Randomized Electronic Promotion of Lung Cancer Screening: A Pilot

abstract

Purpose Screening for lung cancer with low-dose computed tomography is endorsed by the US Preventive Services Task Force, but many eligible patients have yet to be offered screening. Major barriers to the implementation of screening are physician and system related—the requirement for a detailed smoking history, including pack-years, to determine eligibility. We conducted this pilot to determine the feasibility of lung cancer screening (LCS) promotion that would offer screening to eligible persons and patient completion of smoking history to estimate the size of the population of former smokers who may be eligible for LCS in a single health care system.

Patients and Methods Two hundred participants were randomly selected from former smokers who were seen at the University of Minnesota Health in the past 2 years and assigned to control (usual care) and electronic promotion, stratified by age. Electronic messages to promote LCS were sent to an intervention group, including a link to complete a detailed smoking history in the electronic health record.

Results Of 99 participants, 66 (67%) in the intervention group read the message, 24 (36%) of 66 responded, and 19 (79%) of 24 respondents completed the smoking history. Ten intervention participants and 13 usual care participants were eligible for screening on the basis of pack-year history. Four eligible participants underwent screening in the intervention group compared with one participant in the usual care group.

Conclusion Electronic promotion may help identify patients who are eligible for LCS but will not reliably reach all patients because of low response rates. In this sample of former smokers, the majority are ineligible for LCS on the basis of pack-year history. Electronic methods can improve documentation of smoking history.

Clin Cancer Inform. © 2017 by American Society of Clinical Oncology

Abbie L. Begnaud
Anne M. Joseph
Bruce R. Lindgren

All authors: University of Minnesota, Minneapolis, MN.

Supported by Clinical and Translational Science Award program Grant No. UL1TR000114.

Presented at the 2016 CHEST Annual Meeting, Los Angeles, CA, October 22-26, 2016.

Corresponding author: Abbie L. Begnaud, MD, University of Minnesota, 420 Delaware St SE, MMC 276, Minneapolis, MN 55455; e-mail: abegnaud@umn.edu.

INTRODUCTION

Five years after the publication of the National Lung Screening Trial, implementation of lung cancer screening (LCS) remains a challenge for health care systems. Dugan and Cohen¹⁻⁴ have noted barriers to the implementation of new health care services at the level of the patient, physician, and practice organization. Unlike many screening services, which are offered on the basis of age and/or sex, LCS eligibility is also based on smoking history details. In addition to age criteria (age 55 to 80 years), eligible persons must have smoked for at least 30 pack-years, or the equivalent of one package of cigarettes each day for 30 years. In addition, former smokers must have quit less than 15 years before screening. The electronic health record (EHR) has limitations in identifying all those who are eligible for LCS.^{2,3} Of importance, although the smoking status—current, former, or never—is generally indicated in the EHR, details that are required to calculate pack-years are

frequently absent. Determining screening eligibility among former smokers is particularly challenging because quit date is also frequently absent. A recent study demonstrated a 96.2% discordance between patient report and the EHR record of smoking history.⁵ Furthermore, the EHR underreported smoking history such that 54% of patients would have been erroneously deemed ineligible if using the EHR alone.

Many patients use an electronic patient portal in the EHR for different health care needs, including communication and preventive care reminders.⁶ In fact, screening uptake is improved when patients are directly contacted—using electronic or paper mailing—for screening promotion.⁷⁻⁹ Patient-directed, health-related surveys have demonstrated better response rates than surveys of any format to other groups, such as health care providers.¹⁰ Recent studies have also shown that electronic options have a higher yield than paper.^{7,11} Some reports suggest that younger patients are more likely to

interact with the EHR portal than older patients¹²; however, this is not uniformly observed.^{6,13}

We are interested in whether the electronic patient portal can be used to promote LCS to possibly eligible persons. The objectives of this study, among former smokers, were to test the effect of targeted electronic messages to promote LCS,¹ test the feasibility of electronically collecting a complete smoking history,² and assess LCS completion rates among those who received electronic promotion messages compared with usual care.³ We also considered the potential for electronic smoking history completion to estimate the proportion of eligible persons in our health care system.

