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Incorporating a Smoking Cessation Intervention into Lung Cancer Screening Programs: Preliminary Studies

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Abstract

Two preliminary studies assessed whether telephone counseling (TC) is a feasible smoking cessation intervention following lung cancer screening. Seven older smokers undergoing lung cancer screening (pack years = 61.5) completed three TC sessions, which incorporated the screening result as motivation to quit. Participation (87.5%) and retention (85.7%) rates were good, and four smokers quit smoking (three of whom received abnormal results). We conducted four focus groups with 16 current and former older smokers (pack years = 55). Most believed that

an abnormal scan would motivate them to quit and expressed interest in TC. TC may be feasible and potentially efficacious within lung screening programs.

Keywords

focus groups; lung cancer screening; smoking cessation; telephone counseling; teachable moment

INTRODUCTION

Lung cancer is the leading cause of cancer-related death and smoking accounts for almost 90% of lung cancers (American Cancer Society, 2014; U.S. Department of Health and Human Services, 2014). The National Lung Screening Trial (NLST) reported that lung cancer mortality was reduced by 20% due to the detection and treatment of early stage disease (Aberle, Adams, Berg, Black, Clapp, & Fagerstrom, 2011). As a result, the U.S. Preventive Services Task Force recommended screening of individuals at high risk for lung cancer with mandated insurance coverage beginning in 2015 (U.S. Department of Health and Human Services, 2015; U.S. Preventive Services Task Force, 2013). The Centers for Medicare and Medicaid Services (CMS) has also proposed coverage of lung cancer screening among 65- to 74-year-old individuals (Centers for Medicare & Medicaid Services (CMS), 2015).

It is estimated that over 8 million people in the United States meet the criteria to undergo screening and that screening could prevent 12,000 deaths annually (Ma, Ward, Smith, & Jemal, 2013). Cost-effectiveness models suggest that screening plus concurrent smoking cessation programs represent an unprecedented opportunity to save even more lives than with screening alone, and that cessation will be essential to realizing the full benefit of screening (McMahon, Kong, Bouzan, Weinstein, Cipriano, & Tramontano, 2011; Villanti, Jiang, Abrams, & Pyenson, 2013). The USPSTF, CMS, and other organizations recommend that smoking cessation be offered in conjunction with screening. However, there are no clinical guidelines or evidence-based cessation protocols with demonstrated effectiveness in this setting.

The critical ‘teachable moment’ that can occur after a health event such as cancer screening has been shown to enhance both intention to quit and cessation (Anderson, Yip, Henschke, Yankelevitz, Ostroff, & Burns, 2009; Ashraf, Saghir, Dirksen, Pedersen, Thomsen, & Dossing, 2014; McBride, Emmons, & Lipkus, 2003; Ostroff, Shuk, Krebs, Lu, Burkhalter, & Cortez-Weir, 2001; Styn, Land, Perkins, Wilson, Romkes, & Weissfeld, 2009; Taylor, Cox, Zincke, Mehta, McGuire, & Gelmann, 2007; Townsend, Clark, Jett, Patten, Schroeder, & Nirelli, 2005; van der Aalst, van Klaveren, van den Bergh, Willemsen, & de Koning, 2011). Results from our previous observational study suggested that an abnormal screening result was significantly associated with becoming more motivated to quit, while a normal screening result was associated with less motivation (Taylor et al., 2007). Among NLST participants, we have also found that the likelihood of quitting following an abnormal result increased with the severity of the result, in the absence of a cessation intervention (Tammemagi, Berg, Riley, Cunningham, & Taylor, 2014).

One of the unanswered questions in this area is whether offering a cessation intervention can capitalize on the momentum created by undergoing lung cancer screening. Three randomized trials have used cessation interventions with lung screening participants and showed promising overall cessation rates: a pilot telephone counseling (TC) trial reported 22% cessation at 6 months, a comparison between a standard brochure and a tailored web-based intervention reported 12% to 15% cessation at 2 years, and standard versus Internet-based self-help reported 5% to 10% at 1 year (Clark, Cox, Jett, Patten, Schroeder, & Nirelli, 2004; Ferketich, Otterson, King, Hall, Browning, & Wewers, 2012; van der Aalst, van den Bergh, Willemsen, de Koning, & van Klaveren, 2010; van der Aalst, de Koning, van den Bergh, Willemsen, & van Klaveren, 2012). Although very encouraging, these trials found no significant differences between intervention and control arms (Clark et al., 2004; Ferketich et al., 2012; van der Aalst et al., 2010; van der Aalst et al., 2012).

In the present study, we developed a telephone-based cessation intervention in which we specifically leveraged the screening result to enhance motivation to quit, a strategy that previous trials have not employed. Incorporation of an individual's screening result into a cessation intervention attempts to enhance intention to quit by providing an individualized, motivational cessation intervention that is feasible to implement within lung screening programs. This intervention was designed to be evidence-based, brief, scalable, and testable in a randomized trial. Thus, if found to be effective, it can be readily implemented in a cost-efficient manner.

Finally, we conducted a qualitative focus group study with individuals eligible for lung cancer screening to further assess feasibility, attitudes toward lung cancer screening, and interest in an associated smoking cessation intervention.

PILOT STUDY OF TELEPHONE COUNSELING: MATERIALS AND METHODS

Participants

Eligibility criteria included: 1) status as a current smoker; 2) 30 pack-year smoking history (number of years smoked multiplied by packs per day smoked), and 3) enrollment in the Georgetown University Medical Center (GUMC) lung cancer screening program. Participants were included regardless of their readiness to quit.

