Original investigation

Share2Quit: Online Social Network Peer Marketing of Tobacco Cessation Systems

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Abstract

Introduction: Although technology-assisted tobacco interventions (TATIs) are effective, they are underused due to recruitment challenges. We tested whether we could successfully recruit smokers to a TATI using peer marketing through a social network (Facebook).

Methods: We recruited smokers on Facebook using online advertisements. These recruited smokers (seeds) and subsequent waves of smokers (peer recruits) were provided the Share2Quit peer recruitment Facebook app and other tools. Smokers were incentivized for up to seven successful peer recruitments and had 30 days to recruit from date of registration. Successful peer recruitment was defined as a peer recruited smoker completing the registration on the TATI following a referral. Our primary questions were (1) whether smokers would recruit other smokers and (2) whether peer recruitment would extend the reach of the intervention to harder-to-reach groups, including those not ready to quit and minority smokers.

Results: Overall, 759 smokers were recruited (seeds: 190; peer recruits: 569). Fifteen percent ($n = 117$) of smokers successfully recruited their peers (seeds: 24.7%; peer recruits: 7.7%) leading to four recruitment waves. Compared to seeds, peer recruits were less likely to be ready to quit (peer recruits 74.2% vs. seeds 95.1%), more likely to be male (67.1% vs. 32.9%), and more likely to be African American (23.8% vs. 10.8%) ($p < .01$ for all comparisons).

Conclusions: Peer marketing quadrupled our engaged smokers and enriched the sample with not-ready-to-quit and African American smokers. Peer recruitment is promising, and our study uncovered several important challenges for future research.

Implications: This study demonstrates the successful recruitment of smokers to a TATI using a Facebook-based peer marketing strategy. Smokers on Facebook were willing and able to recruit other smokers to a TATI, yielding a large and diverse population of smokers.

Introduction

Smoking is the leading cause of preventable death.¹ Decades of research have produced effective cessation treatments and behavior

change tools including technology-assisted tobacco interventions (TATIs).^{2–4} These TATIs are underused due to recruitment challenges.^{1,4–8} In particular, it has been challenging to engage minority smokers and smokers who are not yet ready to quit.^{1,4}

Online social networks and peer marketing hold promise for recruiting smokers. These networks are used by 74% of US Internet users and disparities in use have decreased.^{9,10} Facebook, the largest social network, had more than 1.49 billion monthly active users in July 2015.¹¹ Peer marketing is increasingly used to engage customers. In peer marketing, companies use tools to encourage current customers to recruit their friends and family. In this way, customers transform their peers into new customers. In the healthcare field, peer recruitment has been used to draw harder-to-reach populations (eg, HIV patients, drug users) to behavioral interventions^{12,13} but has not been rigorously tested as a way to engage smokers in TATIs.

In our National Cancer Institute-funded Share2Quit study, we tested peer recruitment on Facebook as a method for increasing access to a TATI.^{14,15} Our primary research question was whether smokers would recruit other smokers, thereby extending the reach of the intervention. We also tested whether the peer recruitment process would extend the reach to harder-to-reach groups, including those not ready to quit and minority smokers. Our analysis included identifying key characteristics predicting successful recruitment, potential for sustained propagation through the network, and comparison of the Share2Quit recruitment versus previous strategies.

Methods

Study Design

Share2Quit was a prospective peer recruitment intervention. A detailed protocol was published.^{14,15} Share2Quit was implemented in connection with a previously demonstrated effective TATI (Supplementary Appendix Figure 1).^{6,16–19} We developed a peer recruitment tool to facilitate the recruitment of smokers on Facebook to our existing TATI.^{14,15} Participants were recruited from July 2013 to September 2014. Share2Quit was approved by the University of Massachusetts Medical School Institutional Review Board.

The Intervention: Share2Quit Peer Recruitment on Facebook

The Share2Quit tool included four components: (1) A Web site plugin to select and message a Facebook friend, (2) online training video, (3) recruitment tracker, and (4) emailed weekly recruitment reports (Supplementary Appendix Figure 2). This Web site plugin leveraged Facebook API functions²⁰ to allow participants to login to Facebook, select their Facebook friends from a drop-down menu, and send them private recruitment messages. These private messages were viewable on the Facebook inbox and an alert on Facebook indicated that a new message was available to read. We provided a template to help the smoker craft the recruitment message. The online training video demonstrated the TATI's registration steps and the Facebook Web site plugin use. The recruitment tracker displayed a list of each smoker's successful recruits. To encourage recruitment, a weekly recruitment E-mail report was sent. Although we facilitated recruitment through Facebook, we did not prevent users from recruiting by other means.

