

# Approach to Solitary Pulmonary Nodule (SPN)

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# Disclosures

- Nothing to disclose

# Overview

- Case scenario
- Definition
- Epidemiology
- Differential Diagnosis
- Management strategy (ACCP/CHEST)

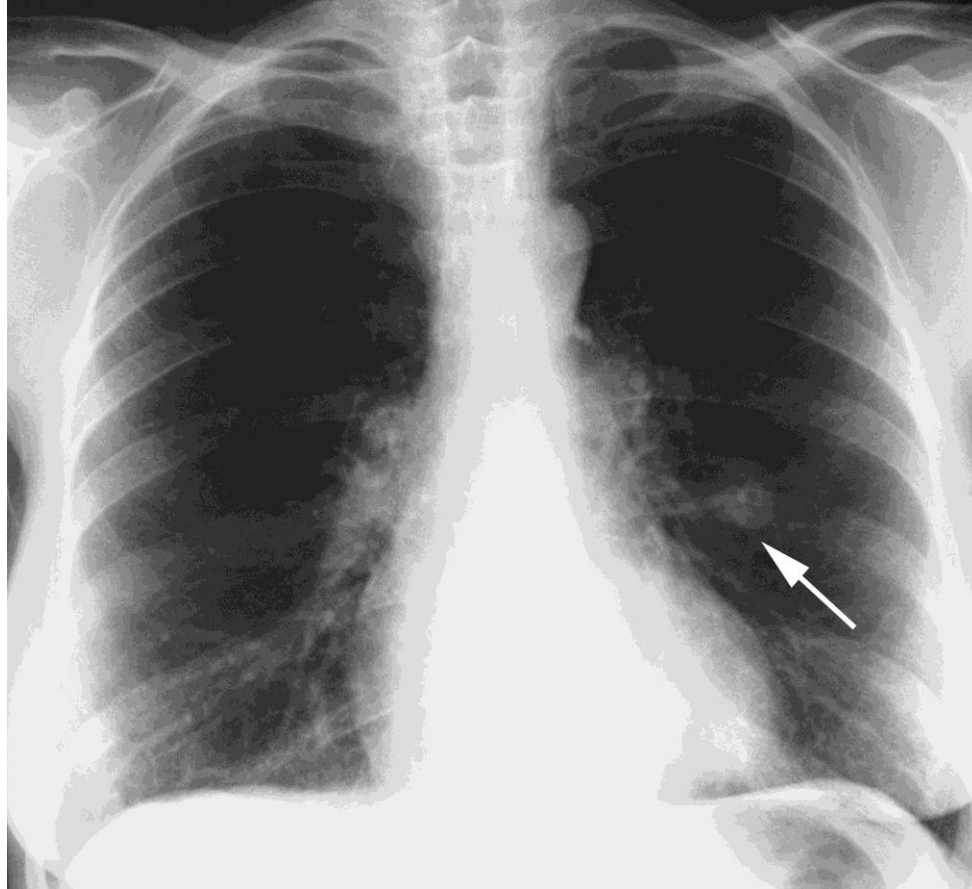
# Overview

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# 60 y.o. female, non-smoker

## Pre-op CXR



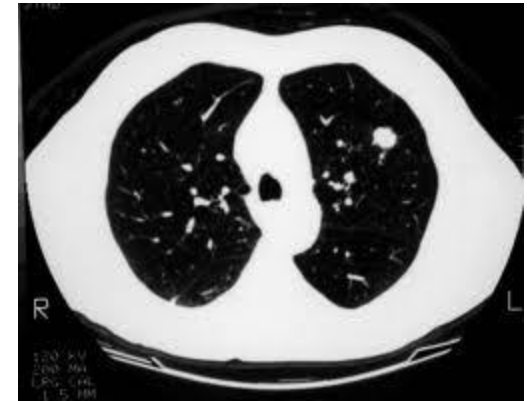
# What next?

- Review old imaging!!!
- Stable solid nodule for at least 2 years  
=No additional evaluation

# Overview

- Case scenario
- **Definition**
- Epidemiology
- Differential diagnosis
- Management strategy (ACCP/CHEST)

# SPN



- Single
- Well-circumscribed, round opacity
- $\leq 3$  cm in diameter
- Completely surrounded by lung parenchyma
- Not associated with adenopathy, atelectasis, or pleural effusion

Ost D, Fein AM, Feinsilver SH. N Engl J Med. 2003 Jun 19;348(25):2535-42



# SPN vs Lung Mass

- **SPN**  $\leq 3\text{cm}$  (typically asymptomatic)
- **Lung mass**  $> 3\text{cm}$  (symptomatic and bronchogenic carcinoma until proven otherwise)

# SPN

- Solid
- Subsolid
  - I. Pure ground glass nodules
  - II. Part-solid nodules

# Overview

- Case scenario
- Definition
- **Epidemiology**
- Differential diagnosis
- Management strategy (ACCP/CHEST)

# Prevalence of lung nodules

- National Lung Screening Trial (NLST)
- ~25% with lung nodules and 39% after 3 years
- 4% of those are malignant

# Likelihood of lung cancer

- Pan-Canadian Early Detection of Lung Cancer Study (**PanCan**) N=1871
- British Columbia Cancer Agency (**BCCA**) N=1090
- The rates of cancer were 5.5% & 3.7%
- Predictors: Older age, female, FHx, emphysema, larger nodule size, UL nodule, part-solid nodule, lower nodule count and spiculation

[N Engl J Med.](#) 2013 Sep 5;369(10):910-9. Probability of cancer in pulmonary nodules detected on first screening CT. [McWilliams A](#) et al.

# Overview

- Case scenario
- Definition
- Epidemiology
- **Differential Diagnosis**
- Management strategy (ACCP/CHEST)

# Differential Diagnosis

- Malignant
  - Primary lung cancer
  - Metastasis
    - Breast, colorectal, head and neck, RCC
  - Carcinoid tumor
- Benign
  - Infection (80%)
  - Hamatomas (10%), fibroma, leiomyoma
  - Inflammatory
  - Vascular

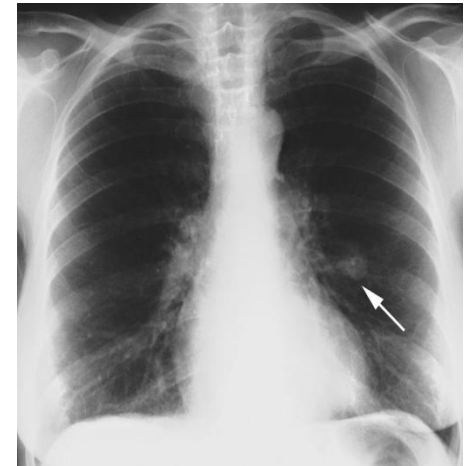
# Overview

- Case scenario
  - Definition
  - Differential diagnosis
  - Evaluation
- **Management strategy (ACCP/CHEST)**



# Back to our case

- 60y.o. female, non-smoker, pre-op CXR
- Previous CXR 2010 was normal
- What next?



