Lung Cancer Screening

Jo-Anne O. Shepard, MD

Director, Thoracic Imaging and Intervention, Massachusetts General Hospital

Professor of Radiology, Harvard Medical School

HARVARD MEDICAL SCHOOL

MGH 1811 MASSACHUSETTS GENERAL HOSPITAL

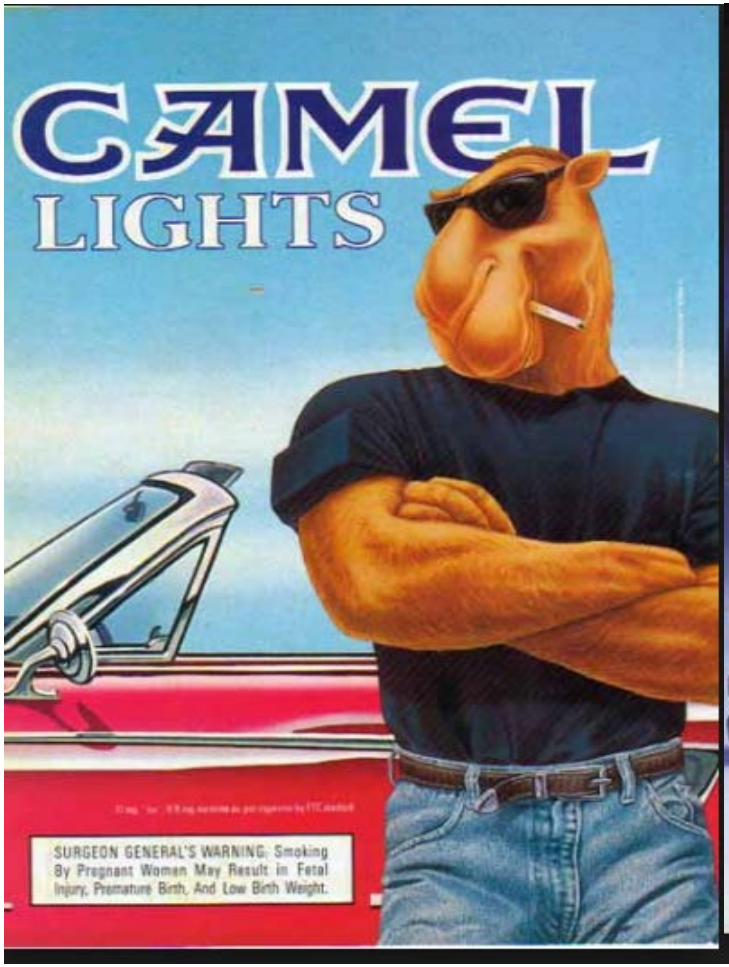
Objectives

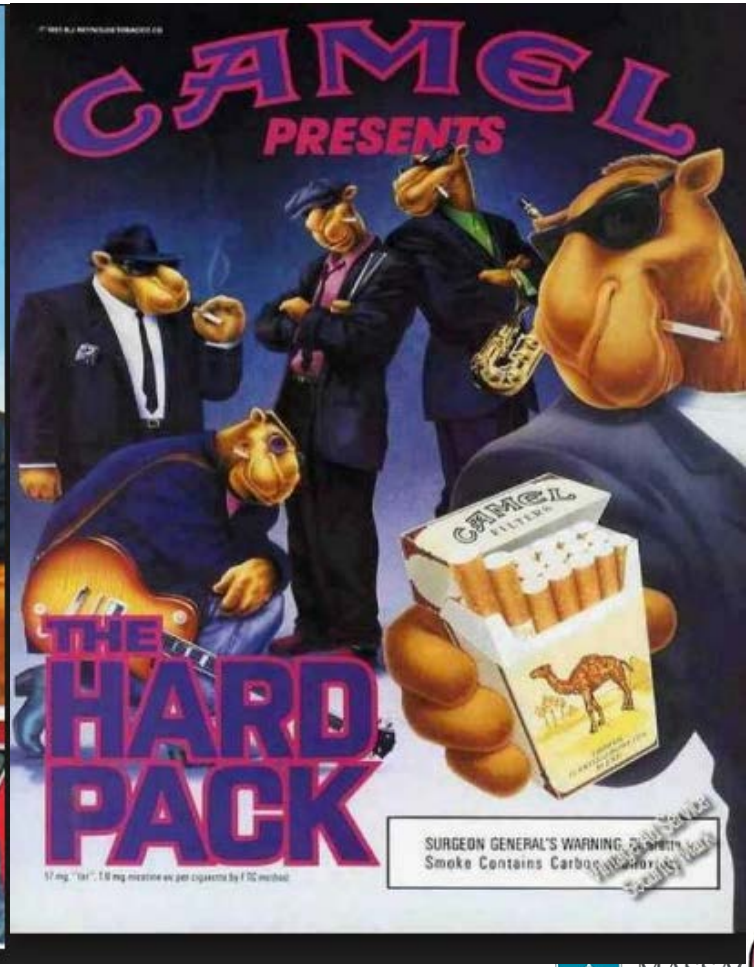
- Development of the Lung Screening Program
- Program Eligibility
- Ordering Lung Screening Exams
- Interpretation of Lung Screening Exams
- Follow-up Recommendations and Management
- Pulmonary Nodule Clinic (PNC)

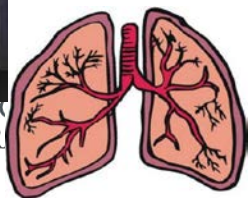
MASSACHUSETTS GENERAL HOSPITAL

History of Smoking and Lung Cancer

History of Smoking and Lung Cancer

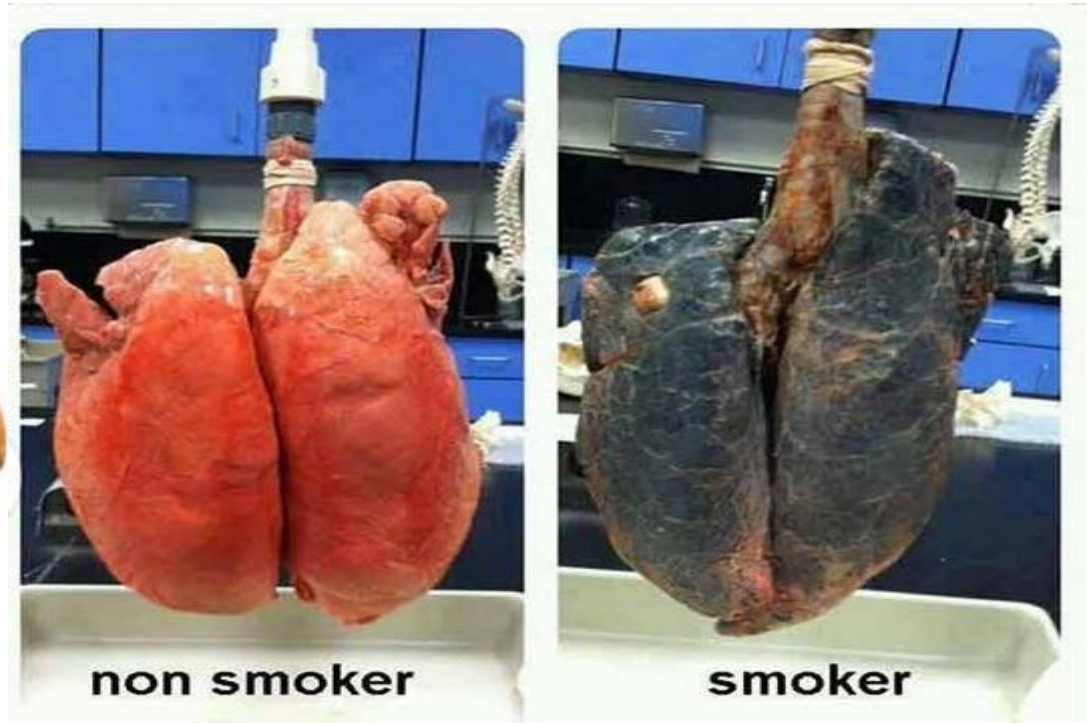






History of Smoking and Lung Cancer

History of Smoking and Lung Cancer



MASSACHUSETTS GENERAL HOSPITAL

Lung Cancer Statistics

EVERY DAY

422

AMERICANS DIE OF LUNG CANCER.

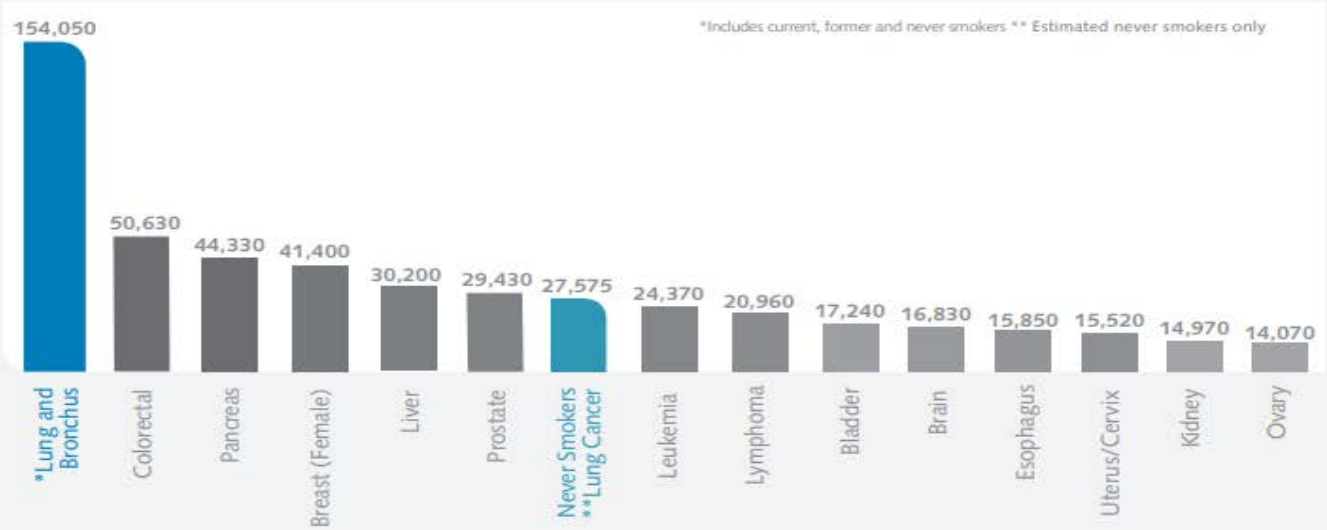
Lung cancer is the leading cancer killer of men & women in **EVERY ETHNIC GROUP.**

Of the men and women with lung cancer, 17.9% are **NEVER SMOKERS.**[2]

Lung cancer makes up 25% of all **CANCER DEATHS.**

2018 LUNG CANCER FACTS

LUNG CANCER IS THE LEADING CAUSE OF CANCER DEATH[1]



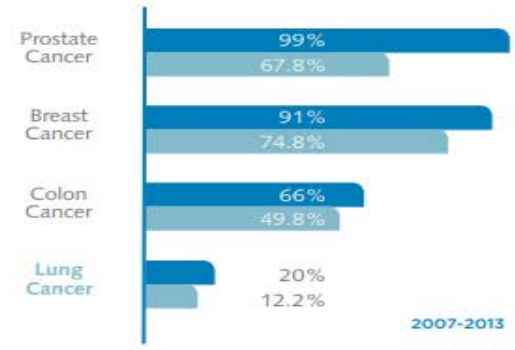
PROFILE OF NEW LUNG CANCER CASES[3]

20.9% CURRENT SMOKERS	61.2% FORMER SMOKERS	17.9% NEVER SMOKED

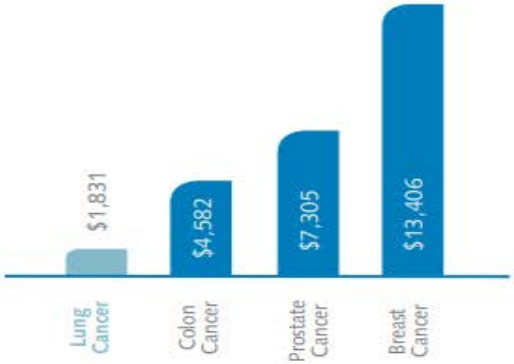
1 National Cancer Institute, Surveillance, Epidemiology, and End Results (SEER), U.S. Cancer Mortality, 1975-2013, published April 15, 2016
2,3 Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report, "Cigarette Smoking Among Adults -- United States, 2006". November 9, 2007/ 56(44);1157-1161.

