Approach to Lung Nodule

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Disclosures

- None

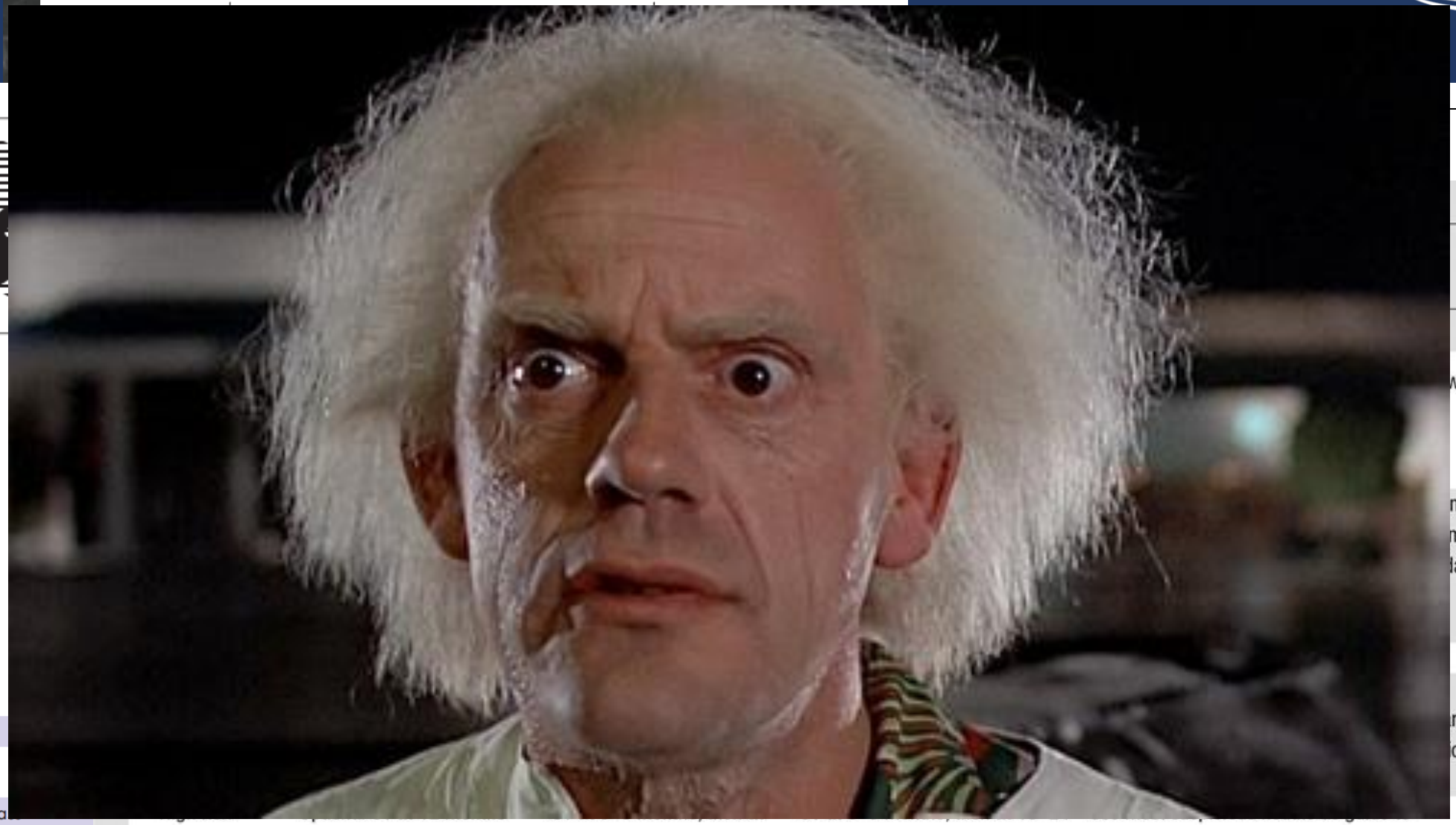
Objectives

- **Discussion about clinical risk assessment of lung nodule and indications for sampling**
  - Probability of malignancy assessment
  - Decision making: surveillance → more testing → treatment

Goal: Expedite the diagnosis and treatment of malignant nodules while minimizing the testing of benign nodules, all while inflicting no physical or emotional harm to patients

Diffuse calcification | Popcorn calcification | Central calcification

Observation threshold | Surgical threshold



w-up in

nodule
may
lation

ry
on 2A).

Part solid

Ground gla

18–24 months | months | management. Follow-up intervals may vary according to size and risk (recommendation 2A).

Housekeeping

- Solitary pulmonary nodule
  - Single well circumscribed radiographic opacity, up to 30mm in diameter, surrounded by aerated lung with no associated atelectasis, hilar enlargement or pleural effusion
- Nodules <8mm rarely need anything other than radiologic follow up
- Look at old images!
  - SOLID nodule stable 2 years leave it
  - Sub-solid (aka pure groundglass) stable for 3 years leave it
    - 5y according to Fleischner 2017
- Comorbidities matter, life expectancy matters, patient preferences matter

Gould M. CHEST 2013; 143(5)(Suppl):e93S–e120S

Housekeeping

Risk factors for malignancy

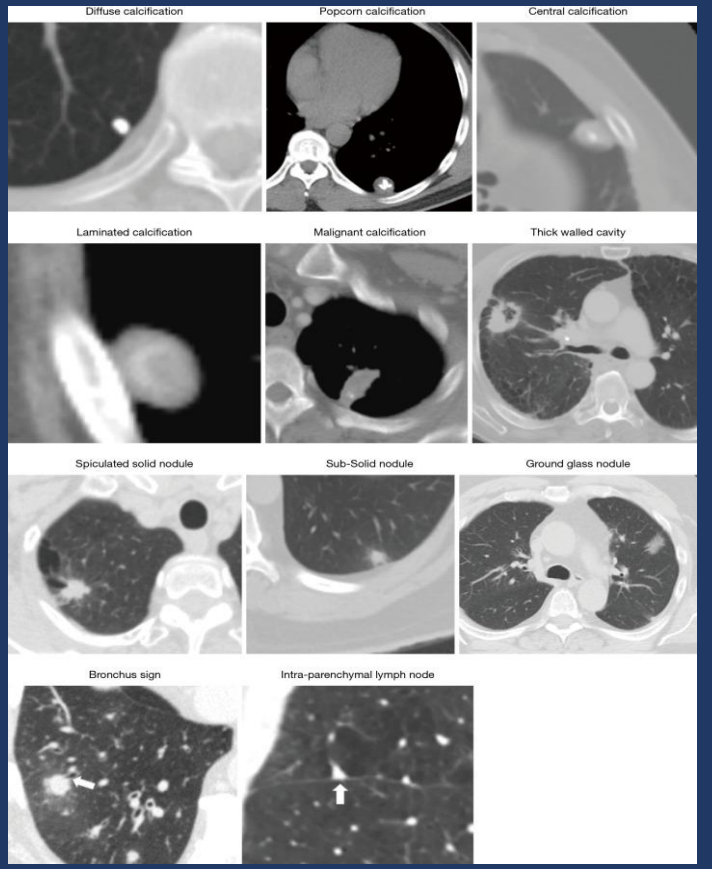
- Smoking
- Age
- Exposures (Asbestos, Radon, etc)
- Family history of malignancy
- Personal history of malignancy

Gould M. CHEST 2013; 143(5)(Suppl):e93S–e120S
Khan T. Ann Transl Med. 2019 Aug; 7(15): 348

Housekeeping

- Size
- Location
  - Upper lobe
  - Lower lobe
- Growth rate (Volumetric Doubling Time)
- Borders
  - Smooth
  - Irregular
- Spiculation

- Attenuation
  - Solid
  - Sub-solid → Pure GG and semi-solid
- Cavitation
- Calcification pattern
  - Popcorn, diffuse, central
  - Laminated, off-centered



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Gould M. CHEST 2013; 143(5)(Suppl):e93S–e120S
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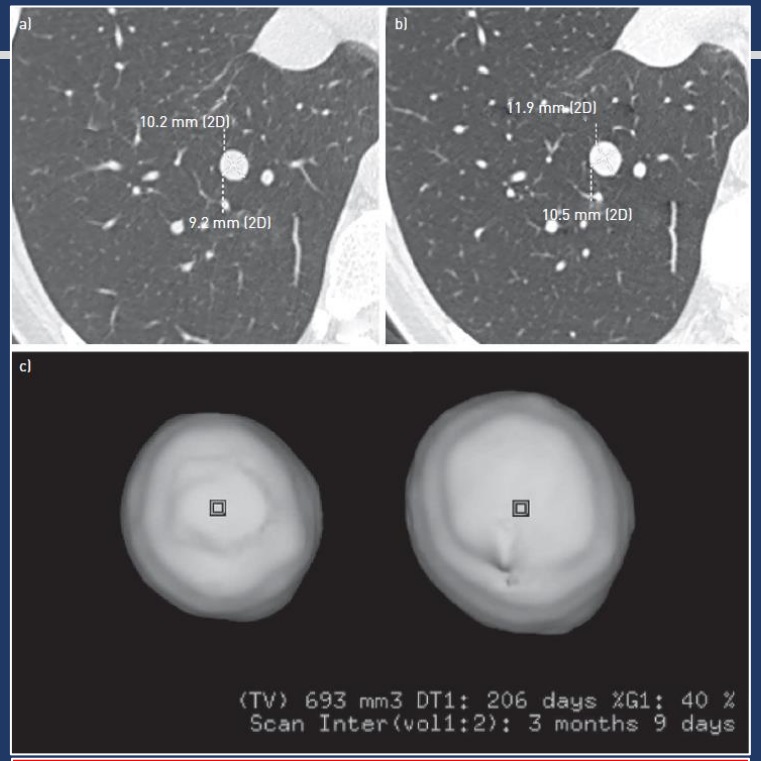
Volumetric Doubling Time

VDT	Risk of malignancy
>600 days	0.8%
400-600 days	4%
<400 days	9.9%
<20 days	Infectious
Pure GG VDT	813 +/- 375 d
Semisolid VDT	457 +/-260 d



