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ORIGINAL ARTICLE

A Coordinated Approach to Implementing Low-Dose CT Lung Cancer Screening in a Rural Community Hospital

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Abstract

Purpose: The authors describe a rural community hospital's approach to lung cancer screening using low-dose CT (LDCT) to address the high incidence of lung cancer mortality.

Methods: An implementation project was conducted, documenting planning, education, and restructuring processes to implement a lung cancer screening program using LDCT in a rural community hospital (population 64,917, Rural-Urban Continuum Code 5) located in a region with the highest lung cancer mortality in Oregon. The hospital and community partners organized the implementation project around five recommendations for an efficient and effective lung cancer screening program that accurately identifies high-risk patients, facilitates timely access to screening, provides appropriate follow-up care, and offers smoking cessation support.

Results: Over a 3-year period (2018-2020), 567 LDCT scans were performed among a high-risk population. The result was a 4.8-fold increase in the number of LDCT scans from 2018 to 2019 and 54% growth from 2019 to 2020. The annual adherence rate increased from 51% in 2019 to 59.6% in 2020. Cancer was detected in 2.11% of persons scanned. Among the patients in whom lung cancer was detected, the majority of cancers (66.6%) were categorized as stage I or II.

Conclusions: This rural community hospital's approach involved uniting primary care, specialty care, and community stakeholders around a single goal of improving lung cancer outcomes through early detection. The implementation strategy was intentionally organized around five recommendations for an effective and efficient lung cancer screening program and involved planning, education, and restructuring processes. Significant stakeholder involvement on three separate committees ensured that the program's design was relevant to local community contexts and patient centered. As a result, the screening program's reach and adherence increased each year of the 3-year pilot program.

Key Words: Low-dose computed tomography, lung cancer screening, rural community hospital, multifaceted implementation strategy

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BACKGROUND

Lung cancer is the leading cause of cancer death in men and women [1]. Although death rates nationally declined between 2014 and 2018, lung cancer accounted for 23% of all cancer deaths [1]. Rural populations experience particularly stark disparities in lung cancer outcomes. Compared with urban areas, residents of rural areas are more likely to report smoking [2], have a higher incidence

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of lung cancer, tend to be diagnosed at a later stage of disease, and are more likely to die of lung cancer once diagnosed [3,4]. Nearly one in five Americans live in a rural area defined by Rural-Urban Continuum Codes 4 to 9 [5]. Early detection is imperative in improving lung cancer survival rates and has the potential to save lives [6,7]. Approximately 56.3% of patients with lung and bronchus cancer survived when the disease was detected when localized (ie, confined to primary site) [8]. The survival rate substantially decreases to 29.7% when detected in regional stage (ie, cancer has spread to lymph nodes) and 4.7% if detected in the distant stage (ie, cancer has metastasized to other organs) [8].

Results from the National Lung Cancer Screening Trial showed that annual low-dose CT (LDCT) lung cancer screening for adults with histories of cigarette smoking resulted in a 20% relative reduction in lung cancer mortality [9-13]. In 2013, the US Preventive Services Task Force (USPSTF) published a grade B recommendation specifying annual LDCT screening eligibility criteria on the basis of age and smoking history [11,13-16]. More recently, the USPSTF revised the grade B recommendation, expanding the definition of high risk for lung cancer by lowering the age to start screening from 55 to 50 and smoking history from 30 to 20 pack-years over a lifetime [17]. This revised recommendation significantly expanded lung cancer screening guidelines to include more high-risk patients, including populations that have a higher risk for lung cancer, including African Americans and women [18].

The availability of LDCT screening is increasing in rural settings. In 2019, 51% of rural hospital-based radiology facilities offered lung cancer screening using LDCT across Oregon [19]. Increased availability of lung cancer screening brings greater attention to the importance of LDCT screening for lung cancer to be implemented properly as a cohesive program supporting patients throughout the entire screening process, from prescreening to postscreening follow-up care, including smoking cessation support. The effectiveness of lung cancer screening using LDCT rests upon providing a continuum of care spanning from accurately identifying high-risk patients to screen, facilitating access to screening, providing appropriate follow-up care, and offering smoking cessation support. LDCT lung cancer screening in rural community hospitals is often viewed as an episodic event rather than a continuum of care [20]. Preliminary data showed this to be the case among hospital-based radiology facilities in rural Oregon in 2019. Although more than half of these facilities perform LDCT screening, few approach it as a continuum of care.

