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Strengthening suicide prevention networks: Interorganizational collaboration and tie strength



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ABSTRACT

One explanation for the continued high rates of suicide in the United States may be insufficient coordination between organizations involved in prevention. Therefore, the factors that promote interorganizational collaboration should be identified and fostered. Surveys were administered to 37 organizations involved in suicide prevention in one Colorado community to: (1) assess the nature of collaboration and (2) identify relationship strength indicators associated with different types of collaboration. Results were examined using social network and regression analyses. Organizations reported more sharing information and resources and sending and receiving referrals than developing service infrastructure and coordinating training and screening activities. Some types of organizations were more connected than others, and the influence of relationship strength indicators was mostly consistent across different types of collaboration. This study offers new insight into the structural and relational aspects of interorganizational collaboration in suicide prevention and may serve as a model to better understand networks within other community health settings.

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Fortalecimiento de las redes de prevención del suicidio: colaboración interorganizativa y fuerza del lazo

RESUMEN

Una explicación de la continuidad de las altas tasas de suicidio en los Estados Unidos puede ser la insuficiente coordinación entre las organizaciones que participan en su prevención. En consecuencia debemos identificar y fomentar aquellos factores que promueven la colaboración entre organizaciones. Se encuestaron 37 organizaciones implicadas en la prevención del suicidio en una comunidad de Colorado para (1) evaluar la naturaleza de la colaboración y (2) identificar indicadores de la fortaleza de las relaciones asociados con los diferentes tipos de colaboración. Los resultados se examinaron con análisis de redes sociales y análisis de regresión. En la relación entre las organizaciones fue más frecuente el intercambio de información y recursos, así como la derivación de usuarios, que el desarrollo de la infraestructura de los servicios, la coordinación de la formación o las actividades de detección. Unos tipos de organización estaban más conectadas que otras, y la influencia de los indicadores de intensidad de la relación eran en su mayor parte consistentes en los diferentes tipos de colaboración. Este estudio ofrece una nueva visión de los aspectos estructurales y relacionales de la colaboración interinstitucional en la prevención del suicidio y puede servir de modelo para entender mejor las redes en otros entornos comunitarios de salud.

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Introduction

With worldwide trends demonstrating an overall increase in suicidal behaviors, suicide is a major global public health concern (Hoven, Mandell, & Bertolote, 2010). At present almost one million people die by suicide worldwide each year (World Health Organization (WHO), 2012), and it is predicted there will be almost 1.5 million suicides per year by 2020, with nearly 10 times that number making a suicide attempt (Hoven et al., 2010). Despite extensive prevention efforts, suicide continues to be the tenth leading cause of death in the United States (Centers for Disease Control and Prevention (CDC), 2012). In 2010, over 38,000 people died by suicide and more than 487,000 were treated in emergency rooms due to self-inflicted injuries.

Colorado ranks as having one of the highest suicide rates in the country, making suicide a particularly salient concern in this state (American Association for Suicidology (AAS), 2012). In 2009, Colorado experienced the highest suicide rate in over two decades; the number of people who died by suicide surpassed the total number who died in car crashes (The Colorado Trust, 2009). A combination of factors, such as geographic isolation due to low population density, high rates of migration into the state and the associated disconnection from established support systems, higher rates of gun ownership compared with other states, stigma surrounding accessing mental health services, and limited availability of mental health services have been cited to explain these high rates (The Colorado Trust, 2009).

In addition to the devastation experienced by those affected by suicide and related behaviors, there is an enormous financial burden. In Colorado, the combination of direct and indirect costs related to suicidal behaviors has been estimated at more than \$1 billion annually (The Colorado Trust, 2009). Direct costs include criminal investigations, health care expenses, and autopsies. Indirect costs include workforce losses primarily due to high rates of suicide among youth.

Due to the diverse needs of suicidal individuals and the disabling nature of severe mental illness that prohibits at risk individuals from receiving appropriate treatment, many have argued for community-based systems of care (Callaly, Berk, & Dodd, 2009; Provan & Milward, 1995). In fact, in 2012 The National Strategy for Suicide Prevention, a strategic planning initiative spearheaded by the U.S. Surgeon General, called for a broad public health-based approach to suicide prevention (U.S. Department of Health and Human Services (DHHS), 2012). One of the core objectives of the strategy is to enlist support for suicide prevention activities from “all organizations and programs that provide community services and support in the community” (DHHS, 2012, p. 30). In the United States, there are a number of community organizations and social institutions—including those from healthcare, government/human services, law enforcement, education, religious organizations and the non-profit sector—that play a direct or indirect role in suicide prevention through education and awareness raising, screening, referrals, treatment, and support services.

There is growing evidence that community support networks can have a meaningful impact on suicide prevention efforts. Fountoulakis, Gonda, and Rihmer (2010) conducted a global review of community education-based suicide prevention interventions. Although all programs reviewed were found to effectively increase knowledge and change attitudes related to suicide, a reduction in suicide rates was only evident in programs that included the establishment of a community support network as a critical intervention component. Cooper, Lezotte, Jacobellis, and DiGuseppi (2006) documented the impact of a community support network as a means of secondary suicide prevention in Colorado. They reported that the presence of a variety of safety net services (e.g., education, gatekeeper training, case and crisis management, ongoing mental

health treatment, peer support groups) provided by different organizations in a county was significantly associated with reduced risk of suicide and of suicide attempts one year after an index attempt. These findings demonstrate the value of providing a comprehensive set of services to address the multiple factors that influence suicidality.

