Original investigation

Efficacy of a Tobacco Quitline Among Adult Survivors of Childhood Cancer

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ABSTRACT

Introduction: The purpose of this investigation was to determine the efficacy of two evidence-based tobacco quitlines in adult survivors of childhood cancer who regularly smoke cigarettes.

Methods: A total of 519 adult survivors of childhood cancer were randomized to either Proactive + 4 weeks of medication (Counselor-initiated intervention, $n = 260$) or a Reactive + 2 weeks of medication (Participant-initiated intervention, $n = 259$) condition. Both conditions received telephone counseling to quit smoking as well as nicotine replacement therapy. The primary outcome was biochemically verified (i.e. cotinine) point prevalence smoking cessation at 12 months follow-up.

Results: Participants randomized to the Proactive + 4 weeks of medication condition self-reported a higher rate of cessation than those survivors in the Reactive + 2 weeks of medication condition at 8 weeks (33.2% vs. 17.0%, $p < .001$), but cessation rates were not significantly different at 12 months (23.0% vs. 18.7%, $p = .29$). However, 80% of participants claiming abstinence failed biochemical verification, indicating marked falsification of self-reported smoking status. Adjusted cessation rates were less than 2% in both intervention conditions.

Conclusions: Our results indicate that neither a Proactive + 4 weeks of medication or Reactive + 2 weeks of medication quitline significantly impacted long-term smoking cessation rates. Our results further indicate that self-reports of smoking status are unreliable in survivors of childhood cancer, a population in considerable need of tobacco abstinence. Rates of smoking cessation may be markedly overestimated in studies of childhood cancer survivors that rely on self-reports of tobacco abstinence, and future studies need to include biochemical verification of tobacco status in this population.

Introduction

Over the past 50 years, survival rates for childhood cancer have dramatically improved, with 1 in 640 adults in the United States now estimated to be a survivor of childhood cancer.¹ Survivorship is

commonly associated with health complications resulting from cancer treatment; by age 45, 95% of childhood cancer survivors (CCSs) will experience a chronic health condition, with 80% encountering life-threatening or disabling conditions.² Two of the most common late effects observed in CCSs include pulmonary and cardiac

dysfunction (affecting 65.2% and 56.4%, respectively),² which are also two of the more common causes of late mortality.³ It is reasonable to speculate that risks associated with both of these treatment-associated adverse outcomes may be further potentiated by tobacco use. As such, CCSs should avoid smoking tobacco in efforts to decrease risk of long-term health problems.

Despite their health vulnerability, estimates suggest that 17%–20% of adult survivors of childhood cancer currently smoke.^{4,5} While results from large randomized cessation trials among CCSs have been suggestive of both short and long-term intervention benefits,^{6–8} smoking outcomes were self-reported by study participants in the absence of biological verification. While self-reports of smoking are generally highly reliable,⁹ membership in a high-risk medical group is one subgroup whose reports of tobacco status are questionable.¹⁰ As a high-risk medical group, CCSs, particularly those participating in smoking cessation trials, may be under pressure to report quitting smoking; therefore, the validity of self-reported smoking cessation must be considered.

Disseminable and distance-based smoking cessation interventions for CCSs are needed given the geographical spread of CCSs and the relatively low numbers of CCSs relative to adult survivors. Thus, the purpose of this study was to determine the efficacy of a tobacco quitline (QL) for adult tobacco users who survived childhood cancer. We compared two standard QL interventions, a Proactive + 4 weeks of medication QL (counselors call the participants) versus a Reactive + 2 weeks of medication QL (participants initiate calls to counselors), with both conditions also receiving free nicotine replacement therapy (NRT). Given the lack of previous research that has validated self-reported cessation in CCSs, we also biochemically validated reports of smoking cessation in this high-risk group.

Methods

Participants

We assessed eligibility among the 2,742 adult participants who were enrolled either in the St. Jude Lifetime Cohort study, The After Completion of Therapy (ACT) Clinic, or the Childhood Cancer Survivor Study.^{11,12} We attempted to enroll all participants who indicated they were regular users of cigarettes. [Figure 1](#) presents the Consort Diagram for this study.¹³

The study protocol was approved by the Institutional Review Board of St. Jude Children's Research Hospital and registered with ClinicalTrials.gov (NCT00827866).

