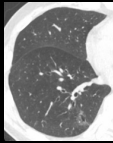


Update on Lung Cancer Screening

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CHESTRAD 2023

A Case Review and Lecture Series
Saturday 15th July - Sunday 16th July - Monday 17th July
27 CPD Points

1

Introduction

- National Lung Screening Trial (US)¹
 - ~53,000
 - 20% reduction lung cancer mortality
 - 7% reduction all-cause mortality
- NELSON Trial (Belgium, The Netherlands)²
 - ~15,000
 - 24% reduction in lung cancer mortality

¹Aberle DR. et al. *NEJM* 2011
²De Koning HJ et al. *NEJM* 2020

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Introduction

- CT lung cancer screening (LCS) has slowly gained traction across the world
- Despite expansion of inclusion criteria, uptake remains low, especially in the US¹
- Australia set to begin LCS by July 2025²

¹Maki KG et al. *JAMA Network Open* 2023
²www.canceraustralia.gov.au May 2023

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Objectives

- Review current recommendations for and status of CT lung cancer screening (LCS)
- Describe the most recent American College of Radiology (ACR) Lung-RADS 2022 update
- Illustrate examples applying Lung-RADS

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Part 1



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LCS Recommendations

	US	Canada	UK	EU	Japan	China
Age	50-80	55-74	55-74	50-75	≥60	50-75
Pack-years	≥20	≥30	Any	≥30	?	≥20
Former smokers	<15 years	Any	Any	<15 years	Yes	<15 years
Never smokers	No	No	No	No	Yes	Yes
Interval	Annual	Annual	2 year	Annual	Annual	Annual

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Current Practices (US)

- Most healthcare systems in the US offer CT LCS
- US Government coverage
 - CMS eligible beneficiaries 50-77 years old
 - Department of Veterans Affairs 50-80 years
- Private insurance
 - Required to offer without copay under Affordable Care Act (“Obamacare”)
 - 50-80 years

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Current Practices (US)

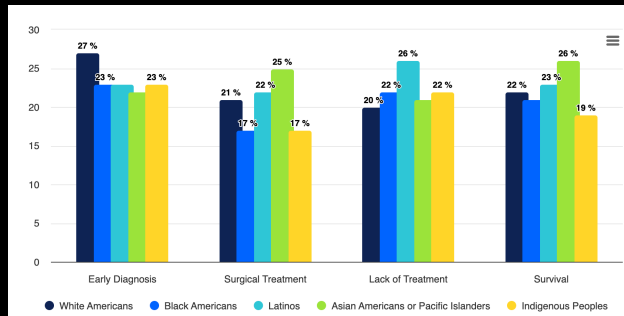
- Uptake is poor out of 14.2 million
- 5.8% of eligible patients
 - California 1%
 - Wisconsin 10%
 - Massachusetts 16.3%



State of Lung Cancer 2022. American Lung Association

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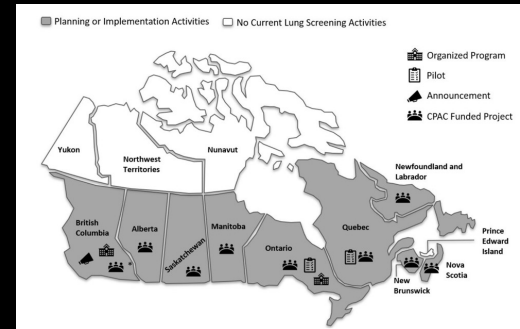
Current Practices (US)



2022 State of Lung Cancer. American Lung Association

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Current Practices (Canada)



Partnership Against Cancer Canada (as of June 2022)

10

Current Practices (Canada)

- British Columbia only province with fully implemented program
- Partially implemented program in Ontario
- Pilot programs in Quebec and Alberta

Partnership Against Cancer Canada (as of June 2022)

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Current Practices (UK)

- NHS program to potentially cover all current and former smokers
- First phase by 2025 (40% of eligible patients)
- Full implementation by March 2030
- LCS CT will be offered 2 years
- Just under 1 million scans annually
- £270 million per year

Department of Health and Social Care - June 2023

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Current Practices (EU)

- Uptake much slower in EU
- Member states are invited to investigate feasibility of CT LCS
- Some pilot programs, mostly in rural areas
- Few national plans

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Current Practices (EU)

