Why IPN Programs are Needed Now More Than Ever

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Disclosures

- Consultant and Speaker, Lung Ambition Alliance
- Member, Clinical Advisory Board, Imidex
- Member, Scientific Advisory Board, GO2 Foundation for Lung Cancer
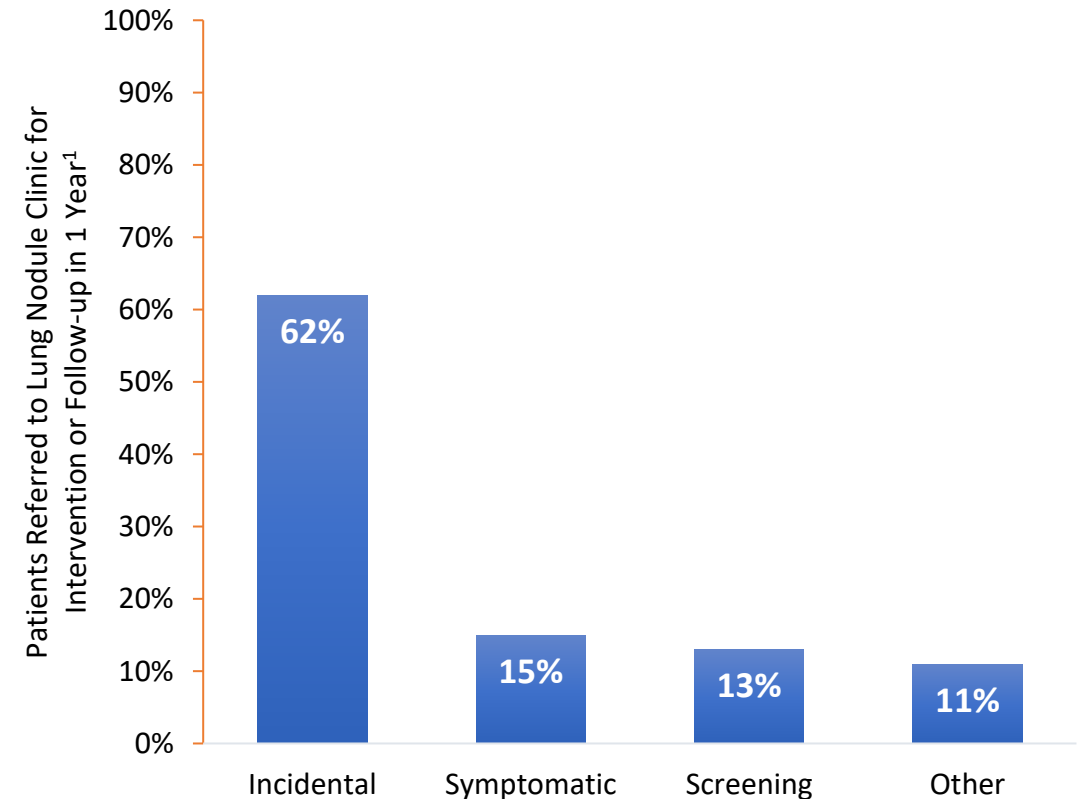
Objectives

- Review incidence and significance of IPNs
- Outline challenges and opportunities in monitoring IPNs
- Describe Nodule Tracking System and Lung Nodule Registry at National Jewish Health
- Discuss how an Incidental Pulmonary Nodule Program and LCS can improve the early detection of lung cancer

Why Now?

- Outlook for lung cancer has improved dramatically over the last 5 years due to screening and treatment advances
- Lung Cancer still remains the #1 cancer killer
- Identifying lung cancer earlier is cost effective
- Lung cancer screening only reaches a small part of the population
- More and more cancers are bring identified in people who have formerly smoked or never smoked
- We know how to manage lung nodules but need better systems in place for managing follow-up
- Clinicians are now more comfortable with the idea of follow-up CT and not immediate work-up
- Effective IPN Programs can result in stage shift to earlier stage lung cancers

The Majority of Lung Nodules Are Incidentally Detected[1]

- In one study of 665 lung nodules[1,a]
  - 62% of lung nodules were incidentally detected on thoracic CT imaging for trauma, cardiac symptoms, or abdominal symptoms[1]
  - 15% were found In patients with symptoms attributed to lung disease[1]
  - 13% were identified in patients who qualified for annual LDCT screening[1,2,b]

Bar chart. Y-axis: Patients Referred to Lung Nodule Clinic for Intervention or Follow-up in 1 Year[1] (0%–100%). Incidental: 62%; Symptomatic: 15%; Screening: 13%; Other: 11%.

- 1. LeMense GP, et al. *BMC Pulm Med*. 2020;20(1):115. 2. Moyer VA. U.S Preventative Services Task Force. *Ann Intern Med*. 2014;160(5):330-338. 3. Gould MK, et al. *Am J Respir Crit Care Med*. 2015;192(10):1208-1214.

Incidental Pulmonary Nodules Are Rarely Followed Up Despite the Potential Benefits for Early Identification of Lung Cancers

Approximately **2 out of 3 patients** with incidentally detected pulmonary nodules **receive no clinical follow-up**[1-3]
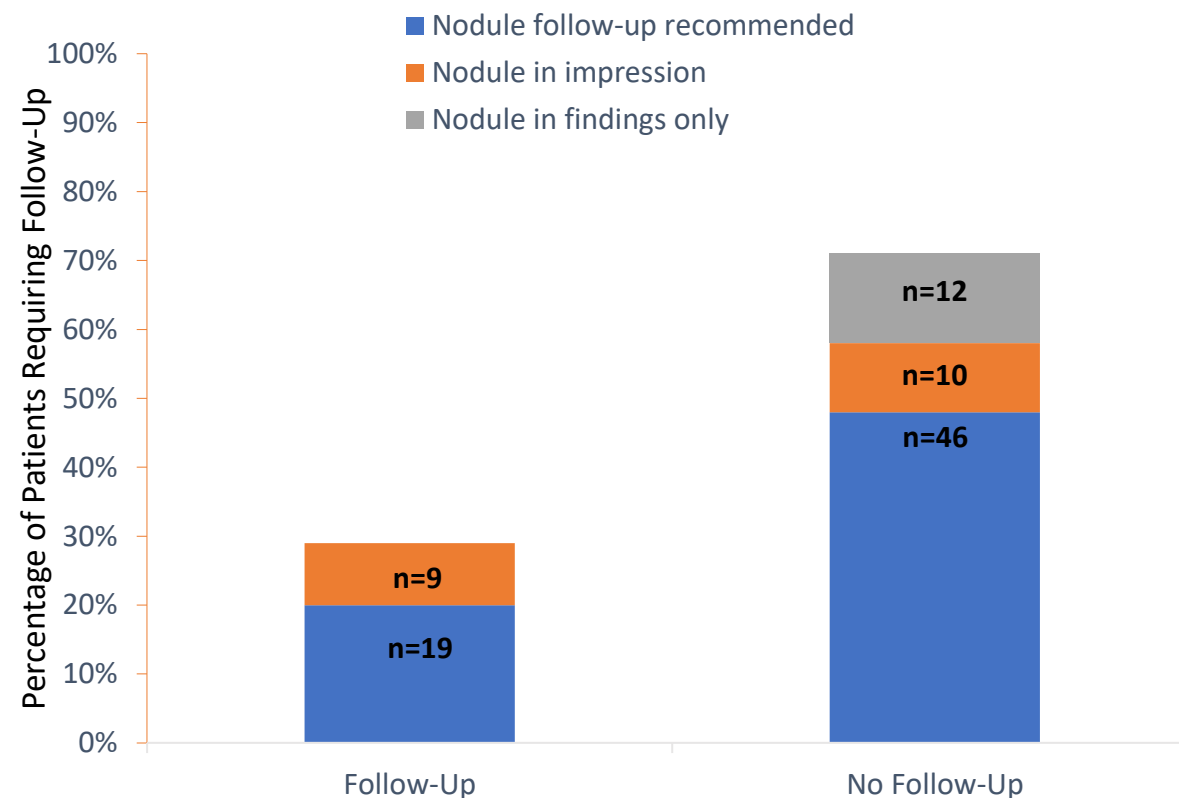
0% follow-up has been observed when incidental nodules are **mentioned only in the findings section** of the radiology report[3]