Yet, the mere presence of a community safety net of organizations is not sufficient—it is also important to consider how the accessibility and availability of services might be enhanced or impeded by interorganizational collaboration. The demand placed on families and individuals to navigate multiple disjointed organizations has been well documented (Sloper, 2004). Some challenges include difficulty acquiring information about available services across organizations, receiving conflicting advice, and situations in which the needs of suicidal individuals fall into gaps between the provision of services by different organizations (Sloper, 2004). Collaboration between organizations involved in suicide prevention can help to integrate service provision through enhanced communication between service providers and reduced duplication of effort across organizations. Collaborative systems of care that provide integrated services across community organizations have been found to be effective in reducing the recidivism of unhealthy and undesirable behaviors and in enhancing the effectiveness of community services (e.g., Saewyc, Solsvig, & Edinburgh, 2008; Zhang & Zhang, 2005).

It is increasingly important to foster collaboration between community organizations involved in suicide prevention in order to ensure timely and accessible services for those in need. However, knowledge regarding exactly how organizations involved in community suicide prevention collaborate with one another and how collaboration could be strengthened is lacking. An understanding of the network of organizations involved in suicide prevention can help the community as a whole by informing ways to improve system efficiency and to increase access to services. It can also help the organizations within the community gain insight into how their programs and services fit within the broader network. The present study employed a network approach to gain a better understanding of interorganizational collaboration regarding suicide prevention in one Colorado community.

Assessing interorganizational collaboration: a network approach

Although organization staff may recognize the need for an optimally efficient and effective system of care, it is difficult for them to objectively evaluate the functionality and strength of collaborative relationships across community organizations. Organization staff tend to have their own agendas, service orientations, funding sources, and personal relationships which do not always align with the complex needs of the populations they serve (Provan & Milward, 2001; Provan, Veazie, Teufel-Shone, & Huddleston, 2004). Thus, organization staff has a tendency to view the community system from the perspective of their own organization and how it affects or is affected by relationships with other organizations (Provan, Veazie, Staten, & Teufel-Shone, 2005). Obtaining an objective view of the presence and nature of collaborative interorganizational relationships requires a systematic process that is inclusive of the perspectives of staff from all organizations.

Network analysis is a technique for studying the relationships across and between multiple individuals, groups or organizations. In network analysis, network members are asked to indicate their relationships with other network members and the data collected is analyzed to identify patterns and characteristics that can be used to describe the reported relationships. The network perspective maintains that: (1) the individuals in a network are embedded in an exchange of relationships; (2) the exchange of relationships is governed by the structural patterns found within the network; and

Table 1

Summary of the dimensions of network analysis examined in the present study.

Network characteristic	Assessed by	Questions that can be addressed related to community suicide prevention
Network cohesiveness (aka density)	The number of observed connections between organizations in proportion to the total number of possible connections	<ul style="list-style-type: none"> - In which ways are organizational collaborating the most/least with other organizations? - Are there certain ways organizations should be collaborating more with one another?
Organizational prominence (aka centrality)	The number of direct connections each organization has with other organizations.	<ul style="list-style-type: none"> - Which organizations are collaborating with other organizations the most? Can these more prominent organizations play a role in strengthening ties between other organizations? - Which organizations are collaborating with other organizations the least? Are these organizations underutilized resources? Should efforts be made to get them more involved?
Relationship strength (aka tie strength)	Assessed in this study as communication frequency, level of trust, and presence of informal relationships between organizations	<ul style="list-style-type: none"> - How strong are the relationships between organizations? For example, <ul style="list-style-type: none"> - How often do the organizations communicate with one another? - How high is the level of trust between organizations? - Do employees have informal relationships with individuals from other organizations?

(3) the content and structure of the relationships in a network determine the opportunities and constraints of individuals and groups (Kilduff & Brass, 2010). In a review of interorganizational network studies, Provan, Fish, and Sydow (2007) found support for the notion that the structure of a network, the position of each organization within the network, and the nature of relationships across and between organizations have significant influence on the functioning of a network.

Many have argued that there is no “one size fits all” network, but rather, that the ideal structure and characteristics will largely depend on the particular context and desired outcomes of the network (Cross, Dickmann, Newman-Gonchar, & Fagan, 2009; Feinberg, Riggs, & Greenberg, 2005; Provan et al., 2007). Within the network of organizations involved in suicide prevention, the goal of collaboration is to offer a flexible and accessible system of care through enhanced coordination of diverse services to meet client needs (Fleury & Mercier, 2002). Keeping this network objective in mind, the present study explored three network dimensions that may influence interorganizational outcomes and effectiveness: network cohesiveness, organizational prominence, and relationship strength (see Table 1 for a summary of these network dimensions).

Network cohesiveness (density)

The concept of network cohesiveness has commonly been defined as density (Kilduff & Brass, 2010). Density is measured by the number of connections between organizations in a network in proportion to the total number of possible connections across all organizations (Hanneman & Riddle, 2005). Density scores have a possible range from zero to one; zero indicates no collaboration across organizations and one represents a network in which all organizations collaborate with one another. Examination of density scores across different types of collaboration can demonstrate ways in which organizations are collaborating most and least.

There is a distinction to be made between confirmed and unconfirmed density scores. Confirmed density scores are those in which the presence of a relationship was indicated by both organizations, while unconfirmed density scores are those in which only one organization indicated having a relationship with the other organization. Confirmed density scores are typically considered to be more trustworthy indicators of network activity, while unconfirmed density scores can be useful in identifying weak relationships that could be strengthened (Provan, Harvey, & de Zapien, 2005).

Evidence suggests that higher density results in more opportunities for collaboration, innovation implementation, and sharing of resources and complex knowledge (Balkundi & Harrison, 2006; Kilduff & Brass, 2010). Higher network density has also been associated with clearer, more firmly held, and more easily monitored and sanctioned behavioral norms because the individuals in a dense network are more connected with one other and share more common contacts (Berardo, 2009; Granovetter, 2005). These findings suggest that higher density may have a positive influence on the readiness, effectiveness, and sustainability of a collaborative interorganizational network.

