TITLE: A mixed-methods evaluation using effectiveness perception surveys, social network analysis, and county-level health statistics: a pilot study of eight rural Indiana community health coalitions

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HIGHLIGHTS

- We developed and piloted a community health coalition (CHC) evaluation framework
- CHCs with greater interconnectedness reported better leadership and functioning
- Centralized CHCs reported more problems for member participation
- Personal relationships were more favorable than formal connections for CHC outcomes
- CHCs responding to crises had greater perceived effectiveness than chronic disease CHCs

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ABSTRACT

Community health coalitions (CHCs) are a promising approach for addressing disparities in rural health statistics. However, their effectiveness has been variable, and evaluation methods have been insufficient and inconsistent. Thus, we propose a mixed-methods evaluation framework and discuss pilot study findings. CHCs in our pilot study partnered with Purdue Extension. Extension links communities and land grant universities, providing programming and support for community-engaged research. We conducted social network analysis and effectiveness perception surveys in CHCs in 8 rural Indiana counties during summer 2017 and accessed county-level health statistics from 2015-16. We compared calculated variables (i.e., effectiveness survey k-means clusters, network measures, health status/outcomes) using Pearson's correlations. CHC members' positive perceptions of their leadership and functioning correlated with interconnectedness in their partnership networks, while more centralized partnership networks correlated with CHC members reporting problems in their coalitions. CHCs with highly rated leadership and functioning developed in counties with poor infant/maternal health and opioid outcomes. Likewise, CHCs reporting fewer problems for participation developed in counties with poor infant/maternal health, poor opioid outcomes, and more people without healthcare coverage. This pilot study provides a framework for iterative CHC evaluation. As the evidence grows, we will make recommendations for best practices that optimize CHC partnerships to improve local health in rural areas.

Keywords: Behavioral Risk Factor Surveillance System; Community Health; Health Promotion; Multilevel Assessment; Program Evaluation; Rural Health

Acronyms: BRFSS: Behavioral Risk Factor Surveillance System; CHC(s): community health coalition(s); CoHealth: county-level health statistics; CSAS: Coalition Self-Assessment Survey; LF: one of the variables resulting from a cluster analysis on the CSAS, describing CHC members' positive perceptions of their leadership and internal functioning; NEP: Nutrition Education Program; PROB: one of the variables resulting from a cluster analysis on the CSAS, describing CHC members' problems for participation; PSE: policy, system, and environment; SNA: social network analysis; SNAP-Ed: Supplemental Nutrition Assistance Program-Education.

MANUSCRIPT

Introduction

Health behaviors and outcomes are worse in rural than in urban/suburban communities. "Geographic isolation, lower socio-economic status, higher rates of health risk behaviors, and limited job opportunities" are hypothesized to cause poor rural health (Rural Health Information Hub, 2014). The resulting health disparities are potentially mutable. For example, disparities in cancer (Zahnd et al., 2017) and chronic disease (Matthews et al., 2017) have been modified through prevention and lifestyle interventions. Engagement, networking, and collaboration strategies may overcome access, resource, and infrastructural limitations and improve the efficacy of public health initiatives (Pennel et al., 2008). Community health coalitions (CHCs) are one strategy for mobilizing local organizations and individuals to improve rural health.

Indiana is predominantly rural and has some of the worst health outcomes in the United States. Indiana ranks 38th out of 50 states for overall health, 40th for health behaviors (e.g., physical inactivity, smoking, and drug deaths), is in the bottom ten states for health outcomes (e.g., obesity, cancer deaths, and infant mortality) and clinical care (e.g., limited access to/availability of dentists, mental health providers, and preventable hospitalizations), and ranks 49th for public health funding (https://www.americashealthrankings.org/explore/annual/measure/Overall/state/IN).

Rural Indiana communities have been developing CHCs in partnership with local public and private organizations, academic institutions, public health associations, and via cross-sector collaborations. One resource for Indiana CHCs is the robust statewide network of Purdue

University Extension Educators and the Nutrition Education Program (NEP, funded by the United States Department of Agriculture; https://extension.purdue.edu/Pages/default.aspx). NEP implements the Supplemental Nutrition Assistance Program-Education (SNAP-Ed) and Expanded Food and Nutrition Education Program (http://www.purdue.edu/hhs/extension/programs/detail.aspx?programId=5&category=food) in Indiana.

Despite efforts of CHCs to supplement public health efforts (Butterfoss, 2007, Roussos and Fawcett, 2000, US Department of Health and Human Services and Office of the Assistant Secretary for Planning and Evaluation, 2012), a major barrier to improving community health is sustaining effective partnerships and activities (Roussos and Fawcett, 2000). Rigorous research examining pathways to successfully developing and sustaining effective CHC efforts is lacking. Zakocs and Edwards (2006) reported that outcome measures rarely encompass internal coalition functioning and external community changes (Zakocs and Edwards, 2006). Roussos and Fawcett (2000) cite "weak outcomes, contradictory results, or null effects" due to lack of strong methodological designs as major limitations to generalizing findings from studies evaluating collaborative partnerships across community settings (Roussos and Fawcett, 2000). Provan and Milward (2001) suggest that partnership network outcomes need to be evaluated at the network-, organization/participant-, and community-level through a systematic, comprehensive, cross-sectional/longitudinal evaluation framework (Provan and Milward, 2001). Accordingly, the W.K. Kellogg Foundation (https://www.bttop.org/sites/default/files/public/W.K.%20Kellogg%20LogicModel.pdf) and the Centers for Disease Control and Prevention (https://www.cdc.gov/prc/pdf/prc-logic-model.pdf) link inputs, activities, outputs, outcomes, and impact as a guiding framework for evaluating and

accomplishing program goals. Unfortunately, coalition evaluation across the logic model from inputs through health impacts seldom occurs. However, there have been multiple examples of mixed-methods, multi-level community engagement evaluation efforts, such as The Need to Know Project (Manitoba, Canada) (Bowen and Martens, 2006), the Tampa Bay Community Cancer Networks (Florida, USA) (Simmons et al., 2015), Healthy Kids, Healthy Communities (49 communities in the United States and Puerto Rico) (Brownson et al., 2015), and Partnering Healthy@Work (Tasmania, Australia) (Jose et al., 2017). Researchers involved in these partnerships engaged community members in a transparent and iterative mixed-methods evaluation, working with community partners to design, develop, implement, and disseminated findings from assessments relevant to community-identified needs. In all cases, both qualitative and quantitative evaluations were conducted, focusing primarily on partnership outcomes, program development, and capacity building. We (the authors) have applied similar methods to our evaluation framework, but also incorporate longitudinal tracking of county-level health statistics related to the health topics of interest to CHCs in our pilot study.

Through partnership with Extension Educators, author "3" provided content-expertise as the Purdue University Extension Specialist in Nutrition Science to identify and recruit county-level CHC members to participate in a mixed-methods, multi-level evaluation pilot study. The evaluation period spans the summer of 2017. We define a CHC as a partnership/collaboration among local (i.e., county- or community-level) organizations addressing disparities in community health statistics. Thus, the term CHC(s) in this report excludes regional, state, and national coalitions, and coalitions with partners from only one discipline such as healthcare or faith-based organizations.

Purpose and Objectives

The Purdue Extension System provides a "link between Land Grant Research and Indiana citizens" (https://extension.purdue.edu/Pages/article.aspx?intItemID=1922#.UxX07fRdXfM). Community outreach and programming are organized and coordinated primarily by Extension Educators in each of Indiana's 92 counties. Many, though not all, Extension Educators engage communities by developing or partnering with local CHCs. According to the Extension Educators partnering with the CHCs described in this manuscript, current health priorities include obesity prevention, wellness, mental health, systems of care, child well-being/maternal health, tobacco control, and substance abuse reduction. As per reporting objectives for the Cooperative Extension System, Purdue Extension CHC effectiveness has been tracked using traditional survey methods; however, county-level differences in health priorities, resources, and human/social capital limits the interpretation and generalizability of findings. Specifically, Extension Educators submit annual Impact Reports, but respondents are de-identified so the results are available only in aggregate. Additionally, multi-level assessments of CHC efforts by Purdue Extension have not been conducted to date. Thus, we undertook an in-depth exploration of CHC partnership dynamics in relationship to salient county-level health statistics.

The objectives of our evaluation were: 1. To determine the optimal CHC internal network structure that correlates to increased CHC perceived effectiveness, 2. To relate CHC internal network structure and perceived effectiveness to the delivery of programs and policy, system, and environment (PSE) change interventions, 3. To relate CHC internal network structure, perceived effectiveness, and programming/PSE change interventions to health status and changes

in county-wide health over time. We plan to collect data from CHCs across Indiana for cross-sectional and longitudinal comparisons.

Community-level differences in health statistics, availability of resources, and organizational representation on CHCs can confound efforts to develop and replicate successful interventions across locations. Thus, CHCs may adapt programming and implement site-specific procedures and activities. However, it is possible to identify general processes to achieving successful health-related outcomes across a diverse group of locales (Miller et al., 1995). Therefore, in this research effort, we aim to identify the underlying developmental approaches and intermediate markers of CHC success. This manuscript describes the development and application of a mixed-methods, multi-level statewide CHC effectiveness evaluation system and presents findings from a pilot study.

Study Population

Purdue Extension CHCs develop across Indiana to address disparities in local health statistics. Through CHCs, the community takes ownership of their public health needs and works together to improve community health. Though technical assistance from Purdue is provided, CHCs retain autonomy and ultimately decide on programming and allocation of available resources.

Inclusion Criteria

We recruited Extension Educators from 8 rural counties in 4 geographic regions of the state: West/Central, Northeast, Southwest, and Southeast. These geographic designations have been utilized by the Indiana Clinical and Translational Science Institute Community Health Partnerships to target community engagement and coalition building strategies. CHCs were chosen within region based on their experience to that point; specifically, they were in between novice/inexperienced CHCs and those that had been in operation for some time and already achieved significant success. Novice/inexperienced CHCs were excluded because they would have been unlikely to answer the survey questions due to their limited time working together, and CHCs having achieved significant success would likely have already achieved network saturation and would have a highly skewed positive perception of their effectiveness. Thus, in order to maintain variability in the survey responses and avoid highly skewed data, we opted to recruit CHCs operating at the middle level. One CHC was recruited from one of the regions, 2 CHCs were recruited from two regions, and 3 CHCs were recruited from the final region.

Counties were not matched on demographic characteristics. Thus, uncontrolled factors affecting CHC work existed, including: external alternative public health initiatives/community interventions, CHC capacity and working relationships, CHC size and comembership, county-level infrastructure, and receptivity of CHC and community members to technological innovations. Extension Educators provided a contact list of their CHC members. Thus, we did not account for CHCs members' external ties to other health promotion partners in the community or the potential skills, resources, and organizational support that each CHC member could bring to the partnership; rather, we entrusted Extension Educators to determine who the most important actors were.

