

Mapping Tobacco Quitlines in North America: Signaling Pathways to Improve Treatment

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In the early 1990s, California became the first state to implement a quitline as a result of funding from a new state tobacco tax. Within a few years, Massachusetts, Arizona, and other states added state quitlines, and now every state in the United States and every province in Canada has a toll-free tobacco quitline to treat tobacco dependence.¹ Moreover, there is now an organization, the North American Quitline Consortium (NAQC), which seeks to foster communication between quitlines with the objective to improve access to, and the quality of, quitline services for residents of the 53 state and territorial and 10 provincial entities that participate in the consortium. Thus, there now exists a system of tobacco treatment in the United States and Canada that is linked functionally, which is recognized by their respective governments, as they prepare to place toll-free national quitline numbers on cigarette packs to refer smokers to those quitlines. However, there are no data on how the quitlines function as an organizational network to foster the adoption and implementation of evidence-based practices, or whether NAQC is functioning to foster that collaboration as intended.

Although extensive research has been conducted on organizational networks over the past 20 years, most of the work focused on the impact of network involvement on individual members. Thus, except in isolated cases,^{2–4} the “systemness” of the network was typically ignored. More specifically, only recently has greater emphasis been placed on the processes by which research is translated into practice and back again, and it is clear that considerable research is needed to further explicate those processes.^{5,6} For example, Valente⁷ actively explored the role of social networks in the diffusion of innovations to better understand how knowledge and decision-making impact changing health practices. Analyzing network structure and function in areas such as obesity,⁸ tobacco control,^{6,9–11} and HIV/AIDS¹²

Objectives. This study was designed to better understand how the network of quitlines in the North American Quitline Consortium (NAQC) interact and share new knowledge on quitline practices.

Methods. Network relationship data were collected from all 63 publicly funded quitlines in North America, including information sharing, partner trust, and reputation.

Results. There was a strong tendency for US and Canadian quitlines to seek information from other quitlines in the same country, with few seeking information from quitlines from the other country. Quitlines with the highest reputation tended to more centrally located in the network, but the NAQC coordinating organization is highly central to the quitline network—thus demonstrating their role as a broker of quitline information.

Conclusions. This first “snapshot” of US and Canadian quitlines demonstrated that smoking cessation quitlines in North America are not isolated, but are part of an interconnected network, with some organizations more central than others. As quitline use expands with the inclusion of national toll-free numbers on cigarette packs, how quitlines share information to improve practice will become increasingly important. (*Am J Public Health.* 2012;102:2123–2128. doi:10.2105/AJPH.2011.300529)

has become increasingly recognized as critical to improving public health. However, much more work is needed to understand the impact of the structure of network relationships (e.g., central roles, cliques, etc.) on the adoption and implementation of practices.

Given the complexity of the quitline system of funders and service providers, and the lack of clarity regarding the communication characteristics of the network, the goal of this study was to provide the first snapshots of the NAQC network, including information on the interactions among quitlines, between quitlines and the NAQC coordinating organization (called the network administrative organization [NAO]),¹³ and the relationship between quitlines with high positive reputation and other quitlines.

METHODS

The network of interest was defined as the 94 organizations (both funders and providers of quitline services) involved in decision-making about the adoption and implementation of quitline practices within the North American

quitline community. This list involved 270 individuals from all 63 jurisdictions (i.e., the 53 state and territorial and 10 provincial entities) in the network, plus 6 people from NAQC’s facilitator, or NAO¹³ (see the following). All data in the present study were derived from a survey conducted in mid-2009, focusing on relationships that existed in the 12 months before survey completion.

Most quitlines are dyadic relationships comprised of 1 funder organization, usually the state department of health or equivalent, and 1 service provider organization with which the funder contracts to provide quitline services in that state or province. In 2009, 16 organizations (service providers) provided quitline services for 53 US states and territories, whereas 5 organizations provided quitline services for the 10 Canadian provinces. Fourteen service providers provided services for a single state or provincial quitline, whereas 7 provided services for more than 1 quitline. Service providers were comprised of a variety of organizations, including universities, government agencies, and for-profit and nonprofit companies.