What diameter increase % is equivalent to VDT?
26%

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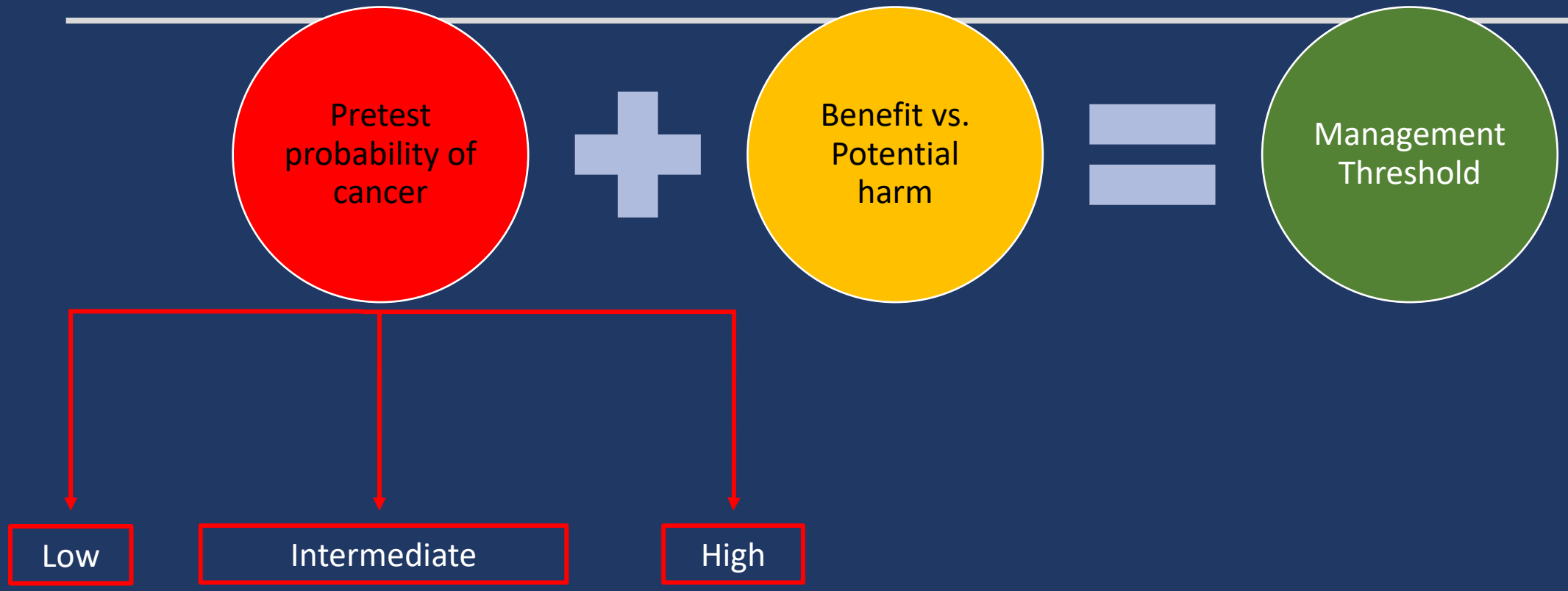
Larici AR, et al. Lung nodules: size still matters. Eur Respir Rev 2017; 26: 170025



What is low, intermediate, and high probability?

Low <5%
Intermediate 5-65%
High >65%

How likely is it to be cancer?

- Subjectively (intuition and experience)

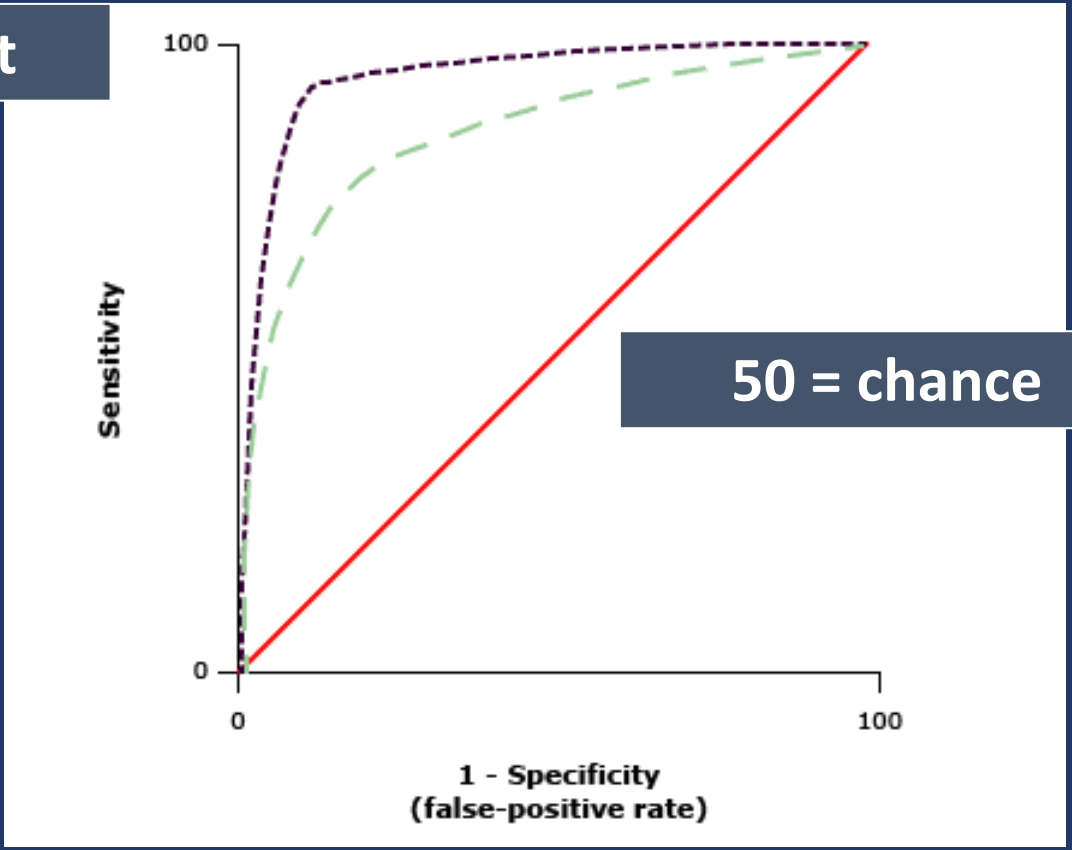
Depend on clinician's knowledge, experience, and biases

- Validated Probability Models

Depend on clinical profile and the prevalence of malignancy in the population

How likely is it to be cancer? ROC/AUC

100 = perfect



50 = chance

Model (Year of Publication)	Study Population	Number of Subjects	Prevalence of Malignancy	Nonsmokers Included	Nodule Size	Statistical Methods	Variables	Calibration	AUC
Models that relied on clinical and chest radiograph or CT scan features									
Gurney (1993)	Consecutive patients with PN identified on chest radiograph	66	67%	Yes	6–70 mm	Bayesian analysis	Nodule spiculation, diameter, and cavity wall thickness. Predictors of a benign etiology were volume doubling time >465 d and calcification.	NR	0.87
Mayo Clinic (1997)	Incidental new PN detected by chest radiography	629	23%	Yes	4–30 mm	Logistic regression	Age, smoking history, history of extrathoracic cancer ⩾5 yr, nodule diameter, nodule spiculation, upper lobe location	Excellent*,†	0.80
VA (2007)	PNs seen on chest radiograph and confirmed on CT scan and/or FDG-PET scan	375	54%	Yes	7–30 mm	Logistic regression	Age, smoking history, time since quitting smoking, nodule diameter	Excellent*,†	0.79
PKUPH (2012)	PNs that underwent surgical resection	371	54%	Yes	9–28 mm	Logistic regression	Age, nodule diameter, nodule border, nodule calcification, spiculation, family history of cancer	NR	0.87
Brock (2013)	Lung cancer screening participants with LDCT	1,871	5.5%	No	1–86 mm	Logistic regression	Age, sex, family history of lung cancer, emphysema, nodule size, nodule type, nodule location, nodule count	Excellent†,‡	0.94
Models that incorporated PET scan results									
Herder (2005)	Patients referred for FDG-PET	106	57%	Yes	<30 mm	Logistic Regression	Mayo Clinic model and FDG-PET avidity intensity (none/faint/moderate/intense)	Excellent*,†	0.92
TREAT (2014)	PN evaluated for surgical resection	492	72%	Yes	NR	Logistic regression	Age, sex, BMI, FEV_1, smoking history, hemoptysis, nodule size, nodule growth, spiculation, nodule location, FDG-PET avidity	Brier score of 0.12†,§	0.87
BIMC (2015)	PN diagnosis with biopsy, or deemed benign if stable at imaging for ⩾2 yr	343	58%	Yes	4–30 mm	Bayesian analysis	Age, smoking, history of previous malignancy, nodule diameter, edges, nodule location, volume doubling time, minimum focal density, enhancement at contrast-enhanced CT, FDG-PET avidity	NR	0.89

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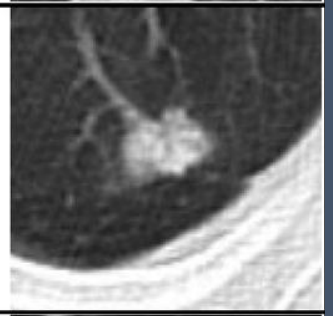
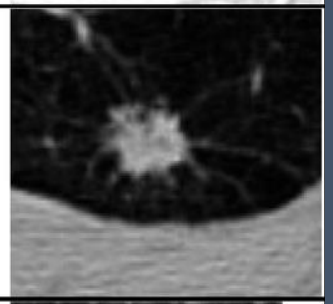
Humberto K. Choi; Michael Ghobrial; Peter J. Mazzone; *Annals ATS* 151117-1126.

Clinical Scenarios		Probability Models							
		Gurney	Mayo	Herder	VA	Brock	TREAT	BIMC	Diagnosis
53-yr-old woman, former smoker, 10 pack-years Quit 15 yr ago No emphysema Smooth RLL 1.2-cm module Hypermetabolic SUVmax 3.3									
69-yr-old man, former smoker, 38 pack-years Quit 20 yr ago History of emphysema Irregular LUL 1.6-cm nodule Hypermetabolic SUVmax 3.2									
54-yr-old man, active smoker, 58 pack-years History of emphysema Spiculated RUL 1.4-cm nodule Hypermetabolic SUVmax 12									
72-yr-old woman, active smoker, 75 pack-years History of emphysema RUL 6-mm nodule found on low-dose CT scan for lung cancer screening No FDG-PET									