A multidisciplinary panel of experts convened in 2013 and provided practical guidance on lung cancer surveillance. The 12-member panel consisted of health care providers, insurers, integrated delivery systems, health economists, clinician researchers, cancer researchers, and patient advocacy groups [21]. The panel proposed five recommendations, or core standards, necessary for an effective and efficient LDCT lung cancer screening program: (1) accurately identify patients eligible for screening, (2) provide access to screening at qualified facilities for eligible patients, (3) ensure appropriate follow-up for positive and negative screening results, (4) promote continuous quality improvement of screening programs and downstream care, and (5) provide smoking cessation support for all current smokers [21]. The panel's recommendations are a best-practice framework addressing the full screening spectrum, from prescreening to postscreening into follow-up care. In this report, we describe how a rural community hospital followed a multifaceted implementation strategy to design and execute a lung cancer screening program guided by an expert panel's recommendations for an efficient and effective program in an effort to reduce lung cancer mortality in the rural region.

METHODS

The purpose of this project was to facilitate the adoption and integration of an LDCT lung cancer screening program in a rural Oregon county by adapting a published multifaceted implementation strategy. The implementation strategy involved planning, education, and restructuring processes involving staffing, workflow, processes, and systems. The setting was a 130-bed acute care community hospital located in rural Oregon. The community hospital serves a rural county in southwestern Oregon (population 64,917, Rural-Urban Continuum Code 5) [22] and had the highest age-adjusted lung cancer mortality rates in the state between 2015 and 2019 (47.9 per 100,000 people) [23]. The age-adjusted lung cancer incidence rate (2014-2018) was 67.4 per 100,000 people, higher than Oregon (52.6 per 100,000) and national (57.3 per 100,000) incidence rates (Table 1) [24]. The self-reported smoking rate among residents in the rural county is the second highest (27.6%) in Oregon [28]. The rural county is more than a 5-hour drive Q7 from the closest National Cancer Institute–accredited cancer center and academic medical center.

This program reached out to all male and female adult residents of the rural county who met the 2013 USPSTF and CMS screening guidelines for high risk. Specifically, the program was focused on screening patients 55 years and older with 30-pack-year smoking histories [17,25]. Note that the program was initiated before changes in USPSTF recommendations and followed the CMS guidelines for defining high risk. Characteristics of the patients screened are shown in Table 1.

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Table 1. Patients screened compared with Coos County and Oregon

Characteristic	Patients Screened	Coos County* [22]	Oregon* [25]
Population	567	64,389	4,217,737
Race/ethnicity			
White alone, not Hispanic or Latino	71.25% (404 of 567)	84.9%	75.1%
Hispanic or Latino	0.71% (4 of 567)	6.8%	13.4%
Black or African American alone	—	0.6%	2.2%
Asian alone	1.59% (9 of 567)	1.3%	4.9%
Two or more races	—	4.4%	4.0%
American Indian or Alaskan Native	—	3.0%	1.8%
Native Hawaiian or other Pacific Islander	—	0.3%	0.5%
Unknown	2.82% (16 of 567)	—	—
Not reported	23.63% (134 of 567)	—	—
Age (44% of Coos County population >50 y; 34% of US population >50 y)			
Persons 50-64 y	39.15% (222 of 567)	23.98%	17%
Persons 65-74 y	53.09% (301 of 567)	11.63%	6.4%
Persons ≥75 y	7.760% (44 of 567)	8.85%	6.4%
Persons in poverty	—	15.6%	12.6%
Adult cigarette smoking [28]	100% (567 of 567)	27.6%	17.6%

*Coos County and Oregon populations reflect all residents, not just those who may meet the screening criteria.

Data to evaluate the effectiveness of the lung cancer screening program were collected by the clinical trials coordinator to test the effectiveness of the implementation strategy on the primary outcomes of interest, program reach and adherence. The clinical trials coordinator who coordinated the lung cancer screening program collected information from patients who were screened and tracked them through the screening process. Data collected included deidentified demographics of the patients who were screened (age and race), number of baseline and annual/follow-up scans performed, adherence rate of follow-up scans, number of patients who were referred but not screened, screening date, Lung Imaging Reporting and Data System (Lung-RADS)™ assessment, the number scans performed, and cancer stage and type when cancer was detected. Implementation strategy process data included the number of provider and community stakeholders involved in planning strategies and types of planning strategies. Education strategy data included the number and type of attendees at LDCT lung cancer screening education events. Restructuring strategy data collected included the number and types of workflow redesign, number of staff members, and allocation of staff time to coordinate the screening program and collect program performance data.

Implementation Strategy

We adapted a multicomponent implementation strategy using Powell et al's [29] compilation of implementation strategies grouped into implementation processes. The implementation strategy was used to facilitate the adoption and integration of the LDCT lung cancer screening into the community hospital's and referring primary care providers' (PCP) routine practice. The strategy was composed of three implementation processes that included planning, education, and restructuring at the health system, provider, and community stakeholder and consumer/patient levels. Planning processes included designing pre- through postscreening workflow processes. Education processes guided the training of PCPs and other medical professionals about lung cancer incidence and mortality in the region and LDCT lung cancer screening. Restructuring processes involved examination of the community hospital's infrastructure, including personnel, technology, software, and equipment.