In addition, 6 staff members from NAQC's central office completed the "information sharing and organizational learning" sections of the survey, plus a tailored version of the "implementation" section of the survey, to help assess the role NAQC plays in the network.

Instrument Design and Implementation

An online survey was developed and implemented to assess a variety of network and decision-making variables, but the present study focused on questions that helped to characterize the nature of interactions between members of the NAQC community. Thus, questions on information sharing between quitlines, and between quitlines and the NAO, were the focus of this study. In addition, those surveyed were asked to report on the reputation of the quitlines. This information allowed for evaluation of a variety of indicators, including the nature of network ties between quitlines, as well as whether those quitlines with the highest reputation interacted with other quitlines in a way that was different than those not rated with a high reputation. In addition, the survey questions on information sharing provided data on the extent to which the NAO served as a hub for information exchange, because that is one of its mandates.

A roster was compiled of the primary quitline funder and service provider organizations for each state or province in the United States and Canada, plus the District of Columbia, Puerto Rico, and Guam. NAQC staff identified potential participants within each organization by consulting with NAQC's primary organizational contact for each organization by phone and asking them for a list of all individuals within the organization who were involved with decision-making about quitline tobacco practices for the organization. All these individuals at each quitline organization were included on our list of potential respondents to the survey.

The total number of organizations asked to complete surveys was 73 funders, 21 service providers, and the NAQC NAO ($n = 95$). Of those 95 organizations, 73 were from the United States (including the NAQC office) and 22 from Canada. Of the 277 possible individual respondents within the 95 organizations, 186 completed the survey (67.1% response rate). Of the 95 total organizations, we

received at least 1 full individual response from 85 of the organizations (89.47% response rate). A partial response, including only organizational data, was returned by 1 individual, giving us an overall organizational response rate of 90.5%. Finally, at least 1 respondent from either a funder or provider organization from 62 of the 63 quitlines completed the survey.

Measures

Network. Because responses were provided by individuals, and the analysis for this study was presented at the organization and quitline (funder or service provider pairs) levels, multiple aggregations of the network data were performed. To create matrixes at the organization level, individual responses to each information sharing question were aggregated to the organization level by selecting the highest intensity of relationship reported by a single individual within an organization as the score for that organization. The rationale for using the maximum score was that the segregation of duties within an organization often necessitates a single individual be the primary individual responsible for maintaining a relationship with a particular organization.^{14,15} Thus, we would not expect every individual in an organization to be knowledgeable about or have a similarly intense relationship with every network partner organization. Operationally, this meant that if 1 individual maintained a relationship, we considered there to be a relationship between the 2 organizations. A similar aggregation process was used to populate quitline level matrixes of information sharing. As with the organization level aggregation, individual responses pertaining to each quitline's information sharing were aggregated using the highest reported intensity as the quitline level score.

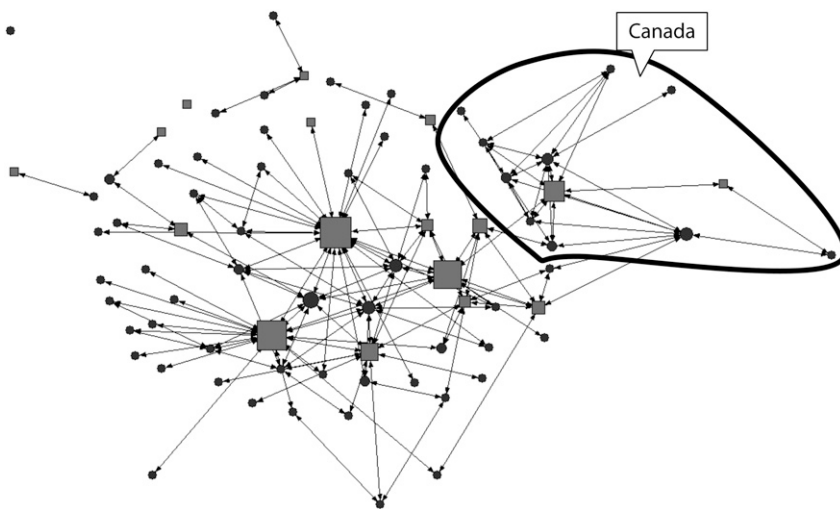
Once matrixes were developed for information sharing at each level of aggregation (organization and quitline levels), additional matrixes were constructed, reporting the existence of a tie only if it was reported at either a moderate (coded 2) or high (coded 3) level of intensity of involvement. Finally, a reciprocal tie matrix was constructed at both the organization and quitline levels, in which a tie between 2 individuals was recorded only if both individuals reported receiving

