Social Networks and Text Messaging in Public Health:
At the frontier of prevention interventions

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Social network analysis is increasingly used to describe, visualize and model existing real-world networks in order to better understand various structural and relational aspects in public health [1]. For example, Figure 1 shows a cell-phone network of Indian men who have sex with men (MSM). Data about social, commuter, and transportation networks allows one to more accurately simulate the spread of a disease outbreak and to evaluate different intervention scenarios to determine an optimal strategy for disrupting disease transmission. A recent example using this method is a model predicting the H1N1 outbreak in the US in 2009 [2].

Social network analysis and public health interventions

One example of a network-based public health intervention is contact tracing [3], which involves finding and testing the contacts of newly diagnosed individuals (a.k.a. the index case). Contact tracing is a common tool used for human immunodeficiency virus (HIV) and sexually transmitted diseases (STD) case tracking, as well as for controlling tuberculosis (TB) outbreaks. While these cases may be hard to identify, contact tracing is useful here because contacts of an index case are at high risk of infection [4, 5].

Using online social networks such as Facebook [7], interventions promoting physical activity [8] and targeting STDs [9] can quickly reach a broad audience at a low cost. Social networks allow for 'viral'-like spread of the intervention among the target population, leading to a wider reach of the intervention and greater effectiveness due to peer-influence [7, 10]. Messages, pictures, and videos can spread virally through a community e.g. by word-of-mouth referral and forwarding of text messages (SMS) and emails, which mimics the spread of a virus from person to person.

Social network analysis is also useful for identifying opinion leaders to target for behavior change campaigns [6]. After surveying community members to construct a social network matrix, opinion leaders can be identified using network centrality measures. These centrality measures include degree (the number of social contacts and a measure of popularity), closeness centrality (those in the center of the network, with few 'hops' between them and everyone else in the target population), and betweenness centrality (those playing a 'broker' or 'bridge' role by connecting different parts of the network) [3, 6].
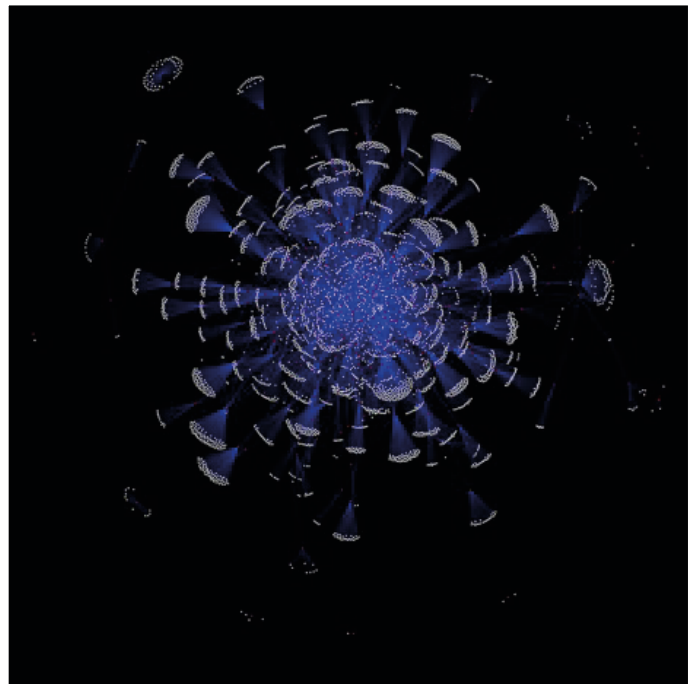

Figure 1: Network of cell-phone contacts among 4891 Indian men who have sex with men (MSM), Hyderabad, India. 241 Indian MSM were interviewed (red) and named their cell-phone contacts (white) [31, 32]. This figure was created using Gephi [33].