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[4]
(CURRENT VS. PAST)

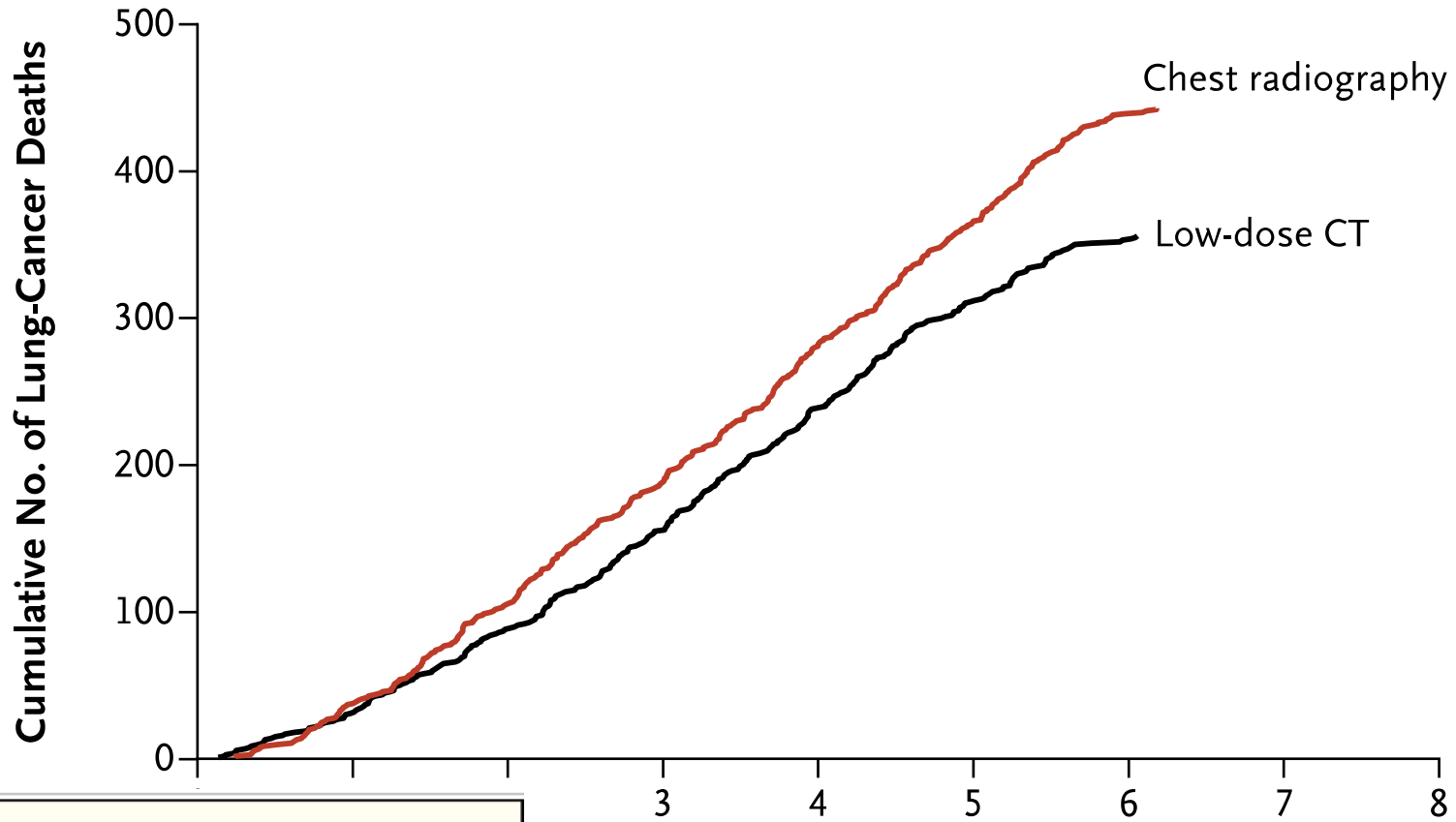


NIH RESEARCH DOLLARS PER DEATH[5]
(ESTIMATED 2016)

LUNG CANCER ALLIANCE IS A NATIONAL NON-PROFIT ORGANIZATION DEDICATED TO SAVING LIVES, ADVANCING RESEARCH AND EMPOWERING PEOPLE.

4 Howlader N, Noone AM, Krapcho M, et al. (eds). SEER Cancer Statistics Review, 1975-2014, National Cancer Institute, Bethesda, MD, http://seer.cancer.gov/ csr/1975_2014/, based on November 2016 SEER data submission, posted to the SEER website April 2017.
5 Funding: National Center for Health Statistics at the Centers for Disease Control and Prevention, "Estimates of Funding for Various Research, Condition, and Disease Categories (RCDC)." https://report.nih.gov/categorical_spending.aspx. Published July 3, 2017.
Deaths: American Cancer Society. Cancer Facts & Figures 2018. Atlanta: American Cancer Society; 2018.

NLST: Reduction in Cancer Mortality - 20%



The NEW ENGLAND JOURNAL of MEDICINE

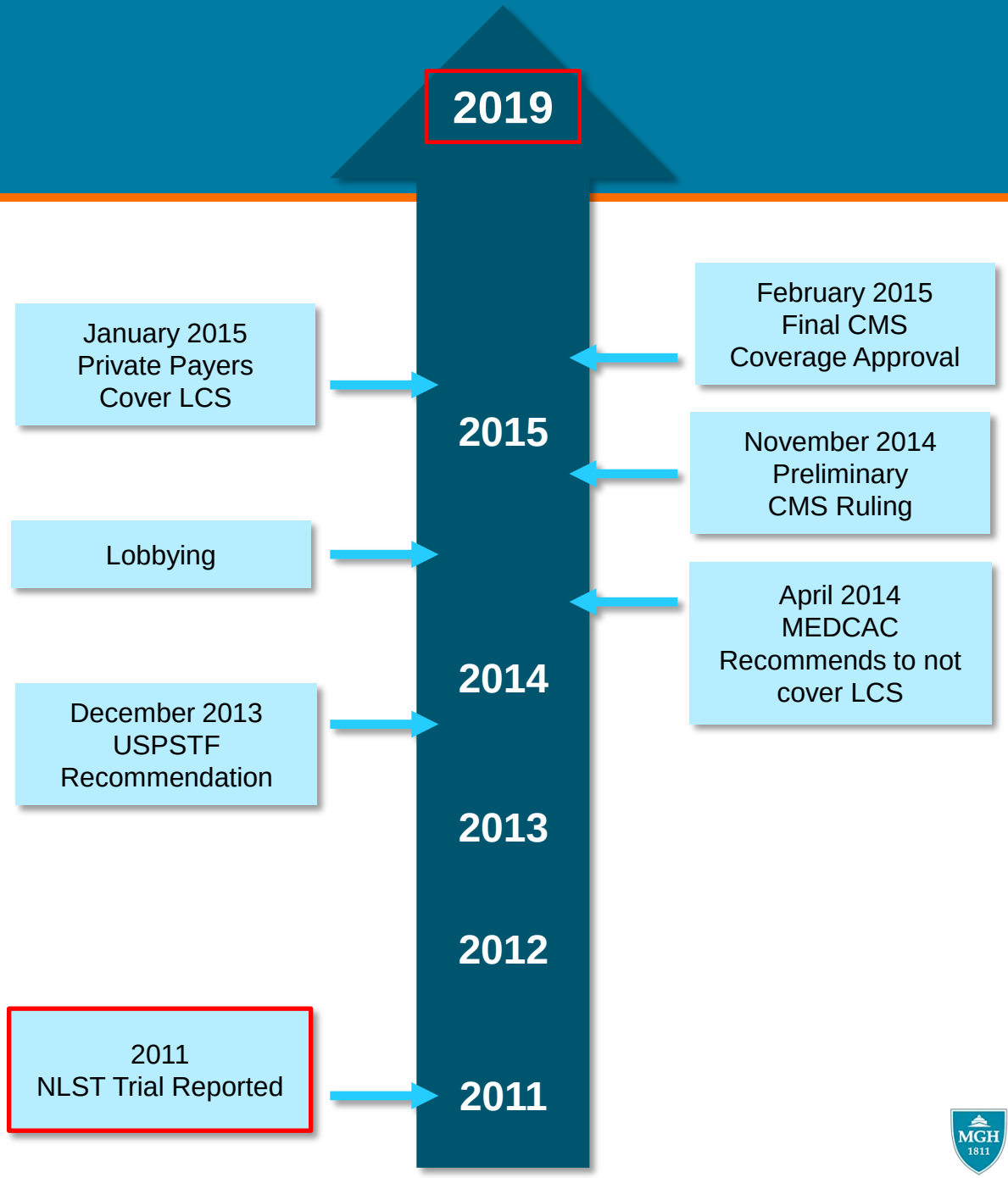
ESTABLISHED IN 1812 AUGUST 4, 2011 VOL. 365 NO. 5

