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# Linking smokers to a quitline: randomized controlled effectiveness trial of a support person intervention that targets non-smokers

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## Abstract

Evidence-based treatments (e.g. quitlines) are greatly underutilized by smokers limiting their public health impact. A three-session phone intervention for nonsmoking family members and friends (i.e. support persons) was successful for increasing smoker quitline enrollment. To enhance the intervention's potential translatability, in this study, we delivered treatment for the non-smoker within ongoing quitline services and compared the efficacy of the three-call intervention to a streamlined version (one call). A total of 704 adult non-smokers (85% female, 95% White) wanting to help a smoker quit and recruited statewide in Minnesota participated in this randomized controlled trial with parallel groups. Non-smokers received mailed written materials and were randomly assigned to a control condition (no additional treatment,  $n = 235$ ), or to a one- ( $n = 233$ ) or three-call ( $n = 236$ ) intervention delivered by quitline coaches. The main outcome was smoker quitline enrollment through 7-month follow-up. Smoker quitline enrollment was similar for those linked to non-smokers in the one- and three-call interventions (14.6% [34/233] and 14.8% [35/236]), and higher than for smokers linked to control participants (6.4% [15/235]),

$P = 0.006$ . Just one quitline coaching call delivered to non-smokers increased treatment enrollment among smokers. The reach of quitlines could be enhanced by targeting the social support network of smokers.

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## Introduction

In 2014, the prevalence of smoking in the United States was 16.8% [1]. About half of smokers attempt to quit each year [2], but most do not utilize evidence-based interventions that could double or triple their success at quitting [3–5]. For example, the use of quitlines improves smoking cessation [6, 7] but these are used by only 1% of smokers in the population [8]. Therefore, promoting use of evidence-based cessation treatments is an important public health priority [5, 8].

A promising approach for increasing the reach of interventions is to target non-smokers within the social support network of smokers [9, 10]. From observational studies, supportive interpersonal relationships [6] and social networks [11] are correlated with quitting success. However, strategies that use buddy systems or involve family members or friends (i.e. support persons) with smokers seeking cessation treatment have not been uniformly effective

[12, 13]. Thus, a key challenge for the field is where and how to leverage social support in the cessation process [12, 14].

Most research has focused on cessation—harnessing support from family members and friends to help smokers who are already in treatment programs and have high levels of quitting readiness [12, 13, 15]. Most smokers, however, are not ready to quit [16], and thus supportive strategies that reach non-treatment seeking smokers may have greater reach and utility. For example, recent studies suggest that targeting community peers and family support networks is effective for increasing quitting among non-treatment seeking smokers [17, 18]. Also, the CDC Tips from Former Smokers national campaign was associated with increases in the proportion of non-smokers who talked to smokers about quitting and recommended treatment [19]. In a prior randomized efficacy trial [20], we evaluated if non-smokers could be effective in prompting a smoker to utilize a quitline. Non-smokers ( $n = 534$ ) received written materials only (control condition) or written materials plus three counseling calls delivered by research staff. Counselors used behavioral change techniques with a motivational interviewing style to teach participants supportive skills for prompting their smoker's use of a quitline. Quitline enrollment was significantly greater for smokers linked to participants who received the intervention (16.1%) than for control participants (8.6%); adjusted OR = 2.09,  $P = 0.008$ .

To enhance the potential translatability of the intervention, in this study, we conducted a randomized clinical trial within the ongoing services of a quitline, transitioning the non-smoker intervention delivery from research staff to existing quitline coaches. With the ultimate goal of reducing costs and enhancing dissemination, we examined if a streamlined version (one call) was as effective as the three-call intervention; both were compared to a control condition. We hypothesized a dose response relationship between number of phone sessions (0, 1, 3) provided to non-smoking support persons and smoker quitline enrollment. This work is novel because it is the first to evaluate a quitline intervention for non-smokers to engage smokers in cessation

treatment. In contrast, prior studies evaluated strategies using health care professionals to engage unmotivated smokers in treatment [21, 22].

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## Materials and methods

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This RCT was conducted in Minnesota, and approved by the Mayo Clinic and National Jewish Health Institutional Review Boards, and registered with clinicaltrials.gov (NCT01331226). All participants provided written informed consent. Data were collected from 2011 to 2014 and analyzed from 2015 to 2016.

### Participants

#### *Sample size calculation*

A prior efficacy trial [20] found the rate of smoker quitline enrollment was 8% for the control group versus 16% for the three-call support person intervention. From prior quitline studies targeting smokers [23], we assumed quitline enrollment rates for one coaching call to be intermediate between the control (i.e. 0 calls) and the three-call conditions. Assuming a linear trend in a logistic regression model for the primary outcome of quitline enrollment, an alpha of 0.05, and the above assumptions, the study was designed with 90% power to enroll 340 support persons per group for a total sample of 1020 participants.