Procedures

The nurse navigator for the lung screening program recruited current smokers when they registered for screening. The screening cost to participants was \$75 (if not covered by insurance). The research assistant later called to conduct the baseline telephone interview (T0) prior to the screening appointment, and then mailed the consent form for participants to return. One week after participants had received their screening results, we conducted the second assessment (T1), followed by three brief TC calls approximately one week apart. One week after the third counseling call (approximately one-month post-receipt of the screening results), we conducted the final telephone assessment (T2).

Measures

Demographic and Clinical Characteristics—We assessed age, sex, race, education, marital status, comorbidities, family history of lung cancer at baseline, and screening-related comorbidities at the one-month assessment.

Smoking History and Smoking Status—At baseline, we assessed smoking history, smoking status in the past 30 days (including cigarettes per day (cpd) and number of days smoked), other tobacco use (including pipes, cigars, tiparillos, e-cigarettes, and snus), and the number of quit attempts for 24 hours since the prior assessment. At each assessment, we assessed nicotine dependence with a single item from the Fagerstrom Test for Nicotine Dependence (Heatherton et al., 1991): time to first cigarette (“less than 5 minutes of waking” to “more than 8 hours after waking”). This question has previously been used as a single-item measure of nicotine dependence (Baker, Piper, McCarthy, Bolt, Smith, & Kim, 2007). Also at each assessment, participants completed the readiness to quit ladder (Biener & Abrams, 1991; Burgess, van, Noorbaloochi, Clothier, Taylor, & Sherman, 2014; Sachs, Wild, Thomas, Hammal, & Finegan, 2012; Webb Hooper, Baker, & Robinson, 2014), from “I enjoy smoking so much that I will not consider quitting no matter what happens” to “I have already cut down and set a quit date.”

Lung Cancer Screening Results—We obtained the screening results and follow-up recommendations from the electronic medical record prior to conducting the T1 assessment. Results were classified as 1) normal, no follow-up required, 2) abnormal findings, not suspicious for lung cancer, or 3) abnormal findings, suspicious for lung cancer.

Perceived Risk and Worry—At each assessment, we measured participants’ perceived risk of developing lung cancer compared to others of the same gender and smoking status. The five response categories ranged from “I am at much less risk than others,” to “I am at much greater risk than others.” We also assessed perceived worry about developing lung cancer on a four-point scale, from “not at all worried” to “extremely worried.”

Biochemical Verification of Cessation—Participants who self-reported quitting during the study were mailed a NicAlert saliva cotinine test kit (Cooke, Bullen, Whittaker, McRobbie, Chen, & Walker, 2008) if they were not using any form of NRT (N = 2) or were scheduled to undergo a carbon monoxide breath test to coincide with a medical appointment (N = 1). One participant who self-reported quitting at the T1 assessment was lost to follow-up and did not complete biochemical verification. Participants were given a \$15 gift card for completing the test.

Telephone Counseling Intervention

The TC intervention followed the U.S. Department of Health and Human Services’ Guidelines for Treating Tobacco Use and Dependence (Fiore, Jaen, Baker, Bailey, Benowitz, & Curry, 2009). It was based on Project Ascend protocol (Graham & Papandonatos, 2008) and modified to incorporate discussion of participants’ lung screening results. The intervention was also shortened from eight to three sessions to promote feasibility and portability to other lung screening settings. Each session was designed to be brief (10 to 15

minutes) and to use motivational interviewing techniques (Rollnick & Miller, 1995). Motivational interviewing is a client-centered style of counseling which seeks to resolve ambivalence toward change. It encourages the counselor to listen empathically, facilitate talk of change, and respond to any resistance to change (Rollnick & Miller, 1995). In the current telephone counseling intervention, the counselor used these strategies to help participants identify the barriers and benefits of quitting, to facilitate changes in smoking habits, and to encourage participants to discuss NRT, Chantix[®] (varenicline), and Zyban[®] (bupropion) with their physician. For participants who reported quitting, calls focused on their reasons for quitting, identified triggers and potential causes of relapse, and discussed ways to recover should the participant slip or relapse. Discussion of lung screening results was incorporated into all counseling calls. Counselors asked participants to discuss the emotional impact of the screening result, any impact that the result had on their smoking, and to elaborate on future smoking plans in light of the results.

At the end of each call, counselors offered smoking cessation resources to participants and tracked requests for information. Resources included: the American Legacy Foundation's *BecomeAnEx* booklet and website (American Legacy Foundation, 2014), the national telephone quitline number (1-800-QUIT-NOW), encouragement to speak with their physicians about NRT and prescription medicines, the Centers for Disease Control's text message cessation program, and a list of phone numbers for local in-person cessation groups.

Counselor Training

The smoking cessation counselor was certified as a tobacco treatment specialist through accredited programs (Association for the Treatment of Tobacco Use and Dependence [ATTUD], 2014).

PILOT STUDY OF TELEPHONE COUNSELING: RESULTS

Participation Rates

We enrolled 7 of 8 (87.5%) eligible participants over a 5 month period at the GUMC lung screening program. All seven participants completed the baseline assessment (T0), the post-screening assessment (T1), and two counseling calls. Six participants (85.7%) completed all three counseling calls and the 1-month assessment (T2).

