



## “It’s a decision I have to make”: Patient perspectives on smoking and cessation after lung cancer screening decisions

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### ABSTRACT

Few studies exist showing that involvement in lung cancer screening (LCS) leads to a change in rates of cigarette smoking. We investigated LCS longitudinally to determine whether teachable moments for smoking cessation occur downstream from the initial provider-patient LCS shared decision-making discussion and self-reported effects on smoking behaviors. We performed up to two successive semi-structured interviews to assess the experiences of 39 individuals who formerly or currently smoked cigarettes who underwent LCS decision-making discussions performed during routine care from three established US medical center LCS programs.

The majority of those who remembered hearing about the importance of smoking cessation after LCS-related encounters did not report communication about smoking influencing their motivation to quit or abstain from smoking, including patients who were found to have pulmonary nodules. Patients experienced little distress related to LCS discussions. Patients reported that there were other, more significant, reasons for quitting or abstinence. They recommended clinicians continue to ask about smoking at every clinical encounter, provide information comparing the benefits of LCS with those of quitting smoking, and have clinicians help them identify triggers or other motivators for improving smoking behaviors. Our findings suggest that there may be other teachable moment opportunities outside of LCS processes that could be utilized to motivate smoking reduction or cessation, or LCS processes could be improved to integrate cessation resources.

### 1. Introduction

Lung cancer screening (LCS) using annual low-dose computed tomography (LDCT) imaging is recommended by the United States Preventive Services Task Force (USPSTF) for adults aged 50–80 years old with a 20 pack-year smoking history and who currently smoke or have quit within the past 15 years. LCS has been shown to reduce lung cancer mortality in clinical trials. (Aberle et al., 2011; De Koning et al., 2020; Jonas et al., 2021; Moyer, n.d.; Wender et al., 2013; Bach et al., 2012; Jaklitsch et al., 2012; Samet et al., 2012; National Comprehensive, 2012) Many organizations require or recommend that patients undergo a shared decision-making interaction with a qualified provider prior to

deciding about accepting or declining the LDCT scan. They stipulate that this interaction must include, among other elements, discussion of smoking cessation and abstinence. (Jensen et al., 2015; Mazzone et al., 2018; Wiener et al., 2015) While the scope and frequency of discussions surrounding smoking vary widely among clinicians involved in LCS decision-making interactions<sup>13</sup>, even brief counseling provided during a clinical encounter improves smoking cessation behaviors. (Carter-Harris et al., 2016; Brenner et al., 2018; Maciosek et al., 2017; United States Public Health Service Office of the Surgeon General, 2020).

On average, people who smoke cigarettes attempt to quit smoking roughly once per year. (United States Public Health Service Office of the Surgeon General, 2020) Many factors motivate individuals to quit or

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remain abstinent, although clinician-patient discussions about LCS do not appear to increase motivation to quit smoking. (Golden et al., 2020a) Common motivators to quit include encouragement from a spouse, health conditions, social pressures, and quality of life. (West et al., 2018; Ockene et al., 2000; Faseru et al., 2013; Vangeli et al., 2011; Zhou et al., 2009; Dorner et al., 2011; Borland et al., 2012; How to Quit Smoking. American Lung Association, 2020) Relatively brief clinician patient counseling (e.g. 3 min) that includes discussion of motivations as well as motivational interviewing can improve outcomes in a smoking cessation attempt. (Tobacco Use and Dependence Guideline Panel. Treating Tobacco Use and Dependence, 2008; Lindson-Hawley et al., 2015).

In large clinical trials of LCS, discussion of LCS or receipt of an LDCT was not associated with smoking cessation, (Slatore et al., 2014) although some studies found that receiving LDCT results resulted in cessation or increased readiness to quit (Poghosyan et al., 2012; Pineiro et al., 2016). Importantly, patients with positive LDCT results (i.e., an abnormal finding, like a nodule) had higher abstinence rates than those with negative scan results. This suggested that the time during which a patient is informed of LDCT results may be a “teachable moment” for smoking cessation. (Slatore et al., 2014) A teachable moment is, “a naturally occurring life transition or health event thought to motivate individuals to spontaneously adopt risk-reducing behaviors.” (McBride et al., 2003) A teachable moment requires a cueing event that spurs discussion and thought about how to reduce risky behaviors. We previously found that the initial LCS decision-making interaction does not appear to be, by itself, a teachable moment<sup>13</sup>. We describe a large, multi-site, longitudinal investigation—first, to our knowledge—to determine whether teachable moments for smoking cessation occur downstream from the initial LCS decision-making interaction. We also investigated patient experiences with smoking cessation and recommendations for improving cessation rates within LCS.

