Lung Cancer Screening

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Professor of Radiology, Harvard Medical School
Objectives

- Development of the Lung Screening Program
- Program Eligibility
- Ordering Lung Screening Exams
- Interpretation of Lung Screening Exams
- Follow-up Recommendations and Management
- Pulmonary Nodule Clinic (PNC)
History of Smoking and Lung Cancer
History of Smoking and Lung Cancer
History of Smoking and Lung Cancer

Bob, I’ve got emphysema.

I miss my lung, Bob.
History of Smoking and Lung Cancer
Lung Cancer Statistics

**EVERY DAY 422 AMERICANS DIE OF LUNG CANCER.**

Lung cancer is the leading cancer killer of men & women in EVERY ETHNIC GROUP.

Of the men and women with lung cancer, 17.9% are NEVER SMOKERS.

Lung cancer makes up 25% of all CANCER DEATHS.

### 2018 LUNG CANCER FACTS

**LUNG CANCER IS THE LEADING CAUSE OF CANCER DEATH**

- **Lung and Bronchus:** 154,050
- **Colorectal:** 50,620
- **Pancreas:** 44,330
- **Breast (Female):** 41,400
- **Liver:** 30,200
- **Prostate:** 29,430
- **Lung Cancer:** 27,575
- **Leukemia:** 24,370
- **Lymphoma:** 20,960
- **Bladder:** 17,240
- **Brain:** 16,830
- **Esophagus:** 15,850
- **Uterus/Cervix:** 15,520
- **Kidney:** 14,970
- **Ovary:** 14,070

*Includes current, former and never smokers. ** Estimated never smokers only.

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1. National Cancer Institute, Surveillance, Epidemiology, and End Results (SEER), U.S. Cancer Mortality, 1975-2013, published April 15, 2016
Lung Cancer Statistics

Lung cancer is the leading cause of cancer death, but receives the least amount of federal research funding.

5 Year Survival Rate

<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>2007-2013</th>
<th>1975-1977</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate Cancer</td>
<td>99%</td>
<td>67.8%</td>
</tr>
<tr>
<td>Breast Cancer</td>
<td>91%</td>
<td>74.8%</td>
</tr>
<tr>
<td>Colon Cancer</td>
<td>66%</td>
<td>49.8%</td>
</tr>
<tr>
<td>Lung Cancer</td>
<td>20%</td>
<td>12.2%</td>
</tr>
</tbody>
</table>

NIH Research Dollars per Death

<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>2016 Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung Cancer</td>
<td>$1,231</td>
</tr>
<tr>
<td>Colon Cancer</td>
<td>$4,582</td>
</tr>
<tr>
<td>Prostate Cancer</td>
<td>$7,305</td>
</tr>
<tr>
<td>Breast Cancer</td>
<td>$13,406</td>
</tr>
</tbody>
</table>

Sources:

NLST: Reduction in Cancer Mortality - 20%

Lung Cancer Screening Program: Workflow

Pre-Screening
- PCP
- Eligibility
- SDM
- Ordering

Screening / Follow-up
- Radiology
- PCP

Suspicious Nodule and Cancer Management
- Radiology
- Multidisciplinary Group
CT Lung Cancer Screening Volume

Practice Support and Dr. Amita Sharma visited and educated 6 MGH offices between Sep-Oct 2017.


Distributed 2,550 brochures between Nov 22, 2016 and March 31, 2017.

Distributed 2,744 infographics between Nov 22, 2016 and March 31, 2017.


CT resources down for replacement and/or upgrade between May and Sept 2018.