Demographic Characteristics

Participants ranged from 49 to 73 years old ($M = 63$, $SD = 8.6$), four were female, five were white, four had a college degree or more education, three were married, five were retired, and all seven had health insurance.

Tobacco Use

We have provided detailed tobacco use and screening information for each participant at each assessment, showing how participants changed over time (Table 1). Pack years ranged from 33 to 112 ($M = 61.5$, $SD = 26.9$). At baseline, five participants smoked 2 to 10 CPD, and five smoked their first cigarette 15 minutes after waking. At the T2 assessment, three

participants reported continued smoking and three reported that they had quit (with biochemical verification of quit status). One additional participant reported having quit at the T1 assessment, but was lost to follow-up and did not complete biochemical verification.

Lung Cancer Screening Results and Change in Smoking Status

Of the two participants with normal results (i.e., there were no nodules or other abnormal findings), one quit smoking and one continued smoking. Both of the participants who had results not suspicious for lung cancer but with another abnormality (e.g., COPD) continued smoking. However, they both became more ready to quit by the end of the study and also increased the time before the first cigarette of the day (Table 1). Finally, the three participants with results that were suspicious for lung cancer (nodule ≥ 4 mm) all reported quitting during the course of the study (two with biochemical verification).

Lung Cancer Screening Results, Lung Cancer Worry, and Perceived Risk

Of the two participants with normal results, both reported decreased worry and perceived risk, from the T0 to the T2 assessment. Considering the four participants who had abnormal results (combining results that were suspicious and not suspicious for lung cancer) and who had complete data, none reported a change in perceived risk from T0 to T2, three reported no change in lung cancer worry from T0 to T2, and one participant reported increased worry.

FOCUS GROUP STUDY: MATERIALS AND METHODS

Participants

Eligible participants were current and former smokers (quit within the past 15 years) with at least a 30 pack-year smoking history.

Procedures

We conducted four focus groups, which included 16 participants we recruited through Craigslist, the GUMC lung cancer screening program, and the GUMC Minority Health & Health Disparities Research Center. Prior to the focus groups, participants completed the consent form, a brief questionnaire, and consented to audiotaping the meeting. We addressed 1) participants' smoking history and prior cessation attempts; 2) interest in various cessation methods; 3) awareness of and attitudes toward CT lung cancer screening; and 4) feedback on potential smoking cessation interventions within a lung cancer screening program. Each participant received a \$20 gift card.

Measures

The brief questionnaire assessed demographic information, lung screening history, pack-years, current smoking status, prior cessation methods, and interest in using cessation methods in the future. The survey also assessed current smokers' readiness to quit and former smokers' confidence in staying quit using the contemplation ladder (Apodaca, Abrantes, Ramsey, & Brown, 2007; Biener & Abrams, 1991).

Qualitative Analyses

To analyze participants' responses in the focus groups, three investigators developed themes based on mutual agreement and then determined the presence of the themes in the transcripts. The themes from the discussions included smoking history, the impact of lung cancer screening and its results, and feasible cessation interventions.

FOCUS GROUP STUDY: RESULTS

Demographics

The 16 participants included 11 women and 5 men, aged 47 to 71 years ($M = 62.5$, $SD = 5.9$). Ten participants were African American, 4 were currently married, 9 were college graduates, 6 were employed full- or part-time, and 15 had health insurance.

Smoking Status

The five former smokers had an average of 52.2 pack years ($SD = 42.1$) and had been quit for an average of 9.8 years ($SD = 7.8$). The 11 current smokers had an average of 55.7 pack years ($SD = 52.5$). Among the current smokers, in the past 30 days, seven smoked every day or almost every day, while four smoked some days. Four of the current smokers were smoking < 1 pack per day (ppd), four were smoking one ppd, and three were smoking > 1 ppd.

Intention to Quit

Among the 10 current smokers with complete data, 2 reported "having cut back and setting a quit date," 6 reported that they "often think about quitting but have no specific plans to quit," and 2 reported "sometimes" or "rarely thinking about quitting."

Lung Screening History

Seven of the 16 participants had previously been screened, and six had discussed lung screening with a doctor. Regarding plans for screening, 10 participants said that they definitely would be screened and 3 said that they probably would be screened within the next year.

Focus Group Discussion

Table 2 presents the major themes that were addressed and exemplar responses. Nine participants endorsed the "teachable moment" of lung screening, believing that an abnormal screening result would motivate them (and other smokers) to quit. Some participants suggested that quitting would be much easier after receiving an abnormal result. In fact, two of the former smokers explained that receiving an abnormal screening result was the reason they had quit smoking. However, three participants acknowledged that an abnormal result could cause a person to accept his/her fate and continue to smoke. Regarding a normal result, only two participants believed that it would give them permission to continue smoking.

Participants also discussed preferences for cessation interventions. Five participants endorsed nicotine replacement therapy (NRT) and medications to help smokers quit (specifically Chantix). However, others did not endorse these cessation methods due to concerns about side effects, as well as the belief that smoking is also a psychological addiction and therefore not amenable to pharmacotherapy. In fact, many participants hoped to “just quit.” However, one current smoker admitted that his willpower would never be that strong. Among the five participants who directly spoke about TC, four believed that it would be useful in helping them quit. However, one participant did not think counseling in general would be effective for him.

