OBJECTIVES

- Discuss historic aspects regarding the rise of lung cancer
- Advent and logistics of lung cancer screening
- Evaluating a pulmonary nodule
- Advanced Diagnostics and minimally invasive strategies to diagnose lung cancer
- New lung cancer staging definitions
- Current and future advancements in lung cancer diagnostics
“At present lung cancer is recognized late. Opportunities to improve survival are through earlier detection, accurate diagnosis, accurate localization, and curative therapy.”

Carbone, PF
NIH Conference
Annals of Internal Medicine (1970)
73:1003

FACTS ABOUT LUNG CANCER

• #1 cause of cancer related death in both men and women
  - Estimated 152,390 deaths in 2009

• #2 overall cause of death behind heart disease¹

• More deaths yearly than next four cancers combined¹
  - Over three times as many men as prostate cancer
  - Nearly twice as many women as breast cancer
  - An average of 437 people every day

Sources:
2. Lung Cancer Alliance 2009
SMOKING

90% OF ALL LUNG CANCERS
40 PACK YEARS OF SMOKING 20X INCREASED RISK
AS NON-SMOKER
PEOPLE WHO QUIT SMOKING
RISK OF LUNG CANCER FALLS GRADUALLY FOR
15 YEARS
REMAINS TWICE THAT OF NON SMOKERS

Mortality in relation to smoking: 50 years' observations on male British doctors.

LUNG CANCER HISTORY

• 1919- A. Ochsner summoned to witness “rare disease” at autopsy
• 1933- E. Graham, pneumonectomy for NSCLC
• 1936- nine cases in WWI vets within six months.
• Ochsner and DeBakey - Smoking contributory factor- Ochsner mocked and criticized by many.

LUNG CANCER EPIDEMIOLOGY
1900-PRESENT

• Increase and change in tobacco use
  —Shift from snuff, chew and pipe to cigarette use
• Decrease in deaths from infectious diseases
  • Sanitation
  • Antibiotics
  • Immunizations
• Increased life expectancy overall.
• Older population with decades of risk exposure

Figure 1. Trends in Age-adjusted Cancer Death Rates* by Site, Males, US, 1930-2014

*Per 100,000, age adjusted to the 2000 US standard population. Mortality rates for pancreatic and liver cancers are increasing.

Due to changes in ICD coding, numerator information has changed over time. Rates for cancers of the liver, lung, and bronchus, stomach, and colon and rectum are affected by these coding changes.


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Figure 2. Trends in Age-adjusted Cancer Death Rates* by Site, Females, US, 1930-2014

*Per 100,000, age-adjusted to the 2000 US standard population. Tissues refers to uterine cervix and uterine corpus combined. The mortality rate for liver cancer is increasing.

Note: Due to changes in coding, new or minor revisions have changed over time. Rates for cancer of the liver, lung and bronchus, uterus, and colon and rectum are affected by these coding changes.


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US Cancer Deaths vs. Federal Research Funding per Death

- **Lung**: 158,946 deaths, $51,490
- **Colorectal**: 49,380 deaths, $56,339
- **Breast**: 39,970 deaths, $521,041
- **Prostate**: 33,720 deaths, $510,765

Figure ©2012 National Lung Cancer Partnership. All rights reserved.

$21,641

$1,490
LUNG CANCER SCREENING

• Prevention is the mainstay of decreasing lung cancer burden
• Clinical outcome is directly tied to early diagnosis
• Tumor size is also related to survival


LUNG CANCER SCREENING

• What is screening?
  • A test done to detect cancer before symptoms develop
  • Lung Cancer symptoms typically do not appear until disease is advanced
  • Why is screening not routine?
    • Until recently, no test has been proven to be efficacious
LUNG CANCER SCREENING

- Multiple trials regarding lung cancer screening
- Observing chest x-rays
- Earliest is in 1960
- No mortality benefit noted
- No significant difference with sputum cytologies