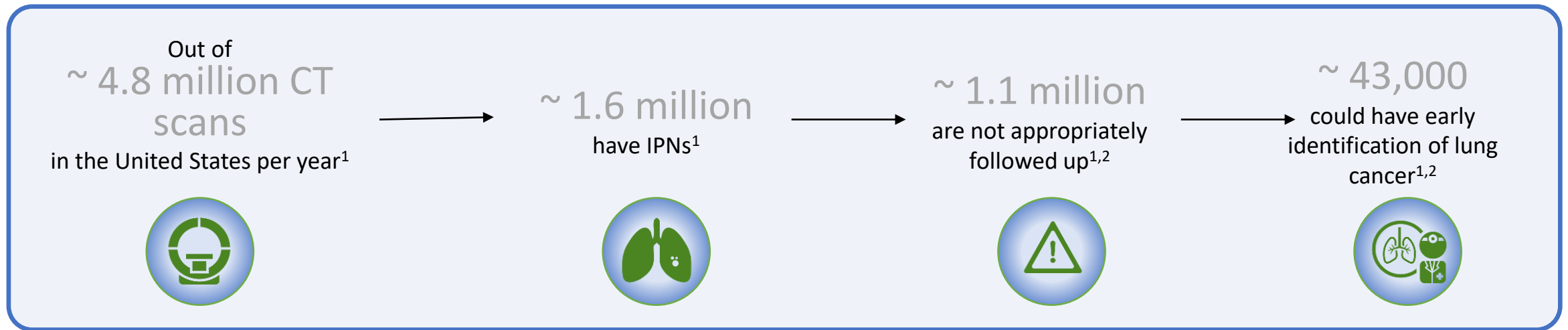In 1 large study, the **mean time** from initial diagnosis of a pulmonary nodule **to first workup** was 8 months[2]

Follow-up by Description of Incidental Nodule in Radiology Reports (n=96)[3]

- Nodule follow-up recommended
- Nodule in impression
- Nodule in findings only

Percentage of Patients Requiring Follow-Up

Follow-Up: n=19 (Nodule follow-up recommended), n=9 (Nodule in impression)

No Follow-Up: n=46 (Nodule follow-up recommended), n=10 (Nodule in impression), n=12 (Nodule in findings only)

1. McDonald JS, et al. *Acad Radiol*. 2017;24(3):337-344. 2. Pyenson BS, et al. *J Health Econ Outcomes Res*. 2019;6(3):118-129. 3. Blagev DP, et al. *J Am Coll Radiol*. 2014;11(4):378-383.

Estimations Indicate That Improved Incidental Nodule Follow-Up Is Needed

- Based on the low rate of follow-up of incidental pulmonary nodules, we can estimate several lung cancer cases are missed at early-stage disease[1,2]

- 41% of NSCLC cases are identified at Stage IV disease, with a 5-year survival rate between <1% and 10%, while Stage IA disease has an incidence of 14% and can have a 5-year survival rate of up to 92%[3,4]

Out of
~ 4.8 million CT scans
in the United States per year[1]

→ ~ 1.6 million
have IPNs[1]

→ ~ 1.1 million
are not appropriately followed up[1,2]

→ ~ 43,000
could have early identification of lung cancer[1,2]

If follow-up was organized and consistent, more early-stage lung cancers could be identified
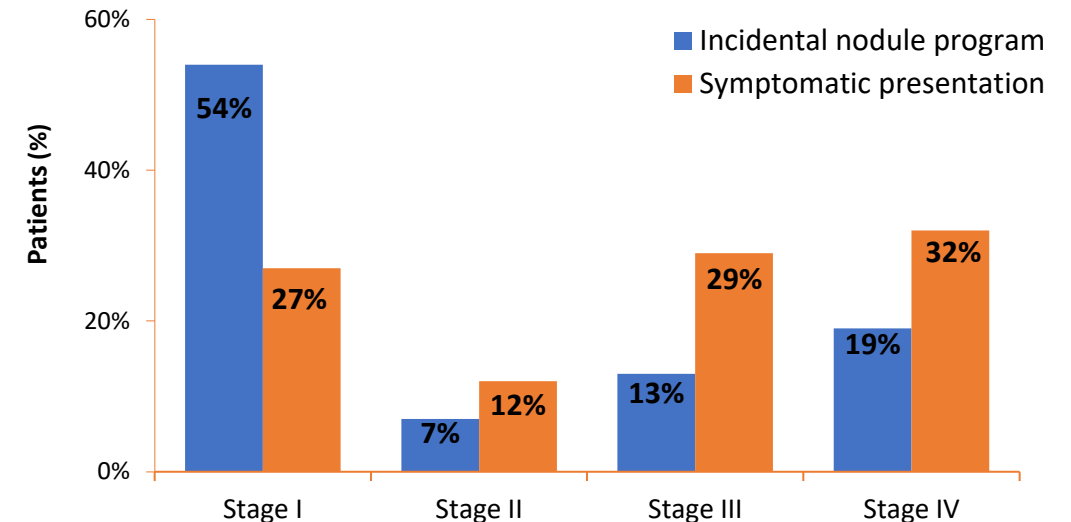
Follow-up of Patients With Incidental Nodule Findings Increases Early-Stage Diagnoses[1]