Outcome Measures

The effectiveness of this multifaceted implementation strategy in facilitating the adoption and integration of the lung cancer screening program intervention was assessed through the outcome measures reach and adherence. Reach is the "the proportion of eligible patients that participated in the lung cancer screening program" [30]. Assessed at the consumer/patient level, adherence is defined as "having the next scheduled LDCT within 90 days of its annual due date or the readjusted due date if a short-interval scan had been ordered" [31].

The expert panel's five recommendations for an efficient and effective lung cancer screening program framed our approach. Planning, education, and restructuring implementation processes applied in the lung cancer screening

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program were organized and executed according to the recommendations, which are as follows: (1) accurately identify patients eligible for screening, (2) provide access to screening at qualified facilities for eligible patients, (3) ensure appropriate follow-up for positive and negative screening results, (4) promote continuous quality improvement of screening programs and downstream care, and (5) provide smoking cessation support for all current smokers [21].

Comprehensive LDCT Lung Cancer Screening Program

Recommendation #1: Identify Patients for Screening. PCPs are integral to an LDCT lung cancer screening program for their role in identifying high-risk patients on the basis of the USPSTF recommendation and referring these patients for lung cancer screening. For this project, PCPs are inclusive of advanced practice practitioners including nurse practitioners and physician assistants. PCPs are ideally positioned to support their patients in assessing symptoms and determining if lung cancer screening is appropriate as well as coordinating care and managing comorbidities after LDCT scans [32]. They assess patient eligibility using electronic medical records and through care appointments, conduct shared decision-making conversations with their patients about LDCT screening before referring them for lung cancer screening, order the screening, and support follow-up care after screening. The importance of shared decision making between providers and patients is demonstrated in reimbursement procedures outlined by CMS and the Patient Protection and Affordable Care Act (ACA) lung cancer screening policies.

Implementation planning processes involved collecting and incorporating the consumer/patient perspective into the design of the lung cancer screening program. Four focus groups were conducted as part of a community needs assessment. Patients provided feedback on the ideal lung cancer screening program, program accessibility, and strategies to effectively communicate the benefits of early detection of lung cancer through LDCT screening to patients in the rural area. Results informed the program's structure and operating procedures ensuring the screening program was accessible and patient centered.

Planning processes also involved engaging community stakeholders in the program's design. The community hospital collaborated with a National Cancer Institute–designated comprehensive cancer center to consult on the screening program's design, with significant input and engagement from local stakeholders. A community-clinical advisory group was established to facilitate stakeholder engagement in the screening program's design and implementation. With an outward, community-facing orientation, the community-clinical advisory group was a forum for open communication between the hospital's cancer program and PCPs, the community-clinical advisory group served as a vehicle for collaboration on community cancer prevention and cancer screening initiatives. Although no patients were a part of the community-clinical advisory group's initial work on the screening program's design and implementation, the group's membership is expanding to include consumers/patients who were screened for lung cancer at the community hospital.

Implementation education processes intentionally engaged primary care and other health care professionals through a series of education and training events. These processes had a dual objective of informing PCPs and other health care professionals about lung cancer incidence and mortality in the region and providing training and education on LDCT lung cancer screening. The community hospital provided several training opportunities for PCPs on engaging with their patients in shared decision making about lung cancer screening. Trainings was offered in several formats, including grand rounds, an annual community cancer educational program that included a session on preventive service delivery in the primary care setting and doctor-patient communication of health behavioral change, as well as webinars on lung cancer screening topics. Printed educational materials with shared decision-making information and resources (a shared decision-making toolkit, a decision memo for lung cancer with LDCT) were distributed by the community hospital to six provider practices at three separate clinics participating in the pilot program. PCP members of the community-clinical advisory group helped guide the development, format, and content of shared decision-making education and resources provided to PCPs participating in the lung cancer screening pilot program.

Six PCP practices piloted the LDCT screening program with the community hospital. They received training on identifying high-risk patients using the USPSTF revised grade B recommendation and information on referral, screening, and postscreening follow-up care processes, including smoking cessation support for screened patients. The six provider practices from three clinics were oriented to LDCT screening as a continuum of care and their roles in referring eligible patients, supporting follow-up care, and providing access to smoking cessation support. The clinical trials coordinator, who also coordinated the LDCT screening program, facilitated ongoing communication and outreach with the practices to share information and provide ongoing support to ensure that LDCT screening was a care continuum in partnership with primary care rather than an episodic event. The LDCT screening continuum is shown in Figure 1.

