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USING SOCIAL NETWORK ANALYSIS TO EVALUATE COMMUNITY CAPACITY BUILDING OF A REGIONAL COMMUNITY CANCER NETWORK

John Luque,

JP Hsu College of Public Health, Georgia Southern University

Dinorah Martinez Tyson,

Florida Mental Health Institute, University of South Florida

Ji-Hyun Lee,

H. Lee Moffitt Cancer Center and Research Institute, and University of South Florida

Clement Gwede,

H. Lee Moffitt Cancer Center and Research Institute, and University of South Florida

Susan Vadaparampil,

H. Lee Moffitt Cancer Center and Research Institute, and University of South Florida

Shalewa Noel-Thomas, and

H. Lee Moffitt Cancer Center and Research Institute

Cathy Meade

H. Lee Moffitt Cancer Center and Research Institute, and University of South Florida

Abstract

The Tampa Bay Community Cancer Network (TBCCN) is one of 25 Community Network Programs funded by the National Cancer Institute's (NCI's) Center to Reduce Cancer Health Disparities with the objectives to create a collaborative infrastructure of academic and community based organizations and to develop effective and sustainable interventions to reduce cancer health disparities. In order to describe the network characteristics of the TBCCN as part of our ongoing evaluation efforts, we conducted social network analysis surveys with our community partners in 2007 and 2008. One key finding showed that the mean trust value for the 20 community partners in the study increased from 1.8 to 2.1 ($p < 0.01$), suggesting a trend toward increased trust in the network. These preliminary results suggest that TBCCN has led to greater collaboration among the community partners that were formed through its capacity-building and evidence-based dissemination activities for impacting cancer health disparities at the community level.

INTRODUCTION

Social network analysis (SNA) has been used to examine organizational structures, coordination of services, communication, and collaboration across organizations (Hanson, Muller, & Durrheim, 2005). In addition, SNA has also been employed to evaluate and provide insights on the partnership process for community coalition building (Lasker, Weiss, & Miller, 2001; Norris et al., 2007). In this article, we argue for the role of SNA as an evaluation tool that can be used to measure process outcomes from coalition building such

as information exchange, evidence of collaboration, and relationship quality. Community coalitions have been criticized for not producing significant public health outcomes in the area of service delivery and for not collecting data that can adequately measure whether goals and objective have been met; however, the realistic timeframe for measuring whether these outcomes have been achieved is subject to debate (Kreuter, Lezin, & Young, 2000; Ostrower, 2005). Others have argued that coalitions should be understood instead as mediating collaborative mechanisms for influencing gradual system-level change among community partners (Wandersman, Goodman, & Butterfoss, 2005).

Social network analysis of service systems has been identified as a promising area for public health program evaluation to answer questions at the systems level, such as identifying service utilization, and which programs facilitate systems development (Eisenberg & Swanson, 1996). For example, Provan, Nakama, Veazie, Teufel-Shone, and Huddleston (2003) explored how a network of health and service organizations working in a rural community developed and strengthened community capacity to address chronic disease. The researchers used SNA to demonstrate how a network based on collaboration and mutually beneficial goals evolved to tackle the health needs of their community. In another example of systems level approaches, Gold, Doreian, and Taylor (2008) used SNA to study the relationship among organizations participating in private–public collaboration among major health plans to address healthcare disparities. Their findings showed that while the organizations did not interact highly with each other, they did collaborate with a few core support organizations that acted as the glue that brought them together for a common purpose.

Other literature suggests relationships between organizations in a network often increases community capacity through communication, shared resources, and cooperation when addressing a common need (Wells, Ford, McClure, Holt, & Ward, 2007). For example, access to cancer screening/treatment services and support programs (e.g., support groups, transportation assistance, medication assistance) pose significant barriers and burden for individuals with limited income and resources. One of the ways that partnerships can address these issues is by building community capacity and facilitating linkages and collaboration (Alfonso et al., 2008). In this context, community capacity can be defined as organizational resources or interactions that exist in a given community that can be leveraged to address a collective problem (e.g., cancer health disparities and/or maintain wellbeing; Chaskin, 2001). Thus, in developing effective partnerships to strengthen cancer prevention and control, we describe here our experiences with using SNA for evaluating changes in community capacity as defined by the level of interaction and exchange of information and resources among organizations in our community partner network.