## 2. Methods

We evaluated qualitative data on the experiences of individuals who formerly or currently smoked and underwent LCS shared decision-making discussions during routine care from three US medical center LCS programs: VA Portland Health Care System (VAPORHCS), Portland, OR; Minneapolis VA Medical Center, Minneapolis, MN; and Duke University Medical Center, Durham, NC. All participants completed the informed consent process using IRB-approved documents (VAPORHCS #3482; Minneapolis VA #4645-B; Duke #Pro00073394). We performed the interviews herein between May 2016 and September 2019.

### 2.1. Subjects

We enrolled patients who were eligible for LCS based on their local institution’s criteria, which were similar to USPSTF 2013 eligibility criteria (i.e., aged 55–80 with a 30 pack-year smoking history and currently smoke or have quit within the past 15 years). (Moyer, n.d.) We briefly describe the methods here as we have previously published a detailed version. (Miranda et al., 2017) We limited enrollees to English speakers. We included patients regardless of whether they agreed or declined to undergo the LDCT and whether they currently or formerly smoked. We chose to include those who formerly smoked since a previous study showed that patients may think of undergoing an LDCT as a “green light” to continue to smoke. (Zeliadt et al., 2015) Additionally, the risk of recidivism among adults who were abstinent for 12 months or less has been shown to be over 50 % and was still 10 % after abstinence of 30 years. (García-Rodríguez et al., 2013) We believed it was important to include people who formerly smoked to see if they re-started or had thoughts about their smoking behaviors. Given our hypothesis that patients found to have lung nodules on LDCT may be at risk of distress, we oversampled 10 patients known to have positive LDCT results, recruited after the initial subjects were enrolled. We interviewed

patients up to three times over the course of one year; only the second and third interviews are used herein (baseline interview results have been published previously). (Golden et al., 2020a; Golden et al., 2020b) These interviews occurred 2–4 weeks post-LDCT for those who accepted the LDCT and 4 weeks after the decision-making discussion for those who did not accept (referred to as 1-month follow-up). The final interviews occurred 12 months after the decision-making discussion regardless of the actual decision (referred to as 12-month follow-up). The interview schedule was the same for those who were oversampled due to positive results. We wanted to interview those who accepted the LDCT scan as close to their receipt of results as possible, which we felt would be 2 weeks to give time for notification. We felt 4 weeks would be the maximum amount of time the patient would receive the results; to be systematic we chose 4 weeks for those who declined as well.

Most patients enrolled at the Duke study site were seen at a specialized smoking cessation clinic after the an initial referral to an LCS coordinator during a routine encounter. Consequently, all patients were currently smoking and exposed to cessation resources differently. Their initial decision-making discussions and their subsequent results notifications occurred at the cessation clinic with a trained smoking cessation counselor (who was also the LCS coordinator).

### 2.2. Analysis

We conducted in-person and telephone interviews using a semi-structured interview guide that remained the same during each interview (Supplement 1). We used probes with participants as much as possible. Questions focused on LCS-related encounters and thoughts after receipt of the LDCT for those who accepted the scan, and thoughts after time had passed for those who declined. The principal investigator was a pulmonologist involved in directing LCS at one of the sites as well as in assisting with smoking cessation, so we had impartial investigators lead the interview (SEG and SSO) and analytic process (SEG, SSO, and LS) to mitigate bias. We digitally recorded and transcribed the interviews, removing identifiers during transcription. Participants are identified by “ID- site,” where D = Duke, P = Portland, and M = Minneapolis.

Interviews focused on communication about smoking, reasons to quit or continue smoking, and recommendations to improve smoking status after the initial LCS decision-making interaction. We achieved saturation of the main themes. (Patton, 2002; Pope et al., 2006) Participants self-reported demographic and smoking characteristics prior to the first interview, and any changes in smoking characteristics prior to each subsequent interview.

