Readiness for Implementation of Lung Cancer Screening

A National Survey of Veterans Affairs Pulmonologists

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Abstract

Rationale: To mitigate the potential harms of screening, professional societies recommend that lung cancer screening be conducted in multidisciplinary programs with the capacity to provide comprehensive care, from screening through pulmonary nodule evaluation to treatment of screen-detected cancers. The degree to which this standard can be met at the national level is unknown.

Objectives: To assess the readiness of clinical facilities in a national healthcare system for implementation of comprehensive lung cancer screening programs, as compared with the ideal described in policy recommendations.

Methods: This was a cross-sectional, self-administered survey of staff pulmonologists in pulmonary outpatient clinics in Veterans Health Administration facilities.

Measurements and Main Results: The facility-level response rate was 84.1% (106 of 126 facilities with pulmonary clinics); 88.7% of facilities showed favorable provider perceptions of the evidence for lung cancer

screening, and 73.6% of facilities had a favorable provider-perceived local context for screening implementation. All elements of the policy-recommended infrastructure for comprehensive screening programs were present in 36 of 106 facilities (34.0%); the most common deficiencies were the lack of on-site positron emission tomography scanners or radiation oncology services. Overall, 26.5% of Veterans Health Administration facilities were ideally prepared for lung cancer screening implementation (44.1% if the policy recommendations for on-site positron emission tomography scanners and radiation oncology services were waived).

Conclusions: Many facilities may be less than ideally positioned for the implementation of comprehensive lung cancer screening programs. To ensure safe, effective screening, hospitals may need to invest resources or coordinate care with facilities that can offer comprehensive care for screening through downstream evaluation and treatment of screen-detected cancers.

Keywords: early detection of cancer; lung neoplasms; health plan implementation; healthcare economics and organizations; surveys and questionnaires

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Lung cancer is the leading cause of cancer death in the United States (1). Despite advances in lung cancer diagnosis and management, most cases are detected at an advanced stage, and long-term survival remains poor (1). In 2011, the National Lung Screening Trial (NLST) demonstrated a 20% relative reduction in lung cancer mortality with annual low-dose chest computed tomography (LDCT) scans in asymptomatic current and former heavy smokers between the ages of 55 and 74 years (2). In light of these results, computed tomography (CT) lung cancer screening of high-risk individuals has been recommended by many organizations and guidelines and it is now covered by both private insurers and Medicare (3–7).

Consequently, medical centers across the country are preparing to offer LDCT lung cancer screening to eligible patients. Although the results of the NLST are encouraging, real-world experience with the development and implementation of lung cancer screening programs remains limited (8–10). Implementation of a comprehensive lung cancer screening program is a complex, resource-intensive undertaking, and both the clinical and cost effectiveness of LDCT screening are expected to vary widely depending on how screening is implemented (11, 12).

Although LDCT screening has the exciting potential to reduce lung cancer mortality, it has a high false-positive rate and confers the potential harms associated with pulmonary nodule evaluation, including radiation exposure, complications of invasive work-up, and the distress related to the prolonged uncertainty of radiographic surveillance (13, 14). Accordingly, the American Thoracic Society (ATS) and the American College of Chest Physicians (CHEST) have released policy statements offering guidance on how to design and implement screening programs with the infrastructure, expertise, and capability necessary to ensure that the benefits of screening outweigh the harms (6, 15). Experts suggest that not all medical centers will be ideally suited or optimally prepared to implement a full-service lung cancer screening program (6, 13, 16).

Like many hospitals and healthcare systems, the Veterans Health Administration (VA) is currently planning large-scale implementation of LDCT lung cancer screening (17). Successful implementation of evidence-based clinical practices is a function of the strength of the evidence as perceived by key stakeholders, the context or environment

in which the program is to be implemented, and the degree to which program implementation is facilitated (18–21). Yet little is known about how VA clinicians perceive the evidence for LDCT lung cancer screening or how many VA facilities have the favorable context and infrastructure for screening implementation. VA pulmonologists are key clinician stakeholders likely to be integral to the design and implementation of LDCT lung cancer screening. We therefore performed a national survey of VA pulmonologists to assess the readiness of VA facilities for implementing comprehensive, multidisciplinary lung cancer screening programs. Some of the results of this study have been reported previously in the form of an abstract (22).

