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Network Analysis of an Organizational Collaboration for Pacific Islander Cancer Control

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Abstract: Community-based participatory research (CBPR) represents a growing research approach for addressing health disparities disfavoring members of racial/ethnic minorities and other underserved populations in the U.S. While such endeavors are often guided by explicit principles regarding the relationships between communities and universities, few studies have reported on the development or strength of such relationships. This paper describes the methods and preliminary results of a cross-sectional analysis of the ties between community and university organizations in a CBPR network to address cancer disparities between Pacific Islanders in Southern California and the general population. These analyses afford a means of representing the collaborative relationships and may enhance tracking improvements in CBPR links for cancer education, research, and training. Such tracking will help concerned parties understand how academic and community groups collaborate and coordinate their efforts to reach shared and overlapping goals.

Key words: Network analysis, cancer control, Pacific Islanders, collaborative research.

Ethnic/racial minority groups and other medically underserved populations experience disproportionately high rates of disease in the U.S.; these health disparities stem not only from medical but also from social and physical/environmental inequalities.¹ Involvement of communities of color in initiatives to address health disparities is essential to offsetting or removing the many individual, organizational, and political factors that underlie them.² An important example is the sharp disparity between Pacific Islanders and others with respect to cancer outcomes. Pacific Islanders in the continental U.S. experience disproportionately high rates of cancer mortality compared with nearly all other racial and ethnic groups in California.³ Importantly, Pacific Islanders have lower rates of screening for colon, breast, and cervical cancers compared with non-Pacific Islanders. For instance, 19.2% of Pacific Islander women ages 40 and older in Southern California reported never having had a mammogram, compared with

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11.1% of non-Pacific Islanders; 18.9% of Pacific Islander women 18 and older reported never having had a Pap test compared with 7.6% of non-Pacific Islanders.⁴ In the first study of Chamorro* women in Southern California, 37% of participants had ever performed a breast self-exam (BSE) and 77% had received a mammogram.⁵ Studies of female Samoans in Hawai'i and California found that only 33% had ever received a mammogram and 63% a Pap smear.^{6,7} Structural barriers confronting Pacific Islanders include lack of health insurance, need for language interpretation, and immigration status problems, while social barriers include cultural modesty and taboos (such as a taboo against discussion of female health concerns with males), and respect for authority (which minimizes patient-provider communication).⁸

Building organizational collaborations (e.g., coalitions) to promote individual, social, and systems-level change is a common approach for addressing health disparities disfavoring ethnic/racial minority groups and other underserved populations.⁹ *Interorganizational theories* are generally interested in understanding the structures and functions of interaction among organizations working together toward a common goal, such as information and resource exchange, and program and service delivery integration designed to make the collaborative stronger than any one partner.¹⁰⁻¹⁵ Community-based participatory research (CBPR) could be viewed as one such organizational collaborative approach, as it is based upon the principles of co-learning between community and research institution members, shared power in decision making, and actions targeting fundamental structural changes for the community.¹⁶⁻²³ The mechanism of CBPR is collaboration between community and university researchers, a highly integrated form of connection that is rooted in interorganizational theories. Many current efforts to reduce health disparities, such as the Centers for Disease Control and Prevention's REACH 2010 (Racial and Ethnic Approaches to Community Health by the year 2010) initiative and the National Cancer Institute's Community Network Programs, have their basis in CBPR.¹⁶⁻²⁵

While collaborative efforts have become common, there are few methods to assess and track the effectiveness of these collaborations. In the interorganizational field, *network analysis* can assess the degree to which and by whom information and other goods are exchanged in the network.^{14,26} For that reason, network analysis is the widely preferred method for evaluating the evolution and effectiveness of collaborative partnerships. Network analysis is a formal method that measures who interacts with whom within a community, enabling researchers to locate partners who are more central to the network, as well as locating those who may be more influential.²⁷ Network analysis can also be used to measure coalition structures and dynamics to explore their capacity to coordinate health promotion efforts and effect policy change.^{26,28}

The aim of this paper is to describe the development of and preliminary results from a network analysis to assess interorganizational relationships within WINCART (Weaving an Islander Network for Cancer Awareness, Research and Training), a Community Network Program funded by the National Cancer Institute's Center to Reduce Cancer Health Disparities to promote cancer control among Pacific Islanders in Southern California.