#### *Screening, eligibility and enrollment*

Non-smokers who were concerned about a smoker and interested in learning how to be helpful were recruited statewide in Minnesota over 25 months (September 2011–2013). The first 93 participants were enrolled utilizing flyers sent to various public health organizations, health fairs, community events, press releases and advertisements in small regional newspapers and radios. The next 611 participants were enrolled through targeted mailings done from a list of potential smoking households in Minnesota, purchased from a direct marketing company. Due to study timeline and budget constraints, we stopped recruitment with 704 subjects

enrolled. Recruitment advertisements included a study toll-free number and an e-mail address. Screening was completed by research staff by telephone or e-mail; those eligible were mailed a consent form and baseline questionnaire. No incentives were offered for enrollment in the study.

Eligibility criteria were: at least 18 years of age; Minnesota resident; non-smoker (never smoked or no smoking for  $\geq 6$  months); interested in supporting someone at least 18 years of age who was a Minnesota resident and smoked on average at least one cigarette per day over the previous 7 days, with whom they had any form of contact on at least 3 days/week; access to a working telephone; and provided written informed consent. Individuals were excluded if another participant from the same household had enrolled. A total of 1301 individuals were screened of which 1169 (90%) were eligible; of these 704 (60%) enrolled (Fig. 1).

## Procedure

In this RCT with parallel groups, participants were stratified according to their gender and if they lived in the same residence as their smoker, and randomly assigned to the one-call intervention group, three-call intervention group or control condition (allocation ratio: 1:1:1). The study stratified participants on gender because some research indicated differences between men and women on provision of and response to social support in smoking cessation [12]. Prior to the trial, the study statistician generated the random allocation sequence based on the stratification variables. Participants completed baseline assessments prior to being informed of their allocation to treatment condition. Participants were mailed a cover letter notifying them of their study group assignment. Enclosed in this mailing were written materials and a colorful silicone wristband with the study logo.

Follow-up data were collected from October 2011 to July 2014. Research staff blinded to treatment condition mailed a questionnaire (i.e. Support Provided Measure [SPM]) at 1 and 7 months to all randomized participants and provided reminders by e-mail or telephone, if needed. Participants received

a pen for completing the 1-month follow-up and a key chain for completing the 7-month follow-up. Participants completing each follow-up were entered into a drawing for 1 of 11 Ipod touches that was conducted after all study assessments were completed. A participant's name was entered after each follow-up was completed, with maximum of two entries.

## Support person interventions delivered to the non-smokers

Participants in all three groups received written materials consisting of: (i) the NCI Clearing the Air brochure that they could share with their smoker, and (ii) a tri-fold brochure containing tips on supportive behaviors and statements, information on nicotine dependence including nicotine withdrawal, and a description of services provided by the Helpline. This brochure included a study-specific quitline toll-free number and a reference code linked to the participant's study ID number that their smoker could use for up to 7 months. This was done to capture the primary endpoint; specifically, to link smokers enrolling in the quitline with the study participants. To ensure consistency in services provided, all smokers who used the study number were eligible to receive quitline services and were not triaged based on insurance status or health plan (the typical procedure for individuals calling). The materials informed participants that their smoker could receive free nicotine replacement therapy and counseling as part of the quitline services. The one- and three-call coaching intervention groups additionally received the Contemplation Ladder as a visual aid for education on readiness to quit.

### *Control group*

Participants assigned to the control group ( $n = 235$ ) received no additional treatment.

### *Three-call coaching intervention group*

This condition ( $n = 236$ ) consisted of three proactive telephone sessions delivered by a quitline coach once per week for 3 weeks. The projected