information from each other at intensity level 2 or higher. Focusing on network ties only at moderate or high levels of intensity was done to compensate for not being able to confirm information sharing ties between organizations because of the overwhelming response burden this would have created for the participants. Data were imported into UCINET v.6 (Analytic Technologies, Lexington, KY),¹⁶ where multiple centrality and other network measures were calculated.

Reputation. In the information sharing section of the survey, respondents were asked to identify up to 5 quitlines (not organizations) other than their own that they "most admire for doing an especially good job regarding tobacco quitline activities." All the weighted organization level reputation scores were summed for each quitline, giving it an overall reputation score ranging from 0 to 56.19. Reputation was also analyzed via UCINET v.6.¹⁶

RESULTS

Figure 1 is a network "map" that shows mutual sharing of information (reciprocated ties) across all quitline organizations (funders and service providers). In this figure, gray squares represent quitline service providers, dark gray circles represent quitline funders, and size of the node is indicative of betweenness centrality (i.e., reflecting the number of organizations a particular organization was connected to, which were not themselves directly connected). Organizations with the highest betweenness centrality were those with a greater number of connections to other quitline organizations that were not themselves well-connected, making them more likely to be intermediaries of information flow—thus placing them in more central roles as "brokers" of knowledge flow within the network. Links from 1 entity to another indicated connections of any type of information (e.g., A receives management information from B and B receives service delivery information from A). We excluded NAQC's coordinating organization from this analysis, so that we just assessed quitline organization contacts directly. The overall network density of the network was 0.041, indicating that 4.1% of all possible relationships existed across the network.



Note. Gray squares represent quiltline providers, dark gray circles represent quiltline funders, and size of the node is indicative of betweenness centrality (i.e., reflecting the number of organizations a particular organization is connected to, which are not themselves directly connected).

FIGURE 1—Reciprocated information sharing ties across all quiltline organizations (funders and providers are separate): Mapping Tobacco Quitlines in North America.

As Figure 1 shows, there were clear clusters representing the United States and Canada, and a few quiltline service providers had particularly high betweenness centrality. In Canada, a quiltline service provider (Canadian Cancer Society—Ontario) serving multiple provinces had the highest betweenness centrality (15.27), whereas the California service provider (25.18) as well as 2 multi-quiltline service providers (Free and Clear and the American Cancer Society) had the highest betweenness centrality in the United States (30.72 and 24.10, respectively). Funders with the highest betweenness centrality were Minnesota (9.56) and Ontario (8.23).

In Figure 2, service providers and funders are “collapsed” and, thus, represent the complete quiltline funder and service provider dyad. As noted, reputation was based on the frequency of being mentioned as being admired for doing an especially good job regarding tobacco quitline activities. Light gray squares reflect those quitlines where the vendor served more than 1 funder, whereas dark gray circles reflect quitlines where the vendor served only a single funder. “Reputation” is indicated by size of the node. In this figure, overall density was 0.52, thus indicating that 52% of all possible connections among quitlines occurred. This quiltline network was far

more dense than the organization network shown in Figure 1. It reflected the fact that although individual quiltline organizations tended to have a relatively low level of involvement with others in the network, the quitlines themselves, represented by funder-service provider pairs, were highly connected to others. This was mainly a function of the connectedness of the service providers, who were linked to both their own funders and to other service providers. As Figure 2 also shows, 3 quitlines emerged as highly reputable (circled in black), and they played a central role in linking US and Canadian quitlines. Those 3 quitlines also had service providers that each served a single funder.