BACKGROUND

The Tampa Bay Community Cancer Network (TBCCN) is one of 25 community network programs funded by the National Cancer Institute's (NCI's) Center to Reduce Cancer Health Disparities with the objectives to create a collaborative infrastructure of academic and community-based organizations and to develop effective and sustainable interventions to reduce cancer health disparities (Chu, Chen, Dignan, Taylor, & Partridge, 2008). The TBCCN aims to address critical access, prevention, and control issues that impact medically underserved, low-literacy, and low-income populations in selected areas of Hillsborough, Pasco, and Pinellas counties, Florida (Meade, Menard, Luque, Martinez-Tyson, & Gwede, 2009). To accomplish these objectives, the TBCCN works assiduously to increase community participation in preventive cancer screenings; involve community partners in community-based participatory research (CBPR) pilot projects; provide small service grants

through a competitive process to community partners; and expand educational, outreach, and awareness opportunities for the community around cancer prevention and control.

Founded in 2005, the TBCCN sustains formal partnerships with multiple community-based organizations and collaborates with NCI programs such as the Cancer Information Service (CIS), Health Communications and Informatics Research Branch, and the Office of Cancer Survivorship. The TBCCN currently consists of 25 community partners who are ethnically and organizationally diverse and include nonprofit groups, federally qualified health centers, county health departments, adult literacy organizations, cancer support and advocacy programs, hospitals, faith-based organizations, local affiliates of national nonprofit organizations, and health education groups. Capacity building is vital to achieving partnership goals, so the TBCCN is being evaluated by its progress toward a sustainable network for cancer prevention, survivorship, and health education. Given the diversity of the TBCCN partner organizations and the central role of the cancer center as the network coordinator with direct access to grant funding resources, a systematic evaluation of network growth and sustainability was developed.

The TBCCN initially conducted a partner needs assessment to document “baseline” resources, assets, needs, and expectations of the community partners. For the needs assessment, detailed in Gwede et al. (2009), the TBCCN collaboratively developed and implemented a survey of the initial 19 partners between 2006 and 2007. The partners reported specific expectations that they hoped to achieve as a result of participation. The qualitative results were grouped into two main thematic categories: material benefits and ideational benefits. Material benefits included improved access to clinical care, preventive screening, and follow-up services, to be provided by both the cancer center and other area hospitals. Other material benefits included health education materials and technical assistance for grant writing and organizational development. Partners also identified ideational benefits such as a forum for knowledge and idea exchange as well as providing a sense of group solidarity.

Following this initial partner needs assessment, team members developed a close-ended survey to collect data for SNA as a process evaluation measurement instrument to gauge specific domains of potential partner interactions. The SNA survey measured material benefits, such as the number of referrals, collaboration, and sharing, and ideational benefits, represented by overall trust in the network. Provan, Nakama, Veazie, Teufel-Shone, and Huddleston (2003) have argued that when measuring the success of community collaborative networks focused on chronic disease, long-term benchmarks such as reducing cancer mortality are not feasible within the short timeframes of grant funding periods, and that short-term measures of community capacity building may serve as a proxy for efficient use of available resources working toward improving community health. Consistent with these recommendations, the objective of conducting the SNA of the TBCCN was to improve ties and interactions among partners, and strengthen community infrastructure for addressing health disparities in the whole network.

