CT Screening for Lung Cancer

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Outline

- Review of National Lung Screening Trial (NLST)
- USPSTF recommendations
- Recent developments
- Implementation at DHMC
Lung Cancer Facts

• Leading cause of cancer death
• 224,210 new cases in 2014
• 159,260 deaths in 2014
• 17% 5-year survival
• Cigarette smoking causes > 80%

American Cancer Society. www.cancer.org
### Mayo Clinic Project

<table>
<thead>
<tr>
<th></th>
<th>Screened (CXR + SC)</th>
<th>Control (Usual)</th>
</tr>
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<tbody>
<tr>
<td>Subjects $^1$</td>
<td>4,618</td>
<td>4,593</td>
</tr>
<tr>
<td>Incident cases</td>
<td>206</td>
<td>160</td>
</tr>
<tr>
<td>% resectable</td>
<td>46</td>
<td>31</td>
</tr>
<tr>
<td>% five-year survival</td>
<td>31</td>
<td>13</td>
</tr>
<tr>
<td>Lung cancer deaths</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Relative risk $^2$ (95%CI)</td>
<td>?</td>
<td>?</td>
</tr>
</tbody>
</table>

$^1$ 91 prevalent cases excluded before randomization
$^2$ based on cumulative lung cancer mortality at eleven year

Biases of Early Detection

• Lead time bias
• Length bias
• Overdiagnosis bias
# Mayo Clinic Project

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<tr>
<td>Lung cancer deaths</td>
<td>122</td>
<td>115</td>
</tr>
<tr>
<td>Relative risk² (95%CI)</td>
<td>1.06 (0.82-1.36)</td>
<td></td>
</tr>
</tbody>
</table>

¹ 91 prevalent cases excluded before randomization
² based on cumulative lung cancer mortality at eleven year

Hamartoma
NLST Study Design

• Prospective randomized trial
• 53,454 individuals @ high risk
• 1:1 randomization LDCT: CXR
• 3 annual screens
• Primary endpoint: lung cancer mortality

NLST: Eligibility

- No symptoms of lung cancer
- Ages 55-74
- $\geq 30$ pack-yr history of smoking
- No prior lung cancer
- Medically fit for surgery

## Stage of Lung Cancers Diagnosed by NLST arm.

<table>
<thead>
<tr>
<th>Cancer Stage</th>
<th>Low-dose CT N=1060</th>
<th>Chest X-Ray N=941</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>IA</td>
<td>416</td>
<td>40</td>
</tr>
<tr>
<td>IB</td>
<td>104</td>
<td>10</td>
</tr>
<tr>
<td>II</td>
<td>73</td>
<td>7</td>
</tr>
<tr>
<td>III</td>
<td>221</td>
<td>21</td>
</tr>
<tr>
<td>IV</td>
<td>226</td>
<td>22</td>
</tr>
<tr>
<td>Total*</td>
<td>1040</td>
<td>100</td>
</tr>
</tbody>
</table>

Cumulative Numbers of Lung Cancers and of Deaths from Lung Cancer

## Lung Cancer Mortality

<table>
<thead>
<tr>
<th></th>
<th>Low-dose CT</th>
<th>CXR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person-years</td>
<td>144,103</td>
<td>143,368</td>
</tr>
<tr>
<td>Lung cancer deaths</td>
<td>356</td>
<td>443</td>
</tr>
<tr>
<td>Lung cancer mortality rate</td>
<td>247</td>
<td>309</td>
</tr>
<tr>
<td>(per 100,000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative risk reduction (%)</td>
<td>20.0</td>
<td>95% CI, 6.8 to 26.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P = 0.004</td>
</tr>
</tbody>
</table>