CHEST XRAY STUDY

- Czechoslovakian and Mayo Clinic studies in 1980’s showed no benefit to frequent testing
- Large outcome-based studies did not adjust for risk
REASONS FOR NO BENEFIT

• Lead time bias
• Length bias
• Volunteer bias
• Potential harm of screening
Original Article

Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team

Large clinical trial 2002-2007
Over 50,000 patients screened 55-74 years old
Selected for former and current smokers

N Engl J Med
Volume 365(5):395-409
August 4, 2011

Selected Baseline Characteristics of the Study Participants.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Low-Dose CT Group</th>
<th>Radiography Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 26,722)</td>
<td>(N = 26,732)</td>
</tr>
<tr>
<td>Age at randomization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 55 yr</td>
<td>2 (0.1)</td>
<td>4 (0.1)</td>
</tr>
<tr>
<td>55-59 yr</td>
<td>11,440 (42.8)</td>
<td>11,420 (42.7)</td>
</tr>
<tr>
<td>60-64 yr</td>
<td>8,170 (30.6)</td>
<td>8,186 (30.7)</td>
</tr>
<tr>
<td>65-69 yr</td>
<td>4,756 (17.8)</td>
<td>4,762 (17.8)</td>
</tr>
<tr>
<td>≥ 70 yr</td>
<td>2,359 (8.8)</td>
<td>2,365 (8.8)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>15,770 (59.0)</td>
<td>15,762 (59.0)</td>
</tr>
<tr>
<td>Female</td>
<td>10,952 (41.0)</td>
<td>10,970 (41.0)</td>
</tr>
<tr>
<td>Race or ethnic group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>24,289 (90.9)</td>
<td>24,260 (90.8)</td>
</tr>
<tr>
<td>Black</td>
<td>1,195 (4.5)</td>
<td>1,191 (4.4)</td>
</tr>
<tr>
<td>Asian</td>
<td>559 (2.1)</td>
<td>536 (2.0)</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>92 (0.3)</td>
<td>98 (0.4)</td>
</tr>
<tr>
<td>Native Hawaiian or other Pacific Islander</td>
<td>91 (0.3)</td>
<td>102 (0.4)</td>
</tr>
<tr>
<td>More than one race or ethnic group</td>
<td>55 (2.1)</td>
<td>546 (1.7)</td>
</tr>
<tr>
<td>Data missing</td>
<td>165 (0.6)</td>
<td>209 (0.8)</td>
</tr>
<tr>
<td>Hispanic ethnic group</td>
<td>478 (1.8)</td>
<td>456 (1.7)</td>
</tr>
<tr>
<td>Smoker or Latino</td>
<td>26,079 (97.6)</td>
<td>26,039 (97.4)</td>
</tr>
<tr>
<td>Data missing</td>
<td>164 (0.6)</td>
<td>237 (0.9)</td>
</tr>
</tbody>
</table>

CT denotes computed tomography.
1 Patients in this age range were ineligible for inclusion in the screening trial and were excluded from all analyses.
2 Race or ethnic group was self-reported.
NATIONAL LUNG SCREENING TRIAL

- People who got low-dose CT scans had a 20% decreased risk of mortality from lung cancer
  - 320 people need to be screened to prevent 1 lung cancer death
  - 1339 for breast CA
  - Earlier detection
- This trial was the first to show a decrease in lung cancer deaths
- Results presented in 2010
SO WHAT IS THE BENEFIT?

• Early detection of lung cancer offers the chance for a surgical cure.

• Decreased mortality from lung cancer

• 7 million Americans estimated to be eligible for lung cancer screening
  • Could potentially save 22,000 lives
  • Estimated that <4% have undergone screening!

USPSTF RECOMMENDATION: WHO SHOULD BE ScreenED

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

• 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.

http://www.uspreventiveservicestaskforce.org/
CMS NATIONAL COVERAGE DETERMINATION
FEBRUARY 5, 2015

Medicare will now cover lung cancer screening with LDCT once per year for Medicare beneficiaries who meet all of the following criteria:

- they are age 55-77, and are either current smokers or have quit smoking within the last 15 years;
- they have a tobacco smoking history of at least 30 “pack years” (an average of one pack a day for 30 years); and
- they receive a written order from a physician or qualified non-physician practitioner that meets certain requirements.