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

The National Lung Screening Trial Research Team*

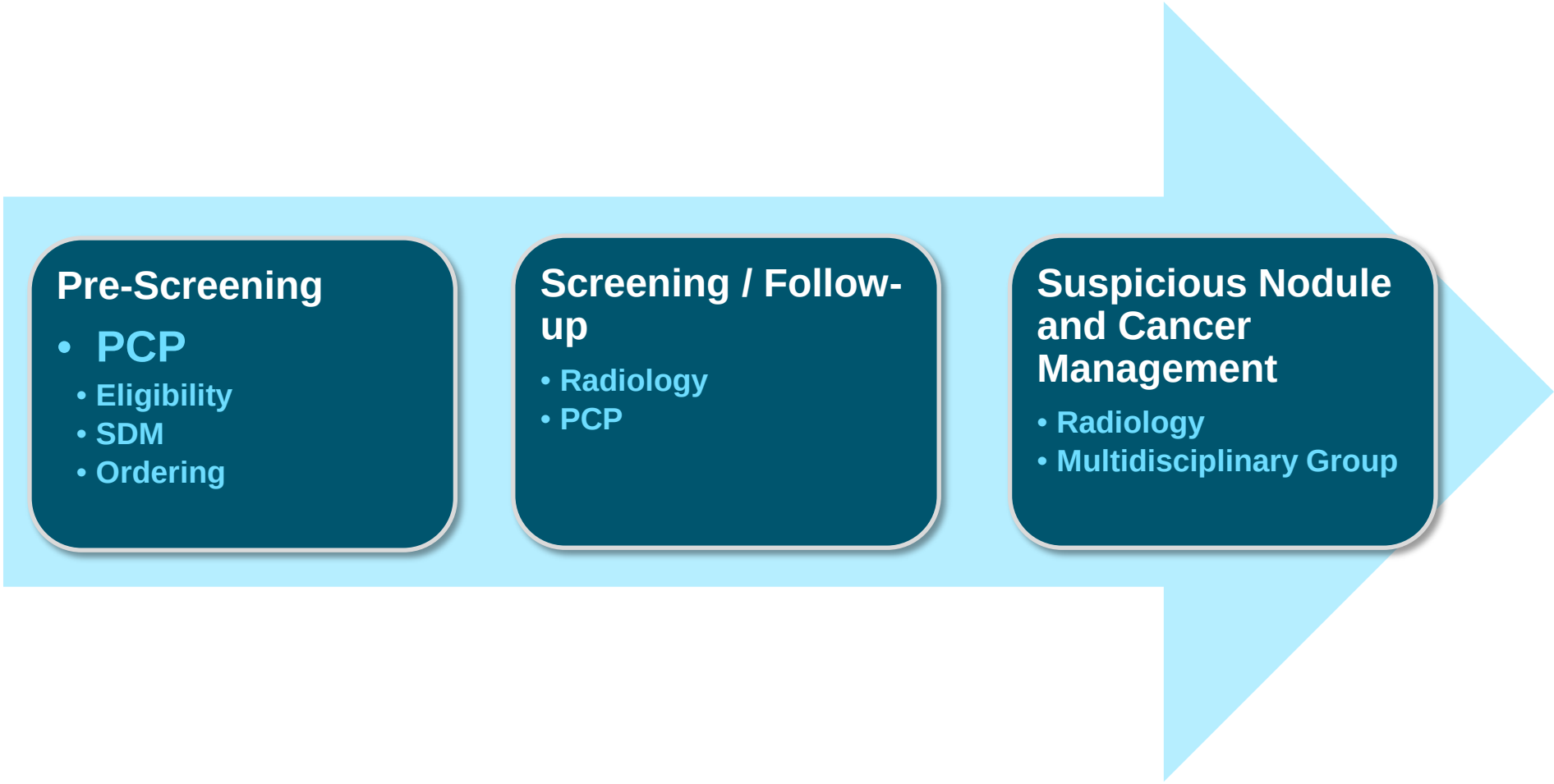
Aberle et al, N Engl J Med 2011

MASSACHUSETTS GENERAL HOSPITAL



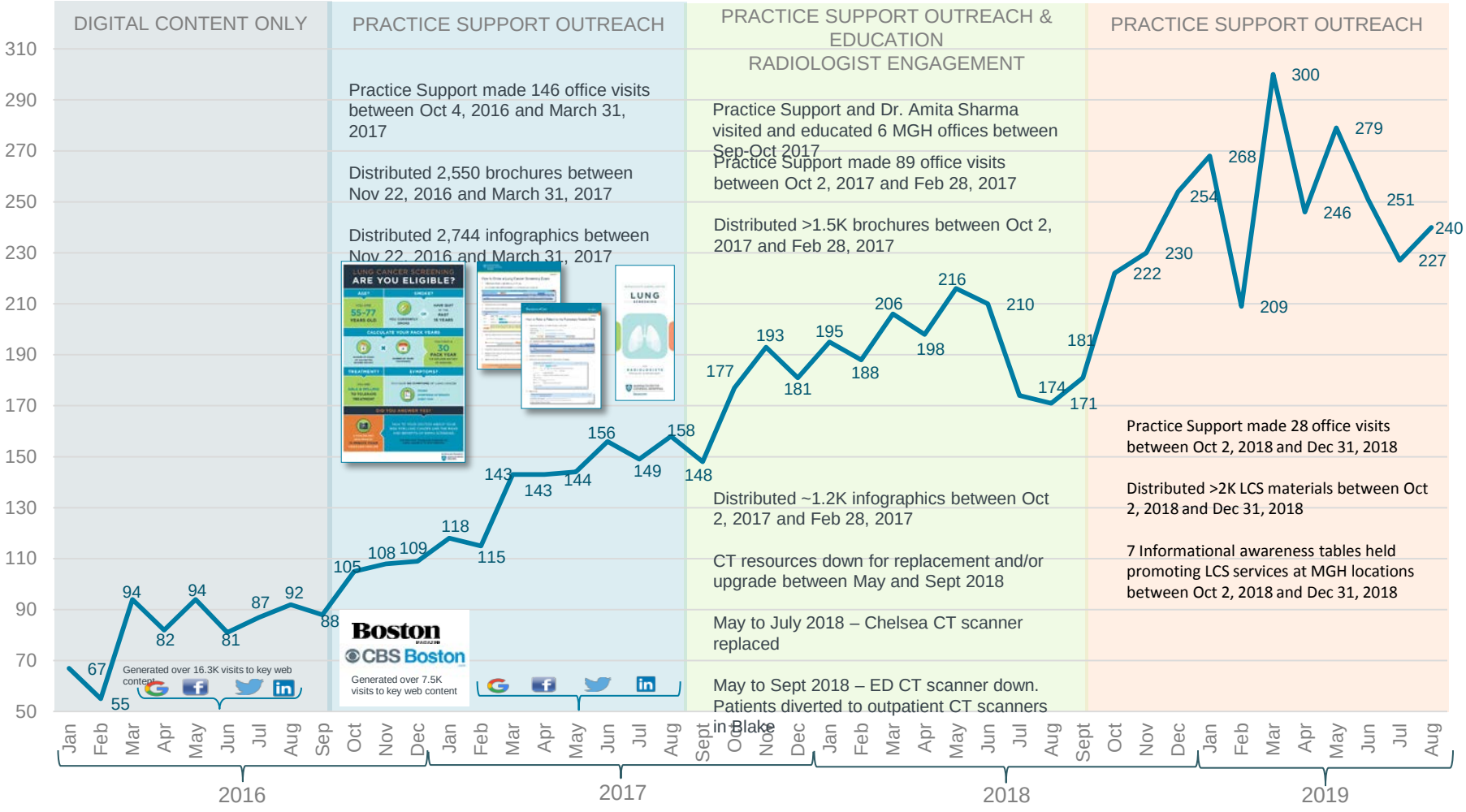
MASSACHUSETTS GENERAL HOSPITAL

Lung Cancer Screening Program: Workflow



MASSACHUSETTS GENERAL HOSPITAL

CT Lung Cancer Screening Volume



MASSACHUSETTS GENERAL HOSPITAL

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

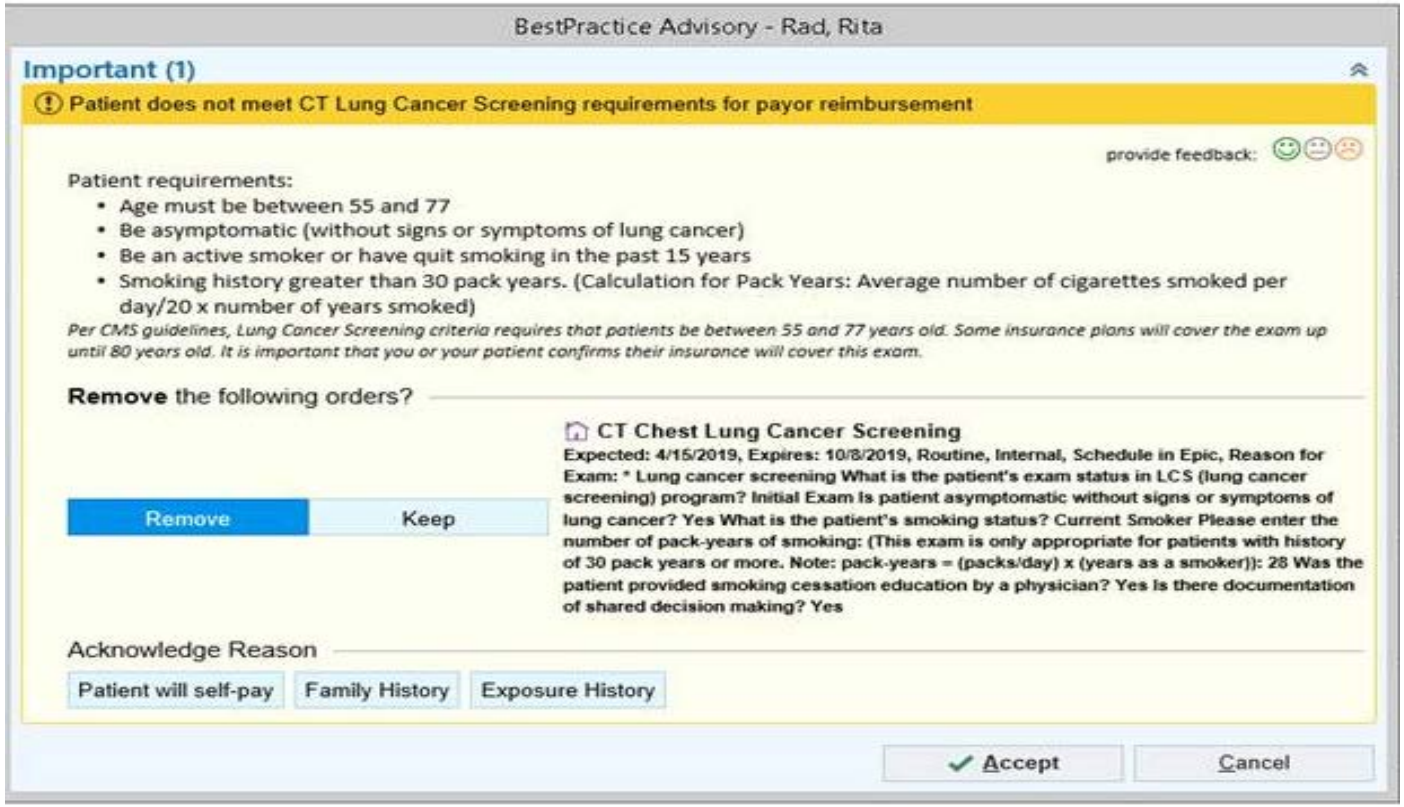
Lung Cancer Screening: Patient Eligibility

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

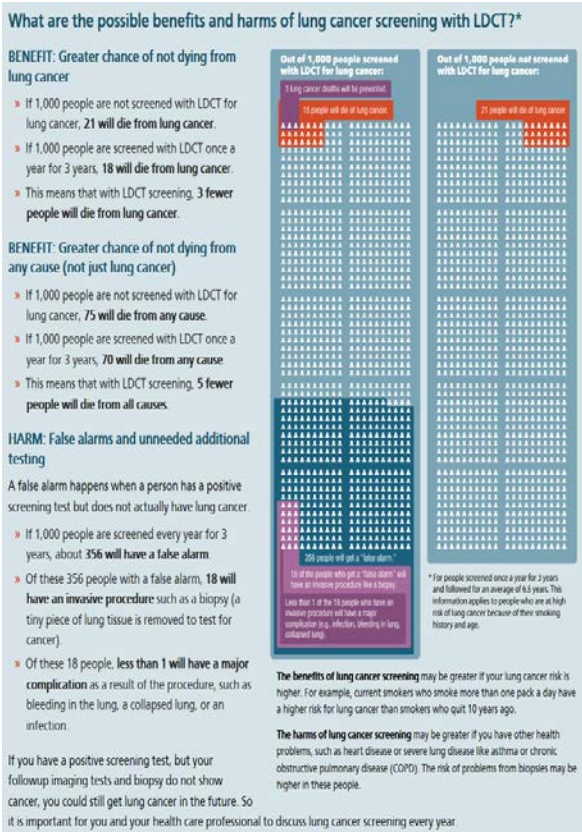
Best Practice Advisory (BPA) Alert upon signing order for those patients that do not meet eligibility



MASSACHUSETTS GENERAL HOSPITAL

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



What are the possible benefits and harms of lung cancer screening with LDCT?*

BENEFIT: Greater chance of not dying from lung cancer

- If 1,000 people are not screened with LDCT for lung cancer, **21 will die from lung cancer.**
- If 1,000 people are screened with LDCT once a year for 3 years, **18 will die from lung cancer.**
- This means that with LDCT screening, **3 fewer people will die from lung cancer.**

BENEFIT: Greater chance of not dying from any cause (not just lung cancer)

- If 1,000 people are not screened with LDCT for lung cancer, **75 will die from any cause.**
- If 1,000 people are screened with LDCT once a year for 3 years, **70 will die from any cause.**
- This means that with LDCT screening, **5 fewer people will die from all causes.**

HARM: False alarms and unneeded additional testing

A false alarm happens when a person has a positive screening test but does not actually have lung cancer.

