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Capitalizing on a teachable moment: Development of a targeted self-help smoking cessation intervention for patients receiving lung cancer screening

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ABSTRACT

Objective: The goal of the current study was to develop and examine the feasibility and acceptability of a self-help smoking cessation intervention targeted to the teachable moment of smokers undergoing low-dose computed tomography (LDCT) lung cancer screening.

Materials and methods: We used a multi-phase qualitative approach, including focus groups (N = 15) and learner verification interviews (N = 16) to develop a targeted intervention for patients receiving a LDCT screening, by extending and modifying a previously validated, self-help intervention. The new intervention was then tested in a feasibility study for acceptability and receptivity by smokers (N = 18) receiving a LDCT screening.

Results: The main themes that emerged from the focus group findings included a need to address the counter-productive thoughts regarding a negative lung screen result, the desire to enjoy a healthy and smoke-free retirement, the need to increase self-efficacy regarding smoking cessation, and the desire to see statistics regarding survival after quitting smoking. Learner verification findings showed that participants responded favorably to most booklet and pamphlet changes. Minor changes were made to improve comprehension and enhance self-efficacy. Formative findings led to the development of a new initial booklet titled, "Lung Cancer Screening & Quitting Smoking: Taking Control of Your Health," as well as modifications of the existing self-help cessation intervention. The intervention was designed to be initiated at the LDCT appointment, prior to receipt of scan results, and with minimal disruption of clinic work-flow. Results from the feasibility study indicated that acceptability and satisfaction with the new intervention were high.

Conclusion: A validated self-help smoking-cessation intervention was modified for smokers receiving LDCT screening for lung cancer based on formative research guided by the teachable moment concept. The new intervention is ready for testing in a randomized controlled trial.

1. Introduction

Tobacco smoking is the primary cause of lung cancer, which remains the leading cancer killer in men and women worldwide [1]. Screening individuals with low-dose computed tomography (LDCT) scans has been found to significantly reduce lung cancer mortality, and the United States Preventive Services Task Force (USPSTF) recommends annual screening with LDCT in high risk individuals based on age and smoking history [2]. In 2015, screening for lung cancer was added as a preventative service benefit under Medicare, expanding access to a large proportion of high risk individuals. Research suggests that lung cancer screening may be a teachable moment for smoking cessation [3], and CMS requires that smokers receive cessation advice and assistance as part of a shared decision-making visit. The concept of a teachable moment has been described as "naturally occurring life transitions or health events thought to motivate individuals to spontaneously adopt risk-reducing behaviors" [4]. McBride et al. [4] identified three key factors that influence the potential of teachable moments: (1) increased perceptions of personal risk and outcome expectancies; (2) strong affective or emotional responses; and (3) redefined self-concept or social role. With respect to LDCT scan, the first two of these factors are most likely active at the time of the scan, and all three may be elevated in the

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Table 1
Final Intervention Booklets and Pamphlets: Titles and Themes.

Booklet Series	Title/Theme	Pamphlet Series	Theme(s)
Booklet 0	*Lung Cancer Screening & Quitting Smoking: Taking Control of Your Health*	Pamphlet 1: Angie's Story	• Difficulty/fear of quitting • Multiple quit attempts
Booklet 1	*Stop Smoking for Good: An Overview*	Pamphlet 2: Michael's Story	• Pharmacotherapy
Booklet 2	*Smoking Urges*	Pamphlet 3: Don's Story	• Generational factors • Quitting after a cancer diagnosis • Coping strategies
Booklet 3	*Smoking and Weight*	Pamphlet 4: Gloria's Story	• Having a slip/relapsing
Booklet 4	*What If You Have a Cigarette?*	Pamphlet 5: Candice's Story	• Health • Stress
Booklet 5	*Your Health*	Pamphlet 6: Maria's Story	• Smoking and weight
Booklet 6	*Stress & Mood*	Pamphlet 7: Barry's Story	• Relapse • Quit aids • Social Support
Booklet 7	*Lifestyle Balance*	Pamphlet 8: Carlos' Story	• Social support • Quit aids • Benefits of quitting
Booklet 8	*Life Without Cigarettes*	Pamphlet 9: Clement's Story	• Cravings • Coping strategies
Booklet 9	*Benefits of Quitting Smoking*		
Booklet 10	*The Road Ahead*		

*Note: This table does not reflect the intervention distribution schedule.

case of an abnormal finding.