DISCUSSION

These pilot studies provide preliminary evidence that a telephone-based smoking cessation intervention may be feasible and potentially efficacious when delivered in conjunction with a lung cancer screening program. Protocol adherence was very good in the TC study, including adherence to the counseling calls and to biochemical verification. Several focus group participants indicated that counseling might help them to quit and that an abnormal screening result would motivate them to quit smoking. However, TC was not endorsed by all participants and thus further work is necessary to determine additional cessation interventions that are also feasible within this setting.

In addition to the question of feasibility, these findings support previous research which provides evidence for lung cancer screening as a teachable moment for smokers (Anderson et al., 2009; Ashraf et al., 2014; McBride et al., 2003; McMahon et al., 2011; Ostroff et al., 2011; Senore, Giordano, Bellisario, Di, & Segnan, 2012; Slatore, Baumann, Pappas, & Humphrey, 2014; Taylor et al., 2007; Villanti et al., 2013). We found that the three smokers whose screening results were suspicious for lung cancer quit during the course of the study. Among the four other participants who received a normal result or a minor abnormality, only one quit smoking. Prior studies have shown that abnormal results in particular may directly increase smoking cessation (Anderson et al., 2009; Ashraf et al., 2014; McBride et al., 2003; Styn et al., 2009; Tammemagi et al., 2014). This study is unique in that it pairs the teachable moment with TC to capitalize on this critical time with an empirically supported cessation method.

One challenge facing cessation interventions following lung cancer screening is that a portion of smokers are not ready to quit at the time of screening. However, several studies of smoking cessation in smokers who do not intend to quit in settings other than lung cancer screening have demonstrated abstinence rates from 10% to 15% (Cox, Clark, Jett, Patten, Schroeder, & Nirelli, 2003; Hepper, Drage, Davies, Rupp, LaMothe, & Schoenfelder, 1980; Loss, Hall, & Speers, 1979). Furthermore, previous research also shows that TC in particular works for older smokers who may not be ready to quit initially (American Lung Association, 2012; Bach, Mirkin, Oliver, Azzoli, Berry, & Brawley, 2012; Jaklitsch, Jacobson, Austin, Field, Jett, & Keshavjee, 2012; van der Aalst et al., 2011; Wender, Fontham, Barrera, Colditz, Church, & Ettinger, 2013; Wood, Eapen, Ettinger, Hou, Jackman, & Kazerooni, 2012). These results are reflected in the TC pilot, which included patients with varying degrees of interest in quitting, yet had promising cessation results.

The TC pilot revealed several opportunities to identify participants' unique patterns of smoking, their level of nicotine dependence, their risk perceptions, self-efficacy, and outcome expectancies. Based on the assessments and the motivational interviewing intervention framework (Rollnick & Miller, 1995), TC provides ample opportunities to increase motivation, to set goals, encourage adherence to pharmacotherapy, and refer for additional cessation assistance (e.g., with a primary care physician).

Although promising, these studies are limited by small sample sizes as well as the lack of a control group in the TC pilot. As the next step in this research, we are conducting a randomized trial in which lung screening participants are randomly assigned to receive TC vs. a minimal treatment intervention. In an effort to improve the impact of the TC intervention, we have modified it in the ongoing study by starting the TC intervention within 1–2 days of receipt of the screening results, and by increasing the TC calls to six, which may be particularly useful for those who are not initially ready to quit. In the event that the TC arm demonstrates an improved cessation rate over the minimal treatment arm, this intervention can be incorporated into lung screening programs with relatively minimal requirements.

Clinical Implications

It is important to note that quitting smoking can greatly improve even a long-term smoker's health, increasing life expectancy by as much as four years among 55- to 64-year-olds who quit versus continue smoking (Jha, Ramasundarahettige, Landsman, Rostron, Thun, & Anderson, 2013). Given that continued smoking remains the single biggest cause of premature death and chronic disease burden, especially among low income populations (U.S. Department of Health and Human Services, 2014), providing evidence-based smoking cessation counseling is a requirement for lung cancer screening programs (Centers for Medicare & Medicaid Services, 2015). Further, capitalizing on the teachable moment of lung screening may be critical to enhancing its impact and cost effectiveness. The challenge for determining the optimal intervention protocol for use in this unique screening setting is to conduct the appropriate demonstration studies, followed with large-scale randomized clinical trials for efficacy, and then implementation-dissemination trials for generalizability and scalability. These studies are especially important given the increased rates of screening that are likely to occur due to the mandated insurance coverage beginning in 2015 (U.S. Department of Health and Human Services, 2015; U.S. Preventive Services Task Force, 2013) and the coverage for 65- to 74-year-old individuals (U.S. Department of Health and Human Services, 2015) for individuals at high risk for lung cancer.