Based on the feedback received through the initial partner needs assessment, and the existing literature on community partnerships, TBCCN approached the SNA with four basic evaluative and programmatic questions. First, is a newly formed, centralized network like the TBCCN, with the cancer center as the hub of the wheel, able to become more decentralized over time and consequently become less susceptible to network disintegration for its heavy reliance on the cancer center’s central, coordinating role? Second, what are the situational dynamics of other partner organizations becoming either more or less central to the network over time? Third, has the TBCCN led to greater collaboration and trust among

partners over time? Fourth, do changes in network collaboration by linkage type move in the same direction over time?

Although the initial partner needs assessment was a participatory initiative to identify assets and expectations, and prioritize health and social issues among the 19 community partners in the network, the aim of the SNA was to identify whether the process of participation in the TBCCN had led to greater collaboration, defined broadly as multiple working relationships, between the community partners. Thus, the SNA was implemented as an evaluative process measure to document network growth and sustainability over time, and sought to unpack the progress being made locally in reducing cancer health disparities through these organizational efforts.

METHOD

The study was conducted in Tampa Bay, Florida with participating representatives of community partners from the tricity area (Hillsborough, Pasco, and Pinellas). A memorandum of understanding (MOU) between the cancer center and each partner stipulated that they attend at least three of four quarterly meetings per year, in addition to the TBCCN Annual Retreat at the cancer center, which provided additional networking opportunities. Survey data were collected at the quarterly meeting in December 2007 and September 2008. The social network questionnaire was conceived, distributed, and explained by a research coordinator (DMT) trained in SNA. A social scientist (JL) entered the data and analyzed the results, and worked with the TBCCN staff to complete necessary follow-up contacts to collect questionnaires from each community partner to complete missing data. The December 2007 social network data were not considered baseline data because the 21 TBCCN partners had already coalesced at that time since its inception in 2005. By mid-2009, the number of TBCCN partners had increased to 25; however, for the purposes of the SNA, we only included in the analysis the 20 partners that we had available baseline and/or follow-up data from 2007 and 2008.

We employed a sociocentric or whole network SNA that required data from the bounded/closed network, and the unit of analysis was the community partner, not a representative individual. Therefore, the representative answering the questionnaire was answering on behalf of the respective partner organization, not as an individual. Methodologically speaking, SNA allows for meaningful comparisons between organizations in a network (Provan, Isett, & Milward, 2004) through a variety of quantitative measures. The SNA survey instrument was adapted from the network data-collection instrument described by Provan, Veazie, Staten, and Teufel-Shone, (2005). The questionnaire was in the form of a matrix, and each partner representative circled their organization, and then completed the worksheet by checking off the presence or absence of a linkage type, and ranked trust on a numerical scale. The linkage type questions were presented in a matrix format with each organization listed vertically in the first column and the following items as column headings: sharing information, sharing resources, referring clients, collaborating on community events, and collaborating on grant proposals with any of the other 19 partners in the network (over the last year). During the analysis, these items were combined to create a multiplexity value. In addition, each community partner was asked to rank their relationship quality (trust measure)—scale ranging from 1 (*little trust*) to 4 (*high trust*)—with each community partner.¹ We compared mean trust levels between 2007 and 2008 using the Wilcoxon Signed Rank test with SPSS version 17.0 (SPSS Inc., 2009).

¹The instrument developed by Provan et al. (2003, 2005) did not measure collaboration on community events or grant proposals, but did measure the “referrals out” versus “referrals in,” which our survey did not differentiate.

For the first survey (2007), the response rate was 76% (16 out of 21 partners). For the follow-up survey (2008), the initial response rate was 67% (14 out of 21 partners), but after further e-mail and fax requests, 20 out of 21 organizations completed the instrument. One community organization peripheral to the network was excluded from the analysis because the organization was missing data on both surveys despite repeated follow-up attempts. Therefore, to increase the reliability of the outcome data and based on the imputation method used, data from 20 out of 21 possible community partners were used for the analysis.

