The Case for Lung Cancer Screening: What Nurses Need to Know

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Background: Lung cancer screening with low-dose helical computed tomography (LDCT) can improve high-risk individuals’ chances of being diagnosed at an earlier stage and increase survival.

Objectives: The aims of this article are to present the risk factors associated with the development of lung cancer, identify patients at high risk for lung cancer qualifying for LDCT screening, and understand the importance of early lung cancer detection through the use of LDCT screening.

Methods: PubMed and CINAHL® databases were searched with key words lung cancer screening to identify full-text academic articles from 2004–2014. This resulted in 529 articles from PubMed and 195 from CINAHL. PubMed offered suggestions for additional relevant journal articles. The National Comprehensive Cancer Network guidelines also provided substantial evidence-based information.

Findings: Nurses need to provide support, education, and resources for patients undergoing lung cancer screening.

A n estimated 8,100 lives are saved each year through early detection of lung cancer (Goulart, Bensink, Mummy, & Ramsey, 2012). Lung cancer screening has been a hotly debated topic, with varying degrees of evidence from a variety of studies in the United States and Europe. The purpose of this article is to examine the controversy surrounding lung cancer screening with low-dose helical computed tomography (LDCT) screening, including risk versus benefit, cost, and insurance coverage. This article will explore evidence from the National Lung Screening Trial (NLST) and the National Comprehensive Cancer Network (NCCN) lung cancer screening guidelines. Management strategies and implications for nursing practice also will be presented.

Pathophysiology

Lung cancer occurs when malignant cells begin to proliferate within the lung tissue or bronchus. Small cell and non-small cell types (squamous, large cell, undifferentiated, and adenocarcinoma) make up about 95% of lung cancers (Humphrey et al., 2013). Lung cancer is staged based on the American Joint Committee on Cancer by the tumor, node, and metastasis (TNM) staging system (Edge et al., 2010). Staging incorporates tumor size, node involvement, metastasis, and specific levels of invasion. Stage 0 represents carcinoma in situ, stages IA and IB include tumors 2–5 cm at their greatest dimension with no node involvement, and stages IIA and IIB include tumors 5–7 cm in diameter with only one positive lymph node (Edge et al., 2010). Stages 0 through IIB are considered to be early stages and have the best survival rates (Crinò, Weber, van Meerbeeck, & Felip, 2010).

Etiology

Cigarette smoking is the leading cause of lung cancer worldwide, with 85% of lung cancer cases occurring in smokers (U.S. Department of Health and Human Services, 2014a). In the United States, an additional 7,000 deaths from 2005–2009 were attributed to secondhand smoke in nonsmokers (U.S. Department of Health and Human Services, 2014b). Radon, a radioactive gas found in high levels in about 1 in every 15...
homes in the United States, may cause lung cancer in smokers and nonsmokers (Richards, White, & Caraballo, 2014). Homes can be tested and have mitigation systems installed to lower radon to safe levels.

Millions of U.S. workers are estimated to be exposed to environmental carcinogens at work every day (President’s Cancer Panel, 2010). Greater levels of exposure to known lung carcinogens such as asbestos, diesel exhaust, nickel, silica, hexavalent, cadmium, beryllium, arsenic, and formaldehyde can occur in certain occupations (Field & Withers, 2012). The 2010 President’s Cancer Panel also made note of potential carcinogens in the tens of thousands of untested chemicals used in households every day.

Increased lung cancer rates in the general population have been linked to exposure to outdoor air pollution (Raaschou-Nielsen et al., 2013). Additional factors increasing the risk of developing lung cancer include a family history of lung cancer, diagnosis of chronic obstructive pulmonary disease, and infection with HIV. The risk of developing a new primary lung cancer increases with a history of other cancer diagnoses such as lymphoma, head and neck cancer, and a prior lung cancer diagnosis (Alberg, Brock, Ford, Samet, & Spivack, 2013).