While higher density scores indicate a greater degree of cohesiveness and are generally associated with greater social capital and potential for success in community networks (Lee et al., 2012), it should be noted that the ideal density depends on the context of each collaborative domain. For instance, when it comes to sharing information, having a very high degree of cohesiveness across organizations may be desirable, whereas in terms of sending referrals, a high degree of cohesiveness may result in redundancies or errors in network functioning. For instance, if all organizations were sending referrals to all other organizations, certain organizations may not have the capacity to receive referrals and would need to refer individuals to other organizations, thus delaying access to required services.

Organizational prominence (centrality)

Another way interorganizational network analysis can provide useful insights is through the examination of organizations that are most and least prominent within the network (Provan, Veazie, et al., 2005). Organizational prominence is commonly captured by a measure called centrality, which reflects the number of direct connections each organization has with other organizations (Provan, Veazie, et al., 2005). Organizations that have higher centrality are thought to have greater access to power and control over the flow of information and resources, and thus are considered to be more influential and powerful (Boje & Whetten, 1981). Additionally, having more connections with other organizations may indirectly improve service quality through increased opportunities to learn from those providing similar services.

Relationship strength (tie strength)

It is also important to examine relationship characteristics that may be associated with enhanced collaboration. The strength

of relationships between organizations in a network, commonly referred to as tie strength, can be conceptualized and measured in multiple ways (Kilduff & Brass, 2010). Previous research has demonstrated that strong ties—in the form of frequent communication (Green, Rockhill, & Burrus, 2008), high levels of trust (Provan et al., 2004), and the presence of informal relationships (Pina-Stranger & Lazega, 2011)—have been associated with enhanced interorganizational collaboration.

Communication frequency

Communication frequency has been established as a critical prerequisite for effective interorganizational collaboration (Corteville & Sun, 2009; Green et al., 2008; Okamoto, 2001). Within an interorganizational collaborative context, communication can be defined as “the channels used by collaborative partners to send and receive information, keep one another informed, and convey opinions to influence the group’s actions” (Pina-Stranger & Lazega, 2011, p. 23). Simply stated, organizations that communicate more frequently with one another are more likely to share information and collaborate than those with less frequent communication (Reagans & McEvily, 2003). Communication frequency may also lead to more effective interorganizational communication through the development of relationship-specific heuristics (Uzzi, 1997).

Trust

Trust is another key indicator of tie strength that has been established as important for enhancing interorganizational collaboration (Greenberg & Rosenheck, 2010; Van Eyk & Baum, 2002). Mutual trust allows network members to share information, risks, and opportunities more freely and easily (Carley, 1999; Comfort, 1999; Hardin, 1982), and is thought to nurture confidence that shared knowledge will not be misused or appropriated (Krackhardt, 1990; McEvily, Perrone, & Zaheer, 2003). In numerous examples, trust has been associated with the emergence of cooperative behavior (Coleman, 1990; Lubell, 2007; Ostrom, 1990), and some have even asserted that trust is a “necessary condition” that must be present in order to successfully reach agreement between opposing viewpoints (Berardo, 2009). Overall, relationships characterized by higher levels of trust are more likely to be supported and maintained, especially when it comes to more time and energy intensive types of collaboration (Provan et al., 2004).

Informal relationships

The importance of informal relationships as a measure of tie strength has also been recognized among network researchers (Krackhardt & Stern, 1988; Pina-Stranger & Lazega, 2011). Informal relationships, such as friendships, are characterized by higher levels of emotional attachment and commitment than formal relationships and have been associated with higher levels of motivation to invest time and energy, share information, provide assistance, and reciprocate services and favors (Reagans & McEvily, 2003). Research has found informal relationships to be associated with reinforced collaboration, improved quality of exchanges, enhanced performance, and reduced interorganizational competition (Ingram & Roberts, 2000; Lazega, Jourda, Mounier, & Stofer, 2008).

In sum, the importance of strong ties within networks as measured through communication frequency, trust, and informal relationships has been established within the context of enhancing interorganizational collaborative strength. However, there has been a lack of focus regarding how these various forms of tie strength may differentially impact different types of collaboration. A greater understanding of how different types of collaboration are affected by the strength of interorganizational relationships can have significant bearing on attempts to improve collaborative outcomes, such as effective service coordination and referrals.

The present study

In order to fill the current knowledge gap regarding interorganizational collaboration in suicide prevention, the present study utilized social network analysis to examine seven types of collaboration—information sharing, resource sharing, developing service infrastructure, sending referrals, receiving referrals, coordinating training activities, and coordinating screening activities—among organizations involved in suicide prevention in one Colorado community. A network approach has not yet been implemented in the context of suicide prevention. The first goal of this study was to assess the overall network density and the centrality of organizations across each type of interorganizational collaboration. The second goal was to investigate if different aspects of tie strength—namely trust, communication frequency, and informal relationships—are more strongly associated with different types of collaboration. Understanding the associations between indicators of tie strength and types of collaboration can help to increase awareness regarding the relationship characteristics that can be strategically developed and reinforced to enhance different types of collaboration.

Due to the exploratory nature of this study, the research questions of interest are descriptive, rather than inferential. The following questions will be addressed:

Research Question 1: What is the degree of cohesiveness (i.e., density) across organizations for each type of collaboration? In which ways do organizations collaborate the most/least?

Research Question 2: Which organizations collaborate with others the most/least across each type of collaboration (i.e., centrality)?

Research Question 3: Are different types of relationship (tie) strength (i.e., communication frequency, trust, informal relationships) more strongly associated with different types of interorganizational collaboration than others?

