Pulmonary Nodules

Michael Morris, MD

	Common Types of Cancer	Estimated New Cases 2017	Estimated Deaths 2017
1.	Breast Cancer (Female)	252,710	40,610
2.	**Lung and Bronchus Cancer**	**222,500**	**155,870**
3.	Prostate Cancer	161,360	26,730
4.	Colon and Rectum Cancer	135,430	50,260
5.	Melanoma of the Skin	87,110	9,730
6.	Bladder Cancer	79,030	16,870
7.	Non-Hodgkin Lymphoma	72,240	20,140
8.	Kidney and Renal Pelvis Cancer	63,990	14,400
9.	Leukemia	62,130	24,500
10.	Endometrial Cancer	61,380	10,920

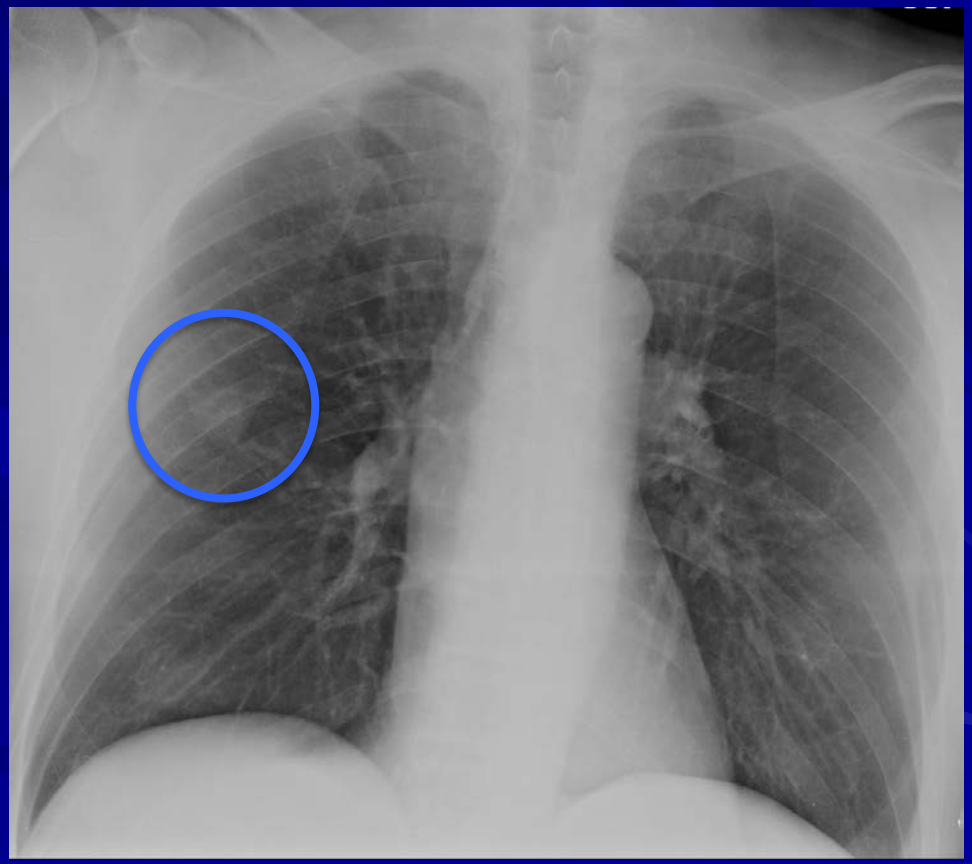
Lung and bronchus cancer represents 13.2% of all new cancer cases in the U.S.

13.2%

http://seer.cancer.gov

Case

- 45 year old healthy male
- Pre-employment screening
  - +PPD
  - screening CXR → “lung nodule”



Case

- 45 year old healthy male
- Pre-employment screening
  - +PPD
  - screening CXR → "lung nodule"

1. Chest CT with contrast
2. Chest CT without contrast
3. PET scan
4. Refer to pulmonary
5. Refer to thoracic surgeon

Case

- 35 year old male
  - Smokes ‘socially’
  - Normal physical exam
- Chest CT ordered for persistent cough

- Chest CT →“9mm nodule”

Case

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  - Smokes ‘socially’
  - Normal physical exam
- Chest CT ordered for persistent cough
- Chest CT →“9mm nodule”

1. Follow with CXR
2. Follow with chest CT
3. PET/CT
4. Percutaneous biopsy
5. Refer to pulmonary
6. Refer to thoracic surgeon

Case

- 67 year old female for annual exam
- 35 pack year smoker
  - Stopped 14 years ago
- Chronic productive cough

- Sent for screening chest CT
  - Chest CT →“9mm nodule”

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4. Refer to pulmonary
5. Refer to thoracic surgeon

Case

- 67 year old female for annual exam
- 35 pack year smoker
  - Stopped 14 years ago
- Chronic productive cough

- Sent for screening chest CT
  - How will you discuss the results with her?

Overview

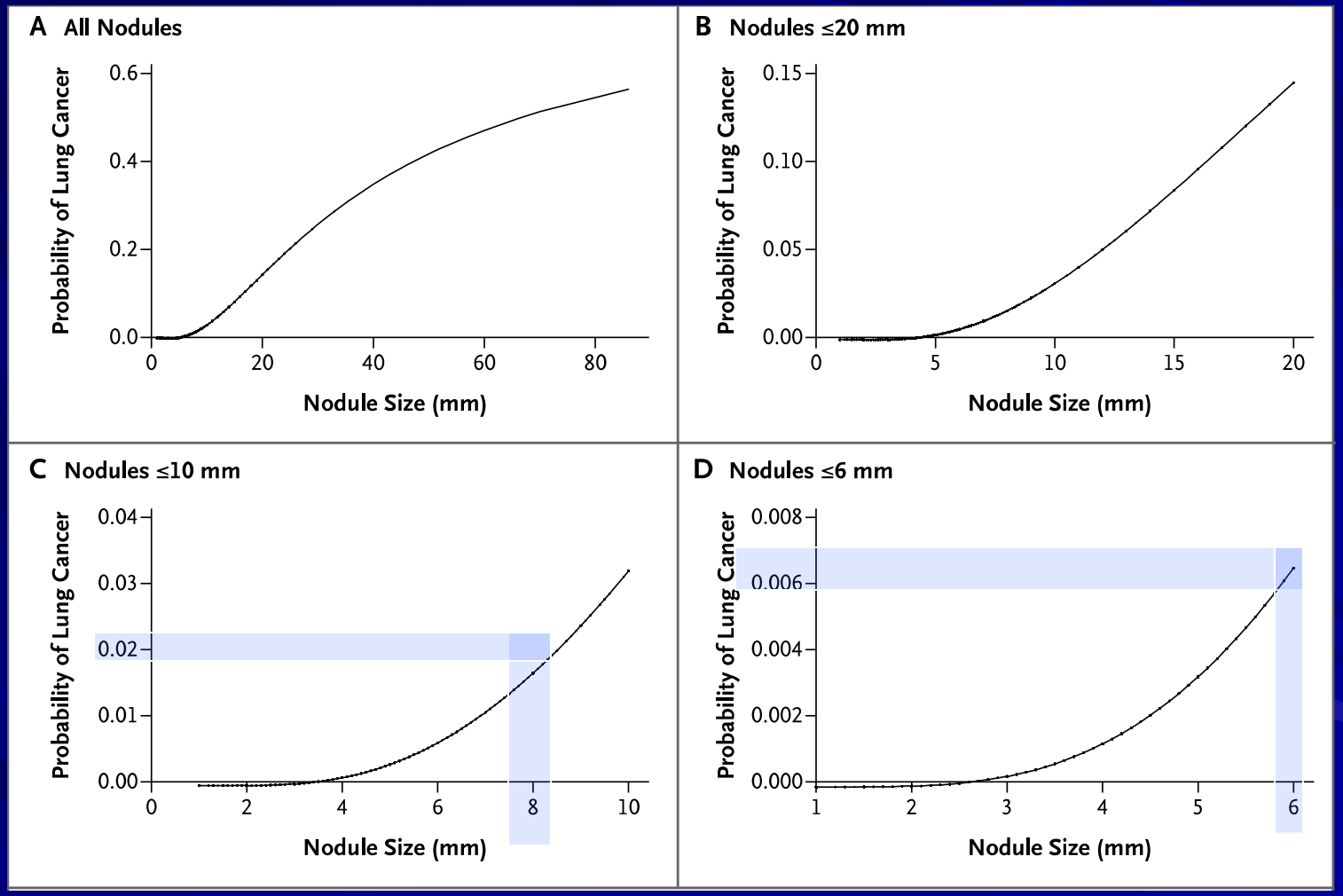
Basics of Lung Nodules

- High Risk Nodules
  - Size
  - Characteristics
    - Solid
    - Part-solid
    - Ground glass
- Management