CHC members were contacted by email or phone to schedule a face-to-face or phone interview for a social network analysis survey or to receive a link to the survey via email; a second survey regarding internal functioning and perceived effectiveness was sent as a link in an email as a follow-up. Informed consent was provided during the interviews or on the first page of the survey link, and signatures were obtained from all study participants. No individual was excluded by age, gender/sex, race/ethnicity, occupation/education, health status, or any other demographic factor.

Development of the Evaluation Framework

Ongoing evaluation allows for iterative recommendations for best practice to improve CHC impact. According to the W.K. Kellogg Foundation, "the program logic model is defined as a picture of how [an] organization does its work—the theory and assumptions underlying the program. A program logic model links outcomes (both short- and long-term) with program activities/processes and the theoretical assumptions/principles of the program" (https://www.bttop.org/sites/default/files/public/W.K.%20Kellogg%20LogicModel.pdf). The Center for Disease Control and Prevention's Logic Model for the Prevention Research Centers Program places inputs, activities, outputs, and outcomes under evaluation and community engagement for refining and improving program activities to elicit long-term impact (https://www.cdc.gov/prc/pdf/prc-logic-model.pdf). Likewise, the evaluation model described in this manuscript assumes that iterative data collection and feedback will guide CHCs toward improving and sustaining community health (Figure 1). In order to operationalize and assess CHC effectiveness along our logic model, we conducted surveys regarding partnership network

connections and perceived effectiveness, then compared our primary data with county-level health statistics. The geometry of partnership network connections was determined using social network analysis (SNA), a statistical technique to objectively analyze, quantify, and visually represent the orientation of actors in a network and network structural characteristics (Figure 2). SNA allows us to explore how underlying CHC relationships impact members' perceived effectiveness and provides insight into partnership sustainability and potential for successful programming. This programming, in turn, should focus on salient disparities in health statistics and result in improvements to county-level health. Developing and maintaining connections are instrumental in Extension Educators' ability to lead or mentor CHCs. Although organization, communication, and activities are at the discretion of CHCs, our mixed-methods, multi-level evaluation framework will contribute to tailored feedback and recommendations for best practices.

Evaluation Methods

In this pilot study, we assessed partnership networks and perceived effectiveness and characterized community health, then compared interrelations between assessment components. 1. Partnership networks were evaluated using SNA, with survey questions adapted from Provan, et al. (2005) (Provan et al., 2005) and Cullerton, et al. (2015) (Cullerton et al., 2016) (survey instrument available upon request). 2. Coalition perceived effectiveness was evaluated using a modified version of the Coalition Self-Assessment Survey (CSAS) developed by Kenney and Sofaer (2000) (Kenney et al., 2000) (survey instrument available upon request). 3. Short-/long-term community health was characterized via publicly-available health statistics (i.e., Indiana

Stats Explorer (https://gis.in.gov/apps/isdh/meta/stats_layers.htm), Behavioral Risk Factor Surveillance System (BRFSS) (https://www.cdc.gov/brfss/annual_data/annual_data.htm), and Feeding America Food Insecurity (http://map.feedingamerica.org/county/2015/overall/indiana)). Indiana Stats Explorer and Feeding America Food Insecurity data are publicly-available at the county-level; BRFSS data are publicly-available at the state level and were made available to us at the county-level via contract with the Indiana State Department of Health. The county-level health statistics (CoHealth) included in our evaluation framework (Table 4, footnote) were selected based on their ability to characterize the status of the CHC priorities identified by the Extension Educators. As future reports of county-level health statistics are released, we plan to track and compare changes in health status to CHC operational metrics (Figure 3).

These three assessment components capture different levels of CHC effectiveness, as defined by Provan and Milward (2001) (Provan and Milward, 2001). SNA measures partnership connections at the network-level. CSAS measures members' perceived effectiveness at the organization/participant-level. CoHealth include measures of community-level public health. We did not measure program activities or PSE change interventions due to the large variability across CHCs and the lack of accepted standardized methods for PSE assessments. Additional qualitative assessment is being pursued to fill this gap.

SNA and CSAS were administered during summer 2017 (primary data), while CoHealth were acquired during summer 2017 and reflect 2015-16 (secondary data). We accessed county-level BRFSS data through contract with the Indiana State Department of Health; all other CoHealth are from publicly-available datasets.

This study was approved by the Purdue Institutional Review Board, protocol number 1506016147. For anonymity, the CHCs are identified as CHC1, CHC2, CHC3, etc. according to size (CHC1 is the smallest, CHC8 is the largest).

Statistical Analysis

Our data analysis was conducted in four parts: 1. Calculating network variables from the SNA survey, 2. Conducting a k-means cluster analysis on CSAS responses, 3. Computing descriptive statistics on CoHealth, and 4. Comparing calculated variables from SNA, CSAS, and CoHealth analyses using Pearson's Correlation. The unit of analysis for cross-county comparisons is the CHC; N=8.

First, we calculated network variables from the SNA survey (Figure 2, Table 1). Due to the dependent nature of social ties between respondents, a low response rate to SNA surveys has historically presented major analytic challenges. Stork and Richards (1992) suggest that in the case of actor non-response, missing data can be imputed by reconstruction if the graph is non-directional, ties are logically symmetrical, and respondents and non-respondents are not systematically different (Stork and Richards, 1992). During reconstruction, within the dyad A (responding) and B (non-responding), A's response about B is assumed to be what B would respond about A. However, the issue of missing data in a dyad of two non-responders persists. Burt (1987) found that missing data corresponded to weak ties (Burt, 1987). However, Huisman (2009) suggests that weak ties (0 in binary networks) should be imputed in sparse networks (density < 0.5), whereas strong ties (1 in binary networks) should be imputed in dense networks

(density > 0.5) (Huisman, 2009). Thus, we reconstructed missing data for dyads with a single non-respondent and imputed values for doubly non-responsive dyads according to the density of the reconstructed network. To examine the robustness of our primary approach, we conducted sensitivity analyses by 1. Replacing no missing data and 2. Replacing all missing data with 0. The overall results and interpretation of findings did not differ significantly (data available upon request).

Second, we performed k-means clustering on CSAS responses (Figure 4). According to the cluster plots, distance matrix, and optimal number of clusters as determined by the average silhouette width, we selected two clusters: 1. containing ten items, describing CHC members' problems for participating in their coalition- **PROB**, 2. containing fifteen items, describing CHC members' positive perceptions of their leadership and internal functioning- **LF**. Although the gap statistic plot indicates that five is the optimal number of clusters, this is inconsistent with the distance matrix and there is overlap between clusters 1 and 4 in the k=5 cluster plot. The optimal number of clusters is difficult to discern based on the total within sum of squares, however, all cluster plots except k=2 have some degree of overlap between clusters. Thus, we settled on two clusters. For subsequent analyses we calculated the cluster means for each county (Table 2).

Third, CoHealth were selected according to CHC-identified priorities. Items from the BRFSS span two years (2015-16) due to the Center for Disease Control and Prevention's data security requirement to only report on sample sizes > 50. We were not able to compare items related to children's health, because sample sizes on these items were below 50 for most counties, even when data from five years (2012-16) were combined. Data from the Indiana Stats

Explorer are from 2016, and the county food insecurity rates from Feeding America are from 2015. In all cases, the latest available data was used.

Finally, we compared calculated variables from SNA, CSAS, and CoHealth using Pearson's Correlations (Table 3, Table 4). Despite our small sample size (N=8 CHCs), only 13/87 calculated variables had a non-Gaussian distribution, thus we performed Pearson's rather than Spearman Correlations. Descriptive statistics for BRFSS data were computed using SAS software, Version 9.3 (SAS Institute Inc., Cary, NC, USA). All other analyses were performed in R 3.5.0 (R Core Team, 2018).

Author "1" collaborated with Purdue University's Extension Specialist and the Purdue Nutrition Education Program's Research and Evaluation Specialist to develop the survey instruments. Authors "2" and "1" collected the primary data; "1" conducted all analyses.

Results

Response rates

CHC size (n) and survey completion rates for SNA and CSAS for each of the 8 counties are shown in Tables 1 and 2. The CSAS response rate for CHC4 was 11/10. We believe this was because a CHC member forwarded the anonymous survey link to a colleague not on our distribution list. CHC size ranged from 7-42 members, SNA response rate ranged from 50%-91%, and CSAS response rate ranged from 32%-89%. The CSAS has been used extensively across coalition evaluation work (e.g., (Hasnain-Wynia et al., 2003, Andrews et al., 2014, Peters

et al., 2016, Peterson et al., 2006)), and the response rates we obtained are consistent with work by Hasnain-Wynia, et al. (2003) (28%-83% across partnerships) (Hasnain-Wynia et al., 2003). The SNA response rate was also satisfactory, as Costenbader and Valente (2003) demonstrated that several network centrality measures remain stable at a sampling rate of at least 50% (Costenbader and Valente, 2003).

Characteristics of study participants

Organizational representation across CHC membership included law enforcement, public schools, community gardens, philanthropies, youth development and 4-H, utility companies, gyms, hospitals, the local public health department, parks and recreation, libraries, legal offices, and others. The primary role of CHC members responding to the CSAS (n=75) was coalition officer or chair (11/75, 14.7%), coalition staff (1/75, 1.3%), chair/co-chair of a committee or task force (2/75, 2.7%), member of executive or steering committee (5/75, 6.7%), committee member (13/75, 17.3%), member having no other responsibility (37/75, 49.3%), and other role (6/75, 8.0%). Member responses to involvement in the CHC over the past year were very (20/75, 26.7%), moderately (16/75, 21.3%%), a little (33/75, 44.0%), and not at all (6/75, 8.0%%). 55/75 (73.3%) CHC members participated in some coalition building activity, 20/75 (26.7%) respondents did not. Of those reporting activities, 26 participated in only 1 activity, 8 participated in 2, 10 participated in 3, 6 participated in 4, and 5 participated in 5. Across activities, 15 people acquired funding or other resources for the coalition, 21 attempted to get outside support for coalition positions on key issues, 20 recruited new members, 20 served as a spokesperson, and 45 worked on implementing activities or events sponsored by the coalition.

Main findings of evaluations:

SNA to CSAS correlations (Table 3, Figure 5)

LF correlated positively to the following calculated SNA variables: cooperation mean degree, coordination mean degree, collaboration mean degree, collaboration closeness centralization, formal ties mean degree, formal ties degree centralization, and frequent mass communication closeness centralization. Thus, overall it appears that partnership networks with higher mean degree (i.e., having more connections on average across the network) and central communication were related to CHC members' perceptions of effective leadership and functioning.

LF correlated negatively to the following calculated SNA variables: cooperation betweenness centralization, coordination betweenness centralization, formal ties density, and good-high trust betweenness centralization. Thus, overall it appears that CHC members rated their leadership and functioning as lower in partnership and trust networks with higher centralization.