# CT thorax

- CT thorax confirmed a solitary nodule of 4mm left lower lobe
- What next?

# SPN

- Probability of malignancy
- Utility of imaging tests
- Benefits vs harms (nonsurgical bx, surgical resection, surveillance with CT thorax)
- Patient preferences

# Probability of malignancy

- Qualitatively
- Quantitatively

# Probability of malignancy

- Qualitatively by clinical judgement
- 30y.o. nonsmoker with 6mm smooth bordered nodule
- 70y.o. 50PY smoker with 2cm spiculated nodule

# Probability of malignancy

- Quantitatively by validated model

**Solitary Pulmonary Nodule Malignancy Risk (Mayo Clinic model)** [Share](#)

**Input:**

Age

Smoker  Current or former (1)  
 Never smoker (0)

Cancer  Extrathoracic cancer more than 5 years prior (1)  
 None (0)

Nodule Diameter

Spiculation  Yes (1)  
 No (0)

Upper Lobe  Yes (1)  
 No (0)

**Results:**

X **-3.97**

Malignancy Probability **1.85** %

Decimal Precision:

**Formula** **Notes** **References**

$X = (0.0391 * \text{Age}) + (0.7917 * \text{Smoker}) + (1.3388 * \text{Cancer}) + (0.1274 * \text{NoduleDiameter}) + (1.0407 * \text{Spiculation}) + (0.7838 * \text{UpperLobe}) - 6.8272$

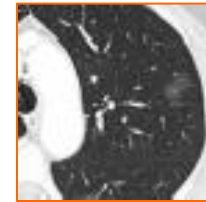
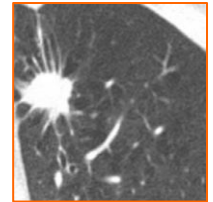
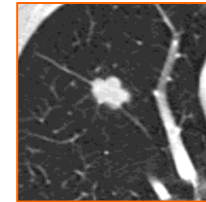
$\text{MaligProbability} = 100 * e^{(X)} / (1 + e^{(X)})$

# Probability of malignancy

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

# Radiological features of malignancy

- Size
- Margins
  - Irregular, lobulated or spiculated
- Density
  - Solid
  - Sub-solid (pure ground glass/ part solid)
- Location
  - Upper lobe

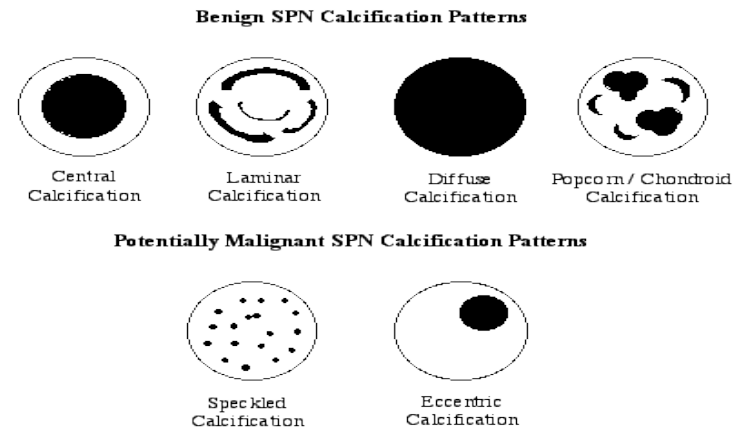




# Radiological features of malignancy

- Calcification patterns

- Benign patterns of calcification



- Growth

- Stability over 2 years suggestive of benign etiology (solid)
- Stability over 3 years (sub-solid)

# Recommendation Categories

- 1) Overall (any size nodule)
- 2) Solid nodules  $\leq 8\text{mm}$
- 3) Solid nodules  $> 8\text{mm}$
- 4) Subsolid nodules

# For any size nodule

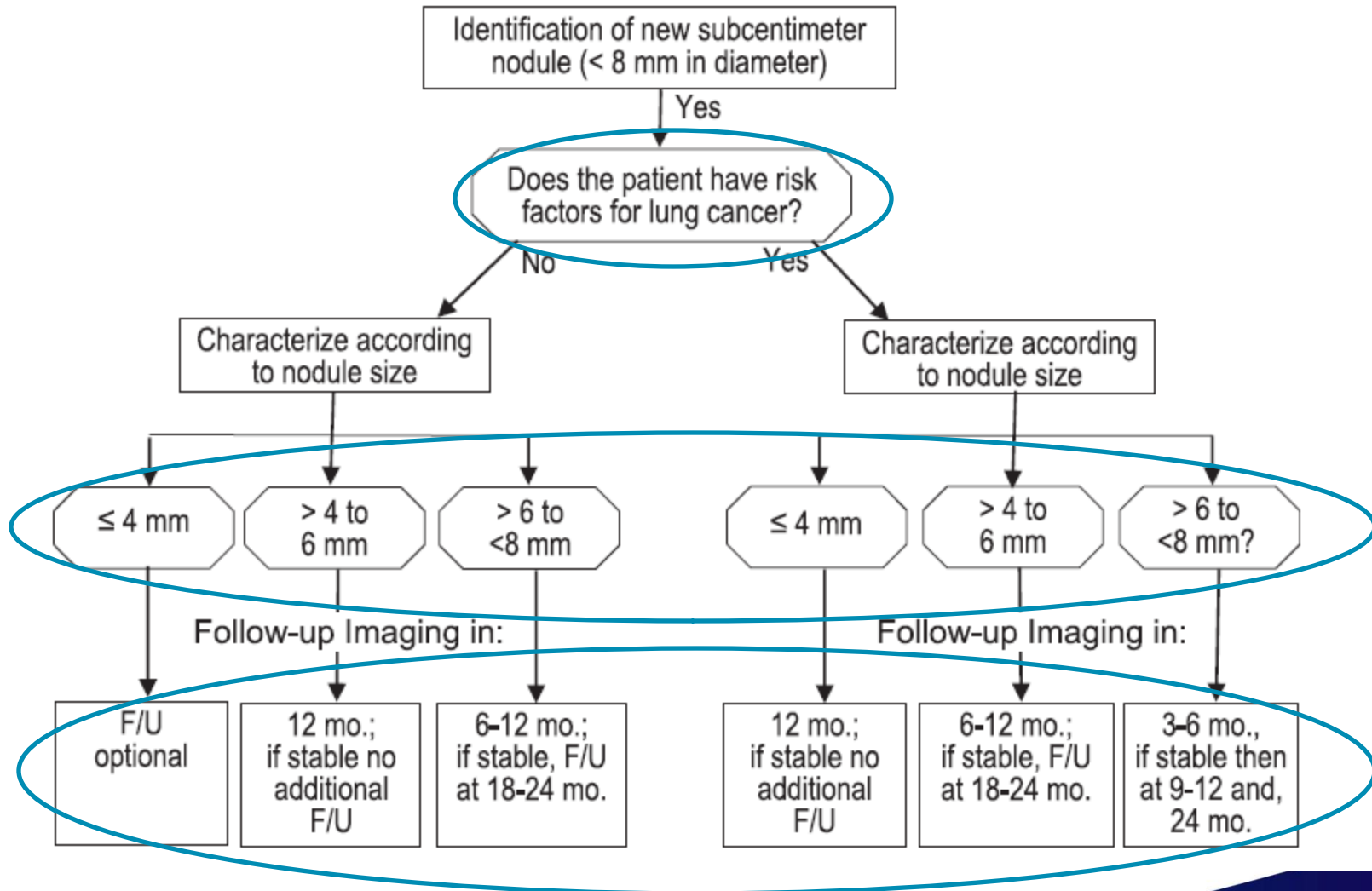
- 1) Assess likelihood of cancer
- 2) Review old imaging: no further workup if nodule has been stable for prolonged period
- 3) Consider suitability of and desire for treatment if nodule turns out to be cancer