We used ATLAS.ti 9.0 (ATLAS.ti GmbH, Berlin, Germany) to organize and support conventional content analysis of the qualitative data. Three qualitative analysts (SEG, SSO, and LS) reviewed data, created preliminary codebooks, and iteratively refined the codebook and coding throughout. We evaluated any overlapping coding or un-coded text to verify appropriateness. We developed initial and integrative memos throughout to capture thoughts or analytic ideas and created a matrix of findings, which aided in the final interpretation of the data through identifying patterns and variations in the transcripts. We utilized an audit trail for tracking of modifications and decisions related to the codebook and analytic process.

## 3. Results

We interviewed 39 participants for a total of 61 follow-up interviews; 32 one month after the decision-making interaction (including those with nodules who were recruited later), and 29 participants 12 months after (patients missed visits due to inability to contact). At their final interview, 26 patients reported currently smoking cigarettes and 3 had quit smoking compared to baseline (Table 1). In opinions of communication and smoking behaviors, there were no differences over time,

**Table 1**  
Self-reported Patient Characteristics, n = 39, 61 interviews.

Characteristic	N (%) <sup>a</sup> Or Mean (SD)
Accepted Screening	32 (82 %)
Treatment location, n (%)	16
VA Portland Health Care System	(41 %) <sup>14</sup>
VA Minneapolis	(36 %) <sup>9</sup>
Duke University	(23 %)
Age (yr.)	63 (5.8)
Gender	31
Male	(80 %)
Race/ethnicity, n (%)	31
White	(79 %) <sup>4</sup>
Black/African American	(11 %) <sup>1</sup>
American Indian/Alaska Native	(2 %) <sup>2</sup>
Hispanic	(5 %) <sup>1</sup>
Refused	(2 %)
Marital Status	15
Married	(38 %) <sup>24</sup>
Not Married	(62 %)
Smoking Status at Baseline:	23
Current Smoker	(59 %) <sup>16</sup>
Former Smoker	(41 %)
Change in Smoking Status from Baseline at Last Follow Up Visit	7
<b>Accepted LCS</b>	(18 %) <sup>2</sup>
Still not Smoking	(5 %) <sup>10</sup>
Quit	(26 %) <sup>10</sup>
Cut Down	(26 %) <sup>2</sup>
No Change	(5 %) <sup>1</sup>
Increased	(3 %)
Relapsed	
<b>Declined LCS</b>	4
Still not smoking	(10 %)
Quit	0
Cut Down	0
No Change	3 (8 %)
Increased	0
Electronic Cigarettes	2 (5 %)
Number Cigarettes Per Day	9
1-10	(23 %) <sup>7</sup>
11-20	(18 %) <sup>2</sup>
21-30	(5 %) <sup>1</sup>
>31	(3 %) <sup>7</sup>
Unknown	(18 %)
Pack-years	61 (21.8)
Education, n (%)	14
High school or less	(36 %) <sup>20</sup>
Some college or vocational work	(51 %) <sup>5</sup>
College graduate or more	(13 %)
Employment status, n (%)	24
Retired, disabled, and/or currently not working	(62 %) <sup>15</sup>
Employed (full time, part time, and/or irregular work)	(38 %)

**Table 1 (continued)**

Characteristic	N (%) <sup>a</sup> Or Mean (SD)
Income, n (%)	25
\$60,000 or more	(64 %)
Comorbidities (self-reported), n (%) <sup>**</sup>	11
Chronic Obstructive Pulmonary Disease (COPD)	(28 %) <sup>12</sup>
Depression	(31 %) <sup>10</sup>
Posttraumatic Stress Disorder (PTSD)	(26 %) <sup>2</sup>
Asthma	(5 %)
Pulmonary Nodules	16 (41 %)

<sup>a</sup> Percent's are of non-missing data.

<sup>\*\*</sup> Patients had the option of choosing more than one comorbidity.

between sites, based on accepting or declining the LDCT, or within those found to have pulmonary nodules except as noted below. Overall, we found three main themes: influence of LCS and LDCT results; influence of other factors relating to smoking behaviors; and recommendations to improve smoking cessation within LCS processes. We provide additional illustrative quotes for each section in [Table 2](#).