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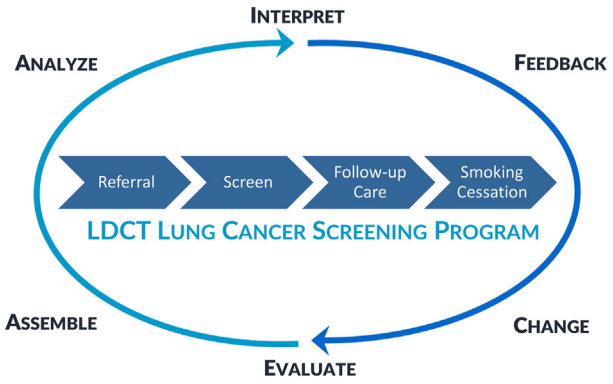

Fig. 1. Lung cancer screening program. LDCT = low-dose CT.

Recommendation #2: Ensure Access to Screening for Eligible Patients. Providing access to LDCT programs is broader than patients' undergoing a scan when they want or need one. Per the expert panel's proposed recommendation, access spans health system and infrastructure issues, adherence to ACA policy, implementation of the USPSTF grade B recommendation, and required participation in the ACR registry. An effective and efficient LDCT program required amending a health system's infrastructure not only to support patient care through the screening continuum but also in response to requirements for CMS reimbursement (ie, electronic medical record content, screening scheduling, and billing).

Implementation planning processes examined and developed internal (community hospital) systems and external (interface with PCP referrals) workflow processes. A multidisciplinary lung cancer screening committee guided this work, examining and designing systems and workflow processes for each component of the lung cancer screening process, referral to postscreening follow-up, and smoking cessation support. Planning processes also involved identifying and adhering to CMS and ACA reporting requirements and gaining ACR Lung Cancer Screening Registry membership.

Implementation restructuring processes involved evaluating the community hospital's existing infrastructure (ie, personnel, technology, software, and equipment) to determine if appropriate trained personnel, staffing, equipment, and software were in place to carry out the program and where changes were needed. Figure 2 shows system processes and workflows along the LDCT screening continuum that were a part of the multifaceted implementation strategy.

Recommendation #3: Postscreening Follow-Up. The Lung-RADS classification system was followed to categorize all LDCT scans. Lung-RADS is a tool designed to standardize lung cancer CT reporting and interpretations and to facilitate outcome monitoring [33]. The classification system consists of six categories ranging from negative (Lung-RADS 1) to suspicious with a >15% change of malignancy (Lung-RADS 4X) [33]. Per the Lung-RADS Version 1.1 Assessment Category matrix, "follow-up" or management scans are those recommended in response to abnormalities found at baseline or at any future annual scan; these are considered diagnostic scans [33]. All patients with scans categorized as Lung-RADS 1 or Lung-RADS 2 were recommended to continue with annual LDCT scanning. Planning processes involved the development of procedures to support all patients through the postscreening phase of the program. The community-clinical advisory group led this process and evaluated procedures jointly implemented by the community hospital and PCPs. Processes included a sequence of events that would occur to support patients with normal and abnormal findings. For negative results, the community hospital notified patients that the results of their

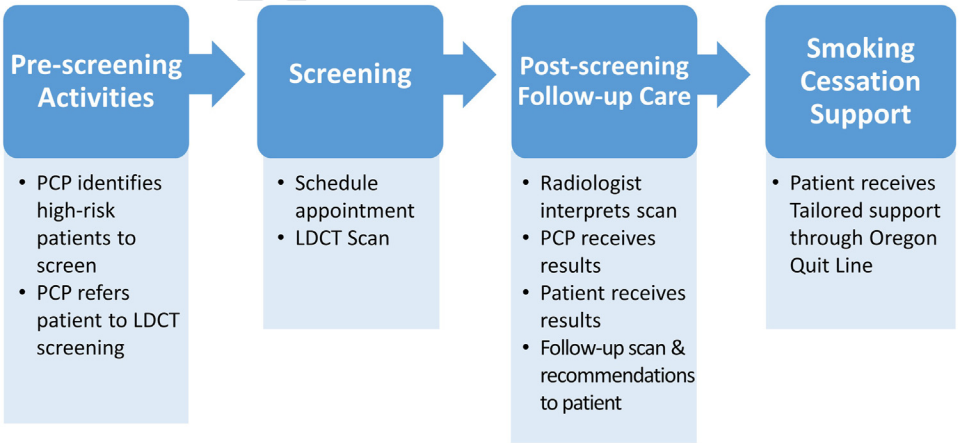

Fig. 2. Lung cancer screening program systems and processes. LDCT = low-dose CT; PCP = primary care provider.

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scans were available from their PCPs. PCPs discussed the negative results with their patient and referred them for annual follow-up screening. A nurse navigator was not involved with patients whose findings were negative. The hospital mailed scheduling reminders to individuals and their PCPs 1 month before the 12-month anniversary of the initial baseline scan.