# No further evaluation

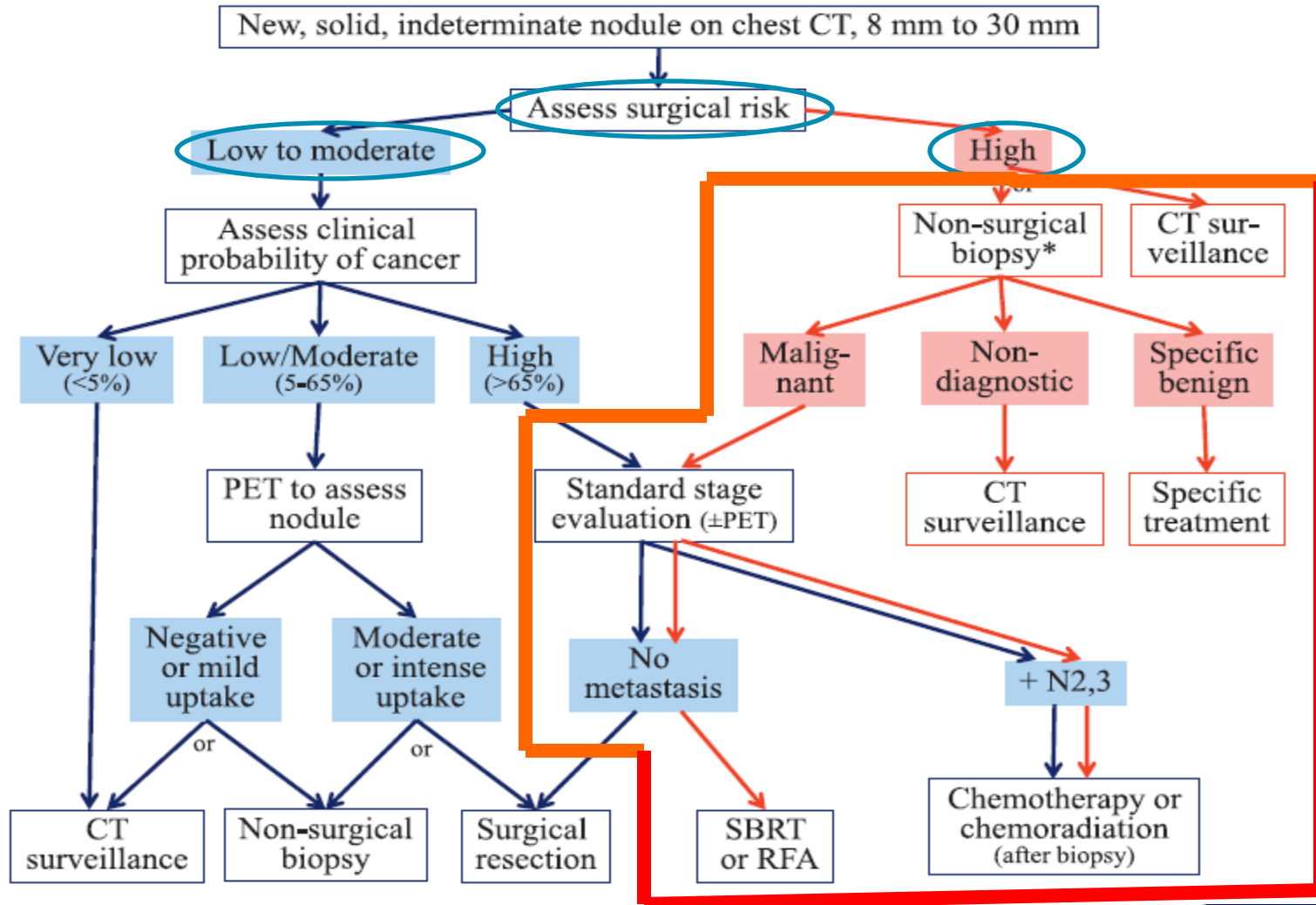
- Nodule stable for prolonged period
- Patient either not a candidate for or does not want treatment if is cancer

Procedure	Potential Benefits		Potential Harms	
	Outcome	% Frequency	Outcome	% Frequency
Surgical wedge resection	<ul style="list-style-type: none"> <li>Prompt, definitive diagnosis</li> <li>Avoid inconvenience and potential complications of nonsurgical biopsy, if malignant</li> <li>Reassurance if specific benign diagnosis established</li> <li>Proceed to lobectomy if frozen section reveals malignancy</li> <li>Acquisition of tissue for molecular testing</li> </ul>	96-100	<ul style="list-style-type: none"> <li>Physical complications               <ul style="list-style-type: none"> <li>Persistent air leak</li> <li>Pneumonia</li> <li>Death</li> </ul> </li> <li>Worsened lung function (short term)</li> <li>Unnecessary surgery if nodule turns out to be benign disease</li> <li>Uncertain benefits of surgery if very-slow-growing tumor</li> </ul>	5 3-5 1-8 0.5 Varies Varies
Bronchoscopy with biopsy	<ul style="list-style-type: none"> <li>Definitive preoperative cancer diagnosis in many cases</li> <li>Fluoroscope-guided</li> <li>EBUS, ENB ± VBN guided</li> <li>Reassurance if specific benign diagnosis established</li> <li>Acquisition of tissue for molecular testing</li> </ul>	~ 30 60-90	<ul style="list-style-type: none"> <li>Physical complications               <ul style="list-style-type: none"> <li>Bleeding</li> <li>Any pneumothorax</li> <li>Death</li> </ul> </li> <li>May still require surgery if biopsy result is nondiagnostic or shows cancer</li> <li>False negative biopsy results</li> <li>False positive biopsy results</li> </ul>	2-5 2-4 <<1 30-70 Rare
CT scan-guided needle lung biopsy	<ul style="list-style-type: none"> <li>Definitive preoperative cancer diagnosis in many cases</li> <li>≤ 15 mm</li> <li>&gt; 15 mm</li> <li>Reassurance if specific benign diagnosis established</li> <li>Acquisition of tissue for molecular testing</li> </ul>	~ 70-80 ~ 90	<ul style="list-style-type: none"> <li>Physical complications               <ul style="list-style-type: none"> <li>Bleeding</li> <li>Any pneumothorax</li> <li>Pneumothorax needing chest tube</li> <li>Death</li> </ul> </li> <li>May still require surgery if biopsy is non-diagnostic or shows cancer</li> <li>False negative</li> <li>False positive</li> </ul>	1 15 6-7 <<1 10-30 Rare
Radiologic surveillance (serial CT ± PET scans)	<ul style="list-style-type: none"> <li>Avoid physical complications</li> <li>Discovering other incidental findings that are clinically important</li> </ul>		<ul style="list-style-type: none"> <li>Radiation exposure</li> <li>Other incidental findings that prompt evaluation but turn out to be of little clinical significance</li> <li>Psychologic toll of uncertainty (eg, moderate to severe distress)</li> <li>Overdiagnosis of indolent cancers</li> <li>Delayed cancer diagnosis and treatment, with uncertain effect on outcomes</li> </ul>	24
No further evaluation	<ul style="list-style-type: none"> <li>Avoid physical complications</li> <li>Avoid radiation exposure</li> <li>Avoid overdiagnosis of indolent cancers that do not need treatment</li> </ul>		<ul style="list-style-type: none"> <li>Psychologic toll of uncertainty</li> <li>Delayed or missed cancer diagnosis</li> </ul>	