Method

Sample

Community selection

The researchers, in cooperation with the Colorado Department of Public Health and Environment (CDPHE) Office of Suicide Prevention (OSP), selected the community to participate in the study based on accessibility and high suicide rates compared with other communities in Colorado. A suicide prevention non-profit organization in the community acted as a liaison between the research team and participating organizations (and will henceforth be referred to as the “liaison organization”).

Organization selection

Participating organizations were selected based on their involvement with suicide prevention according to a broad definition including services related to prevention, intervention, postvention, mental health, education, training, awareness, and support groups. First, geographic boundaries were determined by generating a list of zip codes for the community, and an initial list of all organizations involved in suicide prevention who reside within 10-miles beyond the zip code boundary was generated by the liaison organization. The initial list was circulated to primary network contacts to solicit suggestions for the inclusion of additional organizations. Organizations were added through a “snowball” process if at least two primary network contacts advocated their inclusion. A total of 46 organizations were identified, including broad representation from mental health providers, government/social

services, education, law enforcement, religious organizations, and the non-profit sector.

Instrumentation

The research team, in collaboration with the OSP, solicited opinions from subject matter experts (SMEs) regarding the types of collaboration relevant to a suicide prevention network in Colorado. SMEs identified 11 types of collaboration, which they were then asked to rate by level of importance. A survey was generated to assess interorganizational collaboration across the seven types of collaboration identified by SMEs as most essential to an effective suicide prevention network: sharing information; sharing resources; developing service infrastructure; sending referrals; receiving referrals; coordinating training activities; and coordinating screening activities. Types of collaboration were limited to seven to reduce the respondent burden inherent in social network analysis surveys (i.e., due to the fact that respondents are asked to report on relationships with all network members). Survey questions were also developed to assess the three tie strength indicators: communication frequency, trust, and informal relationships. Communication frequency was assessed on a scale of 1 (none) to 6 (more than one time per week), and trust was assessed on a scale of 1 (marginal) to 6 (excellent). For informal relationships, participants were asked to indicate if they had friends, former coworkers and/or “other” informal relationships working at other organizations.

The first part of the survey included demographic questions regarding total number of staff and volunteers, number of staff and volunteers dedicated to suicide prevention, number of suicide prevention services offered, and number of funding sources received for suicide prevention. The second part of the survey included a matrix with a list of all organizations identified as being part of the network in the far left column, and the seven types of collaboration and three tie strength indicators across the top row. This format allowed for respondents to indicate types of collaboration and relationship strength ratings for each organization on the list. The survey was piloted with an organization involved in suicide prevention in another Colorado community, and final revisions were made based on the feedback received. This pilot process confirmed that the survey would take a minimum of one hour to complete, and that inclusion of additional types of collaboration (i.e., beyond seven) would significantly increase respondent burden.

Procedure

All materials and procedures were approved by the Colorado State University Institutional Review Board before the initiation of the study.

Recruitment

Each organization was contacted and asked to recruit an executive level administrative professional and a direct service staff to be surveyed. It was specified that these two individuals should possess in-depth knowledge of the organization's services and operations, and, in particular, be familiar with the organization's suicide prevention services. When it was not possible to recruit both an executive level administrative professional and a direct serve staff, two individuals were recruited based on availability. Participation was encouraged by offering organizations a high-level report of the findings. Upon agreeing to participate, a time was scheduled for the two individuals to be surveyed simultaneously.

Survey administration

Surveys were administered in person, on-site at each organization. Participants completed the first part of the survey regarding

basic demographic information (e.g., type and size of organization, suicide prevention services provided, funding sources). For the second part of the survey, they were asked to go through each organization on the list one at a time and indicate if they engaged in each of the seven types of collaboration with that organization. The two participants were asked to fill out one survey together and were encouraged to talk through discordant opinions and come to consensus when necessary. If they agreed on a shared relationship, they were instructed to place a “X” in the corresponding matrix cell. If a “X” was placed in at least one of the seven cells (i.e., indicating at least one type of collaboration), participants were further instructed to provide tie strength ratings for that organization. Survey instructions encouraged participants to consider a broad definition of suicide prevention (i.e., inclusive of prevention, intervention, postvention, mental health, education, training, awareness, and support groups). Instructions also asked participants to focus on their relationships with other organizations over the last 12 months when completing the survey, with the exception of a shorter, 3-month retrospective period for communication frequency. A set of laminated cards with definitions of the seven types of collaboration as well as definitions and rating instructions for the three tie strength indicators was provided to each participant to use as a reference while completing the survey. Confidentiality was assured by informing participants that only the aggregated results would be included in the final report and future publications, and verbal consent was acquired from both individuals prior to proceeding with the survey. A member of the research team walked participants through the process for the first organization on the list as an example and remained available in the event that any questions surfaced throughout the process. The survey took approximately one to one and a half hours to complete.

Data analysis

Data analysis included two components. First, social network analysis was used to assess overall network density and centrality scores for each organization across the seven types of collaboration. Then, correlation and regression analyses were conducted to examine the relationships between centrality scores across the seven types of collaboration (outcome variables), the three tie strength indicators (predictor variables), and control variables. All analyses were conducted utilizing the software program, UCINET 6 (Borgatti, Everett, & Freeman, 2002).

Density

In order to answer the first research question, (i.e., What is the degree of cohesiveness across organizations for each type of collaboration?), both confirmed and unconfirmed density scores were calculated for the seven types of collaboration.

Centrality

To answer the second research question (i.e., Which organizations collaborate with others the most/least across each type of collaboration?), centrality scores were calculated by measuring the number of direct links for each organization for all seven types of collaboration (Hanneman & Riddle, 2005). Before calculating centrality scores, data for each type of collaboration were symmetrized according to the maximum rule, which assumes that all ties are reciprocated. In other words, if organization A reported a relationship with organization B, but organization B did not report a relationship with organization A, the symmetrized matrix of data will assume a relationship exists. This approach is justified, as the two individuals surveyed may not have been aware of *all* of the collaborative relationships their colleagues maintained with other

organizations and therefore may have underestimated the reciprocity of interactions.