Stage of policy development	Belgium	Croatia	France	Germany	Italy	Spain	Poland	Sweden	The Netherlands
1. Recent assessment of evidence (since 2019)	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
2. Economic evaluation to determine cost-effectiveness	Ongoing	No	No	Yes	Yes	No	Yes	Yes	No
3. Local pilot/feasibility studies	Awaiting funding/ approval	No	Ongoing	Ongoing	Ongoing	Small independent studies	Ongoing	Ongoing	Ongoing
4. Commitment to program setup	No	Yes, program ongoing	No	Yes	Yes	No	Yes, program ongoing	In current discussion	No
5. Development of a national screening protocol	Taskforce currently working on this	Yes	No	No	In progress	No	Yes	In progress	Taskforce currently working on this
6. Organizational setup and implementation of national program	No	Yes	No	No	In progress	No	Yes	No	No

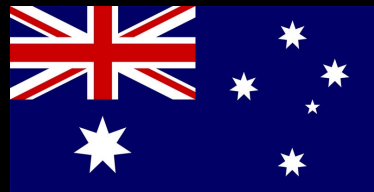
As of February 2022

Wait S et al. *J Thorac Oncol* 2022

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Current Practices (Australia)

- Expected to begin by 2025
- Eligibility
 - 50-70 years
 - 30 pack-years
 - Current smoker or former smoker (quit <10 years)
- Biennial chest CT

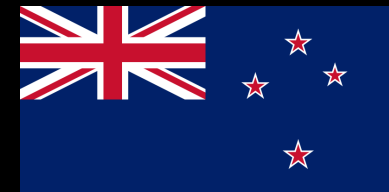


www.canceraustralia.gov.au May 2023

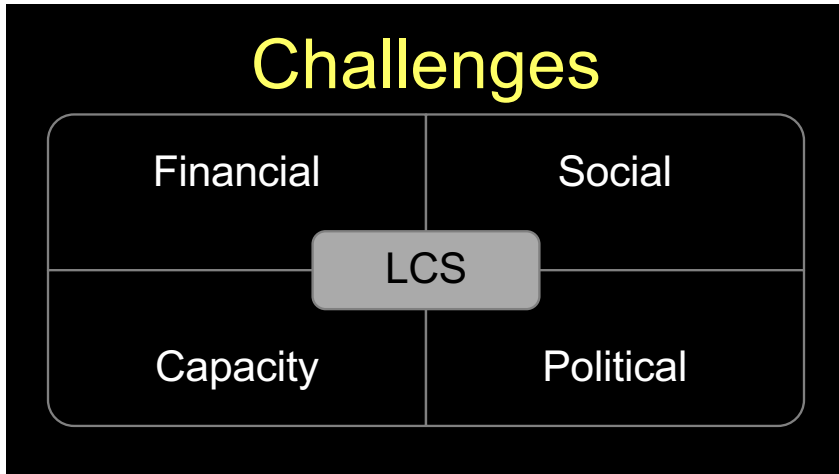
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Current Practices (New Zealand)

- No formal program announced
- Pilot studies and programs announced



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- # Lung-RADS 2022
- Standardize reporting and follow-up
 - Update management based on new data
 - Provide guidance for scenarios not addressed in Lung-RADS 1.x

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Lung-RADS 2022

This slide provides a detailed overview of the Lung-RADS v2022 update. It includes a 'Summary of Changes and Updates' section with a date of November 2022. Below this, there are several sections detailing new classification criteria, such as 'Asymptomatic Cysts', 'Indeterminate Nodules', and 'Inflammatory or Infectious Findings'. A table on the right side of the slide lists the classification categories (1 through 4B) and their corresponding management recommendations. Two QR codes are located at the bottom of the slide.