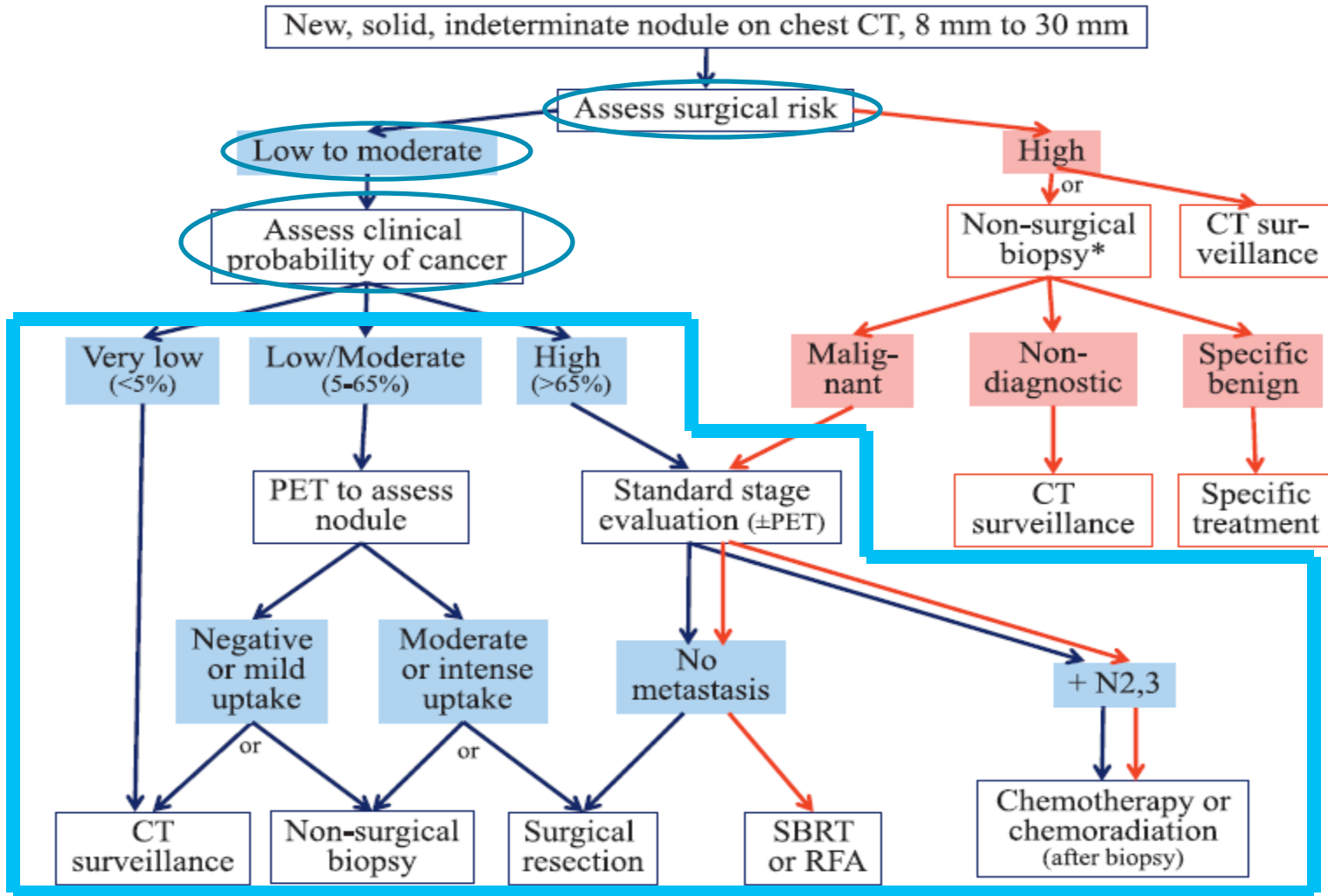
# SPN <8mm



# SPN >8mm

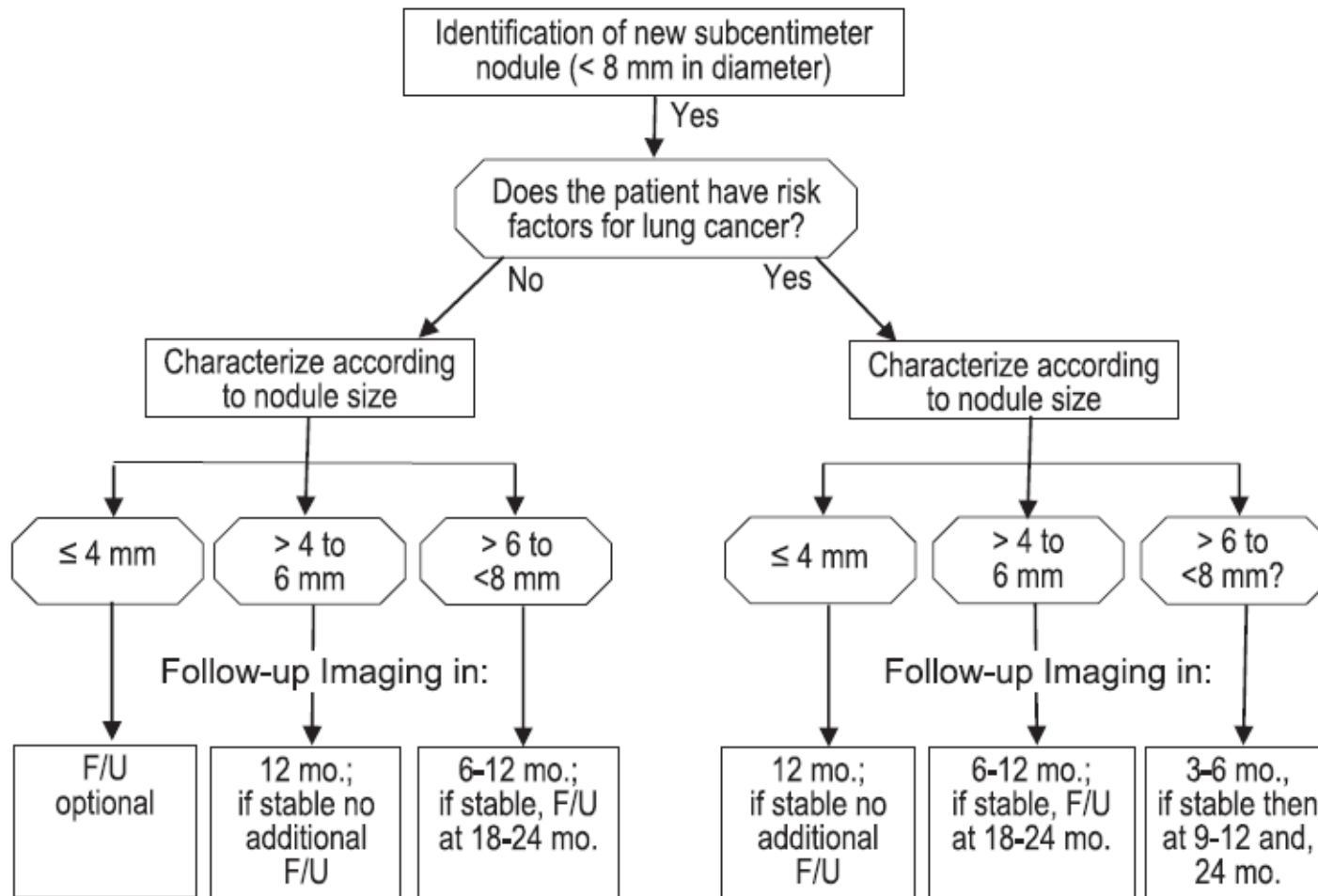


# SPN >8mm

