“Be In The Node”

An Update on Lung Cancer Diagnosis & Screening

AGENDA

1. Epidemiology & Etiology Review
2. A Review of Chest Imaging
3. The Diagnostic Stage
4. The Post-Diagnostic Stage
5. Prevention & Screening
6. Middlesex Health

No Financial Disclosures

Epidemiology & Etiology

Lung Cancer - United States
American Cancer Society 2023 Estimates

Second most common cancer (prostate in men; breast in women)

Leading cause of cancer-related death in US (20%), regardless of gender

Accounts for more deaths than colon, breast, and prostate combined.

Average age of diagnosis 70 years old

In 2023, approximately 239,000 people will be diagnosed, with 127,000 people expected to die from their illness.

In 2018, incidence of lung cancer worldwide was 2.1 million cases

Lung Cancer - Worldwide

Second most common cancer

More than 2.2 million new cases in 2020

Leading cause of cancer-related death in MEN

Second leading cause of cancer-related death in WOMEN

Worldwide Incidence Rates, 2018 & 2020

Rank	Country	Number	ASR/100,000
	World	*2,206,771*	*22.4*
1	Hungary	10,274	50.1
2	Serbia	8,048	47.3
3	France, New Caledonia	166	42.9
4	French Polynesia	144	40.4
5	Turkey	41,264	40.0
6	Montenegro	443	39.7
7	Belgium	9,646	38.3
8	Bosnia and Herzegovina	2,513	37.8
9	North Korea	13,672	37.0
10	Denmark	5,047	36.8

Global Cancer Statistics 2018 & World Cancer Research Fund WCRF.org

Smoking remains the cardinal risk factor for development of lung cancer

The notion that cigarette smoke causes lung cancer was first suggested in 1912

Smoking accounts for approximately 90% of all lung cancer cases

Compared to non-smokers, RR of lung cancer is estimated to be 20X

A “Drag” Down Memory Lane

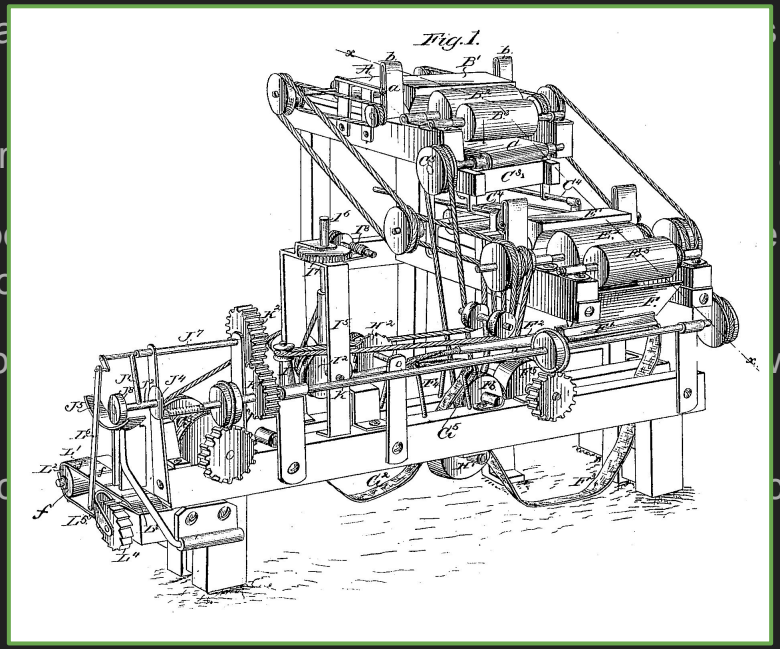
In the late 19th century, per-ca… of tobacco per person aged 18+ (primarily chew)

In the early 20th century, cigar… absorption of nicotine

Cigarettes became a less exp… Bonsack machine, developed by James Albert Bo…

The Bosnack machine was ab… which at the time, cut the cost of cigarettes in half

