7 uses of network analysis in community intervention

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Abstract

Network analysis and visualization are integrated in multiple ways in social and community interventions. In this review, we describe seven specific uses of networks for design, implementation and evaluation of programs, community development, as well as prevention and promotion of health campaigns. Depending on the intervention strategy, we distinguish (a) the selection of health agents, (b) segmentation of groups in campaigns for disseminating prevention and promotion messages, (c) community coalitions, (d) the use of network visualization for participatory action-research, (e) self-help groups, (f) community surveys of personal networks, and (g) analysis of the informal interaction between participants or applicators in implementing programs. In each case, we describe first the characteristics of the intervention strategy, and second we summarize the main applications of technical analysis and graphical representation of networks. These seven strategies are summarized in three functions of network analysis in community intervention: operationalization of variables through relationships, improving effectiveness through social interaction, and intervention tool itself.

Key words: Social network analysis – Social and community intervention – Prevention – Participation – Implementation.

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In the field of public health, "networks" are often mentioned. In social work, as well. For example, it is common to use the term "networking" to refer to collaboration between health professionals or social services; or to describe the coordination between the service provider organizations. Likewise, the term "social networks" is used to refer to online networking websites, in which information is disseminated, health campaigns are launched or communities of practice are organized.

In this review, the different ways of how network analysis and visualisation are part of the social and community intervention processes are highlighted. The aim of this work is to examine how relational data can be used to implement behavioural or community change strategies.

Network-based interventions use relational data to promote desirable outcomes in individuals, the community, or the general population (Valente, 2012). In the context of health, to illustrate a specific scope of application, information about social networks can be part of the selection of health agents, epidemiological research, monitoring of sectoral participation tables, management of preventive campaigns, or efforts to guarantee continuity of care, among others.

In each case, highly specialized data analysis and visualization techniques are applied. However, the quality of the result depends to a large extent on how these techniques are integrated with the social and community intervention process itself. Accordingly, in this review strategies or types of intervention carried out as a guide are used. In this work, a systematic examination of interventions based on networks will be presented. This review is based on a previous analysis of the literature (Maya Jariego & Holgado, 2015).

SEVEN USES OF NETWORKS

In this section, we review seven intervention strategies based on networks, namely: the identification of opinion leaders, the segmentation of a community into subgroups, the monitoring of collaborative networks between organizations, the use of visualization to activate action-research processes, intervention in support groups, surveys of personal networks and the evaluation of informal interaction between the parties involved in the implementation of programs.

For each of them, we first provide an illustrative example; second, we examine the theoretical background on which it is based; and, finally, we review best practices implementing network analysis. That is, respectively, we show that it is an evidence-based practice, before evaluating it according to the criteria of effectiveness and implementation.

A visual comparison of the seven strategies is summarized in Table 1.

Health agents

A selection and training of opinion leaders was a strategy used in an intervention to reduce tobacco consumption among adolescents. A sociometric questionnaire, in which the students indicated who was the most popular in class was applied. Next, the group of natural leaders was trained to spread messages of health promotion and reduction of tobacco consumption, through informal contacts with their peers. This intervention, which was carried out in 30 schools, led to a reduction of 22 percent in the probability of becoming a regular smoker (compared to a control group) (Starkey, Audrey, Holliday, Moore, & Campbell, 2009).

This is an example of the strategy called "health agents". It is based on the assumption that people well connected to the environment facilitate the efficient dissemination of messages and may have some prescriptive capacity. On the one hand, it uses networks of relationships between equals. On the other hand, it consists of training some members of the community to participate in the promotion of healthy habits in their groups of reference.

It is a type of intervention that takes advantage of informal exchanges among equals to promote behavior change. It is a key contribution towards the effectiveness of prevention and promotion programs. First, communication patterns facilitate the reception and understanding of health messages. Second, the distribution in networks through key figures based on interpersonal relationships has a multiplier effect. Third, coverage increases with groups that are difficult to access. Finally, the involvement of community members facilitates the continuity of the intervention, resulting in efficient and sustainable actions.