Social Network Recruitment Procedure

Peer recruitment proceeded via consecutive recruitment waves (Supplementary Appendix Figure 3). We recruited the initial wave of participants (referred to as "wave 0" or "seeds") through Facebook advertisements. These advertisements were displayed on Facebook to US Facebook users searching for keywords such as

"stop smoking" or "I quit smoking." We used Facebook ad manager to create the advertisements. The Facebook ad manager allows advertisers to target users based on their interests. The ad manager identifies Facebook users' interests from their activities, such as the pages they like and groups they visit. Advertisements were displayed on the right hand column of the Facebook home page. Smokers who clicked the advertisements were redirected to register and consent online. Current and former smokers who were over the age of 18 were eligible to participate. Consented smokers were given access to the TATI and Share2Quit toolset. The seeds were then encouraged to recruit other smokers. New smokers peer recruited by our seeds were referred to as "wave 1" smokers and were in turn provided TATI access and the Share2Quit tools to recruit subsequent waves.

Incentives were provided to the peer recruiters for each successful recruitment (\$15 per recruit). In previous peer recruitment studies, incentives have been shown to promote peer recruitment.²¹ However, in an online peer recruitment study, incentives may lead to fraudulent activity. We restricted the potential for fraudulent activity by using a recruitment quota and restricting the total number of days for recruitment to 30 days from the date of registration on the TATI. These decisions were made based on prior experiences with online peer recruitment studies.²² A quota is the maximum number of recruits allowed per recruiter. In online peer recruitment approaches such as respondent-driven sampling, quotas are used as an important control to prevent recruiters with larger networks from over-recruiting within their peer network, since this recruitment behavior could create biased samples with shorter chains.^{21,23} Individuals who want to "game" a system are much less likely to engage if their potential is limited by a quota (than when allowing infinite recruits) and by the time to recruit. Conversely, this artificial cap on recruiters with larger networks can also reduce the rate and reach of peer recruitment. Thus, setting an appropriate quota was important to balance these factors. We determined the quota level of 7 based on a pilot study conducted with online smokers.¹⁵ In this study, we asked smokers how many of their social contacts (ie, other smokers) would be open to referral to a TATI. On average, respondents thought that five of their social contacts (range 1–20; SD = 2.4) would be open to referral. The recruitment quota was enforced by making it clear in our Web site instructions and the weekly recruitment E-mails to smokers that incentives will only be provided for up to seven recruitments. We did not program our software to restrict smokers from recruiting more than seven because we did not want to prevent the recruitment of additional smokers.

Data Collection/Measures

Online surveys and user activity tracking were used. Baseline data included demographics (age, sex, race, and ethnicity), smoking behaviors, and readiness to quit.^{24,25} Readiness to quit was assessed using the five stages of the contemplation ladder (precontemplation, contemplation, preparation, action, and maintenance). A successful peer recruitment was defined as a peer recruited smoker completing the registration on the TATI following a referral.

Size and characteristics of the social network were assessed using the question: "Thinking about people you know who smoke cigarettes, how many are: immediate family, extended family, close friend, friend, co-worker, and acquaintance." In this paper, we use "ties" to refer to relationships with other smokers. "Total ties" refers to the sum of all the above categories of smokers; "strong ties" was the sum of immediate family, extended family, and close friend smokers; "weak ties" was the sum of friend, coworker, and acquaintance smokers.^{13,26}

The 30-day follow-up assessed how the recruitment was conducted—how many people they discussed the study with and (if declined) the primary reason for refusal. On a five-point Likert scale (Strongly agree to Strongly disagree), we assessed *usability of Share2Quit tools* (perceived helpfulness of Share2Quit tools, clarity of instructions, and recruitment). The perceived potential benefit (and risk) of peer recruiting to the smoking cessation efforts of the recruiter was assessed on a five-point Likert Scale (Strongly agree to Strongly disagree) using the following questions: “Recruiting Smokers to Decide2Quit: 1) Was beneficial to my own quit smoking efforts; 2) Motivated me to get support from those around me to quit smoking; 3) Increased my craving for cigarettes; and 4) Made me feel like I was being helpful to my family and friends who are smokers.”²⁷