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References

- Aberle DR, Adams AM, Berg CD, Black WC, Clapp JD, Fagerstrom RM. Reduced lung-cancer mortality with low-dose computed tomographic screening. *The New England Journal of Medicine*. 2011; 365(5):395–409. DOI: 10.1056/NEJMoa1102873 [PubMed: 21714641]
- American Cancer Society. Cancer facts & figures 2014. Atlanta, GA: American Cancer Society; 2014. Retrieved from <http://www.cancer.org/research/cancerfactsstatistics/cancerfactsfigures2014/>
- American Legacy Foundation. BecomeAnEx.org. 2014. Retrieved from <http://www.becomeanex.org/>
- American Lung Association. Providing guidance on lung cancer screening to patients and physicians. 2012. Retrieved from <http://www.lung.org/lung-disease/lung-cancer/lung-cancer-screening-guidelines/lung-cancer-screening.pdf>
- Anderson CM, Yip R, Henschke CI, Yankelevitz DF, Ostroff JS, Burns DM. Smoking cessation and relapse during a lung cancer screening program. *Cancer Epidemiology, Biomarkers & Prevention*. 2009; 18(12):3476–3483. DOI: 10.1158/1055-9965.EPI-09-0176
- Apodaca TR, Abrantes AM, Strong DR, Ramsey SE, Brown RA. Readiness to change smoking behavior in adolescents with psychiatric disorders. *Addictive Behaviors*. 2007; 32(6):1119–1130. DOI: 10.1016/j.addbeh.2006.07.016 [PubMed: 16950572]
- Ashraf H, Saghir Z, Dirksen A, Pedersen JH, Thomsen LH, Dossing M. Smoking habits in the randomised Danish Lung Cancer Screening Trial with low-dose CT: final results after a 5-year screening programme. *Thorax*. 2014; 69(6):574–579. DOI: 10.1136/thoraxjnl-2013-203849 [PubMed: 24443174]
- ATTUD (Association for the Treatment of Tobacco Use and Dependence). Council for Tobacco Treatment Training Programs. Accreditation for Tobacco Treatment Specialist (TTS) Training Programs. 2014. Retrieved from <http://attudaccred.org/>
- Bach PB, Mirkin JN, Oliver TK, Azzoli CG, Berry DA, Brawley OW. Benefits and harms of CT screening for lung cancer: a systematic review. *JAMA*. 2012; 307(22):2418–2429. DOI: 10.1001/jama.2012.5521 [PubMed: 22610500]
- Baker TB, Piper ME, McCarthy DE, Bolt DM, Smith SS, Kim SY. Time to first cigarette in the morning as an index of ability to quit smoking: implications for nicotine dependence. *Nicotine & Tobacco Research*. 2007; 9(Suppl 4):S555–S570. DOI: 10.1080/14622200701673480 [PubMed: 18067032]
- Biener L, Abrams DB. The Contemplation Ladder: validation of a measure of readiness to consider smoking cessation. *Health Psychology*. 1991; 10(5):360–365. [PubMed: 1935872]
- Burgess DJ, van RM, Noorbaloochi S, Clothier B, Taylor BC, Sherman S. Smoking cessation among African American and white smokers in the Veterans Affairs health care system. *American Journal of Public Health*. 2014; 104(Suppl 4):S580–S587. DOI: 10.2105/AJPH.2014.302023 [PubMed: 25100424]
- Centers for Medicare & Medicaid Services (CMS). Decision memo for screening for lung cancer with Low Dose Computed Tomography (LDCT) (CAG-00439N). 2015. Retrieved from <http://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=274>
- Clark MM, Cox LS, Jett JR, Patten CA, Schroeder DR, Nirelli LM. Effectiveness of smoking cessation self-help materials in a lung cancer screening population. *Lung Cancer*. 2004; 44(1):13–21. DOI: 10.1016/j.lungcan.2003.10.001 [PubMed: 15013579]
- Cooke F, Bullen C, Whittaker R, McRobbie H, Chen MH, Walker N. Diagnostic accuracy of NicAlert cotinine test strips in saliva for verifying smoking status. *Nicotine & Tobacco Research*. 2008; 10(4):607–612. DOI: 10.1080/14622200801978680 [PubMed: 18418783]
- Cox LS, Clark MM, Jett JR, Patten CA, Schroeder DR, Nirelli LM. Change in smoking status after spiral chest computed tomography scan screening. *Cancer*. 2003; 98(11):2495–2501. DOI: 10.1002/cncr.11813 [PubMed: 14635086]
- Ferketich AK, Otterson GA, King M, Hall N, Browning KK, Wewers ME. A pilot test of a combined tobacco dependence treatment and lung cancer screening program. *Lung Cancer*. 2012; 76(2):211–215. DOI: 10.1016/j.lungcan.2011.10.011 [PubMed: 22088938]
- Fiore, MC., Jaen, CR., Baker, TB., Bailey, WC., Benowitz, N., Curry, SJ. Treating Tobacco Use and Dependence: 2008 Update. Quick Reference Guide for Clinicians. Rockville, MD: U.S.

Department of Health and Human Services. Public Health Service; 2009 Apr. Retrieved from <http://www.ahrq.gov/professionals/clinicians-providers/guidelines-recommendations/tobacco/clinicians/references/quickref/index.html>