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Lung-RADS 2022

NOTES	12. Atypical Pulmonary Cyst:
<p>1. Lung-RADS Category: Each exam should be coded 0-4 based on the nodule with the highest degree of suspicion.</p> <p>2. Lung-RADS Management: The timing of follow-up imaging is from the date of the exam being interpreted. For example, 12-month interval (LSDT) for Lung-RADS 3 is from the date of the current exam, not the management of an nodule follows a 3-month approach based upon follow-up stability or decrease in size.</p> <p>3. Prevalence Audit Definition: A prevalent screen is defined as categories 1 and 2; a positive screen is defined as categories 3 and 4. A negative screen does not mean that an individual does not have lung cancer.</p> <p>4. Nodule Measurement: To calculate nodule mean diameter, measure both the long and short axis to one decimal place (mm), and report mean nodule diameter to one decimal point. The long and short axis measurements may be in any plane to reflect the true size of the nodule. Volume or volume change should be reported to the nearest whole number in mL.</p> <p>5. Size Threshold: Apply to nodules at first detection and that enlarge, reaching a higher size category. When a nodule crosses a size threshold for other Lung-RADS categories, even if meeting the definition of growth, the nodule should be reclassified based on size and managed accordingly.</p> <p>6. Growth: An increase in mean diameter size of ≥ 1.5 mm (≥ 2 mm) within a 12-month interval.</p> <p>7. Slow Growing Non Solid (Ground Glass) Nodule: A ground glass nodule (GGN) that demonstrates growth over multiple screening exams but does not meet the ≥ 1.5 mm threshold increase or size for any 12-month interval may be classified as Lung-RADS 2, with the nodule means findings criteria of another category, such as developing a solid component (then manage per part solid nodule criteria).</p> <p>8. Slow Growing Solid or Part Solid Nodule: A solid or part solid nodule that demonstrates growth over multiple screening exams but does not meet the ≥ 1.5 mm threshold increase in size for any 12-month interval is suspicious and may be classified as Lung-RADS 4B. Slow growing nodules may not have increased metabolic activity on PET-CT; therefore, biopsy, if feasible, or surgical resection may be the most appropriate management recommendation.</p> <p>9. Post Exam: If testing or prior exams (after a prior screening or diagnostic CT), the Lung-RADS 0 category is temporary until the comparison study is available and a new Lung-RADS category is assigned.</p> <p>10. Suspected Infectious or Inflammatory Findings:</p> <ul style="list-style-type: none"> Lung-RADS 0 with 12-month follow-up (LSDT) may be recommended for pulmonary findings suggesting an indeterminate infectious or inflammatory process. Such findings may include segmental or lobar consolidation, multiple new nodules (more than three), tree-in-bud pattern, or 3+ millimetric nodules, and new nodules in certain clinical contexts (e.g. immunocompromised patient). At 12-month follow-up, a new Lung-RADS classification and management recommendation should be provided based on the most suspicious nodule. New solid or part solid nodules with imaging features more concerning for malignancy than an infectious or inflammatory process meeting Lung-RADS 4B are criteria may be classified as such with appropriate diagnostic and/or clinical evaluation. Some findings indicative of an infectious or inflammatory process may not warrant short-term follow-up (e.g. tree-in-bud nodules or new ≥ 3 millimetric ground glass nodules). These nodules may be resolved using existing criteria with a Lung-RADS classification and management recommendation based on the most suspicious finding. <p>11. Airway Nodule:</p> <ul style="list-style-type: none"> Endobronchial or endobronchovascular abnormalities that are segmental or more proximal are classified as Lung-RADS 4A. Subsegmental and/or multiple bilateral endobronchovascular abnormalities (even if underlying obstructive nodule is identified, these lesions may be classified as Lung-RADS 0 (purely infectious or inflammatory) or 2 (benign). The presence of air in segmental or more proximal airways (even if associated with secretions), if not underlying soft tissue nodule is identified, these findings may be classified as Lung-RADS 2. Segmental or more proximal airway nodules that persist on 3-month follow-up CT are upgraded to Lung-RADS 4B with 	<p>a. Thin-walled Cyst: Unilocular with uniform wall thickness < 2 mm. Thin-walled cysts are considered benign and are not classified as malignancy in Lung-RADS.</p> <p>b. Thick-walled Cyst: Unilocular with uniform wall thickness, asymmetric wall thickening, or nodular wall thickening > 2 mm (spic component) is the dominant feature; manage as an atypical pulmonary cyst.</p> <p>c. Multilocular Cyst: Thick or thin-walled cyst with internal septations. Manage as an atypical pulmonary cyst.</p> <p>d. Cavitory Nodule: Wall thickening is the dominant feature; manage as a solid nodule (total mean diameter).</p> <p>e. Cyst with an Associated Nodule: Any cyst with adjacent internal (endophytic) or external (exophytic) nodule (solid, part-solid, or ground glass). Management is based upon Lung-RADS criteria for the most concerning feature.</p> <p>f. Growth: ≥ 1.5 mm increase in nodule size (mean diameter), wall thickness, and/or size of the cystic component (mean diameter) occurring within a 12-month interval.</p> <p>g. Fluid-containing cysts may represent an infectious process and are not classified in Lung-RADS unless other concerning features are identified.</p> <p>h. Multiple cysts may indicate an alternative diagnosis such as Langerhans cell histiocytosis, LCH or lymphangioleiomyomatosis (LAM) and are not classified in Lung-RADS unless other concerning features are identified. (Reference: Saban R, Mays CA, Olson WJ, McCoskey TK. Cystic Lung Disease at High-Resolution CT. AJR. 2016;196:1309-1317)</p> <p>13. Category 4B: Management is predicated on clinical evaluation (comorbidity), patient preference, and risk of malignancy. Subdiagnosis are encouraged to use the M-Check, or an Assessment tool when making recommendations. (https://www.aacr.org/cancer-screening-and-risk-assessment-tool/)</p> <p>14. Category 4C: Category 3 or 4 nodules with additional imaging findings that increase the suspicion of lung cancer, such as consolidation, lymphadenopathy, bronchovascular disease, a GGN that doubles in size in 1 year, etc. It is a distinct Lung-RADS category. X should not be used as a modifier.</p> <p>15. Exam Modifier: An S modifier may be added to Lung-RADS categories 0-4 for clinically significant or potentially clinically significant findings unrelated to lung cancer.</p> <p>16. Exam Modifier: An I modifier may be added to Lung-RADS categories 0-4 for clinically significant or potentially clinically significant findings unrelated to lung cancer.</p> <p>17. Management: should adhere to available ACR Incidental Findings management recommendations. (https://www.acr.org/Clinical-Resources/Incidental-Findings). The ACR Lung Cancer Screening CT Incidental Findings Quick Reference Guide summarizes common findings and management. (https://www.acr.org/clinical/CurrentGuidelines/LungCancerScreening/Reporting/ICIF/Incidental-Findings-Quick-Reference.pdf)</p> <p>18. Findings that are already known: and have been or are in the process of clinical evaluation DO NOT require an S-modifier. Any evidence of a concerning change in a known significant or potentially significant finding that is unexpected warrants renewed use of the S-modifier.</p> <p>19. Lung Cancer Diagnosis: Once a patient is diagnosed with lung cancer, further management (including additional imaging such as PET/CT) may be performed for purposes of lung cancer staging; this is no longer considered screening.</p> <p>Abbreviations: LSDT: low dose chest CT; GGN: ground glass nodule Additional resources available at: https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/Lung-RADS</p>