Data Analysis

Our primary research question was: Will smokers peer recruit other smokers and extend the reach of the intervention (Q1). Our secondary research question was: Will peer recruitment extend the reach of the intervention to harder-to-reach groups (seeds vs. peer recruits) (Q2). We first measured the number of smokers recruited by wave (Q1), and further compared the characteristics of those who were successful recruiters and those who did not succeed (nonrecruiters) (Q2). We then compared the characteristics of seeds and peer recruits. For these comparisons, we used a two-sided chi-square statistic or a Cochran–Armitage test for trend as appropriate.

To assess whether perceived cessation influence had any influence on peer recruitment, we created a summary score of cessation influence. We then created a multivariable model with the number of successful recruitments (a count variable ranging from zero to seven over a maximum of 30 days) as our dependent variable. Since the dependent variable was a count, a count regression was used to create a multivariable model. Because of overdispersion of the variance of the distribution of the dependent variable, we used negative binomial regression.

Will the Network Continue to Propagate?

Prior peer marketing research has shown that both strong and weak ties of users must be activated to propagate behavior through a network.^{28–32} Strong ties are important to quickly diffuse the information through a subnetwork, while weak ties act as a bridge to diffuse information between subnetworks in a network. In this paper, ties refer to ties with other smokers. We calculated an estimate of smokers whose networks have higher proportions of weak ties. For this estimate, we first created a ratio using the formula:

$$\text{Weak Tie Ratio} = \text{Weak Ties} / \text{Total Ties}$$

To compare the recruitment success of smokers whose networks had higher proportions of weak ties compared to the success of those with lower proportions, our dependent variable was the number of successful recruitments (a count variable ranging from zero to seven over a maximum of 30 days). As noted above, the number of registrations variable was a count and the variance of the distribution of this variable was overdispersed. Thus, we used negative binomial regression and adjusted for sex, smoking status, and the race of the recruiter. The Weak Tie Ratio was categorized into three groups along the 33rd and 66th percentile to use as the independent variable in our model. As noted above, each smoker was given a total of 30 days from the date of registration to peer recruit other smokers. However, depending on the wave in which the smoker was recruited, not everyone had completed the full

allotment of 30 days when the study ended. Thus, to prevent bias in our analysis, we only included those smokers who had completed 30 days.

Total peer recruitment costs were calculated as the sum of direct recruitment (seed recruitment) and peer recruitment costs. Direct recruitment cost was the cost for the Facebook advertisement campaign. Peer recruitment cost was the total of the incentives provided to smokers for successful peer recruitment.

Results

Recruitment Success

Overall, 759 participants were recruited (seeds: 190; peer recruits: 569) (see Supplementary Appendix Figure 4 for a trial flow diagram). Participants reported being connected to 6914 smokers (total ties: mean 9.1 [SD 5.51], median 8, intraquartile range [IQR] 4; strong ties: mean 3.6 [SD 3.3], median 2, IQR 4; weak ties: mean 5.6 [SD 3.5], median 5, IQR 3). Overall, 15% ($n = 117$) of participants successfully peer recruited. Among successful recruiters, 46.1% recruited seven smokers, 18.0% recruited four to six smokers, 15.4% recruited two to three, and 20.5% recruited one smoker. Recruitment resulted in four waves of participants after the initial wave of seeds (ie, wave 0 through wave 4). As the waves progressed from wave 0 to wave 4, we found a proportional increase in male smokers, African American smokers, and smokers not ready to quit. There was a proportional decrease in smokers aged 45 or above (Supplementary Appendix Table 1). At study completion, 70% of the smokers ($n = 593$) had completed 30 days of access to the tools from the date of registration (mean completion time of all smokers: 27.2, SD 5.7, range 8–30). The majority of smokers were recruited in the first 7 days of recruitment (52.4%). Considering the number of smokers who completed the total 30 days of participation (593) and the quota (7), we estimated that the total number of potential recruits was 4151. Thus, approximately 18% (759/4151) of the total potential network was successfully recruited.