Lung Cancer Screening

- High risk patients
  - Smokers
  - Age
  - Other comorbidities

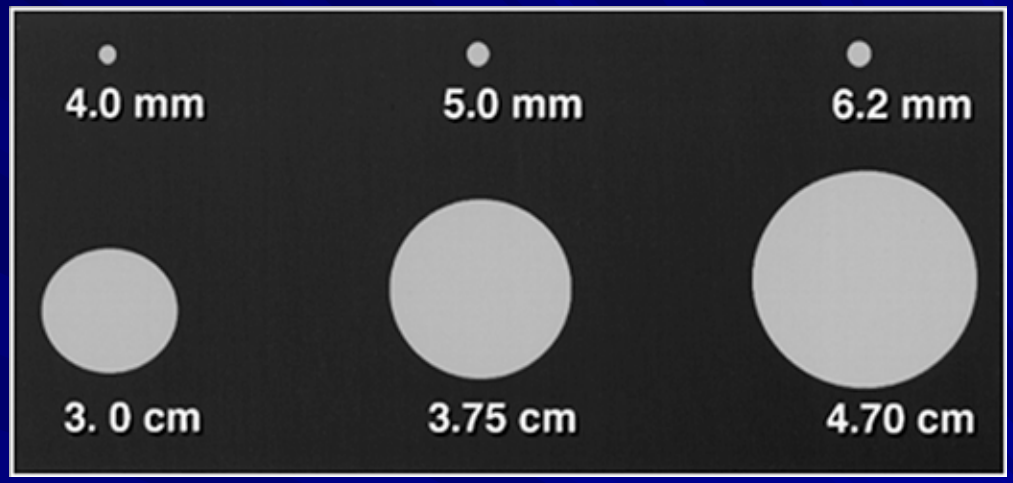
Nodule size and Lung Cancer Risk

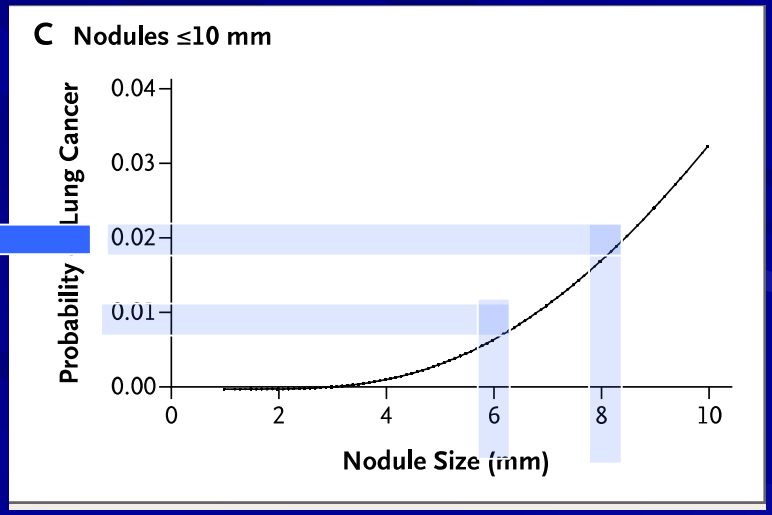


McWilliams et al NEJM 2013;369:910-19

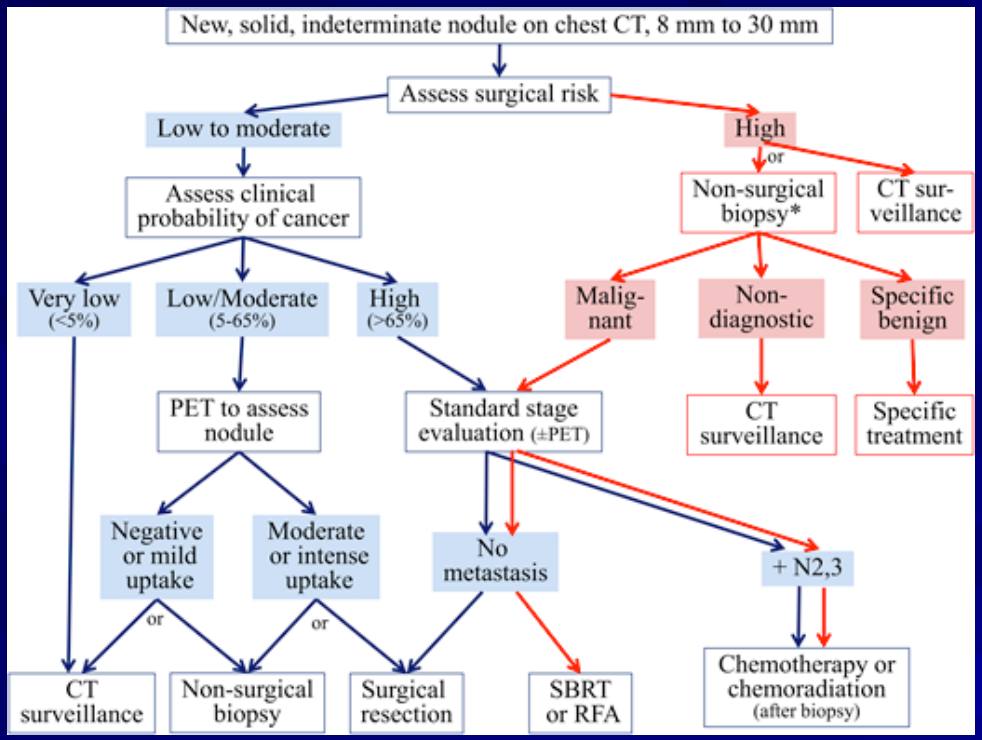
Nodule size and Lung Cancer Risk

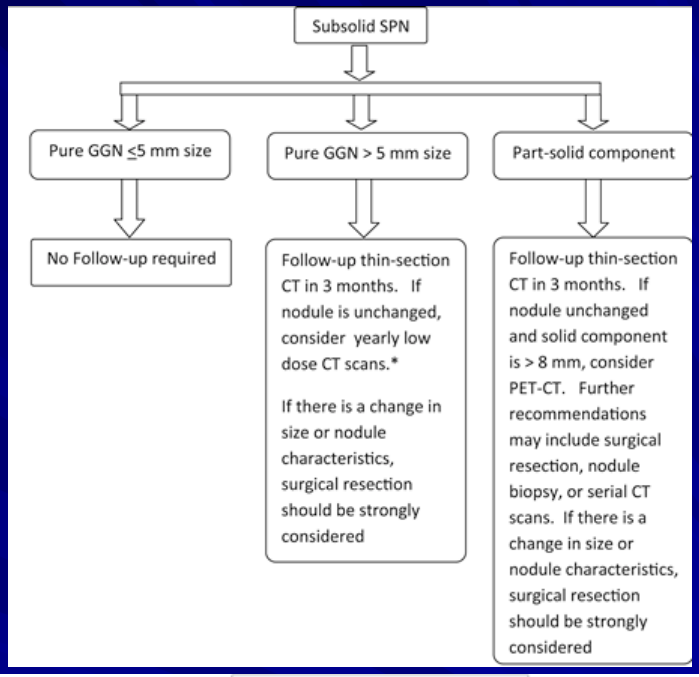
- 2x volume = 26% incr diameter
- Sphere volume $4\pi r^3/3$



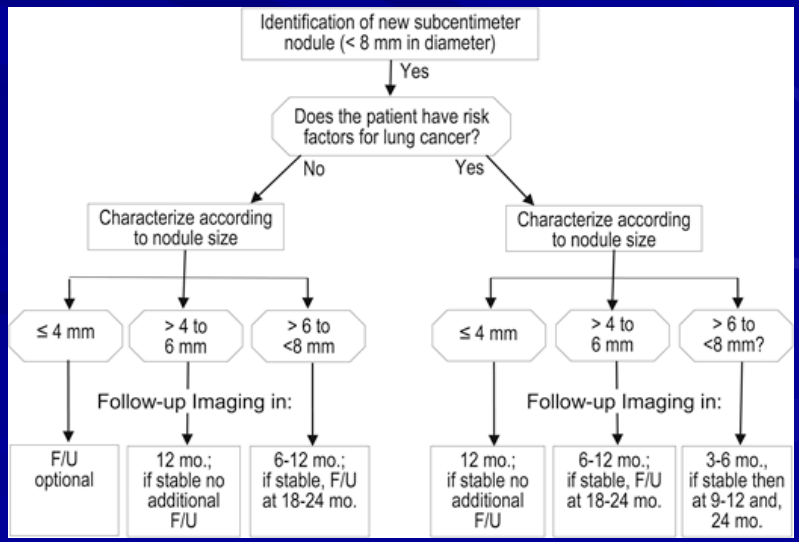


Nodule Management ???





Nodule Type	Management Recommendations	Additional Remarks
Solitary pure GGNs		
≤5 mm	No CT follow-up required	Obtain contiguous 1-mm-thick sections to confirm that nodule is truly a pure GGN
>5 mm	Initial follow-up CT at 3 months to confirm persistence then annual surveillance CT for a minimum of 3 years	FDG PET is of limited value, potentially misleading, and therefore not recommended
Solitary part-solid nodules	Initial follow-up CT at 3 months to confirm persistence. If persistent and solid component <5 mm, then yearly surveillance CT for a minimum of 3 years. If persistent and solid component ≥5 mm, then biopsy or surgical resection	Consider PET/CT for part-solid nodules >10 mm



Gould et al Chest 2013
Naidich et al Radiology 2013
MacMahon et al Radiology 2005

Incidental Nodule Management

Fleischner Society 2017 Guidelines for Management of Incidentally Detected Pulmonary Nodules in Adults

A: Solid Nodules*

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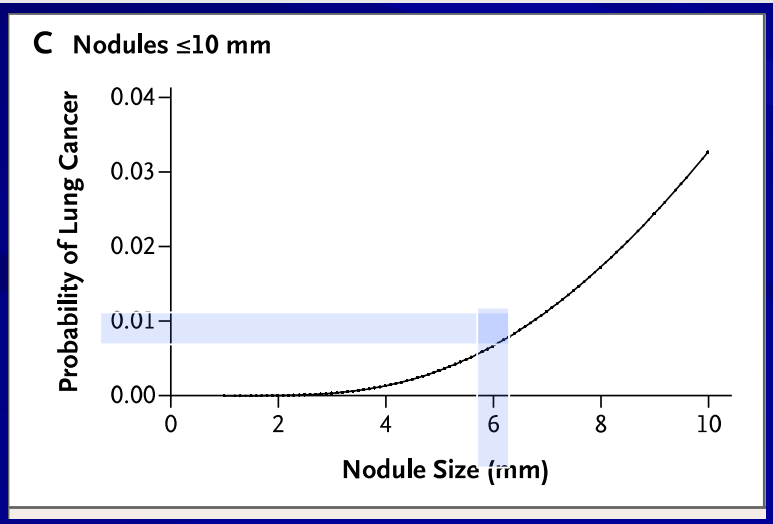

MacMahon et al Radiology 2017

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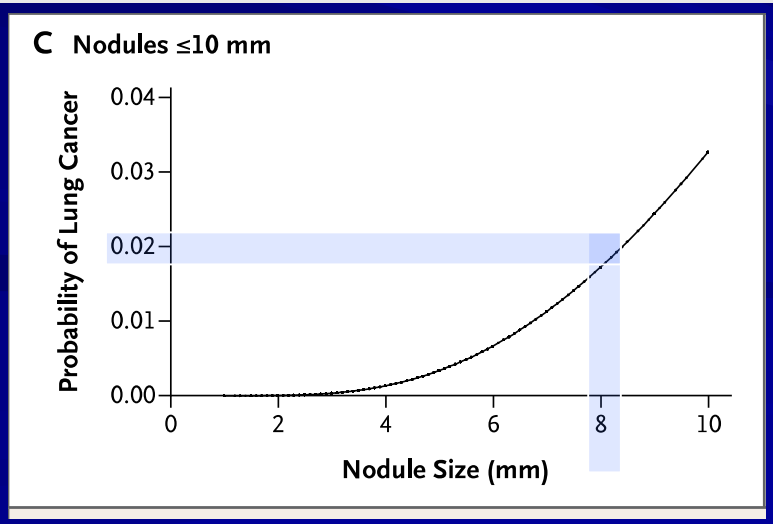

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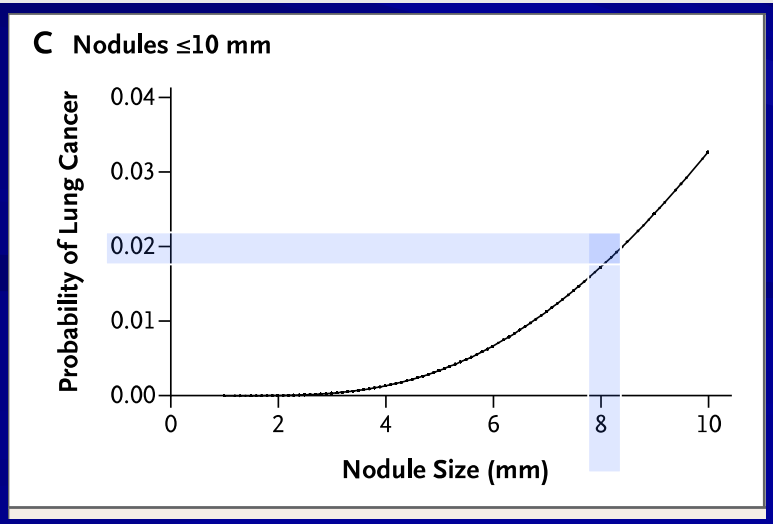
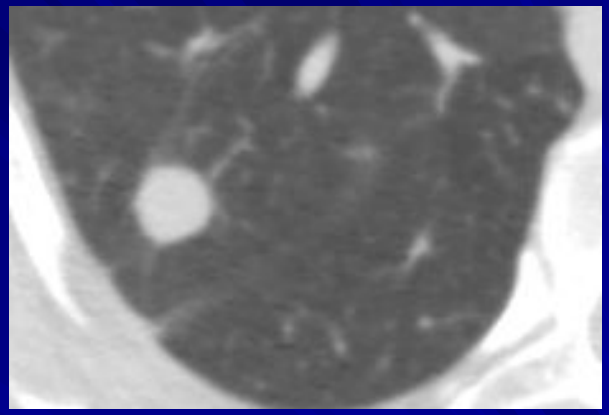


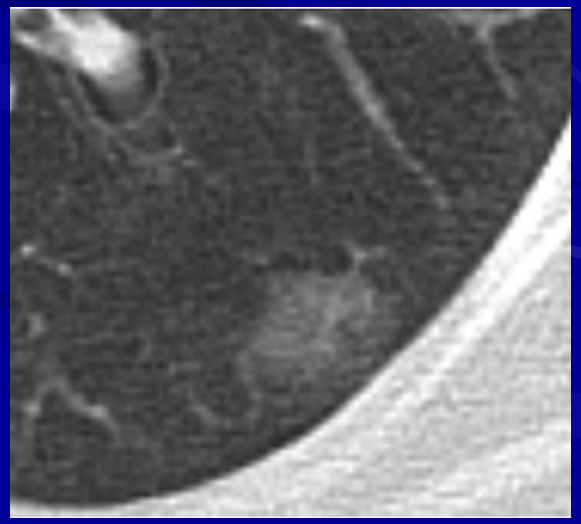
MacMahon et al Radiology 2017

Nodule Characteristics

- Solid
  - Obscures lung parenchyma
  - Ddx: granuloma, infxn, cancer
  - Double time: ~30-400 days



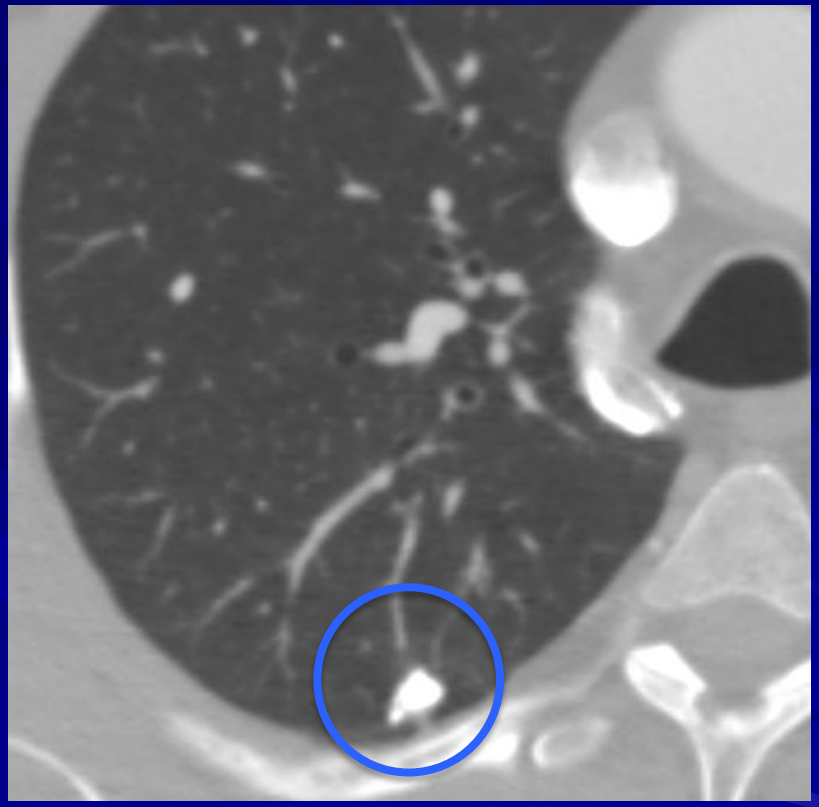
- Ground Glass
  - Nodular area of incr attenuation, but lung still seen
  - Ddx: infxn, AAH, AIS
  - Double time: ~600-900 days