Several studies have evaluated lung cancer screening as a teachable moment for smoking cessation. For example, approximately 65% of patients enrolled in a CT scan trial reported that they were ready to stop smoking within the next 6 months, which is consistent with, if not higher than, same-age adults in the general population, and there was high interest in a range of cessation aids [5,6]. Although some studies have reported little or no association between lung screening results and smoking cessation [7], others have found that receipt of abnormal CT findings has been predictive of future smoking cessation [8], and smokers receiving negative (normal) scan results have demonstrated a lower likelihood of cessation [9]. Nevertheless, very minimal treatments (e.g., a standard smoking cessation booklet or a list of internet resources) have not demonstrated efficacy [10], and there are limited outcome data regarding the efficacy of smoking cessation interventions in this population [11]. As noted by Aberle et al. [12], there remains great potential for combining screening and smoking cessation programs. An effective smoking cessation intervention for this population should be targeted to the CT lung cancer screening situation, and it should attempt to maximize the three factors identified by McBride et al [4].

Our team developed a self-help smoking relapse-prevention intervention (i.e., a booklet series, *Forever Free*® [13]), as well as a modified smoking cessation version of the intervention (*Stop Smoking for Good; SSFG*), both of which have been found to be efficacious in promoting sustained smoking abstinence [14,15]. Key characteristics of these self-help include: (1) content based on empirically supported cognitive-behavioral theory and research; and (2) the intervention extends (via multiple booklets) over 12–18 months. Based on the promising results with the previously tested self-help interventions, we sought to capitalize on the "teachable moment" present during LDCT screening by developing a self-help intervention targeted to patients receiving a lung cancer scan.

Our overarching goal was to develop a self-help intervention that could be provided to smokers within the context of LDCT screening and with minimal disruption to clinic flow. Development of the intervention was accomplished via additions and modifications to the existing SSFG intervention. The new intervention was then tested to evaluate its acceptability and feasibility among patients undergoing LDCT lung cancer screening. The current paper describes the series of iterative steps leading to the development of the targeted intervention, and reports the feasibility and acceptability results.

2. Materials and methods

2.1. Overall study design

Our study was conducted in two phases. Phase I, was formative research via focus groups and learner verification interviews to adapt and modify the existing SSFG intervention for individuals receiving LDCT scan. Phase II, was a feasibility study to evaluate the acceptability of, demand for, and practicality of the new intervention as well as the methodological procedures for a future efficacy trial. Participants for the feasibility study were randomized to (1) Self-Help Intervention (SHI) or (2) Usual Care (UC) condition. SHI participants received the intervention developed in Phase I. UC participants received an existing smoking-cessation booklet [16]. Both phases were approved by the Liberty Institutional Review Board (IRB), and all participants provided informed consent prior to participation.

2.2. Phase I: intervention development

A multi-step iterative approach was used to modify the existing SSFG intervention. This intervention comprised 10 booklets and 9 pamphlets distributed over 18 months [14]. The first booklet provides a general overview about quitting smoking, and each of the remaining 9 booklets includes more extensive information on a topic related to maintaining abstinence: (see Table 1). In addition to the booklets, 9 trifold color pamphlets reinforce key messages about quitting smoking, communicated via a first-person narrative to induce a sense of social support. Materials were written at the 5^{th}–6^{th} grade reading level.

2.2.1. Focus groups

Focus groups with smokers who had received LDCT scans identified and explored novel content topics for inclusion in the materials, and gathered feedback regarding the existing SSFG booklets, including tone and message design.

2.2.1.1. Participants. Participants were smokers who had recently completed a LDCT scan at a large NCI-designated cancer center in the Southeast. Inclusion criteria were (1) having smoked at least one cigarette per week prior to undergoing the LDCT scan; and (2) being able to speak and read English. To provide insight relevant to potential LDCT screening outcomes, we recruited smokers who had received a negative (normal) scan result and as well as smokers who had received

a positive (abnormal) scan result.