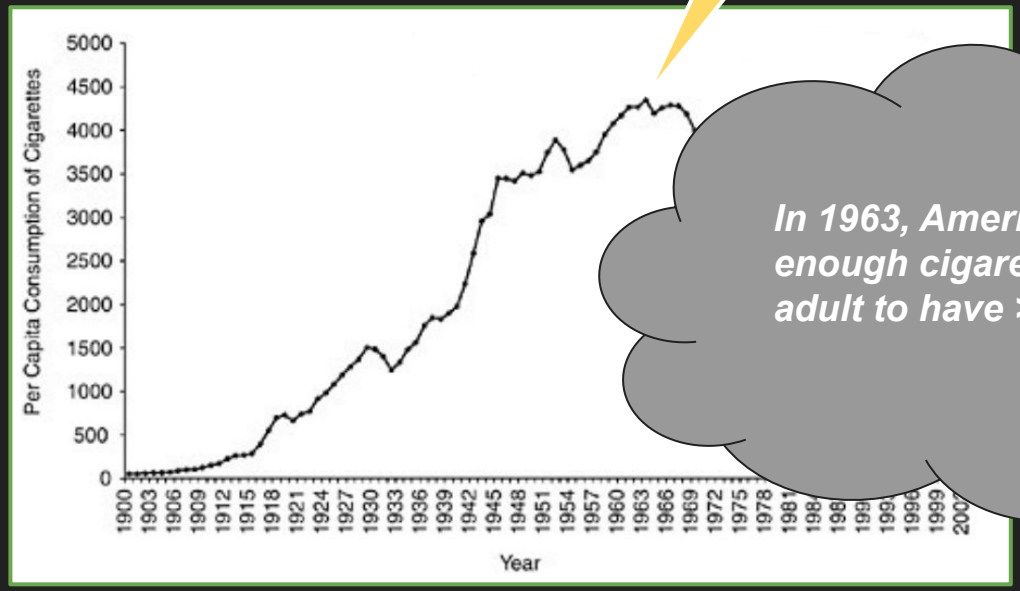
By the 1950’s, manufactured c… cco consumption