Through Jan 15, 2009

Aberle et al. N Engl J Med
### All Cause Mortality

<table>
<thead>
<tr>
<th></th>
<th>Low-dose CT</th>
<th>CXR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person-years</td>
<td>Not Reported</td>
<td>Not Reported</td>
</tr>
<tr>
<td>All deaths</td>
<td>1,877</td>
<td>2,000</td>
</tr>
<tr>
<td>All cause mortality (per 100,000)</td>
<td>1,303</td>
<td>1,395</td>
</tr>
</tbody>
</table>
| Relative risk reduction (%) | 6.7         | 95% CI 1.2 to 13.6  
                           |             |  
                           |             | P = 0.02  |

Through Dec 31, 2009

Aberle et al. N Engl J Med
Absolute Risk Reduction of Lung Cancer Death

\[ \frac{425}{26,232} - \frac{346}{26,455} = 0.0031 \approx 3 \text{ per 1,000} \]

Aberle et al. N Engl J Med
Number Needed to Screen to Prevent One Lung Cancer Death

NNS = 1/ARR

= 1/0.0031

= 320

Aberle et al. N Engl J Med
Harms of CT screening for Lung Cancer

- False-positive screening results
- Overdiagnosis
- Radiation exposure
False-Positive CT Screening Results

- $\approx 27\%$ during first round of screening
- $\approx 37\%$ during all three rounds of screening
- Most common follow-up was a single low-dose CT
- $< 7\%$ of false positive participants had invasive procedure

Overdiagnosis

- More lung cancers in low-dose CT than CXR: 1089 vs 969
- ≈ 11% of the CT screen detected lung cancers overdiagnosed
- Rates of overdiagnosis much higher for in situ and minimally invasive tumors than other NSCLC, 49% vs 3%

Radiation Exposure

- Effective dose low-dose CT 1.4 mSv
- Effective dose standard chest CT 7 mSv
- Effective dose natural background 3.1 mSv
- CT screening for lung cancer would prevent 20 times more lung cancer deaths than it would cause
- Benefit/risk least favorable for younger women with fewer pack-years

Larke et al. AJR, 2011
NLST Summary

• RCT of 53,454 individuals @ high risk
• 20% lung cancer mortality reduction
• 7% all cause mortality reduction
• Cumulative False Positive Rate ≈ 37%
• Modest degree of overdiagnosis

USPSTF Recommendation

The USPSTF recommends annual screening for lung cancer with low-dose computed tomography in adults ages 55 to 80 years who have a 30 pack-year smoking history and currently smoke or have quit within the past 15 years.

Moyer VA. Ann Intern Med. 2013
USPSTF Recommendation

Screening should be discontinued once a person has not smoked for 15 years or develops a health problem that substantially limits life expectancy or the ability or willingness to have curative lung surgery.

Grade B recommendation

Moyer VA. Ann Intern Med. 2013
USPSTF Other Considerations

- Smoking cessation
- Shared decision making
- Standardization of low-dose CT screening and follow-up
- Development of registry

Moyer VA. Ann Intern Med. 2013
MEDCAC

- Voted “low confidence” in April 2014
- Major concerns:
  - Who would be screened?
  - How and for how long would they be screened?
  - Proficiency of screening center?
ACR LungRADS

• Standardize reporting
• Reduce confusion
• Facilitate outcome monitoring
• Reduce positivity rate from 28% to 11%¹

¹Mckee et al. J Am Coll Radiol 2014
ACR Screening Center Designation

- Eligibility requirements
- Smoking cessation
- CT specifications
- Structured reporting
- Follow-up system
Cost Effectiveness Analysis

• Comparison: LDCT, CXR, No Screen
• Health effects: LYS and QALYs
• Costs: $US (reference 2009)
• Perspective: Societal
• Time horizon: Within-trial and lifetime
• Discount rate: 3%

## Base Case Results

<table>
<thead>
<tr>
<th>STRATEGY</th>
<th>$</th>
<th>QALYs</th>
<th>Δ$</th>
<th>ΔQALYs</th>
<th>$/QALY</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDCT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CXR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO SCR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One DH: Lung Cancer Screening Program

• Provider Brochure
• Patient Brochure
• Decision aids for shared decision making
• CT screening telephone access line
• Smoking cessation counseling
• Standardized reporting (LungRADS)
• Follow-up and communication with referring clinicians
Helping you decide about Lung Cancer Screening

This fact sheet explains the benefits and harms of lung cancer screening with low-dose CT scans so you and your health care provider can decide whether it is right for you.