Health agent programs are developed through three consecutive phases: identification, training and involvement of opinion leaders. In such cases, the contribution of network analysis usually consists in the selection of natural leaders. For this purpose, different sociometric indicators are used to measure influence among peers (Valente, 2012). The number of referrals received and the indicators of centrality are the most common in the selection of leaders (Starkey, Audrey, Holliday, Moore, & Campbell, 2009, Valente & Pumpang, 2007). However, it is also possible to resort to individuals who act as...
a bridge between groups (or between conglomerates of relationships) little connected to each other (Gould & Fernández, 1989). Another strategy is to identify the key actors that allow an optimal coverage of all the members of the network (Borgatti, 2006), especially when it comes to disseminating information.

A logic equivalent to health workers is applied in community intervention with mentors, community mediators and the participation of paraprofessionals.

Preventive campaigns and dissemination of health messages

The processes of social influence have also been a reference to reduce risk behaviors in the transmission of the human immunodeficiency virus (HIV). In a psycho-educational intervention to prevent AIDS among injecting drug users, the groups that received the training were identified from prior knowledge of the syringe exchange network. In this way, the same individuals who habitually met to consume drugs received joint training. The intervention reduced the frequency with which they shared syringes, and also decreased the injection of heroin and cocaine compared to a control group (Latkin, Mandell, Vlahov, Oziemkowska & Celentano, 1996).

In this case, the preventive strategy is guided by a prior knowledge of the topology of the relationships in the target population. Intensive training in small groups has proved to be one of the most effective strategies in AIDS prevention in a community (Freudenberg & Zimmerman, 1995). This type of intervention is improved when it is based on the natural resources of the population (that is to say, networks of everyday interactions): specifically, recruitment through personal networks allows health messages to reach the whole group; the lessons taught in the group context reinforce behavior change; and natural leaders exercise greater influence when they are assigned to their reference groups (Valente, Hoffman, Ritt-Olson, Lichtman, Johnson, 2003).

This community prevention is based on networks initiated on two complementary assumptions: recruitment based on personal relationships improves intervention coverage; and acting on natural groups promotes community preparation for change. Apart from high-risk groups, both contributions are also present when the intervention is aimed at the broader population. Recruitment strategies are especially relevant with difficult groups, such as drug addicts or HIV-positive people, among others. Community preparation strategies, however, have a more general scope: the change of attitudes, the modification of health beliefs and the development of healthy norms seem to be facilitated when they are integrated into the relational networks of the community; and they are applicable in any behavioral change program.

Network indicators, as detailed in the previous section, are used to identify opinion leaders on whom community prevention campaigns are based. We have seen how the topology of the network of relationships in the community facilitates the monitoring of health messages dissemination and the distinction of groups and individuals that initially adopt the innovation, from other layers of the population, in which progressively the preventive information is extended. It also serves as a guide to interrupt the processes of contagion, affecting individuals who occupy key positions, either because they act as intermediaries, as cut-off points or as bridges of union between communities.

In both cases, networks are applied in segmentation strategies, through which groups that share a risk behavior are identified or will be simultaneously subjected to preventive action.

Community coalitions

In the early 1990s, the infant mortality rate among the black population of the state capital of Wisconsin, in the United States, was two to three times higher than that of the white population. A decade later, the same epidemiological indicator has been reduced to match the data of the majority population. Such a significant change in such a short time is unusual. An action-research initiative documented the relationships maintained among the group of entities that had carried out maternal and child health activities in that city for 12 years. The resulting organizational network – composed of 23 health service providers – had increased in density and cohesion over time, in parallel with the reduction of health inequalities in the population. In addition, the connectivity of some key entities showed a significant association with the improvements in the effectiveness of the intervention (Faust, Christens, Sparks & Hilgendorf, 2015).

Seen in retrospect, this experience can be understood as a case of effective community coalition. It is a set of entities providing attention to a specific health problem and coordinated to face it. The concrete example shows that interorganizational cohesion is related to the effectiveness in the provision of health services.

Coalitions and community partnerships allow for the development of a shared vision of health needs, serve to deploy a consensual strategic action, and prevent duplication of benefits and efforts (Butterfoss, 2007). They are especially
useful in the integration of services (in diagnosis, as well as, in strategic planning and program implementation). On the one hand, they generate social health standards. On the other hand, they improve coordination among organizations in the sector.