Methods

Survey Development and Administration

We developed a 36-item self-administered online survey consisting of both multiple choice and open-ended items, guided by the Promoting Action on Research Implementation in Health Services (PARIHS) model (18). The survey included items in four domains: (1) provider perception of the evidence relevant to lung cancer screening; (2) provider perception of the local context for implementation of lung cancer screening at his/her VA clinical facility, including culture and leadership support; (3) available infrastructure and barriers to screening implementation; and (4) provider characteristics.

Survey questions related to providers' perceptions of the evidence and local context for screening implementation were adapted from the Organizational Readiness to Change Assessment (ORCA) instrument (19) evidence and context scales, which used a five-point Likert response set. Respondents were asked to rate whether they perceived various potential barriers to screening implementation as "not a barrier," "a small barrier," or "a big barrier." Four VA pulmonologists, one VA oncologist, one VA primary care provider, and four implementation science researchers experienced in survey design assessed the survey for content validity and clarity of individual items; we revised the survey on the basis of their feedback. The final version of the survey is available in the online supplement.

Between July 2013 and February 2014, all eligible VA pulmonologists (the study

population) were invited by e-mail to participate in a voluntary, confidential online survey. To maximize response rate, up to three invitations were sent per unique e-mail address. No compensation was offered for study participation. This study was approved by the institutional review board at the Edith Nourse Rogers Memorial Veterans Hospital, Bedford, Massachusetts, and by the Organizational Assessment Sub-Committee of the Human Resources Committee of the VA National Leadership Board.

Study Population

Our sample frame comprised all staff-level (attending) pulmonologists who regularly see patients in a pulmonary clinic at an eligible VA facility. Eligible facilities were defined as VA healthcare systems or medical centers in the United States (including Puerto Rico); community-based outpatient clinics were excluded because these smaller clinics were considered unlikely to have the resources necessary for developing a comprehensive lung cancer screening program.

VA pulmonologists were identified using data from the VA Office of Patient Care Services, the VA Office of Human Resources, and the VA staff listings from each facility. Pulmonologists who worked at more than one VA facility were permitted to respond to the survey only once; participants were asked to identify their primary VA facility and to respond to questions with that facility in mind. Of 160 VA facilities, 34 were excluded because they did not have a pulmonologist identified on staff ($n = 30$) or because they had one pulmonologist who identified another facility as their primary clinical site ($n = 4$). Of the remaining 126 VA facilities, eligible pulmonologists were confirmed via correspondence with a pulmonary contact at 116 facilities with outpatient pulmonary clinics (we were unable to confirm the list of eligible pulmonologists at 10 facilities despite repeated inquiries).

Outcome Measures

Our primary outcome was the distribution of VA medical facilities in terms of readiness for implementation of lung cancer screening programs, as defined by performance in three domains: evidence, context, and infrastructure. We categorized facilities on the basis of how they performed on two domains of the PARIHS framework: evidence (pulmonologists' perception of evidence, assessed at the facility level) and

context (suitability of the context for implementation of lung cancer screening, including perceived leadership and staff support for implementation). We also asked respondents about the availability of policy-recommended infrastructure components for screening implementation (6, 15). We did not include a measure of the facilitation domain of the PARIHS framework, because most facilities had not yet implemented screening programs and thus had no facilitation strategies in place at the time the survey was conducted (23). A facility was characterized as being ideally prepared for lung cancer screening implementation if it was identified as having a favorable provider perception of the evidence for lung cancer screening, a strong local context for screening implementation, and all the policy-recommended infrastructure (24, 25). Each of these elements is described in detail below.

Evidence. We used a modified version of the ORCA evidence scale to assess pulmonologists' perception of the evidence for lung cancer screening (*see online supplement*). To calculate an individual's score on the evidence scale, we assigned a numeric value to each Likert response (1 [strongly disagree] to 5 [strongly agree]) (23). We subsequently summed the numeric values for each Likert response and divided that sum by the total number of questions to which an individual provided a response to come up with an evidence scale score. If more than one individual from a facility responded to the survey, the mean response for these survey items was used to represent the facility-level response (23). A facility was classified as having a favorable provider perception of the evidence for lung cancer screening if the mean facility-level evidence score was ≥ 3 (range of possible scores, 1–5, with higher scores indicating more favorable evidence perceptions).