For patients whose scans were categorized as Lung-RADS 3 (lung nodule probably benign) or Lung-RADS 4A (lung nodule suspicious), a radiologist with the community hospital notified their PCPs. The hospital followed up with letters to these patients notifying them that their results were available from their PCPs. PCPs informed patients of their results and discussed next steps, including referral to specialists to discuss and address the abnormal finding. Patients with abnormal findings were referred by their PCPs for follow-up scans 6 months after their initial scans. The hospital sent these individuals' PCPs scheduling reminders 1 month before the date of the 6-month follow-up scans. A nurse navigator was not involved with patients with scans categorized as Lung-RADS 3 or 4X.

For patients in whom lung cancer was detected, a radiologist communicated this information to their PCPs, who then informed their patients. A nurse navigator provided support by facilitating communication among patients, their PCPs, and oncology to ensure timely access to specialty care. An oncologist practice contracted with the community hospital was able to treat and manage patients who received lung cancer diagnoses after LDCT scans, alleviating the need for patients to travel to an urban center to receive cancer treatment. In some cases, follow-up care was provided via telemedicine.

Recommendation #4: Promote Continuous Quality Improvement. Continuous quality improvement was prioritized as a key component of an effective and efficient LDCT program. A quality standardization training team was established as an outcome of the planning and restructuring processes to monitor and ensure patient safety and security. Referral screening and follow-up care processes were examined on a continuous basis. The Model for Improvement [34] guided a series of rapid improvement cycles (i.e., plan-do-study-act).

Recommendation #5: Smoking Cessation Support. Lung cancer screening presents an opportunity for discussions regarding smoking cessation with smokers. To that end, smoking cessation support is a vital component of the screening continuum. Planning processes included establishing referral pathways for all consumers/patients who had LDCT scans to the Oregon Tobacco Quit Line, initiated by their PCPs. The Oregon Tobacco Quit Line is a telephone- and web-based counseling service to help Oregonians quit using tobacco and nicotine products [35]. Smoking cessation support provided through the quit line was tailored to the needs of each individual. Strategies for behavioral change, including changing routines, tips for dealing with urges, and methods to quit smoking, were shared with callers. Smoking cessation support was not provided at the local level through the community hospital or primary care practices. Offering smoking cessation locally and tracking the number of consumers/patients accessing cessation support services are future aims of the screening program.

RESULTS

Implementation Strategy Outcomes: Planning, Education, and Restructuring Processes

Planning Processes. Three unique stakeholder committees informed the implementation strategy. The multidisciplinary community-clinical advisory group engaged community stakeholders in the screening program's design and objective of improving lung cancer survival rates through early detection. Composed of 15 members, the community-clinical advisory group included PCPs, surgeons, physician assistants, nurse practitioners, and the medical director for a network of five outpatient care clinics in the area. Participating hospital staff members included medical and radiation oncologists, administrators, the clinical trials coordinator (who also coordinated the lung cancer screening program), and the education director. A second multidisciplinary committee, the lung cancer screening committee, had an internal focus on examining and designing systems and workflow processes for each component of the lung cancer screening process, referral to post-screening follow-up, and smoking cessation support. The 14-member committee consisted of researchers, community engagement specialists, radiologists, oncologists, primary care, hospital administration, and the clinical trials coordinator.

Finally, the quality standardization training team monitored the screening program to ensure an effective and efficient screening program that prioritized patient safety and security.

Education Processes. A total of 11 unique education and training events were provided to PCPs and other medical staff members to raise awareness of lung cancer incidence and mortality in the region and the benefits of cancer early detection through LDCT screening. Training on LDCT screening, screening criteria, and shared decision making was provided to PCPs. A shared decision-making toolkit was

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developed and provided to the six provider practices participating in the pilot program. Other providers, including physician assistants, nurses, technicians, and medical assistants, received training that was tailored to their specific to their roles in the screening program.

Restructuring Processes. Restructuring processes led to identification of the need for screening program personnel to manage and run the program. A program coordinator and nurse navigator were identified as necessary personnel for the screening program. Hospital staff members were assigned to these roles. The clinical trials coordinator assumed coordination of the screening program in addition to their other duties. About 50% of their time on a daily basis, or 0.5 full-time equivalents, is dedicated to coordinating and managing the lung cancer screening program. A nurse navigator with the community hospital also assumed additional duties supporting patients with a lung cancer diagnosis. Their time or full-time equivalents spent on the lung cancer screening program varied and was influenced by the number of patients with lung cancer diagnoses and in need of their support. Other restructuring processes included membership in the ACR Lung Cancer Screening Registry, changes to the electronic medical record and billing codes, and internal processes to ensure compliance with ACA and CMS policy.