Eligibility/Exclusionary Criteria

Participants were CCSs diagnosed prior to 21 years of age and in remission for at least 1 year ([Figure 1](#)). To be eligible, participants had to be at least 18 years and had to be smoking cigarettes regularly for a year or more (like a traditional QL, all individuals who perceived themselves as "regular smokers" were considered eligible without a minimum number of cigarettes smoked per day).

Additional criteria had to be met for participants to receive NRT. Participants with a known contraindication or sensitivity to NRT could participate in this study; however, they did not receive NRT as part of their smoking cessation program. A total of 10.6% ($n = 54$) did not receive NRT, and were equally distributed across the two treatments conditions (5.7% vs. 4.9%, for the Proactive + 4 weeks of medication and Reactive + 2 weeks of medication conditions, respectively). We included these participants in the behavioral interventions because QLs throughout the United States do not deny

behavioral treatment for those participants who desire to quit smoking but for whom NRT was contraindicated.¹⁴

Recruitment

Recruitment was first initiated through a letter that introduced the study and notified survivors that a member of the QL team would be contacting them to provide additional information about the study, answer questions and to assess their interest in participation. Face-to-face recruitment via the St. Jude ACT Clinic was also conducted.

Those participants that expressed preliminary interest were given a description of the study and then asked if they were interested in a free smoking cessation program. If they were not interested, they were given a list of potential nationally available cessation venues (e.g. The National Quitline number), and briefly counseled regarding the benefits of quitting. For those who were interested, staff assessed eligibility, obtained informed consent, baseline measures, and contact information. Randomization and study enrollment was completed by the study staff. Enrolled participants were sent a study packet containing their randomization group, an overview of the research study, risks and benefits associated with participating in the research study, and an explanation of their human subjects' protections.

Design and Procedures

Behavioral Intervention

Both conditions included a well-validated cognitive behavioral intervention applying evidence-based methods for smoking cessation.¹⁵ The intervention followed Clinical Practice Guideline strategies for smoking cessation¹⁵ and constituted three phases: (a) preparing to quit (e.g. reducing number of cigarettes per day, setting a quit date), (b) the quitting process itself (e.g. eliminating cues to smoke, dealing with withdrawal symptoms), and (c) short- and long-term relapse prevention (e.g. dealing with high-risk situations, alternatives to smoking). The intervention was tailored to CCS in terms of identifying their high risk status, namely that they had a catastrophic illness as a child, and indicating that for this reason they are likely to have late effects that can be exacerbated by smoking. In the event the participant failed to quit smoking on their quit date, counselors worked with participants to set another quit date. If participants failed to quit smoking and were unwilling to set another quit date (Proactive + 4 weeks of medication $n = 37$, Reactive + 2 weeks of medication $n = 2$), we initiated a smoking rate reduction protocol, which has been shown to enhance long-term cessation, even in participants unwilling to quit smoking.¹⁶ While all participants received the same behavioral intervention regardless of treatment assignment, there were key differences based on treatment assignment as described below.

Participants in the Proactive + 4 weeks of medication intervention were contacted by study staff to schedule appointments for the intervention to be delivered. Upon successful contact by the project staff, survivors were scheduled for six counseling sessions over an 8-week period of time. In the event that the participant could not be reached for a scheduled counseling session, counselors proactively contacted participants until the intervention was delivered. After three or more unsuccessful telephone attempts to reach a participant, a letter or e-mail was sent, encouraging participants to re-contact study staff.

In the Reactive + 2 weeks of medication intervention, participants were given a toll-free number and were told they could call for intervention sessions by trained counselors any time during the hours of 8 a.m. and 8 p.m. CST. While some tobacco QLs are staffed 24 hr per day, a 12-hr period of time, including early morning and

Figure 1 . Study CONSORT diagram.

early evening hours, was perceived to be a good blend between high accessibility and the available resources for the study. After hours, there was a voice mail where participants could leave a message, and interventionists would contact them as soon as possible. Participants in the Reactive + 2 weeks of medication condition were told to call up to six times over an 8-week period.