Detection of **incidental nodules** on chest CT scans are common and **occur in ≈30% of all scans**[2]

Of an estimated **1.6 million patients with an incidental nodule** detected by chest CT scan in the US in 2010, **>63,000** received a **new lung cancer diagnosis within 2 years**[2]

Incidental Nodule Program Increased the Rate of Stage I Lung Cancer Diagnosis vs Symptomatic Presentation[a] (2016-2018)[1]

Bar chart. Y-axis: Patients (%), 0% to 60%. Legend: Incidental nodule program (blue), Symptomatic presentation (orange).
- Stage I: 54% (blue), 27% (orange)
- Stage II: 7% (blue), 12% (orange)
- Stage III: 13% (blue), 29% (orange)
- Stage IV: 19% (blue), 32% (orange)

Robust management and follow-up of incidental nodules can lead to diagnosis of early-stage lung cancer in individuals who would not otherwise be considered high risk[1]

- [a]Symptomatic patients evaluated by a multidisciplinary committee.
- CT, computed tomography; US, United States.

- 1. Unpublished data shared with permission. Multidisciplinary Thoracic Oncology Program, Baptist Memorial Healthcare, Memphis, TN. 2. Gould MK, et al. *Am J Respir Crit Care Med*. 2015;192(10):1208-1214.

Stage Shift with Comprehensive IPN Program

LeMense GP, et al. *BMC Pulm Med*. 2020;20(1):115.
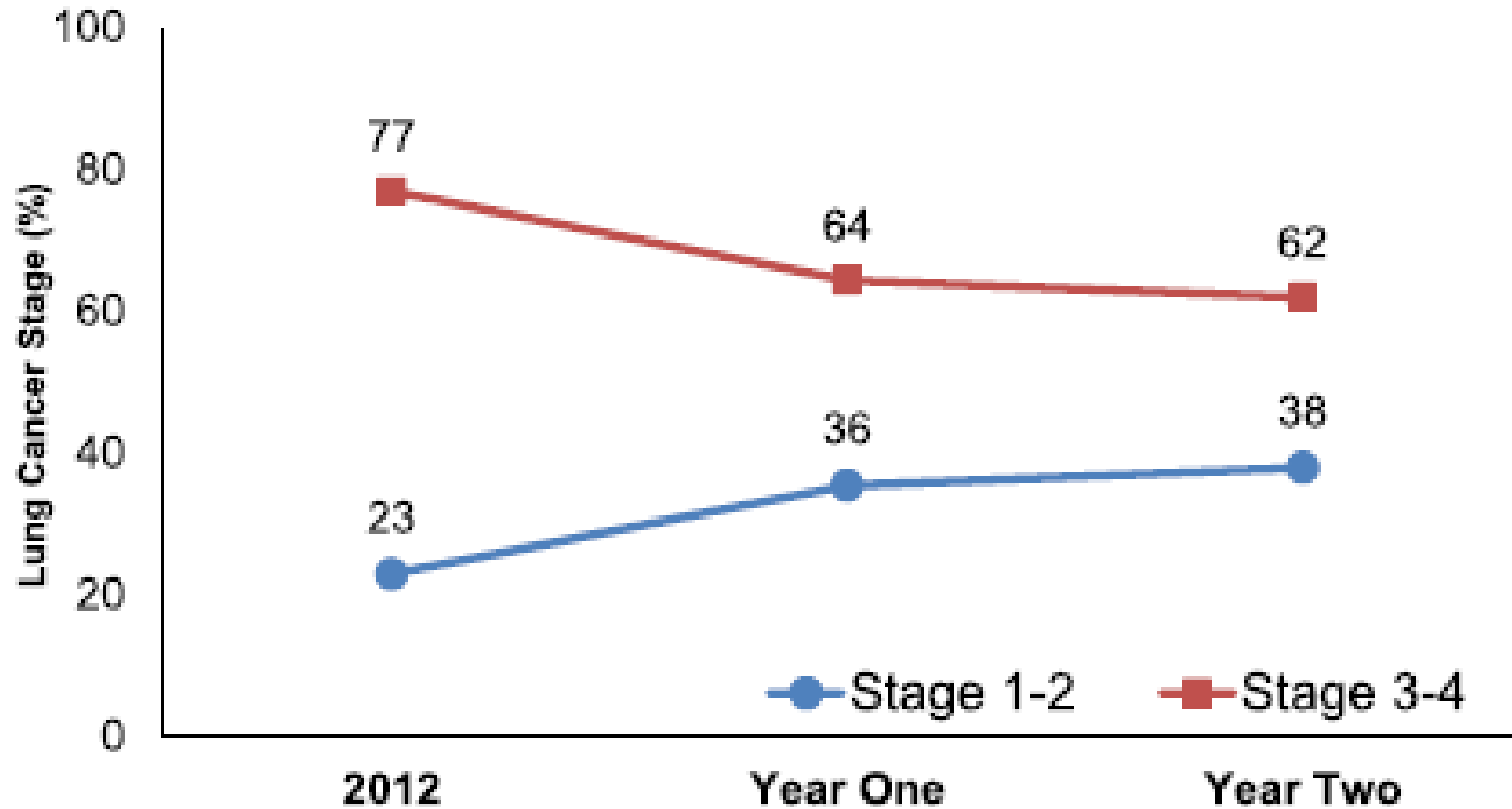
Incidental Nodule Follow-up

- Studies show that adequate lung nodule follow-up ranges from 29% to 39%
- There is considerable variation among radiologists in how they report and manage incidental nodules
- Follow-up is less likely to happen:
  - When incidental nodules are mentioned only in the findings section of the radiology report and not in the Impression
  - When there is no convenient infrastructure embedded in dictation systems for radiologists to indicate follow-up recommendations
- Without clear concise guidance from the radiologist, clinicians are relying more and more on Natural Language Processing software to identify suspicious nodules
- Radiologists can adopt a standardized approach to nodule reporting & tracking and provide a valuable front-end to an Incidental Nodule Program

Pyenson BS, et al. *J Health Econ Outcomes Res*. 2019;6(3):118-129.; Blagev DP, et al.. *J Am Coll Radiol*. 2014;11(4):378-383.;

McDonald JS, et al. *Acad Radiol*. 2017;24(3):337- 344.