Outcome Measures: Reach and Adherence

Six provider practices from three separate clinics participated in the pilot program and referred their patients to the community hospital for LDCT lung cancer screening. Between May 2018 and December 2020, a total of 567 LDCT scans were performed. The majority of the patients who were screened were between the ages of 65 and 69 years and identified as being white. The program's reach (ie, the proportion of eligible patients who participated in the screening program) [30] increased between 2018 and 2020. We characterized the "screen-eligible adults" as patients who reside in the county who are 55 or older and have smoking histories. We recognize that this is a substantial overestimate of the number eligible for screening. This approach to characterizing our denominator will result in an underestimate of reach but will allow us to identify change in reach. In 2020, approximately 6.93% of eligible adults were screened (318 of the 4,611 adults 55 and older who smoke cigarettes) [36], compared with 4.47% in 2019 (206 of the 4,611 adults 55 and older who regularly smoke cigarettes) [36] and 0.93% in 2018 (43 of the 4,611 adults 55 and older who smoke cigarettes) [36] (Fig. 3). The increase in reach was driven by new patients referred for lung cancer screening and undergoing baseline scans. The adherence rate, defined as having the next scheduled LDCT scan within 90 days of its annual due

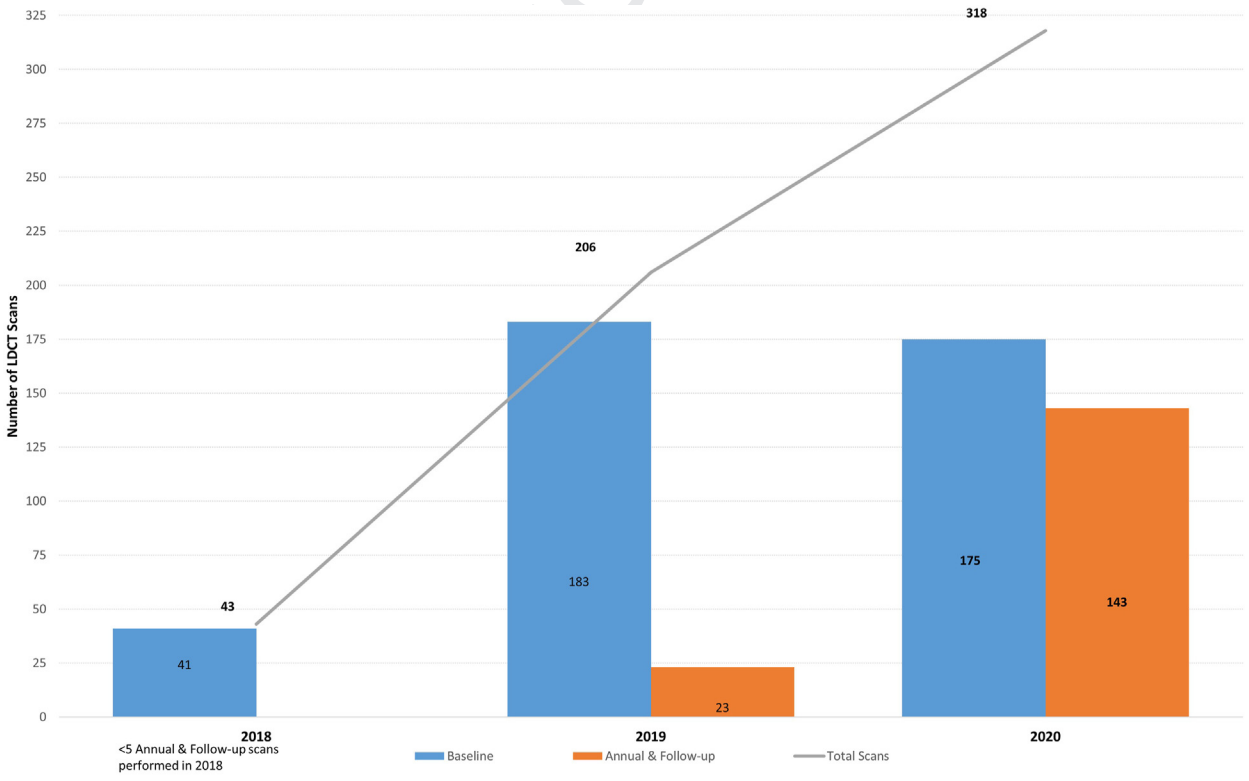

Fig. 3. Baseline and annual scans, 2018 to 2020. LDCT = low-dose CT.

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date [31], also increased from 53.49% in 2019 (23 follow-up scans in 2020, 43 baseline and annual follow-up scans in 2019) to 69.42% in 2020 (143 annual scans performed in 2020, 206 baseline and annual follow-up scans performed in 2019) (Fig. 3).