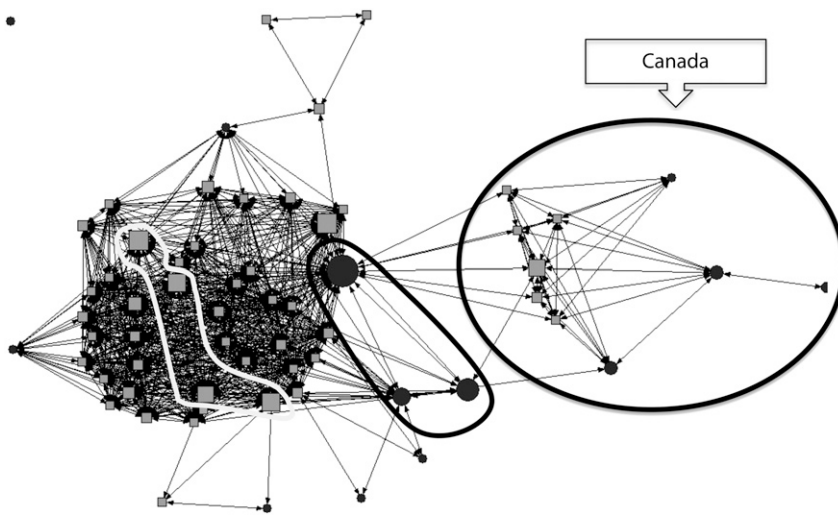
Figure 2 also demonstrates that connectivity within each country was greater than that between countries. This pattern was further drawn out by the E-I index of -0.835 ($P < .05$), which evaluated the difference between the number of ties external (E) to a subgroup (here, a country) and compared with those internal (I) to the subgroup. Specifically, this score indicated a strong tendency for US and Canadian quitlines to seek information from other quitlines in the same country, with very few seeking information from quitlines from the other country.

The fundamental role of NAQC is to foster communication and coordination across

quitlines, so we assessed the structure of the network with NAQC’s NAO included, to assess its relative centrality with the quitline organizations. As Figure 3 demonstrates, NAQC’s NAO was highly central (degree centrality = 67, meaning it was directly connected at a moderate or high level of intensity to most other organizations in the network). These links were to and from most quitline funders and service providers in both the United States and Canada. In comparison, the organization with the next highest degree centrality score was Free and Clear at 27 (the large square next to the NAQC NAO triangle in Figure 3), which primarily reflects its ties to the 18 funder organizations it serves. Figure 3 was originally formatted so that node size corresponded to each organization’s score for betweenness centrality, but the size of the NAQC NAO’s node had to be artificially reduced so that other organizations in the network that had numerous ties and relatively high betweenness centrality could be recognized.

DISCUSSION

These first snapshots of the NAQC network make it very clear that overall, there is a considerable amount of communication between quitlines in the form of transfer of information about finances, management, services, and outreach. The smoking cessation quitlines in the United States and Canada are not isolated organizations providing service to the smokers in each state and province, but are part of a dynamic and interconnected network of funders and service providers. That such connectivity exists should be heartening to those who worked to develop and implement the broadest possible infrastructure of quitlines, because it demonstrates that the quitlines in North America have begun to function as a type of coalition or community. However, from Figures 1 and 2, we could not tell much more than that. For example, although some quitlines clearly played central roles, and in some cases had a high reputation, these analyses could not by themselves demonstrate that 1 quitline or another influenced either the dissemination of specific practices or influenced specific decision-making regarding practices. Future analyses will strive to explicate much more about the nature of the communication



Note. Light gray squares reflect those quitlines where the provider served more than one funder, while dark gray circles reflect quitlines where the provider served only a single funder. "Reputation" is indicated by size of the node (i.e., which state or provincial quitlines, other than your own, do you most admire for doing an especially good job regarding tobacco quitline activities?). The circled section in the middle is not part of the Canadian network and the circle indicates those funders that served as brokers between the 2 clusters. The white circled section to the left indicates high reputation quitlines spanning clusters in the United States.