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IPN Programs

Advantages	Challenges
CT already done	Numerous referring providers including ER
No "Eligibility" criteria	No pre-imaging commitment to diagnosis and treatment
Routine Chest CTs and CTAs	Often no dedicated staff or resources
Very high volume performed	Need system for tracking follow-up
High yield due large volume	
Established guidelines available (Fleischner)	

IPN Management Program at National Jewish Health

- Development of Tracker phrase system based on Fleischner Society guidelines
- Radiologists provide Tracker phrases at the end of their reports which initiates the tracking process
- Tracker phrases are imported into NJH Lung Nodule Registry
- The Registry monitors patient compliance with needed follow-up
- Patients with suspicious nodules are reviewed at weekly Suspicious Nodule Conference

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Lung Nodule Registry Process

- Registry is facility-built SQL database

- Imports Tracker phrases from radiology reports

- Determines patient's lung cancer risk (high or not high) based on EHR data

- Calculates due date for follow-up CT

- Generates monthly report of patients who are one month overdue for follow-up CT

- Reminder letter generated to patient with copy sent to referring provider

Menu of Tracker Phrases based on 2017 Fleischner Society Guidelines

For CT Follow-up:

- Track 3
- Track 6
- Track 12
- Track ad hoc

For Other Actions:

- Track Dx
- Track Complete
- Track Amend

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Sample Tracker Phrases

Voice Command	Cryptic Phrase	Print out on CT looks like this:
Track 3	(Track 3)	Reduced-dose Chest CT is recommended in 3 months
Track 12	(Track 12)	Reduced-dose Chest CT is recommended in 12 months
Track Diagnostic	(Track Dx)	Diagnostic studies such as PET-CT or tissue sampling are recommended. If such studies are not clinically indicated or feasible, reduced dose Chest CT is recommended in 3 months.
Track Complete	(Track Complete)	Further follow-up of the lung nodules(s) is not recommended at this time.

IMPRESSION:

1. Mild emphysema compatible with smoking related lung disease.
2. 8.5 mm solid nodule in the left lower lobe. Recommend follow-up chest CT in 3 months.

LUNG NODULE RECOMMENDATION (**Track3**)(for NJH Patient Tracking System)
The recommendation for follow-up interval is based on Fleischner Society guidelines. Clinical indications may supersede the recommendations.

Recommend reduced-dose chest CT in 3 months.

Track Dx

- The radiologists flag nodules as suspicious for malignancy with the use of "Track Dx"

- CTs assigned this phrase indicate the need for immediate work-up such as PET-CT, biopsy, or surgical referral

- The patients are automatically referred to weekly Multidisciplinary Suspicious Nodule Conference