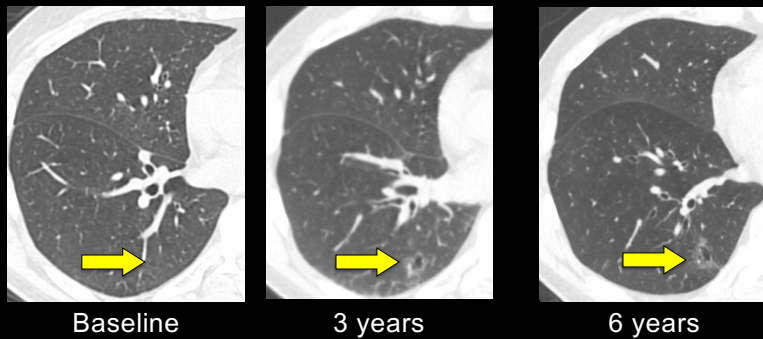
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New Classification Criteria

- Atypical pulmonary cysts
- Juxtapleural nodules
- Inflammatory or infectious nodules
- Airway nodules

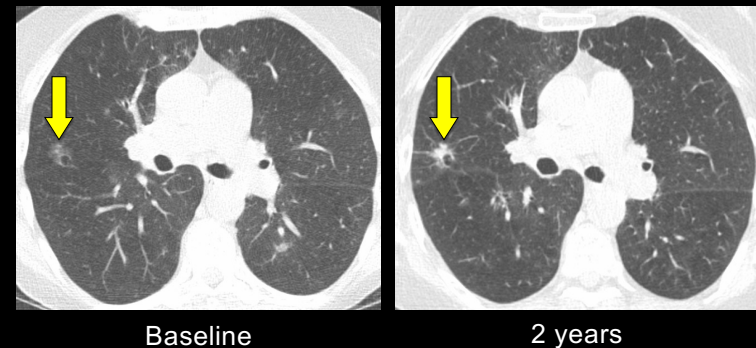
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Atypical Pulmonary Cysts