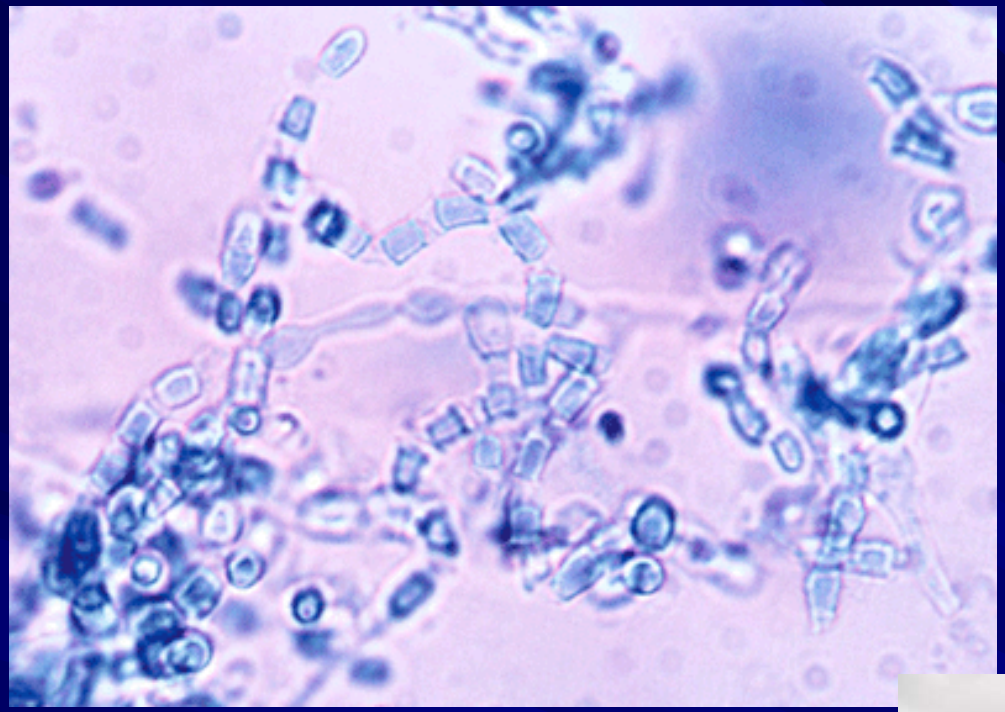


Part Solid Nodules

Nodule Characteristics

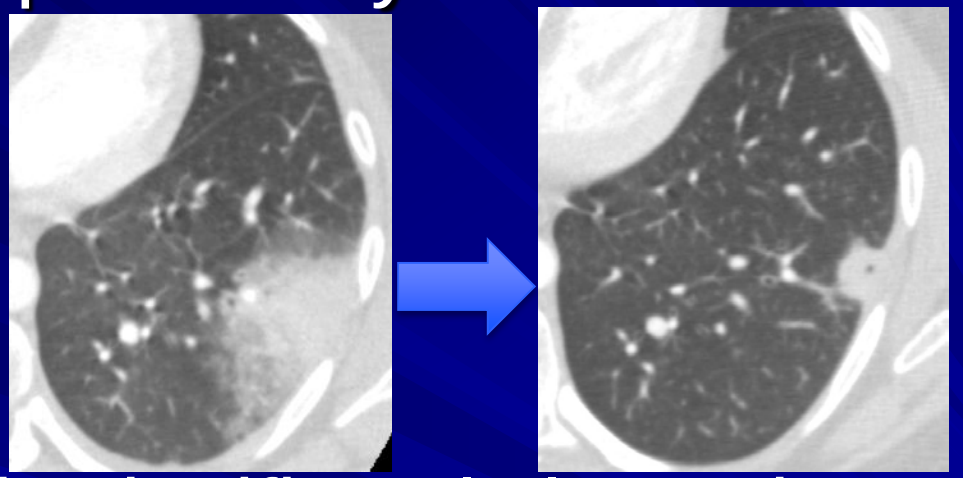
- Usually benign
  - Coarse calcification
    - granuloma
  - Fat containing
    - hamartoma
- Other factors:
  - Spiculated
  - Upper lobe
  - Perifissural





Coccidiomycosis

- Common cause of pulmonary nodules in endemic regions
  - Solid or cavitary
  - Usually >8mm



- Specificity of PET is significantly lower in endemic regions

Research

Original Investigation

Accuracy of FDG-PET to Diagnose Lung Cancer in Areas With Infectious Lung Disease
A Meta-analysis

Deppen et al JAMA 2014

How to reduce lung cancer mortality?

1. Environmental
   - Smoking!!
   - Radon
2. Better treatment
3. Screening?

How to reduce lung cancer mortality?

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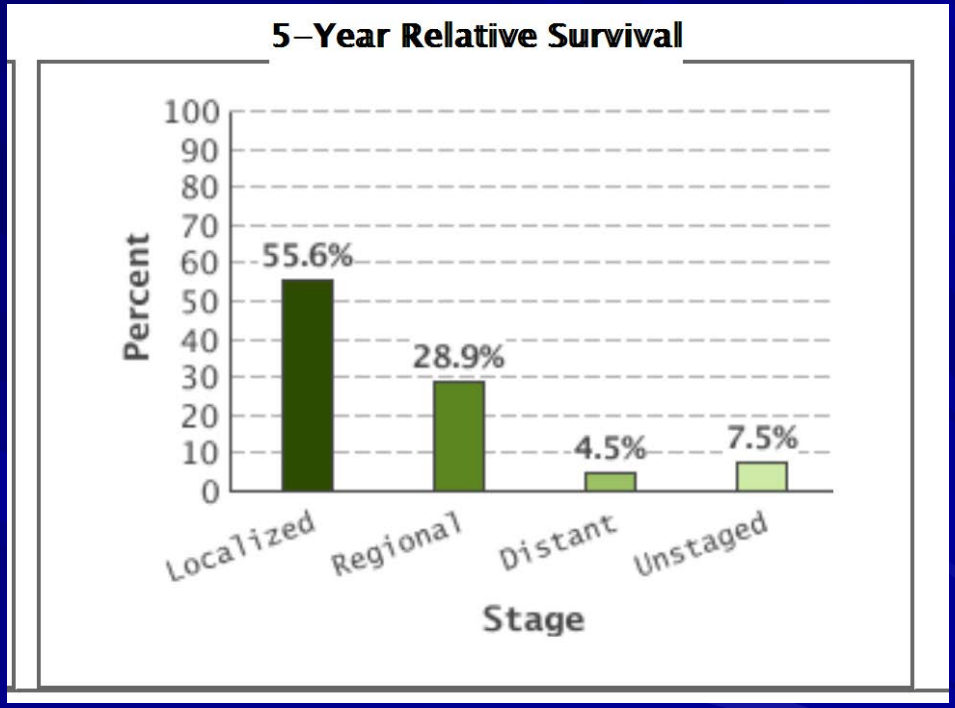
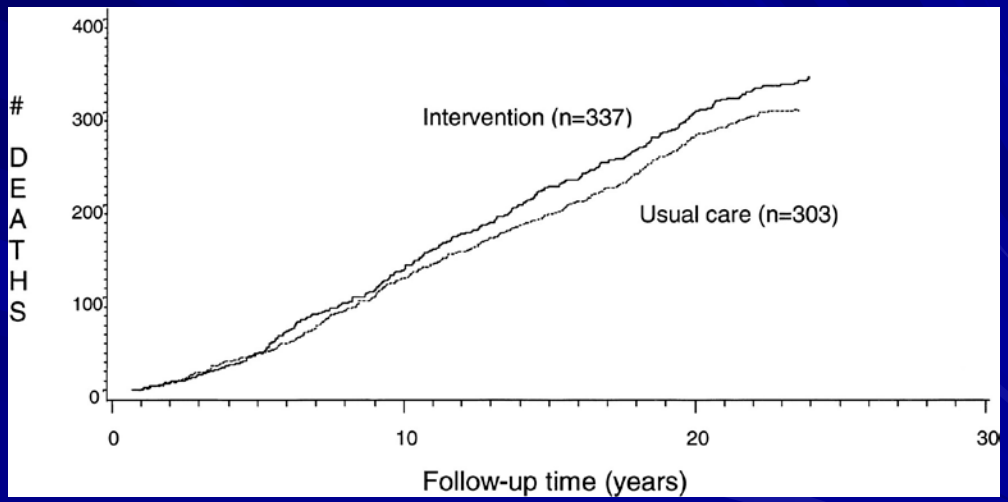
   - earlier stage = better survival



http://seer.cancer.gov

How to reduce lung cancer mortality?

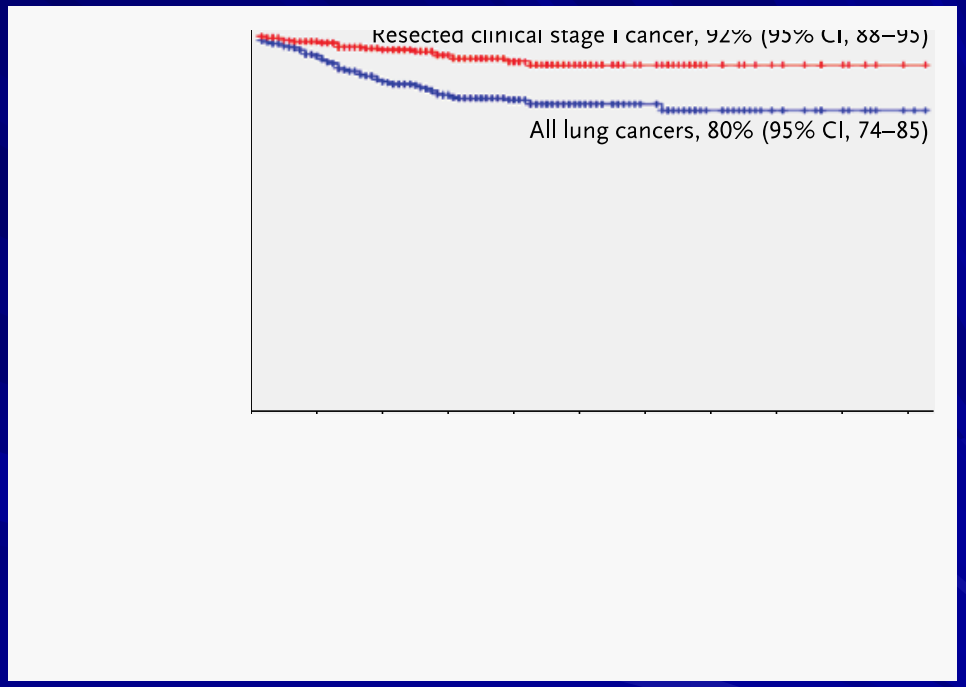
1. Environmental
   - Smoking!!
   - Radon
2. Better treatment
3. Screening?
   - earlier stage = better survival
   - CXR screening doesn't work



Marcus et al JNCI. 2000 92(16):1308-16

How to reduce lung cancer mortality?

1. Environmental
   - Smoking!!
   - Radon
2. Better treatment
3. Screening?
   - earlier stage = better survival
   - CT detects cancer at earlier stage



Henschke et al NEJM 2006;355:1763-71

Chest CT Screening

- NLST
  - 53,454 participants
    - 55-74 year old

      AND
    - 30 pack year smoker
    - Non-smoker if quit <15 yrs
  - CT or CXR x 3yrs
  - + CT if >4mm nodule

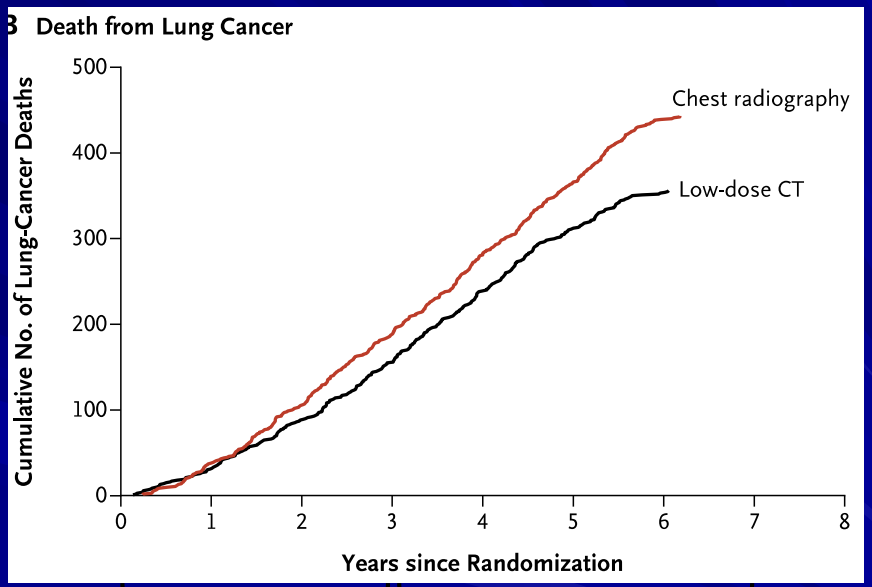
Table 1. Selected Baseline Characteristics of the Study Participants.*