- Approximately 30% of Track Dx nodules are diagnosed with lung cancer
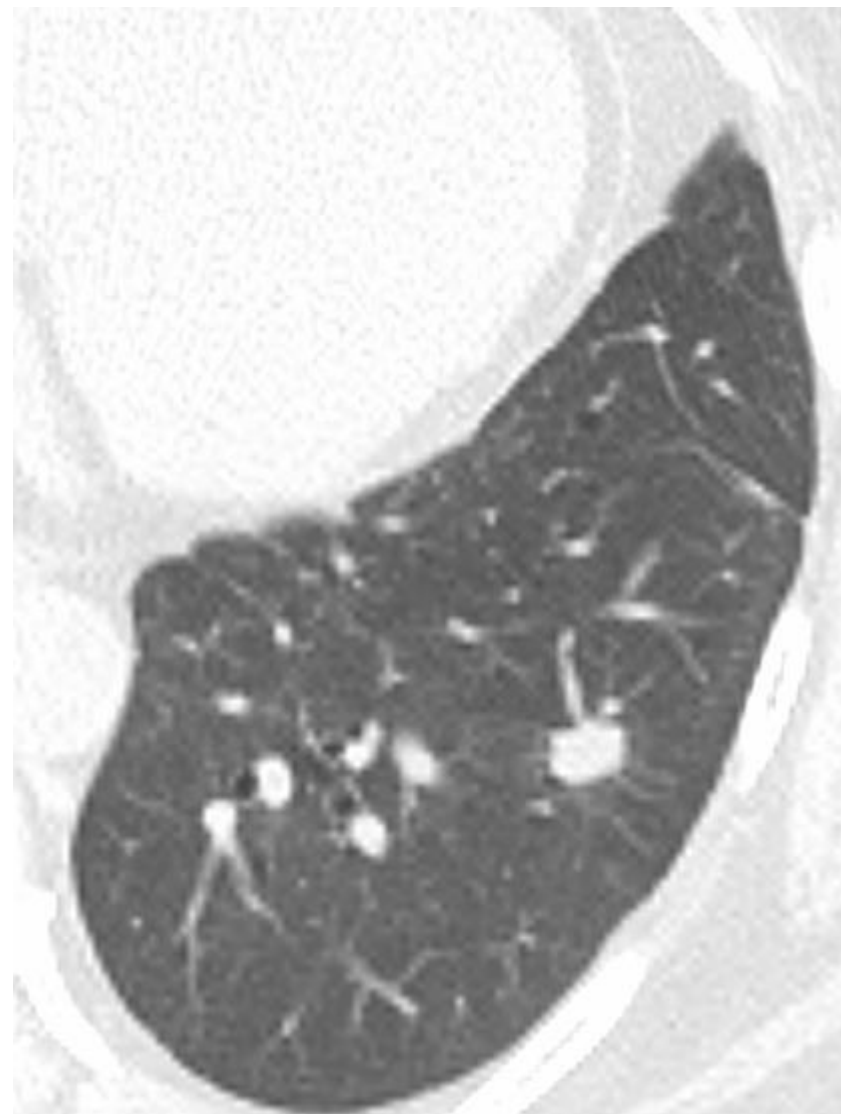
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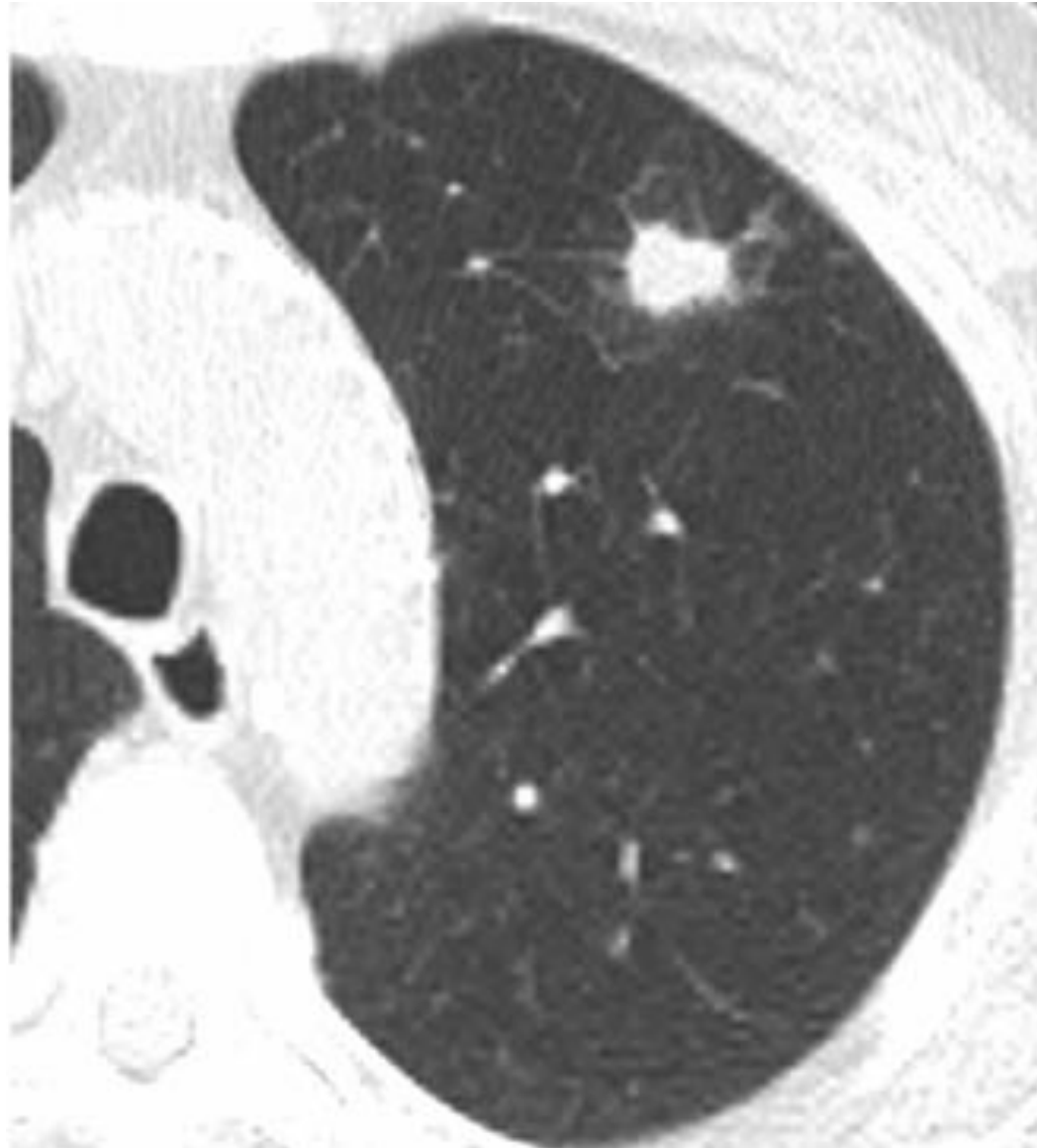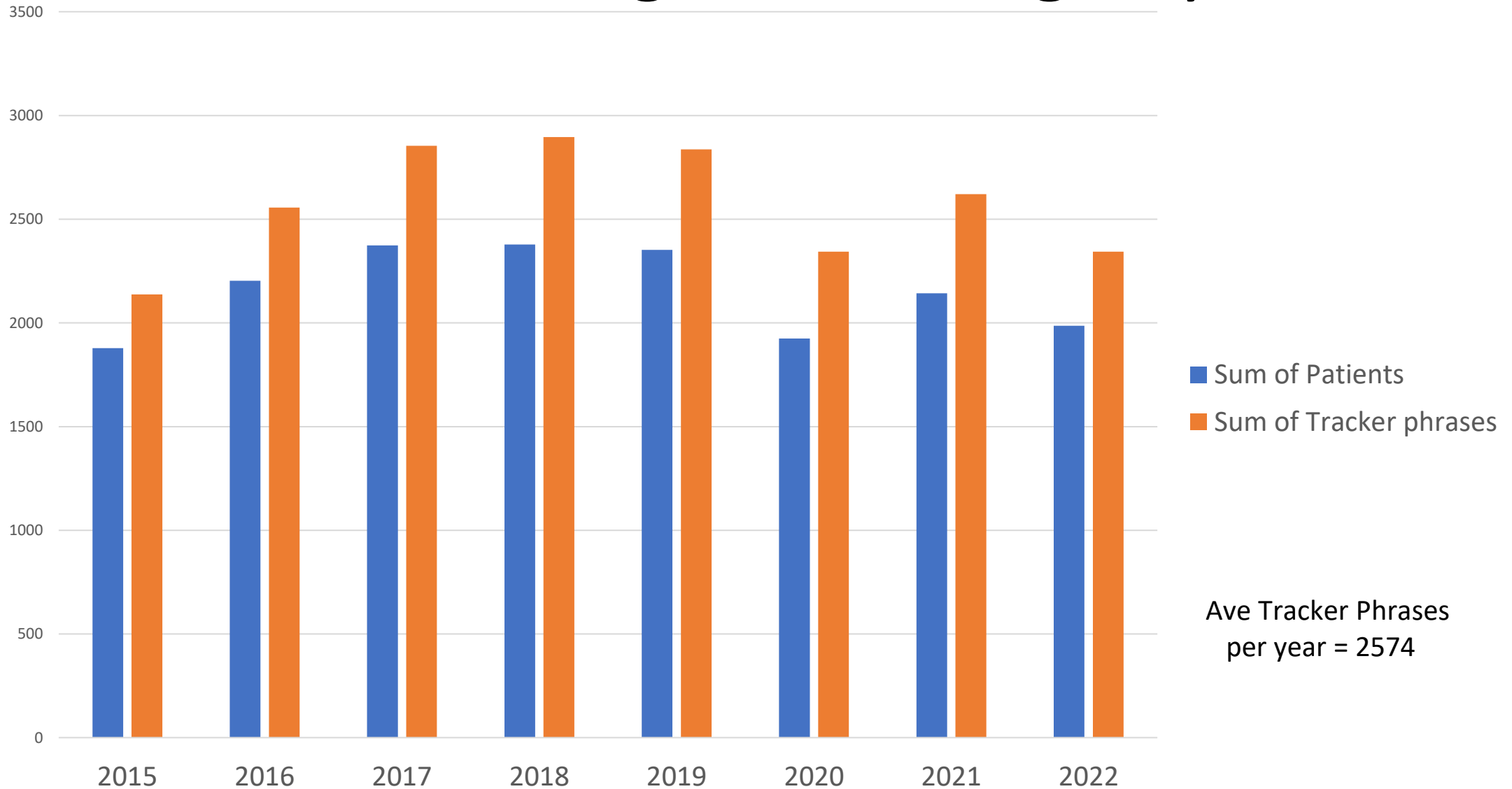
Track Dx Nodule