Our current research aims to show how actual social networks and social network analysis can be incorporated into the design of behavioral prevention interventions using text messaging. Mobile phones have a penetration of 96% globally [11] and text messages (SMS) are the most popular non-voice application [12]. Text messages are increasingly used as a primary means

of communication for promotion and education about sexual and reproductive health [13, 14], physical activity [15, 16], smoking cessation [17, 18] and mental health [19]. These interventions either push out bulk messages to a large number of users [20, 21] or require public health workers to recruit participants who then receive individually tailored text messages [22]. Both types are challenged by either 'reach' or 'richness', i.e. the number of participants reached or the quality of information transmitted [23], where low quality information impacts acceptance and retention rates [24, 25].

Peer-to-peer text messaging and peer education

Peer-to-peer (P2P) text messaging is a new mobile-phone based intervention designed to increase the reach and richness of behavioral prevention interventions, by having participants directly communicate with and educate peers via text messages. Public health workers recruit and train peer-distributors among the target population. Peer-distributors receive prevention content from public health workers and text the intervention messages to their peers by leveraging their cell-phone network. Text messages are tailored to the individual characteristics and needs of each peer. Peers can follow-up with the peer-distributor and can in turn forward the received messages to their peers. See Figure 2.

In our current research, we use a simulation framework and network datasets, such as in Figure 1, to compare the proposed P2P text messaging design against other intervention designs currently used, such as bulk message interventions and personalized interventions. We reason that leveraging the peer-distributor's social network and phone contacts, with the ability to tailor messages individually and then follow-up on these messages with his peers, will increase the richness of the information conveyed, resulting in a higher acceptance of the messages [26, 27]. Additionally, this approach will, especially for targeted campaigns, reach more individuals at lower cost than public health workers recruiting participants for individually tailored text messaging studies; this effect is being observed in peer-driven interventions among HIV-infected injection drug users [28, 29]. Simulating the spread of information and behavior change in social networks

Figure 2: Schematic illustration of peer-to-peer (P2P) text messaging.
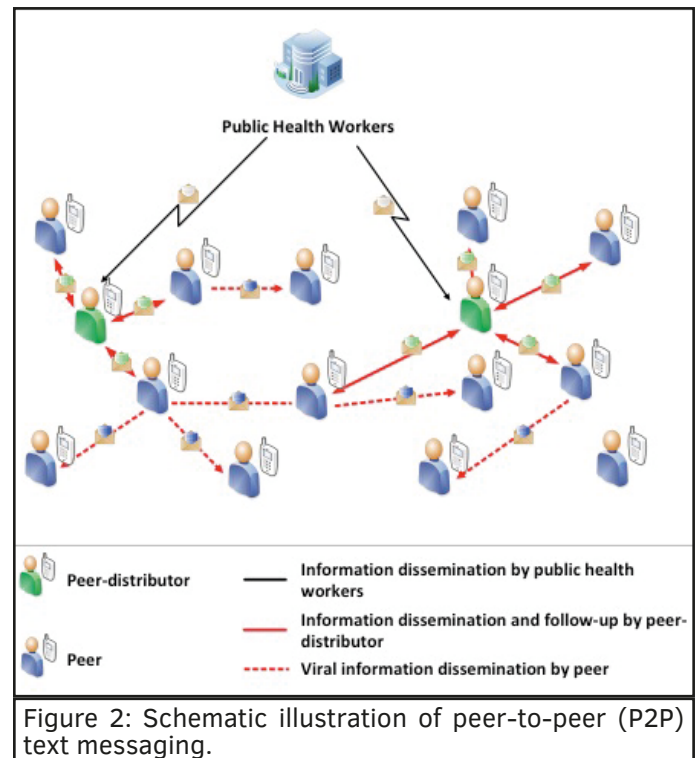
allows us to determine how to best tailor such a text message based intervention in different contexts [30]. P2P text messaging also allows for the dissemination of information and awareness to become viral; a recent idea in marketing whose full impact has not yet been explored by the public health community. Social networks and text messaging are becoming more important for prevention interventions and there is much to be gained by utilizing social network data and analysis in the design of existing prevention interventions.

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