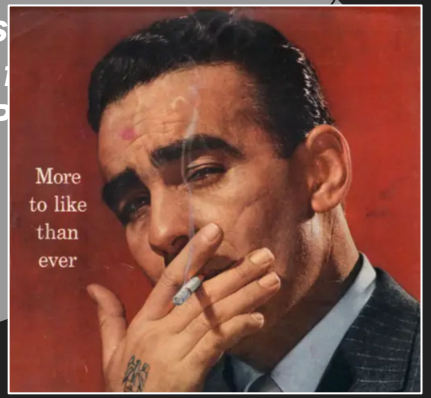
Chaloupka et al. 2002; Giovino 2002

A Staple of American History

Per capita consumption of cigarettes am[illegible]g adults 18+ from 1900-2004

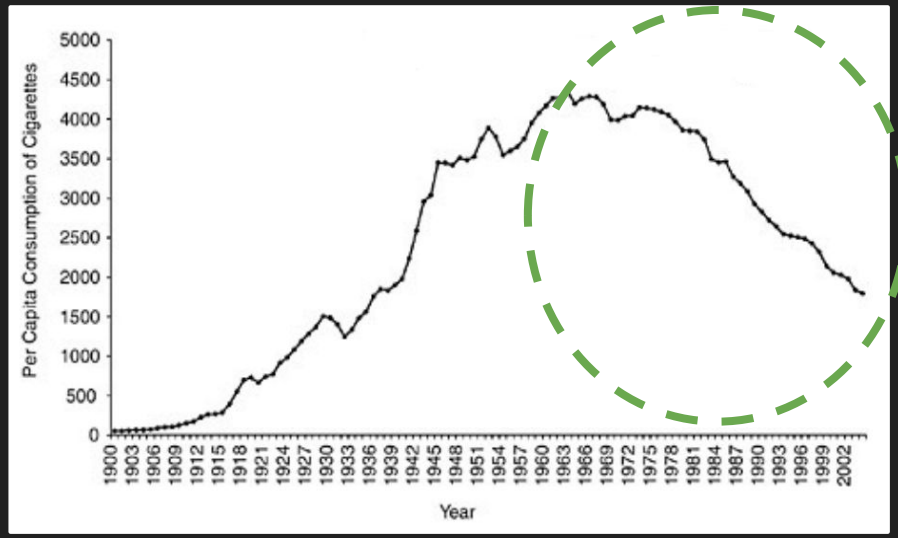


In 1963, Americans
enough cigarettes
adult to have > ½ P



ALA 2004, 2006; Capehart 2004

The Decline In Tobacco Consumption



On January 11, 1964, Luther L. Terry MD, Surgeon General of the U.S. Public Health Service, released the first report of the Advisory Committee on Smoking & Health

- ★ A cause of lung ca and laryngeal ca in men
- ★ A probably cause of lung ca in women
- ★ The most important cause of chronic bronchitis

SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.

Additional Risk Factors

- **Arsenic (strong evidence) can contaminate water supply**
- **Beta carotene supplements (former and active smokers)**
- **Secondhand exposure**: dose-response relationship between intensity of exposure and relative risk of lung ca
- Dietary - processed foods, red meat
- **Cigar smoking**: relative risk 2.1 [NEJM 1999]
- **Marijuana**: reports showing histologic and molecular changes in the bronchial epithelium similar to metaplastic alterations in tobacco smokers
- **Vaping**: not well established (yet)
- **Occupational**
  - Asbestos - long latency period between 10-40 years post-exposure
- **Non-occupational**
  - Radon
  - Indoor burning of unprocessed biomass fuels (coal, wood)
  - Radiation
  - Inflammatory lung disease
  - COPD
  - Genetic factors

Review of Chest Imaging

Chest Radiograph

The most common film take

Employs ionizing radiation i

1 Chest x-ray = 10 BRET (b e)

-

Plai

The limitations of x-ray inclu

- 2-dimensional study w ely localize pathology
- Many factors can impa
- Small pathology can b ules

New pulmonary nodules and/or masses discovered on plain film should always be followed-up with a CT scan…especially before sending them for a consultation. (In case you didn't know, pulmonologists love CT scans)

Computed Tomography (CT)

Employ a rotating x-ray tube to measure attenuations by different tissue in the body

Measurements taken from different angles are processed on a computer using reconstruction algorithms to produce cross-sectional (tomographic) images of the body

Take longer than x-ray, but still pretty quick

Compared to x-ray, provides higher level of detail

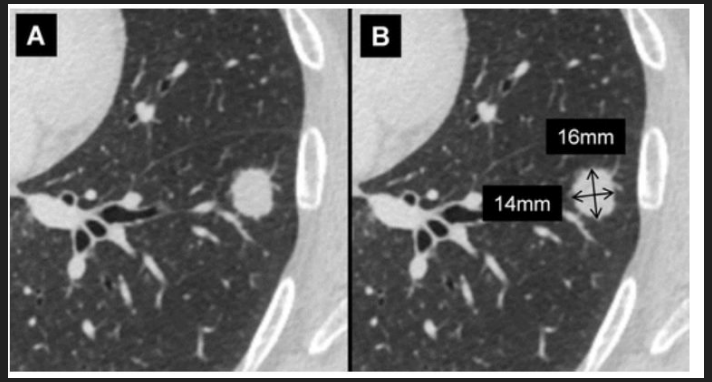
Solitary Pulmonary Nodule (SPN)

By definition, a rounded opacity, well or poorly defined, measuring up to 3 cm, surr

Morphological Features >> Overall Size

The first step in evaluating a SPN is ALWAYS to compare prior imaging

SPN's should be measured by taking the average of the maximum long and short-axis diameters



Case Review

52-year-old female referred to pulmonary for an incidental finding on CT chest following a fall while ac

PMH: al

Social: 1

ROS: (+

What is the recommended management of this patients incidental pulmonary nodule?