Characteristic	Low-Dose CT Group (N=26,722)	Radiography Group (N=26,732)
	number (percent)	
Age at randomization		
<55 yr†	2 (<0.1)	4 (<0.1)
55–59 yr	11,440 (42.8)	11,420 (42.7)
60–64 yr	8,170 (30.6)	8,198 (30.7)
65–69 yr	4,756 (17.8)	4,762 (17.8)
70–74 yr	2,353 (8.8)	2,345 (8.8)
≥75 yr†	1 (<0.1)	3 (<0.1)
Sex		
Male	15,770 (59.0)	15,762 (59.0)
Female	10,952 (41.0)	10,970 (41.0)
Race or ethnic group‡		
White	24,289 (90.9)	24,260 (90.8)
Black	1,195 (4.5)	1,181 (4.4)
Asian	559 (2.1)	536 (2.0)
American Indian or Alaska Native	92 (0.3)	98 (0.4)
Native Hawaiian or other Pacific Islander	91 (0.3)	102 (0.4)
More than one race or ethnic group	333 (1.2)	346 (1.3)
Data missing	163 (0.6)	209 (0.8)
Hispanic ethnic group‡		
Hispanic or Latino	479 (1.8)	456 (1.7)
Neither Hispanic nor Latino	26,079 (97.6)	26,039 (97.4)
Data missing	164 (0.6)	237 (0.9)
Smoking status		
Current	12,862 (48.1)	12,900 (48.3)
Former	13,860 (51.9)	13,832 (51.7)

Aberle et al. NEJM 2011 365: 395-409

Chest CT Screening

- NLST
  - 20% decrease in lung cancer mortality
  - 6.7% reduction in overall mortality
  - If 1000 pts screened
    - Mortality decrease 17 → 14
- NELSON
  - 15,822 participants
  - Final results 1-2 yrs



Screen Observation

Aberle et al. NEJM 2011 365: 395-409

Chest CT Screening

U.S. Preventive Services TASK FORCE

SCREENING FOR LUNG CANCER
CLINICAL SUMMARY OF U.S. PREVENTIVE SERVICES TASK FORCE RECOMMENDATION

Population	Asymptomatic adults aged 55 to 80 years who have a 30 pack-year smoking history and currently smoke or have quit smoking within the past 15 years
Recommendation	**Screen annually for lung cancer with low-dose computed tomography.** **Discontinue screening when the patient has not smoked for 15 years.** **Grade: B**

graphy

CT

200

6 7 8

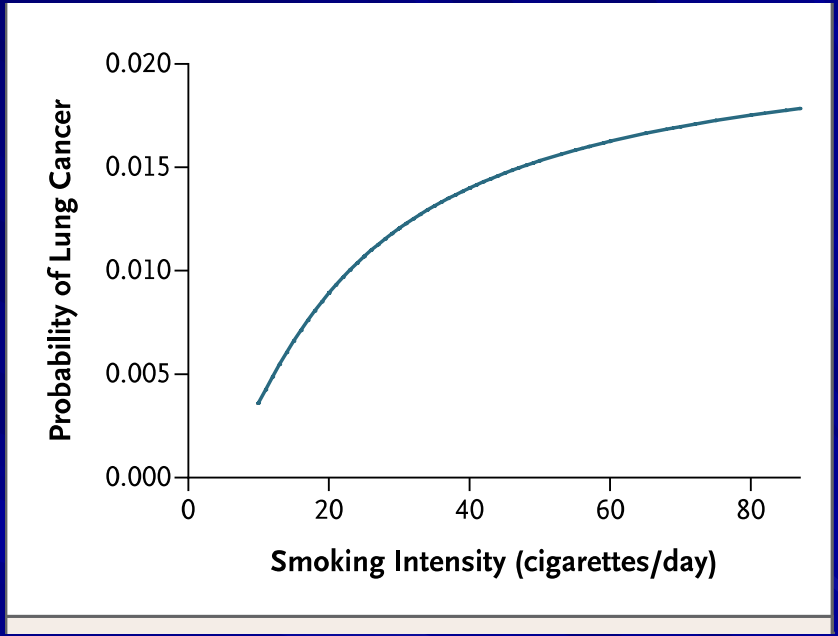
n

Aberle et al. NEJM 2011 365: 395-409

Who Should be Screened 2017

- NLST
  - 55-77* year old

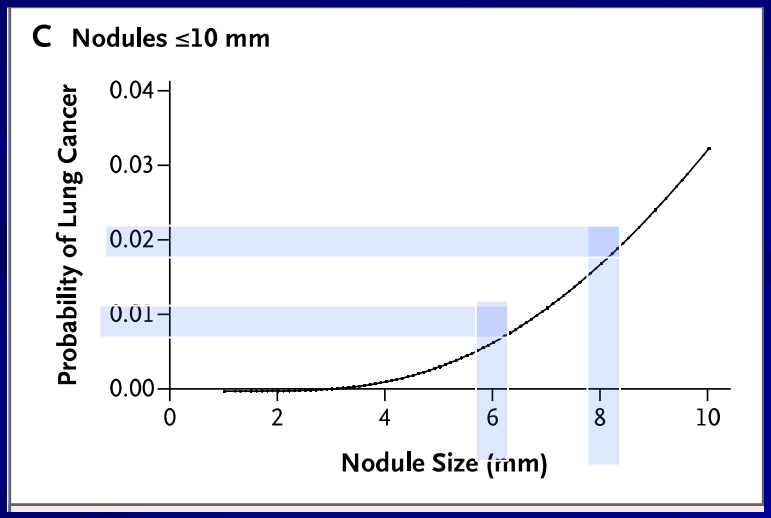
    AND
  - 30 pack year smoker
  - Non-smoker if quit <15 yrs



Tammermagi et al. NEJM 2013;368:728-36
Aberle et al. NEJM 2011 365: 395-409

Screen Detected Management 2017

Category	Category Descriptor	Category	Findings	Management	Probability of Malignancy	Estimated 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			
Benign Appearance or Behavior	Nodules with a very low likelihood of becoming a clinically active cancer due to size or lack of growth	2	solid nodule(s): < 6 mm new < 4 mm part solid nodule(s): < 6 mm total diameter on baseline screening non solid nodule(s) (GGN): < 20 mm OR ≥ 20 mm and unchanged or slowly growing category 3 or 4 nodules unchanged for ≥ 3 months	Continue annual screening with LDCT in 12 months	< 1%	90%
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 at baseline OR new 4 mm to < 6 mm part solid nodule(s) ≥ 6 mm total diameter with solid component < 6 mm OR new < 6 mm total diameter non solid nodule(s) (GGN) ≥ 20 mm on baseline CT or new	6 month LDCT	1-2%	5%
Suspicious	Findings for which additional diagnostic testing and/or tissue sampling is recommended	4A	solid nodule(s): ≥ 8 to < 15 mm at baseline OR growing < 8 mm OR new 6 to < 8 mm part solid nodule(s): ≥ 6 mm with solid component ≥ 6 mm to < 8 mm OR with a new or growing < 4 mm solid component endobronchial nodule	3 month LDCT; PET/CT may be used when there is a ≥ 8 mm solid component	5-15%	2%
		4B	solid nodule(s) ≥ 15 mm OR new or growing, and ≥ 8 mm part solid nodule(s) with: a solid component ≥ 8 mm OR a new or growing ≥ 4 mm 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 solid component.	> 15%	2%
		4X	Category 3 or 4 nodules with additional features or imaging findings that increases the suspicion of malignancy			



Variable	Lung-RADS at Baseline		NLST at Baseline	
	Percentage (95% CI)	*n/N*	Percentage (95% CI)	*n/N*
Sensitivity	84.90 (80.80–89.00)	248/292	93.50 (90.70–96.30)	273/292
False-positive result rate†	12.80 (12.40–13.20)	3343/26 090	26.60 (26.10–27.10)	6939/26 090
PPV	6.90 (6.10–7.70)	248/3591	3.80 (3.30–4.20)	273/7236
NPV	99.81 (99.75–99.86)	22 747/22 791	99.90 (99.86–99.94)	19 200/19 219

NLST = National Lung Screening Trial; NPV = negative predictive value; PPV = positive predictive value.
* Totals of 22 screening results at baseline and 28 after baseline with cancer absent were positive in Lung-RADS and had nodule characteristics meeting the positive screening criteria but were nonetheless reported as negative screening results in the NLST. Otherwise, all screening results that were positive according to the Lung-RADS criteria were also positive according to the NLST criteria.

Pinsky et al. Ann Int Med 2015;162:485-91
https://www.acr.org/Quality-Safety/Resources/LungRADS

Who Should be Screened 2017

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  - 55-77* year old

    AND
  - 30 pack year smoker
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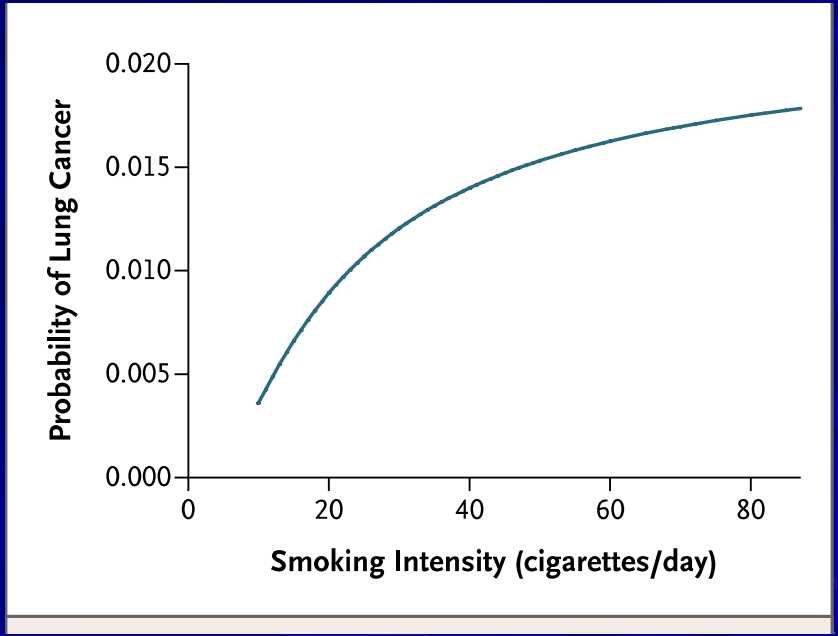


- *Approx. 8 million Americans qualify!!*

Tammermagi et al. NEJM 2013;368:728-36
Aberle et al. NEJM 2011 365: 395-409

Who Should be Screened Risk Based Assessment

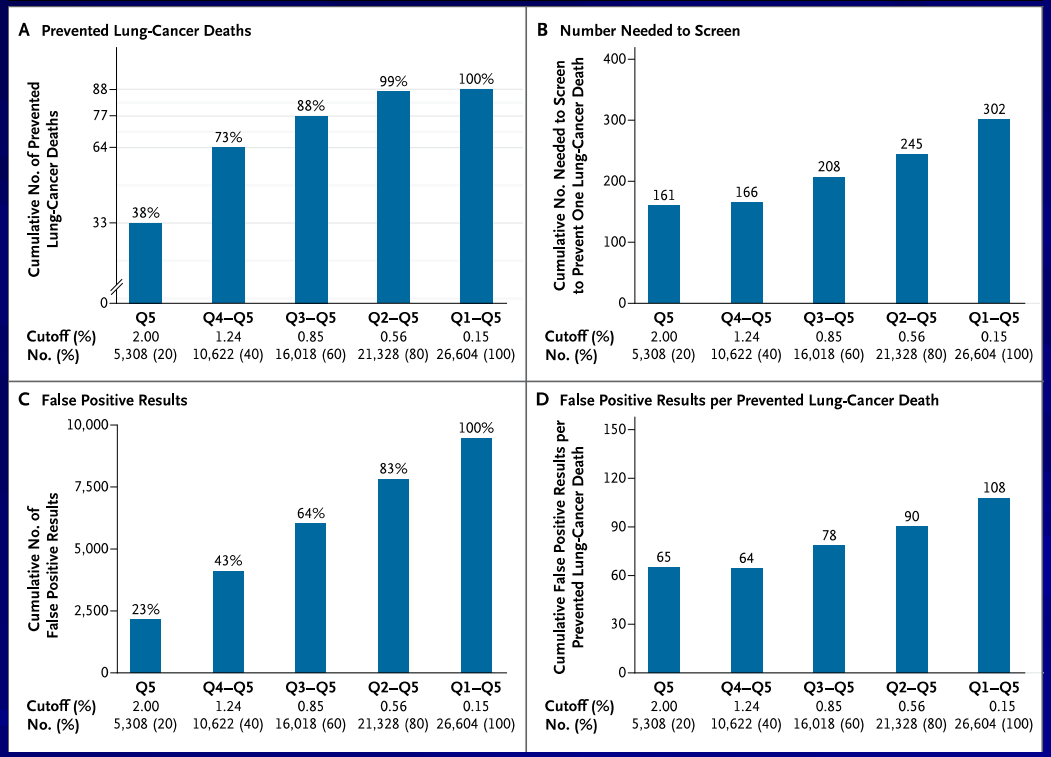


Table 2. Cause-Specific Hazard Models Used in the Risk-Prediction Model for Lung-Cancer Death in the Radiography Group of the NLST.*