*The Chamorro are the people of the Mariana Islands, including Guam and the Commonwealth of the Northern Mariana Islands.

The WINCART program grew out of a partnership between university researchers and community-based organizations serving the Chamorro, Marshallese, Native Hawaiian, Samoan, and Tongan populations in Southern California (Los Angeles, Orange, Riverside, San Bernardino, and San Diego counties). Its specific aims concern education, training and research, and include: 1) to develop and implement programs to increase cancer awareness among Pacific Islanders; 2) to improve access to, and utilization of, effective cancer prevention and control interventions among Pacific Islanders; 3) to create opportunities to increase the number of well-trained Pacific Islander researchers through trainings, mentorship, and participatory research projects; 4) to facilitate the development of research grants that address the cancer needs of Pacific Islanders, with a focus on primary (obesity and tobacco) prevention, access and navigation, and survivorship; and 5) to sustain community-based education, training, and research activities by increasing partnerships with governmental and community agencies, funders, and policymakers.²⁹ The structure of WINCART reflects the philosophy of co-learning and collaboration between community and university partners. The Community Advisory Board comprises representatives from each of the eight community-based organizational members, and it guides the development of educational programs, training plans, and research projects. The Scientific Advisory Board comprises 14 cancer control researchers who assist in technical training of community partners, research proposal development, and review. Lastly, WINCART's Steering Committee manages the operation of the network, and includes one representative from each of these boards as well as the Principal Investigator, Program Manager, Research Coordinator, Policy Coordinator, Network Evaluator, Clinical Coordinator, and the NCI Project Officer.

In this paper, we use data collected from a cross-sectional survey of WINCART members to explore two measures of interorganizational networks, *density* and *centralization*, in order to understand how substantively CBPR principles are being embodied in the WINCART collaborative, as well as to determine how to improve WINCART's interorganizational ties for the future.

Methods

Study design. This study had a cross-sectional design and assessed the levels of organizational closeness and prominence in the WINCART network. Data consisted of a self-administered online questionnaire that was completed by network members at the end of the planning phase for the WINCART collaborative. Questions on the survey concerned relationships prior to the formation of WINCART (in 2005) as well as since the formation of the collaborative. Data captured in the later waves will be used as comparison data for changes, if any, within the collaborative over time.

Study measures. Network analysis was used to assess the relationships between organizations in the WINCART collaborative. As noted above, primary measures in network analysis include *density* and *centralization*.²⁷

Density is the proportion of all possible ties actually present in the network and, because it indicates how many connections exist within the network, is a fundamental measure of a network's structure.²⁷ Dense networks have many connections, indicating many opportunities for network members to share ideas and information. Dense

networks also have many redundant pathways connecting members, making multiple transmissions of information across the paths possible. The greater communication is also thought to create more cohesion (e.g., shared goals, purpose, and commitment) within the network. Conversely, sparse networks provide fewer communication pathways and less opportunity for connections. Sparseness may create more fragmentation which may inhibit diffusion or collective action.^{28,30,31} In sum, network density can help to measure the connections and cohesion of a collaborative and also distinguish where there may be opportunities to improve communication and collective action. Analytically, density is:

$$\text{Density} = l/n(n-1)$$

In this equation l is the number of links and n is the network size (number of network members). Density counts the number of reported links and divides by the maximum possible number. Density scores indicate the degree of connectedness among agencies, with higher scores indicating more connections. The closer the density score is to 1.0, the more fully connected the network is.