Prevalence

In 2014, lung cancer was the leading cause of cancer-related death in the United States and the second most commonly occurring cancer (American Cancer Society [ACS], 2014). Lung cancer accounts for 14% of all newly diagnosed cancers (ACS, 2016). Two-thirds of patients with lung cancer are diagnosed at age 65 years or older, with an average age of 70 years (ACS, 2016).

According to the U.S. Cancer Statistics Working Group (2013), 206,000 people are diagnosed with lung cancer and 160,000 die each year from the disease. More than 50% of lung cancers have metastasized at the time of diagnosis, leaving five-year survival rates for metastasized cancer at less than 5% (Howlander et al., 2013). A diagnosis of lung cancer is estimated to lead to an average of 15 years of life lost, the greatest of any cancer in the United States (National Cancer Institute [NCI], 2012).

High-Risk Individuals

Smoking causes about 90% of lung cancer cases in the United States (Centers for Disease Control and Prevention [CDC], 2014). According to the CDC (Agaku, King, & Dube, 2014), 18% of people in the U.S. population were daily cigarette smokers in 2012, a decline from 21% in 2005. Despite the decline in current smokers, the risk for lung cancer continues for years after quitting, leaving former smokers at high risk. Age and number of years of tobacco exposure are the two most common factors associated with lung cancer incidence (Moyer, 2014).

Controversial Issues

Objections to lung cancer screening with LDCT have included possible harm related to radiation exposure, overdiagnosis, and cost. Overdiagnosis refers to the rate of false positives from LDCT and detection of lung cancers unlikely to be significant in the participant’s lifetime (Patz et al., 2014). The U.S. Preventive Services Task Force (USPSTF) estimates the rate of overdiagnosis at 10% of those screened based on the NLST screening criteria and the death rate from radiation-induced lung cancer at 1% (Moyer, 2014).

Each LDCT exposes patients to 1.5 mSv of radiation (NLST Research Team, 2011). Yearly LDCT screening during a 25-year period incurs an estimated 37.5 mSv of radiation. This could increase if higher-dosed CT scans at 6–8 mSv are ordered for indeterminate nodules discovered on previous screening. The U.S. Regulatory Commission (2014) stated that no data link cancer to levels less than 100 mSv, but 25 years of screening added to environmental exposure of 3 mSv each year results in a cumulative dose of 112.5 mSv. Achieving low radiation exposure requires judicious use of additional scanning.

False positives place patients at risk for additional testing and invasive procedures (Humphrey et al., 2013).Awaiting test results and undergoing unnecessary procedures can lead to complications and distress (Hunnibell et al., 2013). One study discovered that most patients automatically assumed a pulmonary nodule meant they had cancer and experienced greater distress when physicians did not explain the follow-up plan or the cancer risk related to the nodule (Wiener, Gould, Woloshin, Swartz, & Clark, 2013). A systematic review by Slatore, Sullivan, Pappas, and Humphrey (2014) determined that patients undergoing LDCT lung cancer screening do experience distress and anxiety with false-positive screenings. During this time of increased distress, patients require support and a thorough explanation to manage their distress. Performing lung cancer screening at a center offering multidisciplinary services is recommended by NCCN (2016). Many centers have nurse navigators in their pulmonary programs to manage patients with lung nodules, ensuring patient tracking and follow-up (Hunnibell et al., 2013). Navigators can mitigate barriers to care, as well as provide education and reassurance to patients (Hunnibell et al., 2012).

Concern about cost effectiveness is another objection to lung cancer screening. Based on data from the NLST, Goulart et al. (2012) determined that if three-fourths of high-risk individuals were screened annually, it would cost the healthcare system about $1.3–$2 billion, or about $240,000 to prevent one death from lung cancer. However, treating lung cancer in the United States was estimated to cost more than $12 billion in 2010, with a projected cost of $18 billion by 2020 (Mariotto, Yabroff, Shao, Feuer, & Brown, 2011). The first year of lung cancer treatment for a single patient costs more than $60,000, and the final year of life costs more than $90,000 (Mariotto et al., 2011). Screening increases healthcare expenditures but saves on treatment costs and results in less mortality from lung cancer.