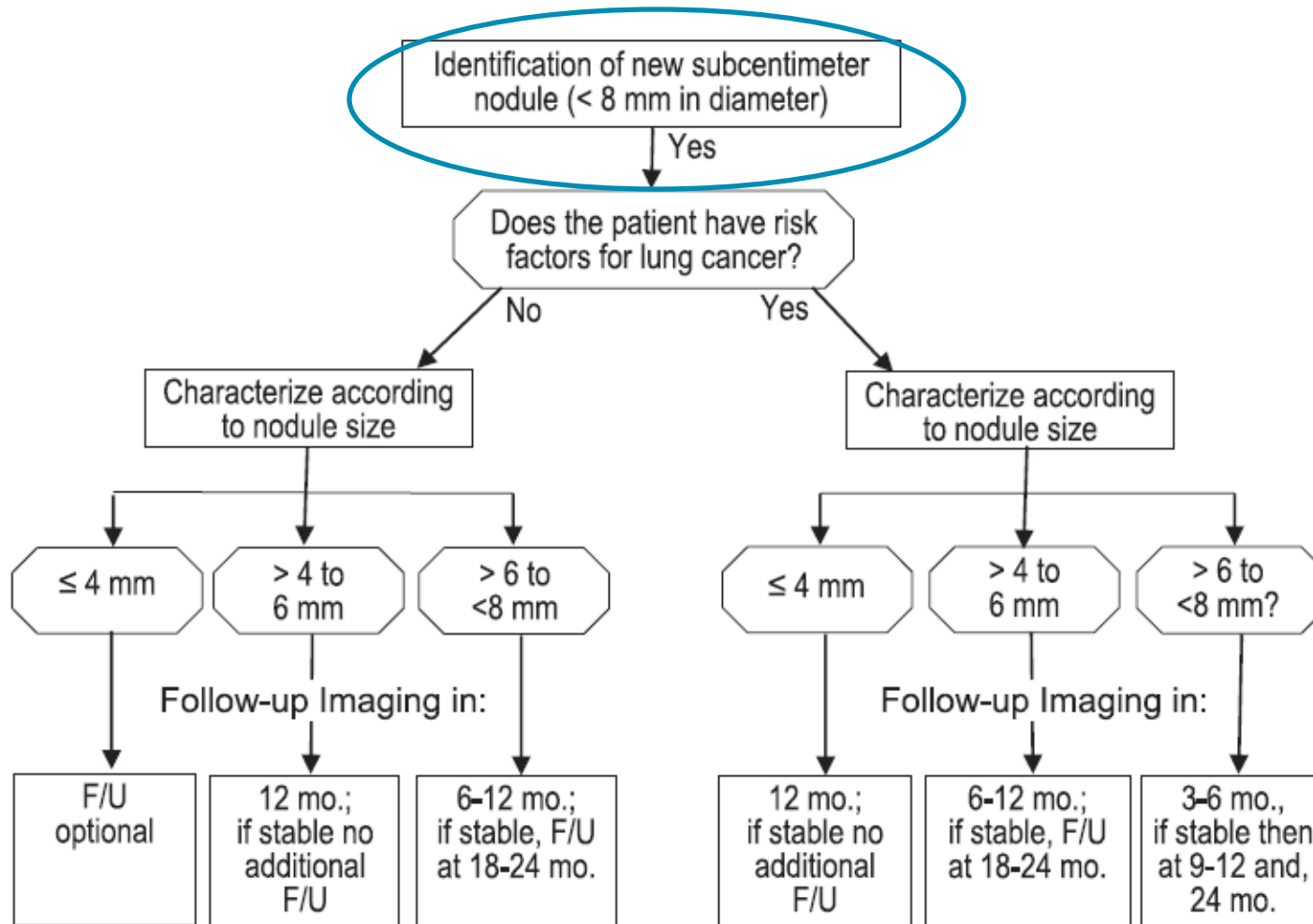




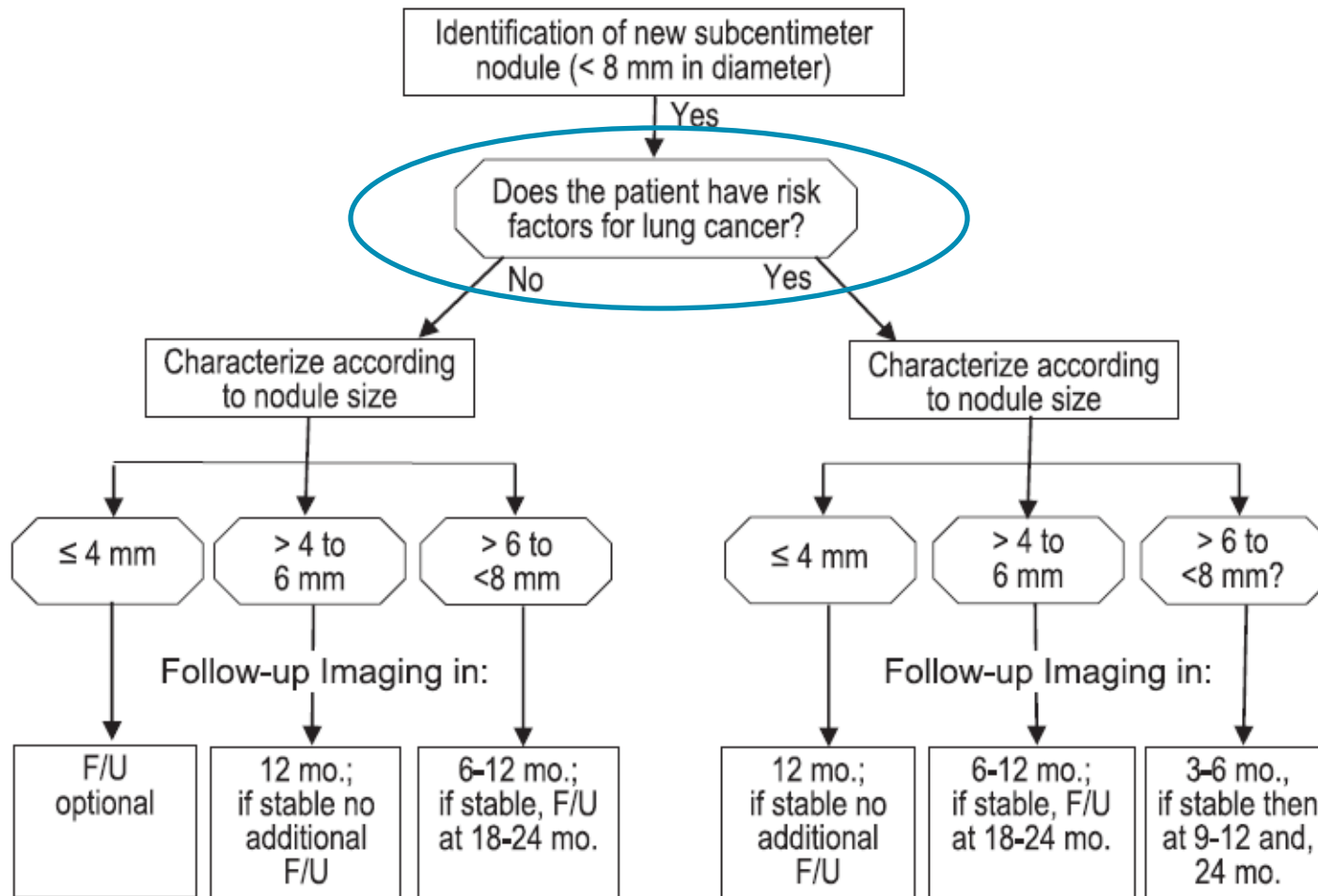
# Back to our case



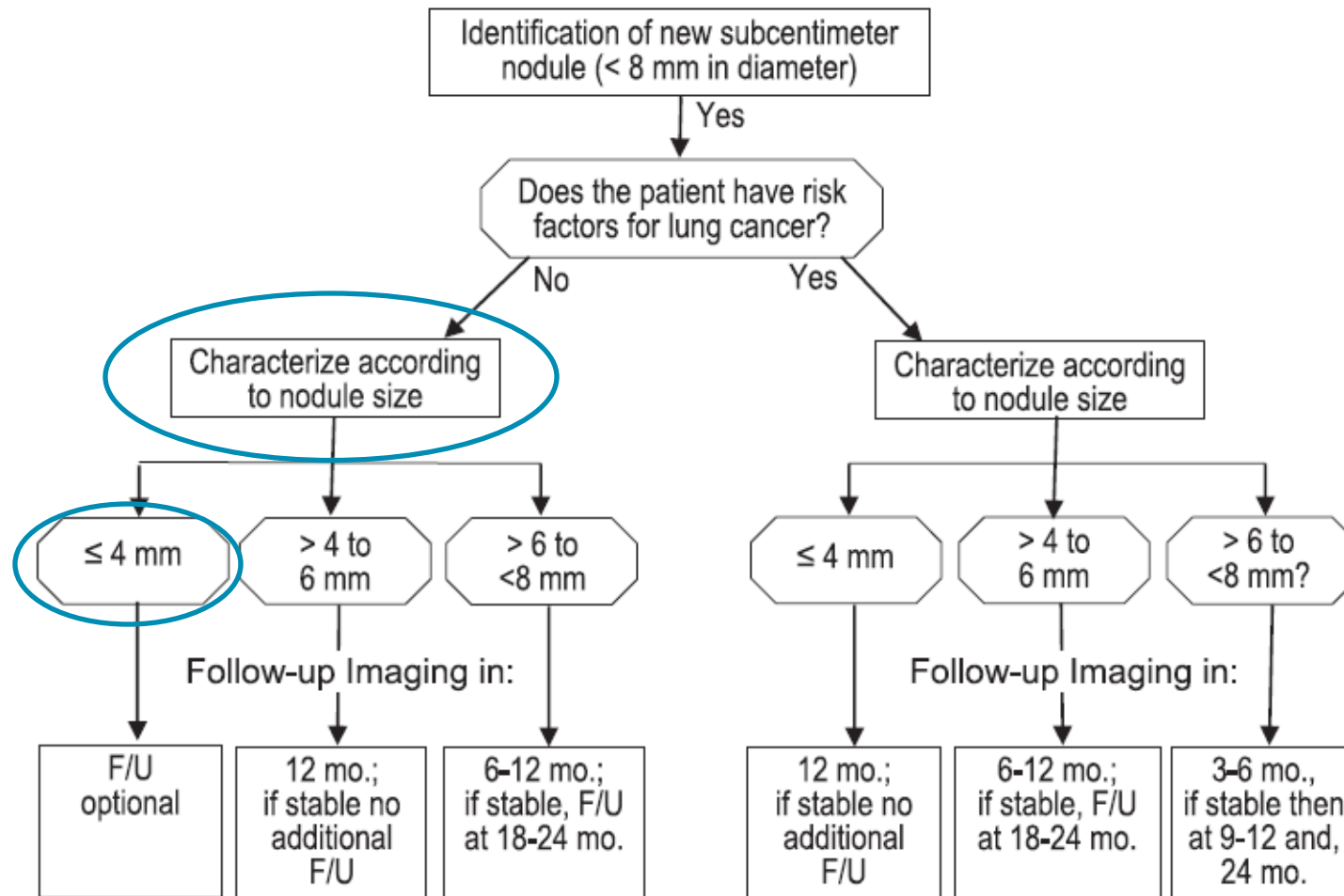