Centralization describes the extent to which links in the network are organized around one or a few focal points (called *nodes*),²⁷ which can affect the spread of ideas and practices around those points. In centralized networks, central nodes have more influence and control over how ideas and practices spread to others; once central nodes embrace a new idea in a centralized network it can spread rapidly. However, given the position of control in the network, central nodes can also act as bottlenecks and hence slow diffusion.³² Thus, centralization helps to measure how effective collaborations may be with information, dissemination, and influence, with a more equitable sharing of position reflecting the CBPR values of shared power and decision-making. Analytically, centralization is:

$$C_D = \text{sum of } n (\text{Degree}_{\text{Max}} - \text{Degree}_i) / n^2 - 3n + 2$$

Here, D is the number of links received by each person and n is the network size, and centralization varies between 0 and 1 with higher numbers indicating a more centralized network. The closer the centralization score is to 0, the less prominent is any one partner in the network. Both of these measures can be applied easily by means of network analysis programs.

Various aspects of density and centralization were measured between WINCART organizations on the basis of responses from network members to a self-administered online questionnaire. Communication was assessed with two questions regarding whether an organization had ever communicated with another organization, both prior to the start of WINCART and after WINCART's formation in 2005. Since formation of WINCART, whether organizations worked together was assessed with three questions specifically regarding WINCART's aims of promoting education, training, and research. In addition to these network questions, demographic information was obtained on the organizational representatives, including gender, years at organization, organization type (community or university), and organizational services provided. The survey was designed using Survey Monkey, a web-based survey tool.³³

Respondent identification and recruitment. All WINCART community and university organizational partners participated in the survey, representing 5 universities and 9 community-based organizations (for a total of 14 organizations). Members of WINCART from each of these organizations provided the names of up to 10 potential survey respondents who fit the following criteria: 1) they were directly involved with WINCART (e.g., other cancer health educators); 2) they might be involved with WINCART in the future (e.g., the Executive Director or other educators in non-cancer departments); or 3) they would be important to deepening the organizational commitment to WINCART in the future (e.g., members of the Board of Directors). These individuals were also required to have access to the Internet and a valid email address to access the web-based survey. The number of possible respondents per organization varied depending on the size and capacity of the organizations. In some, as many as 14 individuals were identified and invited to participate; for a few organizations, only one individual was identified. Altogether, 122 individuals were identified to participate in the survey, with an average of 9 (range of 1 to 11) possible respondents *per* organization.

The online survey was launched on February 1, 2006 and was accessible for eight weeks. Network members were e-mailed an invitation with a link to the online survey. A month later a reminder was e-mailed, another reminder followed in two weeks, and a final reminder was sent with one week left for access to the survey tool. Incentives were provided via a raffle for all participants who completed the survey. The incentives were gift cards to a local general store. The data collected from the survey was converted into a matrix to yield information on the connections among WINCART members, both before and after the initiation of the network.

Data analyses. The data collected from the online survey tool were exported into Microsoft Excel and then into UCINET for network analyses.^{34,35} The data were also read into GAUSS for creating network indicators and then into Netdraw to create the visualization of the network of communications.^{36,37} All patterns of ties that are reported in this paper are based upon unconfirmed ties, meaning that only one person at an organization had to report the presence of a tie with another organization for the tie to be recorded. Unconfirmed ties are those that are reported by any organizational member of a network, regardless of whether the other organization recognizes and reciprocates that tie, and have been reported because they tend to be more accurate measures of a network's actual relationships.³⁸ (Confirmed ties are those that are agreed upon by both organizations as existing between the two groups, and thus discards data that is from only one organization and forces symmetry, even when relations are not symmetrical to begin with.³⁸ For instance advice-seeking and perceived collaborations are often asymmetric relationships.)

Of the 122 members whose participation we requested, 90 completed the survey (with an average of 6 per organization) yielding a response rate of 74%. At least one member from each network organization completed the survey. These 90 respondents were grouped into 14 organizations, allowing for analysis by type (community or university). All survey respondents were included in the analyses.

Results

Demographics of the organizational representatives (N=90) responding to the network survey are shown in Table 1. Respondents represented a diverse mix of staff, managers/administrators, Board members, members, and faculty. Nearly two thirds of the participants were female, with an average of nearly 10 years at the agency s/he represented. Nearly two thirds were from community (rather than university) organizations, with the organizational services provided ranging from health education (82% of organizations) to cancer policy (35% of organizations).

Graphic depictions of the general communication links between all WINCART organizations (n=14, including all 5 university and 9 community organizations) before WINCART and since the inception of WINCART in May 2005 are displayed in Figure 1

Table 1.