PROB correlated positively with the following calculated SNA variables: cooperation betweenness centralization, coordination betweenness centralization, formal ties density, formal ties transitivity, good-high trust transitivity, and frequent direct contact betweenness centralization. Thus, overall it appears that high centralization in the partnership networks was related to CHC members reporting problems for participation in the coalition, as was transitivity in the formal ties and trust networks.

PROB correlated negatively to the following calculated SNA variables: formal ties degree centralization and formal ties eigenvector centralization. Thus, centralization in the

formal ties network was related to CHC members reporting fewer problems for participation in the coalition.

The strongest positive correlation between calculated SNA variables and LF was to coordination mean degree (r=0.675); the strongest negative correlation between calculated SNA variables and LF was to coordination betweenness centralization (r=-0.591); the strongest positive correlation between calculated SNA variables and PROB was to formal ties density (r=0.668); the strongest negative correlation between calculated SNA variables and PROB was to formal ties eigenvector centralization (r=-0.500).

In summary, partnership mean degree was positively correlated to LF, while partnership centralization was negatively correlated to LF; partnership centralization, as well as formal ties density, and trust and formal ties transitivity, were positively correlated to PROB, while formal ties centralization was negatively correlated to PROB. Thus, partnership mean degree may promote CHC effectiveness, while partnership centralization may be a barrier to CHC effectiveness; however, having a formal partner in the center of the network may promote CHC stability, although cliques of trust and formal ties (i.e., high transitivity), may disrupt network cohesiveness.

CSAS to CoHealth correlations (Table 4)

LF correlated positively to the following CoHealth: opioid deaths, opioid treatments, mothers smoking during pregnancy, preterm births, and people reporting poor or fair health. LF correlated negatively to the following CoHealth: people drinking sugar sweetened soda every day and people not having a personal doctor or healthcare provider. PROB correlated positively

to the following CoHealth: people drinking sugar sweetened soda every day, people drinking sugar sweetened fruit drinks every day, and people having on average more chronic diseases at once. PROB correlated negatively to the following CoHealth: opioid deaths, opioid treatments, mothers smoking during pregnancy, people (of all ages and those 18-64) not having healthcare coverage.

In summary, CHCs with highly rated leadership and functioning developed in counties with especially poor health statistics for infant/maternal health and opioid outcomes. Likewise, CHCs reporting few problems for participation developed in counties with poor health statistics for infant/maternal health, poor opioid outcomes, and more people without healthcare coverage. On the other hand, CHCs with low-rated leadership and functioning and those reporting more problems for participation developed in counties with poor dietary behaviors related to intake of sugar sweetened beverages, more chronic disease, and less personalized care.

SNA to CoHealth correlations (Table 4)

The interpretation of correlations between SNA and CoHealth was derived through pattern identification. Groupings of related correlates were visibly detectable when the direction of the correlation (positive or negative) was highlighted in green or red, respectively.

CHCs with high density across connection types (cooperation, coordination, collaboration, formal ties, good-high trust, frequent direct contact, frequent mass communication) had worse CoHealth statistics for substance use prevention, more people not exercising in the past month, fewer mothers receiving prenatal care beginning in the first trimester, but a lower county food insecurity rate, fewer infants born at a very low birth weight,

and fewer people reporting 5 or more days of poor overall or physical health in the last 30 days. Compared to network density, the direction (positive or negative) of correlations to CoHealth was nearly opposite for network mean degree. Notably, networks with higher mean degree were in counties with poorer health behaviors related to tobacco control, poorer obesity prevention indicators, poorer infant/maternal health statistics, and more people with 5 or more days of poor mental or overall health in the past month. The pattern of correlations between centralization measures is less clear; however, it appears that hospitalizations due to opioid overdose are consistently low when degree, betweenness, and closeness centralization are high. Additionally, degree, betweenness, closeness, and eigenvector centralization negatively correlated to people not exercising in the last 30 days. Degree and betweenness centralization in the communication networks were related to better systems of care. However, high degree centralization also coincided with more people reporting 5 or more days of poor overall health in the last month and poor infant/maternal health. Interestingly, network transitivity took on a similar pattern of correlations to CoHealth as network density.

Discussion

In this manuscript we attempted to develop and implement a CHC evaluation framework across the logic model, spanning internal coalition functioning, program delivery, and health outcomes. However, due to the limitations of data sources and evaluation metrics, we were not able to assess CHC programming or long-term health changes, but rather calculated health statistics for the year prior to CHC evaluation and accessed program reports to qualitatively interpret our findings. Thus, our findings may suggest that the CHCs participating in this study

perceived they were more effective when responding to crises than when addressing chronic disease and prevention. On the same note, CHCs responding to crises likely formed cross-coalition partnerships whereby coalition members equally carried the weight and responsibility for delivering programs and activities. Meanwhile, when CHCs lacked a sense of urgency (because they were addressing chronic disease rather than crises), a centralized leader may have acted as the unifying agent to the coalition, while less engaged members rested on the periphery. Furthermore, an interconnected CHC responding to a crisis may have been less stable than a centralized CHC addressing long-term health topics.

There are many opportunities for working collaboratively across disciplines to maximize the potential for both rapid response and institutionalized CHCs. A CHC with a centralized/formal lead agency that serves as a connecting body and support center to external working groups could potentially have the greatest impact on local health. The centralized/formal lead agency could ensure CHC sustainability by coordinating efforts to minimize duplicate public health initiatives and wasted resources by multiple groups addressing similar issues. The CHCs described in this pilot study were partnered with Purdue Extension Educators. As a result, the infrastructure for programmatic sustainability was present; however, the extent to which Extension Educators were able to engage and mobilize their CHC members varied. One recommendation would be to enhance leader training and establish learning communities among CHCs across the state. As such, community stakeholders would have access to a statewide network of CHCs in which members could share success stories and be involved in an iterative discussion about what works. This would lay the groundwork for building the qualitative evidence around recommendations for best practices.

Meanwhile, the collection of objective quantitative effectiveness evaluations on a continuing basis could inform recommendations for best practices through iterative feedback. In this pilot study we attempted to refine and improve CHC evaluations by comparing traditional survey methods with social network analysis and county-level health statistics. These three layers of assessment provide a deeper understanding about the structural mechanisms influencing CHC functioning, as well as underlying environmental factors that affect where CHCs develop and on which health priorities they focus.

Other authors have statistically compared network parameters to effectiveness measures, e.g., Valente, et al. (2008) (Valente et al., 2008) and Valente, et al. (2007) (Valente et al., 2007). A qualitative comparison between network measures and outcomes has been explored by a number of researchers as well, including: Provan and Milward (1995) (Provan and Milward, 1995), Provan and Sebastian (1998) (Provan and Sebastian, 1998), Lucidarme, et al. (2016) (Lucidarme et al., 2016), Varda and Retrum (2012) (Varda and Retrum, 2012), and Lemieux-Charles, et al. (2005) (Lemieux-Charles et al., 2005). However, there is a dearth of quantitative analyses between calculated SNA variables and outcomes. Due to the small sample size of this pilot study (N=8) and inclusion of county-level health statistics in our evaluation model, we utilized Pearson's Correlations. As we collect additional cross-sectional and longitudinal data, we will build a predictive model using linear regression analysis. We will also incorporate the number and quality of coalition-initiated PSE change interventions.

Some of our findings were unexpected. For example, Bavelas found that individuals had lower morale when they were not well connected in a communication network (Bavelas, 1950); likewise, we found that CHC members reported more problems for participation when the direct

contact network had high betweenness centralization. However, we also found that CHC members rated their leadership and functioning higher when the mass communication network had high closeness centralization. Additionally, in agreement with Granovetter (1973) (Granovetter, 1973), we found that there was strength in weak ties: coordination mean degree more strongly correlated to highly rated leadership and functioning than did collaboration mean degree. However, we also found that cooperation mean degree was not as strongly correlated to leadership and functioning as was coordination mean degree.

Additionally, the literature on rural CHCs highlights the tenuous relationship between communities and researchers; whereby coalitions serve as a bridge for building trust and bidirectional communication and feedback for involvement in community engaged research (Baquet et al., 2013). In this pilot study, Extension Educators served as the linking agents between communities and the university. Rural community-university partnerships have also demonstrated great success in addressing methamphetamine use (Calvert et al., 2014); which is parallel to the opioid abuse reduction priority of some of the CHCs in this pilot study. Meanwhile, a community-based participatory research study implemented PSE change to overcome racial/social injustices in a rural community (Devia et al., 2017). PSE change interventions is also one strategy that CHCs in Indiana implement to reduce health disparities.

Finally, our work shares several similarities and differences with existing mixed-methods partnership evaluation efforts. Like others (Bowen and Martens, 2006) (Simmons et al., 2015) (Brownson et al., 2015) (Jose et al., 2017), we are engaging our community partners in an iterative feedback evaluation loop, disseminating our findings to them, making recommendations for best practices, and monitoring programmatic change. Similar to The Need to Know Project

(Manitoba, Canada) (Bowen and Martens, 2006), the Tampa Bay Community Cancer Networks (Florida, USA) (Simmons et al., 2015), Healthy Kids, Healthy Communities (49 communities in the United States and Puerto Rico) (Brownson et al., 2015), and Partnering Healthy@Work (Tasmania, Australia) (Jose et al., 2017), we have administered partnership surveys and, like the Tampa Bay Community Cancer Networks (Florida, USA) (Simmons et al., 2015) we also performed SNA, all of which we plan to track over time. While we rely on anecdotal evidence from Extension Educators to interpret our findings, the researchers of the above community-engaged partnerships conducted systematic, semi-structured key-informant interviews, which strengthened the rigor of their report. Although we are pursuing qualitative assessments of program outcomes and PSE change, the aforementioned researchers had great success analyzing program documents, making direct observations, and conducting environmental scans to fill this gap. In contrast, although community health improvement is a major end goal of many community partnerships, our evaluation framework is one of the few to 1. Identify publicly available health statistics that align with CHC priorities and 2. Track health statistics over time against CHC activities and partnership networks.

Limitations

Though this pilot study provides a framework for future evaluations of CHC effectiveness across the logic model, several limitations exist. First, we were not able to assess CHC activities, including but not limited to PSE change interventions. Thus, it is difficult to elucidate the potential impact of internal CHC functioning on the delivery of programs, as well as the relationship between programming and community-wide health improvements. Second,

there is a lag time in the release of public county health data reports, so evaluating long-term changes in health will need to be conducted as relevant data become available. Additionally, county-level estimates were calculated from small sample sizes that very likely do not accurately capture whole population health status, notwithstanding the health status of CHC target populations, who may differ depending on CHC focus, programming, and reach. Thus, it may be pertinent for researchers to collect additional health-related data from CHC target populations and program participants. Third, we obtained a lower total response number on the CSAS compared to the SNA. The small sample size arguably weakened the cluster analysis. Moreover, we observed that smaller CHCs had a higher response rate on the SNA and CSAS as compared to larger CHCs. This may suggest that it was easier for Extension Educators partnering with smaller CHCs to communicate directly to all members, thus improving participation rates; or alternatively that smaller CHCs may have had a shared sense of solidarity and interest in assisting the Extension Educator in this research study. However, additional qualitative assessment is warranted to understand members' motivation. Fourth, CHC members are more likely than the general public to be attuned to health disparities and usually represent organizations with special health interests. The CHCs surveyed in this pilot study are connected to the Extension System, while other CHCs may be initiated and led by other universities, the private sector, or various public health organizations. Furthermore, we only surveyed CHC members identified by the Extension Educator, although there are likely numerous important relationships being developed between individual CHC members and other individuals in the community. Additionally, this pilot study was conducted in only 8 rural Indiana counties; thus, findings may not be generalizable to all rural counties, to CHCs in urban environments, or to states with different health priorities and higher public health spending. Importantly, we selected

only CHCs operating at the mid-level, so our findings may not be translatable to newly formed CHCs or mature CHCs that are highly operational. In order to assess low- and high-level CHCs, different assessment tools would likely be needed. Finally, we searched for patterns across a large number of correlations, which is problematic in itself, but was exasperated by our small sample size.