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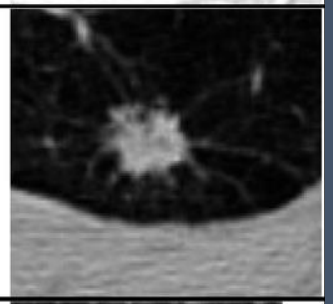
54-yr-old man, active smoker, 58 pack-years History of emphysema Spiculated RUL 1.4-cm nodule Hypermetabolic SUVmax 12									
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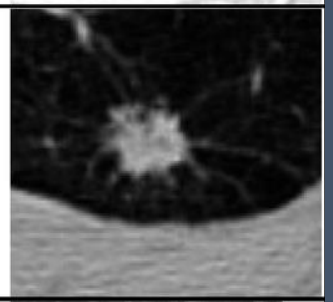
54-yr-old man, active smoker, 58 pack-years History of emphysema Spiculated RUL 1.4-cm nodule Hypermetabolic SUVmax 12									
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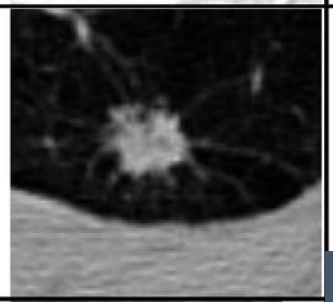
54-yr-old man, active smoker, 58 pack-years History of emphysema Spiculated RUL 1.4-cm nodule Hypermetabolic SUVmax 12		100%	42%	83%	36.1%	25.3%	69%	97%	Adenocarcinoma
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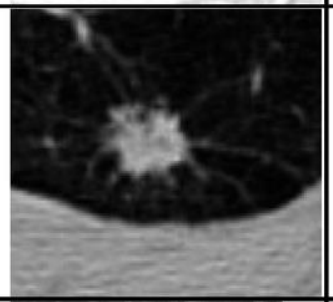
54-yr-old man, active smoker, 58 pack-years History of emphysema Spiculated RUL 1.4-cm nodule Hypermetabolic SUVmax 12		100%	42%	83%	36.1%	25.3%	69%	97%	Adenocarcinoma
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Model	Population to Consider Clinical Application	Comments
Gurney	High risk of lung cancer May consider in cavitary nodules	Presence of cavitation and growth is considered in this model. Its accuracy was lower in direct comparisons with the PKUPH and BIMC models (12, 14, 21).
Mayo	Low to moderate risk of lung cancer	This is the most externally validated model. It does not include growth rate, FDG-PET results, or history of any cancer within 5 yr. Accuracy was lower in comparison studies in populations with high lung cancer prevalence that were sent for surgical evaluation (13, 14).
Herder	FDG-PET result available	Accuracy was higher than the Mayo Clinic, VA, and BIMC models in comparison studies (20, 24).
VA	Males with history of smoking	Accuracy has been overall lower in comparison studies with the other models (14, 18–20, 23).
PKUPH	High risk of lung cancer	It was developed from a Chinese population with high lung cancer prevalence. External validation in different geographic and ethnic populations is necessary.
Brock	Lung cancer screening	It was developed in a lung cancer screening population, but it has demonstrated high accuracy even in populations with high lung cancer prevalence (20, 23, 26).
	General lung nodule population	The model includes PN multiplicity and attenuation on CT scans.
TREAT	High risk of lung cancer	This model was designed for use during preoperative evaluation of high-risk PNs.
	PET and serial imaging available	It is one of the newer models and one of the least externally validated.
BIMC	Moderate to high risk of lung cancer PET and serial imaging available	FDG-PET results and PN growth are considered in this model. Its accuracy was lower when compared with the Herder model (24). It is one of the least externally validated models.

Screening identified nodule: Brock Available in UpToDate

Incidental nodules: Mayo and Herder model calculator https://www.mdcalc.com/solitary-pulmonary-nodule-spn-malignancy-risk-score-mayo-clinic-model

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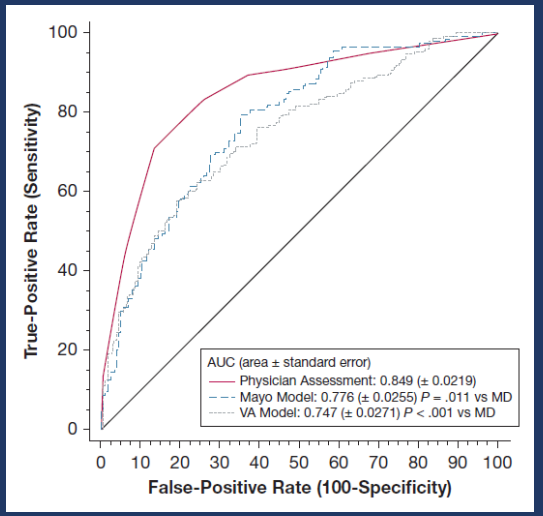
Humberto K. Choi; Michael Ghobrial; Peter J. Mazzone; *Annals ATS* 151117-1126.

How likely is it to be cancer?

- Models Vs. Experts
  - MAYO vs. Expert → AUC 82 vs. 79
  - MAYO vs. VA vs. Expert → AUC 70 vs. 71 vs. 72
  - MAYO vs. VA vs. Expert → AUC 77 vs. 74 vs. 84

"Expert" clinical assessment ≥ Probability models



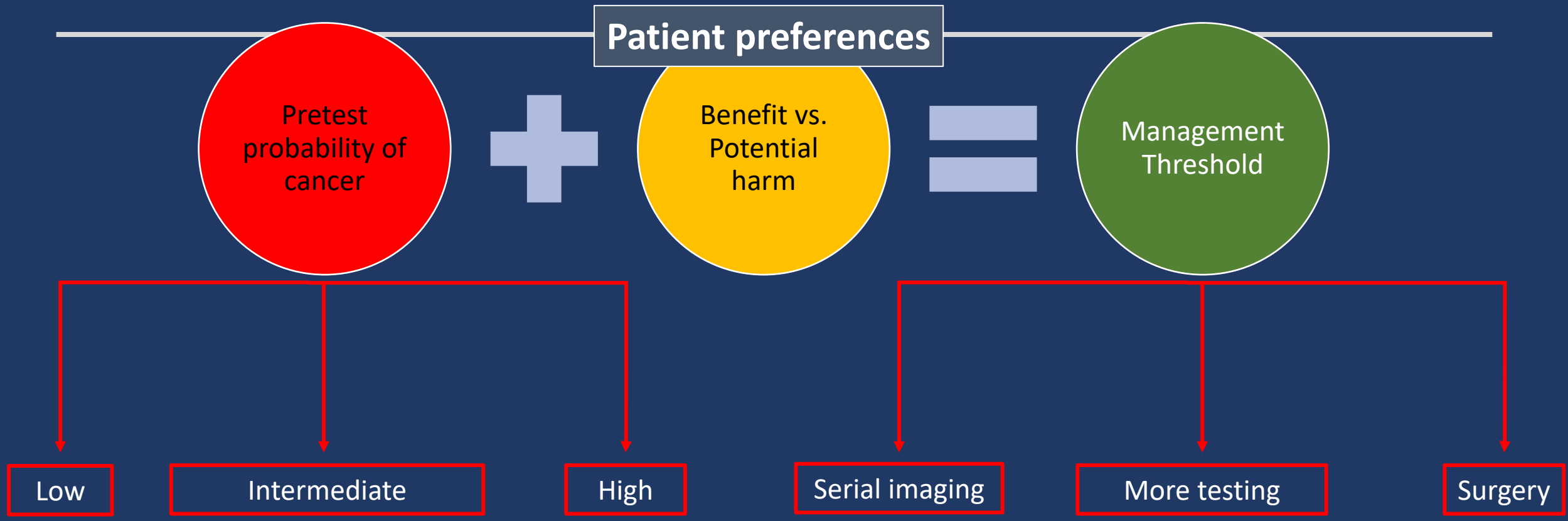
Model	Variables included in model
Swenson Model	Age, nodule diameter, smoking status, upper lobe location, and presence of spiculation
VA Model	Smoking status, age, nodule diameter, number of years since smoking cessation
Brock Model (parsimonious)	Sex, nodule size, upper lobe location and presence of spiculation
Brock Model (Full model)	Age, sex, family history of lung cancer, presence of emphysema, nodule diameter, nodule density, upper lobe predominance, number of nodules and presence of spiculation

Swensen SJ, et al. Mayo Clin Proc 1999;74:319–329.
Balekian AA, et al. Ann Am Thorac Soc 2013;10:629–635.
Fox A. J Thorac Dis 2020;12(6):3296-3302 | http://dx.doi.org/10.21037/jtd.2020.03.68
Tanner M. CHEST 2017; 152(2):263-270

How likely is it to be cancer?

- Predictive models are comparable to expert physician assessment when evaluating the probability of cancer in pulmonary nodules
- Predictive models are tools and as such, they should be used in the right situations by an experienced operator

Is Rolando (PGY11) an "expert" in the management of lung nodules?
8h a day x 5 days x 48 weeks = 1920h per year
10000 / 1920 = 5.2 years



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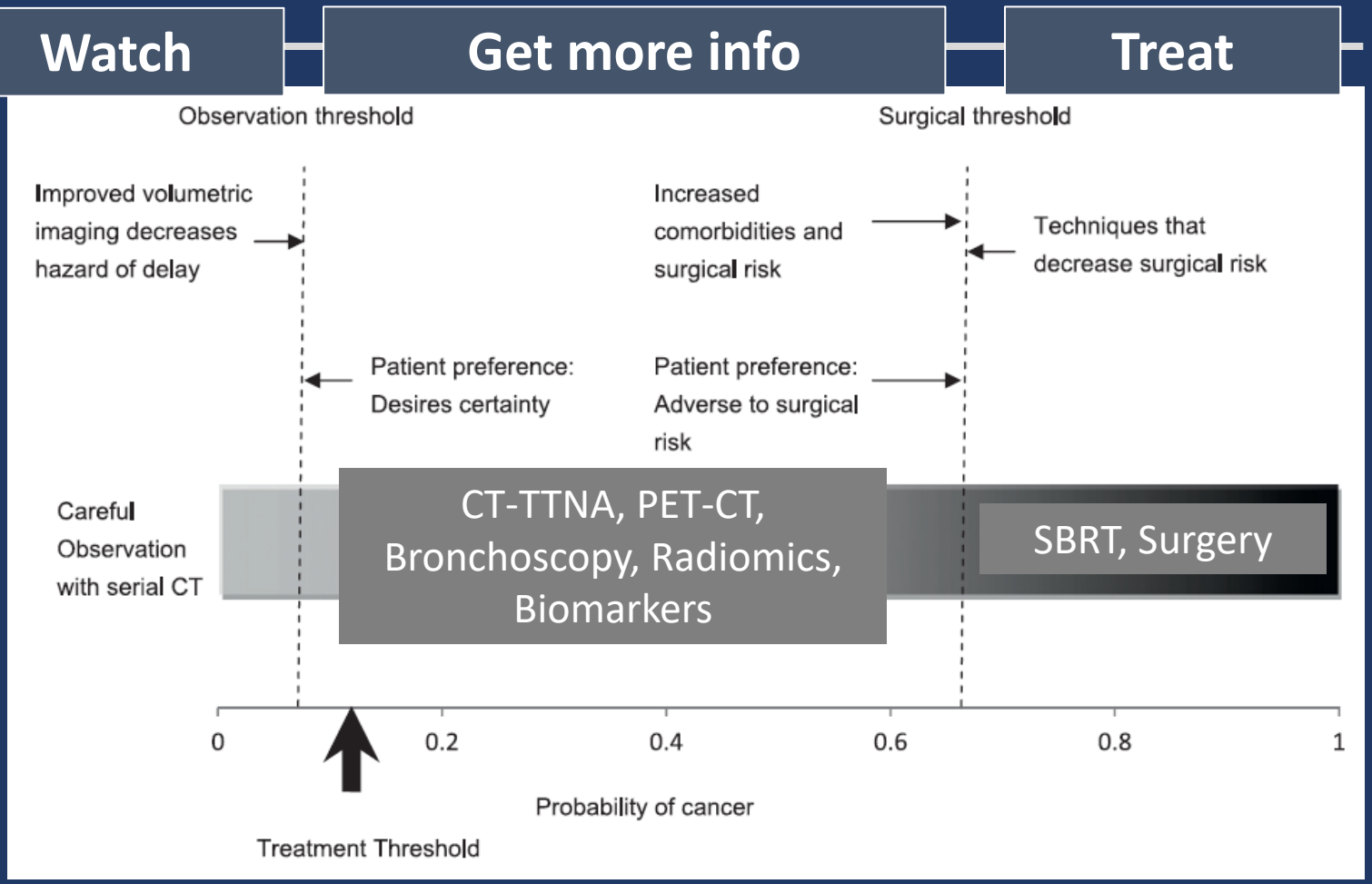
So what now…?