Medicare coverage includes a visit for counseling and shared decision-making on the benefits and risks of lung cancer screening. The NCD also includes required data collection and specific coverage eligibility criteria for radiologists and radiology imaging centers, consistent with the National Lung Screening Trial protocol, U.S. Preventive Services Task Force recommendation, and multi-society multi-disciplinary stakeholder evidence-based guidelines.

It’s the first covered service that explicitly requires shared decision making.
The visit for counseling and shared decision making is reimbursed by CMS.


WHO NOT TO SCREEN?

- Patients should not have symptoms of lung cancer
  - New or changing cough
  - Coughing up blood
  - New or increasing shortness of breath
- Instead, these patients may benefit from a standard dose CT Chest.
RISKS OF LUNG CANCER SCREENING

- But...lung cancer screening with LDCT carries potential harms:
  - Radiation exposure (?)
  - High positive rate:
    - 20-25% per scan
    - ~40% if screened annually for 3 years
  - Invasive procedures
  - Incidental findings (may be a benefit)
  - Over-diagnosis rate estimated at 10-20%

RISKS OF LUNG CANCER SCREENING

• False positives
  • Finding a nodule (spot) that is not cancer
  • Most nodules (95%) seen on CT are not cancer
  • May require additional testing

• False negatives
  • A negative screening CT does not mean you don’t have lung cancer or can’t get lung cancer

Today’s reality
More than 150,000 patients per year in the U.S. present their physicians with the diagnostic dilemma of a Solitary Pulmonary Nodule (SPN)¹

HANDLING A POSITIVE SCREENING

- Negative screen
  - No nodules (spots) seen and no other abnormalities
  - Continue with annual screening
- Positive screen indeterminate for lung cancer
  - A nodule (spot) was seen
  - About 50% of patients will have at least one nodule
  - Most of these spots are NOT cancer
- Positive screen suspicious for lung cancer
  - Further testing or biopsy may be recommended

PULMONARY NODULE MONITORING

- Multiple guidelines for pulmonary nodule monitoring
  - Fleischner Society Guidelines (2017)- most referenced guidelines for management of pulmonary nodules found on CT imaging
  - Lung RADS- Produced by American College of Radiology
    - Produced specifically for management of nodules found on Low Dose CT screening
  - Nodule management guidelines also published by ACCP (2013) and BTS (2015)
# PULMONARY NODULE MONITORING

## FLEISCHNER SOCIETY GUIDELINES

### 2017 Fleischner Society Guidelines for Management of Incidentally Detected Pulmonary Nodules

**A: Solid Nodules**

<table>
<thead>
<tr>
<th>Nodule Type</th>
<th>Nodules &lt;6 mm (&lt;100 mm³)</th>
<th>Nodules 6-8 mm (100-250 mm³)</th>
<th>Nodules &gt;8 mm (&gt;250 mm³)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low risk</td>
<td>No routine follow-up</td>
<td>CT at 6–12 mo, then consider CT at 18–24 mo</td>
<td>Consider CT at 3 mo, PET/CT, or tissue sampling</td>
<td>Nodules &lt;6 mm do not require routine follow-up in low-risk patients (recommendation 1A)</td>
</tr>
<tr>
<td>High risk</td>
<td>Optional CT at 12 mo</td>
<td>CT at 6–12 mo, then consider CT at 18–24 mo</td>
<td>Consider CT at 3 mo, PET/CT, or tissue sampling</td>
<td>Certain patients at high risk with suspicious nodule morphology, upper lobe location, or both may warrant 12-mo follow-up (recommendation 1A)</td>
</tr>
<tr>
<td>Multiple</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low risk</td>
<td>No routine follow-up</td>
<td>CT at 3–6 mo, then consider CT at 18–24 mo</td>
<td>CT at 3–6 mo, then consider CT at 18–24 mo</td>
<td>Use most suspicious nodule as guide to management; follow-up intervals may vary according to size and risk (recommendation 2A)</td>
</tr>
<tr>
<td>High risk</td>
<td>Optional CT at 12 mo</td>
<td>CT at 3–6 mo, then consider CT at 18–24 mo</td>
<td>CT at 3–6 mo, then consider CT at 18–24 mo</td>
<td>Use most suspicious nodule as guide to management; follow-up intervals may vary according to size and risk (recommendation 2A)</td>
</tr>
</tbody>
</table>