2.2.1.2. Measures. Participants first completed a questionnaire consisting of demographic, smoking history, and medical history questions, the Fagerström Test for Nicotine Dependence (FTND), a validated measure of nicotine dependence [17], and the Contemplation Ladder [18], a 10-point scale measuring motivation and readiness to quit smoking. Next, using a semi-structured interview guide, participants were asked a series of standardized, open-ended questions to assess: (a) motivation for getting an LDCT scan; (b) perceived risk of continued smoking; (c) cessation motivations relevant to the teachable moment model generally, and LDCT specifically; (d) emotional response to the LDCT scan; (e) benefits and barriers to quitting; (f) suggestions for cessation intervention; and (g) feedback regarding tone and messages of the existing SSFG booklets. Examples of questions included: "How has the lung cancer screening changed the way you think about smoking?"; "How did you feel after you received the test results?"; "What do you think are key messages to convey to someone who received a negative screening (normal) result to motivate them to quit smoking?"; "What information should be added to ensure that individuals who have participated in lung cancer screening would pay attention to and relate to the information?"

2.2.1.3. Procedures. Current smokers who recently completed an LDCT screening were identified via clinic appointment records. They were then contacted and screened by the study staff via telephone.

Eligible participants were invited to attend a focus group to provide their opinions regarding a smoking cessation intervention designed for lung cancer screening patients. The focus groups lasted approximately 1.5 h, and participants received a $30 gift card for their time. Saturation was achieved (i.e., no new information was being obtained [19]) after 4 focus groups totaling 15 participants.

2.2.1.4. Data analysis. Focus groups were recorded, transcribed, manually coded using an a priori coding scheme related to the guide and emergent themes, and reviewed by members of the research team following standard approaches [20]. Content analysis was performed to identify major themes from smokers who completed an LDCT screening. Members of the research team trained in qualitative research reviewed the transcriptions to develop a code list and open coding was used to identify emergent themes, and new codes were added to the original code list. Summaries of results were used to develop a new booklet uniquely relevant to the lung cancer screening population, as well as to modify and adapt the 9 supportive tri-fold pamphlets.

2.2.2. Learner verification

After the initial drafts of the new booklet and modified pamphlets were generated, the learner verification phase was initiated. This approach verifies the changes resulting from the focus group findings, and enhances the suitability of materials by assessing acceptability, attraction, understanding, self-efficacy, and persuasion of the materials via a series of questions [21–23]. Involving users in the process results in a product containing "their words," thereby enhancing receptivity. Consistent with standard sample sizes for learner verification, [22], 16 participants were recruited, 10 for the first iteration and 6 for the second iteration. Inclusion criteria and recruitment procedures were identical to those of the focus groups. Participants completed a questionnaire containing demographic and smoking history questions, the FTND [17], and the Contemplation Ladder [18]. The individual interviews lasted approximately 60 min, and participants received a $30 gift card for their time.

Using semi-structured interview guides, participants were asked a series of questions to verify the key elements of the new booklet and modified pamphlets. Examples of questions included: "What do you think about the title of this booklet?"; "Overall, what would you say is the main message of the booklet?"; "What do the words "normal" and "abnormal" test results mean to you?"; "After reading the booklet, do you feel it would help to encourage a smoker coming in for a lung scan to quit smoking?"; "Do you feel you could relate to the stories in the booklet and pamphlets?"; "After reading the materials, do you feel motivated to quit smoking?" Results from the first round of interviews were incorporated into the materials and a second round of interviews was used to verify the changes. Interviews were audio recorded, transcribed, and the summarized data was used to direct modifications for the advanced and final drafts.

2.3. Phase II: feasibility study

The feasibility of the newly developed intervention from Phase I was evaluated in a group of 18 smokers who were undergoing a LDCT scan. The goal was to evaluate acceptability of, demand for, and practicality of the new intervention and the methodological procedures for a future efficacy trial.