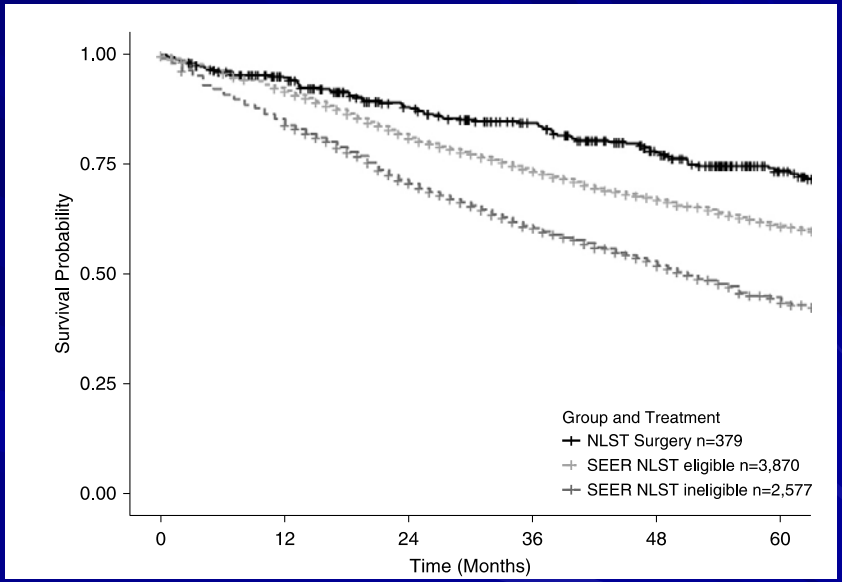
Factor	Coding	Death from Lung Cancer	Death from Another Cause
		hazard ratio (95% CI)	
Age	Continuous	1.08 (1.06–1.10)	1.09 (1.08–1.10)
Female sex	Binary	NA†	0.50 (0.44–0.58)
Race	Categorical	NA†	
Non-Hispanic white			1.00 (reference)
Non-Hispanic black			2.22 (1.78–2.76)
Hispanic			1.34 (0.89–2.03)
Other			1.21 (0.91–1.60)
Body-mass index‡			
Linear term	Continuous	0.75 (0.66–0.86)	0.89 (0.82–0.97)
Quadratic term	Continuous	1.05 (0.99–1.11)	1.06 (1.04–1.09)
Pack-years of smoking	Continuous	1.02 (1.01–1.02)	1.01 (1.01–1.01)
Years since smoking cessation	Trend§	0.62 (0.55–0.70)	0.76 (0.70–0.81)
Presence of emphysema	Binary	1.56 (1.20–2.04)	1.52 (1.28–1.80)
First-degree relative with lung cancer	Trend¶	1.27 (1.00–1.62)	NA‖

Kovalchik et al. NEJM 2013 369: 245-54

Who Should be Screened Risk Based Assessment

	Effect	HR	95% CI	*P* Value
Lung cancer–specific mortality				
Unadjusted	Group (NLST)	0.81	0.62–1.06	0.12
Adjusted	Group (NLST)	0.84	0.64–1.10	0.21
	Age at diagnosis	1.01	0.99–1.04	0.31
	Stage (1B)	1.72	1.48–1.98	<0.01
	Charlson Index (1)	1.24	1.07–1.44	<0.01
	Sex (female)	0.80	0.69–0.93	<0.01
	Smoking status (former)	0.89	0.77–1.03	0.12
All-cause mortality				
Unadjusted	Group (NLST)	0.70	0.57–0.87	<0.01
Adjusted	Group (NLST)	0.71	0.57–0.88	<0.01
	Age at diagnosis	1.02	1.00–1.04	0.02
	Stage (1B)	1.53	1.37–1.71	<0.01
	Charlson Index (1)	1.25	1.12–1.40	<0.01
	Sex (female)	0.77	0.69–0.86	<0.01
	Smoking status (former)	0.77	0.69–0.86	<0.01

Definition of abbreviations: CI = confidence interval; HR = hazard ratio; NLST = National Lung Screening Trial; SEER = Surveillance, Epidemiology, and End Results.
Reference groups: group: SEER-Medicare; stage: 1A; Charlson Index: 0; sex: male; smoking status: current.



Tanner et al. AJRCCM 2017 196: 602-08

Screen Detected Management Risk Based Assessment

	Model 1b: Parsimonious Model, with Spiculation			Model 2b: Full Model, with Spiculation		
	Odds Ratio (95% CI)	P Value	Beta Coefficient	Odds Ratio (95% CI)	P Value	Beta Coefficient
Age, per yr				1.03 (0.99–1.07)	0.16	0.0287
Sex, female vs. male	1.91 (1.19–3.07)	0.008	0.6467	1.82 (1.12–2.97)	0.02	0.6011
Family history of lung cancer, yes vs. no				1.34 (0.83–2.17)	0.23	0.2961
Emphysema, yes vs. no				1.34 (0.78–2.33)	0.29	0.2953
Nodule size		<0.001†	−5.5537		<0.001†	−5.3854
Nodule type						
Nonsolid or with ground-glass opacity				0.88 (0.48–1.62)	0.68	−0.1276
Part-solid				1.46 (0.74–2.88)	0.28	0.3770
Solid				Reference		Reference
Nodule location, upper vs. middle or lower lobe	1.82 (1.12–2.98)	0.02	0.6009	1.93 (1.14–3.27)	0.02	0.6581
Nodule count per scan, per each additional nodule				0.92 (0.85–1.00)	0.049	−0.0824
Spiculation, yes vs. no	2.54 (1.45–4.43)	0.001	0.9309	2.17 (1.16–4.05)	0.02	0.7729
Model constant			−6.6144			−6.7892

* Models 1a and 1b are parsimonious prediction models, and Models 2a and 2b are full logistic-regression prediction models. Age is centered on the mean of 62 years, nodule size is centered on 4 mm, and nodule count is centered on 4 (i.e., 62 is subtracted from the actual age, 4 mm is subtracted from the actual nodule size, and 4 is subtracted from the actual number of nodules).

† Nodule size had a nonlinear relationship with lung cancer and is transformed in this model. The odds ratio of the transformed variable has no direct interpretation without back-transformation. Nodule-size transformation, which is based on multiple fractional polynomial analyses, was performed with the following calculation: $\left(\left(\frac{\text{Nodule size}}{10}\right)^{-0.5}\right) - 1.58113883$; nodule size was measured in millimeters.

McWilliams et al NEJM 2013;369:910-19

Smoking Cessation Counseling

CMS issued NCD 210.14 on August 21, 2015, that provides for Medicare coverage of screening for lung cancer with LDCT. Effective for claims with dates of service on and after February 5, 2015, Medicare beneficiaries must meet all of the following criteria:

- Be 55–77 years of age;
- Be asymptomatic (no signs or symptoms of lung cancer);
- Have a tobacco smoking history of at least 30 pack-years (one pack-year = smoking one pack per day for one year; 1 pack = 20 cigarettes);
- Be a current smoker or one who has quit smoking within the last 15 years; and,
- Receive a written order for lung cancer screening with LDCT that meets the requirements described in the NCD.

Written orders for lung cancer LDCT screenings must be appropriately documented in the beneficiary's medical record, and must contain the following information:

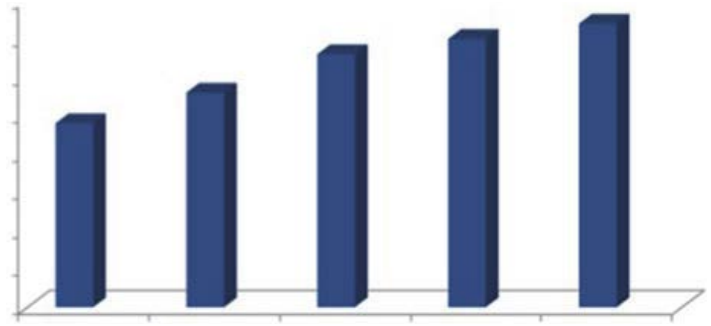
- Date of birth;
- Actual pack–year smoking history (number);
- Current smoking status, and for former smokers, the number of years since quitting smoking;
- A statement that the beneficiary is asymptomatic (no signs or symptoms of lung cancer); and,
- The National Provider Identifier (NPI) of the ordering practitioner.

Counseling and Shared Decision-Making Visit

Before the first lung cancer LDCT screening occurs, the beneficiary must receive a written order for LDCT lung cancer screening during a lung cancer screening counseling and shared decision-making visit that includes the following elements and is appropriately documented in the beneficiary's medical records:

- Must be furnished by a physician (as defined in section 1861(r)(1) of the Act) or qualified non-physician practitioner (meaning a Physician Assistant (PA), Nurse Practitioner (NP), or Clinical Nurse Specialist (CNS) as defined in section1861(aa)(5) of the Act); and

- Must include all of the following elements:
  - Determination of beneficiary eligibility including age, absence of signs or symptoms of lung cancer, a specific calculation of cigarette smoking pack-years; and if a former smoker, the number of years since quitting;
  - Shared decision-making, including the use of one or more decision aids, to include benefits and harms of screening, follow-up diagnostic testing, over-diagnosis, false positive rate, and total radiation exposure;



anish

Lung Cancer Screening Trail.

Pedersen et al. Ann Transl Med 2016;4:157-61

“What Do You Mean, a Spot?”

Question About How to Frame Discussion	Patient-Endorsed Strategy
1. Should physicians directly address the risk of cancer?	Yes, and provide estimate of risk.
2. Does the disclosure need to be verbal?	Yes, and a letter is not a satisfactory alternative.
3. What is the right tone to adopt?	Avoid minimizing or dismissive language.
4. How high a priority should the nodule be given?	Recognize that the nodule may be an important concern for patients and allow time for discussion of the patient’s questions.
5. Is it helpful to provide details about the nodule?	Yes, only if put into context (eg, smaller size suggests lower cancer risk).
6. How much information do patients want to hear about the evaluation plan?	Clearly explain evaluation options and plans to patients upfront, including duration of surveillance and when to take a biopsy specimen.
7. Should downsides of the evaluation strategy be mentioned?	Yes, let patients know what to expect and acknowledge their concerns.

Wiener et al. Chest 2013

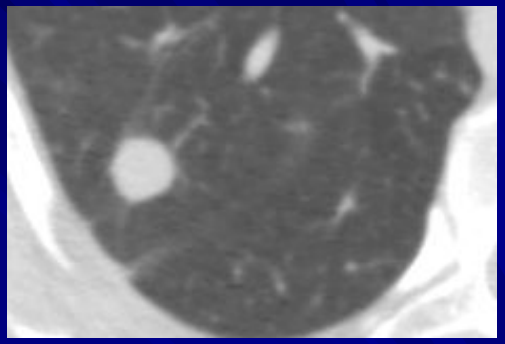
Summary

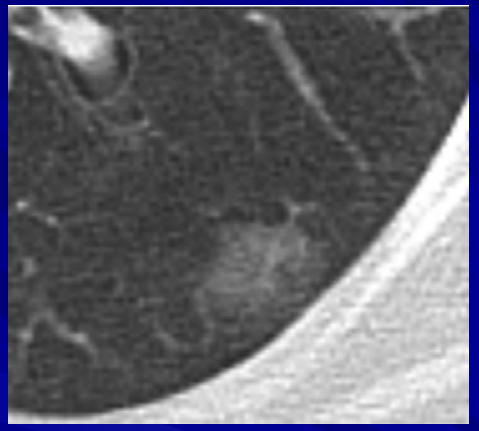
- Size
  - <6mm: Leave alone
  - Growing?
- Type
  - solid>ground glass

- Lung cancer screening
  - Age 55-74
  - 30 pack yr smoker
    - Quit within 15 yrs

- Is it Cocci?
- Call your friendly radiologist

- ….next slide





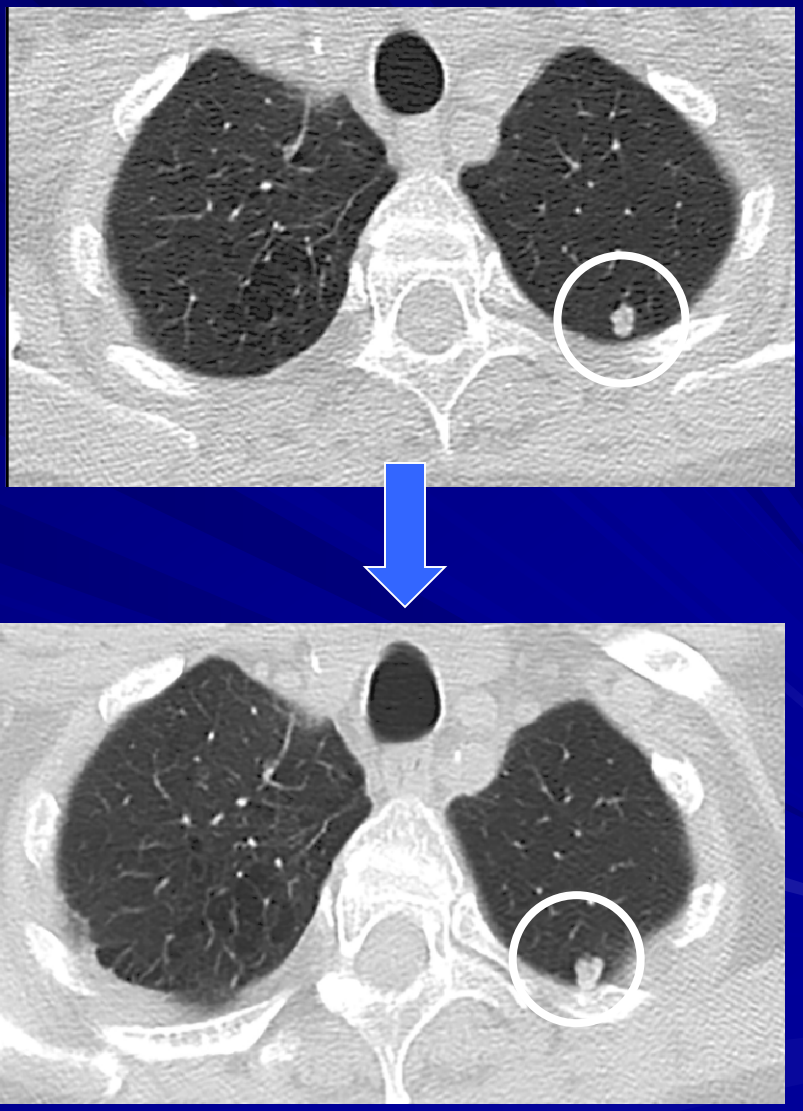
Research Projects

- Oncology
  - Mammography and breast MRI
- Pulmonary
  - Lung nodules
  - ILD
- Cardiology
  - TAVR
  - Cardiomyopathy