In this case, network analysis serves to operationalize community coalitions as inter-organizational networks. It translates the metaphor of collaboration to specific and analytical terms. This allows us to explore the different topologies adopted by inter-organizational networks. It is common for effective coalitions to form a core-periphery structure (Faust et al., 2015, Menger, Stallones, Croos, Henry & Chen, 2015, Rana & Allen, 2015). The nucleus is composed of a small number of very active entities, connected to each other and to the outside. The key players exercise a leadership role in the initial phases and promote relationships with other entities, which progressively add to the preventive action. In this respect, coalitions grow from inside out.

The role of intermediation roles in the integration and continuity of services has also been documented (Faust et al., 2015). Key organizations project their capacity to influence the coalition, facilitate the coordination of resources, increase coverage and contribute to improving the results of preventive action.

The analysis of inter-organizational networks can also be used in consultancy and organizational development projects, as illustrated in Figure 1 (Holgado, Ramos-Vidal & Maya-Jariego, 2014).

**Participatory diagnostic and intervention strategies**

In a development cooperation program in northern Ghana, an innovative action-research process was launched, in which representatives of different interest groups participated in the governance of water of a tributary from the Volta River. The representatives met to identify the list of key actors and indicated the network of relationships between them. Both the diagnostic task and the graphic representation of the relationships were shared by the whole group, in an open discussion. Then, they assessed from a strategic point of view the actions to be carried out in this context to promote local development together with respect for the environment (Schiffer, 2007).

This was one of the first applications of the "Net-Map" technique, which combined participatory diagnosis and strategic planning, with the intervention of the actors involved in an important issue of public health or community development. Through a qualitative procedure, a shared analysis was generated of the key actors and their relationships, which served as the basis for proposing a strategy that is also shared.

The participatory diagnosis captured the point of view of the members of the community, with the collaboration of the different groups and interested parties. It produced a collective representation of the community space, which served as a catalyst to launch coordinated actions. In this respect, it was similar to "action sets" (Villasante & Martín, 2006), and to other participatory action-research strategies based on relationships.

The Net-Map technique has an analytical component. It starts with a list of individuals and organizations that provide assistance. Then the actors are prioritized, and finally the relationships between them are drawn. However, it is fundamentally a consensus-evaluation strategy, linked to decision-making. The group discussion reveals an overall vision of the social structure, which is neither evident nor intuitive for each of the participating individual members. The qualitative analysis is aimed at identifying leaders, actors with power, and entities with a key connection role. Among other aspects, group reflection allows the detection of factions or communication problems.

The visualization of relationships can be in itself an intervention tool. The graphic representation of the existing relationships in the community seems to generate an "awareness" in the observers, reactions and can even contribute to behavior change. In research with small groups, it has been documented that providing visual feedback to team members about the interactions that occur between them induces competition for leadership positions (Borgatti & Molina, 2002). The Netmirror technique consists of visually representing the social structure of a team (or a larger group), as a strategy for group dynamization and organizational development.
Graph 1. Inter-organizational network of social service organizations that provide services to immigrants in the Autonomous Community of Navarra (Holgado, Ramos-Vidal & Maya-Jariego, 2014). In dark grey, unions, non-governmental organizations and immigrant associations are indicated. In light grey, the units of public social services and health services are represented. The size of the node is based on the centrality of intermediation (betweenness) and shows the outstanding role of a social services center (SS7) and a union (Sindicato1). The visualization of relationships served to represent the polarization between public entities and private entities. The social work units formed the most densely connected core of the network. We also identify the secondary role of immigrant associations. The graph was discussed in a forum with representatives of these entities, to agree on a joint plan in the provision of services.

Self-help groups and group intervention

Self-help groups are effective in treating drug addiction. Alcoholics Anonymous, who is usually accredited with the origin of this movement, is the best-known self-help group, and has often been used as a model by other rehabilitation and prevention initiatives. This is the case of an intervention with more than 2000 military veterans who participated in self-help groups after receiving hospital treatment for drug addiction. The groups contributed significantly to the reduction in drug use one year later. In obtaining these results, social networks and psychological resources developed throughout the program played an important role. Specifically, the intervention improved the friendship networks and coping strategies of the participants (Humphreys, Mankowsky, Moos & Finney, 1999).