Lessons Learned

Our work provides a framework for mixed-methods/multi-level assessment that can be conducted cross-sectionally and longitudinally, spanning the public health logic model from inputs through impacts. Notably, depending on the nature of the coalition and/or partnership, different tools can be used. For example, SNA survey questions can be tailored to suit the connection type (e.g., focusing on client referrals or funding received), and other coalition assessment tools (e.g., the Coalition Effectiveness Inventory (Butterfoss, 1994, revised 1998)) might be more appropriate than the CSAS. Additionally, while standardized methods for PSE-focused evaluations are lacking, program- and location-specific observations can be made using guiding frameworks for evaluating health-related interventions, such as RE-AIM (Reach, Effectiveness- Adoptions, Implementation, Maintenance; http://www.re-aim.org/). Finally, disparities in local health statistics should be reflected in coalition priorities, and assessment methods should be adapted to those priorities using a variety of different data sources.

Practically, there may be difficulties in implementing our proposed mixed-methods, multi-level evaluation framework on a large scale. For one, although we attempted to keep our

survey questionnaires to a minimum, we suspect that CHC members potentially experienced survey fatigue if they were also contributing to the assessment and reporting that the Purdue Cooperative Extension System routinely performs or if they were involved in other projects. Thus, researchers collecting data annually may witness further survey fatigue, resulting in inadequate response rates. Second, we built and administered the survey instruments using REDCap, which has excellent capabilities for automating survey reminders; however, we found that some CHC members were more receptive when contacted directly either by email or phone. Thus, the time and labor requirements for reaching out to individual CHC members may not be manageable for larger studies. Finally, we data mined hundreds of correlations using rudimentary visual inspection methods. It took several iterations and rearrangements of our data tables before relationships between evaluation components became apparent. A more methodical and systematic approach will be needed to facilitate interpretation of results, especially for researchers analyzing additional variables.

Conclusions

In conclusion, CHCs are mobilizing to address local health disparities. CHCs may be initiated by community members, pursued via partnerships with universities, or organized under federally mandated programs. As such, the development, growth, and sustainability of CHCs provide numerous opportunities for evaluation and assessment, in order to build the evidence around recommendations for best practices. However, coalition outcomes are variable, and most reports are anecdotal or subjective rather than analytic. Furthermore, assessment tends to be narrow in scope, with much of the published literature and available tools focusing on self-

reported capacity and capacity building activities. Though poor sustainability of partnerships and activities is a major barrier to coalition success, some coalitions do successfully improve local health. Thus, ongoing evaluation is necessary to understand the underlying mechanisms and functional characteristics of effective coalitions. Researchers must engage communities to explore, apply, and refine comprehensive, iterative, mixed-methods, multi-level evaluation that will serve as the basis for feedback and programmatic improvements.

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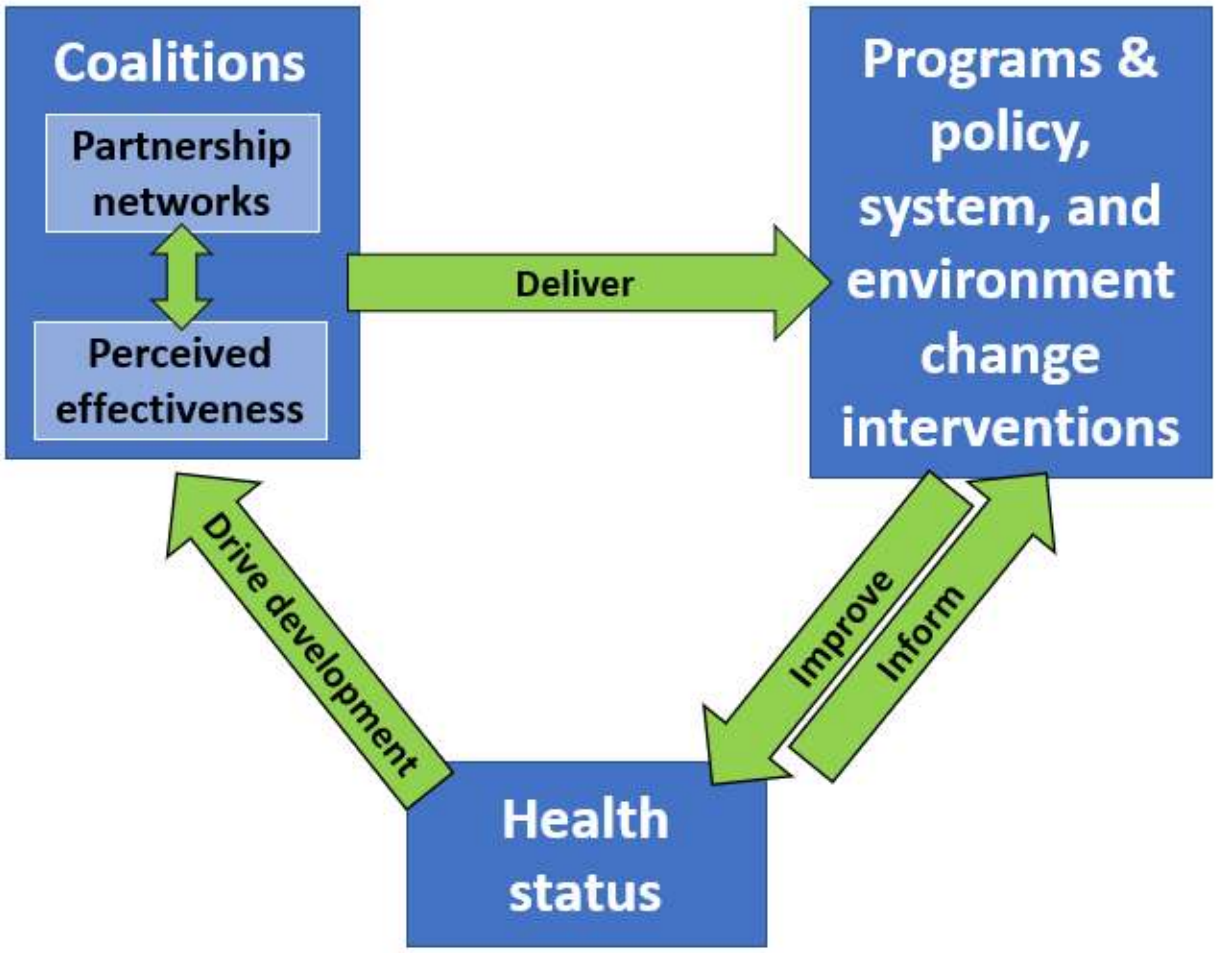


Figure 1: Coalition Evaluation Study Components. Partnership networks were evaluated using social network analysis, with survey questions adapted from Provan, et al. (2005) and Cullerton, et al. (2015). Coalition perceived effectiveness was evaluated using a modified version of the Coalition Self-Assessment Survey (Kenney and Sofaer, 2000). Programs & policy, system, & environment change initiatives were not included in this set of analyses but will be in subsequent evaluations. Short-/long-term community health status was evaluated via publicly available county-level health statistics (i.e., Indiana Stats Explorer, Behavioral Risk Factor

Surveillance System, Feeding America Food Insecurity in Indiana) and county identifiers obtained through contract with the Indiana State Department of Health.

Social network analysis definitions and survey questions

Social network analysis definitions

- **Actors:** individuals in a network; represented by a dot
- **Tie:** the connection between actors in a network; represented by a line connecting two dots
- **Path:** the number of actors an actor must go through to reach another actor; measured by the number of ties between actors
- **Degree:** the number of ties an actor holds
- **Mean degree:*** i.e., Freemen degree; the average number of (incoming and outgoing) ties actors hold across the network
- **Density:*** the proportion of observed ties to possible ties
- **Degree centralization:*** i.e., Freeman degree centralization; the extent to which some actor holds more (incoming and outgoing) ties than other actors across a network
- **Betweenness centralization:*** the extent to which some actor serves as a bridge along the path between other actors across the network; a measure of control over the flow of some tie characteristic
- **Closeness centralization:*** the extent to which some actor has a relatively high proximity to other actors in the network; at the actor level, the average length of the shortest path
- **Eigenvector centralization:*** the extent to which some actor holds ties to other actors holding many ties; a measure of influence or power
- **Transitivity:*** the potential for two actors to be connected through a common connection; i.e., if $actor_x$ sends a tie to $actor_y$ and $actor_y$ sends a tie to $actor_z$ then $actor_x$ is likely to form a tie with $actor_z$

Social network survey questions

- **Describe the level of connection you have with each of the members in your coalition [check one]**
  - No connection (We do not work with each other)
  - Cooperative (We know each other and share information)
  - Coordinative (We work side-by-side on a few projects)
  - Collaborative (We rely on each other to achieve common goals)
- **Describe the type of connection you have with each of the members in your coalition [check one for each of your connections in the coalition]**
  - Formal: Connection is between the overall organization (not tied to certain people)
  - Informal: Connection would be lost if certain people left their organization
- **Rate the connection quality between you and each of the members in your coalition [check one for each of your connections in the coalition]**- Can you trust this organization to keep its word, do a good job, respond to your organization and client needs, and accomplish coalition related activities?
  - Little trust
  - Some trust
  - Good trust
  - High trust
- **How often are you in direct contact with each member of your coalition?** (i.e., an email, phone call, etc. addressed specifically to you or a working group that you actively engage in) **[check one]**
  - Never
  - More frequently than once per month
  - Less frequently than once per month
- **How often do you exchange mass communication with each member of your coalition?** (e.g., a listserv email, group Facebook message, newsletter, texting group) **[check one]**
  - Never
  - More frequently than once per month
  - Less frequently than once per month

Figure 2: Social Network Analysis Definitions and Survey Questions.

*Calculated network variables; used in the primary cross-methods analyses.