FIGURE 2—Reciprocated information sharing ties across all quitline organizations (funder-provider pairs combined to form single quitlines): Mapping Tobacco Quitlines in North America.

and collaboration, in particular how it might impact awareness of new or evidence-based practices, as well as processes by which decisions are made to adopt and implement practices.

Figures 1 and 2 do provide some information suggesting all interactions were not the same. For example, Figure 1 demonstrates that service providers tended to be more connected within the network than funders. As Figure 1 shows, there are several service provider nodes that are quite a bit larger than others, suggesting that they played a stronger information brokering role in the network than did other service providers. Thus, what emerges in Figure 1 is not just connectivity between quitlines, but the observation that some organizations, because of their central network position, were likely to be more influential in the network than others. This was especially true for the multifunder quitline service providers who generally seemed to be more central and, hence, likely to be more influential, than other quitline organizations, especially funders. However, these data did not take into account reputation, which could very well impact influence. Further analyses will explore more fully which factors are related to both

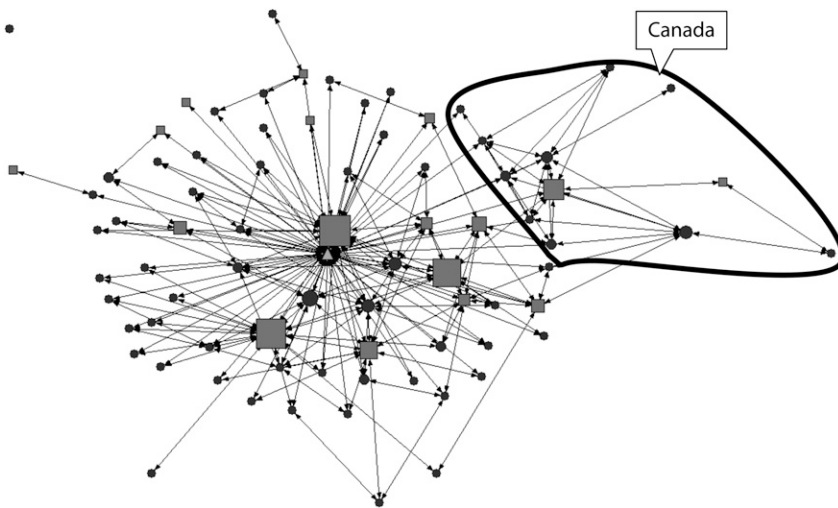
position and centrality and influence in the network. Figure 1 also demonstrates that some quitline funders and service providers had little connectivity with others, including 1 funder and service provider pair (i.e., a network fragment) that did not communicate with much frequency at all with other quitline organizations. This finding had important implications for the widespread dissemination of information about quitline-related services.

In Figure 2, where funder and service provider dyads are formed (i.e., what most would consider the quitline team for a state or province), the node size was determined not by betweenness centrality, but by a quitline's reputation score as reported by other quitlines. In addition, node color (gray or black) was determined by whether a service provider served more than 1 quitline or a single state or province. Figure 2 provides information on quitline connections between states and provinces because funder and provider were collapsed, and patterns emerged that might suggest knowledge flow between them. As Figure 2 shows, a relationship appeared to exist between a quitline's reputation and its position in the network. Specifically, high reputation

quitlines appeared to be important brokers between distinct clusters of quitlines. Most notable were the 3 quitlines that were critical brokers between the United States and Canada. However, it is important to notice a second set of high reputation brokers that spanned distinct clusters of quitlines within the United States (circled in white). It was unclear what the precise nature of these broker roles might be, and further exploration is needed to understand whether greater communication with highly reputed quitlines influences awareness, adoption, and implementation of practices.

The NAQC NAO, a potentially important organizing entity, is missing from Figures 1 and 2. The NAQC NAO was created and funded to foster communication and collaboration among quitlines in the United States and Canada, and to encourage the implementation of evidence-based practices.¹⁷ The network analyses conducted in this study were the first to explore to what extent NAQC's NAO was performing that function. As Figure 3 demonstrates, the triangular node that represents NAQC's NAO was not only very centrally located in the quitline network, but also had so much connectivity with quitlines in the United States and Canada that the size of its node had to be artificially reduced, because it would have dramatically overshadowed all other organizations. Thus, it was clear from our analysis that NAQC's NAO played an important and central role linking quitlines, and was clearly serving the function that was intended when it was created. If the role of quitlines continues to expand, perhaps as a result of greater government promotion of national quitline numbers in the United States and Canada, the NAQC NAO role could become yet even more important as a broker of information, a conduit for evidence-based practices, and a key player in assuring the appropriate evaluation of quitline practices.