The type of group intervention based on extended networks are support groups and self-help groups. Generally, these are small groups in which individuals who share a social problem, display coping strategies and exchange mutual aid. It is a strategy that has been applied successfully in the treatment of drug dependencies, chronic diseases, disabilities, family problems and mental health needs (Gracia, 1997).
Support and self-help groups connect people who have a common problem. They facilitate the learning of coping strategies and promote the reciprocal exchange of company, instrumental help, information and emotional support. They are based on empathy among the participants and mobilize natural resources of the community. Each individual assumes an active role, as a provider of help, which contributes to personal empowerment and autonomy.

The application of graph theory to investigate group problem solving and communication patterns in task-oriented groups is one of the classic uses of network analysis (Bavelas, 1950; Bavelas & Barrett, 1951). These applications can be reconsidered in different contexts of the group intervention. The indicators of position, centrality and grouping allow to formalize the structure of informal relationships in small groups.

Social support literature has undergone a formidable development since the 1970s. Research has shown, among other aspects, the strong association of perceived support with health, psychological adaptation and life satisfaction; together with the pivotal role of confident relationships in the subjective well-being (Cutrona, 1996; Dickens, McGowan, Percival, Douglas, Tomenson, Cotter, Heagerty & Creed, 2004; Maya-Jariego, 2006; Sandgren, Mullens, Erickson, Romanek, & McCaul, 2004; Veiel & Baumann, 1992). Likewise, the provision of multiple types of support is an effective empirical indicator of the depth of a relationship, that is, of strong ties (Agneessens, Waeghe, & Lieveens, 2006; Skvoretz & Agneessens, 2007; Maya-Jariego & Holgado, 2015).

Survey of personal networks

In the metropolitan area of Seville, it was observed that the structural properties of personal networks depend partially on the frequency of interurban mobility. Using a representative sample of the population of Alcalá de Guadaíra, 15 kilometers from the capital, we found that people who made more round trips to Seville from their place of residence had less cohesive networks, with a higher average degree of betweenness (Maya-Jariego & Holgado, 2015b).

Apart from the description of the structure of the interpersonal environment, surveys of personal networks also allow for the comparison with the living conditions of the population. In epidemiological studies, they are integrated into the analysis of risk and protection factors linked to interpersonal relationships. Hence, they are a great potential as a community diagnostic tool.

One of the innovations that has occurred in the last decades consists of the elaboration of personal network typologies (Bidart, Degenne, & Grossetti, 2011, Lozares, Verd, Cruz & Barranco, 2014, Maya-Jariego, 2002, 2006). This method serves to differentiate categories through the combination of the network structure. The strategy has proved to be efficient, generates descriptions of theoretical value and facilitates the identification of interindividual differences.

The potential of personal networks to translate, in relational terms, key concepts of social and community psychology intervention has also been suggested, for instance, in psychological sense of community and empowerment (Maya Jariego, 2004; Maya Jariego & Holgado, 2016).

In the examination of community identity, networks adapt to the study of multiple belongings, with a diversity of levels, and therefore with groups of diffuse borders.

Monitoring of programs implementation

The documentation of the interactions that occur within the framework of a program is uncommon. An exception is the evaluation of the relationships developed among participants of a group intervention to prevent childhood obesity in high-risk families. Through the monitoring of the program, it was observed that the density of the counseling and discussion networks among the participating parents increased throughout the intervention (Gesell, Barkin & Valente, 2013).

This example demonstrates that the intervention programs constitute a scenario of interaction between the participants, where informal dynamics of social influence are set in motion. Each parent expanded the number of partners with whom they shared information during the program. The perceived cohesion of the group as a whole also increased. Presumably, the relationships that occur within the program can potentially affect both the implementation and the results of the intervention.

The same can be said about the relationships between the people responsible for the program; or even in the transfer processes that connect the researchers with the professionals of the intervention. For example, by looking at the implementation of health programs in public schools in Michigan, three different types of roles were identified as intermediaries between researchers and education professionals. Beyond the theoretical knowledge available, these brokers were decisive in the search and selection process of evidence-based practices that were finally applied in the educational context (Neal, Neal, Kornbluh, Mills & Lawlor, 2015).
The interactions that occur during the implementation process open a new space for the examination of social exchanges between different stakeholders and how they sustain an intervention. Consequently, structures and social interaction articulates a point of view that can be incorporated transversally throughout the design process, implementation and evaluation of programs (Gesell, Barkin & Valente, 2013).