Pharmacologic Intervention

Participants in the Proactive condition were mailed a four-week supply of NRT in the form of the patch followed by another four week

supply three weeks later if they had successfully stopped smoking on their quit date. Participants in the Reactive condition received a starter package including two weeks' worth of NRT and a brochure detailing proper patch use to enhance safety of use. Subsequently, they were encouraged to purchase the patch for six additional weeks. Both NRT conditions mirror state-run tobacco QLs that include both free and discounted NRT, along with "starter kits" such as was given in the Reactive condition. NRT in the form of the patch was dosed based on baseline number of cigarettes per day and were consistent with Clinical Practice Guidelines for pharmacologic interventions.¹⁵

Participants who received the rate reduction protocol (those failing to quit smoking and who refused to reset their quit date), received 4 mg gum (a total of six boxes) to use as a substitute for smoking.

Measures

Both demographic and behavioral measures were obtained in this study. In addition, we assessed smoking background and history with standard questionnaires. Finally, a baseline measure of nicotine dependence was obtained by the Fagerstrom Scale of Nicotine Dependence.¹⁷

At the end of treatment and at the 12-month follow-up, two measures of smoking cessation were obtained in line with Society for Research of Nicotine and Tobacco (SRNT) guidelines.¹⁸ First, point prevalence abstinence was evaluated by asking participants if they had smoked (“even a puff”) in the past seven days. Second, continuous abstinence was evaluated by asking participants if they had smoked (“even a puff”) since their quit date. Point prevalence abstinence can be biochemically verified, while only self-report of continuous abstinence can be obtained.

Primary and Secondary Outcomes

The primary outcome measure was cotinine verified point prevalence smoking cessation at the 12-month follow-up. Cotinine is a direct metabolite of nicotine and a level of 3 ng/ml and higher has been set as the cutpoint for those who are smoking.¹⁹ For participants who self-reported abstinence at the 12-month follow-up, salivary cotinine levels were obtained by Examination Management Services, Inc. (EMSI), a company that specializes in mobile specimen and data collection. Cotinine levels were measured using the NicAlert™ salivary cotinine testing system. NicAlert™ is a valid and reliable method for verification of smoking status, with a specificity of 95%, a sensitivity of 93%, a positive predictive value of 95%, and a negative predictive value of 93% (95% CI 86%–100%).²⁰

Participants with at least 10 ng/ml cotinine in their saliva were considered smokers. As the cutoff of 3 ng/ml is considered the criteria for a smoker,¹⁹ this was a very liberal definition of defining “nonsmokers,” while avoiding false positives due to second hand smoke.¹⁹ Those who refused the cotinine test or were not able to be reached by EMSI (even after we successfully contacted them regarding self-reported cessation) were considered smokers.

The secondary outcome measures in this study included self-reports of point prevalence and continuous abstinence at end of treatment (8 weeks) and at 12-month follow-up.

Statistical Analysis

Differences in the characteristics of participants and nonparticipants and those randomized to the two intervention conditions were evaluated using Chi-square tests for categorical variables and two-sample *t*-tests for continuous variables. We applied the same approach to compare the characteristics of survivors who completed 12-month follow-up versus those who did not.

The primary focus of the study was to determine if pharmacologically verified tobacco quit rate (i.e. self-report of quitting that is verified by cotinine test) would be higher in survivors randomized to the Proactive + 4 weeks of medication condition compared to those randomized to the Reactive + 2 weeks of medication condition at 12 months. Quit rates between the two conditions were compared using Fisher's exact test for comparing two binomial proportions, and odds ratio and 95% CI were calculated.

In addition, data on self-reported point prevalence and continuous abstinence was also collected at 8 weeks and 12 months postintervention, respectively. The quit rates between the two conditions at the specified time points were compared using Fisher's exact test. The total number of completed counseling sessions (0–6 sessions) was compared between the two conditions using Exact Chi-Square test and Monte Carlo estimate of *p* value was reported. All analyses were conducted using SAS software package (SAS v9.3 and StatXact, SAS Institute, NC).

Results

Sample Characteristics

Table 1 summarizes the characteristics of survivors randomized to these interventions. Approximately half of the participants were female and 88% were Caucasian. Forty-seven percent of participants were married, and 54% were employed full- or part-time and 58% had post-secondary education. The demographic characteristics of the present sample are similar to a national survey of CCSs.⁴ Participants averaged 16 cigarettes per day, and 63% were moderately or highly dependent based on the Fagerstrom scale of nicotine dependence. Over two thirds of participants had a history of at least one prior quit attempt. There were no significant differences between the Proactive + 4 weeks of medication and Reactive + 2 weeks of medication intervention conditions on any demographic or smoking characteristics.