### 3.1. Influence of LCS and LDCT result

Patients reported being appreciative of clinicians asking them about smoking and offering assistance at LCS-related encounters after the LCS shared decision-making discussion ([Table 2](#) quotes 1–3), however mainly only patients from Duke reported that their clinician verbally discussed smoking while providing results of the LDCT or discussing LCS. The majority of the results were provided by letter since the majority of participants were from VA sites. While some letters included a message about smoking behaviors (Supplement 2), most patients did not recall or mention that part of the letter. Participants who discussed the LDCT result in-person (at Duke) or recalled reading the part of the letter about smoking said the messages regarding smoking cessation (such as the importance of cessation or the Quitline number) were appreciated but already known (quote 4). A handful of patients found that mentioning smoking with the LDCT results was a helpful motivation or as providing them with some “peace of mind while working towards quitting” (3-P and quotes 5–6). One patient said that combining a discussion of smoking cessation with LDCT results made them, “more determined to stay healthy and get healthier as far as the lungs go” (10-P). Another said:

*“When I got the [LDCT] report back, the last sentence in that said: It’s never too late to quit. And that just automatically stuck with me because I wanted to quit in the first place! So it’s just helping me along. I never thought about, “my lungs are good I don’t need to quit I can just keep on smoking.””* (2-P).

Nevertheless, the majority reported the LDCT results had no influence on their motivation to quit smoking (quote 7). A typical response was, “[getting the results] hasn’t changed...my attitude towards quitting smoking” (1-M and quotes 2–3). Patients with pulmonary nodules did not report a difference in wanting to quit, possibly because they also reported very little (or no) distress related to the finding, similar to patients without nodule findings (quote 8). One patient explained when asked why they did not feel distress regarding the nodule, “In all of my dealings with Dr. [name] down there, he’s been honest and I’ve been able to ask him any questions I want. And if I don’t understand he takes time to explain it...” (1-M). Only two patients with nodules mentioned that if the nodule grew, their views might change, saying, “[only if the nodule] spread, or it got worst... then I’ll have to quit [smoking].” (2-P). We asked participants, “how does this finding make you think about your smoking and health” with probes for screening as a substitute for cessation (i.e., “providing a license to smoke”) and all reported that

**Table 2**  
Selected illustrative quotes.

Quote #	Participant ID- Site	Smoking Status at Last Interview	Quote
<b>INFLUENCE OF LCS AND LDCT RESULT</b>			
1	2- P	Decreased	Anytime you can convince a person to quit smoking for whatever the reason I think it's great. And the more information you have the better off you'll be about making that decision.
2	3- D	Still not smoking	I feel that [doctors are] concerned. And they want me to listen to what they are saying about what can happen to me if I keep doing it. You know, I love advice. And sometimes it takes me a minute to heed to it, but this one... smoking was the worst.
3	7- P	Still smoking	[The doctor]'s giving you options as to you could do this, he says you don't have to follow my instructions, but I advise you to. That's about what he's saying.
4	2- P	Still not smoking since visit 2	I know that I shouldn't smoke, and I guess if, at this particularly point in my time at 67 years old they're going to have to tell me there's a problem before I quit smoking. And that's a shame. I'm honestly ashamed; I shouldn't be that way.
5	2- P	Still not smoking since visit 2	When I got the report back, the last sentence in that said: It's never too late to quit. And that just automatically stuck with me because I wanted to quit in the first place.
6	5- D	Increased	[LCS] does [influence me to want to quit more], but I'll tell ya', the addiction to nicotine for me seems to be so strong, that it wins out.
7	6- P	Still smoking	I smoked from basically birth, cause all of my- my mom, my dad, everybody, every car, every house we were in they all reeked of smoke. So that's why I thought my odds were... not good! But I still wanted to quit.
8	5- P	Still smoking	Well I know I wanna quit smoking but [the nodule] didn't freak me out so bad that I was like 'oh God this [unintelligible] me from smoking' or what,' you know.
<b>INFLUENCE OF EXTERNAL FACTORS</b>			
9	7- P	Still smoking	It's a personal choice. That person has to make the decision. You give them the options and then they have to make the decision.
10	9- P	Still not smoking	It's an addiction, it's imprinted into my brain. I quit for 20 years and even in the 20 years I still thought about it.
11	1- M	Still smoking	[Smoking was] something to do, so smoking lamps lit, yep. 'We're going to take a break here, so you guys can take a light up here if you want to.' And that was the culture [in the military].
12	8- P	Decreased	I quit successfully a couple times, but then- one time for almost 3 years and then another time I quit for about 9 months. And various stressors, circumstances, you know... it was easy to fall back on