Correlation and regression analyses

To answer the third research question, (i.e., Are different types of relationship strength more strongly associated with different types of interorganizational collaboration than others?), exploratory correlation and regression analyses were conducted. Network data is inherently relational, and therefore it is not reasonable to assume independence of observations. To account for this, a non-parametric, bootstrapping method, known as Quadratic Assignment Procedure (QAP), employing random sampling across thousands of trials, was used to calculate sampling distributions from the observed network data (Hanneman & Riddle, 2005). In this case, all correlation and regression analyses were run with 10,000 permutations and were conducted using the following variables: centrality scores for the seven types of interorganizational collaboration (outcome variables), centrality scores for the three tie strength indicators (predictor variables), and four control variables. Use of centrality scores for outcome and predictor variables was justified since the research questions were interested in overall network activity, as opposed to activity at the level of organizational dyads. A number of steps were taken in order to prepare the data for correlation and regression analyses, which will be described in the forthcoming paragraphs.

Due to the fact that QAP only allows for data to be entered in matrix form, centrality scores for the seven types of interorganizational collaboration were converted into difference matrices prior to analysis. Difference matrices are created by calculating the difference in scores between each organization and each other organization in the network. As a result, if an organization has a higher score than another organization, they will have a positive value in the matrix and if an organization has a lower score than another organization, they will have a negative value in the matrix.

As for the tie strength indicators, communication frequency and trust scores were calculated by symmetrizing the data according to the average rule, which takes the ratings provided by each organization and the ratings other organizations provided for that organization and creates an average of the two (Hanneman & Riddle, 2005). In this way, both organizations' subjective perspectives of communication frequency and trust were equally accounted for. Informal relationships were examined by first symmetrizing the data according to the maximum rule. Again, symmetrizing in this way assumes that all ties were reciprocated. After symmetrizing, a summed matrix was created reflecting the total number of types informal relationships (i.e., between zero and three) each organization reported sharing with each organization on the list, including friendships, former co-workers, and other informal relationships. Centrality scores were then calculated for the three types of tie strength. These scores represent an aggregate of the tie strength scores each organization had with each other organization. Finally, to make them suitable for QAP, centrality scores for the tie strength indicators were converted into difference matrices.

Because an organization's level of involvement in and resources for suicide prevention activities (including human capital and financial resources) could influence the extent to which they collaborate with other organizations, four control variables were included in the analyses: (1) total number of staff and volunteers, (2) total number of staff and volunteers involved in suicide prevention, (3) total number of funding sources for suicide prevention, and (4) total number of services provided related to suicide prevention. All control variables were also converted into difference matrices.

To recap, the outcome variables were the centrality scores across the seven types of collaboration, the predictor variables were the centrality scores for the three tie strength indicators

(communication frequency, trust, informal relationships), and the four control variables were the totals as described above. All variables were converted into matrix form prior to conducting QAP analyses.

Correlation analyses were run to assess the strength of association between all study variables and to determine which control variables to include in the regression models. Multiple regression models were then constructed for each outcome variable (i.e., for of the seven types of collaboration). In the first model for each outcome variable, significantly correlated control variables were entered. Then, significantly correlated tie strength indicators (i.e., predictor variables) were entered, one at a time, in order of decreasing correlation with the centrality scores, as has been done in previous studies (Brewer, Kramer, & Sawtelle, 2012).

Models were then compared to determine the best fitting model for each type of collaboration using z-tests to test the significance of the difference between each set of predictors by comparing their correlated correlations as described by Steiger (1980) and Tabachnick and Fidell (2007). The difference between the correlation of the outcome variable and first set of predictors (r_{ya}) and the correlation of the outcome variable and the second set of predictors (r_{yb}) was compared to determine if there was a statistically significant difference between the two sets. Final models were selected to make the best prediction for each outcome variable while using the least number of control and predictor variables (Brewer et al., 2012).

Results

A total of 37 of the 46 organizations invited (80.4%) completed a survey. Participating organizations included representation from mental health providers ($n = 3$), government/social services ($n = 2$), education ($n = 4$), law enforcement ($n = 6$), religious organizations ($n = 3$), and the non-profit sector ($n = 19$).

Density

Network density scores were calculated for all seven types of collaboration (see Table 2). The highest density scores were found for information sharing and sending and receiving referrals. There were fewer connections in resource sharing and even fewer in developing service infrastructure and coordinating training and screening activities. Unconfirmed density scores were higher than confirmed density scores across all seven collaborative domains.

Table 2

Confirmed and unconfirmed number of ties and density scores across seven types of collaboration, Colorado community suicide prevention network.

Type of collaboration	Confirmed		Unconfirmed	
	Number of ties	Density	Number of ties	Density
Information sharing	312	.23	704	.53
Resource sharing	144	.11	466	.35
Sending referrals	324	.24	588	.44
Receiving referrals	324	.24	588	.44
Developing service infrastructure	34	.03	234	.18
Coordinating training activities	56	.04	226	.17
Coordinating screening activities	38	.03	152	.11

Note. Number of organizations = 37. Density is the number of observed connections between organizations in proportion to the total number of possible connections. Density scores can range from 0 to 1, with a 0 indicating that none of the organizations are connected to one another and a 1 indicating that all organizations are connected to one another. In this case, density represents the extent to which organizations are collaborating with one another. Confirmed density scores are those in which the presence of a relationship was indicated by both organizations, while unconfirmed scores are those in which only one organization indicated having a relationship with the other organization.