DEMOGRAPHICS OF RESPONDENTS (N=90)

Demographics	Mean (SD)	Percent
Gender		
Male		35.6
Female		64.4
Years at organizations	9.58 (8.45)	
Respondent type ^a		
Administrator/manager/director		18
Board member		8
Faculty		15
Member		6
Staff		22
None (did not designate)		21
Organization type		
Community		63.7
University		36.3
Types of organizational services ^b		
Health education		82.4
Health services		26.4
Advocacy services		38.5
Referrals to outside agencies		41.8
Cancer screening		29.7
Cancer diagnostics		11.0
Cancer treatment		11.0
Research on cancer		47.3
Policy work on cancer		35.2

^aSelf-identified categories by survey respondents.

^bTotals exceed 100% because respondents could answer "yes" to more than one answer category.

and Figure 2, respectively. The data in the diagrams represent the aggregated responses of the 90 respondents into organizational categories (community or university organization). Each line in the graphs represents communication from one organization to the other, with arrows indicating whether the communication was unidirectional or bidirectional. Organizations that have more links occupy more central positions. In both figures, university and community organizations hold central positions, although since inception of WINCART it appears that universities occupy more central nodes. These two diagrams represent only communication among WINCART agencies before and since WINCART's inception and do not graphically depict the network data for cancer education, research, or training.

Density and centralization scores for the network are reported in Table 2; they measure links (1) before the formalization of the network, (2) since the network has been funded, and (3) specifically regarding cancer education, training, and research since the network has been funded. Density (again, representing the extent to which all organizations are connected and showing the proportion of all possible ties in the network) was highest (.654) prior to the start of the WINCART network, indicating that more than half of the total number of possible links between partners existed at that time. Since the start of WINCART, density decreased between partners, with fewer links existing specifically for cancer education (density=.429), training (.423) and research (.390). This shows that while efforts in cancer education, training, and research exist, the proportion of possible links within the network that actually exist

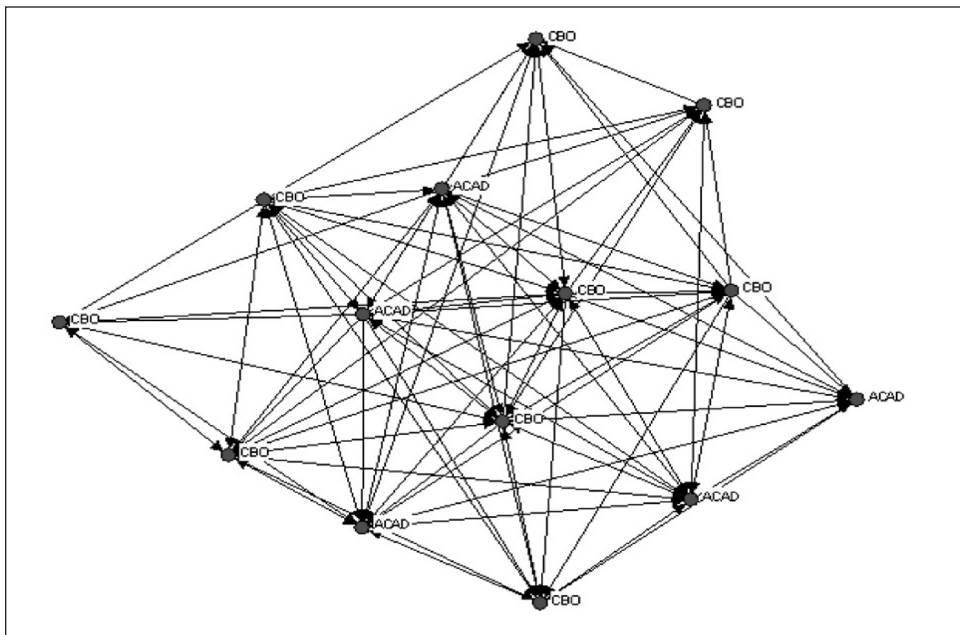


Figure 1. Communication in the collaborative network before WINCART (n=14).
 ACAD = university organization
 CBO = community organization