**Table 2 (continued)**

Quote #	Participant ID- Site	Smoking Status at Last Interview	Quote
13	3- M	Still not smoking	something that gave me a little bit of comfort. It's just a habit. One day the light bulb will turn on again. Whether I get sick from pneumonia or just decide that that it's, I've had enough, you know. 10,000, 100,000, how many cigarettes have I smoked?... the desire will go down with regards to, you know, the habit of putting something in my mouth. I really shouldn't have smoked again, but I did, and, it was almost like a dare, will I enjoy it? It's like I never quit smoking.
14	12- D	Still not smoking	The accomplishment, the joy of the accomplishment of something that I attempted to do so many times in the past and was not able to do or did not do. So, the joy of having done it is what keeps me going. That I did it... I think prayer had a lot to do with it.
15	3- P	Still not smoking	... you don't smell like an ash tray. [laughs]. And then you really don't want to be around people that don't smoke when you're smoking... people who don't smoke don't want to be around you because you're a smoker. It just works that way. Everything cleans up in your life, and it becomes more pleasant.
16	6- P	Still smoking	That was the number one reason I wanted to quit. When I'm around my grandkids or around my friends, or whatever, you know? I'm not risking their health.
17	8- M	Relapsed	When I wake up in the morning I gotta cough up phlegm and clear my lungs. I don't know of other people who are my age that do that very actively. [laughs] It's kind of not part of their morning routine to cough a lot. And that's directly attributable to smoking.
18	3- P	Still not smoking	A lot of reinforcement came from the, from the display of a, of pictures in [hospital], where they have pictures of a healthy heart and a heart that's been smoking for years, and it's like really dirty, it's nasty. It's really bad. And those kinds of things really, really made me aware that, 'hey, maybe I need to quit because it's gonna happen to me eventually, and I don't wanna, I don't wanna go that way.'
19	3- M	Decreased	... [my wife] gave me encouragement and was happy when I did quit. And I think she believed me too when I told her I was done smoking, but she was disappointed, as were some of my friends that had encouraged me to quit and I told them the same thing, happy to tell you I quit smoking, well... And then, I'm sorry to tell ya I started back up
20	3- P	Still not smoking	And then when it started getting physical [wheeze] then it really made me realize and say, 'wait a minute I really need to leave this stuff alone.'
21	10- P	Still smoking	

(continued on next page)

Table 2 (continued)

Quote #	Participant ID- Site	Smoking Status at Last Interview	Quote
22	1- P	Still smoking	There were a couple of days we went down to the coast, there were some relatives and stuff, so I wore the patch and I was okay with it. I have shortness of breath and that just warns me in my own mind that, man, how much more energy would I have if I wasn't smoking? ... Because everybody's got that uncle, you know, that lived to be 95 and did that shit and, so everybody has those same feelings well, I'm better than him... shit. I don't believe the guy exists.
23	14- P	Still smoking	I want to take the same route as a lady I know who just woke up one morning and said, 'that's it, I quit'. And she did. I would love to be able to do that, but right now I don't think I'm capable.
24	7- P	Still smoking	Maybe once or twice a month, still [I have cravings]. I mean most of the time I can just kind of blow it off. But if I see a friend of mine smoking or smell smoke, sometimes I go, 'mmm that would be good right now'
25	13- M	Still not smoking	It really wasn't that hard [to quit] because I didn't ever quit. To this day I haven't quit, I just tell myself I don't want one right now... I'm not gonna put that extra pressure on me saying I quit.
26	1- M	Still smoking	Even if there was something, 'you got cancer', fine. Give me a timeline. I'm still gonna smoke. You know, put a pack in the box with me when they pack me up.
RECOMMENDATIONS			
27	1- P	Still smoking	And just, that was the deal. But the doctor said, 'you have to quit smoking'. How many times has the doctor actually sat down with the patient and said, you know, 'Look. I know you've heard in the past, but you absolutely positively have to quit smokin'. Okay..... it's all in how you say it, you know? 'You know you oughta quit smoking, right?' 'Yeah'. 'Okay'. As opposed to, 'You have to quit smoking'. That's a different conversation all together. Different tone of voice, different level of seriousness.
28	1- P	Still smoking	Get the guy to admit that he's powerless over cigarettes and that cigarettes have made his life unmanageable? Okay well let's talk about that.
29	1- M	Still smoking	And if you can go to them with data, you know, over a couple years study. And say, this, 'hey, this is the odds. This is what the numbers are now if you do or don't.' And then, they have more information to make a decision.
30	10- D	Still not smoking	[The CO monitor] gave me something to improve on; I could see a change, even before I'd actually quit, just reducing how much I smoke up until the time I quit, that number kept coming down.