The estimated cost of lung cancer screening is about $247 for the initial screening and even less for subsequent scans. Compared to other standardized insurance-covered cancer screenings such as breast, cervical, and colon, lung cancer screening is more cost effective (Pyenson, Sander, Jiang, Kahn, & Mulshine, 2012). In 2012 dollars, the cost per life-year saved was $50,000–$75,000 with cervical cancer screening, $31,000–$51,000 with breast cancer screening, and $18,000–$28,000 with colorectal cancer screening (Pyenson et al., 2012). At $18,000–$26,000, lung cancer screening is tens of thousands of dollars more cost effective than breast or cervical cancer screening and similar to colorectal cancer screening.
Supporting Literature

Lung cancer survival is based on tumor staging at the time of diagnosis. Detecting tumors at the earliest possible stage renders better outcomes and improves overall survival. Patients with localized lung cancers (stage IA or IB) have an estimated median five-year survival of 77%, and those with metastatic disease (75% of the cases) have a five-year survival rate of 4% (Dettetterbeck, Bozza, & Tanoue, 2009).

With more than 53,000 study participants, the NLST was one of four randomized, controlled trials used by the USPSTF as evidence supporting LDCT screening (U.S. Department of Health and Human Services, 2014a). The NLST participants were randomized to LDCT or chest radiography (x-ray) during a two-year period. A baseline LDCT scan and two subsequent annual screenings were measured for the LDCT group. The chest radiography group had a baseline chest x-ray followed by two annual chest x-rays. The results of the NLST study showed a 20% reduction in relative mortality from lung cancer with the use of LDCT as compared to screening with chest x-ray alone.

Evidence-Based Screening Protocols

Evidence suggests that the group having the greatest risk/benefit ratio with LDCT screening is current or former smokers aged 55 years and older with a minimum 30 pack-year smoking history (NCI, 2013). Former smokers meeting criteria should be screened within 15 years of quitting. NCI (2013) noted that the risk of lung cancer diminishes by 30%-50% 10 years after quitting.

NCCN was the first organization to publish evidence-based guidelines for lung cancer screening (Wood et al., 2012). NCCN (2016) guidelines suggest consideration of several criteria to safely implement a lung cancer screening program. These include appropriate-grade CT scanners with specialized software to enhance interpretation, physicists to ensure safety with radiation exposure, trained radiology staff, guidelines for the management of positive findings, and a plan for care coordination for follow-up and communication with the primary care physicians ordering the scans (NCCN, 2016). Quality control for the interpretation of scans, well-trained radiologists, and a multidisciplinary approach for the management of positive findings are critical to lung cancer screening programs (Rampinelli, Origi, & Bellomi, 2013).

Incorporating smoking cessation with lung cancer screenings has been adopted by many organizations. The ACS, NCCN, and USPSTF all recommend integrating smoking cessation programs with lung cancer screening to ensure that participants understand the continued risk of smoking (NCCN, 2016; USPSTF, 2014a; Wender et al., 2013).

Management Strategies for Positive Low-Dose Helical Computed Tomography Findings

If a suspicious nodule is identified on LDCT, more diagnostic workup with additional scanning or a biopsy is the next step. However, researchers feel that a wide range of nodule sizes warrant additional testing (Bach et al., 2012). In a systematic review, Bach et al. (2012) noted that some researchers worked up nodules of any size and others focused on nodules ranging in size from greater than 5 mm to more than 15 mm in diameter.

The size of the nodule affects the likelihood of malignancy (Ha & Mazzone, 2014). Ha and Mazzone (2014) noted that the risk of malignancy can be determined by nodule size, growth rate, location, and amount of calcification; therefore, accurate assessment and management of findings are critical. Determining which nodules require additional workup is paramount in preventing unnecessary medical procedures.