PATIENTS AND METHODS

Patient Selection

Eligible patients were former smokers who were seen in primary care or pulmonary clinics at the University of Minnesota within the past 2 years. All patients age 55 to 79 years who were active in the EHR patient portal were identified. We excluded Medicare patients, as reimbursement requires face-to-face visit; current smokers, because they should have smoking cessation assistance concurrently with LCS; patients who had already had LCS; and patients being treated for lung cancer. A population of 642 patients met inclusion criteria, and 200 patients were randomly selected (Fig 1). Sample size was determined using NCSS Statistical Software (Kaysville, UT) on the basis of a two-sided z-test with pooled variance for two independent proportions. A 20% difference in primary outcome—LCS completion—was predetermined to be clinically meaningful and warranted additional consideration of this intervention.

Patients were randomly assigned in block sizes of four and eight to electronic promotion of LCS or usual care, and stratified by age (55 to 65 years or 66 to 79 years) on the basis of the distribution of age groups observed in our clinic population.

Electronic Promotion of LCS

Participants who were randomly assigned to electronic promotion were sent messages in the patient portal that informed them of their potential eligibility for a new preventive health care service. The message included a questionnaire that was linked to their smoking history in the EHR, which could be reviewed and modified by the patients. The letter instructed recipients to determine the number of years of smoking on the basis of the age at which daily smoking started and stopped, and to estimate the number of packs of cigarettes smoked each day for the time they were a smoker.

To avoid influencing responses, the letter did not include eligibility criteria for LCS. All respondents were sent a follow-up portal message to indicate eligibility for LCS and to inform them of the risks and benefits of screening. If eligible, an order for LCS was placed in the chart and the patient was provided imaging scheduling information. The initial electronic messages were all sent on January 1, 2016. If a patient failed to read the message after 30 days, a duplicate electronic message was sent. Patients who failed to read the second message were sent a letter via the US Postal Service with the same information.

Usual Care

Participants in the usual care group did not receive electronic messages. Neither smoking history completion nor LCS were offered to them or their primary care providers. If the patients or primary care providers considered LCS, it would have been ordered via the EHR and scheduled as any other imaging test might be.

Data Collection

The following data were collected in the electronic promotion group: number of participants who read the electronic message, number who responded to the message, number who completed smoking history, number who were eligible for screening by self-reported smoking history, and number of screening examinations completed. For each patient, we noted whether smoking history had previously been completed by a member of the health care team or was incomplete. Only prior completion, not the actual history values, was noted. We also recorded the presence of recent diagnostic chest computed tomography scan and time since and type of last encounter. In the usual care group, chart review was performed to determine smoking history and whether LCS was completed.

Primary outcome was the proportion of patients who underwent LCS within 6 months of study enrollment. Secondary measures were the proportion of respondents in the electronic message group and proportion of patients who were eligible for screening. We estimated the proportion of former smokers who were eligible for screening on the basis of available smoking history, determined after the intervention.

Statistical analysis included the Wilcoxon rank sum test for quantitative characteristics and Fisher's exact test for categorical items. *P* values < .05 were considered statistically significant. We calculated that a sample size of 100 patients per group would have 80% power to detect a 20% difference between groups in the proportion of patients who completed LCS within 6 months (primary outcome).

Fig 1. CONSORT diagram. LCS, lung cancer screening.

This study was exempted from review by the University of Minnesota Twin Cities institutional review board and approved by the directors of the clinics that were included.

RESULTS

Three patients were randomly assigned to electronic promotion but did not receive intervention because they were patients of the principal investigator (A.L.B.) and were known to be ineligible for LCS. Baseline participant characteristics were similar between groups (Table 1). Two thirds of participants in the electronic promotion group read the message (66 of 99) and 36% of those responded (24 of 66). Most respondents (19 of 24) completed smoking history information using the hyperlink to the questionnaire to directly update smoking history in the EHR. Ten participants in the electronic promotion group and 13 participants in the usual care group were eligible for screening on the basis of EHR smoking history, as determined after intervention (Table 2); however, five participants in the electronic promotion group had a recent diagnostic computed tomography scan for another reason and, therefore, did not receive an order for low-dose computed tomography screening exam. Four eligible participants underwent screening in the intervention group compared with one participant in the usual care group.

Less than one half of patients (44%) had complete smoking history in the EHR history section before this pilot study. Most participants who used the smoking history EHR questionnaire (16 of 19) were not eligible for screening. After intervention, 18 participants in the electronic promotion group and 26 in the control group had insufficient smoking history to determine eligibility for LCS. Some incomplete smoking histories were sufficient to preclude eligibility for screening on the basis of remote quit date (ie, they had quit > 15 years ago, but had incomplete pack-years history). Similarly, some smoking histories were complete without patients filing the EHR history questionnaire, which permitted the confirmation of eligibility (ie, a current one-pack-per-day smoker who started 30 years ago).