Analyzing whole networks with unit nonresponse data is subject to validity and bias concerns; however, in this study the problem was more accurately described as a wave nonresponse issue because data were collected at two time points, with missing data in the first wave (Huisman & Steglich, 2008). One possibility would be to use imputation by reconstruction, using the observed incoming relations of the missing actors to replace missing values (Stork & Richards, 1992). This assumes that reported ties would be largely matched among network partners. However, because we were able to collect follow-up data on the four missing partners from the first survey, we instead employed imputation by last value carried backward for the purpose of analysis, noting the shortcoming of underestimated uncertainty levels, thereby necessitating removing the partner who did not complete the baseline or follow-up instrument (Huisman & Steglich, 2008; Lepkowski, 1989).

Analysis of the network data was conducted using UCINET 6, Social Network Analysis software (Borgatti, Everett, & Freeman, 2002). Following procedures for increasing the reliability of the data as described by Scott (1991) and Provan et al. (2003), we completed the analysis of network density for linkage types using confirmed links, wherein there was consensus by both community partners on the presence of a link, although unconfirmed links are also reported. Density is the proportion of actual linkages to possible linkages among group members (Hanneman & Riverside, 2005). Although these data are self-reported, the confirmation of links increases the reliability of the network results so that meaningful conclusions can be drawn. In addition, we calculated centrality measures (degree to which a network revolves around one group member, without whom other members would not necessarily be linked), including degree and betweenness centrality (measuring direct and indirect links, respectively), and multiplexity values, based on “any link” (measuring any one of the five possible links and receiving a value of one; Knoke & Yang, 2007). Multiplexity denotes the strength of the relationship between partners or the number and types of ties that are maintained by pairs of partner organizations (Provan et al. 2005). Using the bootstrap paired sample t test in UCINET, we compared the mean densities of multiplexity between 2007 and 2008, and used the average bootstrap difference with the 95% bootstrap confidence interval (CI) to determine statistical significance. In addition, Netdraw was used to visualize density of multiplexity based on tie strength and node size determined by betweenness centrality.

RESULTS

The first two research questions from the SNA explored whether the network was trending toward decentralization and if the situational dynamics of partner organizations were becoming either more or less central to the network over time. The cancer center remained the most central organization in the TBCCN as measured by degree centrality (the number of direct links to each of the partners), as well as betweenness centrality (the number of nodes another node is connected to indirectly through direct links; Table 1). According to the mean betweenness centrality values, the network centralization was relatively high because only an average of one quarter of all direct connections could be made in the

network without using an intermediary. Moreover, based on the degree centralization, with higher percentages indicating a more centralized network, the value increased slightly from 45.6% in 2007 to 48.0% in 2008, suggesting a high amount of network centralization.

Two organizations, which had high betweenness centrality values in 2007, became less central in 2008. One of these organizations was a health education organization and the other was a health outreach community-based organization. In 2008, a local affiliate of a national nonprofit organization, an urban community health center, and a faith-based migrant clinic had higher betweenness centrality values than in 2007, and moved into the center of the network. Written feedback from the urban community health center stated, "Participation in the TBCCN has been a very positive experience for our organization and our patients. We have made a difference in the way we are impacting the community in reducing cancer health disparities." The cancer center also became more central to the network in 2008. However, the five organizations besides the cancer center who became the most central organizations in 2008 all had higher betweenness centrality values than the fourth-ranked organization in 2007, suggesting that in 2008, there was more "power" in the network, with stronger central relations in the network (refer to Figure 1). The most central organizations behind the cancer center had higher betweenness centrality values in 2008 than in 2007, also adding evidence for increased network centralization. Only the six highest ranked organizations for 2008 are highlighted in Table 1 because the betweenness centrality values dropped significantly from 7.3 to 4.1 for the seventh-ranked organization and are graphically represented in the center of the network according to Figure 1. The organizations least central to the network in 2008 in terms of betweenness centrality values were either small nonprofit organizations with limited resources, or organizations located in Pinellas or Pasco counties, indicating that geographical distance was a possible challenge for network integration.