From the social network survey to each of the 8 coalitions, we analyzed 7 connection types: cooperation, coordination, collaboration (i.e., three levels of partnership), formal ties, good-high trust (i.e., two measures of connection quality), direct contact, mass communication (i.e., communication networks); for each of these 7 connection types we calculated the following network variables: mean degree, density, degree centralization, betweenness centralization, closeness centralization, eigenvector centralization, and transitivity; for a total of 49 measures for each of the 8 coalitions.

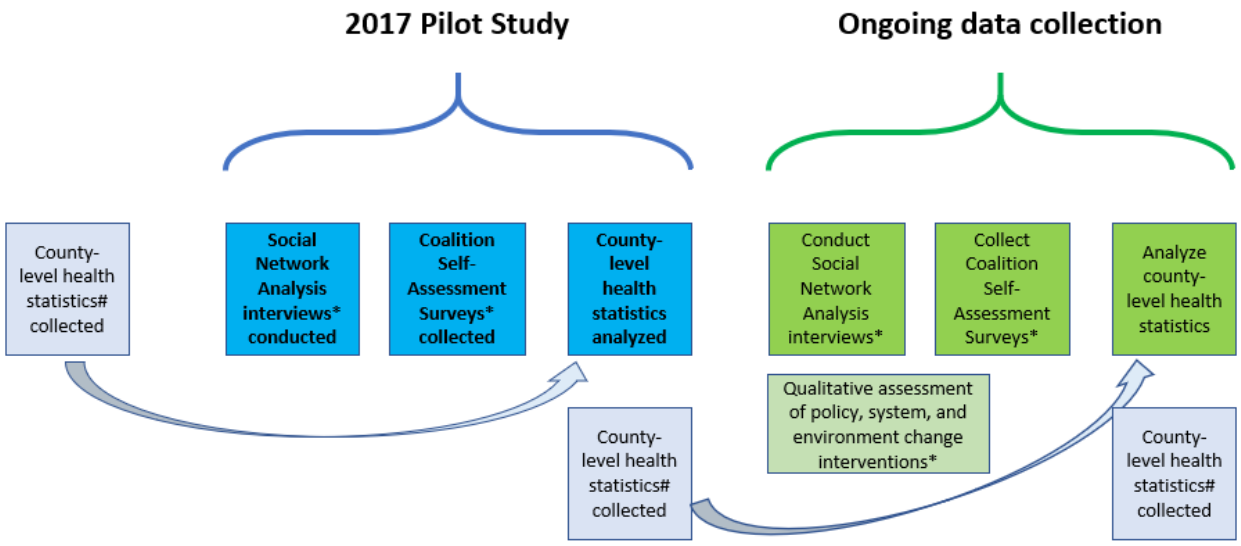
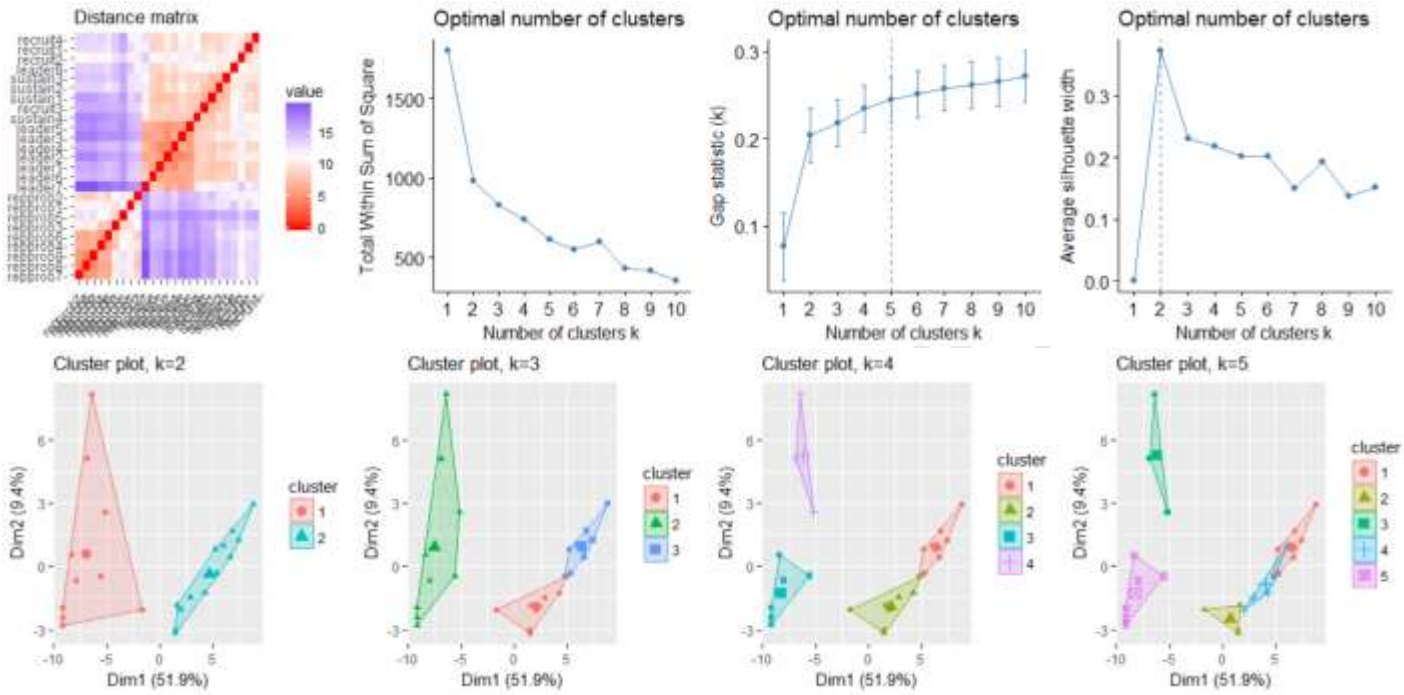


Figure 3: Timeline of data collection. *primary data; #secondary data. During the 2017 pilot study, social network interviews were conducted, the Coalition Self-Assessment Surveys were collected, and county-level health statistics were analyzed for each of the 8 coalitions. In ongoing iterations of this evaluation framework, we will continue collecting and analyzing the

aforementioned data sources, as well as purse qualitative assessment of policy, system, and environment change interventions.



Cluster vectors	
1	repprob1, repprob2, repprob3, repprob4, repprob5, repprob6, repprob7, repprob8, repprob9, recruit2
2	recruit1, recruit3, recruit4, sustain1, sustain2, sustain3, sustain4, leader1, leader2, leader3, leader4, leader5, leader6, leader7, leader8
Within cluster sum of squares by cluster	
1	433.3347
2	547.6419
Between sum of squares/total sum of squares	45.5%

Figure 4: k-means clustering of Coalition Self-Assessment Survey responses: n=75 respondents. k, number of clusters; repprob1, Coalition activities do not reach my primary constituency; repprob2, Being involved in policy advocacy is a problem; repprob3, My skills and time are not well used; repprob4, My opinion is not valued; repprob5, The coalition is not taking

any meaningful action; repprob6, I am often the only voice representing my point of view; repprob7, The financial burden of traveling to coalition meetings is too high; repprob8, The financial burden of participation (barring travel) is too high, repprob9, The coalition is competing with my organization; recruit1, The coalition is actively recruiting new members; recruit2, New members receive adequate orientation to be effective members of the coalition; recruit3, The current method for communication between coalition staff/leadership and its membership is effective; recruit4, Resources are being identified to support the systemic, programmatic changes implemented through the work of the coalition; sustain1, The coalition is making progress in implementing activities that have potential to improve health in the county; sustain2, The coalition is improving health outcomes for people in the county served by this coalition; sustain3, My skills and abilities are effectively used by the coalition; sustain4, I feel respected and recognized for my efforts; leader1, Leadership has a clear vision for the coalition; leader2, Leadership has the necessary knowledge and skills; leader3, Leadership is respected; leader4, Leadership gets things done; leader5, Leadership intentionally seeks others' views; leader6, Leadership utilizes the skills and talents of many, not just a few; leader7, Leadership is ethical; leader8, Leadership is skillful at resolving conflict.

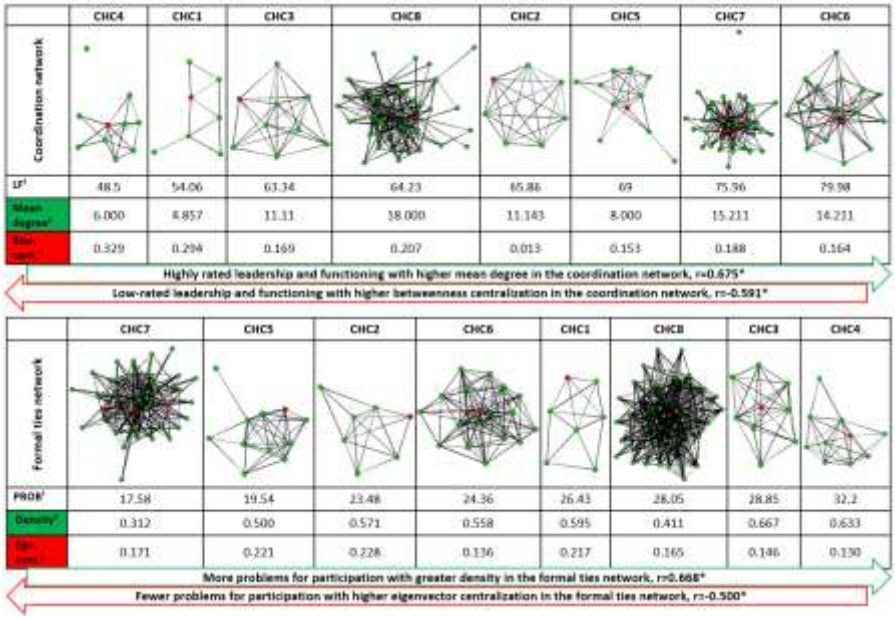


Figure 5: Strongest correlations between Coalition Self-Assessment Survey cluster means and calculated social network analysis variables across eight community health coalitions.

CHC, community health coalition; Btw., betweenness; Egv., eigenvector; cent., centralization; Footnotes: [1]out of 100; [2]out of 2(n-1), where n is the number of members in each CHC; [3]out of 1.0.

Table 1: Social Network Analysis Results by CHC.