Track 12
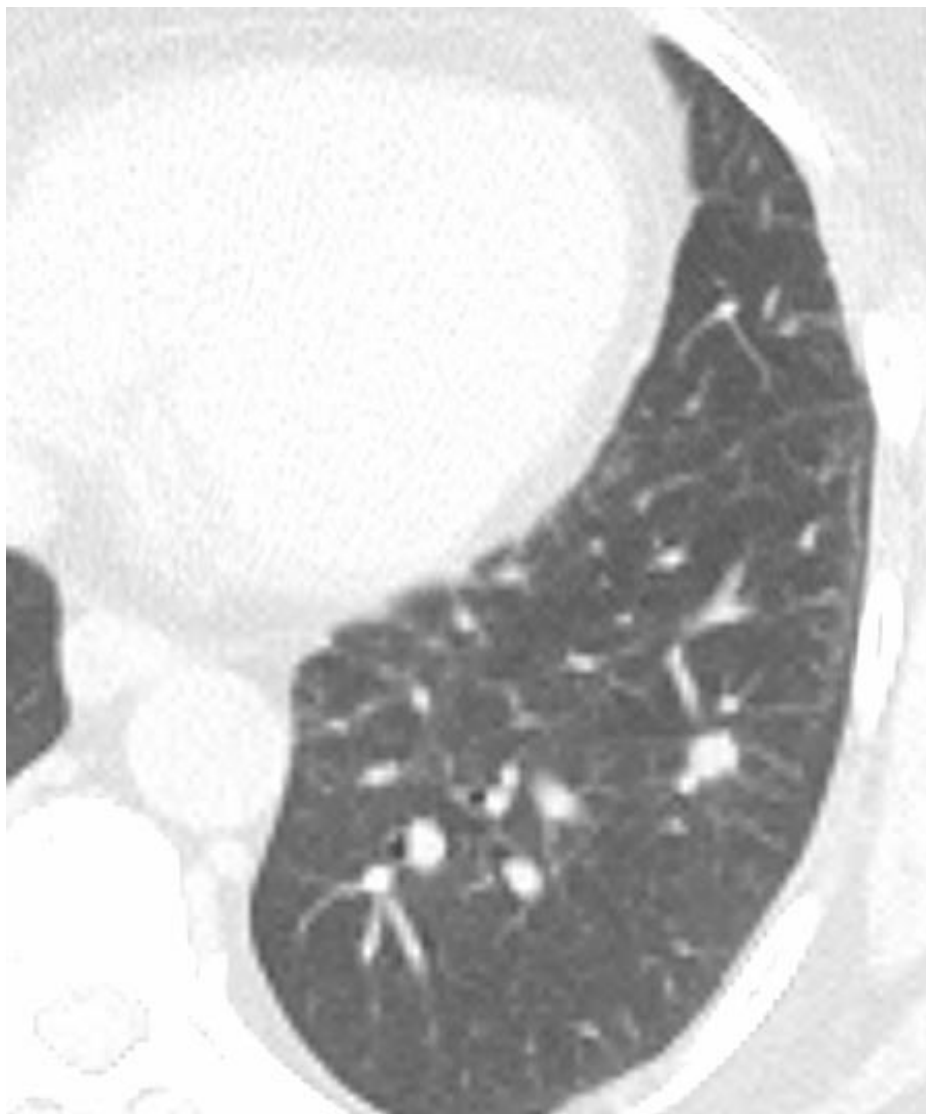
12 months later
now Track Dx

Track Complete

- Radiologist can inactivate patients in the Registry when nodule resolves or remains stable by use of the "Track Complete" phrase

- This recommendation for "no further follow-up" saves health care resources and avoids unnecessary radiation exposure

- Approximately 17% of cases with Tracker phrases are "Track Complete" each year

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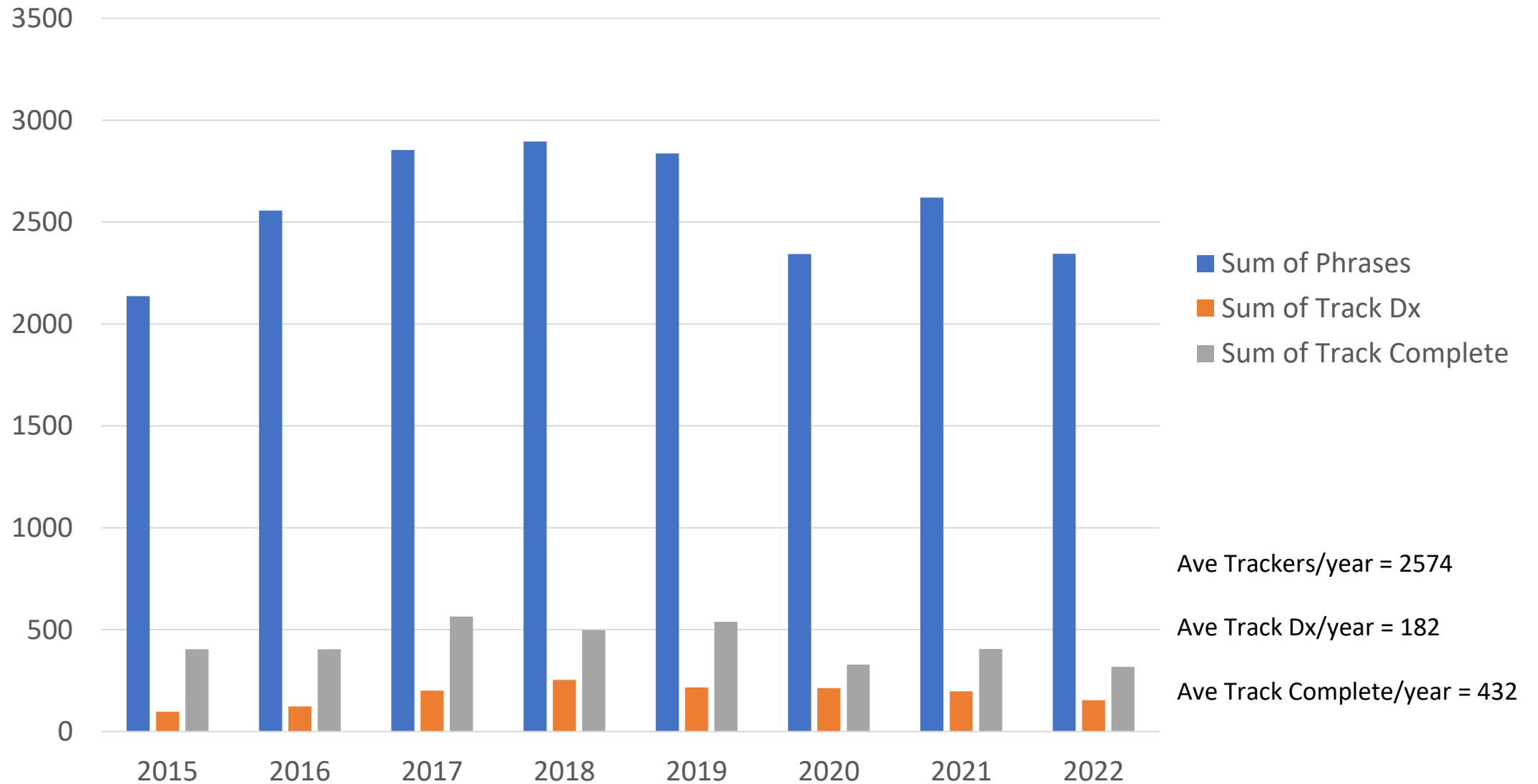
The NJH Experience