This initial characterization of North American quitline network relationships from our first year of observation provided important insights into quitline communication and connectivity, and the results of this study were important to the tobacco control and public health communities for several reasons. First, the data demonstrated that quitlines were truly a functioning network, with NAQC's NAO fulfilling the purpose for which it was created.



Note. Gray squares represent quitline providers; dark gray circles represent quitline funders; and the light gray triangle represents North American Quitline Consortium (NAQC) network administrative organization (NAO). Size of the node is indicative of betweenness centrality (i.e., reflecting the number of organizations a particular organization is connected to, which are not themselves directly connected). The NAQC NAO node is artificially reduced.

FIGURE 3—Reciprocated information sharing ties across all quitline organizations including NAQC (funders and providers are separate): Mapping Tobacco Quitlines in North America.

Whether they remain central over time as the quitline community changes will be clear in future years. Second, we knew very little about the processes by which evidence-based practices were adopted and implemented, so these results were a first look at the range of relationships that existed that had the potential to serve as conduits of knowledge flow. Data from additional years will provide more information on how those relationships actually affect implementation of practices over time, particularly as new practices emerge (e.g., text messaging) and budgets change. In addition, just as the basic science community identified the signaling pathways by which biological networks function, our study provided needed data on how a behavioral network functions, so that changes can be recommended in that functioning over time to improve public health outcomes. Despite these strengths, there were multiple caveats that must be considered in the interpretation of these first results.

First, the findings were based on self-reported data. Thus, there was potential for error based on misperceptions or misrepresentations. Although individual responses were confidential, it was possible that some respondents might have felt compelled to present their

organizational ties in the most favorable light, and thus overreported connections to other organizations.

Second, these data represented snapshots in time, and did not reflect the constantly evolving nature of the quitline environment. However, because we are collecting data annually for 3 years, we will develop a clearer picture of change via an analysis of longitudinal network data. Data from our year 2 and 3 surveys should help to characterize how connectivity changes over time,¹⁰ potentially as a result of changing quitline needs, environmental influences, such as changes in funding or smoking regulations, or shifts in which service provider a quitline funder uses.

Despite some possible limitations of our data, we believed that our findings represented an important contribution to understanding how information flows within a network of organizations attempting to address a critical health problem—in this case, smoking. Our continued research on the quitline community in North America will focus on a number of key areas, including the identification of various network characteristics (e.g., location in the network), individual roles within organizations, geographic or regional characteristics, network and other variables that might play a role in

providing services to underserved populations, and longitudinal analysis of network change (e.g., the impact of changing quitline relationships, such as the merger of quitline service providers). In addition, data from our survey will allow us to explore whether network factors influence awareness, adoption, and implementation of evidence-based quitline practices, and to what extent decision-making and other variables might function as moderating or mediating variables in that process. This will be increasingly important as the United States and Canada place toll-free phone numbers for quitlines on cigarette packs, which should significantly increase call volume and greater reliance on quitlines as a core foundation for national tobacco treatment support. Through these analyses, we are confident that it will be possible to better understand the dynamics of quitline communication and collaboration to provide information back to quitlines that will benefit them as they make decisions on who to contact for the critical information they need to optimize their ability to help more smokers quit. ■

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Contributors

S. J. Leischow originated and led the study. K. Provan led the network analyses and contributed to writing. J. Beagles conducted the network analyses and contributed to writing. J. Bonito helped implement the study and contributed to writing. E. Ruppel helped implement the study and contributed to analyses and writing. G. Moor coordinated implementation of the study. J. Saul helped implement the study and contributed to writing.

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Human Participant Protection

The University of Arizona institutional review board provided human participant approval for this study.

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