Why should I be screened?
Lung cancer is most treatable when it is identified in the earliest stages.

What is lung cancer screening?
Lung cancer screening looks for signs of the disease before there are any symptoms in patients who are at high risk. Using advanced medical imaging equipment known as a CT scanner, a hospital radiology department can take very detailed “pictures” of your lungs. A doctor will then examine these pictures to look for changes that could be signs of lung cancer. Cancer can look like a spot on your lung. A CT scan is the only proven effective way to screen for lung cancer.

Who should consider being screened for lung cancer?
Medical experts agree that lung cancer screening should be offered annually to adults who meet all three of the following criteria:

- Current or former heavy smokers with at least 30 pack-years of smoking history
- Between the ages of 55-74
- Without any major health problems or conditions that would prevent a person from receiving cancer treatments like surgery

How to find your pack-years of smoking

\[
\text{pack years} = \text{years of smoking} \times \text{average number of cigarettes per day}
\]

Who should I be screened for?
Major medical societies recommend that lung cancer screening be done at medical centers with access to multi-disciplinary lung cancer diagnosis and treatment programs. Since the first scan can lead to additional testing, find a center that has the ability to interpret and respond to your results. Sometimes lung cancer screening identifies other things not related to lung cancer that may require follow up.

Potential benefits and harms of lung cancer screening

It is important to consider both the benefits and harms before deciding whether to have lung cancer screening. Use the table below to consider your options.

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Harm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced risk</td>
<td>Increased risk of dying from lung cancer</td>
</tr>
<tr>
<td>Early detection may be more successful</td>
<td>False positive results can lead to unnecessary treatment</td>
</tr>
<tr>
<td>It may detect cancer before you have any symptoms</td>
<td>More radiation exposure</td>
</tr>
<tr>
<td>More treatment options</td>
<td>More patients may have side effects</td>
</tr>
</tbody>
</table>

Are there radiation risks from the CT scan?
Low-dose CT scans expose patients to radiation. Over time, exposure to repeated or high doses of radiation may cause cancer and other health problems. For heavy former or current smokers, the benefit of screening is probably much greater than the harm from radiation.

The most important thing you can do
Stop smoking. Avoiding cigarettes is the most powerful way to lower your chance of dying or suffering from lung cancer, emphysema, and heart attacks. For help quitting, call 1-800-QUIT-NOW.

Benefits of Quitting Smoking

Within minutes of quitting smoking you will experience benefits.

Taking the next step
Talk to your health care provider about lung cancer screening. For more information, you can also visit cancer.dartmouth.edu/cancer-screening.

A patient decision aid by:

- Norris Cotton Cancer Center
- Dartmouth-Hitchcock Medical Center
- Grisel Medical Group
# Potential benefits and harms of lung cancer screening

It is important to consider both the benefits and harms before deciding whether to have lung cancer screening. Use the table below to consider your options.

