                                   |

Abbreviations: BCHC, Big Cities Health Coalition; LHD, local health department; SD, standard deviation.

(green) sectors and no partners from foundations (pink) or for-profits (yellow).

### **Infant mortality**

Infant mortality policy networks included fewer coalitions than the other policy areas but had more government agencies and hospitals/clinics. The infant mortality networks were the smallest on average but had the highest average degree centralization, betweenness centralization, assortativity, and LHD betweenness of the 5 policy areas. The averages for all other metrics tended to be on the low side but not the lowest of the policy areas. Note the small size and centralized structure of the infant mortality network shown in Supplemental Digital Content 2 (available at: <http://links.lww.com/JPHMP/A207>).

### **Obesity and chronic disease**

Obesity and chronic disease policy networks included the fewest government agencies on average but had the most network members, highest transitivity, and highest average LHD centrality of all the policy areas. The obesity and chronic disease networks also shared the distinction of highest density and diversity with the tobacco control networks, had moderate assortativity and degree centralization, and low betweenness centralization compared with the other networks.

### **Tobacco control**

Tobacco control policy networks had the fewest non-profit and the most voluntary/advocacy partners on average and were tied with obesity and chronic disease networks for densest and most diverse. While transitivity and assortativity were also high compared with most other networks, the rest of the metrics were moderate including size, centralization, and LHD centrality.

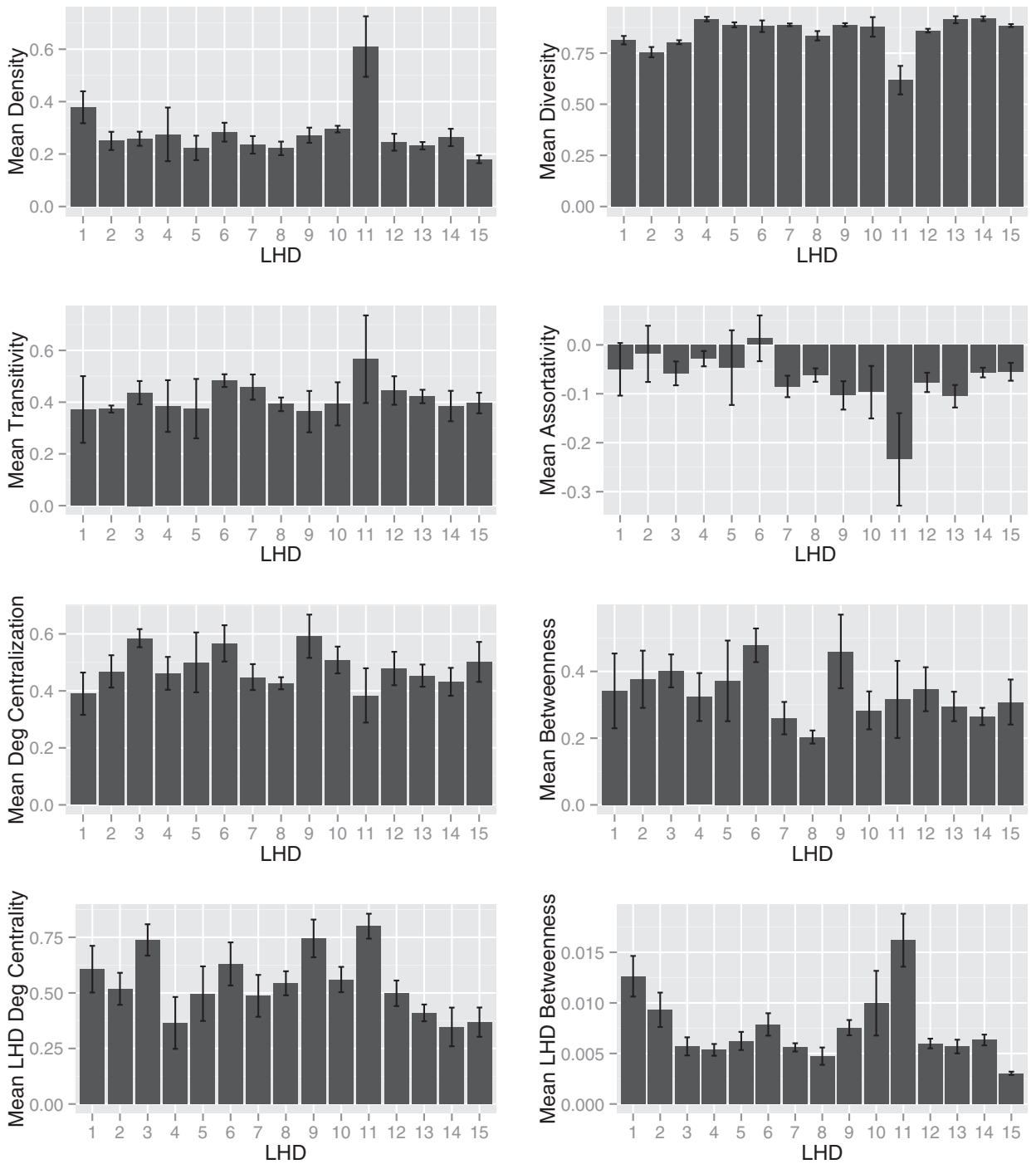
### **Violence and injury prevention**

Violence and injury prevention policy networks had the fewest for-profit and the most nonprofit partners on average. These networks were also tied with the obesity and chronic disease policy networks for lowest betweenness centralization but were otherwise moderate by all metrics compared with the other networks.