Characteristics of Participants Who Completed the Trial

Table 2 presents the characteristics of those we were unable to contact at follow-up (*n* = 72, 14%) compared to those participants who successfully completed the 12-month follow-up (*n* = 447; 86%). A higher percentage of men (*p* = .02), participants identifying with a racial minority group (*p* = .008), and those who were more highly tobacco dependent (*p* = .02) did not complete data collection.

Primary Endpoint: Cotinine Verified Smoking Cessation

Of the 93 participants [51 (19.6%) in Proactive + 4 weeks of medication and 42 (16.2%), in Reactive + 2 weeks of medication conditions, respectively] who reported at 12 months that they had stopped smoking, 59 (63%) were not evaluated for cotinine. Eighteen refused testing (9 from each condition); EMSI was unable to successfully contact 27 participants, despite repeated attempts; cotinine testing was not applicable among 7 participants due to use of other nicotine products (e.g. smokeless tobacco, NRT, e-cigarettes); and 7 participants were not tested for other reasons. A total of 34 participants completed biochemical verification and only 7 (20%) had rates of cotinine under 10 ng/ml (12.5% and 27.8% in the Proactive + 4 weeks of medication vs. Reactive + 2 weeks of medication intervention, respectively, Fisher's exact *p* value = .41, OR = 0.37, 95% CI = 0.06 – 2.26). Thus, 80% of CCS with cotinine testing who reported abstinence had cotinine values that clearly indicated they were using tobacco products.

Among 260 participants who were randomized to the Proactive + 4 weeks of medication condition, 2 (0.77%) tested cotinine negative, compared to 259 participants randomized to the Reactive + 2 weeks of medication condition, 5 (1.93%) tested cotinine negative, the exact *p* value is. 29 (OR = 0.39, 95% CI = 0.04–2.44). Thus, the

Table 1. Quitline Participant Characteristics at Baseline

Factors	Total N (%)	Reactive + 2 weeks of medication N (%)	Proactive + 4 weeks of medication N (%)	<i>p</i> value
Sex				
Female	234 (45.1)	124 (47.9)	110 (42.3)	.22
Male	285 (54.9)	135 (52.1)	150 (57.7)	
Race group				
Others	60 (11.6)	30 (11.6)	30 (11.5)	.99
White	459 (88.4)	229 (88.4)	230 (88.5)	
Relationship status				
Married/Living as married	242 (46.7)	129 (49.8)	113 (43.6)	.20
Single	206 (39.8)	93 (35.9)	113 (43.6)	
Widowed/divorced/separated or no longer living as married	70 (13.5)	37 (14.3)	33 (12.7)	
Employment status				
Working full-time/part-time	279 (53.8)	143 (55.2)	136 (52.3)	.69
Not employed and looking for work	76 (14.6)	35 (13.5)	41 (15.8)	
Caring for home or family (not seeking paid work)	23 (4.4)	14 (5.4)	9 (3.5)	
Student/retired/other	38 (7.3)	17 (6.6)	21 (8.1)	
Unable to work due to illness or disability	103 (19.8)	50 (19.3)	53 (20.4)	
Education				
Less than high school	92 (17.7)	42 (16.2)	50 (19.2)	.62
Completed high school	125 (24.1)	59 (22.8)	66 (25.4)	
Some college/technical training	234 (45.1)	123 (47.5)	111 (42.7)	
Four-year college graduate/post graduate level	68 (13.1)	35 (13.5)	33 (12.7)	
Total family income				
Less than \$20,000	207 (39.9)	104 (40.2)	103 (39.6)	.06
At least \$20,000 but less than \$40,000	154 (29.7)	72 (27.8)	82 (31.5)	
At least \$40,000 but less than \$60,000	71 (13.7)	41 (15.8)	30 (11.5)	
At least \$60,000	74 (14.3)	40 (15.4)	34 (13.1)	
NA/refused	13 (2.5)	2 (0.8)	11 (4.2)	
Fagerstrom score				
Highly dependent	90 (17.5)	48 (18.8)	42 (16.3)	.27
Minimally dependent	190 (37.0)	86 (33.6)	104 (40.5)	
Moderately dependent	233 (45.4)	122 (47.7)	111 (43.2)	
Previous quit attempts				
Zero	164 (31.8)	80 (31.3)	84 (32.3)	.20
1	126 (24.4)	65 (25.4)	61 (23.5)	
2	95 (18.4)	45 (17.6)	50 (19.2)	
3	64 (12.4)	39 (15.2)	25 (9.6)	
4 or more	67 (13.0)	27 (10.5)	40 (15.4)	
On average, how many cigarettes do you smoke each day?	Total mean (SD)	Reactive + 2 weeks of medication mean (SD)	Proactive + 4 weeks of medication mean (SD)	
	16 (10)	16 (9.8)	17 (10)	.24

cessation rates, adjusted for biochemically verified falsification, in both conditions were less than 2%.