- Graham AL, Papandonatos GD. Reliability of internet-versus telephone-administered questionnaires in a diverse sample of smokers. *Journal of Medical Internet Research*. 2008; 10(1):e8.doi: 10.2196/jmir.987 [PubMed: 18364345]
- Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom KO. The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire. *British Journal of Addiction*. 1991; 86(9):1119–1127. [PubMed: 1932883]
- Hepper NG, Drage CW, Davies SF, Rupp WM, LaMothe J, Schoenfelder PG. Chronic obstructive pulmonary disease: a community-oriented program including professional education and screening by a voluntary health agency. *The American Review of Respiratory Disease*. 1980; 121(1):97–104. [PubMed: 7352718]
- Jaklitsch MT, Jacobson FL, Austin JH, Field JK, Jett JR, Keshavjee S. The American Association for Thoracic Surgery guidelines for lung cancer screening using low-dose computed tomography scans for lung cancer survivors and other high-risk groups. *The Journal of Thoracic and Cardiovascular Surgery*. 2012; 144(1):33–38. DOI: 10.1016/j.jtcvs.2012.05.060 [PubMed: 22710039]
- Jha P, Ramasundarathetige C, Landsman V, Rostron B, Thun M, Anderson RN. 21st-century hazards of smoking and benefits of cessation in the United States. *The New England Journal of Medicine*. 2013; 368(4):341–350. DOI: 10.1056/NEJMsa1211128 [PubMed: 23343063]
- Loss RW, Hall WJ, Speers DM. Evaluation of early airway disease in smokers: cost effectiveness of pulmonary function testing. *The American Journal of the Medical Sciences*. 1979; 278(1):27–37. [PubMed: 114050]
- Ma J, Ward EM, Smith R, Jemal A. Annual number of lung cancer deaths potentially avertable by screening in the United States. *Cancer*. 2013; 119(7):1381–1385. DOI: 10.1002/cncr.27813 [PubMed: 23440730]
- McBride CM, Emmons KM, Lipkus IM. Understanding the potential of teachable moments: the case of smoking cessation. *Health Education Research*. 2003; 18(2):156–170. DOI: 10.1093/her/18.2.156 [PubMed: 12729175]
- McMahon PM, Kong CY, Bouzan C, Weinstein MC, Cipriano LE, Tramontano AC. Cost-effectiveness of computed tomography screening for lung cancer in the United States. *Journal of Thoracic Oncology*. 2011; 6(11):1841–1848. DOI: 10.1097/JTO.0b013e31822e59b3 [PubMed: 21892105]
- Ostroff JS, Buckshee N, Mancuso CA, Yankelevitz DF, Henschke CI. Smoking cessation following CT screening for early detection of lung cancer. *Preventive Medicine*. 2001; 33(6):613–621. DOI: 10.1006/pmed.2001.0935 [PubMed: 11716658]
- Ostroff JS, Shuk E, Krebs P, Lu WH, Burkhalter J, Cortez-Weir J. Qualitative evaluation of a new tobacco cessation training curriculum for patient navigators. *Journal of Cancer Education*. 2011; 26(3):427–435. DOI: 10.1007/s13187-011-0229-8 [PubMed: 21553331]
- Rollnick S, Miller WR. What is motivational interviewing? *Behavioural and Cognitive Psychotherapy*. 1995; 23(04):325–334. DOI: 10.1017/S135246580001643X
- Sachs R, Wild TC, Thomas L, Hammal F, Finegan BA. Smoking cessation interventions in the pre-admission clinic: assessing two approaches. *Canadian Journal of Anaesthesia*. 2012; 59(7):662–669. DOI: 10.1007/s12630-012-9716-6 [PubMed: 22544475]
- Senore C, Giordano L, Bellisario C, Di SF, Segnan N. Population based cancer screening programmes as a teachable moment for primary prevention interventions. A review of the literature. *Frontiers in Oncology*. 2012; 2:45.doi: 10.3389/fonc.2012.00045 [PubMed: 22649789]
- Slatore CG, Baumann C, Pappas M, Humphrey LL. Smoking behaviors among patients receiving computed tomography for lung cancer screening. Systematic review in support of the U.S. preventive services task force. *Annals of the American Thoracic Society*. 2014; 11(4):619–627. DOI: 10.1513/AnnalsATS.201312-460OC [PubMed: 24701999]
- Syn MA, Land SR, Perkins KA, Wilson DO, Romkes M, Weissfeld JL. Smoking behavior 1 year after computed tomography screening for lung cancer: Effect of physician referral for abnormal CT