THANK YOU

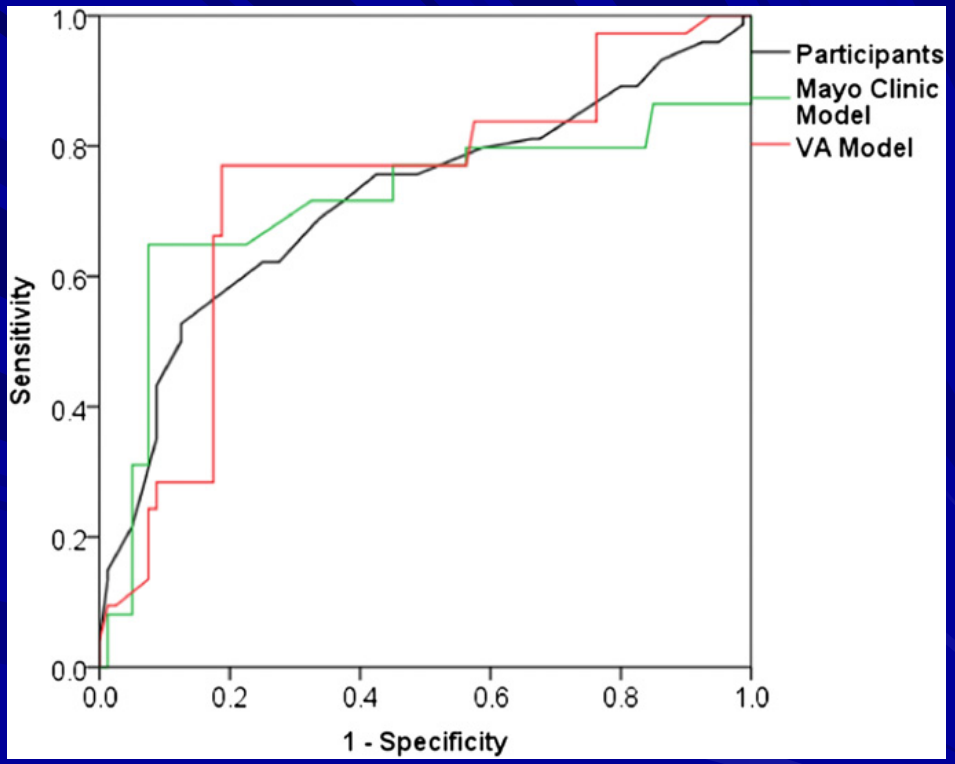
Nodule management - Rule #1

- Compare with old films
  - 2+ years stability is good*
- If seen on CXR and no old films→chest CT without contrast



Nodule Management

- Size
  - <4mm
  - >8mm
    - bigger is worser
- Risk for cancer
  - Use models or clinical judgment



Balekian et al. AATS 2013

Case

- 57 year old female for annual exam
- 30 pack year smoker
  - Stopped 14 years ago
- PE
  - Clear lung sounds
  - No clubbing

- Should she get screened for lung cancer?

1. No
2. Yes, chest xray
3. Yes, chest CT
4. Refer to pulmonary

Benefits of Screening vs **“Harms” of Screening**

Benefits of Screening

- 20% mortality reduction*
  - If 1000 patients screened
  - Absolute decrease 17 → 14

→

- Very big benefits, few people

"Harms" of Screening

NEJM 2014; 371:1793-1802
JAMA Int Med. 2014;174:269-74
Ann Intern Med. 2015;162:485-91

Benefits of Screening

- 20% mortality reduction*
  - If 1000 patients screened
  - Absolute decrease 17 → 14

→ Very big benefits, few people

"Harms" of Screening

- False Positives
  - ~26% recalled
    - 3.8% lung cancer
    - (4→6mm = ~13% recall)
- Radiation exposure
  - Max 30 CXR equivalent
- Cost
  - $81,000/QALY

→ Small harms, many people

→ Small harms, many people

NEJM 2014; 371:1793-1802
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Benefits of Screening

- 20% mortality reduction* → Very big benefits, few people

"Harms" of Screening

- False Positives
- Radiation exposure
- Cost

→ Small harms, many people

- Overdiagnosis
  - ~10-20% with cancer rx unnecessarily

→ Big harms, very few people

NEJM 2014; 371:1793-1802
JAMA Int Med. 2014;174:269-74
Ann Intern Med. 2015;162:485-91

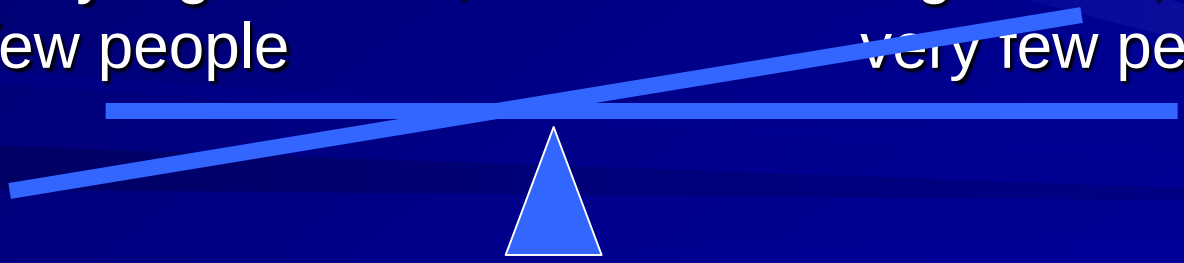
- When to start screening?
  - 55-74 year old
  - 30 pack year smoker
  - Non-smoker if quit <15 yrs
- Screening frequency?
  - Yearly

- What's next?
  - Await NELSON trial results
  - Encourage smoking cessation
    - CT pts more likely to quit?
  - Novel biomarkers (e.g. circulating DNA)

Very big benefits, few people

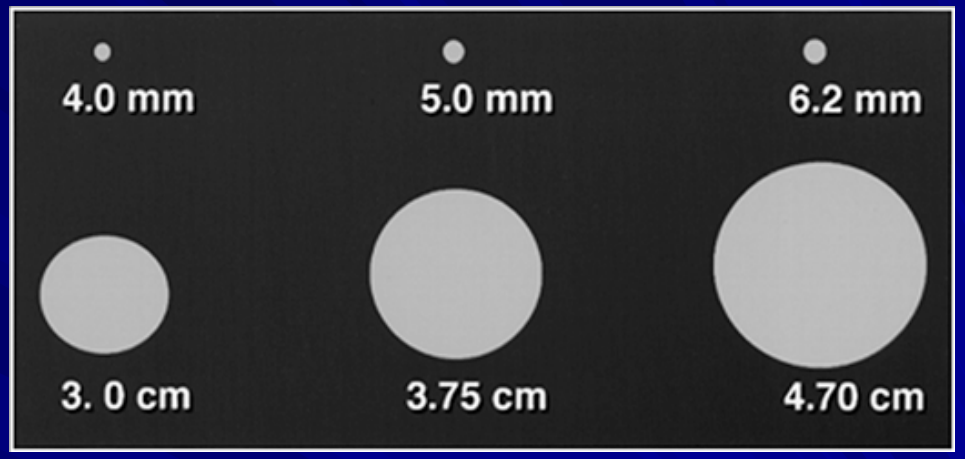
Small harms, many people

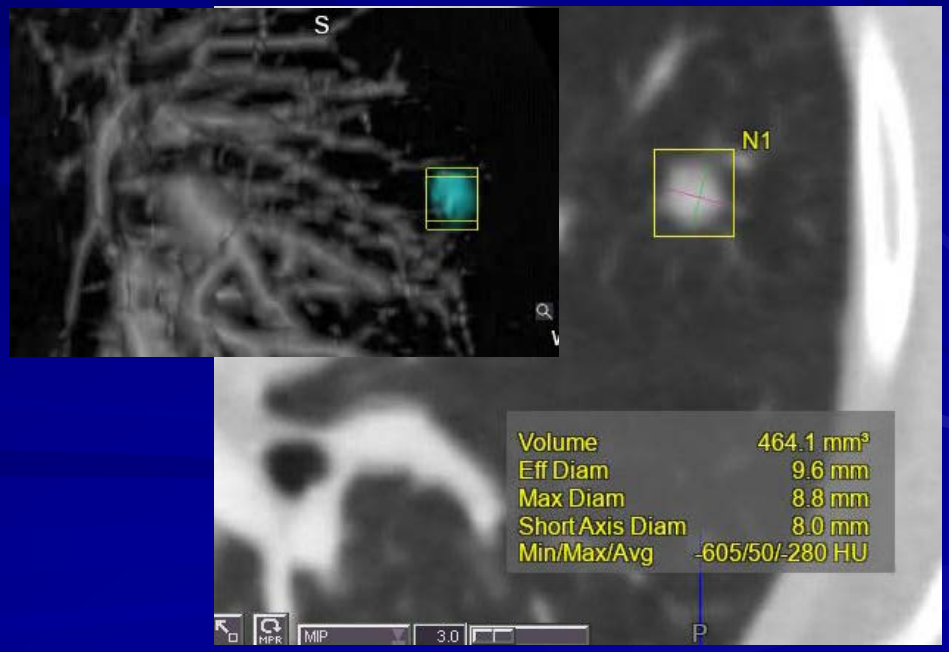
Big harms, very few people



Measurement error

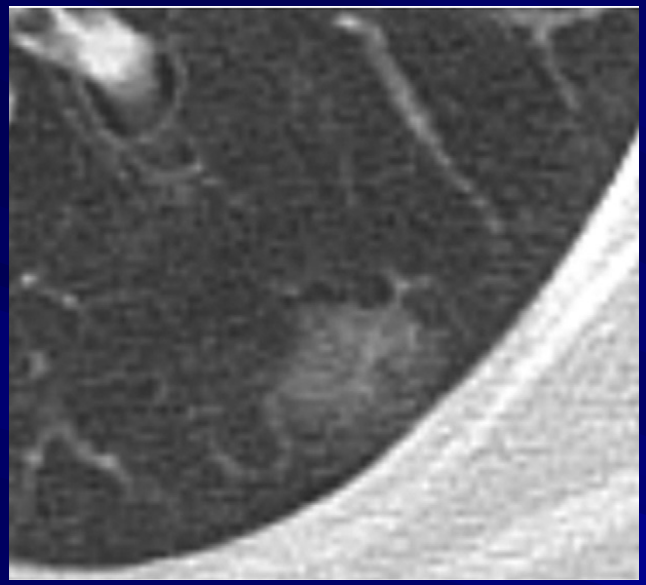
- 2x volume = 26% incr diameter
  - Sphere volume $4\pi r^3/3$
- Volumetric assessment better smaller diameters
- Best bet→same person for serial measurements