- If 1,000 people are screened every year for 3 years, about **356 will have a false alarm.**
- Of these 356 people with a false alarm, **18 will have an invasive procedure** such as a biopsy (a tiny piece of lung tissue is removed to test for cancer).
- Of these 18 people, **less than 1 will have a major complication** as a result of the procedure, such as bleeding in the lung, a collapsed lung, or an infection.

If you have a positive screening test, but your followup imaging tests and biopsy do not show cancer, you could still get lung cancer in the future. So it is important for you and your health care professional to discuss lung cancer screening every year.

Out of 1,000 people screened with LDCT for lung cancer:

Out of 1,000 people not screened with LDCT for lung cancer:

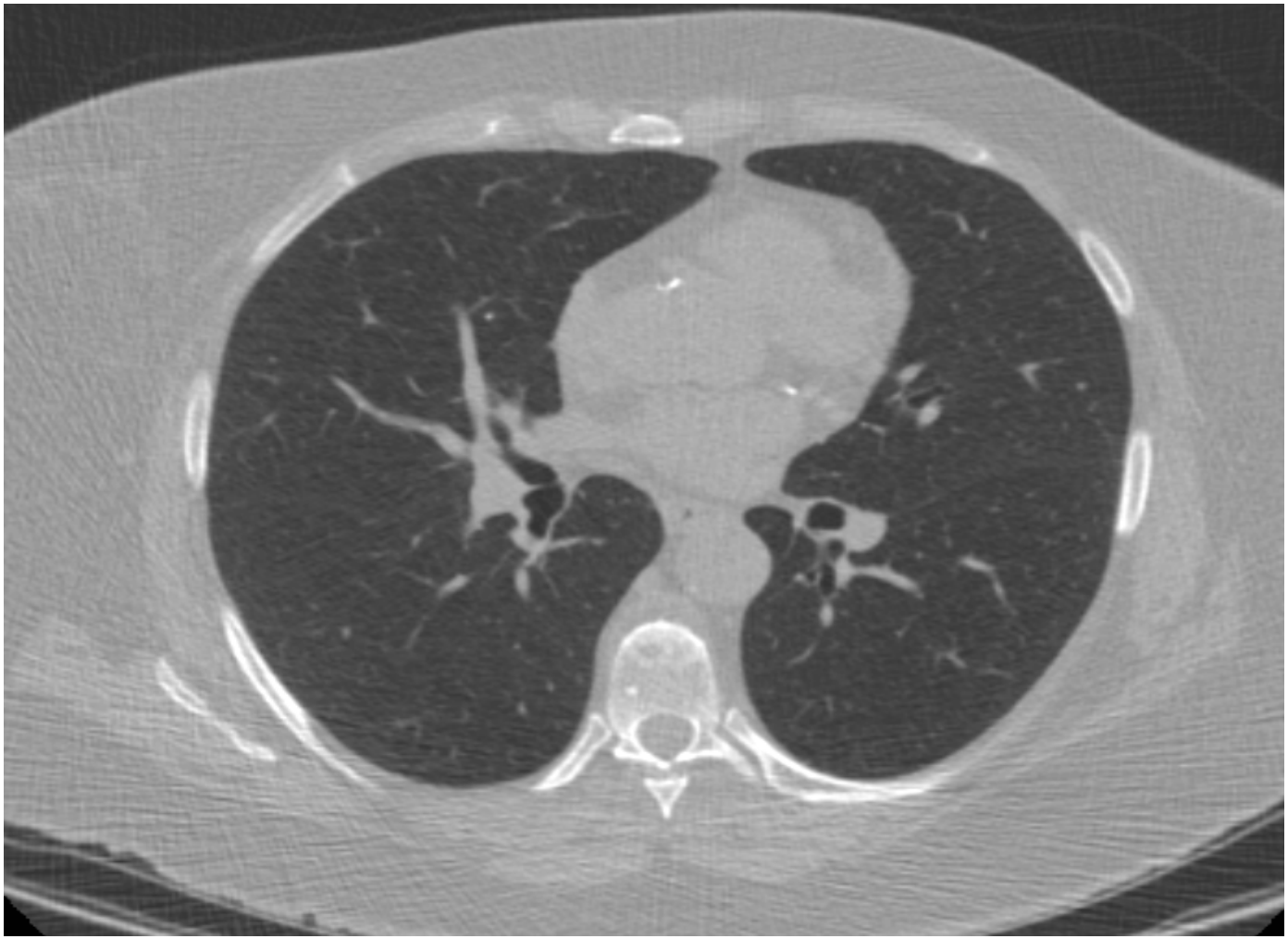
* For people screened once a year for 3 years and followed for an average of 6.5 years. This information applies to people who are at high risk of lung cancer because of their smoking history and age.

The benefits of lung cancer screening may be greater if your lung cancer risk is higher. For example, current smokers who smoke more than one pack a day have a higher risk for lung cancer than smokers who quit 10 years ago.

The harms of lung cancer screening may be greater if you have other health problems, such as heart disease or severe lung disease like asthma or chronic obstructive pulmonary disease (COPD). The risk of problems from biopsies may be higher in these people.

MASSACHUSETTS GENERAL HOSPITAL

LDCT: Normal

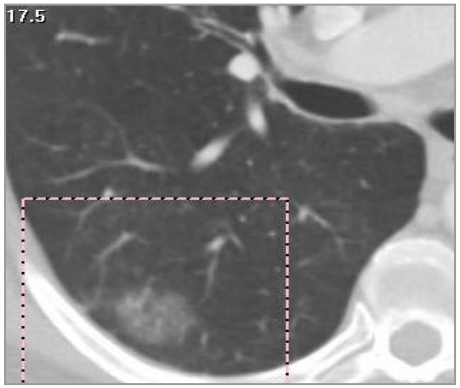


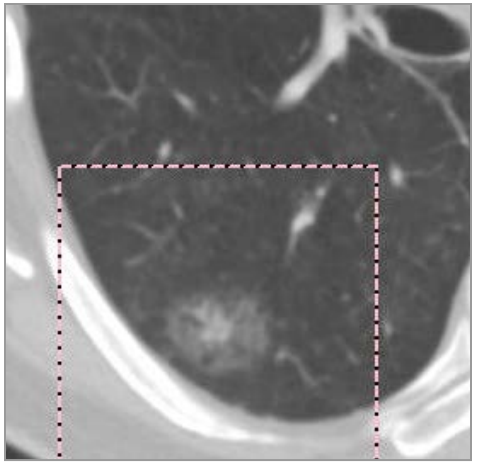
Interpretation of Lung Screening: LungRads Version 1.1

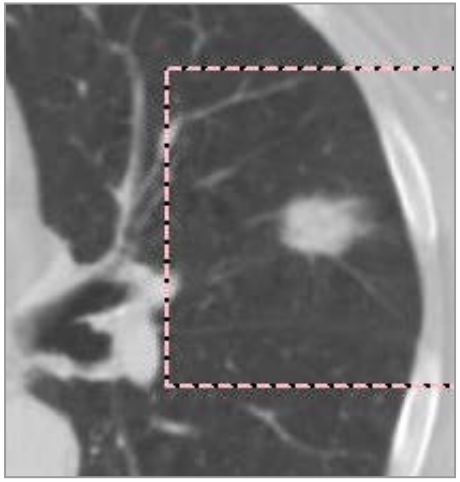
Lung-RADS® Version 1.1

Assessment Categories Release date: 2019

Category Descriptor	Lung-RADS Score	Findings	Management	Risk of Malignancy	Est. Population Prevalence
Incomplete	0	Prior chest CT examination(s) being located for comparison Part or all of lungs cannot be evaluated	Additional lung cancer screening CT images and/or comparison to prior chest CT examinations is needed	n/a	1%
Negative No nodules and definitely benign nodules	1	No lung nodules Nodule(s) with specific calcifications: complete, central, popcorn, concentric rings and fat containing nodules	Continue annual screening with LDCT in 12 months	< 1%	90%
Benign Appearance or Behavior Nodules with a very low likelihood of becoming a clinically active cancer due to size or lack of growth	2	Perifissural nodule(s) *(See Footnote 11)* < 10 mm (524 mm^3) Solid nodule(s): < 6 mm (< 113 mm^3) new < 4 mm (< 34 mm^3) Part solid nodule(s): < 6 mm total diameter (< 113 mm^3) on baseline screening Non solid nodule(s) (GGN): <30 mm (<14137 mm^3) OR ≥ 30 mm (≥ 14137 mm^3) and unchanged or slowly growing Category 3 or 4 nodules unchanged for ≥ 3 months			
Probably Benign Probably benign finding(s) - short term follow up suggested; includes nodules with a low likelihood of becoming a clinically active cancer	3	Solid nodule(s): ≥ 6 to < 8 mm (≥ 113 to < 268 mm^3) at baseline OR new 4 mm to < 6 mm (34 to < 113 mm^3) Part solid nodule(s) ≥ 6 mm total diameter (≥ 113 mm^3) with solid component < 6 mm (< 113 mm^3) OR new < 6 mm total diameter (< 113 mm^3) Non solid nodule(s) (GGN) ≥ 30 mm (≥ 14137 mm^3) on baseline CT or new	6 month LDCT	1-2%	5%
Suspicious Findings for which additional diagnostic testing is recommended	4A	Solid nodule(s): ≥ 8 to < 15 mm (≥ 268 to < 1767 mm^3) at baseline OR growing < 8 mm (< 268 mm^3) OR new 6 to < 8 mm (113 to < 268 mm^3) Part solid nodule(s): ≥ 6 mm (≥ 113 mm^3) with solid component ≥ 6 mm to < 8 mm (≥ 113 to < 268 mm^3) OR with a new or growing < 4 mm (< 34 mm^3) solid component Endobronchial nodule	3 month LDCT; PET/CT may be used when there is a ≥ 8 mm (≥ 268 mm^3) solid component	5-15%	2%
Very Suspicious Findings for which additional diagnostic testing and/or tissue sampling is recommended	4B	Solid nodule(s) ≥ 15 mm (≥ 1767 mm^3) OR new or growing, and ≥ 8 mm (≥ 268 mm^3) Part solid nodule(s) with: a solid component ≥ 8 mm (≥ 268 mm^3) OR a new or growing ≥ 4 mm (≥ 34 mm^3) solid component	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 (≥ 268 mm^3) 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*	> 15%	2%
	4X	Category 3 or 4 nodules with additional features or imaging findings that increases the suspicion of malignancy			
Other Clinically Significant or Potentially Clinically Significant Findings (non lung cancer)	S	Modifier - may add on to category 0-4 coding	As appropriate to the specific finding	n/a	10%