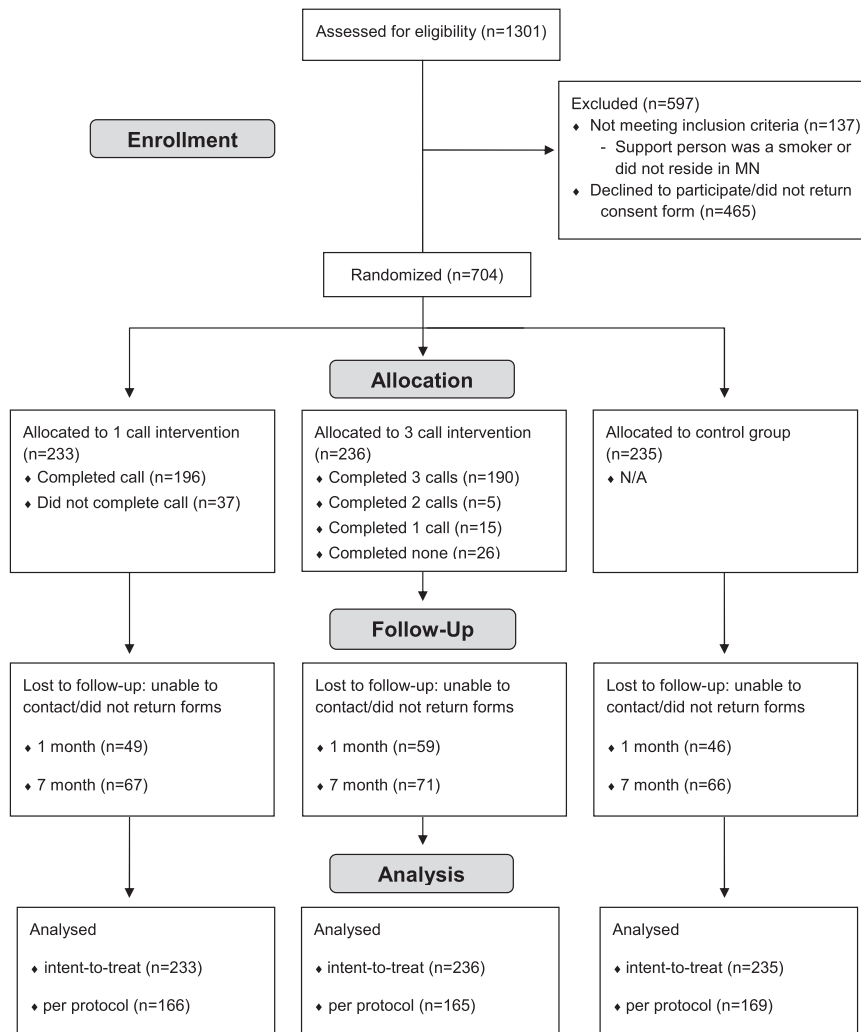


Fig. 1. Participant flow.

duration of each call was 10–20 min. The quitline coaches scheduled and conducted all coaching calls, with appointments available between 7 a.m. and 7 p.m. CST Monday–Friday. Efforts were made to schedule the participant with the same coach for all three sessions. If the participant was unreachable by telephone, a letter was mailed to attempt final contact. The coaches documented call completion and call duration.

The manualized intervention [20] was adapted for implementation within a quitline context (Supplementary Material S1). Coaches used behavior change strategies delivered with a motivational interviewing style [24]. Behavior change techniques used in the intervention manual were independently coded by two authors based on a taxonomy recommended for addiction research [25]; inter-rater agreement 92% (Table I). The conceptual basis for

**Table I.** Behavior change techniques utilized by counselors in support person coaching intervention<sup>a</sup>

<b>1. Goals and Planning</b>	<b>7. Associations</b>
1.1 Goal setting (behavior)	None
1.2 Problem solving	<b>8. Repetition and substitution</b>
1.3 Goal setting (outcome)	8.1 Behavioral practice/rehearsal
1.4 Action planning	8.2 Behavior substitution
1.6 Discrepancy between current behavior and goal	8.4 Habit reversal
	8.6 Generalization of target behavior
<b>2. Feedback and Monitoring</b>	<b>9. Comparison of Outcomes</b>
None	9.2 Pros and cons
<b>3. Social support</b>	<b>10. Reward and Threat</b>
3.1 Support unspecified	10.4 Social reward
3.2 Practical support	10.9 Self-reward
3.3 Emotional support	
<b>4. Shaping Knowledge</b>	<b>11. Regulation</b>
4.1 Instruct how to perform behavior	11.2 Reduce negative emotions
4.2 Information about antecedents	
4.4 Behavioral experiments	<b>12. Antecedents</b>
	None
<b>5. Natural consequences</b>	<b>13. Identity</b>
5.3 Information on social and environmental consequences	13.1 Identification of self as role model
5.5 Anticipated regret	13.2 Framing/reframing
5.6 Information about emotional consequences	
<b>6. Comparison of behavior</b>	<b>14. Scheduled Consequences</b>
6.1 Demonstration of the behavior	None
6.2 Social comparison	<b>15. Self-belief</b>
6.3 Information about others' approval	None
	<b>16. Covert Learning</b>
	None

<sup>a</sup>Behavior change techniques included in one-session coaching intervention manual, based on the taxonomy recommended by Michie *et al.* [27]. Using this taxonomy, coding was done independently by two authors with inter-rater agreement of 92%.

the intervention was Cohen's theory of social support [10] which postulates that supportive actions promote positive health practices of others by encouraging more effective coping. The types of supportive actions (verbal and non-verbal) taught to participants were correlated with successful smoking cessation [15]. These behaviors were instrumental (e.g. providing material aid), informational (e.g. sharing relevant quitline information), and emotional (e.g. expressing empathy, caring, reassurance) [10]. Supportive behaviors were more likely to predict health outcomes when matched to the demands of the situation (e.g. the smoker's readiness to quit) [26]. Another important theoretical dimension is the positive-negative nature of supportive behaviors [15]. Increasing positive

behaviors (e.g. encouragement) while avoiding negative behaviors (e.g. nagging) is consistently associated with change in smoking behaviors. Further, based on the substance abuse treatment literature [27], another theoretical dimension is the support person's self-behaviors—those that maintain well-being and morale (e.g. acceptance that the smoker may not seek help). The intervention goal was for support persons to encourage their smoker to call the quitline. Although not assessed, support persons were also taught to recognize any step made by the smoker toward quitting as progress such as expressing interest in what the quitline offers.