The majority of LDCT scans occurring between 2018 and 2020 had negative findings (Lung-RADS 1; n = 141) or findings that were benign in appearance or behavior, with <1% chance of malignancy (Lung-RADS 2; n = 339) [33]. During the same time frame, 55 scans were classified as having probably benign results, with a 1% to 2% chance of malignancy (Lung-RADS 3) [33]. Patients with scans categorized as Lung-RADS 3 were referred for 6-month follow-up LDCT scans. Between 2018 and 2020, 30 scans were categorized as having suspicious or very suspicious findings (Lung-RADS 4A, 4B, or 4X), and 2 scans performed in 2019 had indeterminate results. Between 2018 and 2020, a total of 17 scans were classified as Lung-RADS 4A, probably suspicious with a 5% to 15% chance of malignancy. Lung-RADS 4A indicates that solid nodules were detected (eg, ≥8 to <15 mm at baseline or growing <8 mm or new 6 to <8 mm) or subsolid nodules (eg, ≥6 mm with solid component ≥6 mm to <8 mm or with a new or growing <4-mm solid component) were detected [33]. Patients with scans categorized as Lung-RADS 4A were referred for 3-month follow-up LDCT screening. Five scans (1 in 2018 and 2 in 2019 and 2020) were classified as Lung-RADS 4B, with a >15% chance of malignancy. The Lung-RADS 4B category is characterized by the detection of solid nodules (ie, ≥15 mm at baseline or new or growing and ≥8 mm) or subsolid nodules (ie, solid component ≥8 mm or new or growing ≥4 mm solid component) [29]. A total of 8 scans (1 in 2018, 5 in 2019, and 2 in 2020) received a Lung-RADS 4X classification of being suspicious, with a >15% chance of malignancy. The Lung-RADS 4X classification signifies an increased suspicion of malignancy where spiculation, ground-glass nodules that double in size in 1 year, and/or enlarged regional lymph nodes are detected on the LDCT scan [33]. Patients with Lung-RADS 4B and 4X classification were referred for additional diagnostic imaging and/or tissue sampling. The distribution of scans by year and by Lung-RADS assessment category is shown in Table 2.

Lung cancer was detected in 2.11% (12 patients) of the 567 scans performed over the 3-year period from 2018 to 2020. Of those persons who received a lung cancer diagnoses, lung cancer was detected at stage I or stage II in 66.66% of patients (n = 8) and at stage IV in 16.66% of patients (n = 2). Cancer types identified included squamous cell (33% [n = 4]) and small cell (33% [n = 4]).

Table 2.

Year	Lung-RADS 1: Negative		Lung-RADS 2: Benign Appearance/ Behavior		Lung-RADS 3: Probably Benign		Lung-RADS 4A: Suspicious		Lung-RADS 4B: Very Suspicious		Lung-RADS 4X: Very Suspicious		Indeterminate		Total Scans by Year
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
2018	11	7.80	19	5.60	9	16.36	2	11.76	1	20	1	12.50	0	0	43
2019	49	34.75	118	34.81	22	40.00	8	47.06	n < 5	40	5	62.50	n < 5	100	206
2020	81	57.45	202	59.59	24	43.64	7	41.18	n < 5	40	n < 5	25	0	0	318
Total scans by category	141		339		55		17		5		8		n < 5 (2)		567

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DISCUSSION

We presented here the successful implementation of an LDCT screening program in a rural hospital. The intervention consisted of following recommendations for an efficient and effective lung cancer screening that included (1) accurately identify patients eligible for screening, (2) provide access to screening at qualified facilities for eligible patients, (3) ensure appropriate follow-up for positive and negative screening results, (4) promote continuous quality improvement of screening programs and downstream care, and (5) provide smoking cessation support for all current smokers [21]. The multifaceted implementation strategy consisted of planning, education, and restructuring processes that were followed. Implementation processes and program outcomes were measured.

This community hospital's approach to LDCT lung cancer screening as a cohesive continuum was an intentional choice. Guided by five standards for effective and efficient LDCT screening, primary and specialty care along with health care administrators worked collaboratively through an intentional implementation strategy consisting of planning, education, and restructuring processes to develop and implement lung cancer screening that supported patients through the entire process, from prescreening shared decision making with their providers through postscreening coordinated follow-up care that included access to smoking cessation support. Collaboration among administrators and specialty care providers, primary care, and community stakeholders ensured that the program met the needs of the community and was driven by quality improvement and that patient- and system-level barriers to accessing screening were removed.

A total of 567 scans were performed over the 3-year period of the pilot program. The LDCT lung cancer screening program's reach increased from 0.93% in 2018, the year the program was implemented, to screening 6.9% of eligible adults in 2020. The adherence rate to follow-up scans increased from 51% in 2019 to 60% in 2020. Cancer was detected in 2.11% or 12 patients between 2018 and 2020.