Among those completing postrecruitment follow-up ($n = 118$), participants reported that they asked a total of 779 smokers from their network to participate in the study (this data were only available for those who completed follow-up). Fifty-nine percent of this subset of smokers were successful recruiters and they had recruited 300 smokers. These participants responded that the major reason that someone refused a referral was that they were not ready to quit smoking (40.0%) or had no time (26.0%).

Characteristics and Smoking Behaviors of Successful Recruiters and Nonrecruiters

Successful recruiters were younger and less commonly minorities (Table 1). Compared with nonrecruiters, a higher proportion of successful recruiters had attempted to quit for 1 day or longer in the 12 months prior to Share2Quit participation ($p < .01$). Successful recruiters were lighter smokers (28.6% of successful recruiters smoked between 0 and 5 cigarettes/day compared to 9.4% of nonrecruiters), and a higher proportion had visited a TATI before participating in the current study (36.3% of successful recruiters compared to 13.5% of nonrecruiters). Recruiters reported larger smoker social networks than nonrecruiters (Recruiters: mean 13.3, SD 5.8, median 14, IQR 8; Nonrecruiters: mean 8.5, SD 5.2, median 8, IQR 3) ($p < .01$).

Table 1. Recruiters and Nonrecruiters: Comparison of Demographics, Internet use, and Smoking Behavior (Total *N* = 759)

	Did not recruit		Recruited successfully one or more smokers		<i>p</i>
	<i>N</i> = 668	88%	<i>N</i> = 91	12%	
Sex					.69
Male	389	58.2	55	60.4	
Female	279	41.8	36	39.6	
Age					<.01 ^a
19–24	37	5.6	14	15.4	
25–34	80	12.0	23	25.3	
35–44	393	58.8	36	39.6	
45+	158	23.6	18	19.8	
Race					
White (reference group)	453	70.0	54	79.4	
African American	142	22.0	6	8.8	.01
Asian	52	8.0	8	11.8	.53 ^b
Ethnicity ^b					<.01
Hispanic or Latino	15	2.3	8	8.8	
Not Hispanic or Latino	630	94.3	69	75.8	
Education					.33 ^a
Less than high school or high school graduate	98	14.7	16	17.6	
Some college	292	43.8	42	46.1	
College graduate	276	41.4	33	36.3	
Marital status					
Married/a member of an unmarried couple (reference group)	197	31.2	28	31.1	
Divorced/separated/widowed	163	25.8	22	24.4	.87
Never married	271	42.9	40	44.4	.89
Internet use					<.01 ^a
0–3 functions	36	5.4	9	9.9	
4–6 functions	81	12.1	34	37.4	
>6 functions	551	82.5	48	52.8	
Do you allow smoking in your home?					<.01
No	517	77.4	50	54.9	
Yes	151	22.6	41	45.1	
About how many cigarettes do you smoke per day?					<.01 ^a
0–5	63	9.4	26	28.6	
6–10	261	39.1	38	41.7	
>11	344	51.5	27	29.7	
Have you ever visited a smoking cessation Web site?					<.01
No	578	86.5	58	63.8	
Yes	90	13.5	33	36.3	
Readiness to quit ^c					.17
Not ready to quit	603	90.4	78	85.7	
Ready to quit	64	9.6	13	14.3	

^aTest for trend.^bSome missing values.^cReadiness to quit was dichotomized into two categories (not ready to quit [precontemplation and contemplation] and ready to quit [preparation, action, and maintenance]) because the numbers were low.

Success in Engaging Harder-to-Reach Groups

Compared to seeds, a greater proportion of the peer recruits were male (seeds: 32.6%; peer recruits 67.1%) and African American (seeds: 10.9%; peer recruits: 23.8%). Since the number of smokers in certain categories was low (precontemplation, preparation, action, and maintenance), we dichotomized the readiness to quit into two categories (not ready to quit [precontemplation and contemplation] and ready to quit [preparation, action, and maintenance]).