The session topics were: *Session 1*: rationale for treatment, role of support person, information about

the Helpline (e.g. efficacy, what happens when smokers call), education on readiness to quit; *Session 2*: supportive behaviors (verbal and non-verbal) based on the smoker's readiness to quit; and *Session 3*: supportive behaviors and how to reinforce (shape) progress made by the smoker.

Eighty-one percent (190/236) completed all three sessions (Fig. 1). Call duration in minutes was: (i)  $22.0 \pm 6.3$ , range 9–52; (ii)  $18.0 \pm 6.7$ , range 6–58; and (iii)  $17.0 \pm 7.1$ , range 5–41.

#### *One-call coaching intervention group*

This condition ( $n = 233$ ) consisted of one 15–25-min proactive telephone coaching session initiated by a quitline coach. It was essentially a scaled down version of the same content of the three-call protocol with less time devoted to each topic (Supplementary Material S2). Eighty-four percent (196/233) completed the session (Fig. 1) with a mean  $\pm$  SD duration of  $26.0 \pm 7.8$  min (range 12–59).

#### *Coaches*

Ten existing QUITPLAN Helpline coaches delivered both interventions. Each had a minimum of a 4-year college degree in a behavioral health or social science-related field. Coaches received 82 h of tobacco-related training as part of their hiring process.

Coaches were provided with ten hours of training on written coaching manuals developed for each intervention and documentation procedures. Training was done using didactics, role plays and simulated treatment sessions. Training emphasized the importance of following the treatment manual, the conceptual framework underlying the intervention, and covered specific strategies for applying the theory to the coaching protocols. Coaches attended quarterly refresher training sessions.

To assess treatment fidelity [28], all sessions were audiotaped and rated using a checklist to compare the number of intended intervention components from the manual that were delivered. Overall, coach adherence was 99% to the one-call intervention and 95% to the three-call intervention manual; thus, the interventions were delivered with fidelity and according to the protocol.

#### **QUITPLAN helpline**

At the time of the study, the vendor for the Minnesota QUITPLAN Helpline was National Jewish Health, based in Denver, Colorado. A study-specific toll-free number was set up by the quitline. When a smoker called, the quitline customer service representatives (CSRs) recorded the date and time, their support person's name, and the study reference code (this was linked to the support person's study ID number). The CSR explained the services provided by the quitline, and, if interested, enrolled him/her in the program. Once enrolled, the CSR immediately transferred the smoker to a Helpline coach to conduct or set up the first call. For quality assurance, CSRs were trained on-site; test calls were conducted by study staff, along with quarterly refresher trainings conducted by National Jewish Health.

Smokers enrolling into the QUITPLAN Helpline received the same services provided to all Minnesota residents. This consisted of free written materials, up to five telephone coaching sessions (15–20 min each), and the option to receive unlimited text messaging and e-mail support over a 6-month period. Smokers could also receive free nicotine replacement therapy (patches, lozenges or gum) by mail, along with information on other cessation medications that could be prescribed by the smoker's physician, if appropriate. For smokers not ready to quit, coaches provided interventions to help resolve ambivalence about quitting smoking.

#### **Measures**

##### *Non-smoker demographics*

A questionnaire documented participant demographics (e.g. age, gender, race/ethnicity) and tobacco use characteristics at baseline.

##### *Smoker information (baseline proxy data)*

On the baseline questionnaire, participants completed questions regarding their smoker's gender, age and race; and were asked to characterize their smoker's level of readiness to quit using the Contemplation Ladder [29]. The Ladder, adapted for use with proxies [30, 31] (Supplementary

Material S3), operates as an 11-point Likert scale from the smoker having no thoughts of quitting to being engaged in action to change one's smoking behavior. One study [30] found that Contemplation Ladder scores of support people and smokers were moderately correlated ( $r = .45$ ,  $P = 0.001$ ), indicating that support people's reports of smokers' readiness to quit are reasonably accurate.

#### *Primary outcome: smoker quitline enrollment*

The primary endpoint was the proportion of participants' smokers enrolling in the quitline during the interval from randomization through 7-month follow-up—which is consistent with clinical trials evaluating quitlines [32]. Quitline enrollment was documented by the CSRs. Only calls to the study-specific number were captured. Thus, if a smoker called the general quitline number, the enrollment rates would be underestimated. Once the smoker enrolled, no other data were collected from the quitline for purposes of this study. As a secondary endpoint the proportion of smokers enrolling by 1-month follow-up was also examined.