Risk of malignancy assessment:
Low <5%
Intermediate 12-65%
High >65%

Patient preference and Harm/Benefit assessment



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Ost D, Am J Respir Crit Care Med Vol 185, Iss. 4, pp 363–372, Feb 15, 2012

So what now…?

- Screening nodule → Follow Lung RADS version 1.1
- Incidental nodules <8mm → Follow Fleischner 2017
- For anything else → enjoy the ride…

Screening nodules – Lung-RADS

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	**Solid nodule(s):** < 6 mm new < 4 mm **Part solid nodule(s):** < 6 mm total diameter on baseline screening **Non solid nodule(s) (GGN):** <30 mm **OR** ≥ 30 mm 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 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) ≥ 30 mm on baseline CT or new	6 month LDCT	1-2%	5%

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ACR Lung-RADS Version 1.1 2019 update

Screening nodules – Lung-RADS

Probably Suspicious Findings for which additional diagnostic testing is recommended	**4A**	**Solid nodule(s):** ≥ 8 to < 15 mm at baseline **OR** growing < 8 mm **OR** new 6 to < 8 mm	3 month LDCT; PET/CT may be used when there is a ≥ 8 mm solid component	5-15%	2%
		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			
Suspicious Findings for which additional diagnostic testing and/or tissue sampling is recommended	**4B**	**Solid nodule(s)** ≥ 15 mm **OR** new or growing, and ≥ 8 mm	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. *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%
		Part solid nodule(s) with: a solid component ≥ 8 mm **OR** a new or growing ≥ 4 mm solid component			
	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%
Volumetric measurements	1.5 mm = 1.8 mm^3 4 mm = 33.5 mm^3 6 mm = 113.1 mm^3 8 mm = 268.1 mm^3		10 mm = 523.6 mm^3 15 mm = 1767.1 mm^3 20 mm = 4188.8 mm^3 30 mm = 14137.2 mm^3		

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ACR Lung-RADS Version 1.1 2019 update

Incidental nodules <8mm (solid)

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).
High risk†	Optional CT at 12 months	CT at 3–6 months, then at 18–24 months	CT at 3–6 months, then 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 H. Radiology: Volume 284: Number 1—July 2017

Incidental nodules <8mm (subsolid)

B: Subsolid Nodules*

Nodule Type	Size: <6 mm (<100 mm³)	Size: ≥6 mm (>100 mm³)	Comments
Single			
Ground glass	No routine follow-up	CT at 6–12 months to confirm persistence, then CT every 2 years until 5 years	In certain suspicious nodules < 6 mm, consider follow-up at 2 and 4 years. If solid component(s) or growth develops, consider resection. (Recommendations 3A and 4A).
Part solid	No routine follow-up	CT at 3–6 months to confirm persistence. If unchanged and solid component remains <6 mm, annual CT should be performed for 5 years.	In practice, part-solid nodules cannot be defined as such until ≥6 mm, and nodules <6 mm do not usually require follow-up. Persistent part-solid nodules with solid components ≥6 mm should be considered highly suspicious (recommendations 4A-4C)
Multiple	CT at 3–6 months. If stable, consider CT at 2 and 4 years.	CT at 3–6 months. Subsequent management based on the most suspicious nodule(s).	Multiple <6 mm pure ground-glass nodules are usually benign, but consider follow-up in selected patients at high risk at 2 and 4 years (recommendation 5A).

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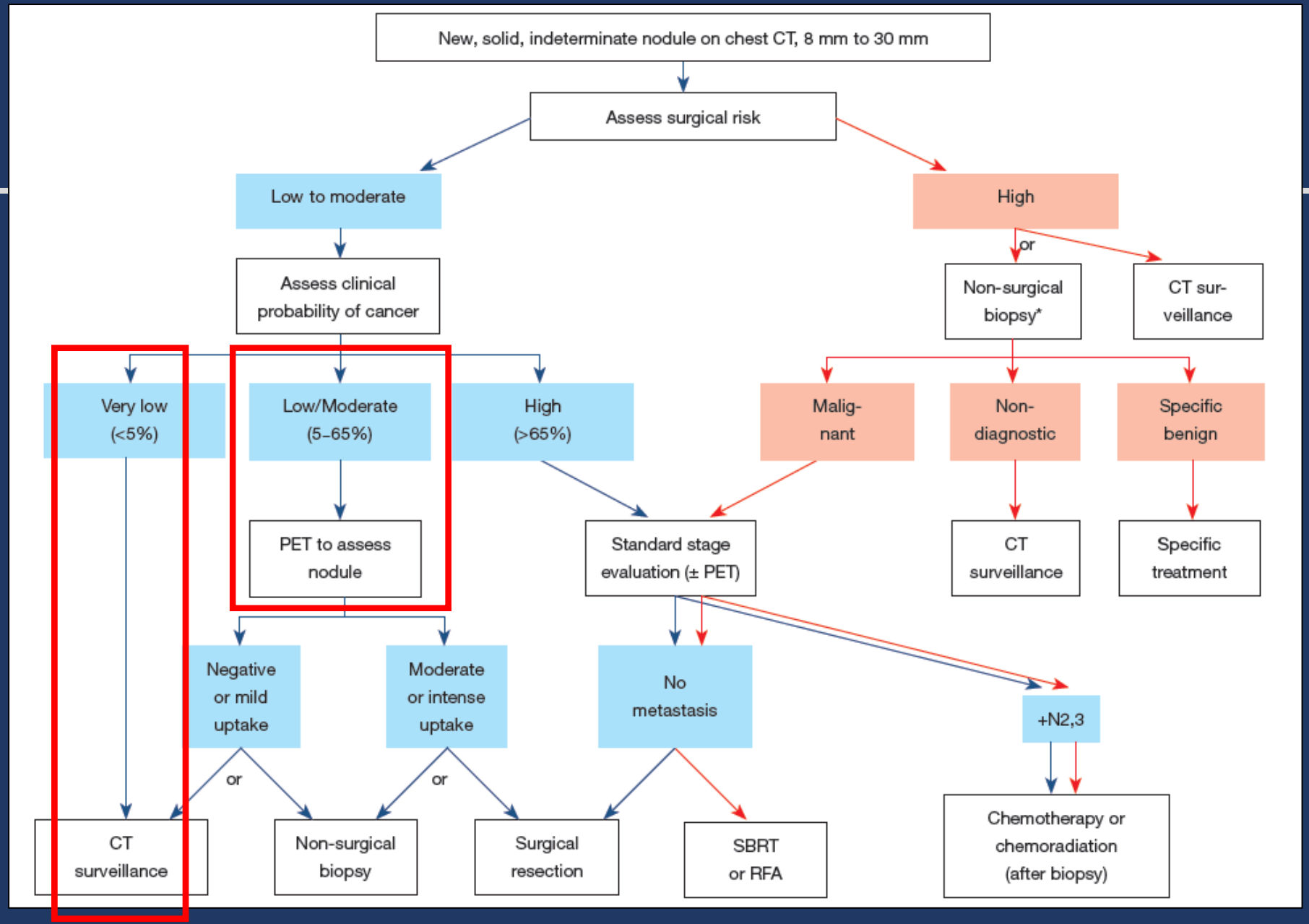
MacMahon H. Radiology: Volume 284: Number 1—July 2017



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Gould M. CHEST 2013; 143(5)(Suppl):e93S–e120S

A PET-ite problem

4.2.4.1. In the individual with a solid, indeterminate nodule that measures >8 mm in diameter and low to moderate pretest probability of malignancy (5%-65%), we suggest that functional imaging, preferably with PET, should be performed to characterize the nodule (Grade 2C).

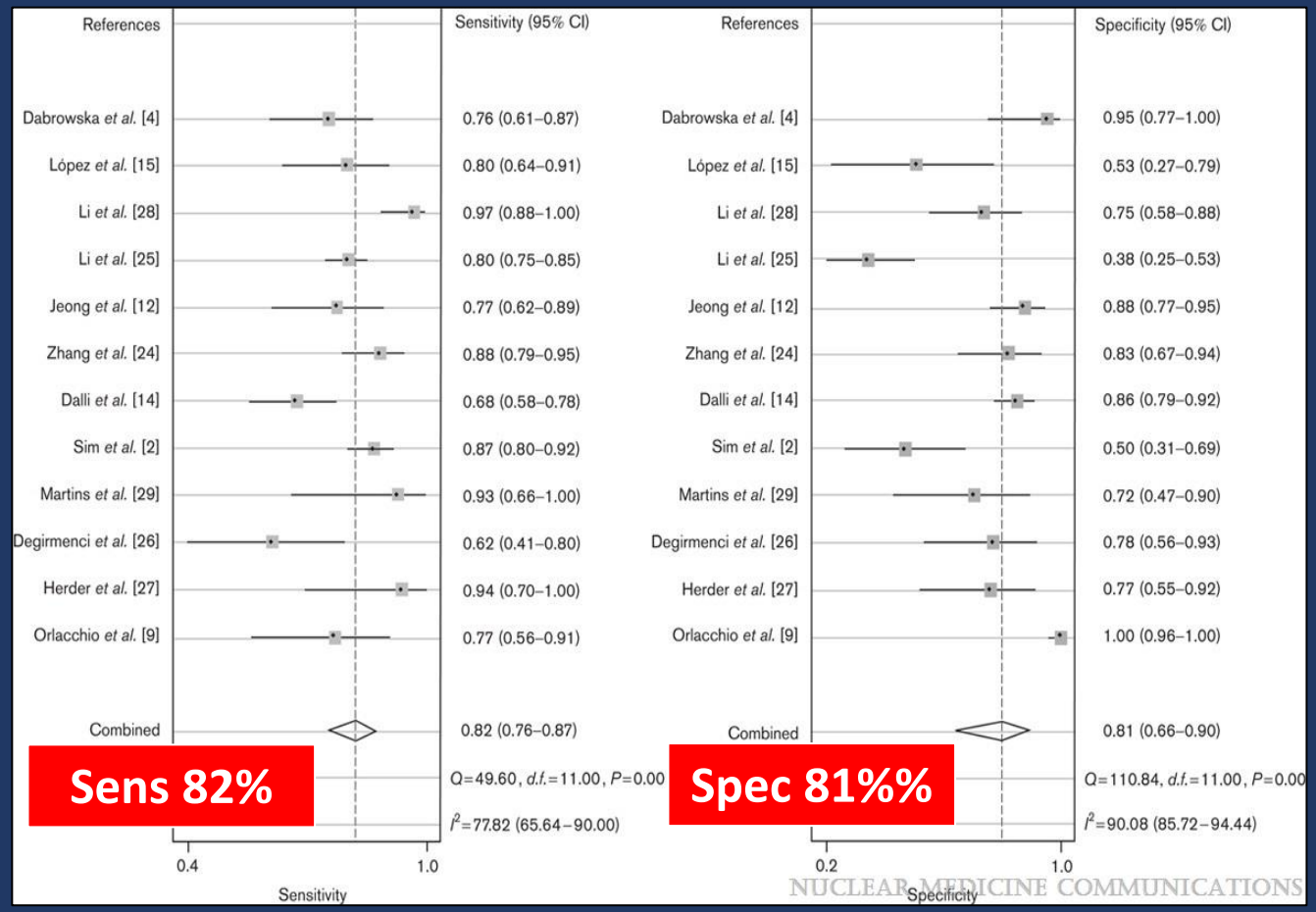
Sensitivity 72-94%

Using 2.5 SUVmax:

- Sen 87
- Spec 50
- PPV 91
- NPV 40

Performance is affected by:

- Pretest probability of malignancy
- Size of the nodule



Zong R. Medicine Communications 2017, 38:67–75
Gould M. CHEST 2013; 143(5)(Suppl):e93S–e120S
Sim YT. Lung. 2013;191:625–32

A PET-ite problem

How does pre-test probability affect the performance of PET-CT?