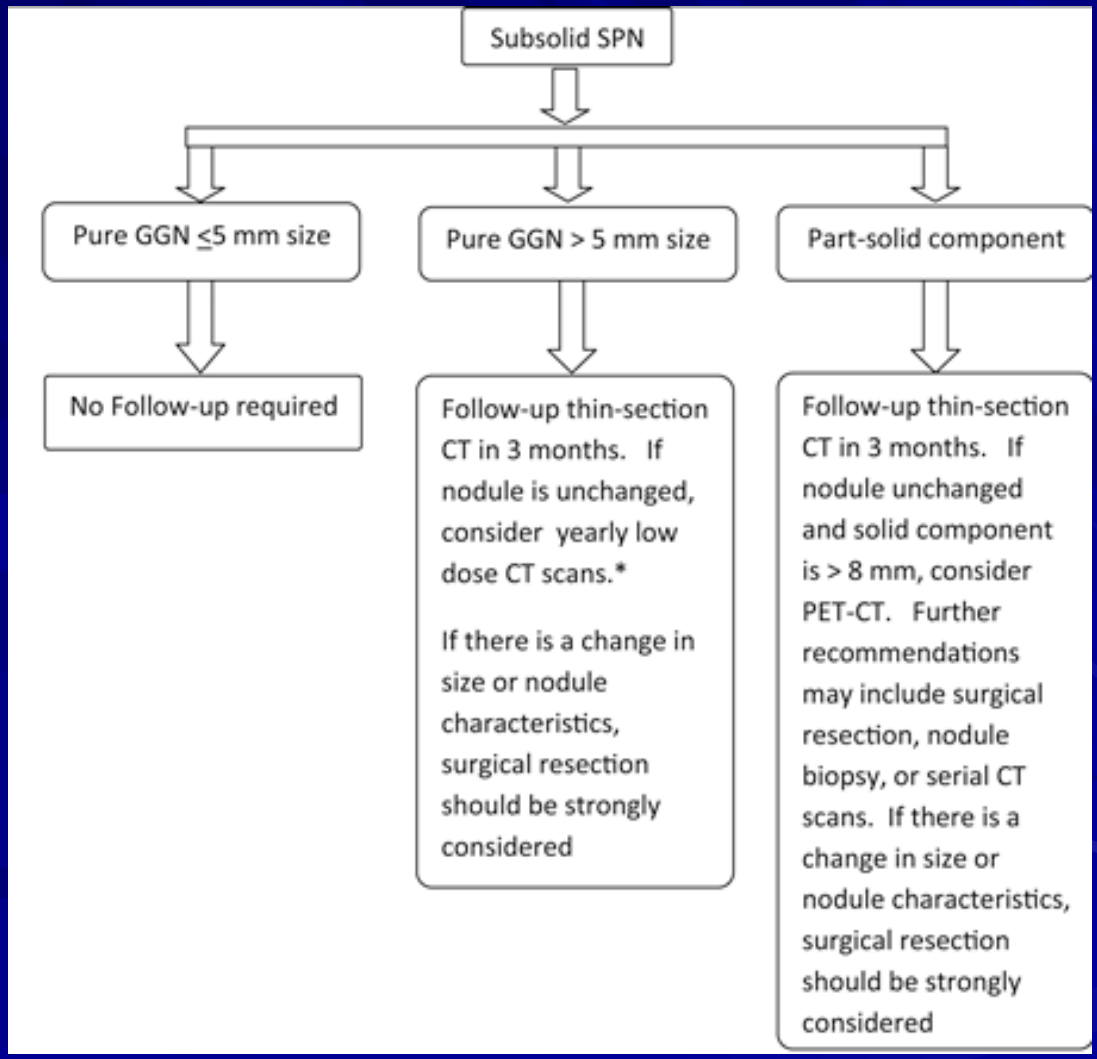




Patel el al Chest 2013

Subsolid Nodules





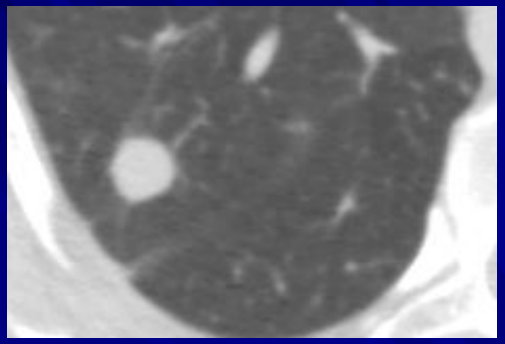
Gould et al Chest 2013
Naidich et al Radiology 2013

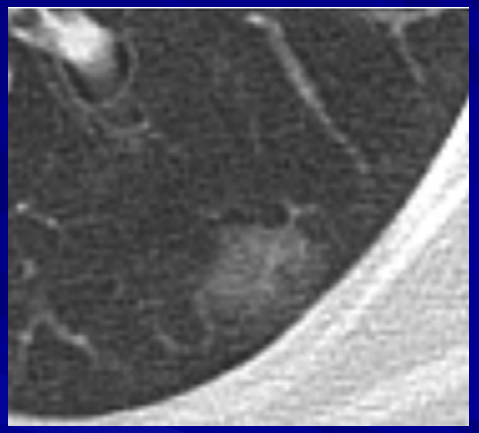
Summary

- Old films for stability?

- Type
- Size (>8mm)
- Risk factors for cancer

- Is it Cocci?
- Call your friendly radiologist





Lung Cancer Screening

- Screening CXR
  - no benefit (Mayo Lung Project)
- Screening chest CT
  - 20% reduction in lung cancer deaths (NLST)
    - (20/1000→17/1000)
    - Age 55-74
    - 30 pack-year smoker
    - Quit <15 yrs ago
  - "NELSON" trial ongoing

NEJM 2011

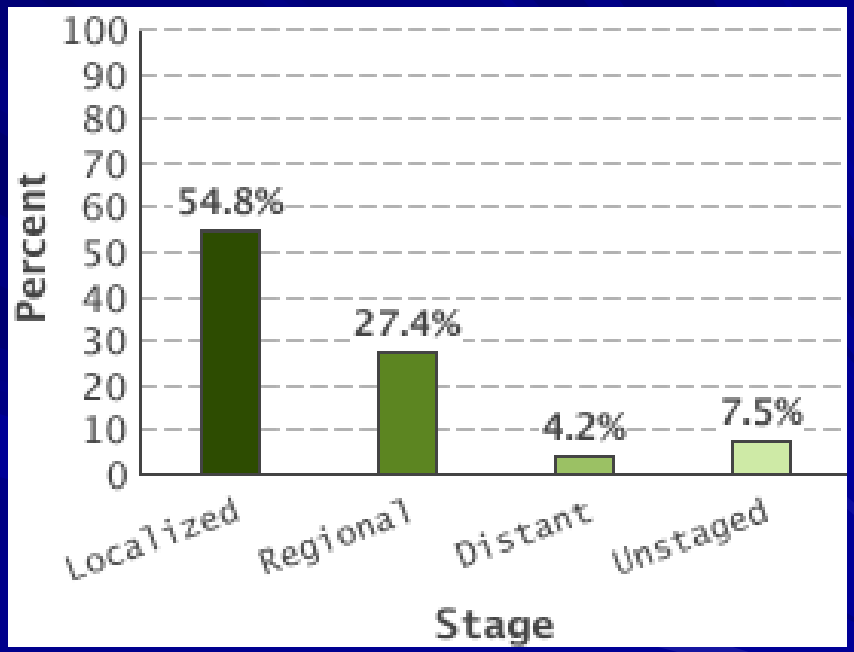
	Common Types of Cancer	Estimated New Cases 2015	Estimated Deaths 2015
1.	Breast Cancer (Female)	231,840	40,290
2.	**Lung and Bronchus Cancer**	**221,200**	**158,040**
3.	Prostate Cancer	220,800	27,540
4.	Colon and Rectum Cancer	132,700	49,700
5.	Bladder Cancer	74,000	16,000
6.	Melanoma of the Skin	73,870	9,940
7.	Non-Hodgkin Lymphoma	71,850	19,790
8.	Thyroid Cancer	62,450	1,950
9.	Kidney and Renal Pelvis Cancer	61,560	14,080
10.	Endometrial Cancer	54,870	10,170

Lung and bronchus cancer represents 13.3% of all new cancer cases in the U.S.

http://seer.cancer.gov

How to reduce lung cancer mortality?

1. Environmental
   - Stop smoking!
2. Better treatment
3. Screening?
   - earlier stage = better survival



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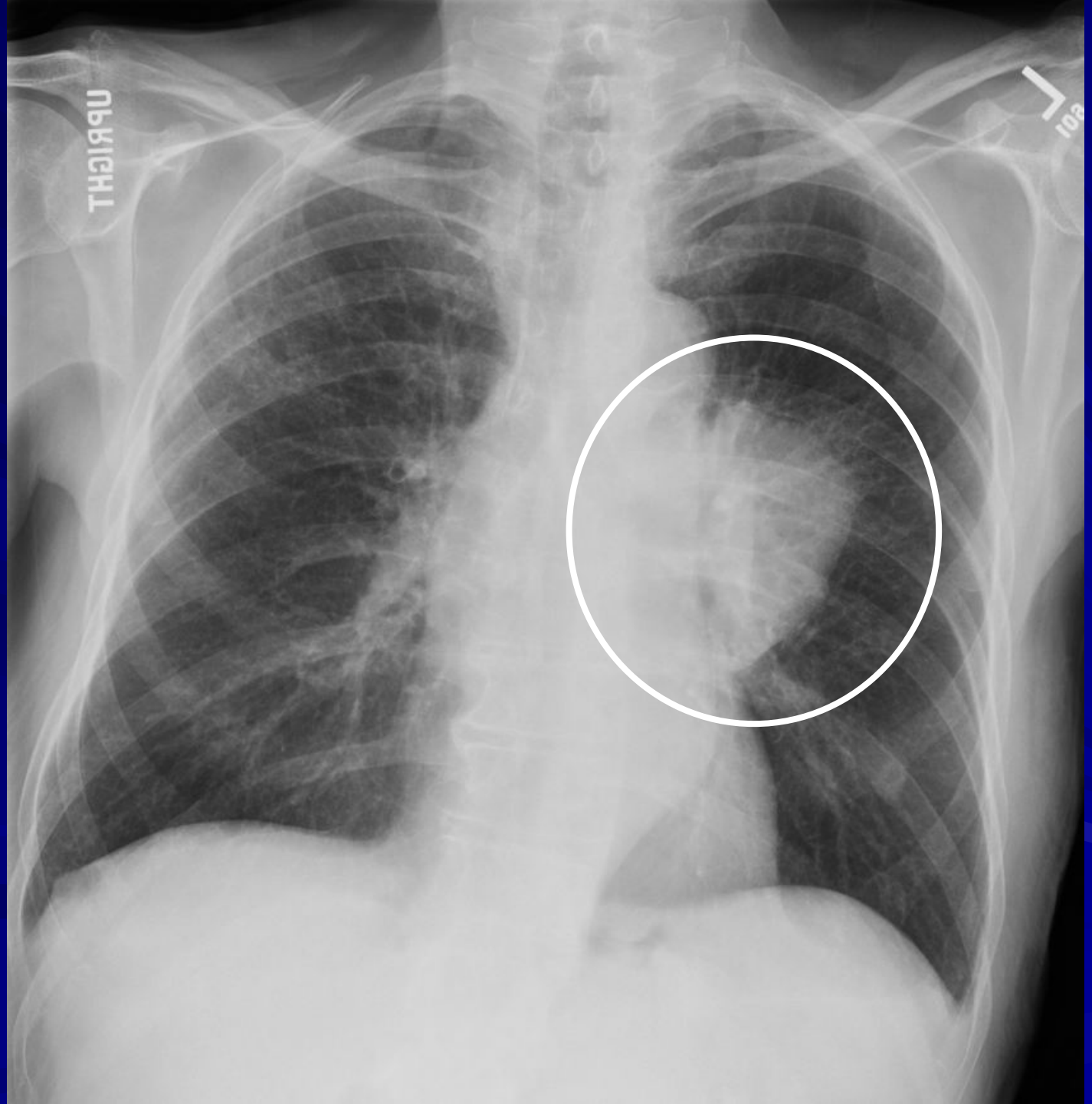

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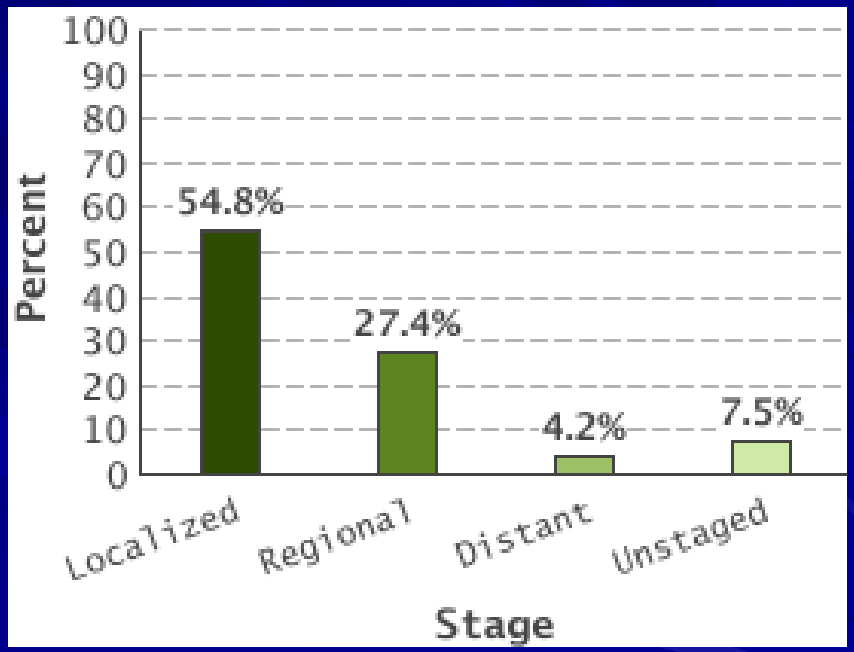