#### *Secondary outcome: SPM completed by non-smokers*

Participants completed the 22-item SPM [33] at baseline and both follow-ups (Supplementary Material S3). The SPM was developed based on our theoretical framework to include instrumental (e.g. 'engage in smoke-free activity with your smoker'), emotional (e.g. 'acknowledge that quitting is hard'), and informational (e.g. 'provide your smoker with information about quitting or medications that can help') support behaviors and items that apply, irrespective of the smoker's readiness to quit. Also included are self-behaviors such as modeling how to cope with stress and showing understanding for the changes associated with smoking. Respondents indicated if each behavior occurred (i.e. 'Yes' or 'No') over the past 2-week period. The SPM demonstrated high internal consistency ( $\alpha = 0.73$ ) in a prior study [20]. For the current baseline sample, Cronbach's  $\alpha = 0.74$ . Factor analysis indicated the scale was best characterized by two factors [33]. The first factor

(Smoker subscale) comprises 17 items emphasizing behaviors primarily done to help the smoker, e.g. 'Asked your smoker if they were willing to discuss their smoking'. The second factor (Self subscale) comprises five items emphasizing behaviors the support person could do for him or herself, e.g. 'Modeled how to cope with stress by relaxing, taking a break, taking a walk or calling a friend'. These factors indicated different functions of support were associated with different behaviors, and thus we examined treatment differences on changes in addition to the total SPM score.

#### **Statistical analysis**

To assess the adequacy of the randomization, baseline demographics were compared between treatment groups using the chi-square (exact) test for categorical variables and analysis of variance (Kruskal-Wallis) test for continuous variables. The percentage of participants completing each follow-up (retention) was compared across groups using the chi-square test. Logistic regression was utilized to examine baseline characteristics (Table II) associated with retention at month 7, adjusting for treatment group. The chi-square test was used to examine treatment differences on the proportion of participants' smokers enrolled in the quitline at 1 and 7 months follow-up, using an intent-to-treat analysis; i.e. all randomized participants ( $n = 704$ ) were included. Logistic regression was used to compare each treatment group to the control condition. A per protocol analysis was also done including smokers whose support person completed the 7-month follow-up assessment. The SPM score at 1-month follow-up was added to these models to assess support provided as a potential mediator of treatment effects on quitline utilization. Logistic regression was used to examine baseline characteristics associated with smoker enrollment in the quitline at 7 months. The first model included the characteristic and treatment group as predictors of quitline enrollment; the second model additionally included the interaction term to assess if the effect of the characteristic was different across treatment groups. The mean

**Table II.** Baseline characteristics by study group ( $n = 704$ )<sup>a</sup>

	Coaching interventions			P-value <sup>b</sup>
	One-call group ( $n = 233$ ) $n$ (%) or mean $\pm$ SD	Three-call group ( $n = 236$ ) $n$ (%) or mean $\pm$ SD	Control group ( $n = 235$ ) $n$ (%) or mean $\pm$ SD	
<i>Support person characteristics</i>				
Age (years)	47.8 $\pm$ 16.4	46.7 $\pm$ 15.5	47.7 $\pm$ 15.8	
Range	18–89	20–83	18–87	0.78
Female gender	198 (85)	199 (84)	200 (85)	0.97
White	221 (95)	225 (95)	222 (95)	0.91
Married	143 (62)	159 (68)	149 (63)	0.38
Lives with smoker	110 (47)	115 (49)	111 (47)	0.93
Employed	167 (73)	171 (75)	183 (79)	0.32
Highest level of education				0.83
Elementary school/junior high	2 (<1)	0 (0)	2 (<1)	
High school/GED	14 (6)	14 (6)	17 (7)	
Some college/trade school	70 (30)	71 (30)	70 (30)	
College degree	110 (48)	104 (44)	109 (46)	
Postgraduate degree	35 (15)	46 (20)	37 (16)	
Tobacco use				0.28
Never	73 (31)	77 (33)	74 (32)	
Experimented	64 (28)	82 (35)	80 (34)	
Former smoker	96 (41)	77 (33)	81 (35)	
Relationship to smoker				0.97
Spouse	79 (34)	85 (36)	80 (34)	0.93
Child	45 (19)	46 (20)	40 (17)	
Friend	29 (12)	25 (11)	30 (13)	
Parent	22 (9)	21 (9)	25 (11)	
Sibling	17 (7)	16 (7)	19 (8)	
Boyfriend/girlfriend	18 (8)	18 (8)	16 (7)	
Coworker	7 (3)	10 (4)	7 (3)	
Other	16 (7)	14 (6)	18 (8)	
<i>Smoker characteristics (proxy data)</i>				
Female	96 (41)	86 (36)	93 (40)	0.56
White	219 (94)	219 (93)	218 (93)	0.84
Age (years)	43.2 $\pm$ 14.1	41.8 $\pm$ 14.1	44.6 $\pm$ 14.4	0.10
Range	19–85	18–76	18–75	
Contemplation Ladder score	4.6 $\pm$ 2.3	4.7 $\pm$ 2.4	4.6 $\pm$ 2.4	0.59
0–3 (low)	67 (29)	59 (25)	68 (29)	
4–6 (medium)	111 (48)	107 (46)	103 (44)	
7–10 (high)	54 (23)	67 (29)	63 (27)	

GED, general educational development.