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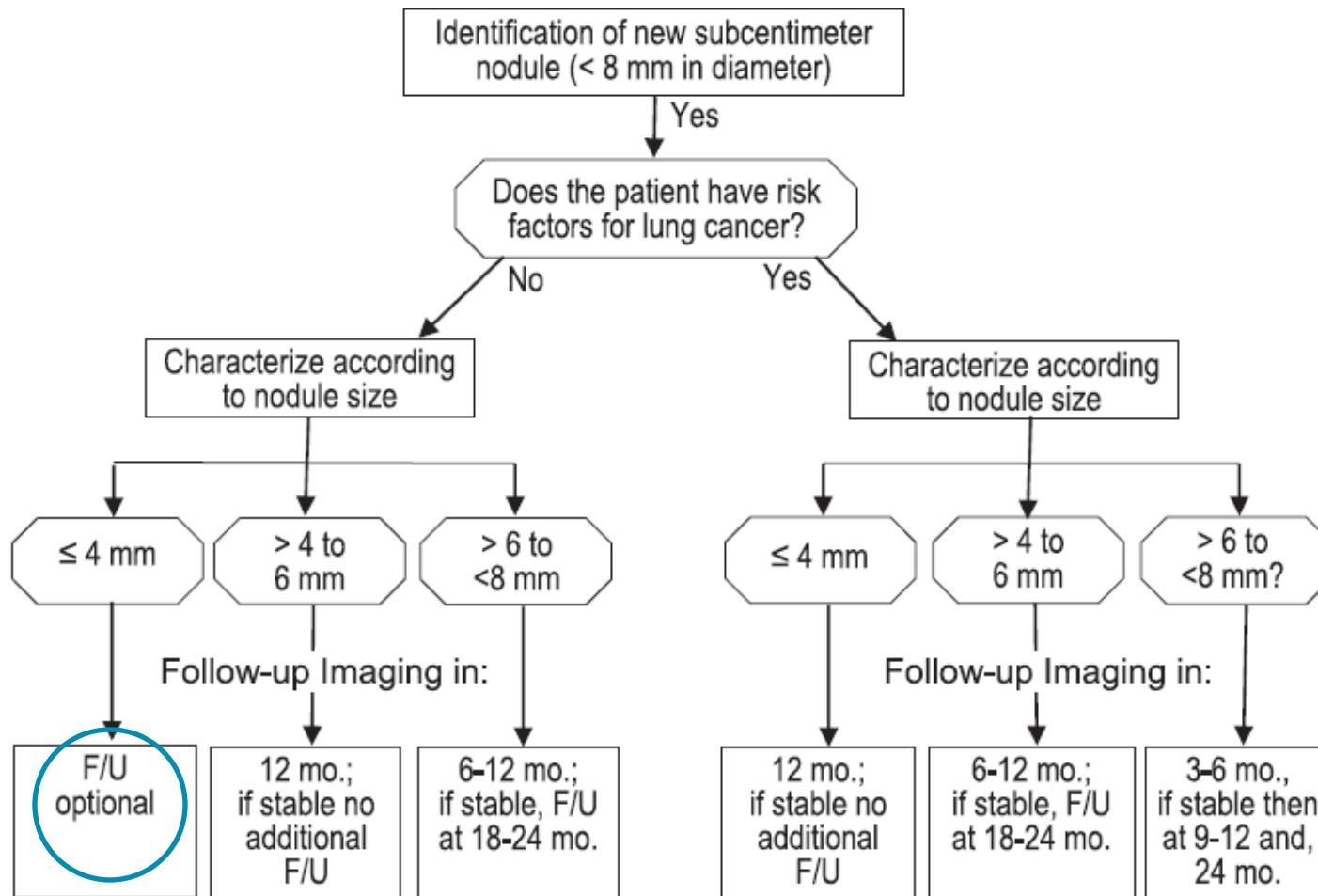
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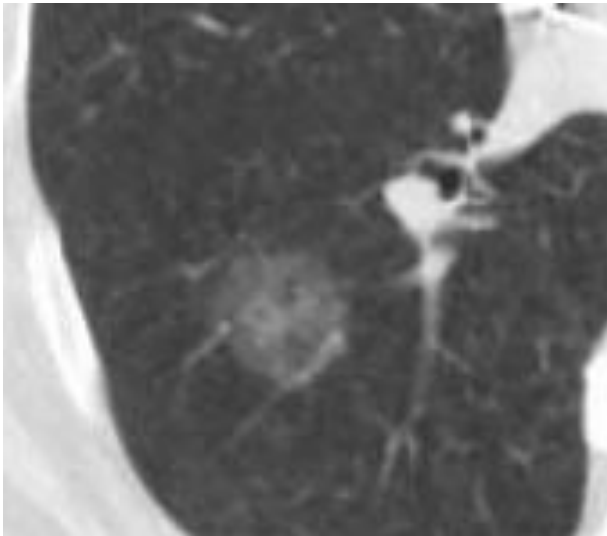
# SPN

- Solid
- **Subsolid**
  - I. Non-solid (Pure ground glass) nodules
  - II. Part-solid nodules