Connection type	Calculated network variable	County (n=network size, response rate)							
		CHC1 (n=7, 5/7)	**CHC2** (n=7, 6/7)	**CHC3** (n=9, 8/9)	**CHC4** (n=10, 8/10)	**CHC5** (n=11, 10/11)	**CHC6** (n=19, 17/19)	**CHC7** (n=38, 19/38)	**CHC8** (n=42, 23/42)
Cooperation	**Density**	0.929	1.000	0.958	0.667	0.800	0.667	0.679	0.641
	Mean degree	11.143	12.000	15.333	12.000	16.000	24.000	50.263	52.571
	Degree centralization	0.100	0	0.054	0.417	0.244	0.373	0.339	0.364
	Betweenness centralization	0.007	0	0.002	0.180	0.029	0.051	0.026	0.024
	Closeness centralization	0.083	0	0.047	0.277	0.177	0.259	0.240	0.260
	Eigenvector centralization	0.028	0	0.015	0.115	0.063	0.093	0.059	0.067
	Transitivity	0.917	1.000	0.955	0.763	0.824	0.732	0.781	0.741
Coordination	**Density**	0.405	0.929	0.694	0.333	0.400	0.395	0.206	0.220
	Mean degree	4.857	11.143	11.111	6.000	8.000	14.211	15.211	18.000
	Degree centralization	0.367	0.100	0.393	0.556	0.367	0.490	0.439	0.410
	Betweenness centralization	0.294	0.013	0.169	0.329	0.153	0.164	0.188	0.207
	Closeness centralization	0.700	0.076	0.275	0	0.605	0.419	0	0.259
	Eigenvector centralization	0.195	0.029	0.124	0.349	0.178	0.239	0.275	0.187
	Transitivity	0.485	0.934	0.753	0.449	0.580	0.526	0.385	0.422
Collaboration	**Density**	0.262	0.857	0.472	0.200	0.218	0.178	0.139	0.135
	Mean degree	3.143	10.286	7.556	3.600	4.364	6.421	10.263	11.095
	Degree centralization	0.333	0.200	0.438	0.444	0.283	0.266	0.410	0.306
	Betweenness centralization	0.131	0.046	0.221	0.401	0.091	0.292	0.257	0.123
	Closeness centralization	0	0.148	0.477	0	0	0.528	0	0
	Eigenvector centralization	0.339	0.061	0.244	0.356	0.284	0.219	0.361	0.245
	Transitivity	0.643	0.876	0.636	0.297	0.644	0.328	0.297	0.359
Formal ties	**Density**	0.595	0.571	0.667	0.633	0.500	0.558	0.312	0.411
	Mean degree	7.143	6.857	10.667	11.400	10.000	20.105	23.105	33.714
	Degree centralization	0.333	0.250	0.348	0.319	0.306	0.462	0.598	0.426
	Betweenness centralization	0.094	0.044	0.185	0.109	0.293	0.103	0.142	0.060

	Closeness centralization	0.449	0.535	0.293	0.311	0.425	0.329	0.346	0.375
	Eigenvector centralization	0.217	0.228	0.146	0.130	0.221	0.136	0.171	0.165
	Transitivity	0.629	0.781	0.724	0.754	0.658	0.671	0.472	0.506
Good-high trust	**Density**	0.643	0.976	0.903	0.622	0.655	0.617	0.356	0.589
	Mean degree	7.714	11.714	14.444	11.200	13.091	22.211	26.368	48.286
	Degree centralization	0.383	0.033	0.125	0.403	0.178	0.397	0.608	0.406
	Betweenness centralization	0.231	0.002	0.011	0.179	0.040	0.072	0.127	0.036
	Closeness centralization	0.322	0.028	0.101	0.308	0.295	0.287	0.388	0.288
	Eigenvector centralization	0.169	0.009	0.036	0.146	0.147	0.111	0.180	0.080
	Transitivity	0.674	0.975	0.904	0.735	0.689	0.704	0.484	0.717
Frequent direct contact	**Density**	0.238	1.000	0.278	0.389	0.436	0.222	0.145	0.194
	Mean degree	2.857	12.000	4.444	7.000	8.727	8.000	10.737	15.905
	Degree centralization	0.250	0	0.366	0.625	0.322	0.776	0.389	0.693
	Betweenness centralization	0.133	0	0.171	0.569	0.175	0.677	0.193	0.408
	Closeness centralization	0	0	0	0.477	0.444	0.498	0	0.441
	Eigenvector centralization	0.387	0	0.395	0.291	0.271	0.387	0.234	0.253
	Transitivity	0.400	1	0.659	0.500	0.590	0.317	0.364	0.427
Frequent mass communication	**Density**	0.333	0.714	0.403	0.344	0.300	0.193	0.227	0.323
	Mean degree	4.000	8.571	6.444	6.200	6.000	6.947	16.789	26.524
	Degree centralization	0.583	0.400	0.446	0.681	0.367	0.809	0.631	0.531
	Betweenness centralization	0.328	0.160	0.381	0.467	0.334	0.743	0.174	0.126
	Closeness centralization	0	0.256	0.269	0.523	0.680	0.529	0.503	0.447
	Eigenvector centralization	0.322	0.123	0.206	0.312	0.361	0.451	0.255	0.164
	Transitivity	0.519	0.736	0.494	0.386	0.612	0.246	0.335	0.494

CHCx, community health coalition in each of the 8 counties, ordered by the size of coalition membership; i.e., CHC1 had the fewest members, CHC8 had the most. Possible values for density, degree centralization, betweenness centralization, closeness centralization, eigenvector centralization, and transitivity are between 0.0 and 1.0. Possible values for mean degree are 2(n-1), where n is the number of members in each coalition.

Table 2: Mean and Median Responses to Coalition Self-Assessment Survey Questions and Cluster Scores by CHC.

CSAS question (response on a scale of 0-100). $\bar{x}$, $\tilde{x}$	County (n=network size, response rate)							
	CHC1 (n=7, 4/7)	**CHC2** (n=7, 6/7)	**CHC3** (n=9, 8/9)	**CHC4** (n=10, 11*/10)	**CHC5** (n=11, 8/11)	**CHC6** (n=19, 11/19)	**CHC7** (n=38, 12/38)	**CHC8** (n=42, 15/42)
Coalition activities do not reach my primary constituency.	21.3, 24.5	40.3, 50	40.8, 45	39.6, 47	18.9, 5	24.4, 20	25.3, 16	23.1, 20
Being involved in policy advocacy is a problem.	27.3, 7	52.3, 51	45.4, 50	35.1, 38	20.9, 20	31.8, 26.5	8.5, 3.5	33.2, 37.5
My skills and time are not well used.	26.8, 29	6, 6	35.4, 33	35.4, 29	25.8, 0	39.3, 25	25.3, 11	24.6, 13.5
My opinion is not valued.	21, 16	6.5, 6.5	11.3, 5	18.6, 15	6.4, 0	9.8, 10	23.8, 4	25.5, 9
The coalition is not taking any meaningful action.	49.3, 41	11.3, 9	42.3, 46.5	45.7, 52	43.6, 41	24.5, 10	15.8, 6	53.7, 45
I am often the only voice representing my point of view.	20.3, 19	27, 27	9.3, 8	7.5, 8.5	13.8, 0	26.5, 15	8.2, 2	22.7, 10
The financial burden of traveling to coalition meetings is too high.	1.3, 0	1, 1	0.7, 0	19.6, 8	0.2, 0	9.8, 2	2.3, 2	8.5, 4.5
The financial burden of participation (barring travel) is too high.	24.5, 24.5	1, 1	10.3, 0.5	5.8, 5.5	0.3, 0	3, 4	2, 1	6.2, 3
The coalition is competing with my organization.	25, 25	0, 0	0.5, 0.5	23.7, 5.5	13, 1	3.3, 5	1.5, 1	2.8, 2
The coalition is actively recruiting new members.	52.5, 52.5	37.7, 37	40.2, 25	42, 41	61.3, 61.5	70.8, 69.5	70.4, 75	52.9, 61
New members receive adequate orientation to be effective members of the coalition.	49.7, 47	20, 5	50, 50	55.9, 61.5	42.7, 36.5	42.5, 37	45.4, 35	43.2, 42.5

The current method for communication between coalition staff/leadership and its membership is effective.	45.5, 45.5	41.8, 36.5	51.1, 52	55.8, 53	62.7, 36.5	77.2, 80	62.9, 73.5	65.5, 67
Resources are being identified to support the systemic, programmatic changes implemented through the work of the coalition.	44, 21	52.8, 58	41.6, 40	60.5, 61	55.4, 51	77.8, 81	62.8, 65	44.9, 47.5
The coalition is making progress in implementing activities that have potential to improve health in the county.	47.8, 48.5	62.8, 63	50, 50	47.9, 51	65.5, 64.5	86.9, 90	78.1, 81	56.4, 59
The coalition is improving health outcomes for people in the county served by this coalition.	35, 31	51.3, 54	48.4, 51	47, 54.5	53.5, 64.5	66.2, 68	75.7, 81	56.3, 60
My skills and abilities are effectively used by the coalition.	45.3, 42.5	45.8, 45	67, 70	40.4, 40	61.5, 50	65.8, 62	59.6, 52	46.7, 50
I feel respected and recognized for my efforts.	53, 50	81.5, 87.5	76.9, 80	55.4, 52	80.4, 83.5	82.7, 81	71.4, 84	66.8, 71
Leadership has a clear vision for the coalition.	56.8, 64	75, 75	60.1, 68	37.2, 19	69.5, 67.5	81.3, 79	78.2, 80.5	52.8, 68
Leadership has the necessary knowledge and skills.	69, 66	83.3, 86	70.3, 73	56.2, 51	76.3, 77	85.7, 90	84.6, 85	73.8, 71
Leadership is respected.	66.7, 64	91.7, 100	71.4, 70.5	49.8, 51	79, 78.5	82.8, 90	85.9, 91	84.8, 84
Leadership gets things done.	57.7, 59	62.3, 68	63.9, 68	50.2, 52	72.8, 70.5	81.9, 80	81.6, 85	60.4, 61.5
Leadership intentionally seeks others' views.	53, 58.5	77, 88	72.8, 76.5	45.8, 40	78.8, 80.5	86.4, 88	81, 94.5	73.5, 85

Leadership utilizes the skills and talents of many, not just a few.	42, 40	79.3, 86	61.1, 59.5	47.5, 46	63.5, 55	82, 78.5	75.7, 81	63.1, 59.5
Leadership is ethical.	85.3, 85	84, 76	92.3, 100	54.8, 56	87.1, 94.5	91.9, 96	92.3, 100	90.3, 97.5
Leadership is skillful at resolving conflict.	64.3, 65	76.7, 86	68.4, 61	28, 20	49.5, 49.5	79.5, 82	75.2, 83	77, 80
CSAS Cluster means								
LF (out of 100)	54.06	65.86	63.34	48.5	69	79.98	75.96	64.23
PROB (out of 100)	26.43	23.48	28.85	32.2	19.54	24.36	17.58	28.05

CSAS, Coalition Self-Assessment Survey. CHCx, community health coalition in each of the 8 counties, ordered by the size of coalition membership; i.e., CHC1 had the fewest members, CHC8 had the most. $\bar{x}$, sample mean. $\tilde{x}$, sample median. LF, coalition members' positive perceptions of their leadership and functioning. PROB, coalition members reporting problems for participating in their coalition. *the response rate for CHC4 exceeded membership size; this is likely because the survey was sent as an anonymous survey link and may have been distributed to members' colleagues who were not on our distribution list.

Table 3: Social Network Analysis and Coalition Self-Assessment Survey Correlation Results.