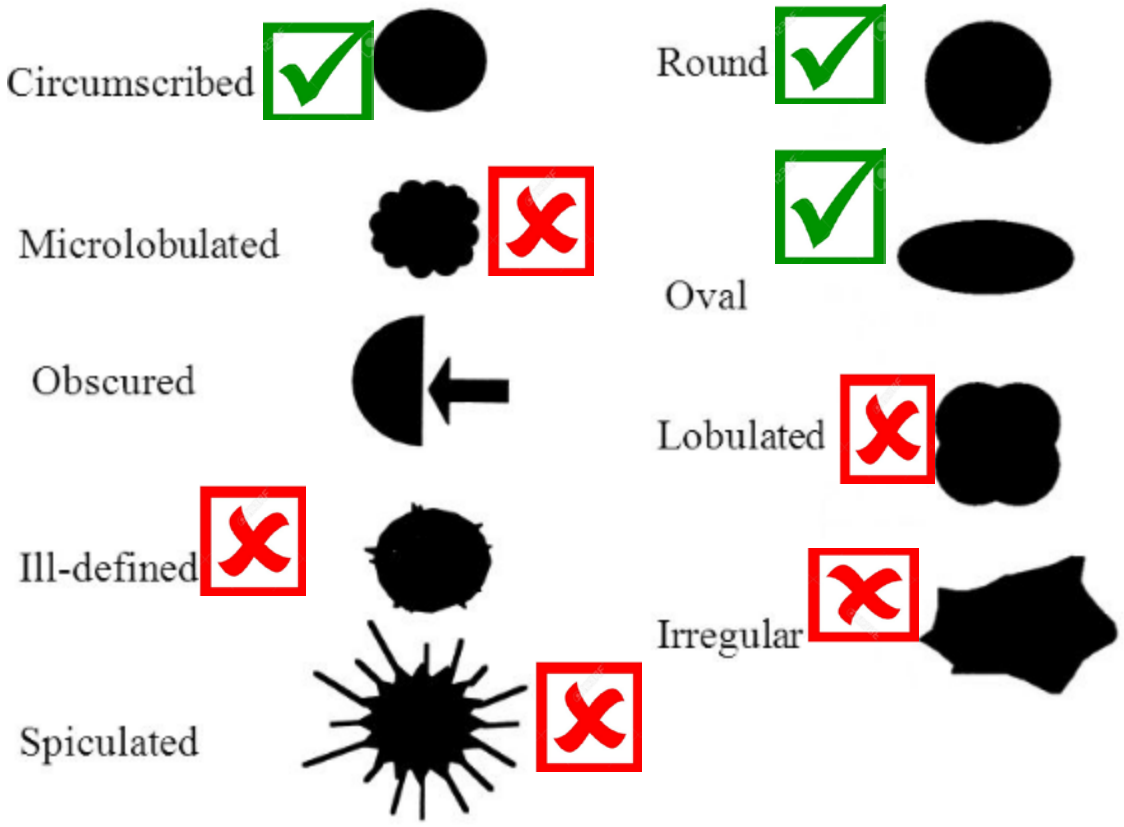




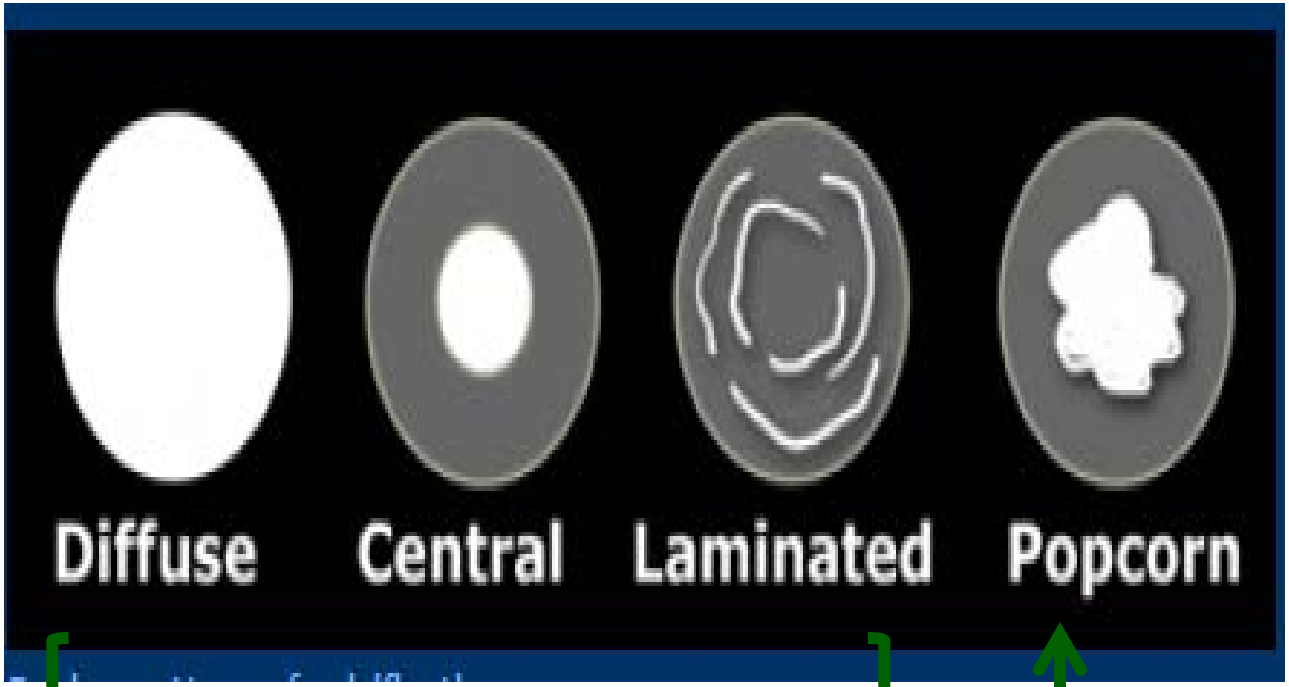


MASSACHUSETTS GENERAL HOSPITAL

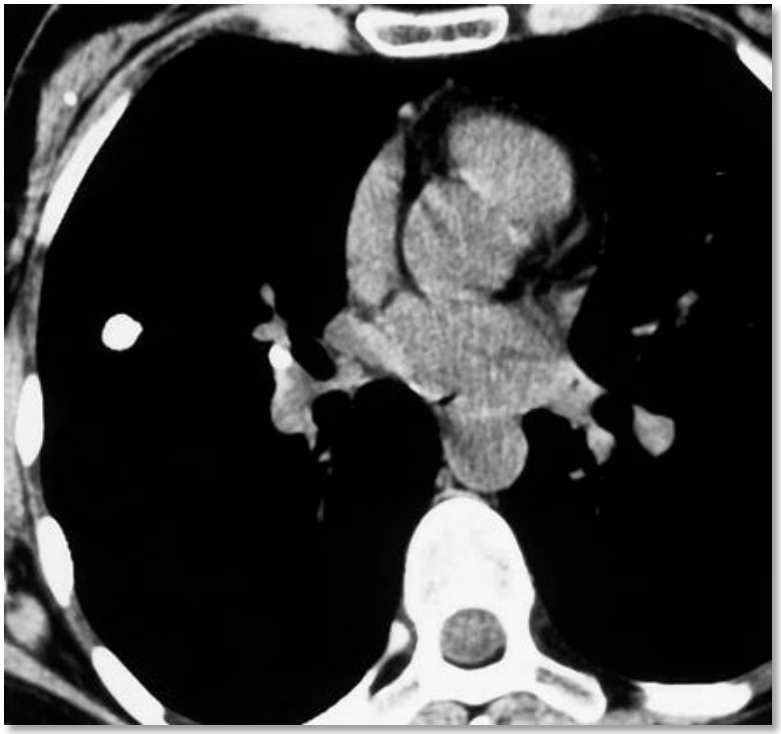
Pulmonary Nodules Morphology

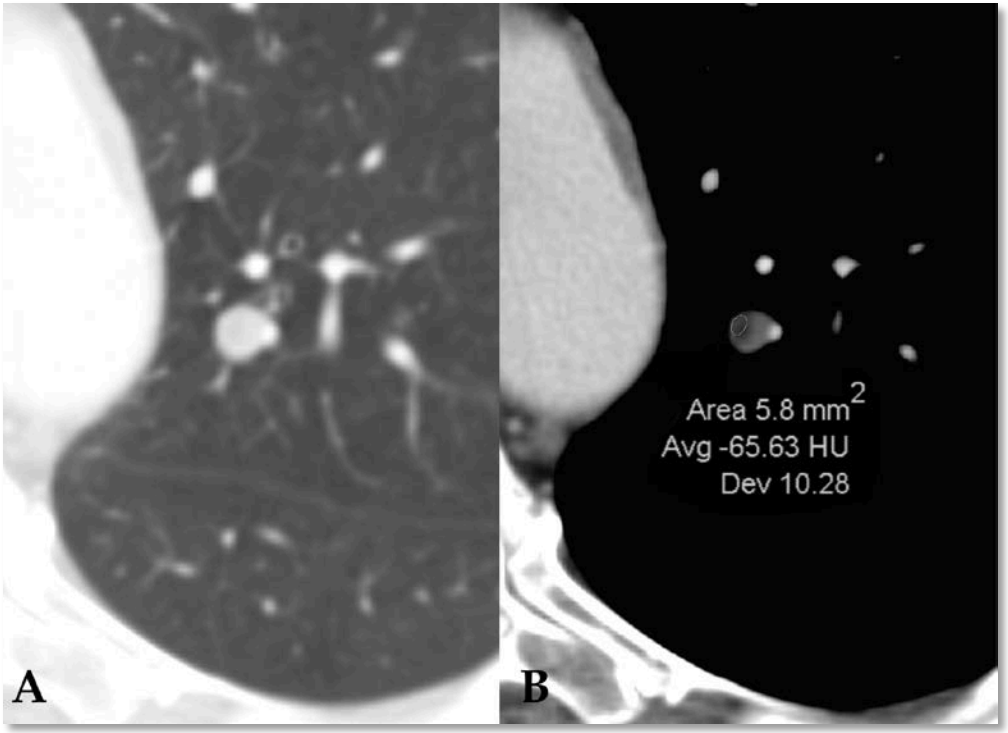


Pulmonary Nodules Morphology
Benign Calcifications



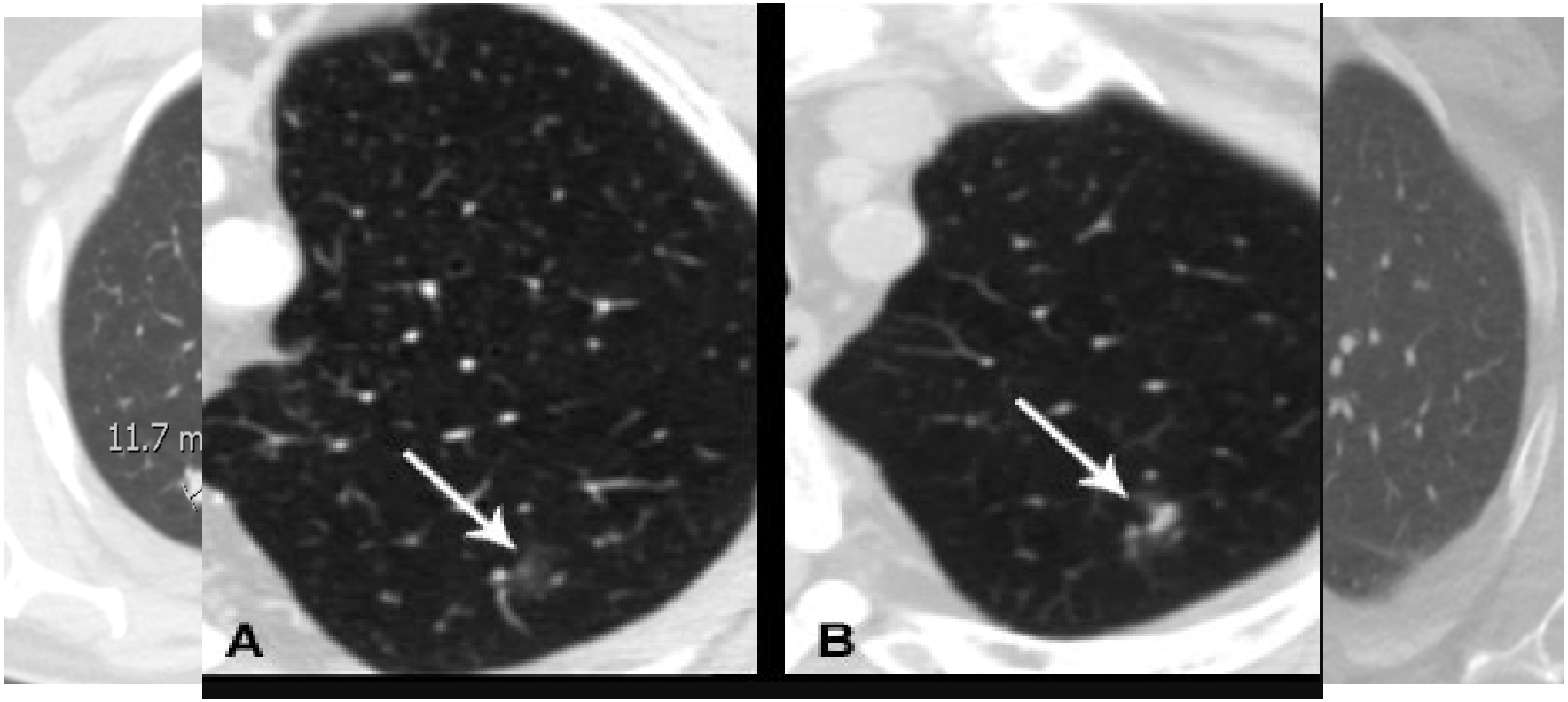
Category 1: Nodules with specific patterns of calcification and/or fat





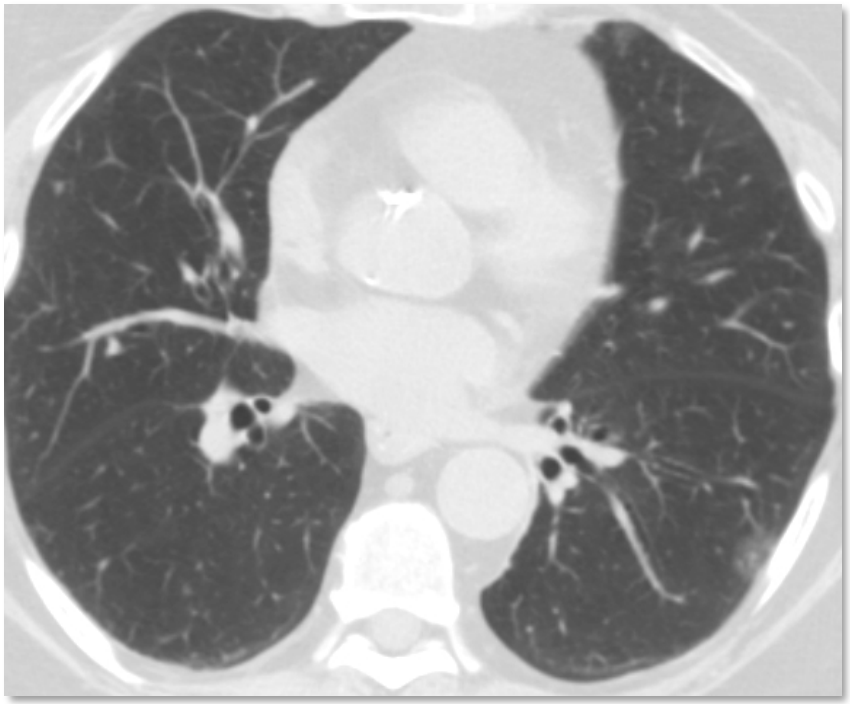
Lung-Rads Category: 1 - Negative, No nodules and definitely benign nodules.
Nodules with specific calcifications: complete, central, popcorn, concentric rings and fat containing nodules, <1% probability of malignancy
Management: Continue annual screening, LDCT in 12 months

Lung- RADS Category 2 (<1%) → 4B
Importance of Yearly Screening



MASSACHUSETTS GENERAL HOSPITAL

Category 2: Non solid nodule