In the above analysis, we assumed all those who did not receive cotinine testing were smokers, as they were told that nicotine testing would be performed. However, if one assumes that all individuals without cotinine testing ($n = 59$) had the same cessation rate as the cotinine verified participants (20%), the adjusted cessation rates are 2.3% ($n = 6$) in the Proactive + 4 weeks of medication condition and 4.6% in the Reactive + 2 weeks of medication condition ($n = 12$), a nonsignificant difference ($OR = 0.49$, 95% $CI = 0.15$ – 1.43 , $p = .16$). Thus, irrespective of the assumption regarding untested participants who claimed abstinence, cessation rates are very small and not significantly different between conditions.

Secondary Outcome Variables

The secondary outcome measures in this study included self-reports of point prevalence and continuous abstinence at end of treatment (8 weeks) and at 12-month follow-up. Given the rates of tobacco cessation falsification, it is not surprising that the self-reported rates of smoking cessation are considerably higher (Table 3). At the end of the intervention (8 weeks), 33.2% of those in the Proactive + 4 weeks of medication condition reported point prevalence abstinence, compared with 17.0% in the Reactive + 2 weeks of medication condition ($p < .001$). Similarly, those in the Proactive + 4 weeks of medication condition reported a significantly higher rate of continuous abstinence at end of treatment (20.8% vs. 12.0%, $p = .009$). At 12-month follow-up, neither self-reported point prevalence (23.0% vs. 18.7%) nor continuous (11.5% vs. 9.7%) abstinence were

Table 2. Attrition: Comparison Between Completed Follow-up at 12 months (n = 447) Versus Not Completed Follow-up (n = 72)—Participant Characteristics at Baseline

Factors	Total N (%)	Complete at 12 months N (%)	Not complete at 12 months N (%)	p Value
Sex				
Female	234 (45.1)	211 (47.2)	23 (31.9)	.02
Male	285 (54.9)	236 (52.8)	49 (68.1)	
Race group				
Others	60 (11.6)	45 (10.1)	15 (20.8)	.008
White	459 (88.4)	402 (89.9)	57 (79.2)	
Relationship status				
Married/living as married	242 (46.7)	213 (47.7)	29 (40.8)	.32
Single	206 (39.8)	172 (38.5)	34 (47.9)	
Widowed/divorced/separated or no longer living as married	70 (13.5)	62 (13.9)	8 (11.3)	
Employment status				
Working full-time/part-time	279 (53.8)	246 (55.0)	33 (45.8)	.10
Not employed and looking for work	76 (14.6)	64 (14.3)	12 (16.7)	
Caring for home or family (not seeking paid work)	23 (4.4)	21 (4.7)	2 (2.8)	
Student/retired/other	38 (7.3)	35 (7.8)	3 (4.2)	
Unable to work due to illness or disability	103 (19.8)	81 (18.1)	22 (30.6)	
Education				
Less than high school	92 (17.7)	77 (17.2)	15 (20.8)	.70
Completed high school	125 (24.1)	106 (23.7)	19 (26.4)	
Some college/technical training	234 (45.1)	203 (45.4)	31 (43.1)	
4-year college graduate/Post graduate level	68 (13.1)	61 (13.6)	7 (9.7)	
Total family income				
Less than \$20,000	207 (39.9)	172 (38.5)	35 (48.6)	.41
At least \$20,000 but less than \$40,000	154 (29.7)	135 (30.2)	19 (26.4)	
At least \$40,000 but less than \$60,000	71 (13.7)	61 (13.6)	10 (13.9)	
At least \$60,000	74 (14.3)	68 (15.2)	6 (8.3)	
NA/refused	13 (2.5)	11 (2.5)	2 (2.8)	
Fagerstrom score				
Highly dependent	90 (17.5)	70 (15.9)	20 (27.8)	.02
Minimally dependent	190 (37.0)	162 (36.7)	28 (38.9)	
Moderately dependent	233 (45.4)	209 (47.4)	24 (33.3)	
Previous quit attempts				
1	126 (24.4)	110 (24.7)	16 (22.5)	.52
2	95 (18.4)	86 (19.3)	9 (12.7)	
3	64 (12.4)	52 (11.7)	12 (16.9)	
4 or more	67 (13.0)	58 (13.0)	9 (12.7)	
Zero	164 (31.8)	139 (31.2)	25 (35.2)	
On average, how many cigarettes do you smoke each day?	Total mean (SD)	Complete at 12 months mean (SD)	Complete at 12 months mean (SD)	
	16.5 (9.9)	16.6 (9.8)	15.9 (10.5)	.59
On average, how many alcoholic drinks do you consume each day?				
0	217 (42.4)	188 (42.4)	29 (42.0)	.90
1	253 (49.4)	218 (49.2)	35 (50.7)	
2	23 (4.5)	21 (4.7)	2 (2.9)	
3	19 (3.7)	16 (3.6)	3 (4.3)	
BMI	Total mean (SD)	Complete at 12 months mean (SD)	Not complete at 12 months mean (SD)	
	26.6 (6.9)	26.5 (6.9)	27.0 (7.0)	.57
BMI category				
Underweight	32 (6.3)	31 (7.0)	1 (1.4)	.32
Normal weight	229 (44.7)	196 (44.5)	33 (45.8)	
Overweight	126 (24.6)	106 (24.1)	20 (27.8)	
Obesity	125 (24.4)	107 (24.3)	18 (25.0)	