Context. We assessed the receptivity of the local context at each facility for implementation on the basis of responses to the context domain of the ORCA instrument, which assesses features such as organizational culture, leadership support, and willingness to change local practices (*see online supplement*). Providers were asked to respond to context-related questions with their primary VA clinical facility in mind. An individual's context scale score was determined in similar fashion to the evidence scale score. For facilities with more than one responding provider, the mean response for these items was used to represent the facility-level

response. A facility was defined as having strong local context for implementation if the mean facility-level context score was ≥ 3 (range of possible scores, 1–5, with higher scores indicating more favorable context).

Infrastructure. Guidelines recommend that comprehensive LDCT lung cancer screening programs have the capacity not only to conduct screening, but also to evaluate screen-detected pulmonary nodules and to treat screen-detected cancers (13). The ATS and CHEST have delineated the infrastructure components needed to achieve this goal (6). We determined whether the facility had the recommended infrastructure in place to offer this spectrum of care through a series of yes/no questions about structures and processes of care at the facility. On the basis of the CHEST/ATS policy recommendations, we defined the infrastructure needed for ideal implementation of comprehensive LDCT lung cancer screening programs as comprising all of the following: physical equipment (CT scanner, positron emission tomography [PET] scanner), personnel (pulmonologist, medical oncologist, radiation oncologist, thoracic surgeon, pathologist), the capability to perform specific procedural interventions (transthoracic needle biopsy, bronchoscopic biopsy, mediastinoscopy, and either thoracoscopic or open lung biopsy), and access to specialized services (multidisciplinary tumor board, smoking cessation services) (6).

For facilities with more than one responding provider, we based our determination of available infrastructure on the responses of the individual most experienced with pulmonary nodule evaluation. To identify this individual, we ranked respondents at the facility by the self-reported number of patients with pulmonary nodules seen per week, followed by the percentage of clinical effort spent in the pulmonary clinic, comfort managing pulmonary nodules, and years in clinical practice. If the top-ranked respondent did not respond to a particular item related to infrastructure, the second-ranked responding provider's response was used to represent the facility. If there was a discrepancy among responders, the top-ranked individual's response was used.

Statistical Analyses

We calculated descriptive statistics for continuous variables with means and

SDs and for categorical variables as frequencies and percentages. Associations between pulmonologist-identified barriers to lung cancer screening implementation and whether a facility was characterized as being ideally prepared for lung cancer screening implementation were analyzed using chi-square and Fisher exact tests as appropriate. For all analyses, a two-sided P value < 0.05 was considered statistically significant. Statistical analyses were performed using SAS version 9.4 (Cary, NC).

Results

Sample Characteristics

Two hundred eighty-six of 573 eligible pulmonologists responded to the survey (individual response rate, 49.9%). These providers represented 106 of 126 eligible VA facilities (facility-level response rate, 84.1%). Characteristics of the respondents are shown in Table 1.

Table 1. Characteristics of responding VA pulmonologists (n = 286)

Characteristic	%
Male	75.5
US Census Region	
Northeast	16.1
Midwest	22.0
South	37.1
West	23.4
Puerto Rico	1.4
Yr in practice	
< 5	13.9
5–9	18.1
10–19	23.7
≥ 20	44.4
Time spent in pulmonary clinic, %	
< 25	39.0
25–49	33.0
50–74	15.0
≥ 75	13.1
No. new nodule patients per week	
0–1	22.7
2–5	58.7
6–10	14.4
> 10	4.2
Current screening program in place	
Yes	8.2
Not yet, planning to start one	66.5
No	25.3
Currently refer patients for lung cancer screening	39.5

Definition of abbreviation: VA = Veterans Health Administration.

Evidence Perceptions

The mean facility-level response for pulmonologists' perception of the evidence for lung cancer screening was 3.44 (SD, 0.44). Overall, 94 out of 106 responding facilities (88.7%) had a mean evidence score ≥ 3 . Facility-level means for the questions composing the evidence domain are shown in Table 2.