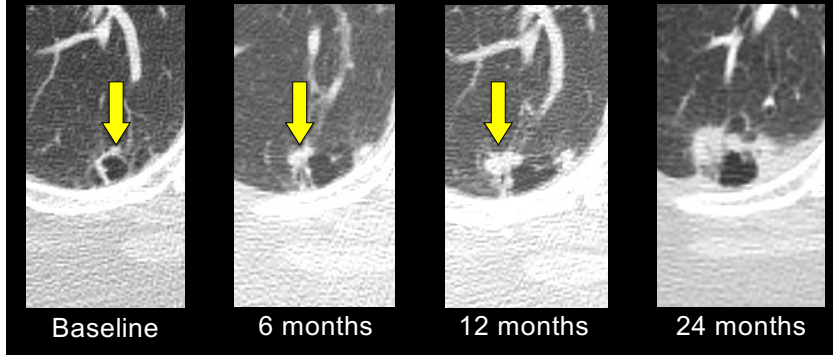
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Atypical Pulmonary Cysts



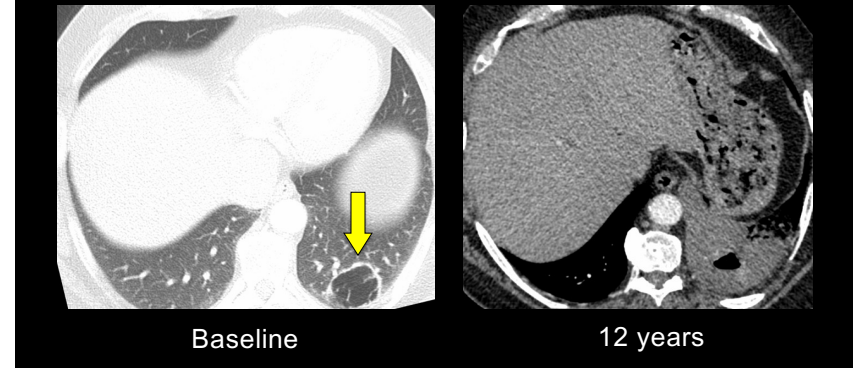
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Atypical Pulmonary Cysts



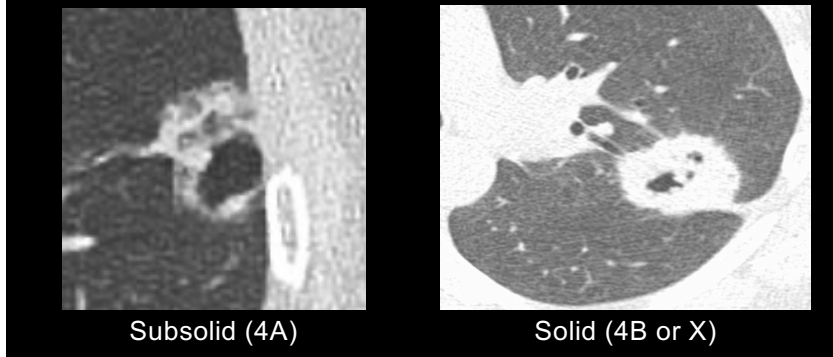
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Atypical Pulmonary Cysts



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Atypical Pulmonary Cysts



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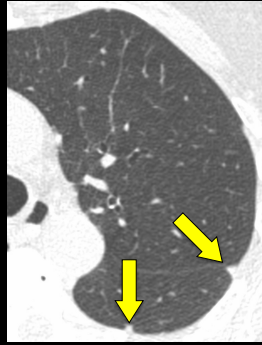
Atypical Pulmonary Cysts

Morphology or behavior	Lung-RADS category
Previously stable thick-walled cyst with a growing cystic component	3
Thick-walled (≥ 2 mm) or multilocular cysts	4A
Growing thick-walled or multilocular cysts as well as multilocular cysts with increased loculation or density	4B
Unilocular thin-walled cysts	N/A
Cavitary nodules (soft tissue > cystic)	Solid nodule criteria

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Juxtapleural Nodules

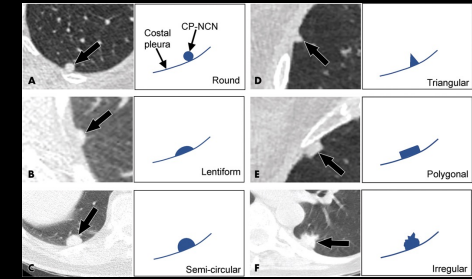
- Size and composition criteria applied to perifissural nodules in Lung-RADS v1.1
- Can safely be applied to all juxtapleural nodules
 - Perifissural
 - Costal pleural
 - Perimedial, Peridiaphragmatic