NCCN and the American College of Radiology (ACR) have changed the lung nodule size qualifying as a positive finding from 4 mm to 6 mm in diameter (Wood et al., 2015). The NLST criterion for a positive finding was 4 mm, but several studies (Gierarda et al., 2014; Horeweg et al., 2014; Yip, Henschke, Yankelovitz, & Smith, 2014) showing an increased number of false positives related to this criterion encouraged a change in the guidelines. Recognizing the negative impact of false-positive findings, NCCN is also in the process of incorporating the ACR’s Lung Imaging Reporting and Data System (Lung-RADS™) into its guidelines. Lung-RADS is a tool used to standardize lung cancer screening through the use of specific categories to classify findings and assimilate outcomes (ACR, 2014). Standardizing the management and reporting of lung nodules using Lung-RADS™ has decreased the number of false-positive results to 1 in 10, compared to 1 in 4 in the NLST (Wood et al., 2015).

Nursing implications for the management of nodules detected on screening include understanding the radiologic findings consistent with malignancy (Hunnibel et al., 2013). According to NCCN (2016), screening programs should be instituted at facilities proficient at providing multidisciplinary services. These services should include nurses capable of understanding findings, educating patients, reducing distress, and planning appropriate follow-up.

Recommendations

In congruence with the ACS, USPSTF, NCCN, and American College of Chest Physicians, lung cancer screening by LDCT is recommended for current or former smokers having quit in the past 15 years who are aged 55–74 years (as old as 80 years for USPSTF recommendations) and have greater than or equal to a 30 pack-year smoking history (Dettetterbeck, Mazzone, Naidich, & Bach, 2013; Moyer, 2014; Simon, 2013; Wood et al., 2015). A screening program with LDCT, smoking cessation, and follow-up is prudent. Lung cancer screening programs should be implemented with established guidelines to maintain quality.

NCCN (2016) integrates results from I-ELCAP, NLST, and additional research studies to provide evidence-based guidelines for lung cancer screening and management of positive findings. Recognized as the standard of oncology care, the NCCN guidelines are the most comprehensive, up-to-date guidelines for clinical practice, incorporating extensive review of literature, evidence, and expert clinical judgment from top cancer physicians and other healthcare providers (NCCN, 2016).

Although cost has been a concern for those objecting to lung cancer screening, maintaining quality standards provides efficient, cost-effective health care (Weston & Roberts, 2015). Provisions in the Affordable Care Act (ACA) mandate that private insurance companies provide preventive care without
cost sharing or copays for screenings recommended as grade A or B by the USPSTF (U.S. Department of Health and Human Services, 2012). USPSTF grade A recommendation is defined as a high likelihood that the action has significant benefit, and grade B has a moderately substantial benefit (USPSTF, 2014b). The ACA ties payment for services to quality patient care (Centers for Medicare and Medicaid Services [CMS], 2012). Designing a lung cancer screening program using the NCCN guidelines can ensure quality care and full reimbursement for services.

Ongoing research for risk determination and early detection of lung cancer includes biomarker testing and volumetric analysis of nodules (Kanodra, Silvestri, & Tanner, 2015). Breath analysis for volatile organic compounds also is being tested as an inexpensive and noninvasive method of detecting lung cancer. Technologic advances have improved the ability to use biomarker testing to determine those who may be at risk for or have lung cancer. Ulivi and Zoli (2014) evaluated MicroRNA (miRNA) expressed from cancer cells in the blood and sputum and discovered a 60%–100% sensitivity and specificity to the diagnosis and prognosis of non-small cell lung cancer. In one retrospective study, integration of this testing with LDCT improved screening sensitivity to 98%, with a five-fold reduction in false positives when patients were positive for both of these tests (Sozzi et al., 2014). Other biomarkers include detection of autoantibodies against tumor proteins, proteomic signatures, and gene expression biomarkers from epithelium in the airways (Kanodra et al., 2015).