Mild FDG uptake

Sen 85%

Spec 85

PPV 86%

NPV 85%

	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	PPV (%) (95% CI)	NPV (%) (95% CI)	Accuracy (%) (95% CI)
Low (< 5%)	66.6 (28.9–100)	95.1 (88.5–100)	66.7 (28.9–100)	95.1 (88.5–100)	91.5 (83.5–99.4)
Low (< 10%)*	75 (53.7–96.2)	93.1 (87.3–98.9)	70.5 (48.2–92.9)	94.4 (89.2–99.6)	89.8 (83.6–96.2)
Intermediate (5–65%)	96.1 (80.5–91.6)	84.9 (78.6–91.2)	87.2 (81.9–92.5)	83.5 (77.1–90)	85.5 (81.4–89.6)
High (> 65%)	86.9 (73.1–100)	50 (15.3–84.6)	83.3 (68.1–98.5)	57.1 (22.9–91.4)	77.4 (62.7–92.1)

Evangelista L. Eur J Nucl Med Mol Imaging (2018) 45:1898–1907

Transthoracic or Bronchoscopic sampling?

- Size of the nodule
- Location of the lesion (central vs. peripheral)
- Bronchus sign (airway going into the lesion)
- Risk/benefit assessment of each strategy
- Expertise of the operator
- Need for additional procedures

Image Guided Bronchoscopy

Table 2—*Inverse Weighted Diagnostic Yield Overall and by Modality*

Technology	Studies, No.	Weighted Proportion, %	95% CI	Q Statistic	Q *P* Value
VB	10	72.0	(65.7-78.4)	21.0	.01
ENB	11	67.0	(62.6-71.4)	13.3	.21
CS	10	73.2	(64.4-81.9)	63.8	< .0001
U	11	70.0	(65.0-75.1)	15.2	.12
R-EBUS	20	71.1	(66.5-75.7)	84.2	< .0001
All	39	70.0	(67.1-72.9)	119.4	< .0001

3.3.2.1. In patients suspected of having lung cancer, who have a peripheral lung nodule, and a tissue diagnosis is required due to uncertainty of diagnosis or poor surgical candidacy, radial EBUS is recommended as an adjunct imaging modality (Grade 1C).
3.4.2.1. In patients with peripheral lung lesions difficult to reach with conventional bronchoscopy, electromagnetic navigation guidance is recommended if the equipment and the expertise are available (Grade 1C).

Wang, J. et al. CHEST 2012; 142(2):385–393
Rivera, M. et al. Chest, Volume 143, Issue 5, Supplement, 2013, e142S–e165S

Robotic Bronchoscopy for PPL

Prospective multicenter safety and feasibility study (n = 55)

- Primary end-points
  - Successful localization by R-EBUS
  - Procedure-related adverse events
    - PTX in 3.7% of patients
- Exploratory end-point
  - Yield 74% (95% CI 61-84%)
    - Concentric 80%
    - Eccentric 70%

Result	No./No. (%)	*P* Value
Lesion localization[a]		
Overall	51/53 (96.2)	
Concentric	31/51 (60.8)	
Eccentric	20/51 (39.2)	
Diagnostic yield		
Overall radial endobronchial ultrasound view	40/54 (74.1)	
Concentric	25/31 (80.6)	.502
Eccentric	14/20 (70.0)	
Bronchus sign		
Present	24/32 (75.0)	>.999
Absent	16/22 (72.7)	
Lesion size, mm		
≤30	30/42 (71.4)	.710
>31	10/12 (83.3)	

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Chen A. CHEST 2021; 159(2):845-852

Surgical resection

- Lobectomy (with lymph node dissection/sampling) Gold Standard
- Sublobar resection
  - Wedge resection
  - Segmentectomy w/o node exploration
  - Anatomical segmentectomy with node exploration
  - Extended segmentectomy (affected segment + adjacent subsegment + node exploration)
- Extended segmentectomy vs. Lobectomy for pT1N0M0 ≤2cm
  - 5-year survival 87% vs 87%

	Opertive Mortality	Complication	Local Recurrence	Overall Survival
Lobectomy	1-4%	0-48%	6-32%	50-94%
Sublobar resection	0.5%	0-46%	3-53%	38-100

Ginsberg R. Ann Thorac Surg 1995;60:615-23
Okada M. Ann Thorac Surg. 2001;71:956–61
Divisi D. Thorac Dis 2020;12(6):3357-3362

Stereotactic Body Radiation Therapy (SBRT)

- Targeted radiation to tumor bed while minimizing radiation to adjacent normal tissue
  - Large doses (>6 Gy/fraction) in less fractions (≤5)
- Toxicity
  - Apical lesions → brachial plexus injury
  - Peripheral lesions → rib pain and fractures

How well do we use guidelines?

TABLE 2] Physician Risk Assessment and Guideline Concordance

Physician-Assessed Pretest Probability	All n = 25 (%)	Cancer n = 3 (%)	Benign n = 22 (%)
Pretest probability ≤ 5%			
Guideline concordant CT surveillance	12 (48.0)	0 (0.0)	12 (54.5)
More aggressive	13 (52.0)	3 (100.0)	10 (45.5)
PET	9 (36.0)	2 (66.7)	7 (31.8)
PET ≤ 30 d before surgery	1 (4.0)	1 (33.3)	0 (0.0)
Biopsy	3 (12.0)	0 (0.0)	3 (13.6)
	All n = 138 (%)	Cancer n = 114 (%)	Benign n = 24 (%)
Pretest probability ≥ 60%			
Guideline-concordant surgery[a]	35 (25.4)	33 (28.9)	2 (8.3)
More conservative	103 (74.6)	81 (71.1)	22 (91.7)
CT	10 (7.2)	5 (4.4)	5 (20.8)
PET[a]	78 (56.5)	63 (55.3)	15 (62.5)
Biopsy	15 (10.9)	13 (11.4)	2 (8.3)

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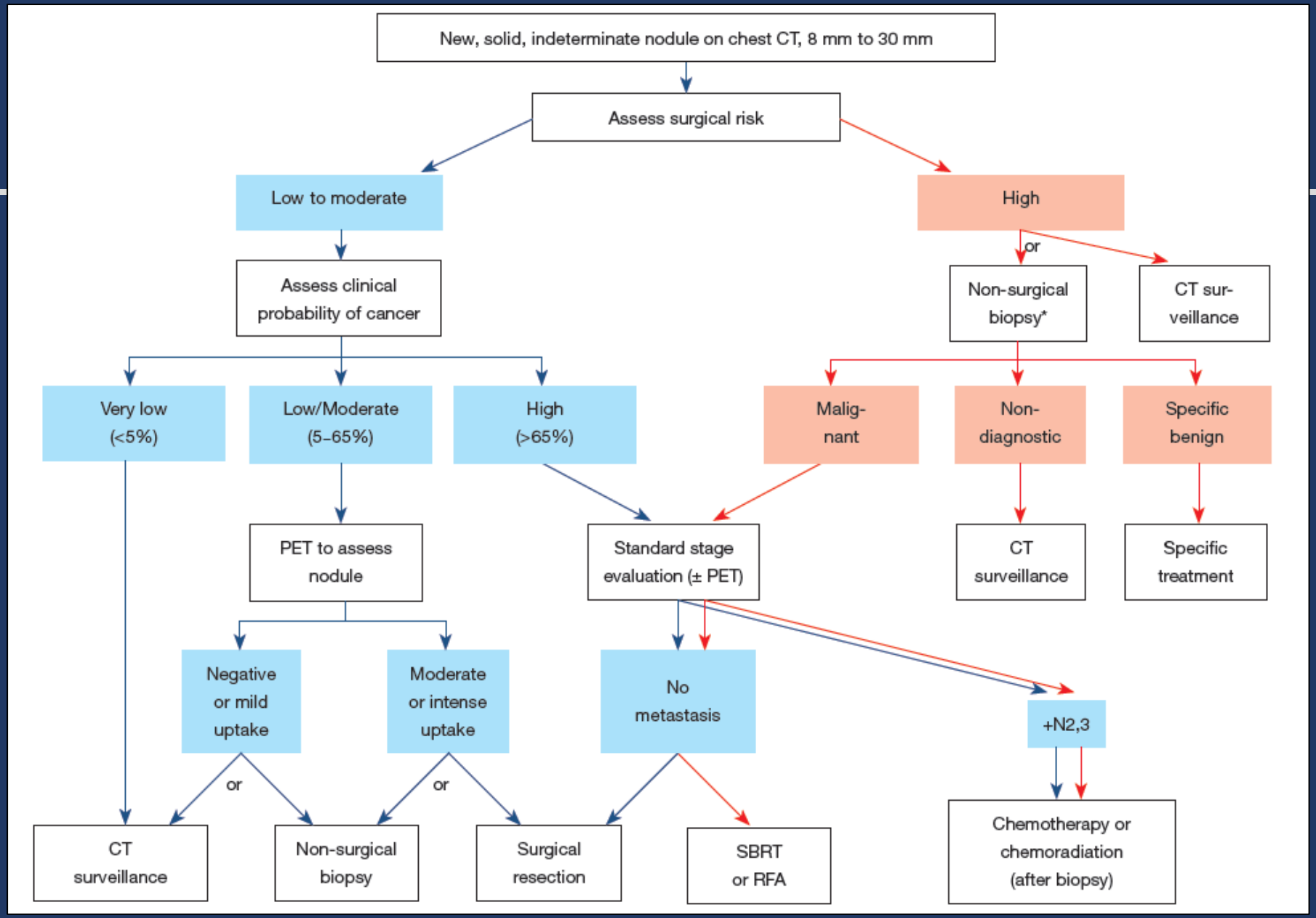
Tanner M. CHEST 2017; 152(2):263-270



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Gould M. CHEST 2013; 143(5)(Suppl):e93S–e120S

Emotional harm to patients

Only one study in the literature investigating the emotional harm in patients undergoing LCS.