- We found a 41% increase in timely follow-up after implementation of the Tracker Phrase System and Lung Nodule Registry

- The Tracker System has been used consistently by our radiologists since 2011 and has been easily adopted by new radiologists

- The addition of simple tracker phrases provide clear messaging in radiology reports that can imported into a Lung Nodule Registry

- The computerized registry allows patient follow-up to be tracked and automatic communication when exams are overdue.

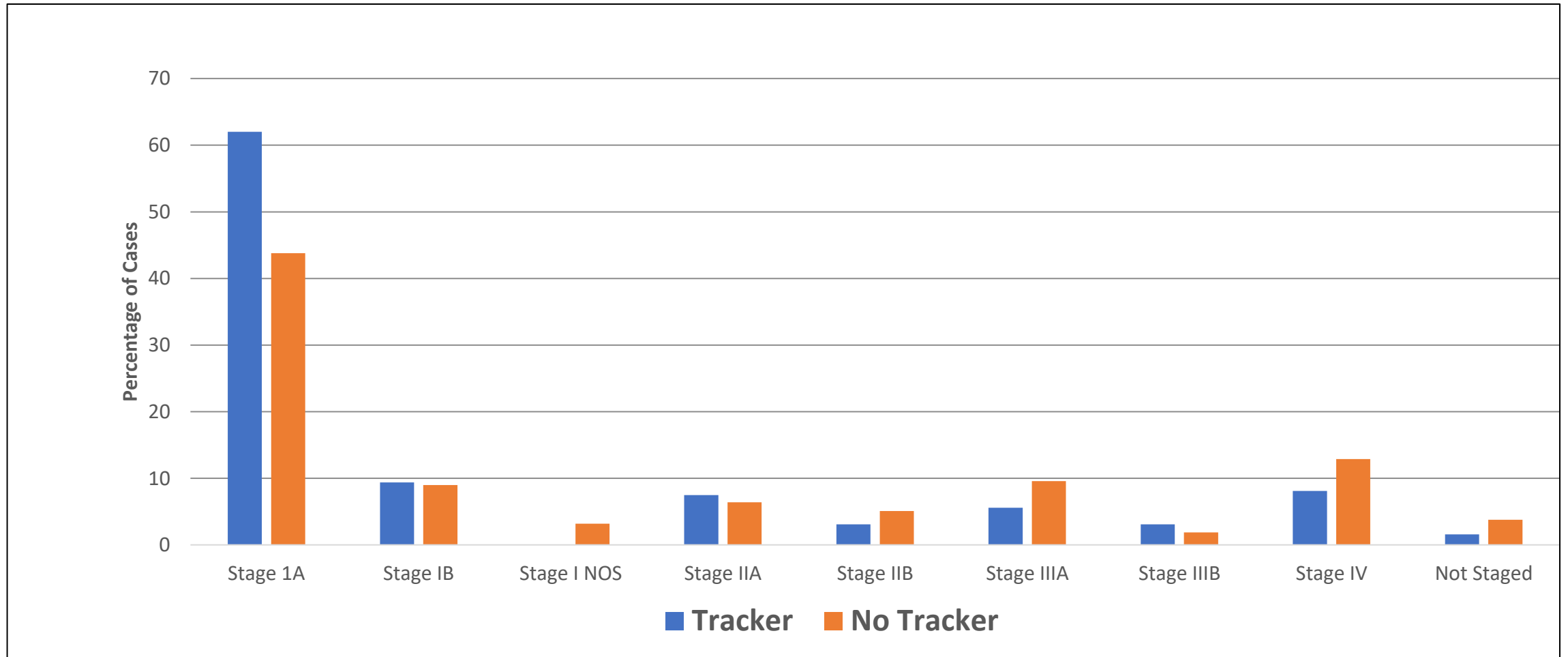Dyer et al, J Am Coll Radiol Feb 2021

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Impact of Tracking System on Stage of Lung Cancer

- Retrospective review of 937 cases of primary lung cancer, 2008 – 2016 with at least one chest CT performed at NJH

- Patient excluded if Lung Cancer Screening CT, if first and only CT resulted in immediate cancer diagnosis, if last chest CT > 2.5 years since cancer diagnosis

- Of 314 remaining patients with diagnosed with Lung Cancer, 200 were Early Stage (Stage I) and 114 were Later Stage (Stages II – IV or not staged)

Carr et al JTOCRR 2022

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IPNs: Cancers by Stage, Tracker vs No Tracker

Synergy with Lung Cancer Screening

Lung-RADS® 2022

ACR
AMERICAN COLLEGE OF RADIOLOGY

Release Date: November 2022

Lung-RADS	Category Descriptor	Findings	Management
0	**Incomplete** Estimated Population Prevalence: ~ 1%	Prior chest CT examination being located for comparison (see note 9)	Comparison to prior chest CT;
		Part or all of lungs cannot be evaluated	Additional lung cancer screening CT imaging needed;
		Findings suggestive of an inflammatory or infectious process (see note 10)	1-3 month LDCT
1	**Negative** Estimated Population Prevalence: 39%	**No lung nodules OR**	12-month screening LDCT
		Nodule with benign features: • Complete, central, popcorn, or concentric ring calcifications **OR** • Fat-containing	
2	**Benign** Based on imaging features or indolent behavior Estimated Population Prevalence: 45%	**Juxtapleural nodule:** • < 10 mm (524 mm³) mean diameter at baseline or new **AND** • Solid; smooth margins; and oval, lentiform, or triangular shape	
		Solid nodule: • < 6 mm (< 113 mm³) at baseline **OR** • New < 4 mm (< 34 mm³)	
		Part-solid nodule: • < 6 mm total mean diameter (< 113 mm³) at baseline	
		Non-solid nodule (GGN): • < 30 mm (< 14,137 mm³) at baseline, new, or growing **OR** • ≥ 30 mm (≥ 14,137 mm³) stable or slow-growing (see note 7)	
		Airway nodule, subsegmental at baseline, new, or stable (see note 11)	
		Category 3 nodule that is stable or decreased in size at 6-month follow-up CT, **OR** Category 3 or 4A nodules that resolve on follow-up, **OR** Category 4B findings proven to be benign in etiology following appropriate diagnostic workup	