A higher proportion of peer recruits also reported that they were not ready to quit (seeds: 74.2%; peer recruits: 95.1%) ($p < .01$ for all comparisons) (Table 2). Since we noted a greater

number of male smokers and African American smokers among peer recruits, we further analyzed among four sex-race categories (White male, White female, African American male, African American female). We then plotted the relative increases of each of the four sex-race category by recruitment wave compared to baseline (Figure 1). For each sex-race category, increases were calculated using the formula multiplied by 100:

$$\frac{(\text{number of recruits in the current wave for the sex/race category} - \text{number of seeds for the sex/race category})}{\text{number of seeds for the sex/race category}} \times 100$$

Table 2. Direct and Peer Recruits: Comparison of Demographics, Internet use, and Smoking Behavior (Total *N* = 759)

	Seeds		Peer recruits		<i>p</i>
	<i>N</i> = 190	25.0%	<i>N</i> = 569	75.0%	
Sex					<.01
Male	62	32.6	382	67.1	
Female	128	67.4	187	32.9	
Age					<.01 ^a
19–24	17	8.9	34	6.0	
25–34	21	11.0	82	14.4	
35–44	49	25.8	380	66.8	
45+	103	54.2	73	12.8	
Race					
White (reference group)	148	85.0	359	66.4	
African American	19	10.9	129	23.8	<.01
Asian	7	4.0	53	9.8	<.01
Ethnicity ^b					<.01
Hispanic or Latino	8	4.2	15	2.6	
Not Hispanic or Latino	166	87.4	533	93.8	
Education					<.01 ^a
Less than high school or high school graduate	69	36.5	45	7.9	
Some college	75	39.7	259	45.6	
College graduate	45	23.8	264	46.5	
Marital status					
Married/a member of an unmarried couple (reference group)	74	40.9	151	27.9	
Divorced/separated/widowed	70	38.7	115	21.3	.30
Never married	37	20.5	274	50.7	<.01
Internet use					<.01 ^a
0–3 functions	17	8.9	28	4.9	
4–6 functions	44	23.2	71	12.5	
>6 functions	129	67.9	470	82.6	
Do you allow smoking in your home?					<.01
No	100	52.6	467	82.1	
Yes	90	47.4	102	17.9	
About how many cigarettes do you smoke per day?					.24 ^a
0–5	42	22.1	47	8.3	
6–10	45	23.7	254	44.6	
>11	103	54.2	268	47.1	
Have you ever visited a smoking cessation Web site?					<.01
No	127	66.8	509	89.5	
Yes	63	33.2	60	10.5	
Readiness to quit ^c					<.01
Not ready to quit	141	74.2	540	95.1	
Ready to quit	49	25.8	28	4.9	

^aTest for trend.^bSome missing values.^cReadiness to quit was dichotomized into two categories (not ready to quit [precontemplation and contemplation] and ready to quit [preparation, action, and maintenance]) because the numbers were low.

Compared to seeds, the relative number of White male smokers increased by recruitment waves, while White female smokers decreased. Among African Americans, there was a marked increase in the relative number of African American male smokers, while the relative number of female smokers stayed the same.

Usability and Cessation Influence

Participants (*n* = 118) responded that the Share2Quit tools were helpful (79.7%), the Web site's instructions were clear (78.0%), and that the recruitment process was not burdensome (72.0%). Most participants strongly agreed or agreed that peer recruitment was beneficial to their own quit smoking efforts (75.4%), motivated

them to get support from those around them to quit smoking (64.4%), did not increase their cravings (83.1%), and made them feel like they were being helpful to their family and friends who are smokers (71.2%). Cessation influence score ranged between 7 and 20 with 4 indicating that the tools had the lowest cessation influence and 20 indicating that the tools had the highest influence. There was a trend toward higher rate of peer recruitment as the cessation influence score increased (incidence rate ratio [IRR] 1.15, *p* < .01).

Potential of Network to Continue Propagating

Mean total ties (connections to other smokers) reduced with each recruitment wave (seeds: 12.1 [SD: 7.3]; wave 1: 8.2 [SD: 5.8];

Sex/Race categories	Wave 0 or seeds (n=167)	Peer Recruits		
		Wave 1 (n=180)	Wave 2 (n=167)	Wave 3 (n=141)
White male	43	71	85	87
White female	105	65	31	20
African American Male	9	26	39	27
African American Female	10	18	12	7

The relative increases of each category by recruitment wave was calculated using the formula:

$$\left[\frac{(\text{number of recruits in the current wave for the sex - race category} - \text{number of seeds for the sex - race category})}{\text{number of seeds for the sex - race category}} \right] \times 100$$

In this table, we only compared Whites and African Americans. The number of Hispanics or Latinos were too low to make inferences.