neither negative nor positive LDCT results had an impact on their desire to quit or not. Of note, even those who declined the LDCT reported no impact on desire to quit based on the LCS discussion or decision to decline.

### 3.2. Influence of external factors on smoking behaviors

All patients reported that their decisions to quit smoking must be individual and that they would quit when they were personally ready. The LDCT results did not appear to make as large of an impact as other factors on motivation to quit smoking. For example, when asked if the LDCT results influenced smoking behaviors, one patient said, "My thought process is about quitting smoking has been there for the last couple of years, and I don't know if there's anything you can do or say that's going to change that; it's a decision that I have to make" (2-P and quote 9). Stress was the main reason reported for continuing to smoke or relapsing. Participants reported several factors that motivated them to continue smoke or made it hard to quit, including the enjoyment smoking provides, the addiction, and the physical habit (quotes 10–12). One patient said simply, "I enjoy smoking and I'm gonna continue" (4-P). Another described cigarettes and their use as such:

*"[Cigarettes are] an incestuous drug... wicked. I use cigarettes to dull my hunger when I'm hungry and I can't eat. I use cigarettes to sharpen my appetite just so I can eat. And I use them to help me with my digestion after I'm done. I use cigarettes as a clock: if I have something on the stove and it takes 6 min I say, "Oh okay I'll smoke a cigarette". I'll use the cigarette as a reward for an activity that I accomplished. I'll use the cigarette to wake up, I'll use the cigarette to help me sleep."* (1-P).

Many participants described previous quit attempts, and many described being successful for years before relapsing (quotes 13–14). Reasons for wanting to quit, or quitting previously for those who formerly smoked, were mainly related to health concerns or family encouragement (quotes 15–21). All participants talked about the difficulties in quitting, including resources that did or did not work for them in the past (quotes 22–26). One participant mentioned:

*"[Experts] say the most effective way to quit smoking is just quit smoking! And so they have Chantix now, which I've used, and my problem with Chantix is that when I get on it it completely eradicates my urge to or my need to have a cigarette, but it doesn't address the psychological aspects of smoking, the other behaviors that are affiliated with it, the habits. Then what happens is that a habit cannot be eliminated, a habit can only be replaced: you replace bad habits with good habits and good habits with bad habits."* (1-P).

Prior failed quit attempts were explained as reasons for feeling reluctant to try again or take clinicians up on offers to help, although patients from Duke who were recruited from the smoking cessation clinic were more inclined to use resources and report optimism about the ability to quit.

### 3.3. Recommendations to improve smoking cessation within LCS

While the minority of participants described receiving the LDCT results as a unique moment to help them quit smoking, patients did describe some recommendations for how to improve smoking cessation efforts during LCS processes. All participants agreed that integrating smoking cessation within all LCS visits makes sense. One participant commented:

*"Stopping smoking is very, very hard for everybody, I don't care who you are. It's all a mental game. Lung cancer screening is a good thing, cause it's making sure you didn't hurt yourself when you did that stupid stuff. So, I mean, together they work well!"* (7-P).