Table 1 Attributes and Definitions Used in the Card Sort

Card-Sort Attribute Name	Card-Sort Attribute Definition
Reduced Deaths from Lung Cancer	A decrease in lung cancer deaths
Routine Screening	If the computed tomography (CT) scan is normal, the need to come back for a CT scan every year as part of routine screening
Significant Incidental Finding	The need to get further testing if a CT scan finds an abnormality not related to lung cancer
Follow-up in a Nodule Clinic	If the CT shows a small spot or nodule, the need to have a CT scan at least twice a year to follow it
Invasive Procedures	The need to undergo a lung biopsy to determine if a lung nodule is cancer
False-Positive Test	An abnormal finding on the CT scan (such as a scar or spot on the lung) that with further testing turns out not to be cancer
Overdiagnosis	Being given a diagnosis of lung cancer even though the cancer found would never have progressed to cause any symptoms
Overtreatment	The need to undergo cancer treatment even if the cancer found would never have progressed to cause any symptoms
Radiation Exposure	Having a small increased risk of getting lung cancer due to the radiation from CT scans

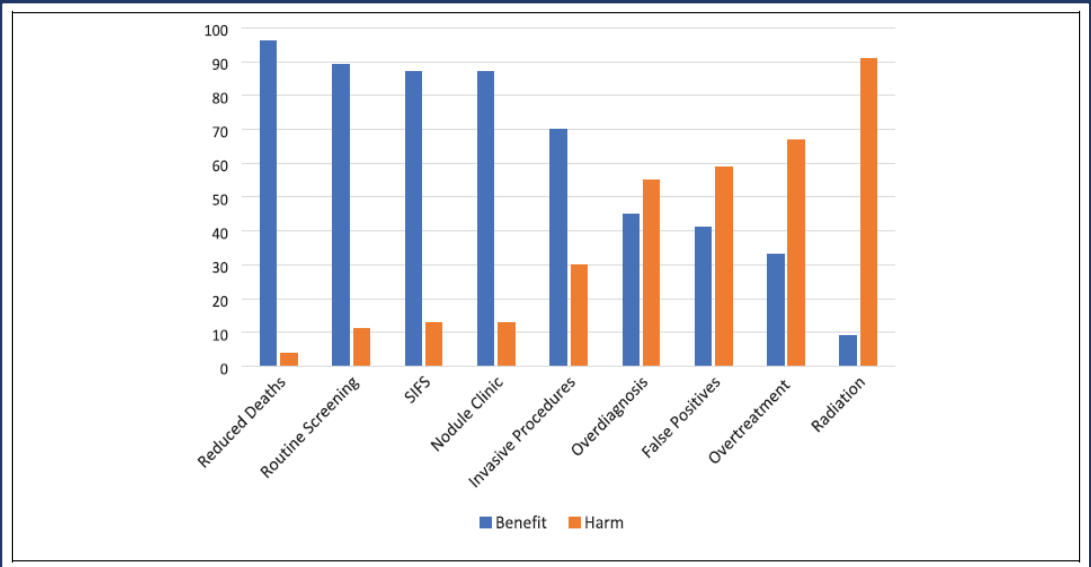


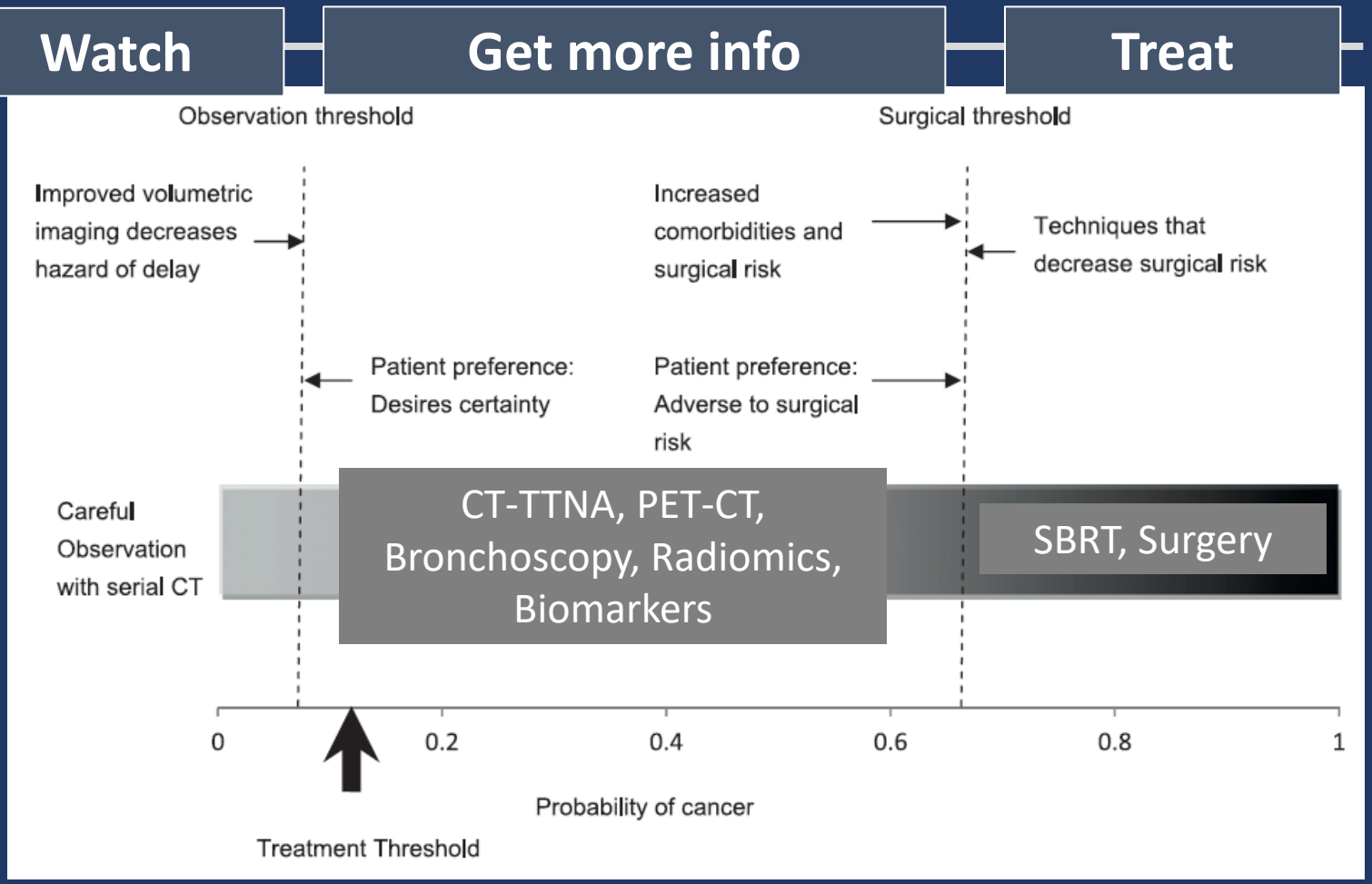
Figure 1 Percentage sorting lung cancer screening attribute as benefit or harm

Schapira M. Med Decic Making. 2021 Feb 6;272989X20987221

So what now…?

Risk of malignancy assessment:
Low <5%
Intermediate 12-65%
High >65%

Patient preference and Harm/Benefit assessment



A. Rolando Peralta

Ost D, Am J Respir Crit Care Med Vol 185, Iss. 4, pp 363–372, Feb 15, 2012

Thank you!

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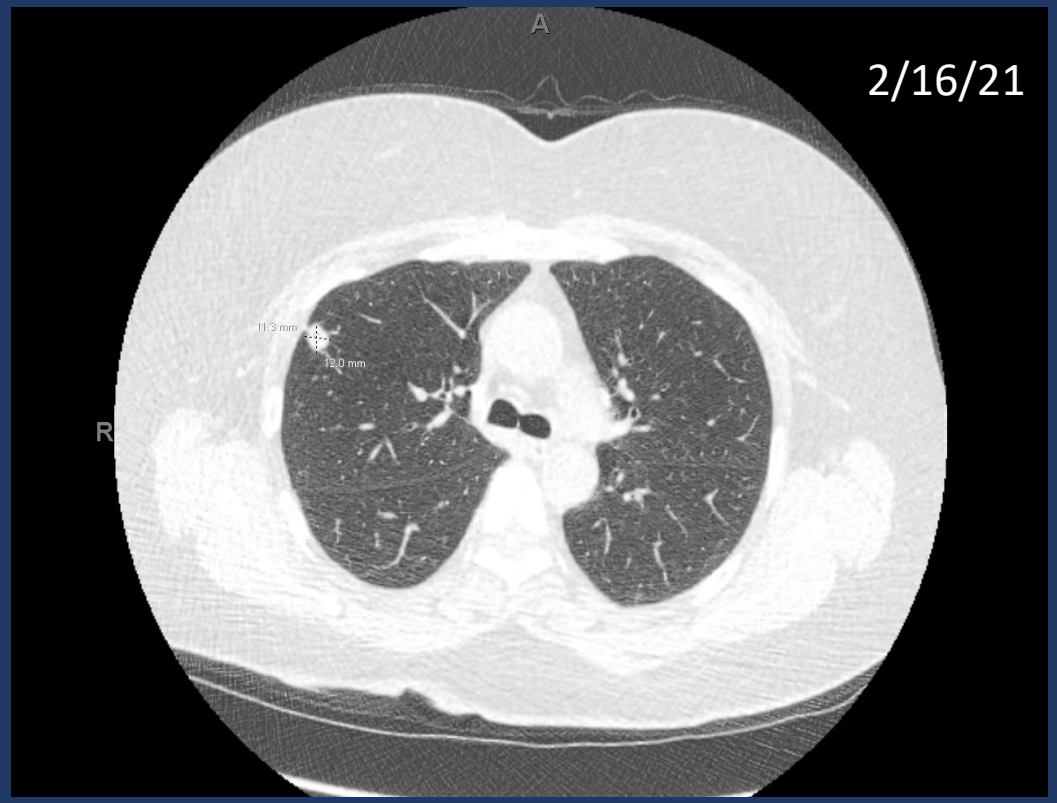
Question #1

You are asked to review the screening LDCT of a 58yo woman. She has a 45PYH of smoking (active 1/2PPD) and was recently started on inhaler therapy for dyspnea due to COPD. Which of the following models would be most appropriate to assess the risk of malignancy in this patient?

a) Brock model
b) HERDER model
c) Mayo model
d) PKUPH model
e) VA model
f) Who cares… I do not need one



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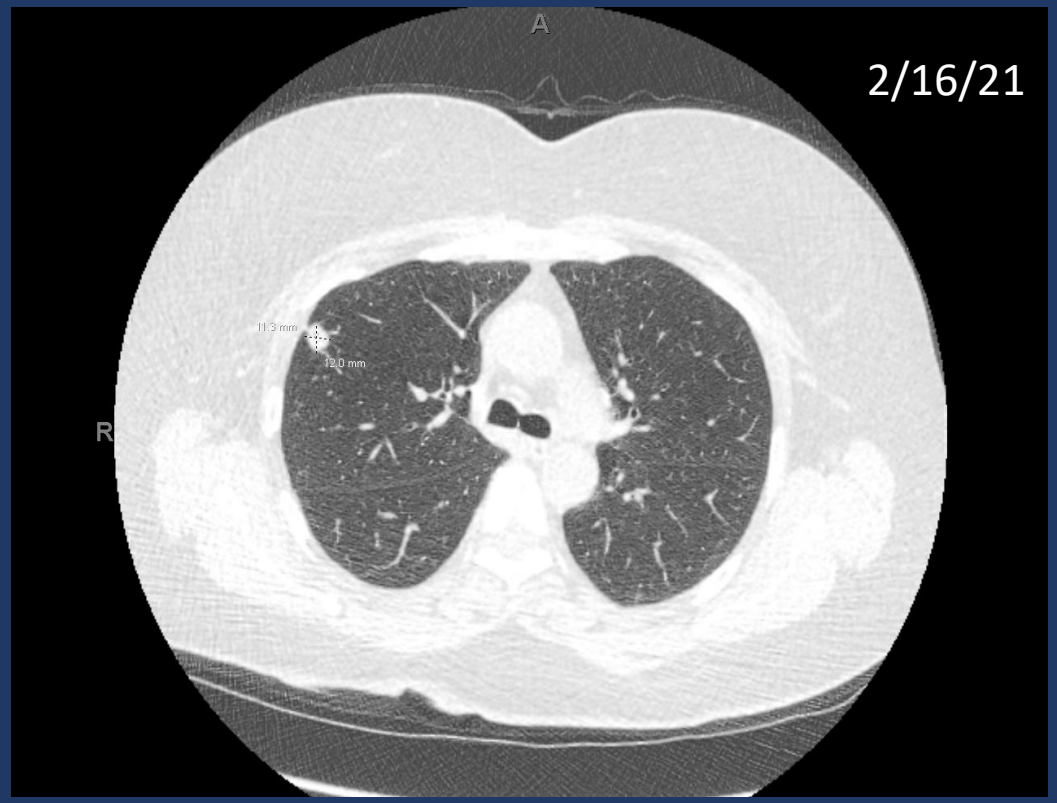