2.3.1. Participants and procedures

Potential participants were approached and screened for eligibility by a research coordinator at the time of their appointment. Inclusion criteria were (1) having smoked at least one cigarette per week prior to undergoing the LDCT scan; and (2) being able to speak and read English. Eligible participants who provided consent completed the baseline assessment. Subsequently, participants were randomized and provided with the appropriate intervention materials (SHI or UC). Participants in the SHI condition received the new booklet at the time of their LDCT scan appointment. Participants in the Usual Care condition received the National Cancer Institute's *Clearing the Air* booklet at their scan appointment [16]. The remaining SHI materials, including the 10 SSFG booklets and 9 supportive pamphlets were sent to participants via US mail over a 6-month period. Follow-up assessments were sent by e-mail link or US mail (participants' choice) at 1, 3, 6, and 9 months following enrollment. Participants were paid $20 per follow-up assessment.

2.3.2. Measures

The baseline assessment included: (1) a demographics and smoking history questionnaire, including 1-item (1–5 scale) that assessed confidence in quitting smoking and 1-item (1–7 scale) that assessed commitment to being smoke-free; (2) the FTND [17]; (3) the *Contemplation Ladder* [18]; and (4) 8-items assessing perceived risk of smoking and illness [24]. The follow-up assessment included the same measures as the baseline assessment, with the addition of the eight-item *Client Satistfaction Questionnaire* (CSQ-8) [25], a measure of treatment satisfaction.

3. Results

3.1. Focus groups

3.1.1. Participant characteristics

The total sample (N = 15) from the four focus groups was 53% male and 100% Caucasian, with a mean age of 62.47 years (SD = 5.34), 80% with more than high school education, and 47% with greater than $70 K annual income. They smoked a mean of 20.00 cigarettes per day (CPD) (SD = 8.30), had smoked a mean of 39.75 years (SD = 6.57), and scored a mean of 3.40 (SD = 1.84) on the FTND, indicating a low-moderate level of nicotine dependence. They scored a mean of 6.85 (SD = 3.51) on the Contemplation Ladder, indicating a moderate level of motivation to quit smoking. Four of the 15 participants (27%) had received a positive (abnormal) LDCT scan result.

3.1.2. Key findings

Key themes from the focus groups along with illustrative quotes and feedback pertaining to the SSFG intervention are presented below.

Although the groups contained participants with both positive (abnormal) and negative (normal) scan results, the groups generally gave similar responses and suggestions.

3.1.2.1. Motivation for getting LDCT scan. The majority of participants cited the possibility of early treatment for lung cancer, health concerns, and ability to receive the scan at a low cost as the primary motivators for screening.

"You know, you hear these stories off and on and all of the sudden you've got stage 4 and you've got 2 months to live and you're dead. I'd like to have a little longer, ya know,"
"I've been coughing up a lot of mucus lately and that started to scare me a little."

3.1.2.2. Perceived risk of continued smoking/Change in smoking behavior after CT scan. A few participants indicated a decrease in smoking following the scan; however, the majority of participants indicated that there was no change in their smoking behavior.

"*I kept cutting down to about a pack a day to probably four or five cigarettes a week…I don't want to have to go through that again and say hey you got a spot there, we're going to have to biopsy up and check it out…,"*
'No, [the results] really had no impact on me. I wasn't scared of getting lung cancer or anything."

3.1.2.3. Teachable moment of emotional response to LDCT scan. Participants were asked how they felt both before their scan and after receiving their results. Almost half of the participants reported feelings of anxiety prior to receiving their test results.

"*I was, I was nervous, ya know. I just wanted to know…"*
"Major anxiety… it took a long time, it was like 7–10 days and that was an excruciating wait."

After obtaining the results, the majority of participants who received negative results felt that they had "dodged a bullet," and thus continued to smoke.

"*It (negative result) is a relief and it is almost like approval… you can keep smoking. If it was positive, I probably would be much more concerned about quitting smoking.*"
"*I was like okay, I can smoke for another year,"*

3.1.2.4. Benefits and barriers to quitting smoking. One frequently cited barrier that participants expressed was the difference in social norms from when they began smoking. In particular, participants noted that smoking in the past was not stigmatized as it is today and as a result, they spent many years smoking without any social pressure to quit.

"*I was raised on a tobacco farm in North Carolina. Everybody smoked, ya know?"*
"But it's generational too, I think, how we all started young, probably very young. It was all more acceptable back then."

In addition, some of the participants reported low cessation self-efficacy as a barrier to quitting smoking.