<sup>a</sup>Because of rounding, not all percentages total 100.

<sup>b</sup>Chi-square (exact test) for categorical variables and analysis of variance (Kruskal-Wallis) for continuous variables.

change in SPM score (total and subscale scores) at each follow-up was compared between treatment groups using analysis of covariance (ANCOVA) with the baseline score as a covariate. All analyses used two-sided tests with  $P \leq 0.050$  used to denote statistical significance.

## Results

### Non-smoker baseline characteristics and study retention

Baseline characteristics of non-smokers are presented in Table II. The sample was primarily female (85%)



and White (95%). Also provided in Table II are demographic information provided about the smokers; i.e. proxy data. The study groups were comparable on all baseline characteristics.

Figure 1 shows the participant flow with respect to non-smoker recruitment, treatment compliance, and study retention. There were no adverse events associated with the interventions. The study groups were comparable for study retention at 1 and 7 months ( $P = 0.34$  and  $0.89$ , respectively). At 7 months, retention rates were 71% for the one call group, 70% for the three call group, and 72% for the control group. Adjusting for treatment group, older age of the participant (odds ratio [OR] = 1.02, 95% CI: 1.01–1.03,  $P = 0.001$ ) and being married (OR = 1.66, 95% CI: 1.19–2.32,  $P = 0.003$ ) were associated with study retention at 7-month follow-up. No other baseline characteristics (see Table II) were significantly associated with study retention. Our inability to contact participants contributed to loss to follow-up; reasons for attrition are unknown.

### Support provided measure

After adjusting for the baseline score, the SPM total score at 1-month follow-up was significantly different across treatment groups ( $P = 0.006$ ) but not at 7-month follow-up ( $P = 0.42$ ) (Table III). A similar pattern of results was found for the Smoker subscale score, but for the Self subscale the score was not significantly different across study groups at either time point.

### Main outcome: smoker quitline enrollment

Using an intent-to-treat analysis, the proportion of smokers enrolling in the quitline at 7 months was significantly different across support person study groups ( $P = 0.006$ ) (Table IV). The proportion of smokers enrolling was 14.6% in the one-call group, 14.8% in the three-call group, and 6.4% in the control group. When the SPM total score at 1-month follow-up was included in the model, the effect of treatment on quitline utilization ( $P = 0.040$ ) was not significantly reduced (one-call group versus control: OR = 2.33, 95% CI: 1.18–4.59,  $P = 0.014$ ; three-call group versus control: OR = 2.04, 95% CI:

1.04–4.01,  $P = 0.039$ ), indicating that treatment effects were not mediated by support provided. Moreover, SPM subscale scores did not mediate treatment effects.

Using a per protocol analysis, the proportion of smokers enrolling in the quitline at 7 months was significantly different across treatment groups ( $P = 0.013$ ) (Table IV). When the SPM total score at 1 month was included in this model, the effect of treatment on quitline utilization was similar although not statistically significant ( $P = 0.060$ ) (one call versus control, OR = 2.08, 95%: 0.98–4.38,  $P = 0.055$  versus control; three call versus control OR = 2.33, 95%: 1.13–4.80,  $P = 0.022$  versus control). SPM subscale scores did not mediate treatment effects.

Quitline utilization at 1-month follow-up was not significantly different across study groups (Table IV). Table IV provides median duration for time to call the quitline by treatment condition.

All baseline characteristics of non-smokers (and smokers via proxy data; see Table II) were examined as potential predictors of quitline utilization at 7-month follow-up. No significant associations were detected between quitline utilization and support person: gender, race, marital status, employment, education, tobacco use history, type of relationship to the smoker, residing with the smoker or SPM score; or smoker: gender, age or race. Adjusting for treatment group, older age of the non-smoker (OR = 1.02, 95% CI: 1.01–1.04,  $P = 0.009$ ) and higher Contemplation Ladder score of the smoker (OR = 1.19, 95% CI: 1.07–1.32,  $P = 0.001$ ) were associated with increased likelihood of smoker enrollment in the quitline. To illustrate the later finding, the rate of quitline enrollment was 7% (13/194) for smokers with low levels of readiness to quit, 12% (40/321) for those with medium levels, and 16% (30/184) for those with high readiness. However, there was no interaction effect detected between Contemplation Ladder score and treatment group on quitline enrollment ( $P = 0.71$ ). Thus, the effect of treatment group on quitline enrollment was not dependent on the smokers' baseline readiness to quit; i.e. no moderation effect.