May to July 2018 – Chelsea CT scanner replaced

May to Sept 2018 – ED CT scanner down. Patients diverted to outpatient CT scanners


7 Informational awareness tables held promoting LCS services at MGH locations between Oct 2, 2018 and Dec 31, 2018.
Components of a Lung Screening Program

- Patient eligibility criteria
- Shared decision making with provider
- Smoking cessation education & assistance
- Screening site requirements
- Radiologist requirements
- Interpretation guidelines: Lung-Rads
- ACR Registry: Outcomes monitoring
The Lung Cancer Screening: Patient Eligibility

CMS Eligibility

- Asymptomatic patient
- 55-77 years old (most commercial insurers up to age 80)
- Minimum of 30 Pack years - cigarettes only
  - Current smokers
  - Former smokers no more than 15 quit years
- Willingness to pursue diagnosis and treatment
Lung Cancer Screening: Patient Eligibility

NCCN Eligibility- National Comprehensive Cancer Network

- Age 50+
- 20 Pack years
- At least one additional risk factor
  - Exposure to Radon, asbestos or other cancer-causing agents
  - Family HX lung cancer, COPD, Bronchitis
- No quit years limit
- Only follow ups covered not screenings
Ordering Lung Screening Exams: ALERT

Best Practice Advisory (BPA) Alert upon signing order for those patients that do not meet eligibility.
Lung Cancer Screening: Shared Decision Making Requirements

- Risks and Benefits
  - Radiation
  - False positives and false negatives
    - Additional exams, program adherence
  - Overdiagnosis
  - Procedures and complications
- Willingness to seek diagnosis and treatment
- Smoking Cessation Counseling
- Documentation and Written order for LCS
LDCT: Normal
### Interpretation of Lung Screening: LungRads Version 1.1

<table>
<thead>
<tr>
<th>Category Description</th>
<th>Lung-RADS Score</th>
<th>Findings</th>
<th>Management</th>
<th>Risk of Malignancy</th>
<th>Est. Population Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incomplete</td>
<td>0</td>
<td>Normal</td>
<td>Management</td>
<td>n/a</td>
<td>1%</td>
</tr>
<tr>
<td>Negative</td>
<td>1</td>
<td>No lung nodules</td>
<td>Node(s) with specific characteristics: complete, central, popcorn, concentric rings and fat containing nodules</td>
<td>&lt; 1%</td>
<td>50%</td>
</tr>
<tr>
<td>Biopsy-proven malignant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benign Appearance or Behavior</td>
<td>2</td>
<td>Peripherally located node(s) (See Footnote 11) &lt; 10 mm (524 mm³)</td>
<td>Continue annual screening with LDCT in 12 months</td>
<td>&lt; 1%</td>
<td>50%</td>
</tr>
<tr>
<td>Nodule(s) with a very low likelihood of becoming a clinically active cancer due to size or lack of growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biopsy-proven malignant</td>
<td>3</td>
<td>Solid nodules (0.8 to &lt; 8 mm (≤ 115 to &lt; 288 mm³) at baseline OR new 4 mm to &lt; 8 mm (24 to &lt; 113 mm³))</td>
<td>6 month LDCT</td>
<td>1-2%</td>
<td>5%</td>
</tr>
<tr>
<td>Possibly Benign</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biopsy-proven malignant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspicious</td>
<td>4A</td>
<td>Solid nodules (≥ 8 to &lt; 15 mm (≥ 208 to &lt; 707 mm³) at baseline OR growing &lt; 8 mm (≤ 288 mm³) OR new 0.8 to 8 mm (113 to 288 mm³))</td>
<td>3 month LDCT; PET/CT may be used when there is a ≥ 8 mm (≥ 288 mm³) solid component</td>
<td>5.15%</td>
<td>2%</td>
</tr>
<tr>
<td>Very Suspicious</td>
<td>4B</td>
<td>Solid nodules (≥ 16 mm (≥ 1176 mm³) OR new or growing, AND ≥ 8 mm (≥ 288 mm³))</td>
<td>Chest CT with or without contrast, PET/CT and/or tissue sampling depending on the “probability of malignancy and comorbidities. PET/CT may be used when there is a ≥ 8 mm (≥ 288 mm³) solid component. For new large nodules that develop on an annual repeat screening CT, a 1 month LDCT may be recommended to address potentially infectious or inflammatory conditions</td>
<td>&gt; 10%</td>
<td>2%</td>
</tr>
<tr>
<td>Other Clinically Significant or Potentially Clinically Significant Findings (other than lung cancer)</td>
<td>8</td>
<td>Modifier - may add to category 0-4 coding</td>
<td>As appropriate to the specific finding</td>
<td>n/a</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Footnote 11:**
- 24 mm (24 mm³) solid component
- 113 mm³ (113 mm³) solid component
- 288 mm³ (288 mm³) solid component
- 707 mm³ (707 mm³) solid component
- 1176 mm³ (1176 mm³) solid component
- 208 mm³ (208 mm³) solid component