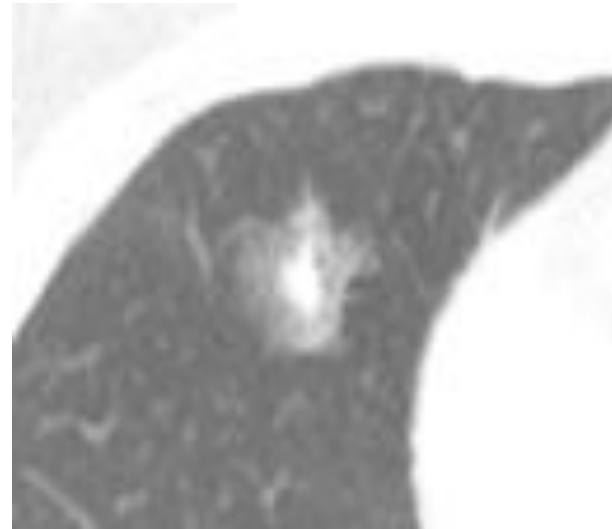


# Subsolid nodules

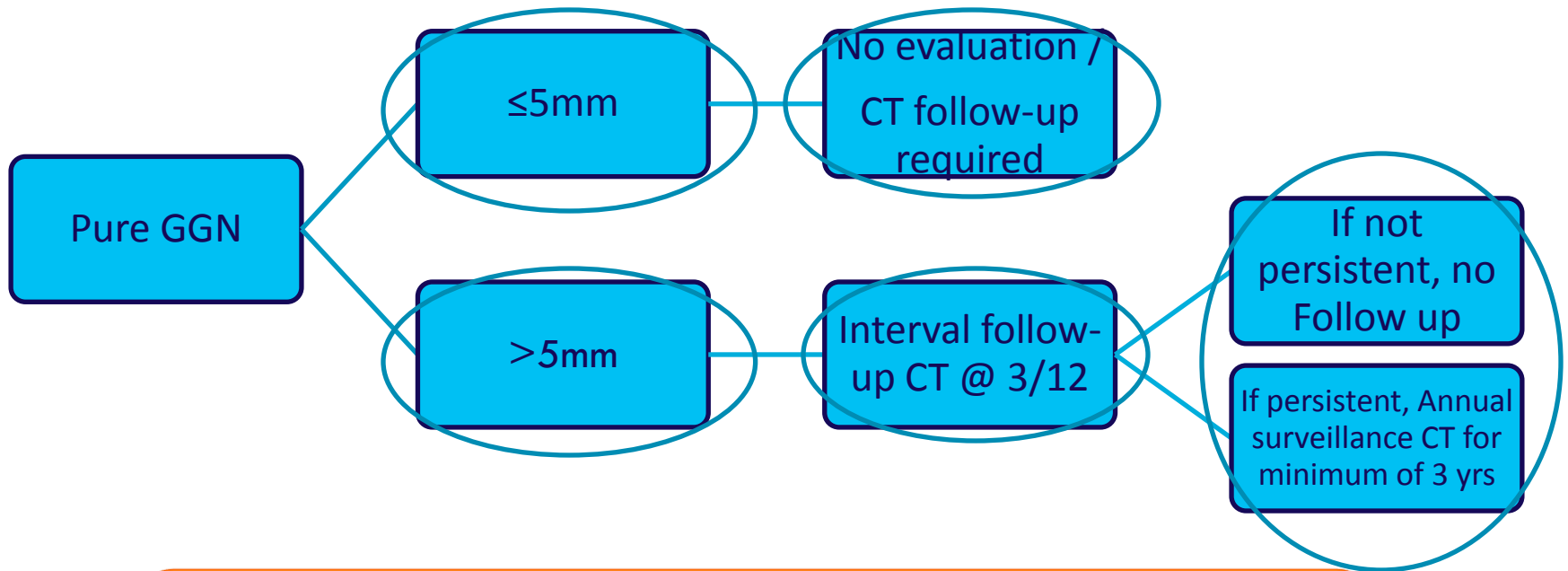
Pure ground glass nodule



Part-solid nodule



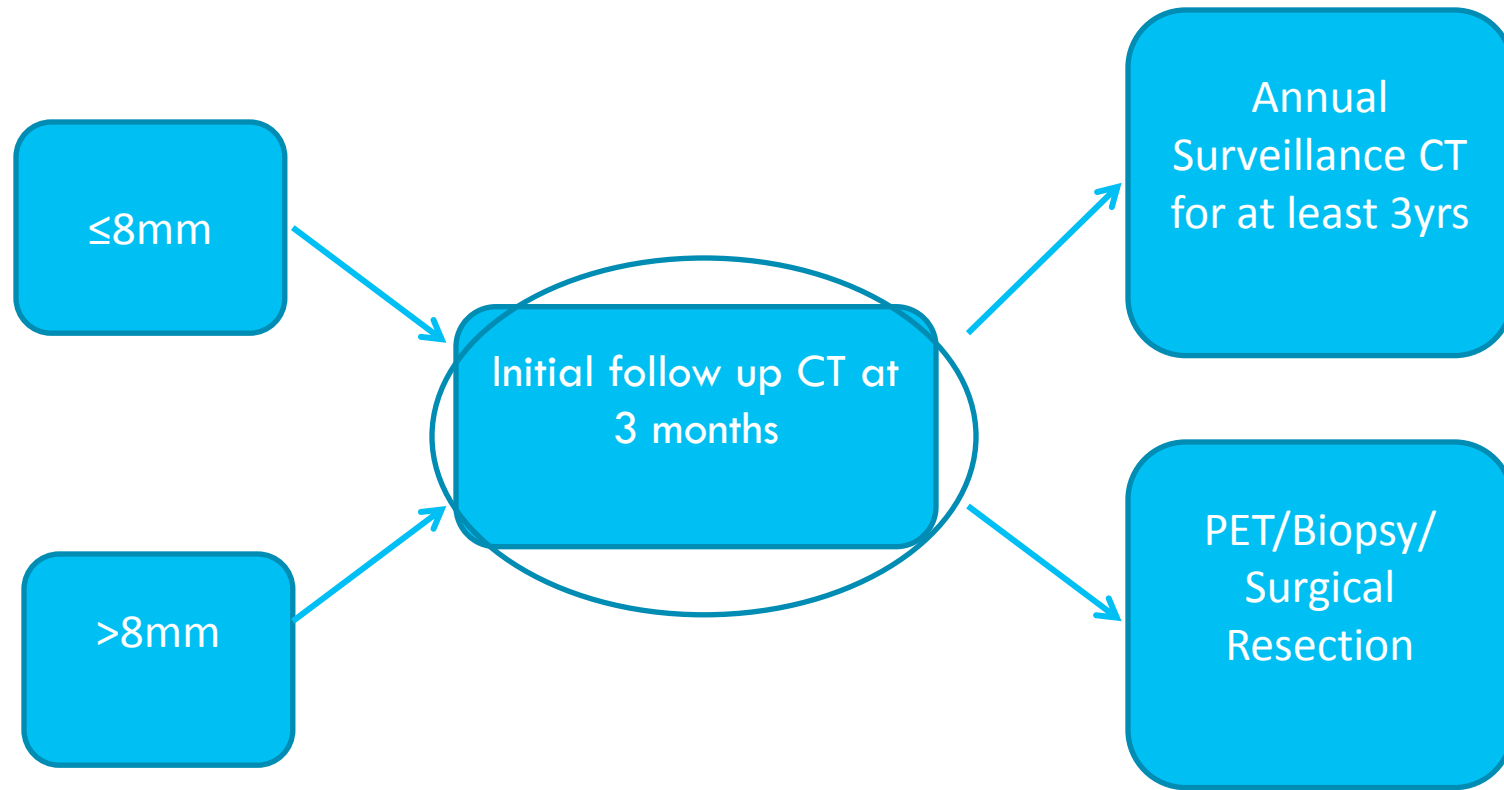
# PURE GROUNDGLASS NODULES



Any increase in size / development of new solid component -> proceed to Evaluation +/- resection



# PART SOLID NODULES



For Part-solid nodules  $\geq 15\text{mm}$  further evaluation with FDG-PET, non-surgical biopsy and/or surgical resection

# Take home message

- Not all pulmonary nodules require further evaluation
- The importance of reviewing old imaging
- The importance of shared decision making
- ACCP guidelines evaluation of pulmonary nodules based on size and attenuation of nodules

**THANK YOU**