Provider awareness and communication are critical, as screening relies on primary care to refer patients who are at high risk for lung cancer [37]. Through grand rounds and other tailored outreach activities, the community hospital successfully augmented PCP awareness of lung cancer incidence and mortality in the region, the availability of LDCT screening, and referral eligibility per the USPSTF grade B screening recommendation. Furthermore, PCPs participated on two separate multidisciplinary planning committees that provided guidance on the implementation strategy's planning, education, and restructuring processes. Through their contributions, PCPs were informed and engaged in the LDCT screening program's objective to improve lung cancer health outcomes through early detection.

Revision of the USPSTF 2013 grade B recommendation, coupled with Medicaid and ACA policy changes, LDCT screening reimbursement policy significantly increased the availability of lung cancer screening in rural communities [17]. The expansion of LDCT screening in rural communities presents an opportunity to improve lung cancer survival rates through early detection. However, ineffective screening in community hospital settings threaten the enormous lifesaving potential of LDCT screening. Consequences of an ineffective and inefficient LDCT program include using the wrong criteria to define "high risk," such that the wrong patients are screened; fragmented or error-prone reporting systems; uncoordinated patient care after LDCT screening; and neglecting to consider the importance of smoking cessation support.

A notable strength of the implementation strategy, which encompassed planning, education, and restructuring processes, was the intentional involvement of multidisciplinary stakeholders in the screening program's design. This approach engaged a broad cross-section of community stakeholders to come together to reduce lung cancer mortality and improve lung cancer outcomes in their area through early detection. In addition to fostering community ownership of the lung cancer screening program, this multidisciplinary community stakeholder approach facilitated planning, education, and restructuring processes that incorporated several different areas of expertise and leveraged local community knowledge. The result was a screening program that is intentionally responsive to the unique contexts of a rural area with a high percentage of smokers.

A notable weakness of this approach was the reliance on a lung screening program champion who led the community engagement effort. The program's champion was a respected physician in the community and successfully garnered support for the program and participation in the multifaceted implementation strategy by area providers participating on the community-clinical advisory group and lung cancer screening committee. However, when the screening program's champion moved out of the area, a leadership void was created.

Recommendations

The following are a series of recommendations based on this community hospital's experience designing and implementing a lung cancer program using LDCT.

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1. Approach the development of a lung cancer screening program as an interrelated series of components within an overarching program oriented toward process improvement (ie, prescreening, screening, postscreening follow-up care for normal and abnormal results, and smoking cessation support and annual follow-up scans).
2. Position PCPs as key stakeholders in the LDCT lung cancer screening program and create opportunities for primary and specialty care to collaborate around program design, workflow processes, and outcome assessment.
3. Have a dedicated LDCT program coordinator to manage all aspects of the lung cancer screening program. The screening program coordinator assumed this role in addition to their other duties. The coordinator reported that 50% of their job involved managing the lung cancer screening program. Their recommendation after 3 years of working within this model is that a dedicated program coordinator solely focused on the program's operations is an important component of a lung cancer screening program.
4. Strategically position change agents who have influence and decision-making authority in both internal and outward-facing community LDCT planning committees. This recommendation is aimed at ensuring consistency in communication and accountability across stakeholder groups, including primary care. The inclusion of multiple change agents on these committees acts as a safety-net strategy to ensure that program design, planning, and implementation continue uninterrupted should personnel changes occur.

CONCLUSION

Lung cancer is the leading cause of cancer-related mortality in Oregon and nationally, with four in five lung cancer deaths in Oregon related to tobacco smoking [1]. Early detection is imperative in improving lung cancer survival rates and has the potential to save lives [6,7]. An effective population-based lung cancer screening program has the potential to save many lives, if implemented properly. This rural community hospital's approach involved uniting primary care, specialty care, and community stakeholders around a single goal of improving lung cancer outcomes through early detection. The implementation strategy was intentionally organized around five recommendations for an effective and efficient lung cancer screening program and involved planning, education, and restructuring processes. Significant stakeholder involvement on three separate committees ensured that the program's design was relevant to local community contexts and patient centered. As a result, the screening program's reach and adherence increased each year of the 3-year pilot program.

TAKE-HOME POINTS

- LDCT lung cancer screening is an evidence-based approach to improving lung cancer survival rates through early detection.
- Approaching LDCT lung cancer screening as a screening continuum, supporting patients from prescreening shared decision making with their PCPs through postscreening follow-up care and smoking cessation support, is a promising approach to facilitate an effective and efficient patient-centered screening program.
- Uniting primary care, specialty care, and the community hospital cancer center in support of the LDCT screening program facilitated an effective and efficient lung cancer screening program by aligning clinicians and health care administrators around a single goal, to improve lung cancer outcomes through early detection.
- The LDCT lung cancer screening program discussed in this report is an example for replication for other rural community hospital settings. Approaching screening as a continuum, rather than an episodic radiology event, coupled with engagement of primary care in the planning and design of the screening program, facilitated alignment of specialty and primary care in a shared goal of accurately identifying high-risk individuals to screen and supporting them throughout the screening process.

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