There was no significant difference in age between participants who read or responded to messages and those who did not. Those who read messages had a longer median time since last encounter compared with those who did not read the message (1.8 years v 1.5 years; $P = .033$).

DISCUSSION

In this sample of former smokers who were in the age range of those eligible for LCS, the majority of recipients read an electronic message but did not respond to the message. Most respondents successfully updated their EHR smoking history using a hyperlink to their chart. We estimated that

Table 1. Baseline Participant Characteristics

Characteristic	Electronic Promotion (n = 99)	Usual Care (n = 101)	P
Median age, years (min/max)	62.0 (55.0/79.0)	62.0 (55.0/79.0)	.613
Median time since last encounter, years (min/max)	1.7 (0.2/2.2)	1.8 (0.3/2.2)	.217
Sex, No. (%)			.201
Female	50 (50.5)	41 (40.6)	
Male	49 (49.5)	60 (59.4)	
Encounter type, No. (%)			.322
Office visit (face-to-face)	53 (53.5)	46 (45.5)	
Other (telephone, administrative)	46 (46.5)	55 (54.5)	
Smoking history adequate to determine eligibility,* No. (%)			.355
No	54 (54.6)	57 (56.4)	
Yes	43 (43.4)	44 (43.6)	
Unknown	2 (2.0)	0 (0)	
Eligible for LCS*			.239
Before intervention	7 of 99	13 of 101	

Abbreviations: EHR, electronic health record; LCS, lung cancer screening; max, maximum; min, minimum.

*On the basis of smoking history available in EHR, compared with US Preventive Services Task Force LCS recommendation.

12% of former smokers were eligible for screening on the basis of their detailed smoking history. There was no statistically significant increase in screening among the intervention group; however, one half of participants in the electronic promotion group who were otherwise eligible for screening had recently had low-dose computed tomography for some other reason and, thus, did not receive the offer of LCS, which diluted the effect of the intervention. Although this pilot study did not show significant effect, additional studies should be conducted to leverage the cost- and time-efficient technique of electronic promotion. Potential benefits include improving the quality of EHR smoking data,

educating patients and health care providers, and increasing the identification of patients who are eligible for LCS. Electronic promotion alone will not reliably reach all eligible patients because of the incomplete penetration of patient portal engagement.

To our knowledge, this is the first published study of the electronic promotion of LCS. A proactive mammography scheduling protocol⁷ showed improvement of uptake at the Mayo Clinic, whereas targeted informational mail improved mammography in Medicare beneficiaries.⁹ Others have shown improvement in compliance with recommendations using EHR tools.¹⁴

Table 2. Outcomes by Treatment Group

Outcome	Electronic Promotion (n = 99)	Usual Care (n = 101)	P
Message read	66	N/A	—
Responded to message	24	N/A	—
Electronically completed smoking history	19	N/A	—
Eligible for LCS on the basis of EHR smoking history postintervention	10 of 99	13 of 101	.659
Order placed for LCS	5 of 10	2 of 13	.169
LCS performed	4 of 10	1 of 13	.127
Reasons order not placed for LCS			
Other CT scan in the last year	1	—	
Patient did not schedule LCS	4		

Abbreviations: CT, computed tomography; EHR, electronic health record; LCS, lung cancer screening; N/A, not applicable.

Whereas other screening tests have eligibility primarily on the basis of age, LCS requires specific smoking history quantification. Assessing detailed smoking history is time consuming. Furthermore, EHR smoking history records tools lack adequate detail to capture typical smoking behavior. Thus, in addition to the usual barriers of implementing a new preventative health care service, LCS implementation is hindered by incomplete smoking history in the EHR. Combining the smoking history update with information about LCS may help to improve the identification of persons who can benefit from LCS; however, technological barriers to using EHR portals exist for some patients.¹² Furthermore, the stigma of smoking-associated cancers¹⁵ may have influenced the patient response rate.

Limitations of this study include the sample size, which was small, and that the study was conducted at a single institution. Some data, including quantification of the pack-year history, were not available for all patients. Blind assignment was not possible as a result of the visibility of portal

messages to all reviewers of a patient's EHR; however, visibility was not an obstacle to achieving the desired clinical outcome because this portal message might prompt a primary care provider to discuss LCS with that patient and ultimately achieve our objective of increasing screening when appropriate.