**Note:**
- LDCT: Low-Dose Computed Tomography
- PET/CT: Positron Emission Tomography/Computed Tomography
Pulmonary Nodules Morphology

- **Circumscribed**: ✓
- **Microlobulated**: ❌
- **Obscured**: ❌
- **Ill-defined**: ❌
- **Spiculated**: ❌
- **Round**: ✓
- **Oval**: ❌
- **Lobulated**: ❌
- **Irregular**: ❌
Pulmonary Nodules Morphology
Benign Calcifications

Granulomas

Hamartoma
Category 1: Nodules with specific patterns of calcification and/or fat

Lung-Rads Category: 1 - Negative, No nodules and definitely benign nodules. Nodules with specific calcifications: complete, central, popcorn, concentric rings and fat containing nodules, <1% probability of malignancy
Management: Continue annual screening, LDCT in 12 months
Lung- RADS Category 2 (<1%)  
Importance of Yearly Screening
Category 2: Non solid nodule

Finding: Nonsolid nodule, <20 mm
Lung-RADS: Category 2-Benign
appearance or behavior, <1% probability of malignancy
Management: LDCT in 12 months

Finding: New > 4 mm solid component
Lung-RADS: Category 4B, Suspicious,
>15% probability of malignancy
Management: Chest CT, PET/CT and/or tissue sampling
Finding: LLL solid ≥ 6 mm nodule (average diameter)
**Lung-RADS Category: 3** – Probably Benign (1-2% probability of malignancy)
Management: Follow in 6 months with LDCT, if no change reverts to Category 2
Follow-up Recommendations and Management

• Lung-RADS 1 (No nodules, definitely benign)
  – Return to Annual Screening

• Lung-RADS 2 Nodules present with low likelihood of becoming a clinically active cancer (Less than 1% malignancy)
  – Return to Annual Screening

• Lung-RADS 3 Nodules present (1-2% risk malignancy)
  – 6 month LCS follow-up

Significant Finding “S” as needed
Lung-RADS “S”

Exam modifier:

• “S” modifier may be added to the 0-4 category
  – “S”-Clinically significant or potentially clinically significant findings (non lung cancer)
  – Requires further evaluation or could have substantial clinical implications
  – Ao aneurysm, ILD, mass, CAC
6.7% reduction in all cause mortality

### Table 7. Cause of Death on the Death Certificate, According to Screening Group.‡

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Low-Dose CT Group</th>
<th>Radiography Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>number/total number (percent)</td>
<td>number/total number (percent)</td>
<td>number/total number (percent)</td>
</tr>
<tr>
<td>Neoplasm of bronchus and lung†</td>
<td>427/1865 (22.9)</td>
<td>503/1991 (25.3)</td>
<td>930/3856 (24.1)</td>
</tr>
<tr>
<td>Other neoplasm</td>
<td>416/1865 (22.3)</td>
<td>442/1991 (22.2)</td>
<td>858/3856 (22.3)</td>
</tr>
<tr>
<td>Cardiovascular illness</td>
<td>486/1865 (26.1)</td>
<td>470/1991 (23.6)</td>
<td>956/3856 (24.8)</td>
</tr>
<tr>
<td>Respiratory illness</td>
<td>175/1865 (9.4)</td>
<td>226/1991 (11.4)</td>
<td>401/3856 (10.4)</td>
</tr>
<tr>
<td>Complications of medical or surgical care</td>
<td>12/1865 (0.6)</td>
<td>7/1991 (0.4)</td>
<td>19/3856 (0.5)</td>
</tr>
<tr>
<td>Other</td>
<td>349/1865 (18.7)</td>
<td>343/1991 (17.2)</td>
<td>692/3856 (17.9)</td>
</tr>
</tbody>
</table>
Past Due Patient Reminder Letters