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Juxtapleural Nodules

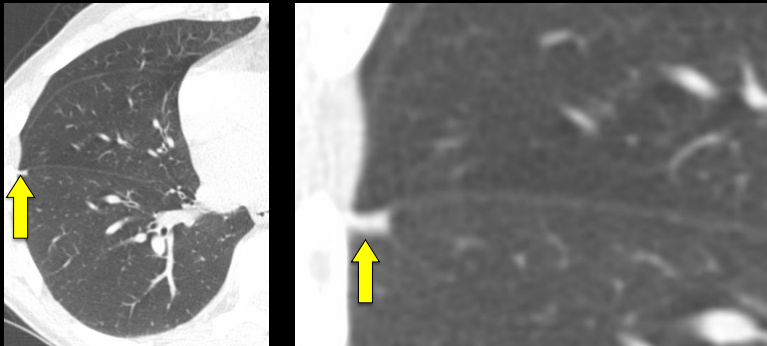
- Solid
- ≤ 10 mm mean diameter
- Smoothly margined
- Triangular, lentiform, or ovoid



Zhu Y et al. *Radiology* 2020

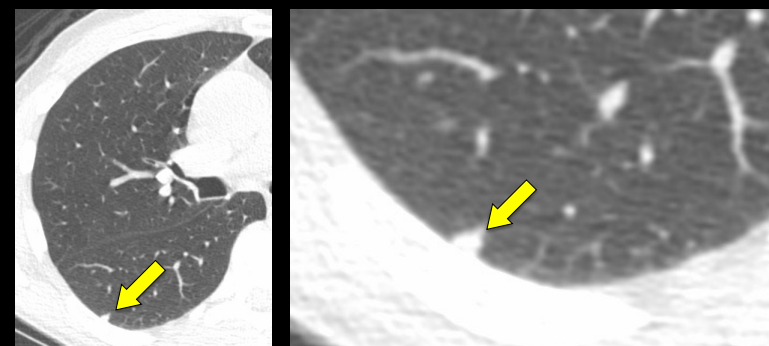
30

Juxtapleural Nodules



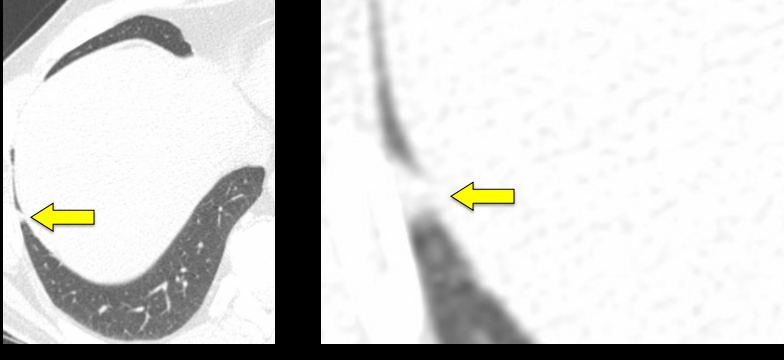
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Juxtapleural Nodules



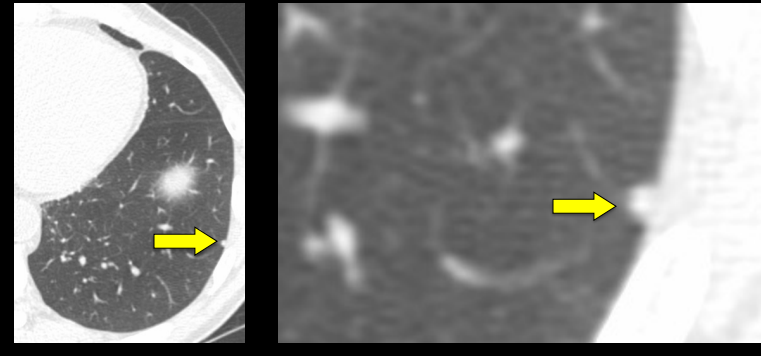
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Juxtapleural Nodules



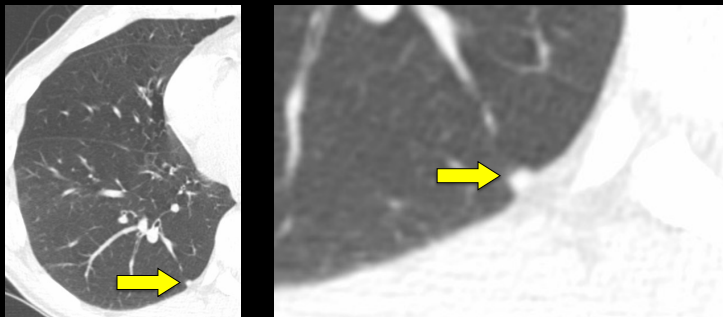
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Juxtapleural Nodules