significantly different for the Proactive + 4 weeks of medication versus Reactive + 2 weeks of medication conditions, although the trends in self-reported cessation rates favored the Proactive + 4 weeks of medication condition.

Adherence to Behavioral Treatment

One proposed mechanism for the increased efficacy of proactive QLs is that participants receive more treatment than those in reactive QLs. Thus, we conducted analyses to determine if the lack of

Table 3. Self-Reported Abstinence at End of Treatment (8 Weeks) and at Follow-up (12 Months)

Secondary endpoints	Reactive + 2 weeks of medication N (%)	Proactive + 4 weeks of medication N (%)	Fisher's exact <i>p</i> Value
Reporting point prevalence abstinence at 8 weeks?			
No	185 (83.0)	141 (66.8)	<.001
Yes	38 (17.0)	70 (33.2)	
Reporting continuous prevalence abstinence at 8 weeks?			
Continuous abstinence	31 (12.0)	54 (20.8)	.009
Smoking or did not set a quit date	228 (88.0)	206 (79.2)	
Reporting point prevalence abstinence at 12 months?			
No	183 (81.3)	171 (77.0)	.29
Yes	42 (18.7)	51 (23.0)	
Reporting continuous prevalence abstinence at 12 months?			
Continuous abstinence	25 (9.7)	30 (11.5)	.57
Smoking or did not set a quit date	234 (90.3)	230 (88.5)	

Table 4. Total Number of Counseling Sessions Completed

Number of sessions completed	Reactive + 2 weeks of medication N (%)	Proactive + 4 weeks of medication N (%)
0	89 (39.6)	27 (12.2)
1	100 (44.4)	30 (13.5)
2	23 (10.2)	26 (11.7)
3	4 (1.8)	42 (18.9)
4	3 (1.3)	28 (12.6)
5	4 (1.8)	23 (10.4)
6	2 (0.9)	46 (20.7)
Total	225 (100)	222 (100)
Mean (SD)	0.9 (1.1)	3.2 (2.0)

Proactive/Reactive differences were a function of treatment adherence. Overall, participants in the Proactive + 4 weeks of medication condition demonstrated a significantly higher total number of completed counseling sessions compared to participants in the Reactive + 2 weeks of medication condition among those who completed 12-month follow-up (see Table 4, $p < .0001$). Of those in the Reactive + 2 weeks of medication condition, 84.0% of participants completed one session or fewer, whereas 43.7% of participants in Proactive + 4 weeks of medication condition completed four or more sessions. Of those in the Proactive + 4 weeks of medication condition, 20.7% completed all six sessions while only 0.9% of participants completed all six sessions in the Reactive + 2 weeks of medication condition.