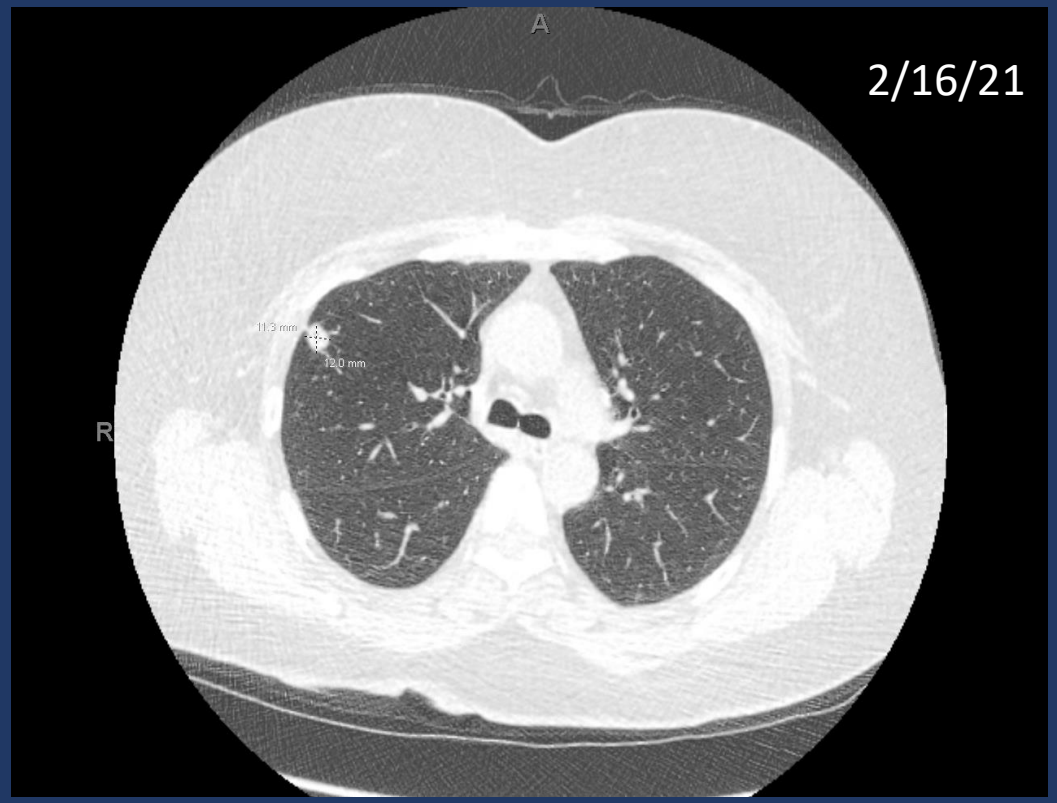
Brock Model → 18% risk of malignancy

Age	58	years
Sex	◉ Female (0.6011)	
	○ Male (0)	
Family history of lung cancer	☐ (0.2961)	
Emphysema	☑ (0.2953)	
Nodule size	12	mm
Nodule type	○ Nonsolid or ground-glass (-0.1276)	
	○ Partially solid (0.377)	
	◉ Solid (0)	
Nodule in upper lung	☑ (0.6581)	
Nodule count	1	#
Spiculation	☐ (0.7729)	

Results:

Log odds	-1.50	
Cancer probability	18.19	%

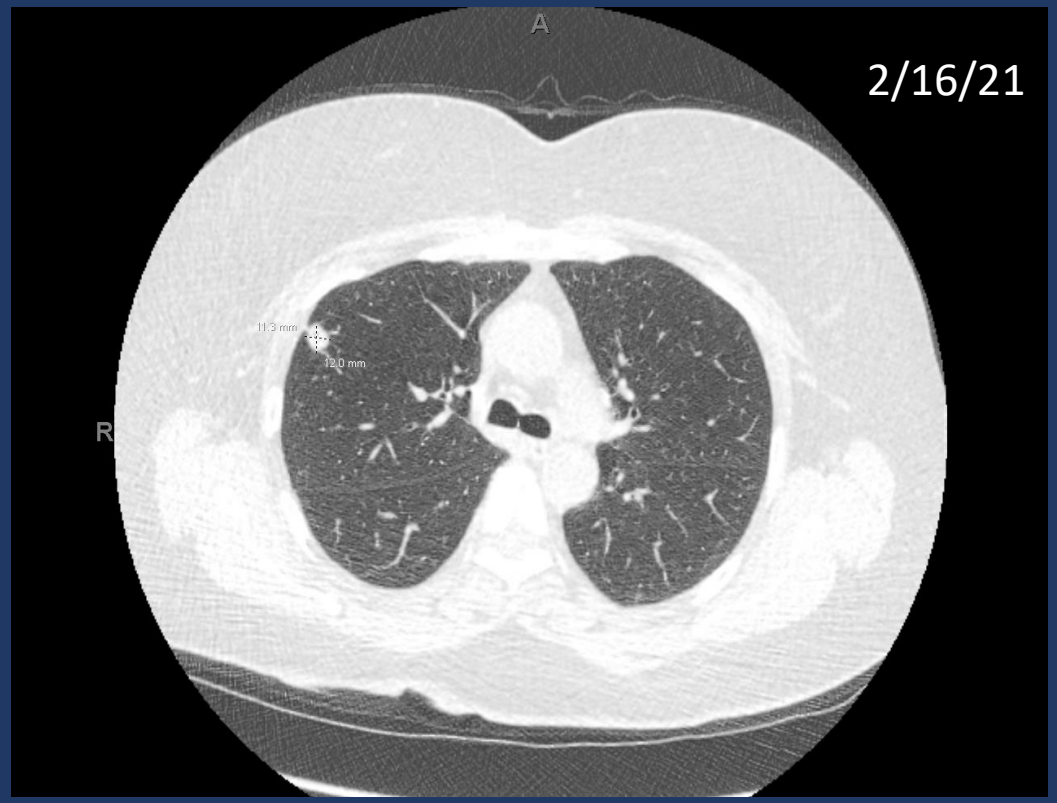
Decimal precision 2



Question #2

You are asked to review the screening LDCT of a 58yo woman. She has a 45PYH of smoking (active 1/2PPD) and was recently started on inhaler therapy for dyspnea due to COPD. What is the next best step?

a) Clinic visit to discuss patient preference and assess surgical risk
b) Diagnostic contrast enhanced chest CT
c) PET-CT
d) Referral to thoracic surgery
e) Repeat LDCT in 3 months
f) Review old images



Question #2 → Lung RADS 1.1

Probably Suspicious Findings for which additional diagnostic testing is recommended	**4A**	**Solid nodule(s):** ≥ 8 to < 15 mm at baseline **OR** growing < 8 mm **OR** new 6 to < 8 mm	3 month LDCT; PET/CT may be used when there is a ≥ 8 mm solid component	5-15%	2%
		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			
Suspicious Findings for which additional diagnostic testing and/or tissue sampling is recommended	**4B**	**Solid nodule(s)** ≥ 15 mm **OR** new or growing, and ≥ 8 mm	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. *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%
		Part solid nodule(s) with: a solid component ≥ 8 mm **OR** a new or growing ≥ 4 mm solid component			
	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%
Volumetric measurements	1.5 mm = 1.8 mm^3 4 mm = 33.5 mm^3 6 mm = 113.1 mm^3 8 mm = 268.1 mm^3		10 mm = 523.6 mm^3 15 mm = 1767.1 mm^3 20 mm = 4188.8 mm^3 30 mm = 14137.2 mm^3		

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ACR Lung-RADS Version 1.1 2019 update

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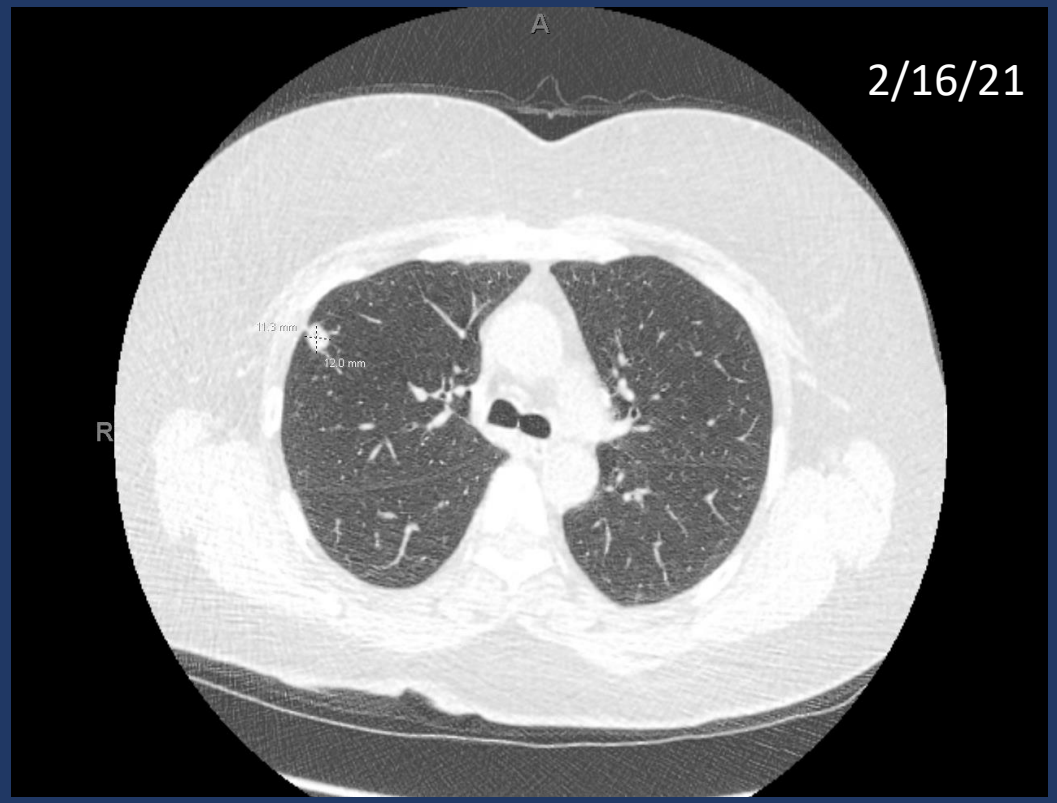