Table 3

Centrality ranges, averages and standard deviations across seven types of collaboration, Colorado community suicide prevention network.

Type of collaboration	Range	Average	SD
Information sharing	4–32	19.03	7.60
Resource sharing	3–31	12.60	7.41
Developing service infrastructure	0–22	6.81	5.73
Sending referrals	2–34	19.08	7.60
Receiving referrals	2–34	19.08	7.60
Coordinating training activities	0–18	6.11	4.52
Coordinating screening activities	0–15	4.11	3.73

Note. Number of organizations = 37.

Centrality

Centrality scores for all seven types of collaboration were computed for each organization. Mirroring the density scores, higher averages for centrality were found in information sharing and sending and receiving referrals, with much lower averages in developing service infrastructure and coordinating training and screening activities. See Table 3 for a summary of centrality ranges and averages across the seven types of collaboration.

Overall, there was a subset of organizations that was highly connected and another group that consistently played a more peripheral role in the network across the seven types of collaboration. Generally, non-profits focused on mental health issues, mental health providers and one government/social services organization had the highest centrality scores, while religious organizations, law enforcement, and non-profits targeting issues peripheral to mental health (e.g., financial and housing services) had the lowest centrality scores. For developing service infrastructure and coordinating training and screening activities, there were a handful of organizations with a centrality score of 0, indicating that those organizations did not collaborate on those activities with any other organizations in the network. See Fig. 1 for an example network graph (often referred to as a sociogram) representing centrality scores (indicated by node size) and organization type (indicated by node shape) for the collaborative domain “coordinating training activities.”

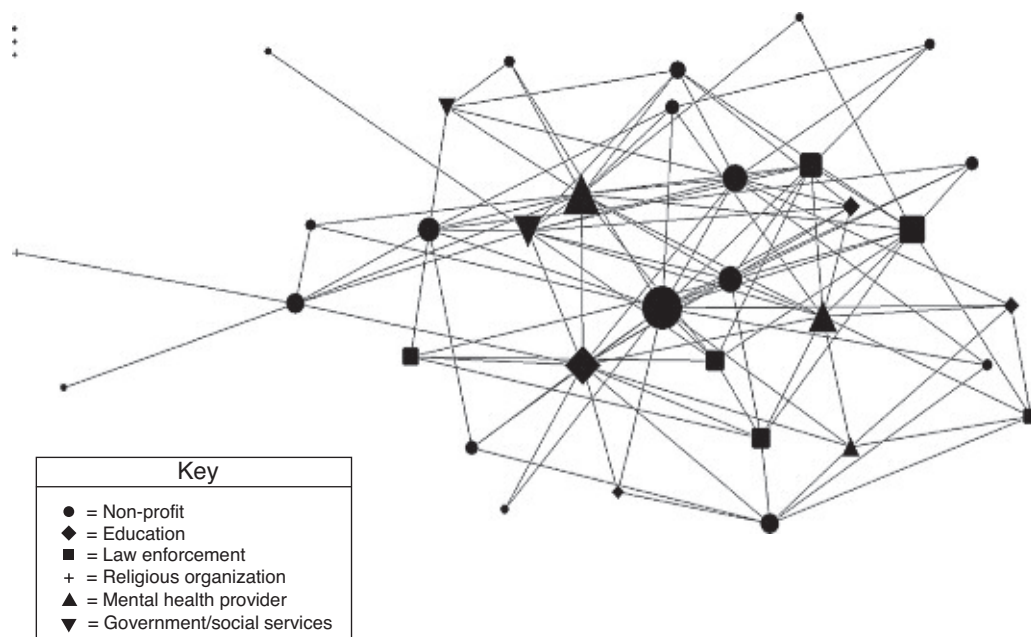


Fig. 1. Example network graph for the collaborative domain “coordinating training activities.” Centrality scores are represented by node size, with larger sizes reflecting higher scores. Organization type is represented by node shape (see key).

Tie strength

Average communication frequency scores ranged from 0.86 to 3.54 out of 6.00 ($M = 2.17$, $SD = 0.68$), indicating organizations typically reported communicating with one another approximately 1–3 times in a 3-month period. Average trust ratings ranged from 1.30 to 4.00 out of 6.00 ($M = 2.73$, $SD = 0.61$), suggesting organizations typically rated their trust with other organizations as “slightly better than average.” The total number of informal relationships for each organization ranged from 2 to 47 ($M = 18.49$, $SD = 11.39$).

Control variables

Four control variables were included as follows: (1) total number of staff and volunteers (range = 5–4650, $M = 368.65$, $SD = 825.52$), (2) total number of staff and volunteers involved in suicide prevention (range = 0–200, $M = 38.92$, $SD = 55.97$), (3) total number of funding sources for suicide prevention (range = 0–9, $M = 3.68$, $SD = 2.60$), and (4) total number of services related to suicide prevention (range = 1–9, $M = 4.81$, $SD = 2.32$). Due to the wide range of values for “total number of staff and volunteers,” this variable was transformed prior to being included in analyses by dividing the values by 100.

Correlation analysis

Correlation analyses were run to examine the associations between all outcome, predictor and control variables. See Table 4 for correlation results across all study variables. Correlations between centrality scores for the seven types of interorganizational collaboration (outcome variables) and centrality scores for the three strength indicators (predictor variables) ranged from .39 to .88 and were all significant. Correlations between centrality scores for the seven types of interorganizational collaboration and the four control variables ranged between .02 to .62 and 10 were significant. For information sharing, resource sharing, developing service infrastructure, sending referrals and receiving referrals, “total number of services related to suicide prevention” was the only significantly correlated control variable. For coordinating training and screening

Table 4
Correlations between seven types of collaboration (outcome variables), tie strength indicators (predictors), and control variables, Colorado community suicide prevention network.