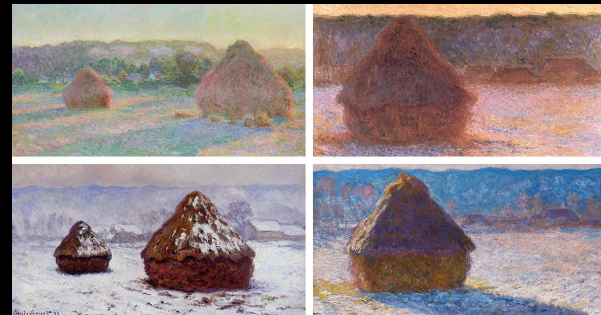
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Juxtapleural Nodules



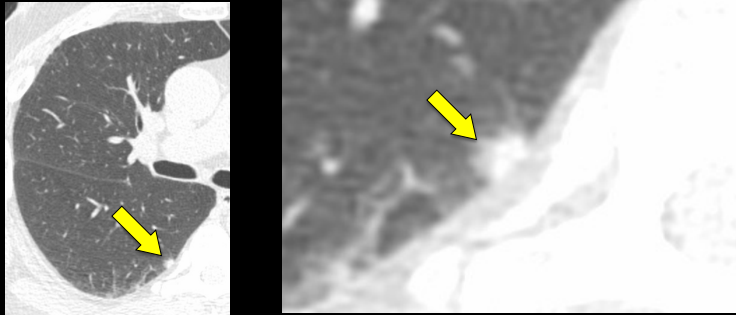
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Juxtapleural Nodules



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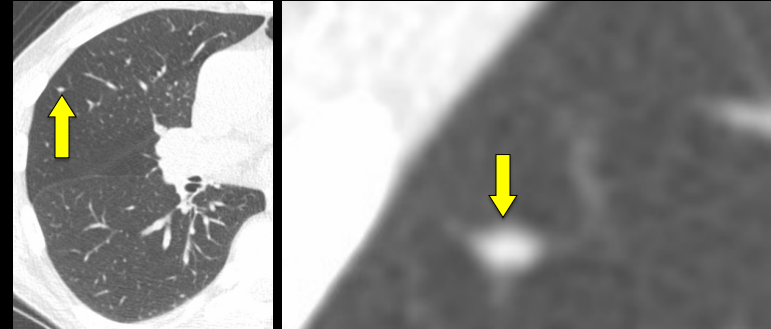
Juxtapleural Nodules



This should *not* be counted as a juxtapleural nodule because of shape

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Juxtapleural Nodules



Perivenous nodules are not specified in Lung-RADS 2022

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Inflammatory or Infectious

- Segmental or lobar consolidation
- Multiple new nodules (>6)
- Large solid nodules (≥ 8 mm) appearing in a short interval
- New nodules in certain clinical contexts
- Category 0

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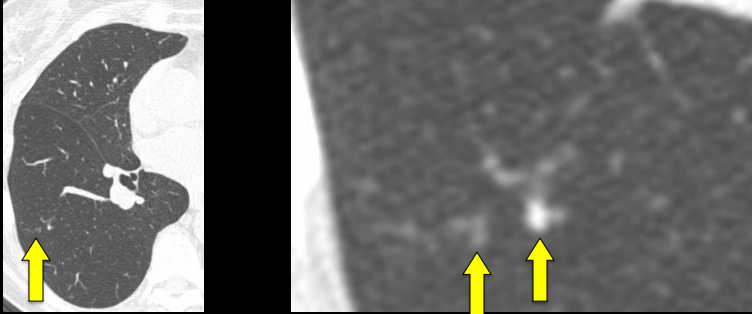
Inflammatory or Infectious

- Findings such as tree-in-bud nodules that are most likely infectious or inflammatory without concern for underlying malignancy.
- Category 2



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Inflammatory or Infectious



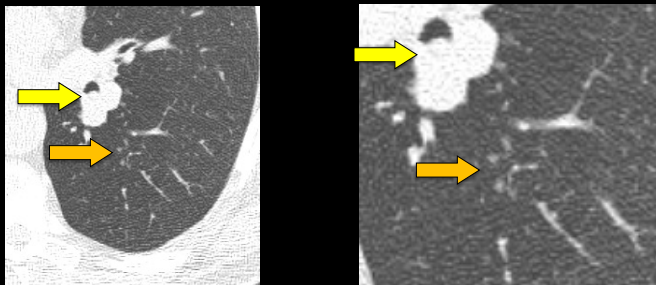
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Inflammatory or Infectious

- New findings where the concern for malignancy is greater than an infectious or inflammatory process should be classified and managed based on nodule size and composition criteria.