For multiplexity average values, the trend was toward increasing the mean number of linkages; however, the average change was modest, from 1.07 to 1.10. For degree centrality, the mean decreased from 11.2 average ties in 2007 to 9.9 average ties in 2008. Therefore, another sign that the network appeared to be moving in the direction of network decentralization was based on a growing number of indirect ties between partners occurring simultaneously with a decreasing number of direct ties.

The third research question examined whether the TBCCN led to greater collaboration and trust over time. Each community partner ranked each of the other partners on a scale of 1 to 4 for relationship quality, ranging from *poor relationship* or *little trust* to excellent *relationship* or *high trust*. The mean trust value for all 20 community partners increased from 1.8 to 2.1 ($p < 0.01$), suggesting a trend toward increased overall trust among network partners.

The fourth research question asked whether changes in network collaboration by linkage type moved in the same direction over time (Table 2). For four of the five linkage types (shared information, referrals, shared resources, and collaboration on community events) there was a trend toward increased network density based on the data from the confirmed links. Likewise, there was a statistically significant trend toward increased network density based on "any link" relationships, which did not differentiate between linkage type, average bootstrap difference = -0.06 , 95% boot-strap CI ($-0.10, -0.01$). The "average" partner maintained 5.3 confirmed links out of a possible 19 links in 2008, increasing from 4.2 confirmed links in 2007.

DISCUSSION AND CONCLUSIONS

The cancer center remains the nexus of the TBCCN, a network characterized by high network centralization (central nodes with both high degree and betweenness centrality). This finding is a direct result of the nature of the origin of the partnership network, which was initiated by a community partnership grant from the NCI. One advantage of highly centralized networks is the capacity to easily adopt evidence-based programs (Valente, Chou, & Pentz, 2007). Another feature of TBCCN was the strong leadership role of the cancer center, which provided direction and organizational capacity for the community partner network, a critical element in mobilizing efforts (Chaskin, 2001). The SNA of the community partner network is part of TBCCN's continuing efforts to develop collaborative models of evaluation for community-based research (Wallerstein, Polascek, & Maltrud, 2002). Employing SNA allowed community partners to visualize their place in the network to more efficiently disseminate information and resources. We presented the findings of our SNA at a quarterly meeting to demonstrate the types of linkages in the network, to show that trust had increased in the network, and to suggest that our partners reach out to other potential partners from either the public or private sector that could assist in the TBCCN's goal to reduce cancer health disparities.

Efforts have been underway to move the quarterly meetings into the community at one of the cancer center's off-campus locations to address the challenges of a geographically dispersed network. In fall 2009, the TBCCN held a partner's retreat in Pinellas County to accommodate regional partners. Although there was discussion of having quarterly meetings at community partner locations, because of the wide geographical dispersion of network partners throughout the tricity area, there was a consensus decision to continue meeting in north Tampa, a convenient and geographically central location for the majority of partner organizations. Despite the geographical challenges, the TBCCN has been successful in disseminating interventions and programs through its innovative approach to developing community outreach programs for the medically underserved (Meade, Menard, Martinez, & Calvo, 2007; Meade et al., 2009).

In a relatively short time, partner organizations became either more or less central to the TBCCN. The ebb and flow of centrality observed from 2007 to 2008 may reflect changes in partner organization's priorities. For example, some community partners engaged in collaborative research grant activities and community health events with the cancer center in 2008. Therefore, although the confirmed density of grant proposal collaboration did not change, different organizations were involved in TBCCN's research activities and small grant award opportunities in 2007 and 2008 to fund meetings, as well as education and screening programs (Luque et al., 2010).

In addition to changes in material linkages, the network saw a significant increase in overall trust in the network. Provan et al. (2005) argue that growing networks may actually produce decreased mean trust values because newly connected partners have not established the trust levels that more established network partners have maintained. In the case of the TBCCN, the same organizations were surveyed in 2007 and 2008, and consequently, positive network collaboration may have led to increased mean trust values in 2008. Importantly, as the hub of the TBCCN, the cancer center's mean trust value approached the high range value in both 2007 and 2008.