- findings. *Cancer Epidemiology, Biomarkers & Prevention*. 2009; 18(12):3484–3489. DOI: 10.1158/1055-9965.EPI-09-0895
- Tammemagi MC, Berg CD, Riley TL, Cunningham CR, Taylor KL. Impact of lung cancer screening results on smoking cessation. *Journal of the National Cancer Institute*. 2014; 106(6):1–8dju084. DOI: 10.1093/jnci/dju084
- Taylor KL, Cox LS, Zincke N, Mehta L, McGuire C, Gelmann E. Lung cancer screening as a teachable moment for smoking cessation. *Lung Cancer*. 2007; 56(1):125–134. DOI: 10.1016/j.lungcan.2006.11.015 [PubMed: 17196298]
- Townsend CO, Clark MM, Jett JR, Patten CA, Schroeder DR, Nirelli LM. Relation between smoking cessation and receiving results from three annual spiral chest computed tomography scans for lung carcinoma screening. *Cancer*. 2005; 103(10):2154–2162. DOI: 10.1002/cncr.21045 [PubMed: 15825210]
- U.S. Department of Health and Human Services. The health consequences of smoking—50 years of progress: A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014. Retrieved from <http://www.surgeongeneral.gov/library/reports/50-years-of-progress/full-report.pdf>
- U.S. Department of Health and Human Services. Read the Law. The Affordable Care Act, 4 U.S.C. Sect. 4106 (2010). 2015. Retrieved from <http://www.hhs.gov/healthcare/rights/law/>
- U.S. Preventive Services Task Force. Recommendation summary. Lung cancer: Screening. 2013 Dec. Retrieved from <http://www.uspreventiveservicestaskforce.org/Page/Topic/recommendation-summary/lung-cancer-screening>
- van der Aalst CM, de Koning HJ, van den Bergh KA, Willemsen MC, van Klaveren RJ. The effectiveness of a computer-tailored smoking cessation intervention for participants in lung cancer screening: a randomised controlled trial. *Lung Cancer*. 2012; 76(2):204–210. DOI: 10.1016/j.lungcan.2011.10.006 [PubMed: 22054915]
- van der Aalst CM, van den Bergh KA, Willemsen MC, de Koning HJ, van Klaveren RJ. Lung cancer screening and smoking abstinence: 2 year follow-up data from the Dutch-Belgian randomised controlled lung cancer screening trial. *Thorax*. 2010; 65(7):600–605. DOI: 10.1136/thx.2009.133751 [PubMed: 20627916]
- van der Aalst CM, van Klaveren RJ, van den Bergh KA, Willemsen MC, de Koning HJ. The impact of a lung cancer computed tomography screening result on smoking abstinence. *The European Respiratory Journal*. 2011; 37(6):1466–1473. DOI: 10.1183/09031936.00035410 [PubMed: 21148233]
- Villanti AC, Jiang Y, Abrams DB, Pyenson BS. A cost-utility analysis of lung cancer screening and the additional benefits of incorporating smoking cessation interventions. *PLoS One*. 2013; 8(8):e71379.doi: 10.1371/journal.pone.0071379 [PubMed: 23940744]
- Webb Hooper M, Baker EA, Robinson RG. Efficacy of a DVD-based smoking cessation intervention for African Americans. *Nicotine & Tobacco Research*. 2014; 16(10):1327–1335. DOI: 10.1093/ntr/ntu079 [PubMed: 24838844]
- Wender R, Fontham ET, Barrera E Jr, Colditz GA, Church TR, Ettinger DS. American Cancer Society lung cancer screening guidelines. *CA: A Cancer Journal for Clinicians*. 2013; 63(2):107–117. DOI: 10.3322/caac.21172 [PubMed: 23315954]
- Wood DE, Eapen GA, Ettinger DS, Hou L, Jackman D, Kazerooni E. Lung cancer screening. *Journal of the National Comprehensive Cancer Network: JNCCN*. 2012; 10(2):240–265. Retrieved from <http://www.jnccn.org/content/10/2/240.long>. [PubMed: 22308518]

TABLE 1

Tobacco Use and Screening Information for Each Participant at each Assessment

Assessment	Smoking Cessation Outcomes										Perceived Risk Outcomes	
	Number of TC sessions completed	Screening result	Number of Quit Attempts (at least 24 hours)	Number of days smoked (out of 30)	Cigarettes per day	Time to first cigarette	Intention to quit	Resources requested during counseling calls	Final smoking status	Risk of developing lung cancer	Worry about developing lung cancer	
<i>Subject 1 Baseline (pre-screen; T0)</i>	3 sessions	Abnormal, suspicious for lung cancer	Missing	20–27 days	2–5 per day	Within 5 min	Ready to quit in 6 months	1–800-QUIT-NOW quitline, list of in-person cessation groups	Quit during study (Verified with NicAlert)	At the same risk as others	Somewhat worried	
<i>One-week post receipt of screening results(T1)</i>			Quit Smoking	3–5 days	6–10 per day	Former smoker	Former smoker			At the same risk as others	Very worried	
<i>One-month post-receipt of screening results (T2)</i>			Quit Smoking	0 days	0 per day	Former smoker	Already quit/worried about relapsing			At the same risk as others	Very worried	
<i>Subject 2 Baseline</i>	2 sessions	Abnormal, suspicious for lung cancer	1	28–30 days	6–10 per day	30 min to 1 hour	Ready to quit in 30 days	None requested	Quit during study (as of T1 assessment) Not verified-lost to follow-up	At the same risk as others	Somewhat worried	
<i>Post-receipt of results</i>			Quit Smoking	0 days	0 per day	Former smoker	Former smoker			At the same risk as others	Somewhat worried	
<i>One-month</i>			Lost to follow up	Lost to follow-up	Lost to follow-up	Lost to follow-up	Lost to follow-up			Lost to follow-up	Lost to follow-up	
<i>Subject 3 Baseline</i>	3 sessions	Normal	6	20–27 days	2–5 per day	1–2 hours	Already cut down/set a quit date	None requested	Current smoker	At the same risk as others	Very worried	
<i>Post-receipt of results</i>			15	10–19 days	2–5 per day	1–2 hours	Ready to quit–6 mos			At the same risk as others	Somewhat worried	
<i>One-month</i>			3	20–27 days	6–10 per day	30 minutes to 1 hour	Already cut down/set a quit date			At less risk than others	Not at all worried	
<i>Subject 4 Baseline</i>	3 sessions	Normal	0	28–30 days	20 (1 pack) per day	15–29 minutes	Often thinks about quitting but no plans	1–800-QUIT-NOW quitline	Quit during study (verified with NicAlert)	At the same risk as others	Very worried	
<i>Post-receipt of results</i>			Quit Smoking	0 days	0 per day	Former smoker	Former smoker			At higher risk than others	Somewhat worried	
<i>One-month</i>			Quit Smoking	0 days	0 per day	Former smoker	Quit and 100% confident can stay quit			At less risk than others	Not at all worried	
<i>Subject 5 Baseline</i>	3 sessions	Not suspicious	0	28–30 days	6–10 per day	6–14 minutes	Often thinks about quitting but no plans	None requested	Current smoker	Refused	Not at all worried	