Context

The mean facility-level response for perceived support for lung cancer screening implementation was 3.42 (SD, 0.61). Seventy-eight facilities (73.6%) had a mean context score ≥ 3 . Facility-level means for questions related to perceived support are shown in Table 3.

Available Infrastructure

Table 4 shows the facility-level infrastructure for implementation of lung cancer screening. Thirty-six of 106 eligible facilities (34.0%) reported all the recommended infrastructure on site to implement a comprehensive lung cancer screening program. The most common deficiencies were a lack of on-site PET scanners and radiation oncologists. Fifty-nine of 106 facilities (55.7%) reported all the recommended infrastructure with the exception of on-site PET scanners and radiation oncology.

Readiness for Implementation

Respondents provided information on evidence, perceived context, and available infrastructure at 102 VA facilities (4 had missing information). Overall, 27 of these facilities (26.5%) were considered ideally prepared for the implementation of a lung cancer screening program on the basis of favorable provider perceptions of evidence and context for screening implementation and possession of all recommended infrastructure components (Figure 1). In the Northeast, 3 of 19 facilities (15.8%) were ideal, 4 of 22 (18.2%) in the Midwest, 13 of 39 (33.3%) in the South, 6 of 21 (28.6%) in the West, and 1 of 1 (100%) in Puerto Rico. If on-site PET scanners and radiation oncologists were not considered necessary infrastructure, 45 facilities (44.1%) were classified as ideal.

Perceived Barriers to Implementation

Overall, 81.2% of responding pulmonologists perceived that

Table 2. Mean facility-level response to items related to evidence for lung cancer screening

Evidence-related Item: Implementation of CT screening for lung cancer among middle age smoker	Mean (SD)
Is supported by randomized controlled trials	3.9 (0.52)
Should be effective in the VA on the basis of current scientific knowledge	3.8 (0.62)
Is supported by clinical experience with VA patients	3.3 (0.68)
Meets a need I perceive for patients at my VA facility	3.8 (0.68)
Is perceived as a need by PCPs at my VA facility	3.2 (0.63)
Is requested by patients at my VA facility	2.7 (0.71)
Takes into consideration the needs and preferences of VA patients	3.3 (0.56)
Appears to have more advantages than disadvantages for VA patients	3.6 (0.65)

Definition of abbreviations: CT = computed tomography; PCP = primary care provider; VA = Veterans Health Administration.

Possible responses range from 1 to 5, with higher numbers indicating a greater level of agreement.

implementation would be somewhat or very difficult at their VA facility. However, 90.0% of respondents believed that implementation of lung cancer screening would ultimately be somewhat or very likely to succeed at their facility. The most frequently identified barriers to implementation included insufficient staffing, insufficient infrastructure,

Table 3. Facility-level mean response to items related to local context (perceived support)

Context Item	Mean (SD)
Staff members at my VA facility	
Have a sense of personal responsibility for improving patient care and outcomes	4.3 (0.65)
Cooperate to maintain and improve effectiveness of patient care	4.2 (0.64)
Are willing to innovate and/or experiment to improve clinical procedures	3.9 (0.82)
Are receptive to change in clinical processes	3.8 (0.78)
Believe that the current practice patterns can be improved	4.1 (0.56)
Encourage and support changes in practice patterns to improve patient care	4.0 (0.72)
Are willing to try new clinical protocols	3.9 (0.69)
Work cooperatively with clinical management to make appropriate changes	3.9 (0.68)
In general, at my VA facility, when there is agreement that change needs to happen, we are provided with	
The necessary budget or financial resources	2.7 (0.84)
The necessary support for training	2.8 (0.81)
The necessary facilities	2.8 (0.82)
The necessary staff support	2.4 (0.81)
Senior leadership at my VA facility	
Reward clinical innovation and creativity to improve patient care	3.1 (0.89)
Solicit opinions of clinical staff regarding decisions about patient care	3.1 (0.94)
Seek ways to improve patient education and increase patient participation in care	3.4 (0.76)
Provide effective management for continuous improvement of patient care	3.2 (0.89)
Clearly define areas of responsibility and authority for staff	3.2 (0.86)
Promote team building to solve clinical care problems	3.2 (0.94)
Promote communication among clinical services and units	3.2 (0.88)
Provide staff with information on VA performance measures and guidelines	3.6 (0.72)
Establish clear goals for patient care processes	3.4 (0.77)
Provide staff with feedback (data) on effects of clinical decisions	3.1 (0.90)
Hold staff accountable for achieving results	3.6 (0.71)

Definition of abbreviation: VA = Veterans Health Administration.