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Inflammatory or Infectious



Lung-RADS 2 or 4A?

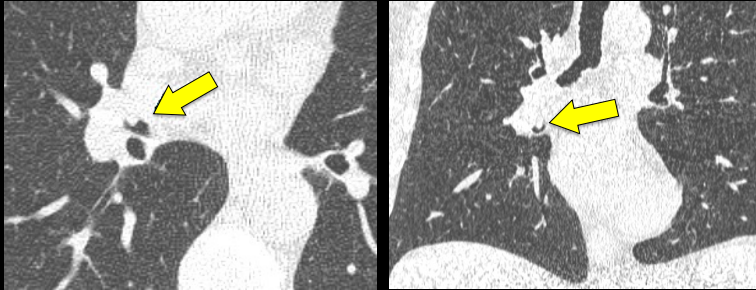
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Airway Nodules

Morphology	Lung-RADS category
Subsegmental airway nodules Any airway nodule with features favoring a benign process (mucus)	2
Solid endotracheal or endobronchial nodule that is segmental or more proximal	4A
Persistent endotracheal or endobronchial 4A lesions at 3-month LDCT	4B (bronchoscopy)
Subsegmental and/or multiple tubular endobronchial abnormalities favor an infectious process.	0 or 2

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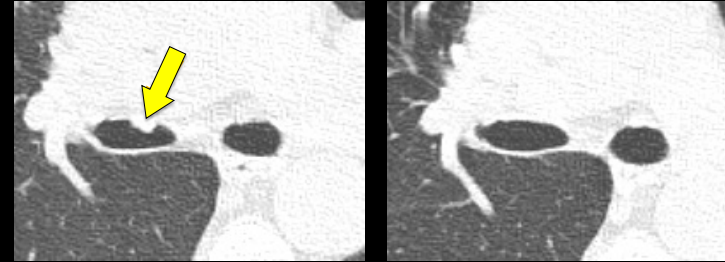
Airway Nodules



Lung-RADS 4A

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Airway Nodules



Baseline
Lung-RADS 4A → 2

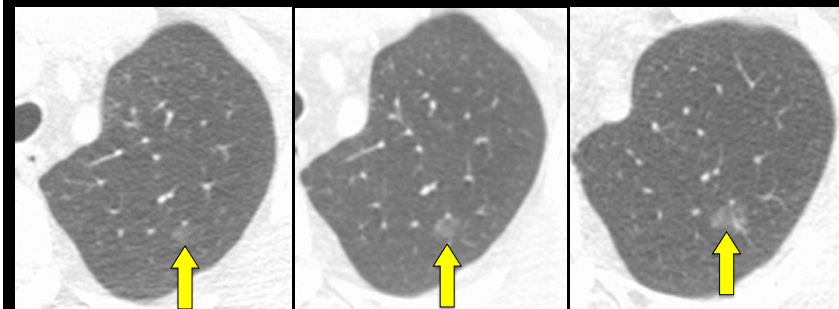
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Growth Definitions

Term	Definition	Category
Nodule growth	>1.5 mm increase mean diameter in <i>any</i> dimension over 12 months	4A, 4B, 4X
Slowly-growing solid or part-solid nodules	Growth over multiple screening exams but not meeting the >1.5 mm increase in size for any 12-month interval	4B
Slowly growing ground-glass nodules	Growth over multiple screening exams but not meeting the >1.5 mm increase in size for any 12-month interval	2

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Growth



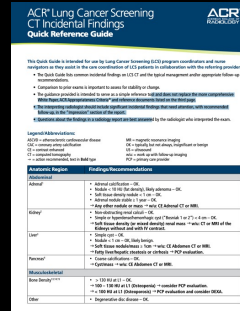
Baseline 2 years later 4 years later

Martin MD et al. *Radiographics* 2017

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S Modifier

- Specific recommendations per ACR Incident Findings publications
- Known incidental findings do not require S modifier



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Summary

- Adoption of CT LCS has been slow with only full implementation in the US and China.
- Patient uptake is less than robust for a host of reasons.
- Standardized reporting and management is key to optimizing the benefits of LCS and minimizing costs.

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