LungRADS 1 & 2
"Negative" Screen

1	**Negative** Estimated Population Prevalence: 39%	**No lung nodules OR**	12-month screening LDCT
		Nodule with benign features: • Complete, central, popcorn, or concentric ring calcifications **OR** • Fat-containing	
2	**Benign** Based on imaging features or indolent behavior Estimated Population Prevalence: 45%	**Juxtapleural nodule:** • < 10 mm (524 mm^3) mean diameter at baseline or new **AND** • Solid; smooth margins; and oval, lentiform, or triangular shape	
		Solid nodule: • < 6 mm (< 113 mm^3) at baseline **OR** • New < 4 mm (< 34 mm^3)	
		Part-solid nodule: • < 6 mm total mean diameter (< 113 mm^3) at baseline	
		Non-solid nodule (GGN): • < 30 mm (< 14,137 mm^3) at baseline, new, or growing **OR** • ≥ 30 mm (≥ 14,137 mm^3) stable or slow-growing (see note 7)	
		Airway nodule, subsegmental at baseline, new, or stable (see note 11)	
		Category 3 nodule that is stable or decreased in size at 6-month follow-up CT, **OR** Category 3 or 4A nodules that resolve on follow-up, **OR** Category 4B findings proven to be benign in etiology following appropriate diagnostic workup	

LungRADS 3
"Positive" Screen

3	**Probably Benign** Based on imaging features or behavior Estimated Population Prevalence: 9%	**Solid nodule:** • ≥ 6 to < 8 mm (≥ 113 to < 268 mm^3) at baseline **OR** • New 4 mm to < 6 mm (34 to < 113 mm^3)	6-month LDCT
		Part-solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm^3) with solid component < 6 mm (< 113 mm^3) at baseline **OR** • New < 6 mm total mean diameter (< 113 mm^3)	
		Non-solid nodule (GGN): • ≥ 30 mm (≥ 14,137 mm^3) at baseline or new	
		Atypical pulmonary cyst: (see note 12) • Growing cystic component (mean diameter) of a thick-walled cyst	
		Category 4A nodule that is stable or decreased in size at 3-month follow-up CT (excluding airway nodules)	

LungRADS 4
"Positive" Screen

4A	**Suspicious** Estimated Population Prevalence: 4%	**Solid nodule:** • ≥ 8 to < 15 mm (≥ 268 to < 1,767 mm³) at baseline **OR** • Growing < 8 mm (< 268 mm³) **OR** • New 6 to < 8 mm (113 to < 268 mm³)	3-month LDCT; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm³) solid nodule or solid component
		Part-solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm³) with solid component ≥ 6 mm to < 8 mm (≥ 113 to < 268 mm³) at baseline **OR** • New or growing < 4 mm (< 34 mm³) solid component	
		Airway nodule, segmental or more proximal at baseline or new (see note 11)	
		Atypical pulmonary cyst: (see note 12) • Thick-walled cyst **OR** • Multilocular cyst at baseline **OR** • Thin- or thick-walled cyst that becomes multilocular	
4B	**Very Suspicious** Estimated Population Prevalence: 2%	**Airway nodule,** segmental or more proximal, and stable or growing (see note 11)	Referral for further clinical evaluation
		Solid nodule: • ≥ 15 mm (≥ 1767 mm³) at baseline **OR** • New or growing ≥ 8 mm (≥ 268 mm³)	Diagnostic chest CT with or without contrast; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm³) solid nodule or solid component; tissue sampling; and/or referral for further clinical evaluation Management depends on clinical evaluation, patient preference, and the probability of malignancy (see note 13)
		Part-solid nodule: • Solid component ≥ 8 mm (≥ 268 mm³) at baseline **OR** • New or growing ≥ 4 mm (≥ 34 mm³) solid component	
		Atypical pulmonary cyst: (see note 12) • Thick-walled cyst with growing wall thickness/nodularity **OR** • Growing multilocular cyst (mean diameter) **OR** • Multilocular cyst with increased loculation or new/increased opacity (nodular, ground glass, or consolidation)	
		Slow-growing-solid or part-solid nodule that demonstrates growth over multiple screening exams (see note 8)	
4X	Estimated Population Prevalence: < 1%	Category 3 or 4 nodules with additional features or imaging findings that increase suspicion for lung cancer (see note 14)	

Weekly Nodule Conference Summary

LAST name	MRN	Date of Interpretation @ NJH	Date of Outside exam (if appropriate)	Lung RADS	Tracker Phrase	Size (mm)	Location	Tammi magi Risk %	Vancouver Probabil of Malig %	Referring Provider	Recommendation
XXXXXX	XXXXXXX	9/13/2021		4B		23	LLL	1.6	29.5	XXX	Rad rec: Tissue sampling Conf rec: CT-guided biospy
XXXXXX	XXXXXXX	9/9/2021		4A		10	RUL	1.3	13.5	XXX	Rad rec: Follow-up CT in 3 months Conf rec: Follow-up CT in 3 months
XXXXXX	XXXXXXX	9/9/2021		4X		27	LUL	5.5	36.6	XXX	Rad rec: Tissue sampling Conf rec: Referral to IP for Bronchoscopy
XXXXXX	XXXXXXX	9/8/2021		4B		15	RLL	3.9	32.4	XXX	Rad rec: Follow-up CT in 4-6 weeks Conf rec: Follow-up CT in 4-6 weeks
XXXXXX	XXXXXXX	9/13/2021	8/30/2021		Trackdx	9	RUL		16.4	XXX	Rad rec: PET/CT Conf rec: PET-CT and referral to IP
XXXXXX	XXXXXXX	9/9/2021	7/30/2021		Trackdx	17	LUL		59.3	XXX	Rad rec: Tissue sampling Conf rec: Follow-up CT in 3 months
XXXXXX	XXXXXXX	9/9/2021			Trackdx	14	LLL		9.5	XXX	Rad rec: Tissue sampling Conf rec: Referral to Rad Onc
XXXXXX	XXXXXXX	PET-CT 9/13/2021			Trackdx	15 (SUV 3)	LLL		16.6	XXX	Rad rec: Tissue sampling Conf rec: Referral to Thoracic Surgery

Summary

- Incidental Lung Nodules are common but follow-up is often variable or lacking

- Appropriate management of IPNs through an IPN Program can lead to a stage shift to early stage lung cancer

- An IPN Program is an important adjunct to LCS and essential for the Early Detection of Lung Cancer

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