Furthermore, most agreed that clinicians should ask about smoking at each clinical encounter regardless of the clinical reason for the visit. As one patient said, "... it's nice having people inquiring about your smoking progress [at each visit] 'cause I think it's beneficial" (3- M and quotes 27–28). Another said, "[The doctor is] one of those individuals

that, you know, that's part of his job to try to get you to quit, and it's part of my job to tell him, 'hell no!'" (4-P) Several of those same patients commented that clinicians asking about smoking would not be (or would not have been) helpful for them because quitting is, "a state of mind" (3-P).

Participants suggested providing comparisons of the benefits of the LDCT with the benefits of quitting smoking to give a clear contrast. Patients also mentioned clinicians helping them identify triggers or other motivators for improved smoking behaviors (e.g., family members, health concerns, etc.) (quotes 29–30). Some patients recommended having a mental health provider or other counselor speak with patients about smoking after the LDCT results rather than a primary care provider to see "different ways to look at the problem and make a recovery plan" (1-P).

A few patients noted irritation with the lack of more intensive resources for smoking cessation such as group counseling or other in-person classes. One patient explained:

*"I don't think that as a society, that we give much credence, to the cigarette addict that we do to the alcohol addict, the narcotic addict. I mean, they have meetings you can go to. Because, cigarettes can't be acknowledged as being like that. ... if there was [a meeting like that], it would probably make it easier for people who want to quit smoking. Because then they can go to these groups, and they can rage, and so forth and so on."* (1-P).

Another said support groups would be beneficial since then patients could "understand other people's struggles" (5-D). Patients from the Duke smoking cessation clinic reported they would recommend their clinic to their friends or family who smoke since it was helpful to have more follow-up.

#### 4. Discussion

We found that LCS and LDCT results communications after the initial LCS shared decision-making interaction do not appear to be teachable moments for improving smoking behaviors for most patients. The majority of those who did remember hearing about the importance of smoking cessation did not report communication about smoking influencing their motivation to quit or abstain from smoking, including participants with pulmonary nodules. In contrast to one previous study that concluded some patients perceive negative LDCT results as a "license to smoke," participants in our study denied this belief. (Zeliadt et al., 2015) Participants reported that there were more significant reasons for quitting or abstaining from smoking and that it was a personal decision that often resulted in failed attempts. They provided recommendations for improvement.

LCS discussions themselves may not be teachable moments for smoking cessation, (Kathuria et al., 2020) however some evidence has shown the opposite among patients who were very worried about the risk of lung cancer. Notably, the results from this study and another were from randomized control trials for smoking cessation among patients who all underwent the LDCT, indicating that those who enrolled were already more apt to change behaviors. (Williams et al., 2022; Taylor et al., 2007) Our group and others have found that the initial LCS decision-making interaction is not a teachable moment leading to improved smoking behaviors for many patients. (Golden et al., 2020a; Kathuria et al., 2020; Park et al., 2014) We previously identified three possible mechanisms to explain this finding: 1) Patients are not able to spontaneously recognize LCS discussions as a cueing event; 2) LCS discussions do not cause a strong enough negative emotional response since a) patients do not seem to be strongly bothered by their risk of lung cancer and/or b) they do not feel any distress from stigma towards them as individuals who actively smoke; or 3) since patients already know that cigarette smoke causes lung cancer, clinicians may not use LCS to reframe as a cueing event. It could also be a combination of these reasons or different reasons altogether. Since smoking abstinence resources were mentioned with the LDCT results as a form of communication, we posit that numbers 2 or 3 above may be the most important reasons why a

teachable moment is not occurring during LCS.