A. No follow up indicated
B. Short interval CT scan in 3 months
C. Repeat CT scan in 6-12 months
D. PET/CT
E. Tissue sampling

CT chest: 7.4 mm solid, non-calcified nodule in the right upper lobe. Background of mild centrilobular emphysema. No prior imaging for comparison.

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What is the recommended management of this patients incidental pulmonary nodule?

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B. Short interval CT scan in 3 months
C. Repeat CT scan in 6-12 months
D. PET/CT
E. Tissue sampling

A: Solid Nodules*

Nodule Type	Nodules <6 mm (<100 mm³)	Nodules 6–8 mm (100–250 mm³)	Nodules >8 mm (>250 mm³)	Comments
Single				
Low risk	No routine follow-up	CT at 6–12 mo, then consider CT at 18–24 mo	Consider CT at 3 mo, 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 mo	CT at 6–12 mo, then at 18–24 mo	Consider CT at 3 mo, PET/CT, or tissue sampling	Certain patients at high risk with suspicious nodule morphology, upper lobe location, or both may warrant 12-mo follow-up (recommendation 1A)
Multiple				
Low risk	No routine follow-up	CT at 3–6 mo, then consider CT at 18–24 mo	CT at 3–6 mo, then consider CT at 18–24 mo	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 mo	CT at 3–6 mo, then at 18–24 mo	CT at 3–6 mo, then at 18–24 mo	Use most suspicious nodule as guide to management; follow-up intervals may vary according to size and risk (recommendation 2A)

B: Subsolid Nodules*

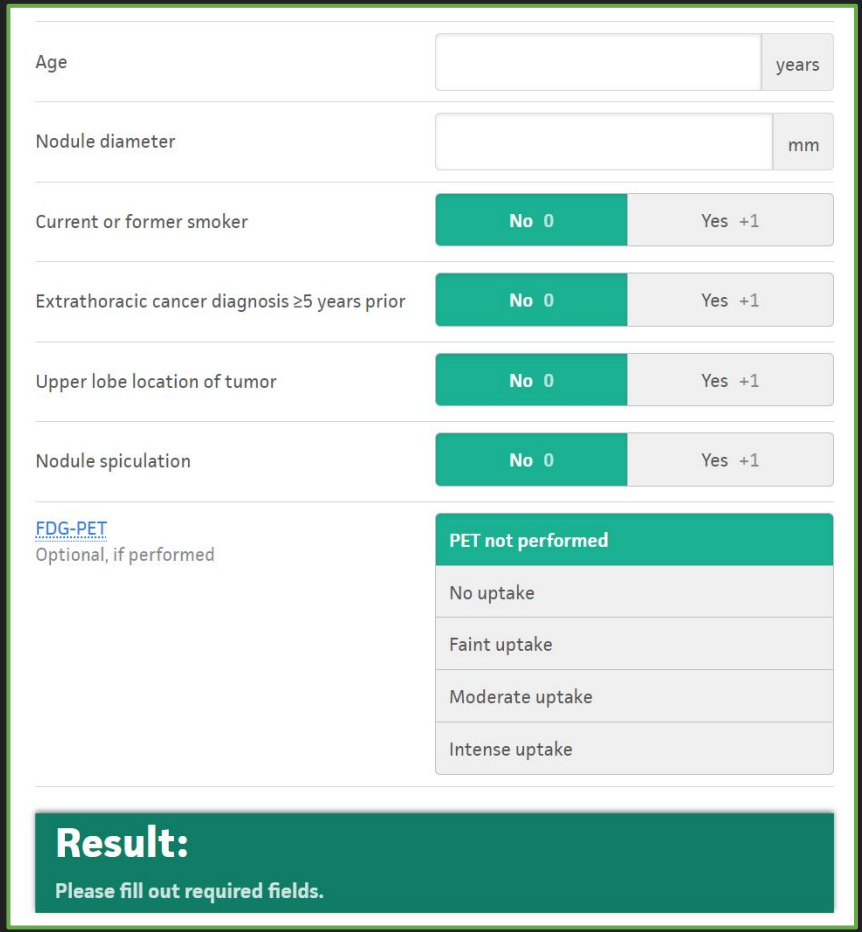
Nodule Type	Nodules <6 mm (<100 mm³)	Nodules ≥6 mm (≥100 mm³)	Comments
Single			
Ground glass	No routine follow-up	CT at 6–12 mo to confirm persistence, then CT every 2 y until 5 y	For certain suspicious nodules <6 mm, consider follow-up at 2 y and 4 y; if solid component(s) develops or growth occurs, consider resection (recommendations 3A and 4A)
Partly solid	No routine follow-up	CT at 3–6 mo to confirm persistence; if lesion is unchanged and solid component remains <6 mm, annual CT should be performed for 5 y	In practice, partly solid nodules cannot be defined as such until they are ≥6 mm, and nodules <6 mm usually do not require follow-up; persistent partly solid nodules with a solid component ≥6 mm should be considered highly suspicious (recommendations 4A–4C)
Multiple	CT at 3–6 mo; if lesion is stable, consider CT at 2 y and 4 y	CT at 3–6 mo; subsequent management based on the most suspicious nodule(s)	Multiple <6-mm pure GGNs† usually are benign, but consider follow-up at 2 y and 4 y in select patients at high risk (recommendation 5A)