	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Outcomes														
01. Info sharing	–													
02. Res sharing	0.83***	–												
03. DSI	0.65***	0.72***	–											
04. Send Refs	0.80***	0.66***	0.57***	–										
05. Rec Refs	0.80***	0.66***	0.57***	1.00***	–									
06. Coord Train	0.65***	0.66***	0.63***	0.48**	0.48**	–								
07. Coord Screen	0.62***	0.52***	0.59***	0.66***	0.66***	0.69***	–							
Predictors														
08. Comm Freq	0.84***	0.76***	0.72***	0.84***	0.84***	0.69***	0.72***	–						
09. Trust	0.88***	0.78***	0.74***	0.86***	0.86***	0.68***	0.73***	0.97***	–					
10. IR	0.56***	0.64***	0.39**	0.58***	0.58***	0.39**	0.51**	0.62***	0.63***	–				
Controls														
11. S&V	0.13	0.07	0.12	0.02	0.02	0.22	0.21	0.20	0.15	0.02	–			
12. SP S&V	0.17	0.17	0.27	0.26	0.26	0.52**	0.62**	0.37*	0.32*	0.16	0.24	–		
13. Funding	0.11	0.10	0.13	0.19	0.19	0.31*	0.20	0.12	0.14	0.21	–0.08	0.13	–	
14. Services	0.49***	0.44**	0.46**	0.44**	0.44**	0.52**	0.56**	–0.48**	0.48**	0.18	0.14	0.52**	0.17	–

Note. Number of organizations = 37. Info sharing, information sharing; Res sharing, resource sharing; DSI, developing service infrastructure; Send Refs, sending referrals; Rec Refs, receiving referrals; Coord Train, coordinate training; Coord Screen, coordinate screening; Comm Freq, communication frequency; Funding, total number of funding sources for suicide prevention; IR, sum of informal relationships; Services, total number of services related to suicide prevention; S&V, staff and volunteers; SP S&V, staff and volunteers involved in suicide prevention.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

activities, “total number of staff and volunteers involved in suicide prevention” was also significantly correlated, and for coordinating training activities “total number of funding sources for suicide prevention” was significantly correlated as well. The control variable “total number of staff and volunteers” was not significantly correlated to any of the outcome variables, and was therefore not included in the regression analyses.

Regression analysis

Based on the results of the correlation analyses, a series of regression models was specified for each type of collaboration. Again, significantly correlated control variables were entered in the first model, and significantly correlated tie strength indicators were entered in subsequent models one at a time in order of decreasing correlation with the outcome variable. Next, z-test model comparisons were conducted to determine the best fitting model for each outcome variable.

For all outcome variables, best fitting models included a combination of control and predictor variables, and accounted for between 56% and 78% of the variance in interorganizational collaboration. For information sharing, resource sharing, developing service infrastructure, sending referrals, and receiving referrals, the control variable “total number of services related to suicide prevention” and trust comprised the best fitting models. For coordinating training activities, the three significantly correlated control variables and communication frequency comprised the best fitting model, and for coordinating screening activities the two significantly correlated control variables and trust comprised the best fitting model. Z-test model comparisons revealed that adding a second predictor variable did not significantly increase the variance explained in any of the models. The results of the best-fitting and alternative regression models are summarized in Table 5.

Discussion

The present study serves as an initial step toward acquiring a more objective and comprehensive view of the nature of interorganizational relationships in a community suicide prevention network. In answering the first research question, density scores revealed that organizations were more highly connected in terms of sharing information and resources and sending and receiving referrals, and less connected in developing service infrastructure and coordinating training and screening activities, which is consistent with the results of previous network studies addressing different types of networks (Fried, Johnsen, Starrett, Calloway, & Morrissey, 1998; Luque et al., 2010; Provan, Harvey, et al., 2005). Overall, there were higher unconfirmed density scores than confirmed density scores. In other words, there were more cases in which one organization indicated having a collaborative relationship with another organization that did not confirm sharing the same relationship (unconfirmed ties) than there were cases in which the presence of a relationship was confirmed by both organizations (confirmed ties). This difference could suggest that the connections between organizations were too weak to be recognized by both parties (Provan, Harvey, et al., 2005).

Centrality analyses helped to identify the extent to which organizations varied in their level of collaboration with other organizations in the network. Across all seven types of collaboration, there was a subset of organizations that was well connected (primarily non-profits focused on mental health issues, mental health providers and government/social services organizations) and another group of organizations that consistently played a more peripheral role in the network (mainly religious organizations, law enforcement, and non-profits targeting issues other than mental

Table 5

Best-fitting and alternative regression models for each type of collaboration, Colorado community suicide prevention network.