### B: Subsolid Nodules

<table>
<thead>
<tr>
<th>Nodule Type</th>
<th>Nodules &lt;6 mm (&lt;100 mm³)</th>
<th>Nodules ≥6 mm (≥210 mm³)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground glass</td>
<td>No routine follow-up</td>
<td>CT at 6–12 mo to confirm persistence, then CT every 2 y until 5 y</td>
<td>For certain suspicious nodules &lt;6 mm, consider follow-up at 2 y and 4 y; if solid component(s) develops or growth occurs, consider resection (recommendations 3A and 4A)</td>
</tr>
<tr>
<td>Partly solid</td>
<td>No routine follow-up</td>
<td>CT at 3–6 mo to confirm persistence; if lesion is unchanged and solid component remains &lt;6 mm, annual CT should be performed for 5 y</td>
<td>In practice, partly solid nodules cannot be defined as such until they are ≥6 mm, and nodules &lt;6 mm usually do not require follow-up; persistent partly solid nodules with a solid component ≥6 mm should be considered highly suspicious (recommendations 4A–4C)</td>
</tr>
<tr>
<td>Multiple</td>
<td>CT at 3–6 mo; if lesion is stable, consider CT at 2 y and 4 y</td>
<td>CT at 3–6 mo; subsequent management based on the most suspicious nodule(s)</td>
<td>Multiple &lt;6-mm pure GGNs usually are benign, but consider follow-up at 2 y and 4 y in select patients at high risk (recommendation 5A)</td>
</tr>
</tbody>
</table>
# Pulmonary Nodule Monitoring
## Lung RADS Guidelines
### Lung RADS 0-3
#### Negative-Benign-Probably Benign

<table>
<thead>
<tr>
<th>Category</th>
<th>Category Descriptor</th>
<th>Category</th>
<th>Findings</th>
<th>Management</th>
<th>Probability of Malignancy</th>
<th>Estimated Population Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodule(s)</td>
<td>Nodule(s) and definitely benign nodules</td>
<td>0</td>
<td>at least one nodule(s) with specific characteristics: complete, central, geographic, nonair containing</td>
<td>Additional chest CT imaging required with correlation to prior chest CT examination if needed</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Benign</td>
<td>Nodule(s) with specific characteristics: complete, central, geographic, non-air containing</td>
<td>1</td>
<td>nodule(s) with specific characteristics: complete, central, geographic, non-air containing</td>
<td>Continue annual screening with LUCR in 12 months</td>
<td>&lt; 1%</td>
<td>10%</td>
</tr>
<tr>
<td>Benign</td>
<td>Nodule(s) with specific characteristics: complete, central, geographic, non-air containing</td>
<td>2</td>
<td>nodule(s) with specific characteristics: complete, central, geographic, non-air containing</td>
<td>6 months LUCR</td>
<td>3-5%</td>
<td>5%</td>
</tr>
<tr>
<td>Probablebenign</td>
<td>Nodule(s) with specific characteristics: complete, central, geographic, non-air containing</td>
<td>3</td>
<td>nodule(s) with specific characteristics: complete, central, geographic, non-air containing</td>
<td>12 months</td>
<td>0%</td>
<td>5%</td>
</tr>
</tbody>
</table>