Possible responses range from 1 to 5, with higher numbers indicating a greater level of agreement.

Table 4. Facility-level infrastructure for lung cancer screening implementation (n = 106)

Policy-recommended Infrastructure Components	%
Facilities with all recommended components	34.0
Equipment	
CT scanner	81.1
PET scanner	54.7
Personnel	
Medical oncologist	95.2
Radiation oncologist	67.6
Thoracic surgeon	81.0
Pathologist	83.5
Procedures	
Transthoracic needle biopsy	85.7
Bronchoscopic biopsy	95.2
Mediastinoscopy	79.8
Surgical lung biopsy	99.1
Other	
Multidisciplinary tumor board	86.7
Smoking cessation services	91.4

Definition of abbreviations: CT = computed tomography; PET = positron emission tomography.

and high costs (identified as “a big barrier” by 62.5, 52.7, and 37.8% of respondents, respectively) (Figure 2). There was no significant difference between the rates of any of the provider-perceived barriers at ideally prepared vs. other facilities.

Discussion

Clinicians at most VA facilities appeared to have strong buy-in to the evidence

supporting lung cancer screening. At most VA facilities, the context for lung cancer screening implementation was considered favorable, although respondents were more enthusiastic about staff members’ willingness to collaborate and embrace change and less certain about the level of financial and leadership support for such initiatives. Less than a third of facilities had all of the policy-recommended infrastructure components in place on site for the implementation of a comprehensive lung cancer screening program. Of the 102 facilities for which we had complete information, 27 were considered ideally prepared for immediate screening implementation. These facilities were distributed geographically throughout the country. At both ideally prepared and other facilities, pulmonologists were optimistic that commonly perceived barriers to screening implementation (e.g., insufficient staff and infrastructure and high cost of implementation) could be overcome.

Implementing comprehensive, multidisciplinary lung cancer screening programs with the capacity to manage patients from the time of screening through evaluation of screen-detected nodules and through treatment of newly diagnosed lung cancers is a complex undertaking. Although the results of the NLST are encouraging, if implemented poorly, lung cancer screening may not only fail to realize the mortality benefit observed in the NLST but may also result in patient harm (16). Hospitals around the country,

both VA and non-VA, are struggling to determine how best to implement safe and effective lung cancer screening programs (26).

The results of this survey can help inform optimal strategies to facilitate screening implementation across the VA (20). On the basis of where sites fall on the spectrum of readiness (Figure 1), targeted, needs-based implementation strategies can be tailored to specific facilities (e.g., social marketing and academic detailing for sites that perceive the evidence as weak [Figure 1, lower right box], and staff training for sites with weak intradisciplinary collaboration limiting contextual readiness for implementation [Figure 1, upper left box]). However, the results of this study suggest that the rate-limiting step for most facilities preparing for the implementation of a comprehensive lung cancer screening program is lack of one or more of the recommended infrastructure components on site at the facility (Table 3). Of note, this situation is likely representative of many community hospitals in the United States and would require capital investment to rectify.

Integrated healthcare systems such as the VA are faced with multiple potential options when considering how to provide access to eligible patients in need of a preventive care service such as lung cancer screening. One option would be to invest the necessary resources to bring VA facilities that are not currently ideally prepared for implementation up to a state of optimal readiness.

Although some facilities may be able to purchase missing infrastructure components such as a PET scanner, it is unrealistic to assume that all facilities that care for patients eligible for screening will have a high enough volume of patients with lung cancer to warrant investment in bringing policy-recommended services such as radiation oncology or thoracic surgery to the facility. Even if they did, they may not be ideally poised to offer optimal care, because hospitals with a lower volume of patients with lung cancer may provide less guideline-concordant care than do high-volume hospitals, and outcomes of lung cancer resections are worse among lower-volume surgeons (27, 28). Furthermore, it is not clear whether having resources such as PET scanners or radiation oncology services on site improves

Figure 1. Suitability of Veterans Health Administration facilities for implementation of lung cancer screening. *Ideally prepared sites had strong provider buy-in to the evidence for lung cancer screening, a context perceived as strongly suited for implementation, and all policy-recommended infrastructure components in place on-site.