This opens a wide range of possibilities. Among other evaluative aspects, it can be assumed that the position that individuals occupy in the community may be associated with perceived problems; the interaction between participants conditions the implementation of the program; the continuity of the action can be facilitated by the involvement of some key actors in community networks, etc. Possibly, each of these areas will lead to new applications of short-term network analysis.

CONCLUSIONS

Network analysis allows social structures research at multiple levels: micro, meso and macro. It is considered among the “methods that capture the context” (Luke, 2005), and, consequently, have a greater development potential in social and community psychology intervention (Jason & Glenwick, 2016). It is a relationship-centered approach that helps detect interaction dynamics that are not intuitively evident to observers or directly involved actors.

In this review I have identified three different ways in which network analysis can be useful in the intervention: (a) the translation of key concepts, (b) for improving effectiveness, and (c) as an intervention tool in itself.

First, it serves to translate operationally, in terms of relationships, concepts such as community coalitions, “networking” or community cohesion. In fact, even the process of implementing programs (or the transfer of results) can be interpreted in relational terms. In short, networks are an instrument of effective operationalization.

Second, network analysis takes advantage of the potential of relationships to contribute to the effectiveness of the intervention. Networks of relations facilitate recruitment and increase coverage; have a multiplier effect; are sustainable; help design specific actions for each interest group; mobilize the exchange of social support; promote a shared vision; activate the development of social norms or the formation of consensus; and improve coordination among individuals or organizations in the community.

Third, networks are an intervention tool by themselves. Becoming aware of the structure of relationships in a group, in an organization or in the community, reinforces the participation of the actors involved and has direct effects on individual behavior. Networks can be integrated into participatory action processes.

In all three cases, network techniques acquire full meaning when they are incorporated into the intervention process. As we have seen, networks can be instrumental in assessing needs, giving content to program activities or monitoring the implementation process. In this work, the very practice of action research has helped to distinguish seven different strategies for the use of networks.
Table 1  
Seven network applications in community intervention

<table>
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<th>Strategy</th>
<th>Fundamentals</th>
<th>Contributions</th>
<th>Network analysis</th>
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</table>
| Health agents | Well-connected people contribute to the efficient dissemination of messages and have prescriptive power | • Natural communication  
• Multiplier effect  
• Increase coverage  
• Facilitate continuity | Selection of opinion leaders according to (a) centrality, (b) betweenness, or (c) key players. |
| Dissemination of preventive messages | Training in natural groups facilitates changing social norms and increases the effectiveness of the intervention | • Facilitate recruitment  
• Improve coverage  
• Contributes to community readiness for change | It is used to (a) monitoring the dissemination of health messages, (b) interrupting contagion processes and (c) segmenting intervention in natural groups |
| Community coalitions | Inter-organizational networks generate shared norms, improve coordination and increase effectiveness | • Shared vision  
• Social norms  
• Prevent duplication of services  
• Improve coordination | Topology of collaboration between organizations: (a) core-periphery structure and (b) intermediary roles |
| Participative assessment | Different stakeholders name key players and their relations with each other, to implement strategic actions | • Perceived needs  
• Interest groups  
• Shared vision  
• Linked to action | Visualization of relationships in a process of consensus-assessment that identifies (a) actors with power, (b) factions, and (c) roles of connection |
| Self-help and support groups | Exchange of support and coping strategies among people who share a common problem | • Empathy  
• Empowerment  
• Reciprocity  
• Mobilization of natural resources | Exchanges of support: (a) networks of interaction in small groups; key role of (b) confidants, and (c) social support providers with greater multiplicity |
| Surveys of personal networks | Epidemiological studies of personal networks and living conditions of the population | • Risk and protective factors based on personal relationships | Development of (a) typologies of personal networks and (b) relational translation of psychosocial processes |
| Monitoring implementation of programs | Interactions that occur during the implementation of a program or during transfer results | • Informal relations between participants  
• Exchange between applicators of the program  
• Chains science-practice | Analysis of (a) the intermediaries in the chain of transfer of evidence-based practices, and (b) exchanges between participants and between project facilitators during implementation |

Source: own elaboration, IMJ.
REFERENCIAS


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