5 Step Approach to Morphological Assessment on CT imaging

1. Density: solid, mixed, ground glass
2. Shape: round, oval, polygonal
3. Margins: smooth, round, lobulated
4. Internal characteristics: fat, calcification, cavitation
5. Complex findings: pleural retraction, air bronchograms, bubble-like lucencies, cystic airspace, vascular convergence

Solitary Pulmonary Nodule (SPN) Malignancy Risk Score Mayo Clinic Model

Should not be used in patients with prior history of lung cancer and/or extrathoracic cancer within the last 5 years.



Positron Emission Tomography (PET)

Nuclear medicine study that uses a radiotracer to detect pathology

Most commonly used radiotracer is F-18 Fluorodeoxyglucose (FDG)

Accumulate in areas of high metabolic activity, i.e. tumors, inflammation, infection

Most useful when utilized for staging following diagnosis with tissue sampling

Be careful when selecting PET imaging in the pre-diagnosis or work-up phase

Limitations of PET/CT

Accuracy is highly dependent on the size and density of nodules

Solid Nodule Size	Accuracy	Sensitivity
< 10 mm	76%	51%
10-15 mm	92%	86%
> 15 mm	88%	98%

Mixed/GG Nodule Size	Accuracy	Sensitivity
< 10 mm	53%	17%
10-15 mm	47%	25%
> 15 mm	70%	64%

European Respiratory Journal, 2015

Accuracy of PET/CT depends on tumor type & location

Most lung cancers have FDG uptake, but intensity varies drastically

- Adenocarcinomas tend to have the lowest uptake (sensitivity 53%)
- Squamous cell & small cell carcinomas have the highest uptake (82-92%)
- Carcinoid has high potential for false negative PET
  - **Neuroendocrine-PET** studies FDA approved in 2016
  - Uses Gallium-68 which binds to somatostatin receptors