Analysis of the data by linkage type differentiated between strong and weak ties. The most robust type of collaboration was sharing information, followed by participating in joint community events and sharing resources. Examples of sharing information at the quarterly meetings included items such as announcements of health fairs, outreach events, and

community forums, such as the TBCCN's hosting of a health literacy town hall meeting in collaboration with the U.S. Department of Health and Social Services and the Centers for Disease Control and Prevention, the biennial Cancer, Culture, and Literacy Conference, grantwriting workshops, dissemination of NCI's Cancer Information Service (CIS) Body and Soul training programs, the annual African American Men's Health Forum, and support groups and programs for cancer survivors (Martinez, Aguado Loi, Martinez, Flores, & Meade, 2008). Collaborating on community events followed from these sharing of announcements, and important service collaborations continue at health fairs that target the medically underserved, combining the efforts of the faith-based migrant clinic (providing free cervical cancer screening [Pap tests]), the cancer center (providing free mammograms), county health departments, and federally qualified health centers (delivering other health and wellness screenings). Finally, sharing resources included tangible items such as the cancer information stations (cabinets with audiovisual and print cancer educational materials from the NCI's CIS, the American Cancer Society, and Susan G. Komen for the Cure), as well as other resources such as time, services, and small grant funding. As of January 2010, seven community partners maintained cancer information stations at their community sites. Referrals and collaborating on grant proposals represented weaker ties, but provide future opportunities for network strengthening.

There are strengths and limitations to this approach to evaluate community health networks. This study is the first published article to quantify the impact of the Community Networks Program for increasing community capacity among partner organizations. The TBCCN is a unique network in the Tampa Bay area because it creates informal linkages between health service organizations, nonprofit organizations, health education organizations, and advocacy groups, some of whom had not previously been connected. Future research will explore whether these new informal ties transform into formal linkages between partner organizations over time. Similar efforts have been underway at the Detroit CNP, according to published conference abstracts (Albrecht & Stengle, 2008; Albrecht et al., 2006). The Detroit CNP demonstrated that one-way relationships from the cancer center to partner organizations evolved over time into bidirectional relationships and resulted in more effective community partnerships. The same phenomenon is occurring in the TBCCN example as evidenced by the significant trend toward increased "any link" multiplexity values and increased confirmed density values from 2007 to 2008. Moreover, as in the Detroit example, the SNA data were communicated to our community partners during our quarterly meetings to assist them in visualizing the resource potential of the network relationships. As additional initiatives that require the involvement of community partners to advance biomedical and social science research continue, SNA serves as a useful tool to measure and evaluate the impact of these partnerships. Another strength was the manageable sample size of 20 organizations, which allowed us to explore the bounded social network without the necessity of securing additional funding to carry out this research project or weaken the results due to high unit nonresponse data.

One limitation of the social network questionnaire was that it was only completed by one member of each organization, and that individual may not have been aware of all the links between their organization and the other network partners. However, those responding were usually senior leadership personnel or someone who was authorized to represent the organization, and there has been little change in the partner representatives who have been attending the quarterly meetings. The social network data were self reported, and even though responses were to be kept confidential, it is possible that some individuals may have been disinclined to report negatively about their network peers because they identified their own organization on the questionnaire, yet there were a few instances where an organization's representative proffered explanations for why their organization did not have a good working relationship with some other organization in the network for various

reasons. However, it would not have been possible to interpret the survey results meaningfully if organizations were anonymous to the researchers. In this article, the six most central organizations are given fictitious acronyms to protect the participating organization's anonymity. Although it is difficult to eliminate the missing data problem in SNA data collection, we are confident that by using imputation by last value carried backward to complete the wave nonresponse data in 2007, we produced valid findings based on our knowledge of the network linkages. Future collection of social network data will further characterize changes in the network as a necessary component of the ongoing process evaluation. Preliminary results from the 2009 SNA survey show that trust and multiplexity values have not changed significantly from 2008 values, with the highest average values attributed to the cancer center based on the partner representatives' pooled responses.