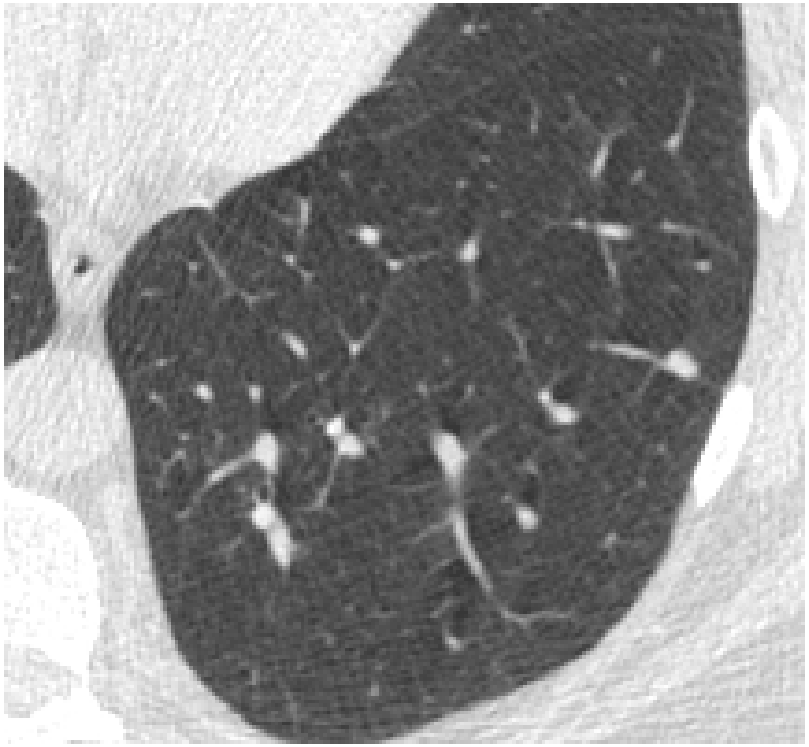


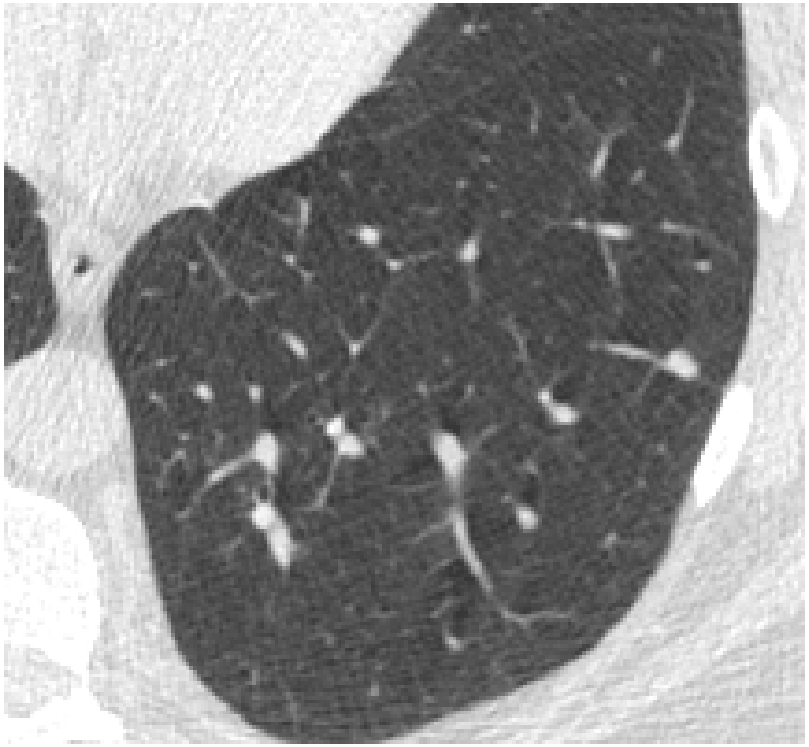
Finding: Nonsolid nodule, <20 mm
Lung-RADS: Category 2-Benign appearance or behavior, <1% probability of malignancy
Management: LDCT in 12 months

Finding: New > 4 mm solid component
Lung-RADS: Category 4B, Suspicious, >15% probability of malignancy
Management: Chest CT, PET/CT and/or tissue sampling

MASSACHUSETTS GENERAL HOSPITAL

Category 3: Solid Nodule





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

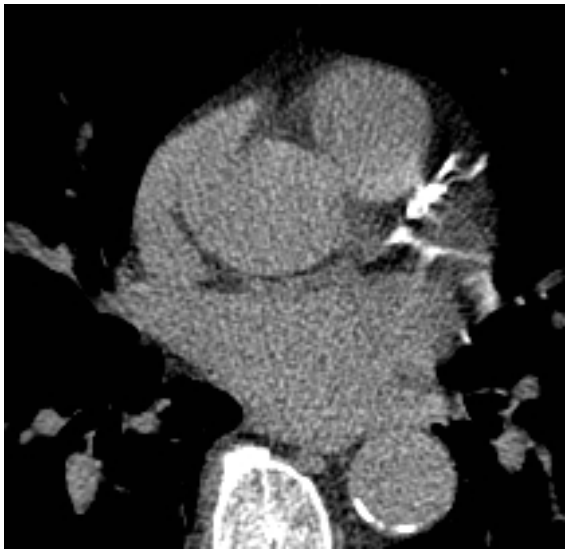
- Lung-RADS **1** (No nodules, definitely benign)
  - Return to Annual Screening
- Lung-RADS **2** Nodules present with low likelihood of becoming a clinically active cancer (Less than 1% malignancy)
  - Return to Annual Screening
- Lung-RADS **3** Nodules present (1-2% risk malignancy)
  - 6 month LCS follow-up