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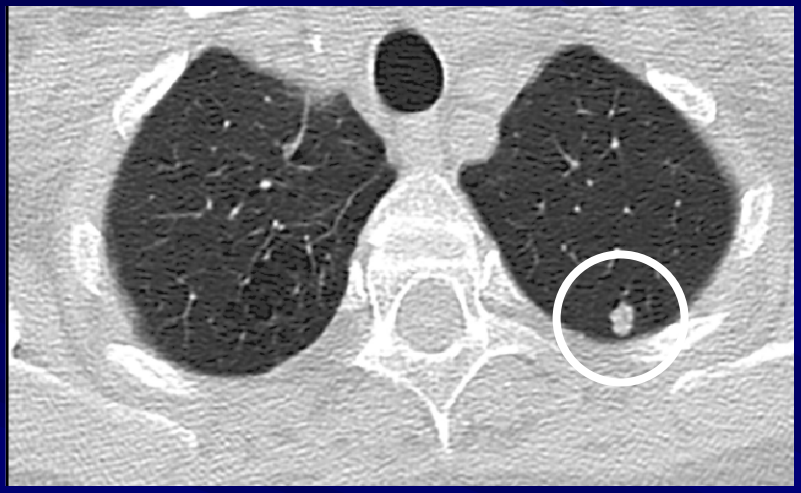
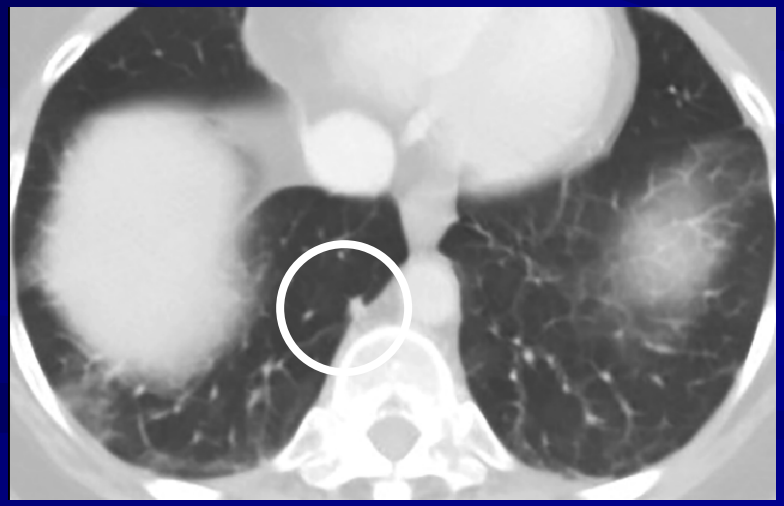
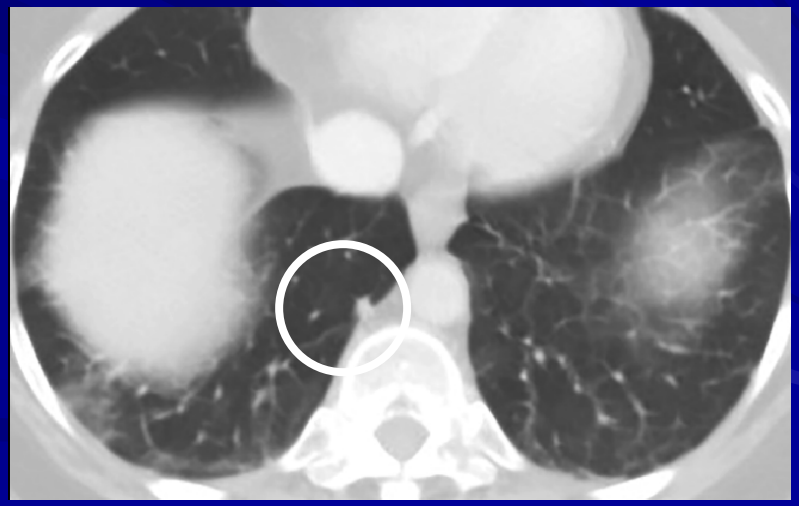


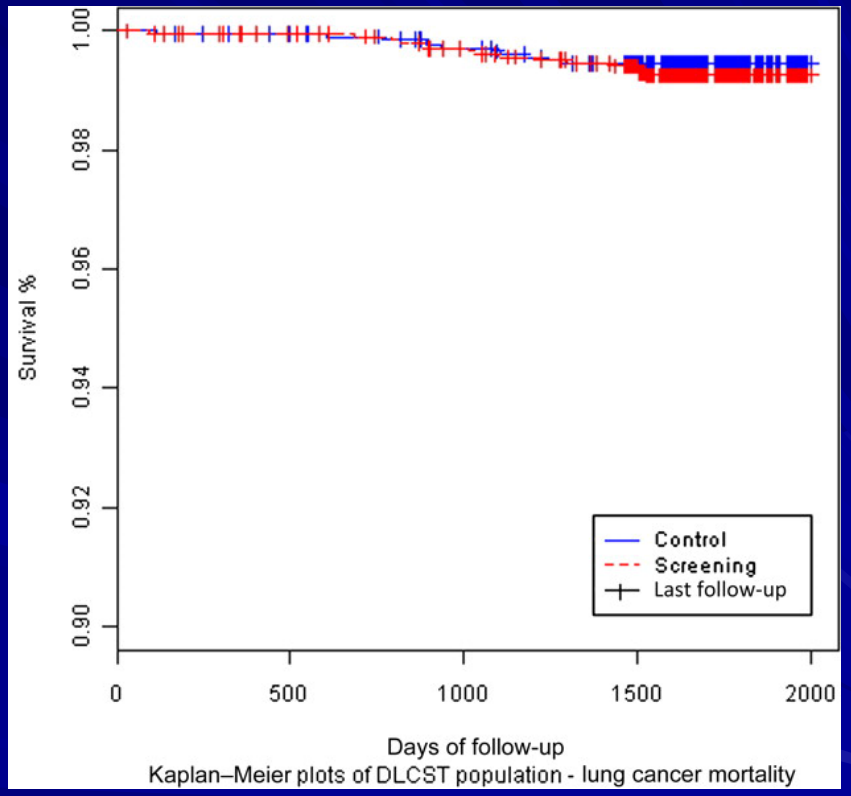
Folllow-up





Chest CT Screening

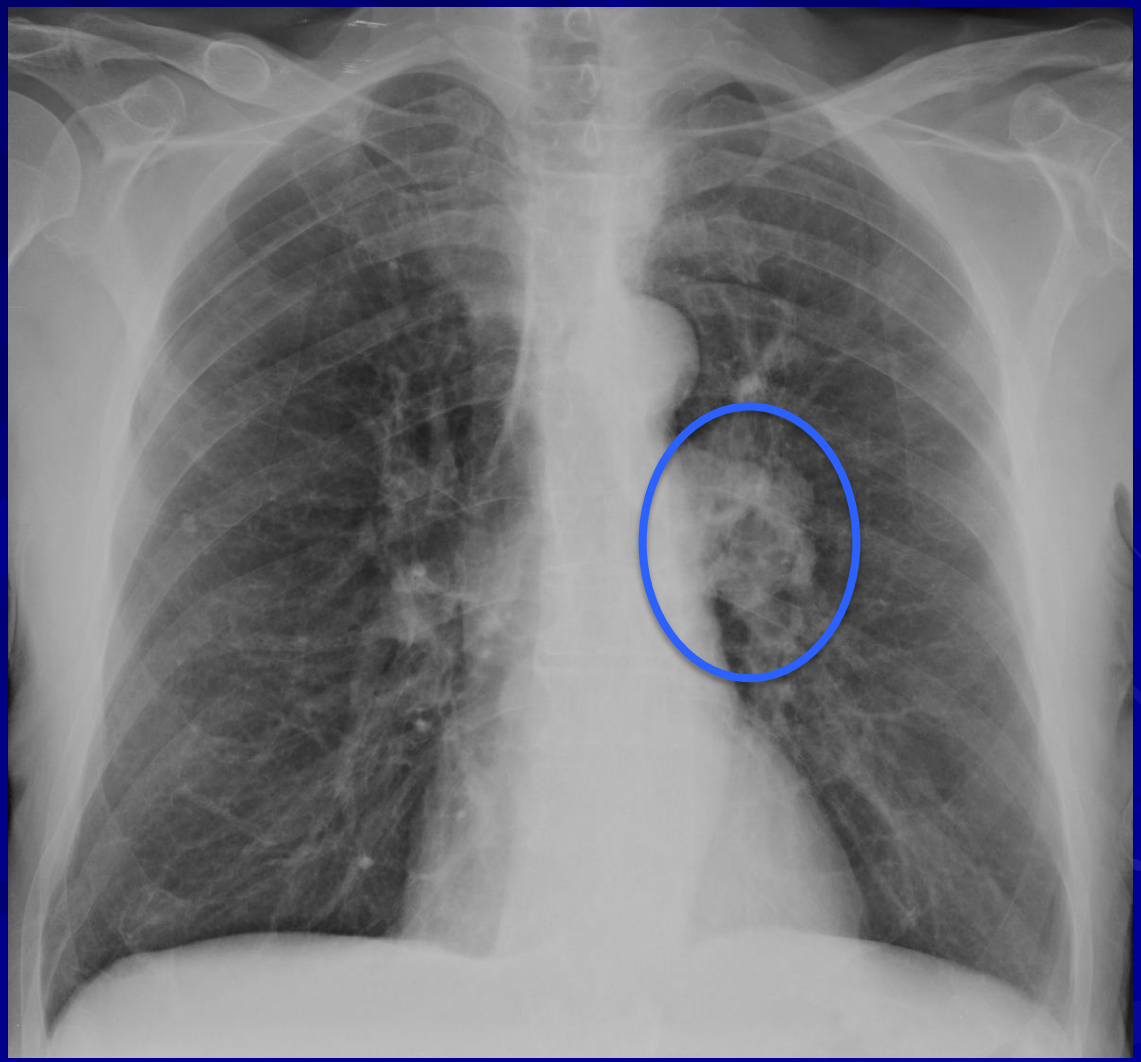
- DANTE trial
  - 2472 participants
  - CXR vs CT
- DLST
  - 4104 participants
  - CT vs no screen



Saghir et al Thorax 2012 67(4):296-30
Infante et al AJRCCM 2009 180(5):445-45

“Danger” Zones on CXR

1. Apex
2. Hila
3. Lung periphery
4. Behind ribs



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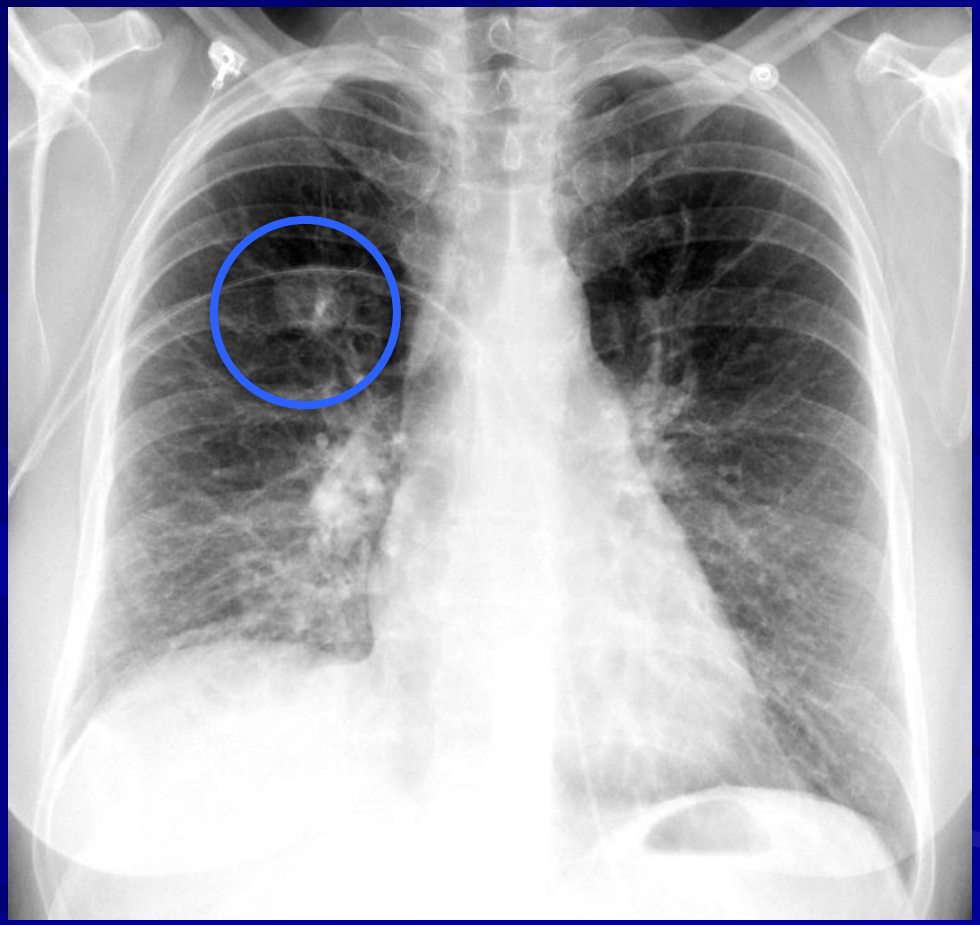

Pulmonary nodule management

1. How many nodules?
   - Single
   - Multiple
2. Nodule characteristics?
   - Calcified
   - Solid; Part solid; Ground glass
3. Nodule size?
4. Why was it detected?
   - Incidental imaging finding
     - risk factors for lung ca?
   - Screening

Overview

1. Imaging basics for nodules

2. Pulmonary nodule management
   a) Nodule size?
   b) How many nodules?
      - Single
      - Multiple
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