**Implications for Nursing**

Although great controversy has surrounded the risks and benefits of lung cancer screening, nurses without a doubt play a crucial role in cancer screening, care, and prevention. At no cost to patients, CMS reimburses for annual lung cancer screening with LDCT for high-risk individuals aged 55–77 years who are current or former smokers reporting an equivalent of one pack per day for 30 years or more (CMS, 2015). In addition, former smokers also are covered for screening if they quit within the past 15 years and have no symptoms of lung cancer at the time of screening.

Screening for tobacco use and cessation counseling are recommended as a core measure by CMS and were given an A recommendation by the USPSTF (CMS, 2014; USPSTF, 2015). Following these recommendations, nurses and advanced practice nurses (APRNs) should assess their patients’ smoking history and offer cessation counseling. Understanding the criteria and the pros and cons for lung cancer screening can facilitate patient education regarding high-risk behaviors and promotion of screening for prospective candidates. Recognizing a high-risk individual older than age 55 years with at least a 30 pack-year of cigarette smoking within the past 15 years allows nurses to speak directly to the patient’s risk for lung cancer. Nurses can provide patients with resources for lung cancer screening guidelines and smoking cessation (Hunnibell et al., 2013).

Nurses and APRNs can share information about lung cancer screening to help patients make an informed decision (see Figure 1). Education should include the potential benefits and harms from lung cancer screening, the need for follow-up care, the importance of being screened at a high-quality center, and adherence with continued smoking cessation (Lehto, 2014). The influence of nurses on behavior change can result in prolonged life expectancy, improved quality of life, fewer complications, and cost containment (Smith & Berg, 2008). Tobacco cessation has been shown to increase following even brief nursing interventions (U.S. Department of Health and Human Services, 2008). Medication and counseling increase smoking cessation and are even more effective when used in combination (U.S. Department of Health and Human Services, 2008). APRNs are in a position to counsel and prescribe recommended first-line smoking cessation medications.

The public health relevance of addressing lung cancer in the United States is clear and presents an opportunity for the nursing profession to take an active role in changing health outcomes. The impact of the current recommendations by CMS supporting annual lung cancer screening for high-risk individuals has a direct bearing on nurses and APRNs (Smith & Berg, 2008).

**Conclusion**

The NLST presents decisive evidence supporting lung cancer screening and describes the risks and benefits. The outcomes of this trial assisted in the identification of specific criteria to determine those at highest risk who would benefit from screening to provide early diagnosis for optimal health outcomes and preserve remaining lung function. The NLST demonstrated that screening, early diagnosis, and treatment can decrease morbidity and mortality, enhance quality of life in the face of diagnosis, and decrease the cost for patients with lung cancer. Creating a successful and effective lung cancer screening program requires evidence-based guidelines and quality assurances to reproduce study findings and, therefore, affect mortality rates. Implementing evidence-based protocols, such as the NCCN guidelines, can assist with screening

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**American Cancer Society**
Lung cancer screening guidelines

**American Lung Association**
Is lung cancer screening right for me?

**Lung Cancer Alliance**
Understanding lung cancer risk and screening

**National Comprehensive Cancer Network (NCCN)**
NCCN Guidelines for Patients®: Lung cancer screening
[https://nccn.org/patients/guidelines/lung_screening](https://nccn.org/patients/guidelines/lung_screening)

**UpToDate®**
Patient information: Lung cancer prevention and screening

**FIGURE 1. Resources for Patient Education**
program design and decision making for treatment of positive findings. Understanding the impact of lung cancer screening is critically important for nurses practicing at the front line of disease prevention and health promotion efforts. The aforementioned guidelines and recommendations provide nurses with additional prevention measures to achieve optimal health outcomes for patients with tobacco dependence.

References