**Table III.** Support provided measure scores among support persons at baseline and follow-up by study group ( $n=704$ )<sup>a</sup>

SPM	Coaching interventions		Control group ( $n=235$ )	
	One-call group ( $n=233$ ) mean $\pm$ SD	Three-call group ( $n=236$ ) mean $\pm$ SD	mean $\pm$ SD	<i>P</i> -value <sup>b</sup>
Total score <sup>c</sup>				
Baseline	11.4 $\pm$ 4.1	11.0 $\pm$ 4.1	11.2 $\pm$ 3.8	0.61
Range	4–21	4–21	4–21	
1-month follow-up	15.5 $\pm$ 3.7 <sup>d</sup>	16.3 $\pm$ 3.6 <sup>c</sup>	15.4 $\pm$ 3.9	0.006
Range	6–22	4–22	4–22	
7-month follow-up	13.6 $\pm$ 4.7	13.7 $\pm$ 4.8	14.0 $\pm$ 3.9	0.42
Range	4–22	4–22	6–22	
Smoker sub-scale <sup>f</sup>				
Baseline	8.5 $\pm$ 3.4	8.1 $\pm$ 3.3	8.3 $\pm$ 3.2	0.56
Range	2–16	3–16	1–16	
1-month follow-up	11.8 $\pm$ 3.2	12.4 $\pm$ 3.1	11.6 $\pm$ 3.4	0.008
Range	4–17	4–17	4–17	
7-month follow-up	10.1 $\pm$ 3.9	9.9 $\pm$ 4.0	10.2 $\pm$ 3.5	0.60
Range	3–17	4–17	4–17	
Self sub-scale <sup>g</sup>				
Baseline	2.9 $\pm$ 1.4	2.9 $\pm$ 1.4	2.9 $\pm$ 1.4	0.94
Range	0–5	0–5	0–5	
1-month follow-up	3.7 $\pm$ 1.2	3.9 $\pm$ 1.1	3.7 $\pm$ 1.2	0.27
Range	0–5	0–5	0–5	
7-month follow-up	3.5 $\pm$ 1.4	3.8 $\pm$ 1.2	3.8 $\pm$ 1.2	0.09
Range	0–5	0–5	0–5	

<sup>a</sup>The number of participants with completed SPM forms at baseline were 231 for the one-call intervention, 234 for the three-call intervention and 228 for the control group. The respective numbers at 1 month were 181, 177 and 191; and at 7 months follow-up were 166, 164 and 168.

<sup>b</sup>Analysis of variance at baseline and analysis of covariance at 1- and 7-month follow-up adjusting for the baseline support measure.

<sup>c</sup>The SPM total score is calculated by summing the number of items endorsed in the direction of supportive behaviors and can range from 0 to 22.

<sup>d</sup>Pairwise comparisons were significant for the one- versus three-call group ( $P=0.012$ ) but not for the one-call versus control group ( $P=0.65$ ).

<sup>e</sup>Pairwise comparisons were significant for the three-call versus control group ( $P=0.003$ ).

<sup>f</sup>The Smoker subscale comprises 17 items and emphasizes behaviors done primarily to help the smoker. The score is calculated by summing the number of items endorsed in the direction of supportive behaviors and can range from 0 to 17.

<sup>g</sup>The Self subscale comprises five items and emphasizes behaviors the support person can do for himself or herself. The score is calculated by summing the number of items endorsed in the direction of supportive behaviors and can range from 0 to 5.

## Discussion

This RCT found that coaching interventions for non-smokers can be successfully conducted within a 'real world' quitline setting, and just one call is effective for increasing quitline enrollment among smokers. The information and skills learned within one brief session may be sufficient for non-smokers, without the added contact time and counselor support being necessary (unlike clinical trials enrolling smokers where providing more treatment

corresponds to better outcomes) [6]. Previous studies of social support interventions have not been uniformly effective [12, 13] but most were conducted among smokers already engaged in treatment. Because the majority of smokers are not ready to quit in the next month [15, 34, 35], targeting the social support network is a promising avenue to reach smokers on a population level. Encouragingly, we observed the treatment effect on quitline enrollment was consistent across smoker levels of quitting readiness.

**Table IV.** Smoker quitline utilization by support person study group ( $n = 704$ )<sup>a</sup>

Smoker Quitline Enrollment	Support person study group			P-value <sup>a</sup>
	One-call intervention group ( $n = 233$ ) $n$ (%)	Three-call intervention group ( $n = 236$ ) $n$ (%)	Control group ( $n = 235$ ) $n$ (%)	
1-month follow-up (ITT)	11 (5)	8 (3)	7 (3)	0.58
7 months follow-up				
ITT	34 (15) <sup>b</sup>	35 (15) <sup>c</sup>	15 (6)	0.006
PP <sup>d</sup>	26 (16) <sup>c</sup>	31 (19) <sup>f</sup>	13 (8)	0.013
Median duration of time to call quitline, days <sup>g</sup>	37	60	42	
Range	8–210	13–210	8–210	

Note: *ITT*, intent to treat; analyses based on the smokers of all randomized support persons ( $n = 704$ ). *PP*, Per protocol; analyses based on the smokers of support persons completing the 7-month follow-up.

<sup>a</sup>Chi-square test.