Figure 1. Relative changes in sex and gender by recruitment waves.

wave 2: 8.4 [SD: 3.7]; wave 3: 7.6 [SD: 2.4]). This was mostly due to a reduction in the mean number of strong ties (seeds: 5.8 [SD: 3.4]; wave 1: 3.1 [SD: 3.3]; wave 2: 2.9 [SD: 2.7]; wave 3: 2.3 [SD: 2.2]) in each smoker's network. The mean number of weak ties in each smoker's network remained consistent after direct recruitment (seeds: 6.3 [SD: 5.0]; wave 1: 5.1 [SD: 3.6]; wave 2: 5.5 [SD: 2.2]; wave 3: 5.4 [SD: 1.7]) (Figure 2).

In our model, we only used the smokers who had completed 30 days of access to the tools ($n = 593$). Compared with those smokers who had the highest proportion of strong ties (strong tie-rich smokers [category 1]), the recruitment rate reduced with each category (category 2: IRR: 0.69 [95% CI: 0.31, 1.53], category 3: IRR: 0.44 [95% CI: 0.20, 0.92]). Conversely, as the proportion of weak ties of a smoker increased, the recruitment rate decreased. This did not change after adjustment for sex and smoking status. Adding race to the model further strengthened the association between the dependent and primary independent variable in the model. The recruitment rate for each category after adding race to the model: (category 2: IRR: 0.59 [95% CI: 0.27, 1.30], category 3: IRR: 0.26 [95% CI: 0.12, 0.60], p for trend < .01).

Peer Recruitment Costs

Facebook advertisement costs were US \$14,083.44. Cost per seed recruited was US \$74.12. Costs of incentives provided for successful peer recruitment were US \$8,535.00. Total peer recruitment costs were US \$22,618.44. The cost per smoker recruited was US \$29.80.

Discussion

To our knowledge, Share2Quit presents the first evidence that smokers on Facebook are willing to recruit other smokers to a TATI, and that peer recruitment can reach a large and diverse population of smokers. Beginning with 190 smokers, peer recruitment quadrupled the sample (final $n = 759$). Of particular note, peer recruitment was successful in recruiting harder-to-reach populations. Our network analysis indicated that there is potential for the network to continue propagating, but smokers with networks containing high proportions of weak ties may benefit from further training and motivation to recruit.

Prior Facebook recruitment efforts have used direct marketing, ie, using advertisements to market the intervention directly to users.³³⁻³⁵

Figure 2. Mean strong and weak ties by recruitment waves.

However, direct marketing does not take advantage of the interconnectedness of online social networks. At an NIH-funded meeting on online social networks and smoking cessation, peer marketing use and the identification of influential ties to drive propagation within online social networks were identified as important research areas.³⁶ Our peer recruitment strategy recruited approximately 18% of the total potential network. Smokers between the ages of 35 and 44 were more successful recruiters, consistent with prior reports that Facebook users over age 31 have the strongest peer influence.³⁷ This age group also reflects typical TATI users.^{38–43} Successful recruiters were lighter smokers, and a higher proportion had prior experiences participating in TATIs. These characteristics may be markers for higher motivation to quit, which may have resulted in greater participation in peer recruitment.

In our study, peer recruited smokers differed significantly from seeds. Peer recruitment increased the proportion of male smokers (32.6–67.4), who typically do not participate in TATIs,⁶ as well as the proportion of African American smokers (10.9–23.8) in the sample. This finding may be driven by differences in the acceptability of the intervention to men and to African American smokers or it may be the result of random chance in the recruitment of seeds and their corresponding networks. While tobacco interventions have reduced population smoking prevalence, the impact has not been uniform. This has led to increases in tobacco-related disparities. Although cessation rates of African American smokers are similar to Whites, they are more likely to die from smoking-related diseases than Whites.⁴⁴

In comparison to White smokers, more African American smokers initiate quit attempts; however, African American smokers are also more likely to fail because they do not use behavioral support. While we did not design our recruitment tools to specifically target any racial group, our success in recruiting from the African American smoker Facebook population merits further study, since this is a population that could greatly benefit from our intervention. Very few Hispanic or Latino smokers were recruited in this study. Reasons for this lack of participation might include language barriers, the direct marketing campaign on Facebook, or the peer recruitment strategy. Future studies are needed to test the effectiveness of peer recruitment with Hispanic or Latino smokers.