Figure 2. Provider-perceived barriers to lung cancer screening implementation at ideally prepared facilities compared with not ideally prepared facilities for implementation. PCP = primary care provider. $P < 0.05$ for all comparisons.

outcomes if appropriate referral pathways are in place to ensure timeliness and quality of lung cancer care (29, 30).

Accordingly, other options revolve around referring veterans served by facilities that currently lack the full complement of policy-recommended services to other facilities that have the capability to implement full-service lung cancer screening programs. One option would be to implement comprehensive screening programs only at facilities where all the recommended infrastructure is already available or easily obtained and to capitalize on the VA's interfacility transportation system and universal electronic medical record to allow veterans who live near facilities without the full complement of services to receive additional downstream cancer care at a designated comprehensive VA lung cancer screening facility.

For example, smaller VA facilities that have a CT scanner and a pulmonary clinic could conduct LDCT screening and radiographic surveillance of screen-detected nodules but defer resection of any screen-detected cancers to larger VA facilities that have comprehensive thoracic oncology services. This may pose problems for regularly needed therapeutic services such as radiation therapy, in which distance needed to travel has been correlated with likelihood of receiving

treatment (31). Thus, a second option would be for smaller VA facilities without the full complement of policy-recommended services to partner with local non-VA sites to obtain access to comprehensive thoracic oncology care. However, such referral-based strategies face challenges related to access and coordination of care (32–36). The optimal solution to provide access to screening to as many eligible patients as possible while maintaining the efficacy and safety seen in the NLST therefore remains unclear.

It is important to note that these challenges are not unique to the VA. Indeed, there are several reasons to believe that the VA may be better prepared for lung cancer screening implementation than are many hospitals in the private sector. First, the VA, the nation's largest integrated health system, has a proven track record in providing high-quality preventive care and care for chronic illnesses (37–39) and is undertaking implementation of lung cancer screening in a deliberate fashion (17, 40). Second, VA facilities are more likely than are many academic and community hospitals to have processes of care in place to facilitate pulmonary nodule evaluation (41). Third, the VA has a shared electronic medical record across all sites and a referral and transportation network in place to facilitate coordination

of care. Well-established arrangements are already in place for veterans with non-screen-detected cancers to receive PET scan and radiation oncology services at nearby non-VA facilities, which may obviate the need to have these services available on site. Indeed, the presence of these infrastructure elements on site did not correlate with timeliness of lung cancer care in a prior national VA study (29). If the CHEST/ATS policy recommendation for on-site PET scanners and radiation oncologists were waived, then almost one-half (44%) of facilities would be categorized as ready for immediate screening implementation.

Limitations

Our study has limitations. First, our survey questions were based on an implementation science model designed to assess generic readiness for implementation of new clinical programs. It is possible that these questions inaccurately reflect the actual favorability of individual VA facilities for lung cancer screening implementation. Second, we surveyed pulmonologists, who may or may not represent the views of other clinicians at their facility. Although we targeted pulmonologists under the assumption that they would be knowledgeable informants about the infrastructure available for lung cancer screening, evaluation, and treatment, it is possible that they may have inaccurately reported the infrastructure elements in place, especially if located outside the pulmonary department (e.g., surgical services). Moreover, lung cancer screening is a new and rapidly evolving clinical area; it is possible that our study underrepresents current clinician knowledge and/or facility preparedness for implementation. Finally, we achieved a 50% response rate, and although this is considered an acceptable rate for most physician surveys (42), it is not clear whether the respondents represent the views of all VA pulmonologists.

Conclusions

Although most VA pulmonologists are enthusiastic about lung cancer screening, challenges to implementation exist even at ideally prepared facilities. Our results suggest that screening implementation within the VA may require the investment of both time and money to ensure that facilities are supported adequately. The VA

has embarked on a carefully designed, multifacility demonstration project of lung cancer screening in the real world (17, 40); the lessons learned from this pilot project will no doubt inform large-scale implementation of lung cancer screening both within and outside the VA. ■

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