"*If I'm not 100% convinced that I'm going to be able to do it, why try?"*

With regard to the benefits of quitting smoking, participants emphasized the desire to live and be healthy during their retirement years.

"*I'm 62, ummm, in 3 years I'll be looking to retire and I don't wanna die at 65, just as I retire. I wanna be able to enjoy my retirement."*

3.1.2.5. Intervention suggestions. There were a variety of suggestions regarding the intervention, however, the most frequently mentioned were to include statistics regarding the benefits of quitting for older adults and to add messages that one "might not be so lucky next time" for individuals who "dodged a bullet" by receiving negative test results.

"*If you can find out what the effect of quitting smoking is beginning at more senior age…some statistics that show, okay, at 68, if you quit you'll live to probably 75…"*

In response to a negative result:

"*Might not be so lucky next time."*

Although some participants felt the intervention would be best delivered after the scan, the majority felt that it should be offered prior to receiving the results to capitalize on the high anxiety and motivation during that period (i.e., the teachable moment), and importantly, prior to a potential decrease in motivation following a negative scan result.

"*It's good to, you know, get it to the person before because I think if the results aren't good, at least they, it's fresh on their mind… I just think up front and before would benefit either way with the results of the CAT scan, whether they are good or bad."*
"You're there because you're concerned, or you wouldn't be there."

3.1.2.6. SSFG booklet feedback. Participants provided mixed opinions regarding the original SSFG booklets. Although some felt the booklets would not be helpful or motivating during a quit attempt, others stated that they would be interested in reading them and, in fact, asked to take them home.

"*I can't imagine that it's going to teach me anything that after 40 years of smoking I don't' already know."*
"…for me the books are better.. . I would probably keep these in my car and read them. And I would read them, and I'm sure I'd learn a thing or two in here, cause I don't know everything, you know."

Participants were particularly interested in the personal stories conveyed in the booklets and pamphlets.

"*That's why I picked up this brochure. You know I looked at this and what caught me was her story.*"

3.2. Summary of modifications and draft of the new intervention

Based on the themes that emerged from the focus group interviews, a new booklet titled "Lung Cancer Screening & Quitting Smoking: Taking Control of Your Health," was developed to address lung cancer screening and smoking early and directly. This booklet was designed to precede the SSFG series, and consistent with focus group results, to be provided to patients prior to receiving LDCT results (typically at the time of screening appointment). The emphasis of the new booklet is on motivating smokers who are undergoing LDCT screening to quit smoking.

The first few sections of the new booklet provide support for the reader's decision to receive a LDCT scan, as well as encouragement and motivation for considering quitting smoking at this time. In addition, a section, "If Your Results Are Normal," was incorporated to address the focus group theme of "dodging the bullet." This section provides several examples and challenges the illogical thinking that leads to continued smoking following a negative lung cancer screening result. In response to another suggestion we included a chart depicting reduction in mortality risk from smoking-related illnesses as a function of quitting smoking [26]. The last section of the new booklet focuses on enhancing self-efficacy as it relates to quitting smoking. It includes personal stories of individuals who received a lung cancer screening and their decision to quit smoking. Finally, the findings and specific themes outlined above informed the content of the personal vignettes contained in the 9 supportive pamphlets.

3.3. Learner verification

3.3.1. Participant characteristics

Sixteen participants were recruited (63% female). The mean age was 61.39 years (SD = 4.84), 94% were Caucasian, 94% had more than a high school education, and the median income was $70-79 K. Participants had smoked for a mean of 40.12 years (SD = 6.93), with a mean CPD of 19.40 (SD = 8.90), and were moderately dependent on nicotine as indicated by the FTND (M = 5.07, SD = 2.79). The Contemplation Ladder mean was 7.31 (SD = 3.28) which corresponds to moderate-high motivation to quit smoking, with 50% indicating that they were taking action to quit. Seven participants (44%) had received a positive LDCT scan result.

3.3.2. 1st iteration

The drafts of the new materials were evaluated with 10 participants regarding five learner verification concepts: attraction, cultural acceptability, understanding, self-efficacy, and persuasion [22,23].