Discussion

This study utilized a tobacco QL approach, a common evidence-based methodology to disseminate tobacco cessation interventions,^{21–23} in order to provide an intervention to geographically dispersed CCSs. Although there was successful recruitment to the intervention, successful retention of participants at 12-month follow-up and good treatment adherence in the Proactive + 4 weeks of medication condition, the Proactive + 4 weeks of medication QL was not significantly more effective than a Reactive + 2 weeks of medication QL in producing long-term self-reported cessation. These results stand in contrast to a meta-analytic review of the QL literature that indicates that QLs have been shown to be effective for increasing long-term smoking cessation, with those in treatment having approximately a 40% increased odds of long-term cessation.¹⁵

In addition, while self-reported rates of smoking cessation in this study were similar to previous interventions for CCSs^{6,8} and trends

avored the Proactive condition like previous research,²⁴ 80% of contacted participants who claimed abstinence from cigarettes failed the cotinine test, indicating they were falsifying their tobacco status. When adjusted for cotinine verification, the rates of smoking cessation in both conditions at 12 months were less than 2% in both conditions; a similar rate of cessation would be expected via spontaneous cessation in a non-treated group of smokers.¹⁵

There are several important and highly clinically salient findings in this study. First, although our cessation outcomes were disappointing, the results are consistent with a recent meta-analysis that documented that smoking cessation interventions among *adult* survivors were not efficacious.²⁵ Combined with the results from this meta-analysis, the current findings suggest that intervening with cancer survivors may be extremely challenging. Future research should evaluate alternative and potentially more aggressive behavioral (e.g. a stepped care intervention, a motivational interviewing-based intervention) and/or pharmacologic interventions for this population, as it appears that a traditional QL may not be sufficient. Second, in this first study to use biochemical validation of tobacco status in CCSs, rates of falsification in reporting of tobacco status in this sample of CCSs were extremely high. These results are consistent with previous findings indicating that individuals in a high-risk medical group, like CCSs, may be more likely falsify tobacco status,¹⁰ because they may feel pressure to report quitting smoking. Since a large number of participants either refused the cotinine test, or could no longer be reached despite being successfully contacted at 12-month follow-up to obtain self-reports of cessation, one could plausibly assert that these rates are actually underestimates of rates of falsification. It is recommended that all future tobacco intervention studies of CCSs should include biochemical verification as the gold standard for

confirmation of smoking cessation. Finally, given the rates of falsification observed in this study, clinicians might consider framing questions about tobacco use in ways that may make it easier for CCSs to disclose use (e.g., “It is hard for some patients to admit this, but we know that many cancer survivors smoke and use other tobacco products. It is certainly understandable—nicotine is a very addictive drug. But it is important to tell me if you smoke.”). With this knowledge, clinicians can then assist the patient with accessing tobacco cessation assistance (e.g., pharmacotherapy, support groups).

There are several limitations that should be noted about this study. First, while both groups received NRT, the Proactive condition received up to 8 weeks of pharmacotherapy, whereas the Reactive condition only received 2 weeks. Previous investigations have shown that the provision of NRT significantly increases smoking abstinence rates compared to QL support alone.²⁶ The use of 2 weeks of introductory NRT supplies has also been shown to increase smoking abstinence rates.²⁷ However, a previous meta-analysis of NRT for smoking cessation concluded that: (a) the effectiveness of NRT appears to be largely independent of the intensity of additional support, and (b) longer courses of NRT are not demonstrably superior to shorter durations of therapy.²⁸ Nonetheless, one should be cognizant of the fact the Proactive condition received more NRT than the Reactive condition. In addition, our generalizability may be limited because we had a low proportion of participants completing cotinine testing; however, ours is the first study to ever attempt to test cotinine in CCSs. Since childhood cancer is relatively rare, participants are geographically disperse, making biochemical verification challenging. Nonetheless, even if one completely discounts the cotinine data and relies on self-reports alone, the participants report very low rates of cessation and no proactive/reactive differences.

In summary, we found no significant difference between a Proactive + 4 weeks of medication QL and Reactive + 2 weeks of medication QL in long-term cessation rates among CCSs. Furthermore, falsification rates of tobacco status were extremely high in this cohort of CCSs, and biochemically verified rates of smoking cessation were extremely low. Future studies of cancer survivors, as well as other medically compromised smokers, may wish to verify self-reports of abstinence. Nonetheless, these negative findings do not obviate the need for programs that produce cessation in this high-risk and often hard-to-reach population.

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Declaration of Interests

None declared.

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