Lung-RADS 1-3 Patients only
- LR1 & LR2 Reminder Letter – 60 days past due
- LR3 Reminder Letter – 30 days past due

Lung-RADS 4 Direct communication
Category 4X: Spiculated Solid Nodule

Finding: ≥ 15 mm spiculated nodule in RML

**Lung-RADS Category: 4X** – Suspicious, features that increase suspicion of malignancy, (> 15% probability of malignancy)

Management: Chest CT, PET/CT and/or tissue sampling (which revealed squamous cell carcinoma)
Not all masses are lung cancers: Infection
Lung-RADS 4 A,B,X patients referred for Specialist Consultation

- Navigator contacts Provider/Nurse with findings and recommendations
- PCP places referral to PNC/specialist consultation
- Exceptions include short term Lung Screening CT follow-up recommendations to rule out Inflammation or Infection
Nodule and Cancer Management

- Actionable nodules: Lung-RADS 4A,B,X
- Individual subspecialty services
- Multidisciplinary PNC
  - Thoracic Oncology
  - Pulmonary
  - Thoracic Surgery
  - Radiation Medicine
  - Thoracic Radiology/IR
  - Smoking cessation counselor
- Access Nurse
  - 617-643-8728
  - May self-refer
Surgical Outcomes in a Large, Clinical, Low-Dose Computed Tomographic Lung Cancer Screening Program

Bryan L. Walker, BS, Christina Williamson, MD, Shawn M. Regis, PhD, Andrea B. McKee, MD, Richard S. D’Agostino, MD, Paul J. Hesketh, MD, Carla R. Lamb, MD, Sebastian Flacke, MD, PhD, Christoph Wald, MD, PhD, and Brady J. McKee, MD

Tufts University School of Medicine, Boston; and Departments of Cardiovascular and Thoracic Surgery, Radiation Oncology, Hematology and Oncology, Pulmonary and Critical Care Medicine, and Radiology, Lahey Hospital & Medical Center, Burlington, Massachusetts

Surgical Outcomes

• 1654 screened patients from 1/12-6/14
• 1.5% of screened patients had surgery (NLST 2.7%)
• Incidence of surgery for non-lung cancer was 0.3% (NLST 0.62%)
• Incidence of surgery for benign disease (0.24%)
• No surgical deaths, 4% major surgical complication at 30 days
• Only by minimizing surgery for benign disease and having low M&M will full benefit of LCS be realized in widespread clinical practice


Necrotizing granuloma
Perceived Barriers to LCS

Wang GX, et al. Barriers to lung cancer screening engagement from the patient and provider perspective. Radiology, 2018
ACR LCR registry analysis: 7.6 million eligible individuals

Conclusions

- LCS is approved for high risk patients
- Shown to decrease mortality from lung cancer and other causes
- Multidisciplinary care can minimize intervention for benign disease and have low surgical M&M
Are you eligible?

**TREATMENT?**

YOU ARE WILLING & ABLE TO HAVE TREATMENT

**DID YOU ANSWER YES?**

A 15-MINUTE EXAM COULD SAVE YOUR LIFE

- PAINLESS
- NON-INVASIVE
- NO PREPARATION

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**EARLY DETECTION SAVES LIVES**

THE BEST WAY TO REDUCE YOUR RISK OF LUNG CANCER IS TO STOP SMOKING

TALK TO YOUR DOCTOR ABOUT YOUR RISK FOR LUNG CANCER AND THE RISKS AND BENEFITS OF BEING SCREENED

MEDICARE AND PRIVATE INSURANCE NOW COVER LUNG SCREENING FOR HIGH-RISK PATIENTS WHO MEET THE CRITERIA

MASSACHUSETTS GENERAL HOSPITAL
Questions?

- Lung-RADS  Version 1.1
  
  http://www.massgeneralimaging.org/lungrads

- Pulmonary Nodule Clinic (PNC) Referrals
  Calling 617-643-8728
  EPIC http://www.massgeneralimaging.org/pnc

- Lung Screening Navigation
  MGH Lung Screening Program Navigator
  MTateosian@Partners.org 617-724-4254