### Lung RADS 4A-4B-4X
#### Suspicious

<table>
<thead>
<tr>
<th>Category</th>
<th>Findings for which additional diagnostic testing and/or tissue sampling is recommended</th>
<th>Management</th>
<th>Probability of Malignancy</th>
<th>Estimated Population Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspicious</td>
<td>Suspicious nodules (solid or non-solid) with a diameter of 8 mm or greater, or non-solid nodules with a diameter of 5 mm or greater</td>
<td>4A</td>
<td>6-month LUNG, PET/CT may be used when there is a 5-8 mm solid component</td>
<td>&gt; 15%</td>
</tr>
<tr>
<td>Suspicious</td>
<td>Suspicious nodules with a diameter of 5 mm or greater, or non-solid nodules with a diameter of 4 mm or greater</td>
<td>4B</td>
<td>PET/CT may be used when there is a 4-5 mm solid component</td>
<td>&gt; 15%</td>
</tr>
<tr>
<td>Suspicious</td>
<td>Suspicious nodules with a diameter of 3 mm or greater, or non-solid nodules with a diameter of 2 mm or greater</td>
<td>4C</td>
<td>Category 3 or 4 nodules with additional features or imaging findings that increase the suspicion of malignancy</td>
<td>&gt; 15%</td>
</tr>
<tr>
<td>Other</td>
<td>Clinical significance: progressive Clinical, tumor long course</td>
<td>5</td>
<td>As appropriate to the specific finding</td>
<td>1/3</td>
</tr>
<tr>
<td>Prior lung cancer</td>
<td>Modifier for patients with a prior diagnosis of lung cancer who have been screened</td>
<td>D</td>
<td>Modifier may add on to category 0-4 finding</td>
<td>1/3</td>
</tr>
</tbody>
</table>
## Traditional Diagnostic Options

<table>
<thead>
<tr>
<th>Least Invasive</th>
<th>Thoracic Needle Aspiration (TTNA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Pneumothorax rate: 42%</td>
</tr>
<tr>
<td></td>
<td>- Chest tube insertion rate: 17%</td>
</tr>
<tr>
<td></td>
<td>- Hemoptysis &amp; hemorrhage risk</td>
</tr>
<tr>
<td></td>
<td>- Position of lesion may not allow TTNA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Most Invasive</th>
<th>Thoracotomy (Wedge Resection)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Higher risk of mortality</td>
</tr>
<tr>
<td></td>
<td>- High non-therapeutic rate (20-45%)</td>
</tr>
<tr>
<td></td>
<td>- Not option for compromised patients</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Least Invasive</th>
<th>Traditional Bronchoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- 65% fail to reach peripheral lesions</td>
</tr>
<tr>
<td></td>
<td>- &lt; 2 cm peripheral lesion diagnostic yield: 14%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Least Invasive</th>
<th>Watchful Waiting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Cancer may grow</td>
</tr>
<tr>
<td></td>
<td>- Patient anxiety</td>
</tr>
</tbody>
</table>

---

BRONCHOSCOPY

PERIPHERAL LESIONS

- Multiple factors involved
- Size
  - > 3 cm yield of 46-80%
  - < 3 cm yield 14-50%
- “Air Bronchus” Sign


ELECTROMAGNETIC

superDimension™ Navigation System
Version 7.0

PLANNING
PROCEDURE
Sampling techniques and diagnostic reach of mediastinal and hilar lymph node stations (1, highest mediastinal; 2, upper paratracheal; 5, subaortic; 7, subcarinal; 8, paraesophageal; 9, pulmonary ligament; 10, hilar; 11, interlobar; and 12, lobar).