<table>
<thead>
<tr>
<th>Benefits of Being Screened for Lung Cancer</th>
<th>Facts*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced risk</td>
<td>4 fewer lung cancer deaths when 1,000 people are screened.</td>
</tr>
<tr>
<td>Reduced chance of dying from lung cancer.</td>
<td></td>
</tr>
<tr>
<td>If caught early, treatment may be more successful.</td>
<td>Studies show that early treatment of lung cancer allows some patients to live a longer life.</td>
</tr>
<tr>
<td>It may detect cancer before you have any symptoms.</td>
<td>9 out of 10 lung cancers will be detected by screening.</td>
</tr>
<tr>
<td>More treatment options</td>
<td></td>
</tr>
<tr>
<td>If caught early you may have more treatment options.</td>
<td>Early lung cancer may be removable with surgery. Advanced lung cancers are often inoperable.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Harms of Being Screened for Lung Cancer</th>
<th>Facts*</th>
</tr>
</thead>
<tbody>
<tr>
<td>False alarms</td>
<td>365 in 1,000 will have a false alarm.</td>
</tr>
<tr>
<td>There is the chance of a false alarm. A false alarm is a result that looks like cancer but is not.</td>
<td></td>
</tr>
<tr>
<td>A false alarm could lead to an invasive procedure like surgery or a biopsy.</td>
<td>25 in 365 of those with a false alarm will have an invasive procedure.</td>
</tr>
<tr>
<td>Invasive procedures sometimes cause serious complications.</td>
<td>3 in 25 invasive procedures from false alarms will have a major complication.</td>
</tr>
<tr>
<td>Over diagnosis</td>
<td>4 in 1,000 people will be diagnosed with a slow growing cancer that would not lead to illness or death.*</td>
</tr>
<tr>
<td>Sometimes screening identifies slow growing cancers that would not lead to illness or death.*</td>
<td></td>
</tr>
</tbody>
</table>

*Benefits and harms based on results of the National Lung Screening Trial, which included three annual screens and five years of additional follow up. For more information cancer.gov/clinicaltrials/noteworthy-trials/nlst
eDH Order Entry

eDH name: CT Chest Screening Lung Cancer
eDH order code: IMG4556

Eligibility Criteria:
1. Willing and able to undergo lung cancer treatment
2. No symptoms or signs of lung cancer or respiratory infection in past 12 weeks
3. Minimum of 30 pack-years of smoking
4. If former smoker, quit within 15 years
5. Age 55-80 years
6. No hx of lung cancer ever or other cancer with metastatic potential in last 5 years
### Eligibility criteria:
1. Willing and able to undergo lung cancer treatment
2. No signs/symptoms of lung cancer or respiratory infection in past 12 weeks
3. Minimum of 30 pack-years of smoking
4. If former smoker, quit within 15 years
5. Age 55-80 years
6. No history of lung cancer ever or other cancer with metastatic potential in last 5 years

Screening Access Line will confirm eligibility.

### Status
- Future
- Expected: 2/4/2014
- Approx.
- Expires: 4/5/2014

### Priority
- Routine
- STAT

### Class
- Ancillary Per
- Ancillary Performed
- External

### Questions

<table>
<thead>
<tr>
<th>Prompt</th>
<th>Answer</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reason for exam and clinical history:</td>
<td>Lung Cancer Screening</td>
<td></td>
</tr>
<tr>
<td>2. Where will study be performed?</td>
<td>Leb - Radiology</td>
<td></td>
</tr>
<tr>
<td>3. This patient meets the eligibility criteria</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>4. Other pertinent information:</td>
<td>Asymptomatic but at high risk for lung cancer</td>
<td></td>
</tr>
<tr>
<td>5. Does patient require sedation?</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>6. GA rationale:</td>
<td>Airway Concerns, Anxiety/Claustrophobia, Obesity</td>
<td></td>
</tr>
<tr>
<td>7. Date of injury if applicable:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Requested Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Should this service/procedure be billed to the research sponsor?</td>
<td>Yes (STYO Encounter)</td>
<td></td>
</tr>
</tbody>
</table>
Treatments for Lung Cancer

- Surgery - lobectomy or wedge resection
- Stereotactic Radiation (within 1 week)
- Conventional radiation (several weeks)
- Radiofrequency ablation
- Chemotherapy
Payment Considerations

• Full coverage by private insurance in 2015

• Insurance should cover evaluation and treatment of findings, but these may be subject to deductibles and co-payments
Summary

• USPSTF recommend CT screening to select patients
• Full coverage by private insurance by Jan 1, 2015
• CMS proposal Nov 10, 2014.
• DH program based on USPSTF recommendation
• DH high standard for CT screening, eligibility criteria, informed decision making and thorough patient follow-up
References


References (cont)