Outcome	Model	R ²	Variables in model (β)
Information sharing	1	0.24**	Services ($\beta = .49^{**}$)
	2	0.78***	Services ($\beta = .09$), trust ($\beta = .84^{***}$)
	3	0.78***	Services ($\beta = .09$), trust ($\beta = 1.10^{**}$), comm ($\beta = -.27$)
Resource sharing	1	0.20**	Services ($\beta = .44^{**}$)
	2	0.61***	Services ($\beta = .09$), trust ($\beta = .73^{***}$)
	3	0.61***	Services ($\beta = .09$), trust ($\beta = .66$), comm ($\beta = .07$)
DSI	1	0.22**	Services ($\beta = .46^{**}$)
	2	0.56***	Services ($\beta = .14$), trust ($\beta = .67^{***}$)
	3	0.56***	Services ($\beta = .14$), trust ($\beta = .56$), comm ($\beta = .11$)
Sending referrals	1	0.19**	Services ($\beta = .44^{**}$)
	2	0.74***	Services ($\beta = .04$), trust ($\beta = .84^{***}$)
	3	0.74***	Services ($\beta = .04$), trust ($\beta = .79^{*}$), comm ($\beta = .05$)
Receiving referrals	1	0.19**	Services ($\beta = .44^{**}$)
	2	0.74***	Services ($\beta = .04$), trust ($\beta = .84^{***}$)
	3	0.74***	Services ($\beta = .04$), trust ($\beta = .79^{*}$), comm ($\beta = .05$)
Coordinate training	1	0.40***	Services ($\beta = .32^{*}$), SP S&V ($\beta = .32^{*}$), funding ($\beta = .21$)
	2	0.61***	Services ($\beta = .11$), SP S&V ($\beta = .23^{*}$), funding ($\beta = .20^{*}$), comm ($\beta = .53^{***}$)
	3	0.61***	Services ($\beta = .10$), SP S&V ($\beta = .26^{*}$), funding ($\beta = .19^{*}$), comm ($\beta = .21$), trust ($\beta = .33$)
Coordinate screening	1	0.46***	Services ($\beta = .33^{*}$), SP S&V ($\beta = .44^{**}$)
	2	0.70***	Services ($\beta = .09$), SP S&V ($\beta = .39^{*}$), trust ($\beta = .57^{***}$)
	3	0.71***	Services ($\beta = .08$), SP S&V ($\beta = .42^{***}$), trust ($\beta = .90^{*}$), comm ($\beta = -.34$)

Note. Number of organizations = 37. Model numbers reflect the number of variables contained in each step. First, all significantly correlated control variables were added in Model 1. Then, significantly correlated predictor variables were added in decreasing correlation strength. Z-tests were run to select the best model for each outcome variable while using the least number of variables. Best-fitting models are bolded and alternative models are in plain font. Comm, communication frequency; Funding, total number of funding sources for suicide prevention; Services, total number of services related to suicide prevention; SP S&V, staff and volunteers involved in suicide prevention; β , unstandardized regression coefficient.

* $p < .05$.** $p < .01$.*** $p < .001$.

health), indicating that there were differing levels of connectivity and influence among the organizations in the network.

Taken together, these descriptive findings may provide useful capacity building insights for members of the suicide prevention network by simultaneously revealing collaborative strengths as well as opportunities for improvement. For instance, an examination of density scores across different types of collaboration can facilitate discussion regarding which areas are most important to strengthen to optimize network effectiveness. Additionally, centrality scores may help to identify organizations playing a more peripheral role in the network that may be underutilized resources in the community, and strategies can be developed to increase the participation of these organizations. On the other hand, organizations that are more highly connected can be supported and encouraged to continue establishing and sustaining collaborative bonds with other organizations. The results from the present study were shared with participating organizations and used to facilitate action planning in order to close gaps and reduce service redundancies and, ultimately, to provide more accessible and consistent care to those in need.

This study also offers a novel understanding of how tie strength indicators operate as determinants of interorganizational collaboration. Previous research has demonstrated that strong ties—in the form of frequent communication, high trust, and the presence of informal relationships—have been associated with enhanced interorganizational collaboration (e.g., communication frequency, Green et al., 2008; trust, Provan et al., 2004; informal relationships, Pina-Stranger & Lazega, 2011). However, the extent to which these indicators of tie strength are associated with diverse types of collaborative relationships has been minimally explored. Of the three tie strength indicators, trust was the most prominent predictor variable in the best fitting models. The only exception was the finding that communication frequency was in the best fitting model for

coordinating training activities. However, it is important to note the possibility that these findings may have been conflated due to the high correlation ($r = .97$, $p < .001$) between trust and communication frequency. In fact, although trust was often the most highly correlated with the outcome variables (and thus was the first predictor variable added to the models), the correlation was only slightly higher than that between communication frequency and the outcome variables.

Overall, it seems that the best way an organization can work to enhance collaboration with other organizations is by working to increase communication frequency and develop more trusting relationships with other organizations. A number of strategies can be implemented to enhance interorganizational trust. For instance, efforts can be made to promote awareness of positive outcomes resulting from collaborative ventures while highlighting the influential role of the integrity and ability of the organizations involved (Lee et al., 2012; Soesters & van Ijtersen, 2002). Trust among organizations from different sectors can also be fostered through identification of shared values and concerns, common interests and goals and ways in which collaboration is likely to lead to mutual benefit (Lee et al., 2012).

One of the primary limitations of this study, common to the methods of social network analysis, is that not all of the community organizations identified as part of the suicide prevention network completed a survey. There is also the possibility that relevant organizations were missed when the initial list was generated. Another limitation is the inclusion of only two individuals from each organization; if more staff from the organizations had been surveyed, the trustworthiness of the data would be strengthened. In addition, there may be other types of collaboration and types of tie strength that are influential within a suicide prevention network that were not included in the present study. Future research should investigate if other variables influence collaboration within a suicide

prevention network. Future research should also explore the directionality of the relationships between collaboration and tie strength by using longitudinal data collection methods. Finally, it is also important to examine the link between interorganizational collaboration and client outcomes (i.e., the actual impact on suicidality; Fried et al., 1998). Only when client outcomes are considered, can the true impact of interorganizational collaboration be evaluated. Of course, cost effectiveness of the network should be evaluated as well (Provan & Milward, 2001).

In an environment of scarce resources for mental health services, it is increasingly important for community organizations to develop strong collaborative relationships in order to build capacity and provide an integrated system of care to serve at-risk individuals. Future research is required to better understand the barriers to and facilitators of interorganizational collaboration with the goal of strengthening community safety nets that aim to prevent suicide. In addition to providing new insights regarding the structural and relational aspects of a network of organizations involved in suicide prevention, this study may also serve as a model for research to better understand networks within other community psychosocial health settings.

Conflict of interest

The authors of this article declare no conflict of interest.

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