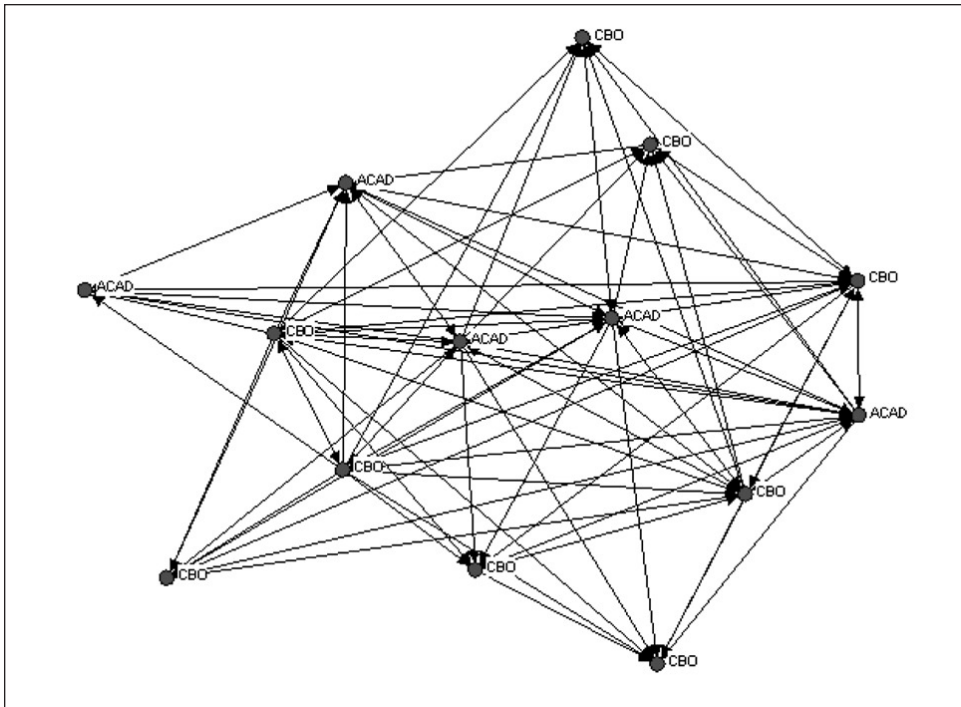


Figure 2. Communication in the collaborative network since WINCART (n=14).
 ACAD = university organization
 CBO = community organization

in these specific areas are low, and underscores the potential for strengthening the organizational linkages in these three specific areas (in the hope that future network density measures would approach 1.0).

Centralization scores for the network were quite different, depending upon the time period that respondents were asked to consider. (Readers will recall that centralization describes the extent to which links are organized in the network among a few specific points/agencies.) Prior to the inception of WINCART, communication centralization was high (.314) implying a larger number of key organizations initiating collaboration and/or partnerships. This larger number of both university and community organizations as central to the network is depicted in Figure 1. However, since the inception of WINCART, communication centralization was much lower (.141) implying that the network contained fewer organizations that were actively sharing information regarding WINCART-specific aims. Figure 2 depicts the network as having both community organizations and universities holding central positions, which implies that the network is less centralized and broader than before WINCART. Interestingly, as shown in Table 2, since inception of WINCART centralization varies by network aims. Cancer education had the lowest centralization score (.308), while cancer training (.314) and cancer research (.353) had higher centralization scores, indicating more prominence of certain organizations in these activities.

Table 2.**NETWORK DENSITY AND CENTRALIZATION (N=14)^a**

	Density	Centralization
Communication before WINCART	.654	.314
Communication since WINCART	.571	.141
Cancer education since WINCART	.429	.308
Cancer training since WINCART	.423	.314
Cancer research since WINCART	.390	.353

^aThe closer the density score is to 1, the more fully connected the network. The closer the centralization is to 1, the more centralized the network.

Conclusions

This study examined the inter-organizational linkages among 14 organizations working together to reduce cancer health disparities affecting Pacific Islander communities in Southern California. Network analysis was used to measure the connections between WINCART organizations in terms of communication and collaboration on various categories of cancer control topics, with the long-term goal of strengthening ties between all members over the course of the 5-year effort.