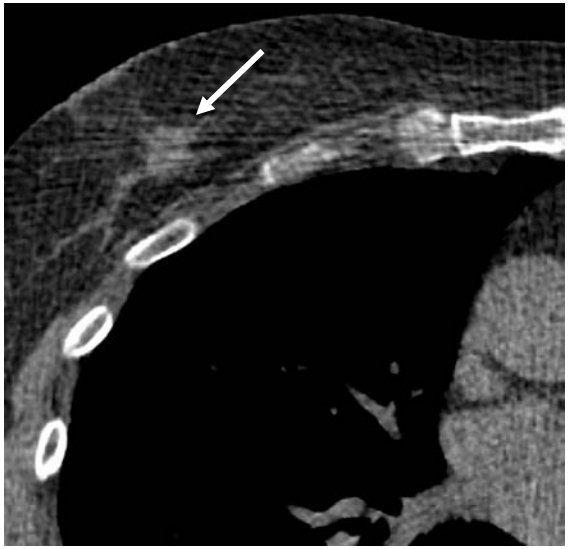
Significant Finding “S” as needed

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

REDUCED LUNG-CANCER MORTALITY WITH LOW-DOSE CT SCREENING

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

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

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

The National Lung Screening Trial Research Team*

MASSACHUSETTS GENERAL HOSPITAL

Navigation

Past Due Patient Reminder Letters

<u>Lung-RADS 1-3 Patients only</u>

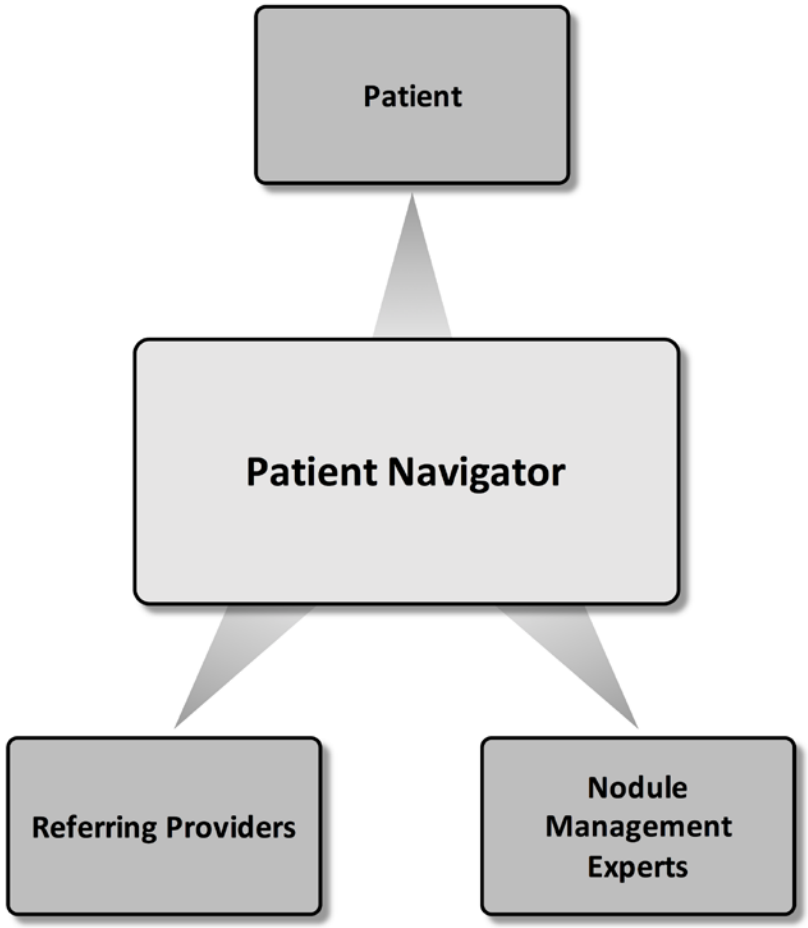
- LR1 & LR2 Reminder Letter –

  60 days past due

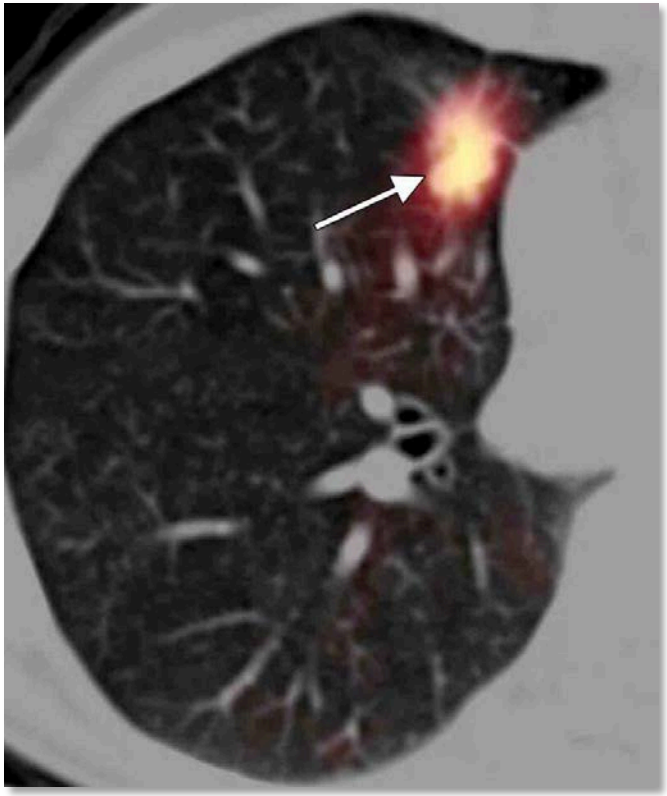
- LR3 Reminder Letter –

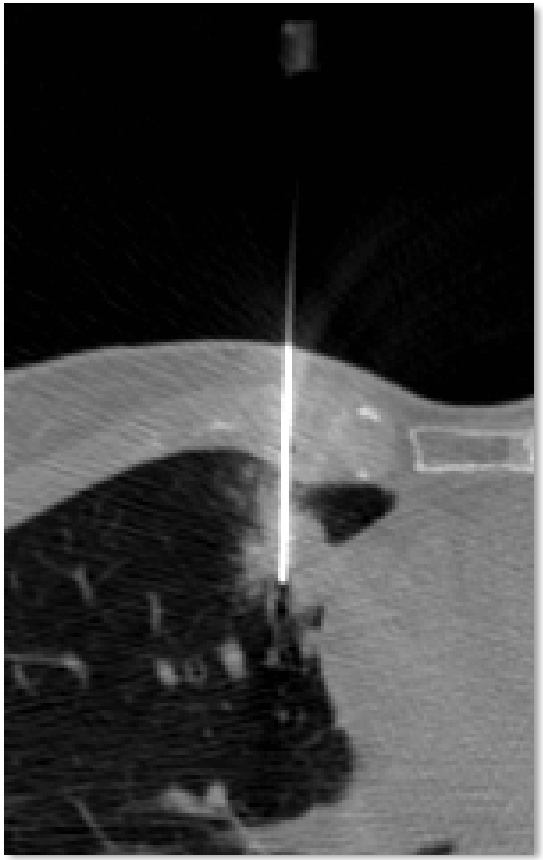
  30 days past due

<u>Lung-RADS 4 Direct communication</u>



Category 4X: Spiculated Solid Nodule





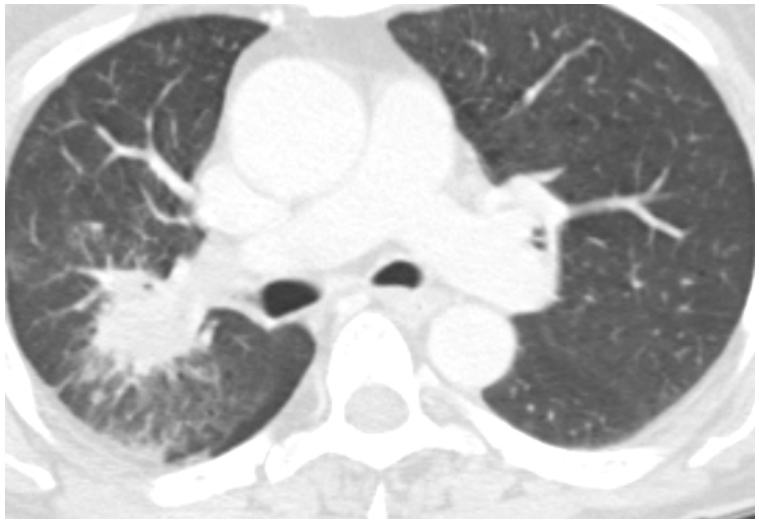
Finding: ≥ 15 mm spiculated nodule in RML

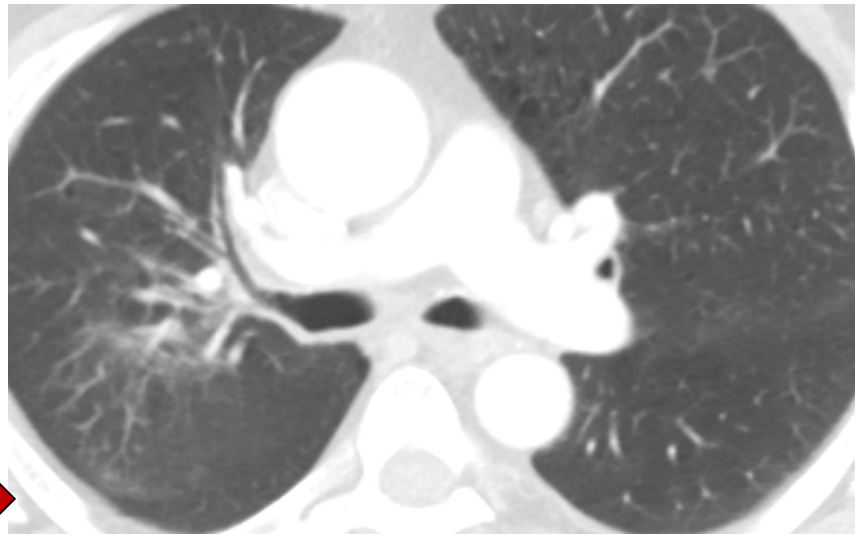
Lung-RADS Category: 4X – Suspicious, features that increase suspicion of malignancy, (> 15% probability of malignancy)

Management: Chest CT, PET/CT and/or tissue sampling (which revealed squamous cell carcinoma)