Evolution of Bronchoscopy

1897  1968  1990's  2007
The Eighth Edition Lung Cancer Stage Classification

Frank C. Detterbeck, MD, FCCP, Daniel J. Boffa, MD, Anthony W. Kim, MD, FCCP, Lynne T. Tanoue, MD, FCCP

CHEST
Volume 151, Issue 1, Pages 193-203 (January 2017)
DOI: 10.1016/j.chest.2016.10.010

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Lung Cancer Stage Classification (8th Edition)

General Note:
All Stage I-III tumors are N0
Tx, Nx should be used only if no information at all is available about T or N stage (including no clinical staging information).
Mx is not allowed, because symptoms and physical exam information is always available.
Specific Notes:
- Tumor size defined as largest dimension of the solid (imaging, c-stage) or invasive (p-stage) component.
- Direct extension of the primary tumor into an adjacent node counts as nodal involvement. Extension of a nodal metastasis into a T structure does not count for the T category.
- The highest T category is used when there is a discrepancy between T by size or by other factors.
The Percepta classifier is built on a combination of 23 genes, including 17 cancer genes, gene expression predictors of smoking status, smoking history, and gender, as well as patient age.

<table>
<thead>
<tr>
<th>Features</th>
<th>Genes within features</th>
<th>Biological themes</th>
<th>Regulation in cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung cancer gene clusters</td>
<td>BST1, CD177.1, CD177.2</td>
<td>Innate immune response</td>
<td>Downregulate</td>
</tr>
<tr>
<td></td>
<td>ATP12A, TSPAN2</td>
<td>Mitotic cell cycle</td>
<td>Downregulate</td>
</tr>
<tr>
<td></td>
<td>GABBR1, MCAM, NOVA1, SDC2</td>
<td>Response to retinoic acid, cell cycle</td>
<td>Upregulate</td>
</tr>
<tr>
<td></td>
<td>CGREF1, CDR1, CLDN22, NKB1-1</td>
<td>Sub-mucosal gland markers</td>
<td>Upregulate</td>
</tr>
<tr>
<td></td>
<td>EPHX3, LYPD2</td>
<td>Xenobiotic detoxification</td>
<td>Downregulate</td>
</tr>
<tr>
<td></td>
<td>MIA, RNF150</td>
<td>Cartilaginous markers</td>
<td>Downregulate</td>
</tr>
<tr>
<td>Genomic gender (male / female)</td>
<td>RPS4Y1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genomic smoking status (current / former)</td>
<td>SLC7A11, CLND10, TKT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genomic pack years (&lt;10 / &gt;10)</td>
<td>RUNX1T1, AKR1C2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Rise in Adenocarcinoma

- **1950-1991 ADENOCARCINOMA**
  - INCREASED 17 FOLD FOR WOMEN (0.9-15.2 /100K)
  - INCREASED NEARLY 10 FOLD FOR MEN (2.4-23.2/100K)

- **CHANGE IN CIGARETTE DESIGN**
  - FILTER TIPS: LESS TAR, LESS NICOTINE
  - ANTI-IRRITANTS: PERMIT DEEPER INHALATION.
  - ‘BLENDED’ TOBACCO INCREASED NITROSAMINES


Liquid and tissue are complementary...

**Plasma, Tissue, and Urine Identify Unique and Overlapping Subsets of T790M-Positive Patients**

- 181 samples had matched pretreatment T790M results in plasma, tissue, and urine
  - 7 were T790M-negative or inadequate by all 3 sample types (4%)
  - 174 were T790M-positive by at least 1 sample type (96%)

**T790M-Positive Cases**

- Total positive by tissue: 146 of 181
- Total positive by plasma: 145 of 181
- Total positive by urine: 144 of 181

104 (57%) were positive by all 3 sample types
FUTURE ADVANCEMENTS

• Technology further aiding in bronchoscopic accuracy
• Delivery of minimally invasive therapeutics
• Evolution of serologic and airway markers

CONCLUSIONS

• Lung cancer is the deadliest cancer in the United States today
• Finding these in the earliest stages will give the best chances of survival
• Process involving proper screening, diagnostic advancements, and a multidisciplinary approach
• Technology and skillsets are constantly evolving
• Only together can we make a difference…
“Coming together is a beginning; Keeping together is a process; Working together is a success.”

—HENRY FORD