Future steps to improve access to LCS for eligible persons may include EHR system tools to document an accurate and detailed smoking history, which will permit systematic identification of possibly eligible persons. Furthermore, targeting preventative care information might be more effective with a message signed by the participants' primary care provider rather than one signed by the study principal investigator. Such systematic identification should not supplant shared decision making, but, rather, should be a tool to improve the timely screening for eligible and interested persons.

DOI: <https://doi.org/10.1200/CCI.17.00033>

Published online on ascopubs.org/journal/cci on June 30, 2017.

AUTHOR CONTRIBUTIONS

Conception and design: All authors

Collection and assembly of data: Abbie L. Begnaud

Data analysis and interpretation: All authors

Manuscript writing: All authors

Final approval of manuscript: All authors

Accountable for all aspects of the work: All authors

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The following represents disclosure information provided by authors of this manuscript. All relationships are considered

compensated. Relationships are self-held unless noted. I = Immediate Family Member, Inst = My Institution. Relationships may not relate to the subject matter of this manuscript. For more information about ASCO's conflict of interest policy, please refer to www.asco.org/rwc or ascopubs.org/jco/site/ifc.

Abbie L. Begnaud

Consulting or Advisory Role: Medtronic, Covidien

Anne M. Joseph

No relationship to disclose

Bruce R. Lindgren

No relationship to disclose

REFERENCES

1. Shumaker SA, Schron EB, Ockene JK, et al (eds): The Handbook of Health Behavior Change (ed 2). New York, NY, Springer Publishing, 2004
2. Chen LH, Quinn V, Xu L, et al: The accuracy and trends of smoking history documentation in electronic medical records in a large managed care organization. *Subst Use Misuse* 48:731-742, 2013
3. Wu YC, Perkovich MT, Woldemichael KM, et al: Electronic medical record smoking history does not accurately identify candidates for lung cancer screening—Disproportionately affecting vulnerable and high-risk populations. *Am J Respir Crit Care Med* 193:A1092, 2016
4. Ostroff JS, Copeland A, Borderud SP, et al: Readiness of lung cancer screening sites to deliver smoking cessation treatment: Current practices, organizational priority, and perceived barriers. *Nicotine Tob Res* 18:1067-1075, 2016
5. Modin HE, Fathi JT, Gilbert CR, et al: Pack-year cigarette smoking history for determination of lung cancer screening eligibility: Comparison of the electronic medical record versus a shared decision making conversation. *Ann Am Thorac Soc* [epub ahead of print on April 13, 2017]
6. Neuner J, Fedders M, Caravella M, et al: Meaningful use and the patient portal: Patient enrollment, use, and satisfaction with patient portals at a later-adopting center. *Am J Med Qual* 30:105-113, 2015
7. Chaudhry R, Scheitel SM, McMurtry EK, et al: Web-based proactive system to improve breast cancer screening: A randomized controlled trial. *Arch Intern Med* 167:606-611, 2007
8. Church TR, Yeazel MW, Jones RM, et al: A randomized trial of direct mailing of fecal occult blood tests to increase colorectal cancer screening. *J Natl Cancer Inst* 96:770-780, 2004

9. Fox SA, Stein JA, Sockloskie RJ, et al: Targeted mailed materials and the Medicare beneficiary: Increasing mammogram screening among the elderly. *Am J Public Health* 91:55-61, 2001
10. Sitzia J, Wood N: Response rate in patient satisfaction research: An analysis of 210 published studies. *Int J Qual Health Care* 10:311-317, 1998
11. Horevoorts NJ, Vissers PA, Mols F, et al: Response rates for patient-reported outcomes using Web-based versus paper questionnaires: Comparison of two invitational methods in older colorectal cancer patients. *J Med Internet Res* 17:e111, 2015
12. Tavares J, Oliveira T: Electronic health record patient portal adoption by health care consumers: An acceptance model and survey. *J Med Internet Res* 18:e49, 2016
13. Sorondo B, Allen A, Bayleran J, et al: Using a patient portal to transmit patient reported health information into the electronic record: Workflow implications and user experience. *EGEMS (Wash DC)* 4:1237, 2016
14. Krasowski MD, Savage J, Ehlers A, et al: Ordering of the serum angiotensin-converting enzyme test in patients receiving angiotensin-converting enzyme inhibitor therapy: An avoidable but common error. *Chest* 148:1447-1453, 2015
15. LoConte NK, Else-Quest NM, Eickhoff J, et al: Assessment of guilt and shame in patients with non-small-cell lung cancer compared with patients with breast and prostate cancer. *Clin Lung Cancer* 9:171-178, 2008