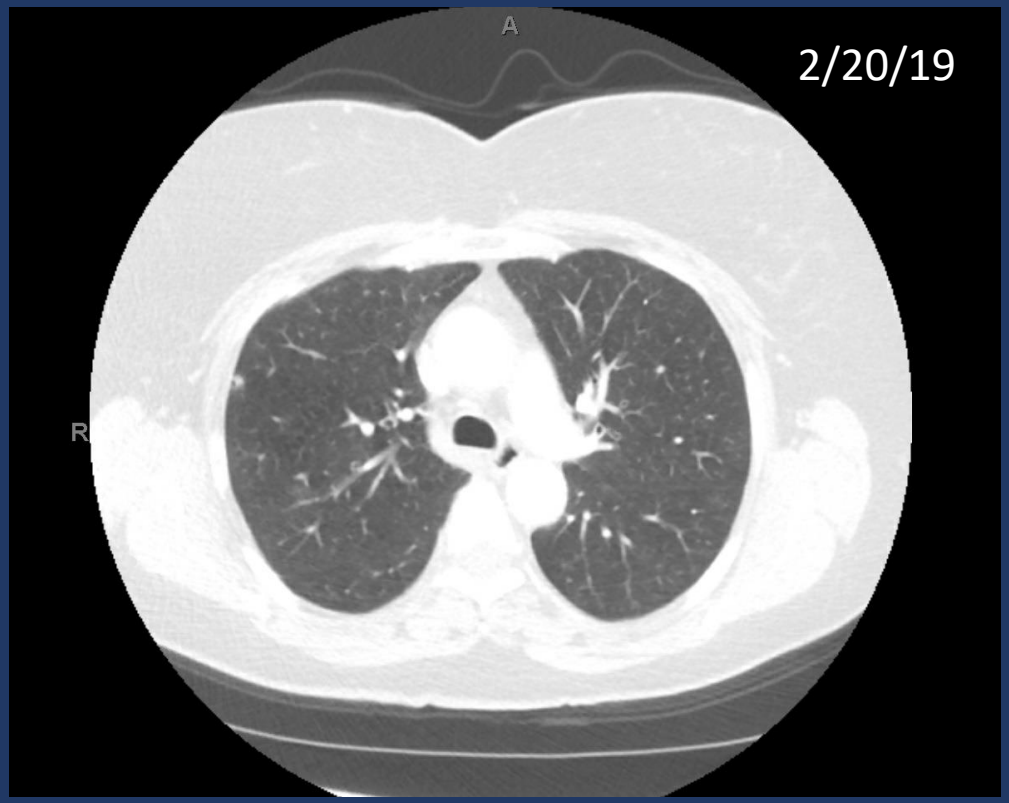

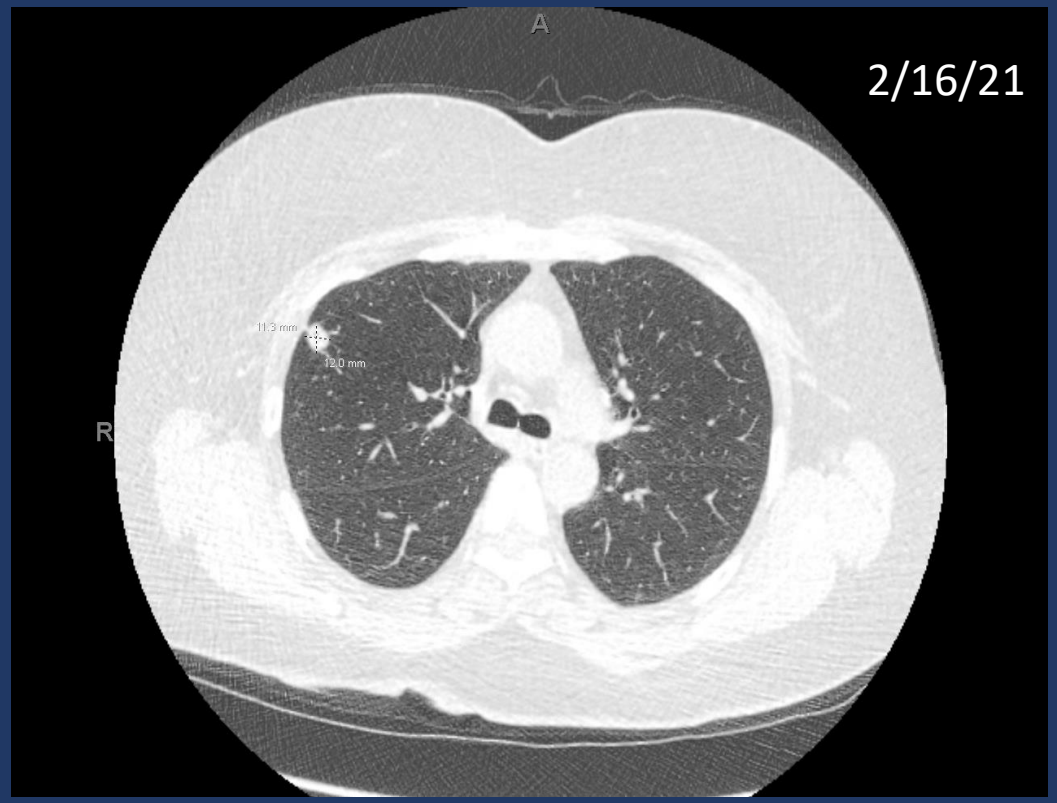

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Question #3

You are asked to review the screening LDCT of a 58yo woman. She has a 45PYH of smoking (active 1/2PPD) and was recently started on inhaler therapy for dyspnea due to COPD. The nodule is 12mm with minimal cavitary component and was non-solid 6mm two years ago. What is the next best step?

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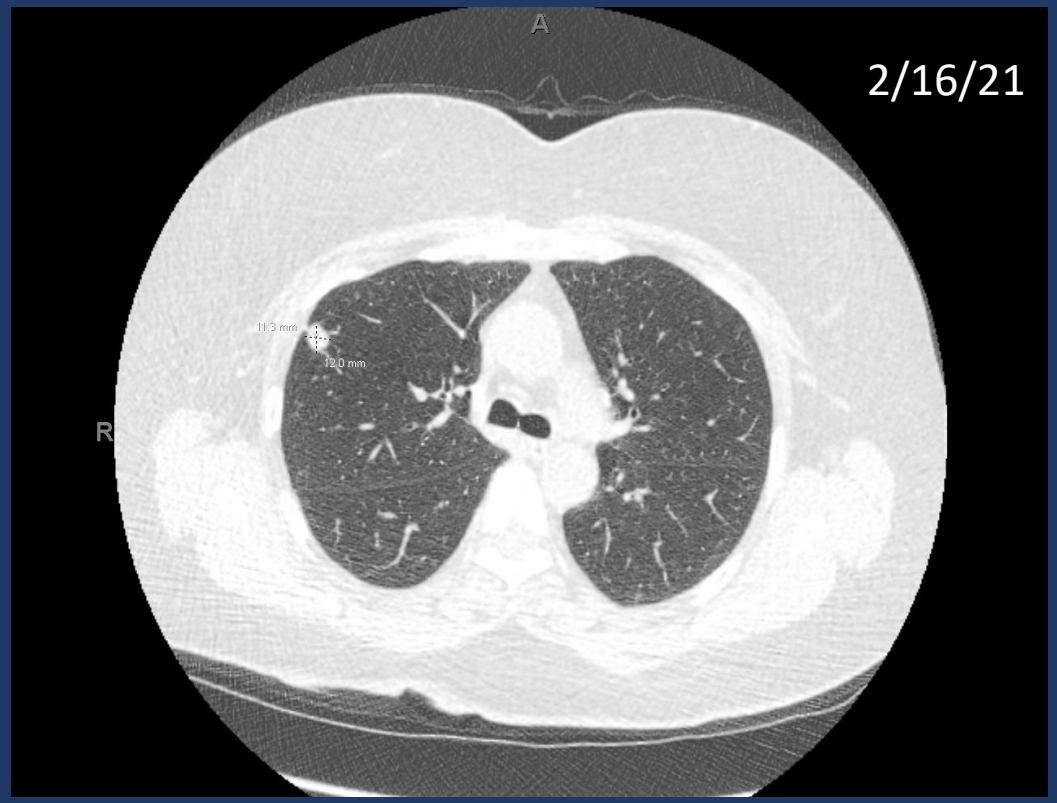

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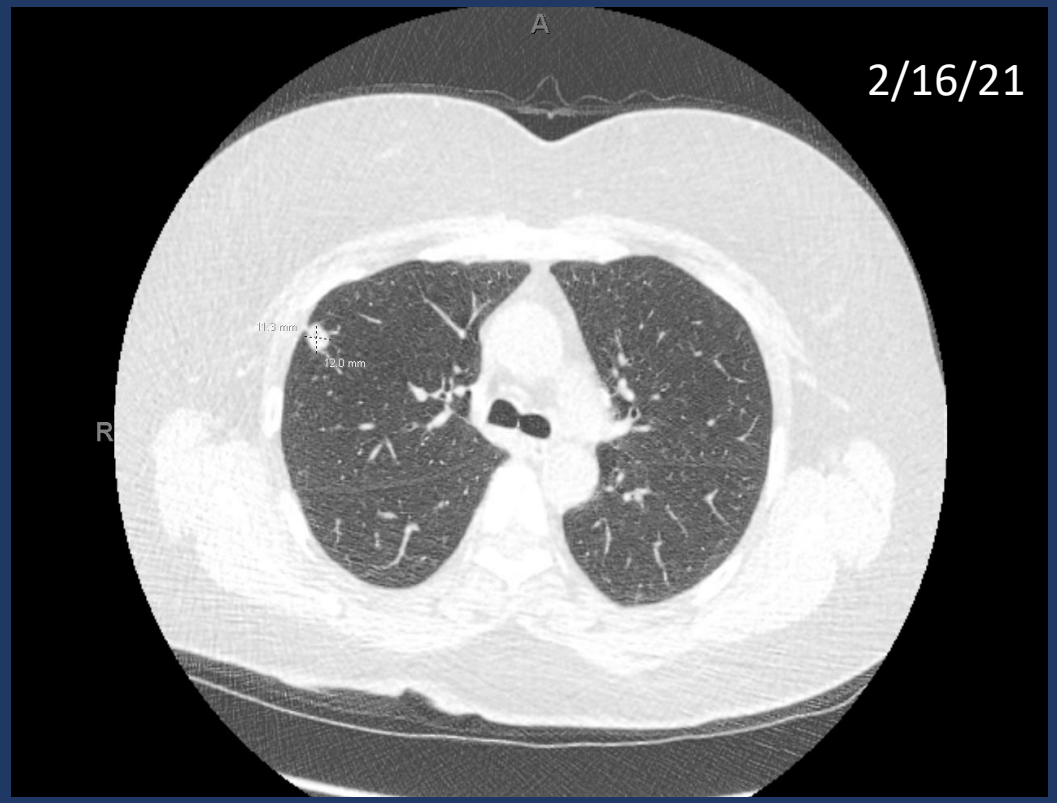

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