3.3.2.1. Attraction. Participants in the learner verification interviews responded favorably to the visual appearance of the booklets as well as the content (e.g., "Yes, engaging, I wanted to get to the next story to see if I related to it."), but they felt the number of "dodging the bullet" examples made the booklet too long. Furthermore, some participants felt some of the "dodging the bullet" examples were too farfetched and suggested some more relatable scenarios.

3.3.2.2. Cultural acceptability. With respect to acceptability, most participants found the personal stories and images to be relatable and representative of individuals from different backgrounds.

3.3.2.3. Understanding. Overall, the participants were able to identify the main message of the new booklet (i.e., to quit smoking) and felt the booklet and pamphlets were easy to read and understand. However, about half of the participants felt the post-cessation mortality graph was unclear and difficult to interpret.

3.3.2.4. Self-efficacy and persuasion. Participants also expressed concerns about self-efficacy to quit smoking (e.g., "I've tried it all and I can't") and provided mixed feedback regarding persuasion (e.g., "I have to reach that level on my own. I need to be mad about it"). Feedback regarding the pamphlets was positive, and no changes were suggested.

3.3.2.5. 1st iteration changes. Changes to the new booklet based on interview feedback included a redesign of a post-cessation mortality graph to improve comprehension, addition of several "Myths of CT scans" to further clarify faulty logic, and addition of a section on appearance-based and lifestyle benefits of smoking cessation. The number of "dodging the bullet" examples was reduced, and the stories were modified to increase relatability. Motivational messages to increase self-efficacy and motivation to quit smoking were also enhanced.

3.3.3. 2nd iteration

The second round of learner verification interviews (n = 6) suggested that participants responded favorably to the addition of the "Myths of CT scans" (e.g., "Loved them. A lot of fear going into CT scan. Having facts helps."), and the more selective dodging the bullet examples. Participants also reported better understanding of the redesigned post-cessation mortality graph, and that the modified motivational messages further increased motivation to quit. No additional changes were identified during the second round of interviews, thus an additional round of iterations was determined to be unnecessary.

3.4. Final intervention

The final developed intervention was based upon: (1) results from formative research, (2) the existing SSFG booklets and pamphlets, and (3) existing research and theory regarding teachable moments and smoking cessation. It comprised a new LDCT-specific booklet, the original SSFG series of 10 booklets, and 9 modified supportive pamphlets. The new booklet, "Lung Cancer Screening & Quitting Smoking: Taking Control of Your Health," covered topics relevant to smokers undergoing a lung cancer screening, including the decision to have a LDCT scan; waiting for the scan result; receiving a positive vs. negative result; common myths about lung cancer screening and smoking; and benefits of quitting smoking regardless of scan results. Content for the personal vignettes contained in the supportive pamphlets was derived from experiences conveyed during the focus groups as well as from the existent literature on factors unique to lung cancer screening patients who smoke (e.g., positive vs. negative test results, perceived risk, self-concept, and emotions related to the screening). The content of the various intervention materials is summarized in Table 1.

3.5. Feasibility study

3.5.1. Participant characteristics

Among the participants in the pilot study (N = 18), 56% were male and 100% were Caucasian, with a mean age of 64.78 years (SD = 6.04). Similar to Phase I samples, a large proportion of participants reported high education and income levels, including 41% with a bachelor degree or higher, and 78% with annual income above $60,000. At baseline, they smoked a mean of 21.59 CPD (SD = 9.82), had smoked a mean of 45.00 years (SD = 10.15), and scored a mean of 5.00 (SD = 1.65) on the FTND, indicating a moderate level of nicotine dependence. With regard to motivation, they scored a mean of 6.10 (SD = 3.51) on the Contemplation Ladder, and a mean of 5.05 (SD = 2.06) on the commitment to remain quit item, indicating a modest-moderate level of motivation to quit smoking. Their confidence in being smoke-free over the next 6 months was low (M = 2.55; SD = 1.54; range 1–5).

3.5.2. Demand and acceptability

Among all patients undergoing a LDCT screening (n = 87), 22% were smokers and met study eligibility criteria. Among them, 18 (82%) consented and enrolled (9 in UC and 9 in SHI). There were no difficulties in distributing the intervention materials and completing the baseline assessment during the clinic visit and clinical flow was not disrupted. All participants received an intervention. Response rates for follow-up assessments were: 1 m = 94%, 3 m = 72%, 6 m = 72%, and 9 m = 61%.