<sup>b</sup>From logistic regression: one call group versus control, OR = 2.51, 95% CI: 1.33–4.74,  $P = 0.005$ .

<sup>c</sup>From logistic regression: three call group versus control, OR = 2.55, 95% CI: 1.35–4.82,  $P = 0.004$ .

<sup>d</sup>The number in each study group was one call group = 166, three call group = 165, and control group = 169.

<sup>e</sup>From logistic regression: one call group versus control, OR = 2.23, 95% CI: 1.10–4.51,  $P = 0.026$ .

<sup>f</sup>From logistic regression: three call group versus control, OR = 2.78, 95% CI: 1.40–5.52,  $P = 0.004$ .

<sup>g</sup>Of smokers who enrolled in the quitline; calculated from date of support person's enrollment.

One of the strengths of this translational work is that the effectiveness of the three-call intervention on smoker quitline enrollment (15%) was similar to the original efficacy trial in which the coaching was delivered by research staff (16%) [20]. Other strengths are the use of an experimental design [36]; verified quitline utilization by smokers [37]; use of theoretically-based, well-specified manuals to enhance replicability of the intervention method [25]; treatments delivered by real-world quitline coaches with high fidelity; inclusion of quality control procedures; and very good rates of participant treatment completion and follow-up retention.

This study does have limitations. We did not assess the potential downstream effect of this approach on quitting or the level of engagement in the quitline program after the smoker enrolled—such as use of pharmacotherapy. The interventions were designed to motivate smoker calls to the quitline. This outcome, consistent with a phase-based framework recommended for advancing the science of tobacco treatment [38], was achieved. Nonetheless, it is possible that smokers enrolling in a quitline, as prompted by a support person, may be a select group compared to smokers

initiating cessation treatment on their own with very different quitting outcomes. Another limitation is that all smoker information at baseline was from proxy reports with unknown reliability. Thus, as the next step, we plan to attempt to engage and incentivize smokers to complete assessments to measure the potential impact of this approach on quitting and to directly assess smoker characteristics such as heaviness of smoking.

Another limitation was that it is unclear how the interventions worked because support provided by the non-smoker as measured by the SPM did not appear to account for the treatment effects on quitline utilization. Thus, alternative constructs of social support could be considered in future research to better understand the mechanisms of the intervention effect such as, social control and autonomy support provided [12, 39]. Potential theory-based mechanisms that could also be explored among the smokers including support received and enhanced coping [12, 39].

Some sample characteristics limited generalizability and potential impact of the intervention, i.e. 85% female, 95% White, and highly educated non-smokers. Finally, the sample size recruited was less

than originally targeted. However, the observed treatment differences were statistically significant even with a smaller sample size.

Despite these limitations, the results provide evidence for tobacco cessation quitlines—a treatment available in all 50 states via 1-800-Quit-Now. The North American Quitline Consortium [8] reported that about 5% of ~500 000 annual quitline callers (25 000) were individuals calling on behalf of a loved one who smokes; these calls are unsolicited. Findings from this study provide real-world guidance for the first time to quitlines on the types of coaching that may aid non-smokers in linking their family members and friends to quitline services. Quitlines could elect to advertise the availability of such coaching targeting non-smokers through a ‘Help a Loved One Quit’ campaign or other promotional activities [19]. These marketing efforts could leverage the enormous potential of online social networks [14, 40–42]. The cost to the Minnesota quitline to implement this one-call intervention (not recruitment) was \$60, including the coaching session and 10–12 min of subsequent documentation. A standard quitline call was \$38; however, the one-call support person intervention was \$60 due to the extended length of the call, and the cost for the three-call intervention was \$135 (same rationale). The cost is very reasonable in light of the finding that one call was associated with essentially a doubling of the rate of smoker enrollment in the quitline beyond written materials—currently the ‘standard of care’ provided by most state quitlines [43]. Although on average the one- and three-call interventions were not time intensive it is important to note the wide range of session durations and thus implementing the interventions on a wide scale basis would require greater standardization of intervention delivery among quitline coaches.

An important next step for this line of research is to understand how the interventions apply to underserved populations as cultural and family differences may influence how support is received (acceptability) and effectiveness [44–47]. The emerging use of mobile technologies such as text messaging in low-

income populations offers novel opportunities to deliver the support person interventions [48].

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## Conclusions

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This real-world quitline study found that coaching interventions targeting non-smokers can result in significant increases in the rates that a smoker enrolls in a quitline. Just one session yielded results essentially equal to having three calls. These results provide early guidance for quitlines that want to expand their services to offer an efficient (one call) intervention to help non-smokers link their family members and friends to quitline services. Our two studies—one an efficacy trial, the other an effectiveness trial—showed brief coaching delivered to non-smokers significantly increased quitline enrollment among smokers and would seem to constitute a basis for broad adoption of such a program by quitlines.

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## Supplementary data

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Supplementary data are available at *HEAL* online.

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### Conflict of interest statement

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None declared.

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