Perhaps surprisingly, prior to the start of WINCART, the number of links between organizations was high. As described by Tanjasiri et al., the WINCART network may be unique in that it was founded by a group of community and university partners that had a long history of previous CBPR collaboration.²⁹ For example some of these collaborative partners (such as one of the Chamorro, Samoan, and Tongan agencies) had worked together on previous collaborative grants (a CDC REACH 2010 project) that promoted a social-ecological program to increase breast and cervical cancer screenings in Southern California.² Other collaboratives and coalitions may not yield high density, as a result of a lack of existing relationships and trust in sharing information and resources. What was surprising to us, however, was how much density has decreased since WINCART began. While we do not have survey data to support this, our community partners have told us that the decrease reflects the more specialized focus of WINCART's aims on cancer education, training, and research, which are different from their previous collaborative efforts.

This decrease in density represents an important challenge for our network, and we are currently exploring different ways to strengthen links with WINCART as well as outside, with external organizations (such as medical providers, hospital systems, and policymakers). It is our hope that the various strategies employed by the network (such as trainings and celebratory retreats for network members, CBPR skill-building workshops, and joint proposal development)²⁹ will add to the quantity and quality of ties between network members over time. Such an increase in density, we believe, is at

the heart of the CBPR principle of participation and co-learning among all collaboration members. Increased density would signify greater connectedness among agencies and perhaps between university and community partners. Increasing density, without attention to the quality of the relationships and their distribution among agencies, is neither a necessary nor a sufficient condition for successful collaboration.²⁸ Over time it is anticipated that if density increases then centralization decreases and the quality of the relationships improves (in keeping with the principles of CBPR, which is intended to cultivate an inclusive, co-learning, and shared power relationship).

The relatively low centralization scores of our network since the inception of WINCART indicate that we already possess a large core of organizations that include both community and university partners. We believe that these low centralization scores reflect a level of shared participation that is a hallmark of the WINCART's approach to CBPR,^{2,11} although we will be monitoring whether community organizations occupy more central nodes (in subsequent surveys of our network) to gauge whether network influence can truly be called shared. There are very few organizations that can claim to have all the information or resources in cancer education, research, and training. However, where this is the case, we hope to increase links to create a wider network of resources for all members. Other collaboratives or coalitions that do not have a strong history of working together may expect to see much higher centralization initially, with a small number of groups wielding control and influence over the network. If that proves to be the case, they are encouraged also to use strategies that promote increased participation in power sharing and decision making.

While the findings of the present study provide insight into the types of links that can exist in the development of a CBPR collaborative, the data concern only one network. Questions about the network that delved into areas other than measurement of density and centralization might have given a different picture of WINCART's development. Furthermore, selected survey participants may have influenced the findings in this study. Due to the different types of people within an organization who could respond to the survey, the lack of organizationally equivalent respondents from each agency may have biased the results towards the perspective of the larger organizational network members. For instance, there may have been a selection bias in that those who chose to participate may have been in organizations more actively engaged in relevant work prior to WINCART (e.g., community organizations rather than universities). These data also only reflect change as of one point in time and thus do not reflect overall network trends or dynamics.

Over the life of the program, WINCART hopes to continue to support the capacity-building of community organizations to define and create their own educational, research, and training efforts to address the multiple causes of cancer disparities in the populations to which they are dedicated. These data provide a baseline for WINCART and will be used to evaluate how our network develops and deepens the ties between community and university organizations, with the hopes of creating truly shared partnership and ownership in this CBPR process. We also hope that this network analysis will be helpful to others interested in developing similar collaboratives to address health disparities. As WINCART develops, we also hope to be able to observe the effects of changes in density and centralization on the number, quality, and effects of WINCART

initiatives to increase cancer control indicators (such as risk reduction and early detection behaviors) in this greatly underserved population. This study contributes to the growing literature on understanding and measuring CBPR collaboratives, as well as addressing how networks can exemplify the values of community capacity-building and empowerment that are at the core of cancer health disparities research.

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