Assessment	Smoking Cessation Outcomes										Perceived Risk Outcomes	
	Number of TC sessions completed	Screening result	Number of Quit Attempts (at least 24 hours)	Number of days smoked (out of 30)	Cigarettes per day	Time to first cigarette	Intention to quit	Resources requested during counseling calls	Final smoking status	Risk of developing lung cancer	Worry about developing lung cancer	
<i>Post-receipt of results</i>		for lung cancer, but other finding present	0	28–30 days	6–10 per day	30 minutes to 1 hour	Often thinks about quitting but no plans			Refused	Not at all worried	
<i>One-month</i>			0	10–19 days	6–10 per day	1–2 hours	Ready to quit in 6 months			At the same risk as others	Not at all worried	
<i>Subject 6 Baseline</i>	3 sessions	Abnormal, suspicious for lung cancer	2	28–30 days	11–20 per day	15–29 minutes	Sometimes thinks about quitting but no plans	<i>BecomeAnEx</i> website, <i>BecomeAnEx</i> booklet, 1–800-QUIT-NOW quitline	Quit during study (verified with CO monitor)	At the same risk as others	Somewhat worried	
<i>Post-receipt of results</i>			0	28–30 days	2–5 per day	More than 8 hours	Ready to quit in 6 months			At the same risk as others	Somewhat worried	
<i>One-month</i>			0	0 days	0 per day	Former smoker	Refused			At the same risk as others	Somewhat worried	
<i>Subject 7 Baseline</i>	3 sessions	Not suspicious for lung cancer, but other finding present	0	28–30 days	6–10 per day	15–29 minutes	Often thinks about quitting but no plans	<i>BecomeAnEx</i> booklet	Current smoker	At the same risk as others	Somewhat worried	
<i>Post-receipt of results</i>			0	28–30 days	6–10 per day	30 minutes to 1 hour	Often thinks about quitting but no plans			At the same risk as others	Very worried	
<i>One-month</i>			0	28–30 days	6–10 per day	1–2 hours	Ready to quit in 6 months			At the same risk as others	Somewhat worried	

TABLE 2

Discussion Topics and Quotes from 4 Focus Groups (N = 16)

Discussion Topics	Themes	Examples of Participant Responses
The Effect of Abnormal Screening Results on Smoking	Abnormal screening results motivate smokers to quit.	<p>"It was always in the back of my mind that it's going to be somebody else and not me until I saw that x-ray. That really brought it home."</p> <p>"I would be frantic. I would just probably pass out and die then. It would make me want to stop, yes."</p> <p>"I always felt that people, when they're confronted with a bad x-ray, that to me is easy [to quit]... What's hard is to quit when you're not looking in the face of evidence."</p> <p>"... I contracted double pneumonia and during the process of hospitalization they did an x-ray of my lung and they found a [benign] golf ball-sized blot on my lung... That really freaked me out. And I've never touched a cigarette [since]."</p> <p>"I mean, suddenly it just hit me cold and I suddenly realized that I could die... it was an infection related to double pneumonia—it wasn't a cancer or whatever, but the idea that it could have been a malignant tumor just freaked me out. And that basically is how I stopped."</p> <p>"Well yeah, if it's a positive result a person is going to realize 'I'm going to die.' And they could continue smoking because they're going to die anyway."</p>
The Effect of Normal Screening Results on Smoking	Abnormal screening results encourage continued smoking. Normal screening results give permission to smoke.	<p>"I remember getting results and they were good and I remember thinking, good, I can still smoke."</p> <p>"If the tests come out normal, can I cheat [a little longer]."</p>
Interest in Nicotine Replacement Therapy and Other Cessation Medications	Normal screening results do not give permission to smoke Hope to quit without using these aids.	<p>"I don't think of it that way, anyway, like I got a clean scan and now I have a license to smoke. That's just not a particular connection."</p> <p>"The medicine and all that, the medicine's no good to me because you have to go here first (pointing to head) and condition yourself."</p> <p>"The side-effects [of Chantix] alone are scary enough. Thoughts of suicide."</p> <p>"I'm hoping to have a moment of clarity one morning when I wake up... [and say], 'I'm not smoking anymore.'"</p>
Interest in Telephone Counseling	Would be interested in using these aids. Counseling would help me (and others) quit smoking.	<p>"I did acupuncture as well and the acupuncturist was extremely effective. So much so that it was actually disconcerting."</p> <p>"If I had somebody, or a text message, who would keep me on the sort of awareness path of a constant reminder and sort of make me realize how weak and ineffectual I am."</p> <p>"The scan is the first step. So then the second step that I would consider is a counseling program and/or, as part of that counseling program, they could discuss some of these alternative methods like herbal therapies or homeopathic medicines."</p> <p>"... Chantix really works. I was amazed. I wasn't even tempted for a cigarette."</p> <p>"... individual counseling, whether face-to-face or by telephone is something that could keep someone engaged with the process of wanting to quit."</p> <p>"I think individual counseling would keep people engaged. Like a career counselor or a life coach or whatever, making sure you're aware of the risk and making sure you're on track."</p> <p>"I'm just thinking about if someone called me once a week... Just knowing that there's someone that cares... It's just that personal touch of someone out there saying 'hey, keep it up.'"</p>

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Discussion Topics	Themes	Examples of Participant Responses
	Counseling may not be for everyone.	"I don't think anyone can talk to me to get me to stop."