As waves progressed, the proportion of smokers in our sample who were not ready to quit increased. Since the majority of smokers are in this not ready to quit phase at any given time (70–80%),⁴⁵ it is important to identify methods to encourage these smokers to participate in interventions. Peer recruitment potentially enhances the personal relevance of the intervention, and peers may be able to more easily engage and encourage participation.

Most smokers (79.7%) responded that peer recruitment was helpful in their cessation efforts. They also reported that participating in the peer recruitment motivated them to get support from those around them to quit smoking (64.4%), and made them feel like they were being helpful to their family and friends who are smokers (71.2%). Two randomized trials have previously tested the effectiveness of pairing smokers with another person (buddy system)

on smoking cessation. In one report, the cessation rate was significantly higher in the buddy condition than the solo condition (27% vs. 12%).⁴⁶ This effect was not seen in another group treatment program.⁴⁷ In these studies, the investigators selected the buddies. In contrast, peer recruitment provides smokers the opportunity to select their own buddies, which might enhance the effect of social support. It was interesting to note the trend toward higher recruitment rate for those participants who reported a greater influence of peer recruitment on their cessation behavior. Trials that investigate long-term cessation of smokers' peer recruiting are needed, as well as the perceived influence of cessation of the intervention on peer recruitment.

Not all smokers peer recruited. Propagation also declined with each wave. Smokers with larger networks were more successful in recruitment than were those with smaller networks. However, the size of the smokers' social networks tended to decrease across successive recruitment waves. Further analysis indicated that the reduction in the size of the networks was mostly due to a reduction in the mean number of strong ties, while the mean number of weak ties remained consistent. Considering that the social networks of smokers are made up of a number of subnetworks, strong ties are important to quickly diffuse the information through a subnetwork. Weak ties act as a bridge to diffuse information from one subnetwork to another. Thus, both are needed to achieve deep (within a subnetwork) and wide (across subnetworks) spread of information. In our study, smokers with networks containing a high proportion of weak ties recruited at a lower rate than smokers whose networks included a high proportion of strong ties. Acknowledging that smokers will have lesser influence over their weak ties, additional training on how to communicate with their weak ties may increase recruitment potential.

Limitations

Using Facebook limited our ability to directly collect referral data and we relied on self-report. Our study sample was recruited primarily from Facebook and their characteristics depended on the characteristics of the Facebook population of smokers. The characteristics of Facebook smokers may be different from that of the general population of smokers, and the characteristics of participants may differ if another social networking site is used. In an online peer recruitment study, there is high potential for fraudulent activity.⁴⁸ As noted, we used a quota system and a restricted recruitment time to reduce potential fraudulent participants. We also manually verified each peer recruitment using data entered by the user (eg, E-mail address, IP address, demographic characteristics); however, there may have been additional fraudulent activity that was undetected. We also did not collect data on whether the recruitment had any effect on cessation, although prior papers have demonstrated the effectiveness of our TATI.^{16,17,49}

Conclusions

Christakis et al.⁵⁰ have shown that members of smoker groups can influence each other and quit in concert, ie, both health information and quit behavior spreads between smokers, creating cascading effects throughout a network.^{51,52} This effect was also corroborated in other studies.^{53,54} However, whether proactive efforts can achieve this is yet to be determined. Share2Quit presents evidence that Facebook smokers are willing to encourage their peers to participate in a TATI. Peer recruitment expanded the reach of the recruitment to traditionally hard-to-reach groups. With peer recruitment the cost per smoker recruited was reduced from US \$74.12 (for direct-only)

to \$29.80 for study overall. Compared with our prior study evaluating the costs to recruit smokers to the same TATI using electronic referrals from 87 clinical practices (cost per smoker: US \$87.40),⁵⁵ peer recruitment had a relatively lower cost. There was also some evidence that participation in peer recruitment may be helpful in assisting cessation in those who decide to make a quit attempt, an important research theme for future work.

Supplementary Material

Supplementary Appendix can be found online at <http://www.ntr.oxfordjournals.org>

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Declaration of Interest

RSS and TKH have a patent 14/055098 pending for the technology-assisted tobacco intervention. SLC receives grant support from the AHRQ and from Pfizer Independent Grants for Learning and Change. Other authors reported no conflict.

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