Connection type	**Calculated SNA variable**	**CSAS Cluster**	
		LF	**PROB**
Cooperation	**Density**	.	.
	Mean degree	0.458	.
	Degree centralization	.	.
	Betweenness centralization	-0.449	0.488
	Closeness centralization	.	.
	Eigenvector centralization	.	.
	Transitivity	.	.
Coordination	**Density**	.	.
	Mean degree	0.675	.
	Degree centralization	.	.
	Betweenness centralization	-0.591	0.497
	Closeness centralization	.	.
	Eigenvector centralization	.	.
	Transitivity	.	.
Collaboration	**Density**	.	.
	Mean degree	0.486	.
	Degree centralization	.	.

	Betweenness centralization	.	.
	Closeness centralization	0.430	.
	Eigenvector centralization	.	.
	Transitivity	.	.
Formal ties	**Density**	-0.533	0.668
	Mean degree	0.401	.
	Degree centralization	0.589	-0.411
	Betweenness centralization	.	.
	Closeness centralization	.	.
	Eigenvector centralization	.	-0.500
	Transitivity	.	0.429
Good-high trust	**Density**	.	.
	Mean degree	.	.
	Degree centralization	.	.
	Betweenness centralization	-0.488	.
	Closeness centralization	.	.
	Eigenvector centralization	.	.
	Transitivity	.	0.448
Frequent direct contact	**Density**	.	.
	Mean degree	.	.
	Degree centralization	.	.
	Betweenness centralization	.	0.403
	Closeness centralization	.	.
	Eigenvector centralization	.	.
	Transitivity	.	.
Frequent mass communication	**Density**	.	.
	Mean degree	.	.
	Degree centralization	.	.
	Betweenness centralization	.	.
	Closeness centralization	0.423	.
	Eigenvector centralization	.	.
	Transitivity	.	.

SNA, Social Network Analysis. CSAS, Coalition Self-Assessment Survey. LF, coalition members' positive perceptions of their leadership and functioning. PROB, coalition members reporting problems for participating in their coalition. Pearson's correlation coefficients between calculated SNA variables and CSAS cluster means. An arbitrary cutoff value of ±0.4 was selected to identify correlation values that may be important (i.e., "significant"). Any correlation values falling between +0.4 and -0.4 are denoted by a period (.). For visual clarity, positive correlation values are highlighted in green and negative correlation values are highlighted in red.

Table 4: Calculated Social Network Analysis Variables and Coalition Self-Assessment Survey Cluster Means versus County-level Health Statistics Correlation Results.

Coalition priorities:	Substance use prevention					Tobacco control			Obesity prevention						Infant/maternal health					Systems of care								*	(← *Mental health) Wellness					
County-level health statistics	opdeath	opEd	opHosp	opTrt	_RFBING5	SMOKDAY2	USENOW3	ECIGNOW	_BMI5CAT.A.avg	_RFBMI5.A	SSBSUGR2	SSBFRUT2	_TOTINDA	FoodInsec	LBW	VLBW	pregsmok	prenatal	preterms	MEDCOST	HLTHPLN1	_HCVU651	PERSDOC2	CHECKUP1	FLUSHOT6	PNEUVAC3	_RFMAM2Y	_RFPSA21	MENTHLTH5	_RFHLTH	PHYSHLTH5	POORHLTH5	ChronicAvg	ChronicSum3	FrailtySum1
CSAS Cluster																																			
LF	.421	.	.	.431	.	.	.	.	.	.	-.503	.	.	.	.	.	.641	.	.713	.	.	.	-.454	.	.	.	.	.	.	.423	.	.	.	.	.
PROB	-.622	.	.	-.645	.	.	.	.	.	.	.448	.443	.	.	.	.	-.798	.	.	.	-.624	-.604	.	.	.	.	.	.	.	-.472	.	.	.544	.	.
Density																																			
Cooperation	.	.	.887	.	.	.	.	.	.	.	.	.	.619	-.448	.	-.732	.	-.629	-.463	.	.	.	.524	.736	.	.	.	.	-.443	.	.	-.561	.	.	.
Coordination	.	.	.604	-.630	.563	.	.	.	.	.	.	.	.559	-.502	.	-.578	.	-.530	.	.	.	.	.	.	.	.	.511	.	.	-.401	.	-.439	-.546	.	.	.
Collaboration	.	.	.559	-.530	.584	.	.	.	.414	.	.	.	.636	-.458	.	-.602	.	-.553	.	.	.	.	.	.435	.	.517	.	.	.	.	.	-.454	-.486	.	.	.
Formal Ties	-.745	.	.422	-.876	.	-.499	-.409	.	.	.	.	.	.	-.654	.	.	-.924	.	.	.	-.700	-.726	.	.	.	.	.	.	-.597	-.580	.	-.522	.	.	-.532
Good-high Trust	-.659	.	.591	-.774	.622	.	.	.	.	.	.	.	.515	-.521	.	-.424	-.526	-.401	.	.	.	.	.	.	.	.	.	.	.	-.405	.	-.585	.	.	.
Frequent Direct Contact	.	.	.465	-.565	.760	.	.	.	.	.	.	-.417	.	-.573	.	-.604	.	.	.	.	.	.	.	.	.	.	.499	.	.	.	.	-.553	-.600	-.419	.	.
Frequent Mass Communication	.	.	.513	-.530	.691	.	.	.	.557	.	.	.	.636	-.452	.	-.550	.	-.444	.	.	.	.	.	.429	.462	.448	.	.	.	.	.	-.400	-.464	.	.	.
Mean degree																																			
Cooperation	.609	.	-.649	.767	-.457	.627	.692	.	.	.	.	.496	.	.781	.479	.646	.719	.	.	.	.425	.473	.	.	.	.	.	.	.	.703	.568	.	.716	.	.	.505
Coordination	.	.	-.598	.436	.	.623	.665	.	.409	.	.	.466	.	.611	.671	.597	.606	.	.720	.	.	.	-.431	.	.	.	.	.	.	.527	.441	.	.518	.	.	.
Collaboration	.	.	.	.	.	.	.650	-.605	.735	.524	.	.	.622	.503	.682	.	.645	-.474	.482	.	.	.	.	.	.	.	.	.	.	.542	.413	.	.415	.	.	.
Formal Ties	.	.	-.761	.531	-.422	.486	.767	.	.	.	.	.633	.	.651	.621	.766	.499	.	.533	.	.	.	.	.	.	-.468	.	.	.642	.	.	.622	.	.	.
Good-high Trust	.	.	-.634	.456	.	.591	.874	.	.404	.	.	.715	.	.611	.761	.717	.471	.	.520	.	.	.	.	.	.	-.495	.	.	.703	.	.	.524	.	.	.
Frequent Direct Contact	.	.	-.445	.	.	.690	.741	-.622	.502	.	.	.	.	.	.687	.	.659	.	.577	.	.443	.444	.	.	.	.	.	.	.686	.	.	.	.	.	.
Frequent Mass Communication	.	.	-.555	.534	.	.766	.904	.	.600	.543	.	.656	.	.644	.739	.608	.584	.	.	.	.444	.485	.	.	.	.	.	.	.802	.	.	.568	.	.	.459
Degree centralization																																			
Cooperation	.	.	-.856	.	.	.	.	.	.	.	.	.	-.700	.	.	.691	.	.689	.405	.	.	.	-.524	-.780	.	.	.	.	.	.	.	.512	.	.	.
Coordination	.	.	-.661	.	.	.	.	.	.	.	.	.	-.647	.	.	.658	.	.557	.	.	.	.	.	-.641	.	.	.	.	.	.	.558	.548	.	.	.
Collaboration	.	.647	.	.	.	.	.	.	.	.486	.466	.	.	.524	.	.465	.	.	.	.600	.	.	.	.	.	.	.617	.846	.	.482	.901	.714	.594	.	.492
Formal Ties	.794	.	-.678	.806	-.718	.	.	.	.	.	.	.	.	.715	.	.525	.634	.	.	.	.	.	.	.	.	.	.	.	.	.602	.	.764	.	.	.
Good-high Trust	.626	.	-.677	.670	-.689	.	.	.	.	.	.	.	-.466	.454	.	.413	.413	.443	.	.	.	.	.	.	.	.	.	.	.	.	.	.636	.	.	.
Frequent Direct Contact	.	.	-.810	.	.	.	.	.	.	.	.	.495	-.600	.	.	.777	.	.660	.500	.	-.413	.	-.466	-.707	-.480	.	.	.	.	.	.	.432	.	.411	.
Frequent Mass Communication	.	.	-.687	.	-.549	.	.	.	.	.	-.484	.	-.674	.	.	.	.	.672	.	.	-.534	-.491	-.483	-.438	.	.	-.499	.	.	.	.	.	.	.712	-.440
Betweenness centralization																																			
Cooperation	.	.	-.532	.	.	.	.	.	.	.	.	.	-.623	.	.	.	.	.653	.	.	-.452	-.449	-.471	-.728	.	.	.	.	.	.	.	.	.	.	.
Coordination	.	.	.	.	.	.	.	.432	.	.	.	.	-.502	.	.	.	.	.557	-.492	.	.	.	.	.	.	.	.	.	.	.	.	.505	.	.	.	.
Collaboration	.	.	-.687	.	.	.	.	.	.	.	.	.	-.518	.	.	.466	.	.427	.	.	-.665	-.635	-.626	-.682	.	.	.	.403	.	.	.446	.536	.	.	.
Formal Ties	.	.481	.	.	.	.	.	.	-.564	.	.	.	.	.	-.551	.	.	.	.	.	.	.	.	.	-.716	.	.510	.	.	.510	.457	.	.	-.816	.451