The results of the social network analysis provide preliminary evidence that the formation of TBCCN may have led to greater collaboration and trust among the network members formed through its partner-building efforts. However, there is always the concern that the partnerships approach to capacity building may fail in the absence of sustained funding and the central coordinating role of the grantee (Crisp, Swerissen, & Duckett, 2000). The aim of the current centralized network is to facilitate dissemination of evidence-based materials and practices to impact cancer health disparities. Long-term, the TBCCN will work toward decentralization to empower community organizations, produce positive changes in community health, and foster network sustainability. Social network analysis can be used to improve group processes, provide feedback, and offer a systematic overview of the community network to increase community partner buy-in. A social network analysis of the partnership approach for building community capacity, guided by a coordinating center that promotes and rewards collaborative relationships, provides further evidence that this strategy may be effective for creating sustainable partnerships to promote community health.

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Figure 1.

The Tampa Bay Community Cancer Network diagram of multiplexity, 2008 follow-up data (node size based on betweenness centrality, line size based on tie strength). MCC, Cancer center; FBMC, faith-based migrant clinic; LANNA, local affiliate of national nonprofit A; UCHC, urban community health center; CHD, county health department; LANNB, local affiliate of national nonprofit B; letters A–N, other partner organizations.

Table 1

Centrality, Multiplexity, and Trust Values for Most Central Organizations in the Tampa Bay Community Cancer Network

Organization	<u>Degree centrality</u>		<u>Freeman betweenness centrality</u>		<u>Multiplexity (Scale 0–5)</u>		<u>Trust (Scale 1–4)</u>	
	2007	2008	2007	2008	2007	2008	2007	2008
Cancer Center	19	19	15.3 (1)	23.9 (1)	3.21	3.74	3.4	3.9
Faith-based migrant clinic	10	15	1.9 (10)	10.3 (2)	1.53	1.95	2.0	2.8
Local affiliate of national nonprofit A	13	14	3.2 (7)	9.9 (3)	1.47	1.58	2.2	2.5
Urban community health center	13	15	4.5 (5)	9.7 (4)	0.95	1.05	1.8	1.8
County health department	12	12	2.1 (9)	7.3 (5)	1.53	1.26	1.8	2.2
Local affiliate of national nonprofit B	11	12	2.5 (8)	7.3 (6)	1.10	1.16	1.8	2.4
Mean for all organizations	11.2	9.9	3.9	4.6	1.07	1.10	1.8	2.1 *

Top 6 of 20 organizations ranked in order of their betweenness centrality values in 2008. Individual ranking listed in parentheses next to this value. Multiplexity values range from 0 to 5 for any possible link.

* Wilcoxon Signed Rank test, $p < 0.01$.

Table 2

Confirmed and Unconfirmed Network Values for the Tampa Bay Community Cancer Network: 2007 and 2008

Linkage type	<u>Unconfirmed density</u>		<u>Confirmed density</u>		<u>Mean confirmed links</u>	
	2007	2008	2007	2008	2007	2008
Shared information	.484	.490	.174	.205	3.3	3.9
Referrals	.195	.242	.053	.063	1.0	1.2
Shared resources	.347	.326	.100	.142	1.9	2.7
Collaborated on community events	.321	.311	.121	.147	2.3	2.8
Collaborated on grant proposals	.216	.226	.090	.090	1.7	1.7
Any links ^a			.221	.279 ^b	4.2	5.3

^a“Any links” represents a value of 1 if the partner had any confirmed link of the five linkage types with another partner. Density = actual links/total possible links. Mean confirmed links = total number of confirmed links maintained by the “average” partner.

^b Average bootstrap difference = -0.058, 95% bootstrap CI (-0.10, -0.01).