MASSACHUSETTS GENERAL HOSPITAL

Not all masses are lung cancers: Infection





MASSACHUSETTS GENERAL HOSPITAL

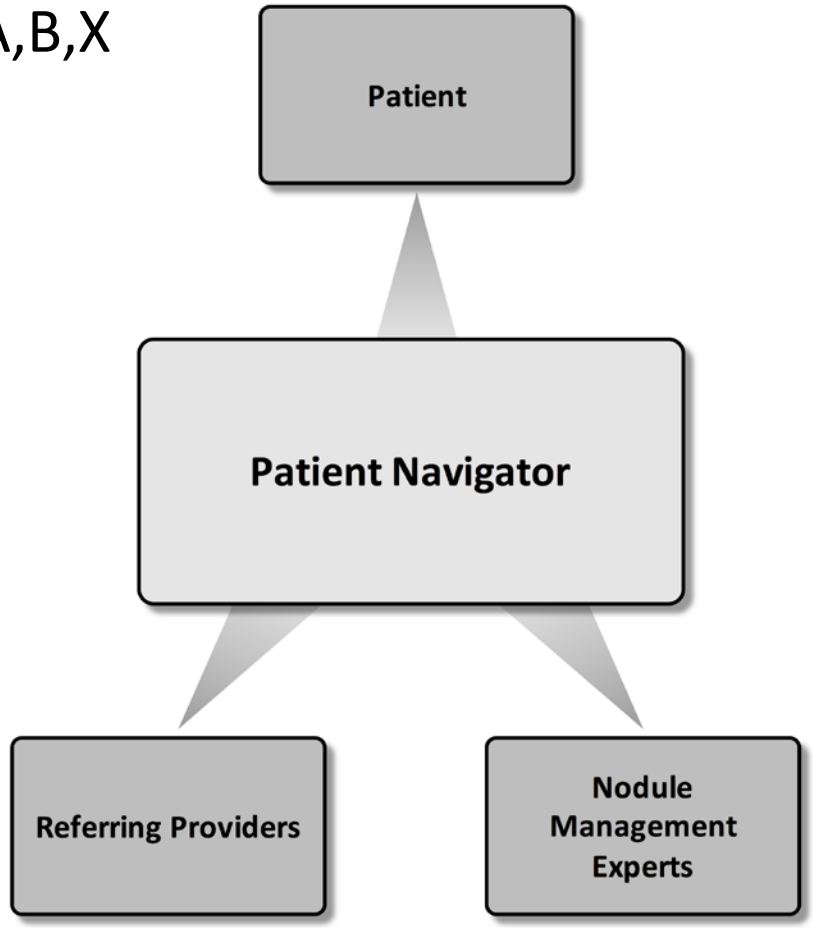
Navigation

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

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

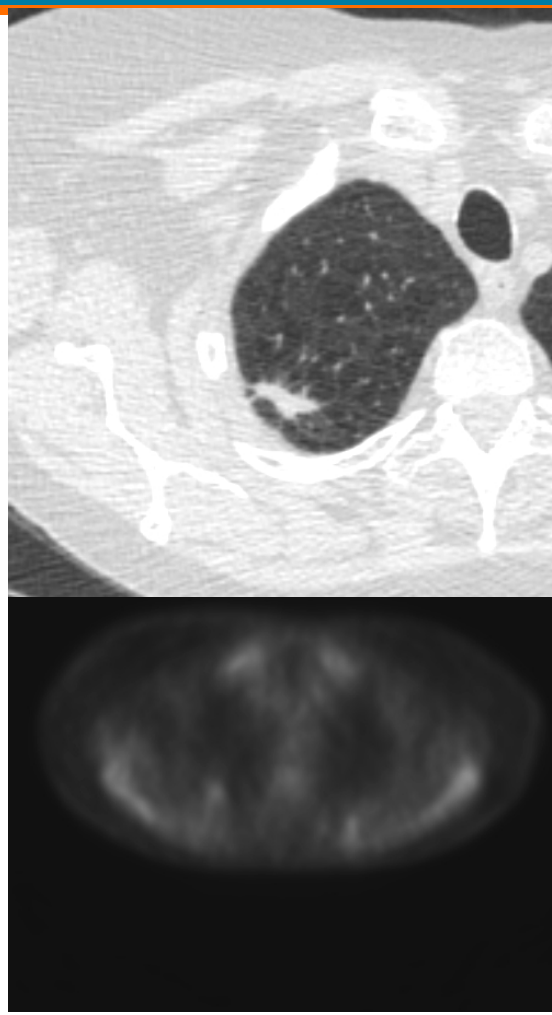
Tufts University School of Medicine, Boston; and Departments of Cardiovascular and Thoracic Surgery, Radiation Oncology, Hematology and Oncology, Pulmonary and Critical Care Medicine, and Radiology, Lahey Hospital & Medical Center, Burlington, Massachusetts

Walker et al. Ann Thorac Surg 2015; 100: 1218-23

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

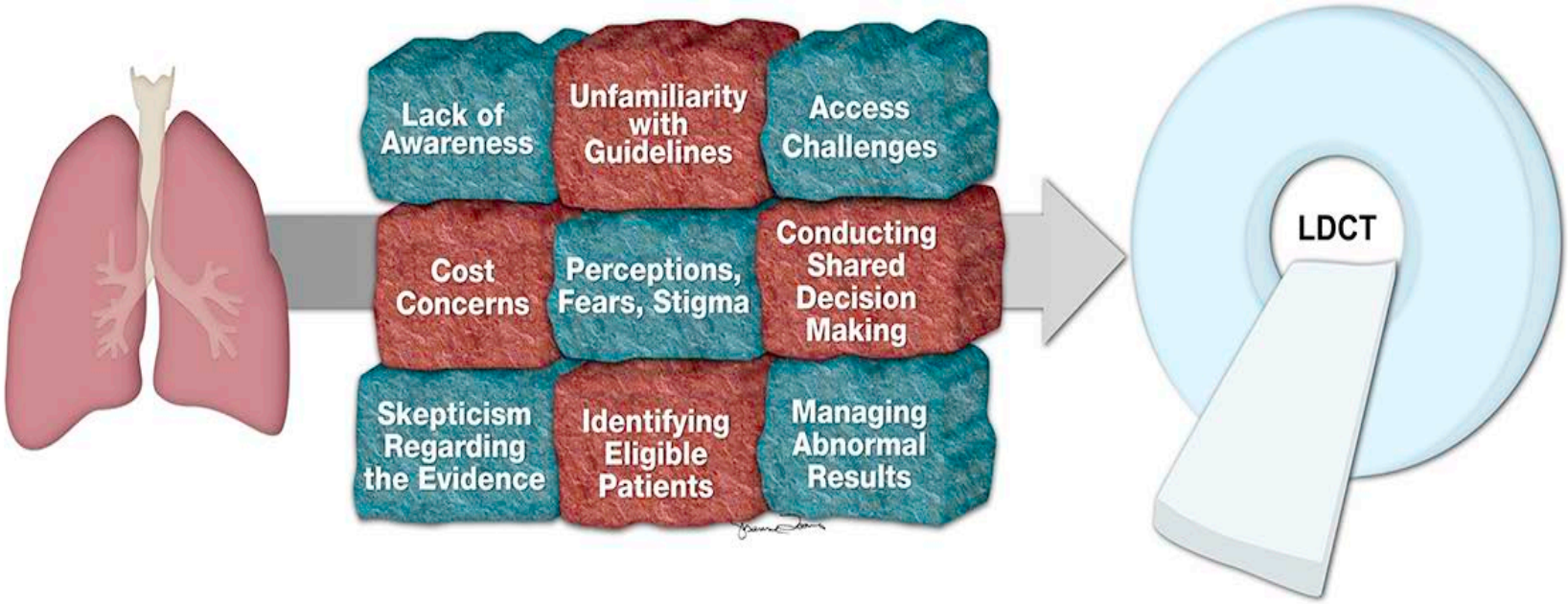


Necrotizing granuloma

Walker et al. Ann Thorac Surg 2015; 100: 1218-23

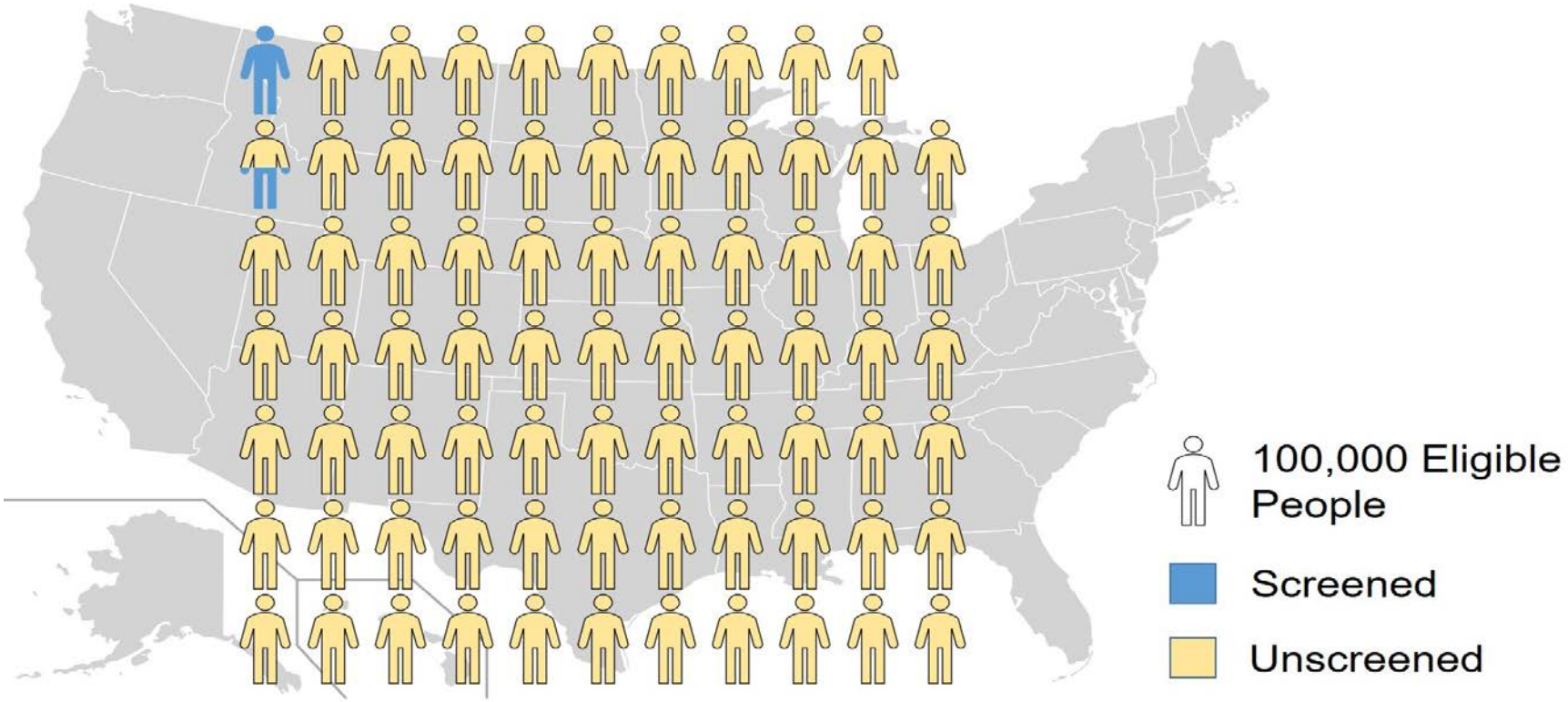
MASSACHUSETTS GENERAL HOSPITAL

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



Pham D, et al. Lung cancer screening rates: Data from the lung cancer screening registry. J Clin Oncol 2018;36:6504

MASSACHUSETTS GENERAL HOSPITAL

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

MASSACHUSETTS GENERAL HOSPITAL

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

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

MASSACHUSETTS GENERAL HOSPITAL