Good-high Trust	.	.	.	.	-.430	-.461	.	.468	.	.	.	.	-.503	.	-.509	.	.	.502	-.680	.	.	.	.	.	.446	.	.	.	.	.	.	.	.	.	.
Frequent Direct Contact	.	.	-.767	.	.	.	.	.	.	.	.	.	-.740	.	.	.579	.	.790	.494	.	-.588	-.570	-.575	-.775	.	.	.	.	.	.	.	.	.	.477	.
Frequent Mass Communication	.	.	.	-.419	.	-.790	-.531	.440	-.744	-.686	-.511	.	-.701	.	.	.	-.484	.531	.	-.593	-.779	-.790	-.406	-.507	-.422	.	-.408	.	-.619	.	.	.	.	.	-.619
Closeness centralization																																		
Cooperation	.	.	-.846	.	.	.	.	.	.	.	.	.	-.693	.	.	.701	.	.678	.	.	.	.	-.489	-.753	.	.	.	.	.	.	.	.521	.	.	.
Coordination	-.442	.	.573	.	.	-.646	.	.845	-.639	-.533	-.519	.	.	.	.	.	.	.	.	-.694	.	.	.669	.	.	-.689	.	-.550	-.436	.	.	-.586	.	.	.
Collaboration	.	-.461	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.498	.	-.735	-.743	-.404	.	.	.	.	.	-.445	.	.	.	.663	.	.
Formal Ties	.	.	.656	.	.	.	.	.	.	.	.	-.457	.	-.560	.	-.784	.	.	.	.	.532	.496	.486	.615	.463	.	.	-.451	.	-.452	-.684	-.711	-.676	.	.
Good-high Trust	.449	.	-.452	.631	-.609	.	.	.	-.408	.	.	.	-.660	.	.	.	.	.549	.	.	.	.	.	.	.	.	.	.	.	.	.	.405	.	.	.
Frequent Direct Contact	.	.	-.505	.	.	.	.	.	-.449	-.407	.	.	-.725	.	.	.516	.	.765	.535	-.483	.	.	.	-.780	-.643	.	.	-.524	.	.	.	.	.	.	.
Frequent Mass Communication	.	.	-.556	.	.	.	.	-.501	.	.	.	.	-.455	.403	.	.603	.	.	.667	.	.	.	-.645	-.862	-.700	.	.	.	.463	.474	.	.	.	-.476	.
Eigenvector Centralization																																		
Cooperation	.	.	-.743	.	.	.	.	.	-.418	.	.	.	-.832	.	.	.567	.	.799	.	.	.	.	-.520	-.843	.	.	.	.	.	.	.	.	.	.	.
Coordination	.	.	-.664	.	.	.	.	.	.	.	.	.	-.719	.	.	.466	.	.633	.	.	.	.	.	-.609	.	.	.	.	.	.	.478	.519	.	.	.
Collaboration	.401	.586	.	.509	-.442	.	.	.	.	.	.	.	-.440	.	-.486	.	.	.	-.441	.	.	.	.	.	.	.	.	.442	.	.	.698	.509	.	.	.
Formal Ties	.	.	.793	.	.	.	.	.	.	.	.	-.413	.	.	.	-.740	.	.	.	.	.710	.673	.655	.688	.	.	.	.	.	.	-.434	-.621	-.567	-.467	.
Good-high Trust	.448	.460	.	.554	-.518	-.410	.	.	-.519	.	.	.	-.652	.	-.619	.	.	.455	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Frequent Direct Contact	.	.	.	.	-.573	-.536	.	.699	-.538	.	.	.	-.412	.	.	.	-.504	.	.	.	-.405	.	.	.	-.413	.	.	.	.	.	.	.	.535	.	.
Frequent Mass Communication	.	.	.	.	-.403	-.866	-.600	.521	-.949	-.831	-.693	.	-.886	.	-.607	.	.	.617	.	-.741	.	.	.	-.423	-.443	.	-.431	.	-.501	.	.	.	.	.	-.428
Transitivity																																		
Cooperation	.	.	.826	.	.	.	.	.	.	.	.	.	.700	.	.	-.702	.	-.685	-.462	.	.	.	.466	.728	.410	.	.	.	.	.	.	-.471	.	.	.
Coordination	.	.	.589	-.588	.599	.	.	.	.	.	.	.	.579	-.430	.	-.507	.	-.567	.	.	.	.	.	.	.	.484	.	.	.	.	-.430	-.532	.	.	.
Collaboration	.	.	.909	-.403	.430	.	.	.	.	.	.	.	.556	-.507	.	-.740	.	-.546	.	.	.	.	.522	.663	.	.	.	.	.	.	-.426	-.709	.	.	.
Formal Ties	-.642	.	.403	-.915	.690	.	-.464	.	.	.	.	.	.	-.705	.	-.445	-.673	.	.	.	-.594	-.646	.	.	.	.594	.	.	-.532	-.513	.	-.593	.	.	-.480
Good-high Trust	-.679	-.425	.433	-.814	.671	.	.	.	.	.	.	.	.495	-.485	.	.	-.523	.	.	.	.	-.421	.	.	.	.	.	.	.	-.415	.	-.505	.	.	.
Frequent Direct Contact	.	.	.543	-.514	.798	.	.	-.440	.414	.	.403	.	.620	.	.	-.467	.	-.550	.	.	.	.	.	.	.	.551	.	.	.	.	.	-.444	.	.	.
Frequent Mass Communication	.	.	.763	.	.604	.	.	.	.	.	.	.	.579	.	.	-.543	.	-.462	.	.	.464	.418	.542	.550	.	.	.	.	.	.	.	-.578	.	-.481	.

CSAS, Coalition Self-Assessment Survey. Pearson's correlation coefficients between calculated social network analysis variables (density, mean degree, degree centralization, betweenness centralization, closeness centralization, eigenvector centralization, and transitivity; across the following connection types: cooperation, coordination, collaboration, formal ties, good-high trust, frequent direct contact, frequent mass communication) and CSAS clusters (LF, coalition members' positive perceptions of their leadership and functioning. PROB, coalition members reporting problems for participating in their coalition). An arbitrary cutoff value of ±0.4 was selected to identify correlation values that may be important (i.e., "significant"). Any correlation values falling between +0.4 and -0.4 are denoted by a period (.). For visual clarity, positive correlation values are highlighted in green and negative correlation values are highlighted in red.

County-level health statistics retrieved from: STATS, Indiana Stats Explorer (https://gis.in.gov/apps/isdh/meta/stats_layers.htm). BRFSS, Behavioral Risk Factor Surveillance System (https://www.cdc.gov/brfss/annual_data/annual_data.htm). FeedingAmerica, Feeding American Food Insecurity in Indiana (http://map.feedingamerica.org/county/2015/overall/indiana).

opdeath, STATS (2016), Deaths from drug poisoning- involving opioid pain relievers; *rate (crude rate per 100,000 population)*. **opEd**, STATS (2016), Non-fatal emergency department visits due to opioid overdoses; *rate (crude rate per 100,000 population)*. **opHosp**, STATS (2016), Non-fatal hospitalizations due to opioid overdoses; *rate (crude rate per 100,000 population)*. **opTrt**, STATS (2016), Substance abuse treatment- other opiates and synthetics; *rate (crude rate per 100,000 population)*. **_RFBING5**, BRFSS (2015-16), Calculated variable for binge drinkers (males having five or more drinks on one occasion, females having four or more drinks on one occasion); *percent responding yes, that they did drink in the last 30 days and that they had 5 (men), 4 (women), or more drinks on one or more occasions*. **SMOKDAY2**, BRFSS (2015-16), Do you now smoke cigarettes every day, some days, or not at all?; *percent responding every day or some days*. **USENOW3**, BRFSS (2015-16), Do you currently use chewing tobacco, snuff, or snus every day, some days, or not at all?; *percent responding every day or some days*. **ECIGNOW**, BRFSS (2015-16), Do you now use e-cigarettes or other electronic "vaping" products every day, some days, or not at all?; *percent responding every day or some days*. **_BMI5CAT.A.avg**, BRFSS (2015-16), Calculated variable for the average adult BMI; *mean*. **_RFBMI5.A**, BRFSS (2015-16), Calculated variable for adults who have a body mass index greater than 25.00 (overweight or obese); *percent of adults who are overweight or obese*. **SSBSUGR2**, BRFSS (2015-16), During the past 30 days, how often did you drink regular soda or pop that contains sugar? Do not include diet soda or diet pop; *percent of people responding that they drank sugar-sweetened soda every day in the last 30 days*. **SSBFRUT2**, BRFSS (2015-16), During the past 30 days, how often did you drink sugar-sweetened fruit drinks (such as Kool-aid and lemonade), sweet tea, and sports or energy drinks (such as Gatorade and Red Bull)? Do not include 100 percent fruit juice, diet drinks, or artificially sweetened drinks; *percent of people responding that they drank noncarbonated sugar-sweetened beverages every day in the last 30 days*. **_TOTINDA**, BRFSS (2015-16), During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?; *percent of people responding that they had no physical activity at all in the last 30 days, i.e., 0 days of physical activity in the last 30 days*. **FoodInsec**, FeedingAmerica (2015), County food insecurity rate; *percent*. **LBW**, STATS (2016), Low birthweight infants; *percent of live births*. **VLBW**, STATS (2016), Very low birthweight infants; *percent of live births*. **pregsmok**, STATS (2016), Mothers smoking during pregnancy; *percent of live births*. **prenatal**, STATS (2016), Mothers receiving prenatal care beginning in the first trimester; *percent of live births*. **preterms**, STATS (2016), Preterm infants, less than 37 weeks; *percent of live births*. **MEDCOST**, BRFSS (2015-16), Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?; *percent responding yes, this is true*. **HLTHPLN1**, BRFSS (2015-16), Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?; *percent responding no, they do not have health care coverage*. **_HCVU651**, BRFSS (2015-16), Calculated variable for respondents aged 18-64 who have any form of health care coverage; *percent responding they do not have healthcare coverage*. **PERSDOC2**, BRFSS (2015-16), Do you have one person you think of as your personal doctor or health care provider?; *percent responding no, they do not have a personal doctor or health care provider*. **CHECKUP1**, BRFSS (2015-16), About how long has it been since you last visited a doctor for a routine checkup?; *percent responding that it has been longer than two years or that they are not sure*. **FLUSHOT6**, BRFSS (2015-16), During the past 12 months, have you had either a flu shot or a flu vaccine that was sprayed in your nose?; *percent responding no*. **PNEUVAC3**, BRFSS (2015-16), A pneumonia shot or pneumococcal vaccine is usually given only once or twice in a person´s lifetime and is different from the flu shot. Have you ever had a pneumonia shot?; *percent responding no or don't know/now sure*. **_RFMAM2Y**, BRFSS (2015-16), Calculated variable for women respondents aged 40+ who have had a mammogram in the past two years*; percent responding no (5 year estimate)*. **_RFPSA21**, BRFSS (2015-16), Calculated variable for male respondents aged 40+ who have had a Prostate-Specific Antigen test in the past 2 years; *percent responding no (5 year estimate)*. **MENTHLTH5**, BRFSS (2015-16), Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?; *percent reporting 5 or more days of poor mental health in the last 30 days*. **_RFHLTH**, BRFSS (2015-16), Would you say that in general your health is: excellent, very good, good, fair, poor; *percent responding fair and poor*. **PHYSHLTH5**, BRFSS (2015-16), Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?; *percent reporting 5 or more days of poor physical health in the last 30 days*. **POORHLTH5**, BRFSS (2015-16), During the past 30 days, for about how many days did poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?; *percent reporting 5 or more days in the last 30 days*. **ChronicAvg**, BRFSS (2015-16), The average number of chronic diseases people have, out of nine possible options: myocardial infarction, angina/coronary heart disease, stroke, asthma, cancer, COPD/emphysema/chronic bronchitis, arthritis/rheumatoid arthritis/gout/lupus/fibromyalgia, kidney disease, diabetes; *mean*. **ChronicSum3**, BRFSS (2015-16), The percentage of people having three or more chronic diseases (from the above list of nine) at once; *percent responding three or more*. **FrailtySum1**, BRFSS (2015-16), Percent of people having at least one indicator of frailty: difficulty walking or climbing stairs, difficulty dressing or bathing, difficulty running errands because of a physical/mental/emotional condition; *percent having one or more*.