### **Network structures by city**

To determine whether network structures varied by LHD jurisdiction, we examined the means of network measures across the 6 networks for each LHD. We found mostly minor differences across health departments (Figure). The one major exception was health department 11, which was notably different from the other health departments by several measures

**FIGURE ● Characteristics of BCHC Networks by LHD Jurisdiction.**



Abbreviations: BCHC, Big Cities Health Coalition; LHD, local health department.

including much higher density, transitivity, assortativity, and LHD betweenness but much lower diversity. This health department had the smallest networks overall and included a large proportion of partners that were coalitions, as shown in Supplemental Digital Content 3 (available at: <http://links.lww.com/JPHMP/A208>).

● **Discussion**

We identified and examined contact and working relationships across 15 LHDs in large urban areas and their local partners working on public health policy. The obesity and chronic disease and tobacco control networks were the most diverse, densest, had the highest

transitivity, and had the most central LHDs by degree centrality of the 5 policy area networks. Infant mortality policy networks had the greatest assortativity, the highest degree, and betweenness centralization overall and had LHDs with the highest average betweenness centrality. Of the 5 policy areas, core local funding had the lowest average density, transitivity, diversity, degree centralization, and degree centrality for the LHD. An examination of the network by LHD jurisdiction identified a single jurisdiction with notably different network structure, whereas most jurisdictions were somewhat similar to one another.

Several network characteristics have been associated with better performance of LHD networks<sup>22-24</sup> and policy networks.<sup>31,33,35</sup> Specifically, networks with more diverse members, assortative ties, higher network density, more centralization, and greater transitivity tend to perform better.<sup>22-24,31,33,35</sup> Likewise, 2 of the 3 highest performing network structures for LHD networks have a central LHD.<sup>24</sup> However, very high density and centralization have also been identified as possible weaknesses in organizational networks, resulting in decreased efficiency in high-density networks and very central nodes being overwhelmed in highly centralized LHD networks.<sup>21,36,37</sup> In the context of these studies, the obesity and chronic disease, tobacco control, and infant mortality policy networks seem to have the most potential to be high performing, whereas the core local funding policy networks have the most potential to be low performing.

The relative structure of networks in certain policy areas is consistent with public health priorities nationwide. For example, reducing tobacco use has been a public health priority for decades and tobacco policy is considered a public health success in the United States.<sup>38,39</sup> Compared with other policy areas, the National Association of County & City Health Officials 2010 and 2013 surveys of LHDs nationwide found that policy activity was highest in the area of tobacco, alcohol, and other drugs.<sup>40,41</sup> Likewise, reducing obesity and associated chronic diseases has become a major focus of public health funding, research, and practice.<sup>42</sup> Prior research has suggested that fewer resources can result in less cohesive networks.<sup>43</sup> Obesity and chronic disease policy was the third most active policy area for LHDs in 2013, with 48% of LHDs nationwide conducting activities in this area following 65% for tobacco, alcohol, and other drugs and 58% for emergency preparedness and response.<sup>40</sup> Just 20% of LHDs reported conducting violence or injury prevention policy activities in 2013; core local funding and infant mortality were not among the policy areas in the survey.<sup>40</sup> The network structures reflecting public health priorities,

and the consistency in network structures across LHDs and policy areas, suggest validity of the measured constructs.

Additional research is needed to further quantify the success of the policy networks in effecting policy change. The creation of statutes, ordinances, regulations, and other policy language is varied, complex, and difficult to measure. However, further data collection from network members and research into recently passed ordinances and related rules may shed light into this area. One additional area of future research is to better understand how policy networks and programmatic networks are related in local jurisdictions. For example, do cities with strong programmatic networks delivering services to women and children have more robust infant mortality policy networks than cities where such service delivery networks do not exist, or are weak? Other work in this area might focus on specific roles LHDs play in coalitions and networks since, as public agencies, LHDs cannot engage in some advocacy or lobbying work. Finally, while the overall patterns are useful for researchers and practitioners to better understand who is involved and partnering on public health policy at a local level, the individual networks may also tell each LHD a useful story about their partnerships. More granular analyses of these 89 networks may provide targeted information for LHDs and for researchers and practitioners working in each of the LHDs and policy areas.

## Limitations

This study may be limited in its generalizability. In contrast to health departments in large urban areas, the organizational networks of local health departments in rural areas tend to be less diverse<sup>22</sup> and rural local health departments conduct fewer policy activities.<sup>11,40,44</sup> In addition, existing evidence regarding the influence of network structure on LHD or public health system performance is still developing and, to date, some findings are contradictory. Finally, we may also be limited by the network delineation process. The networks were identified by a small number of participants, and it is possible that these individuals may have been unaware of some important local partnerships. Despite these limitations, this study was the first that we know of to map multiple LHD policy networks, providing a first look at the composition and structures of these networks in big cities across the United States. Future studies may seek additional information in 2 areas: (1) the composition and structures of networks in small/rural LHD jurisdictions; and (2) how LHD network composition and structures influence LHD performance.

## ● Conclusion

Policy development is one of the most effective tools public health has to modify the urban environment and protect and promote population health. Policy successes are lauded as some of the “greatest public health achievements” of the past century.<sup>45</sup> Tobacco control is perhaps the best example of the importance of policy networks in policy change. The development of robust, interconnecting, programmatic, and policy networks nationally, statewide, and locally coincided with uptake of clean indoor air policy, tobacco taxation, and restrictions on tobacco advertising and sale.<sup>34,46-48</sup> Our study shows that some of the largest urban health departments in the country have diverse and cohesive policy networks; however, network characteristics vary somewhat by city and policy area, and opportunities exist to strengthen these networks to support local policy efforts.

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