Patients did not report a negative emotional response when diagnosed with a pulmonary nodule. Despite some studies finding that patients highly overestimate their risk of lung cancer, (Freiman et al., 2016; Slatore et al., 2015) patients in our study did not mention cancer risk as strongly influencing their thoughts on smoking, which matches previous work finding that lack of knowledge about cancer risk was not associated with a negative emotional response. (Slatore and Wiener, 2018) Interestingly, one study found that higher perceived risk was associated with less readiness to quit smoking, going against the teachable moment conceptual model. (Williams et al., 2022) Patients seemed to understand that the likelihood of the nodule being cancerous was very low. (Golden et al., 2020a; Balata et al., 2020) It could be that other health-related findings could be more influential. For instance, in a study of a community based LCS program in England, participants were assessed for respiratory symptoms, lung cancer risk, and spirometry. After one year, there was a 10.2 % self-reported smoking abstinence rate and quit attempts were associated with baseline symptoms, but not screening results. A survey of participants showed that 55 % of those who quit attributed quitting to the assessment and 44 % of all participants who smoked said the assessment made them consider stopping. (Balata et al., 2020) Another study showed that increased respiratory symptom burden in those with and at risk of COPD was associated with higher intentions to quit. (Melzer et al., 2016) Possibly incorporating other assessments of health or information on lung cancer fatality rates in addition to the LDCT results would create enough emotional response to trigger a teachable moment to improve smoking behaviors.

Our participants did have suggestions for improvement. For instance, one benefit of LCS is the annual nature of the LDCT, which gives clinicians longitudinal opportunities to build relationships with patients. Indeed, repeated offerings of cessation support has been shown to increase positive smoking outcomes (Maciosek et al., 2017; Bailey et al., 2018). At each visit, clinicians can connect people to more or newer resources, ask patients directly about triggers or motivators besides health-related issues that influence smoking behaviors, or refer patients to mental health providers or outside groups using evidence-based practices, as desired. Cessation is cessation whenever and wherever it happens, so does not need to be during LCS discussions, although LCS does provide an opportunity. There is room for improving integration of tobacco treatment into LCS, related to some of the patient suggestions. For instance, possibly providing outreach from a cessation counselor after results are delivered as a support to primary care. In modeling studies, several interventions that included counseling and/or pharmacotherapy during LCS were shown to be cost effective, and decreased lung cancer cases and deaths. (Cadham et al., 2021; Tramontano and Sheehan, 2016).

Our current findings mirror previous findings that participation in the LCS process was not a teachable moment. (Jensen et al., 2015) Our findings differ, however, in that we did not find that the presence of pulmonary nodules leads patients to report an increased motivation to quit smoking, as found in a systematic review. (Slatore et al., 2014) One reason for these differences may be that the systematic review relied on clinical trial data. Participation in clinical trials typically includes more intensive communication and the participants enrolled can be different from those participating in observational studies like ours, and from those who do not participate in research studies of any kind. It is also possible that the information provided about nodules in our study was presented as less risky than those presented in clinical trials.

There are limitations. While the inclusion of multiple sites increases the generalizability of the study, most of the cohort were Veterans, however non-Veterans who smoke and are eligible for LCS likely have similar disadvantaged socioeconomic characteristics. (Kinsinger et al., 2017; Elshatarat et al., 2016) Workflow differences at each site may increase generalizability, but may also introduce bias since Duke participants all currently smoked. It is possible that results might suffer from sampling, moderator acceptance, and recall biases. Timing of data

collection may not capture all feelings and attitudes since each interview captures just one snapshot in time; however, the longitudinal design of this study helps compensate for this limitation. Finally, including participants who formerly smoked may bias our sample since smoking cessation discussions would not apply to them. However, we thought it was important to include them since they may re-start or have differing thoughts on smoking behaviors.

## 5. Conclusion

We provide longitudinal findings that communication about LCS and LDCT results do not appear to be teachable moments for improving smoking behaviors for most patients. Our findings suggest that clinicians can continue to ask about smoking at every encounter and provide comparisons of the benefits of the LDCT with the benefits of smoking cessation or abstinence. There may be other teachable moments outside of LCS processes that can be utilized for improving smoking behaviors, or LCS-related encounters could be used to ask about external motivations for quitting beyond LCS.

## CRedit authorship contribution statement

**Sara E. Golden:** Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft. **Liana Schweiger:** Formal analysis, Validation, Writing – review & editing. **Anne C Melzer:** Conceptualization, Resources, Validation, Writing – review & editing. **Sarah S. Ono:** Methodology, Supervision, Writing – review & editing. **Santanu Datta:** Resources, Writing – review & editing. **James M. Davis:** Project administration, Resources, Writing – review & editing. **Christopher G. Slatore:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Validation, Writing – original draft.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2022.102014>.

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