Fifteen participants completed the CSQ scale one month after treatment enrollment. Overall, satisfaction with the program was high, (M = 23.73, SD = 3.79; maximum score = 32) across both treatment groups. Among the respondents who received the new intervention (n = 7), all rated the quality of service received as "mostly good" or "very good," and reported that they "generally" received the kind of service that they wanted. Five of the seven participants said the program met "most" of their needs. All but one participant were "mostly satisfied" or "very satisfied" with the amount of help received and would recommend it to a friend. Four of the seven participants reported that the booklets helped them deal more effectively with trying to quit smoking and remaining smoke-free.

With regard to adherence, five of six SHI responders indicated that they read the newly developed booklet received at the LDCT scan appointment (one participant did not answer that question), and five of seven responders indicated that they read at least some of the additional SSFG booklets that they received via mail.

4. Discussion

The U.S. Preventive Services Task Force recommendation for annual screening for lung cancer with LDCT [2] in individuals who are at high risk based on age and smoking history has created an opportunity to capitalize on a teachable moment for providing cessation. Given this potential, the goal of the current study was to develop a self-help smoking cessation intervention targeted to the lung cancer screening context based on the validated SSFG smoking-cessation self-help intervention [14]. We aimed for an intervention that would be easy to disseminate in screening centers with minimal disruption of clinic flow.

Results of this study have several implications for the potential effectiveness of our materials as well as smoking cessation within LDCT clinics more broadly. Indeed, we encountered several challenges to working within this context, consistent with other published trials. However, based on our feasibility and acceptability results, our intervention shows promise in overcoming some of these barriers to better reach this population. For example, our formative research identified characteristics and challenges unique to smokers undergoing lung cancer screening. First, given the current screening criteria, these individuals are older and have long smoking histories. Although these smokers tend to report motivation to quit, cessation rates are low [6,8,27,28]. Hence, the new intervention focused on increasing self-efficacy and capitalizing on motivation to quit smoking. Motivating factors included enjoyment of retirement and learning the benefits of quitting smoking at an older age. Second, although the experience of undergoing LDCT screening presents a unique teachable moment for smoking cessation, many patients receive a normal scan result often misinterpreted as “permission” to continue smoking. Indeed, previous research has shown that cessation attempts are more likely following positive (abnormal) test results [28–31]. A special section in the new booklet was created to counter the faulty reasoning and address this dilemma, referred to by smokers as “dodging the bullet.” Finally, theoretical conceptualization of the teachable moment [4], existing literature [9], and results from our formative research suggest that the new intervention should be offered prior to receipt of screening results. Hence, the new, LDCT-specific part of the intervention was provided at the time of the LDCT screening appointment. The new intervention and its dissemination at the time of the lung cancer screening was well received by most patients. Participants rated the new intervention as helpful and were satisfied with the help they received.

The main limitations of the current study are small sample size and generalizability. The overall recruitment into the feasibility study was a significant challenge due to much lower than anticipated LDCT patient volumes, a challenge that has manifested nationally [32]. As a result, the sample size obtained was insufficient to examine smoking cessation outcomes. Ongoing research is attempting to address the barriers to screening as well as factors that may enhance screening uptake [33,34]. Additional limitations of the current study include a sample with significantly higher education and income than participants in other studies of smoking among LDCT screening patients [32] and a lack of racial and ethnic diversity limiting the generalizability of the findings. However, some research has suggested that the scrupulous criteria for LDCT eligibility limits demographic diversity, given that a significant number of women and minorities fall just short of meeting criteria [34]. Therefore, the new intervention needs to be tested in a larger, more representative sample of smokers undergoing LDCT scans. This will likely be more feasible once LDCT screening becomes more acceptable to the population at large. Nevertheless, findings from the present study contribute to the nascent literature on the content, modality, and timing of smoking cessation interventions in the context of LDCT screening. The next step in the development of this targeted intervention is to test its efficacy in a RCT with a large, diverse sample of smokers undergoing LDCT lung cancer screening.

Conflicts of interest

Thomas H. Brandon has received research support from Pfizer, Inc. All other authors declare that they have no conflicts of interest. The authors alone are responsible for the content and writing of the article.

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