Acquisition time of PET imaging can take up to 5 minutes

Changes in volume during respiration and atelectasis affect FDG uptake

Upper lung fields experience less atelectatic effects compared to lower fields

Sensitivities found to be 53% and 71% in lower and upper lobes, respectively

Recommendations for PET/CT

PET has the highest accuracy for differential diagnosis of indeterminate nodules detected at baseline, that are solid > 10 mm, or mixed > 15 mm, and localized in the upper lobes

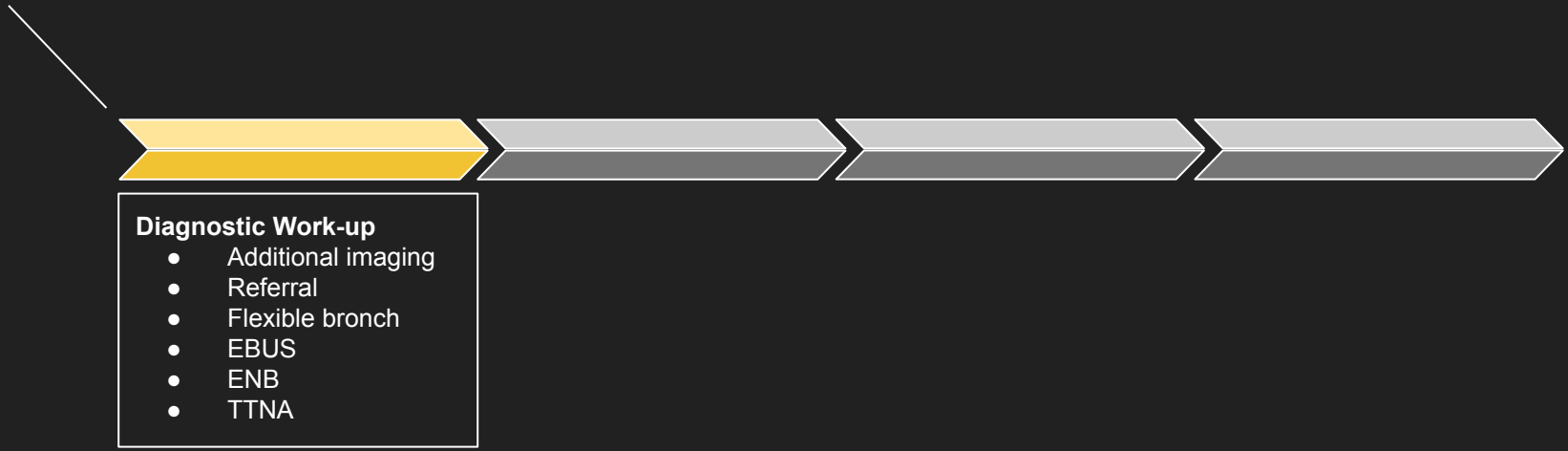
PET imaging should only be obtained when the pretest probability of malignancy is low to moderate

If the pretest probability of malignancy is high, tissue sampling is the recommended next step. A PET/CT should NEVER change the management of a highly suspicious lesion.

The Diagnostic Stage

Abnormal Imaging Study

- Incidental on chest x-ray or CT scan
- LDCT



Diagnostic Work-up

- Additional imaging
- Referral
- Flexible bronch
- EBUS
- ENB
- TTNA

Case Review

70-year-old female with 50 pack year (active) smoking history

Multiple, bilateral ground glass sub 6 mm nodules dating back to 2017

LDCT 2/9/21 showed interval growth of a prior solid nodule, measuring 1.3 x 1.1 cm (previously 1.0 x 0.7 cm)

CT scan flagged through high risk lung nodule pathway

Consultation in pulmonary office on 2/18/21

Factors that determine the most appropriate method for diagnosing lung cancer include:

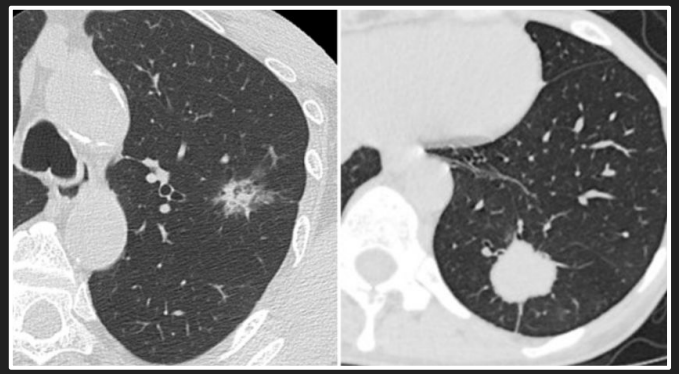
1. Type of lung cancer suspected
2. Size of the lesion
3. Location of the lesion
4. Presence of metastatic lesions
5. Overall clinical status of the patient

Type of Lung Cancer Suspected

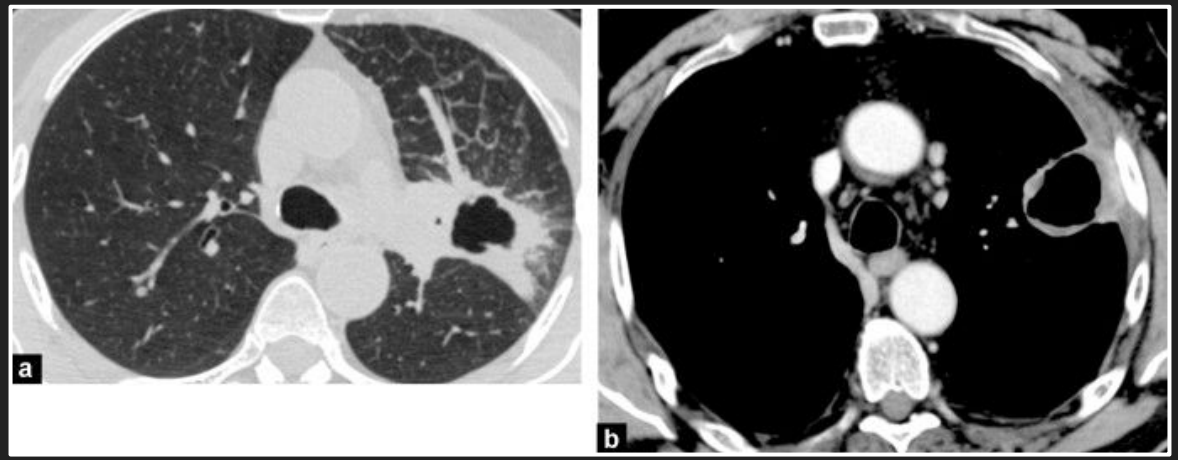
Approximately 75-80% of lung cancers are non-small cell (NSCLC)

The location of the dominant lesion on CT imaging can often provide a clue as to the histopathology

- Adenocarcinoma + Bronchoalveolar carcinoma (adenocarcinoma in situ)
  - Represents 31% of all lung cancers
  - Tend to favor more peripheral locations
  - Aggressive forms can infiltrate the mediastinum and pleura in up to 51% of cases
  - < 4% will show cavitation
  - Ground glass (doubling time > 1 year) and solid lesions (doubling time < 1 year)



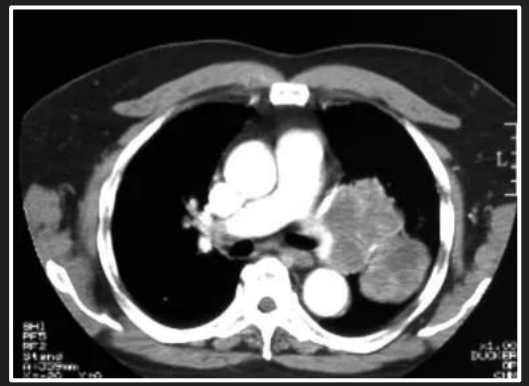
- Squamous cell carcinoma
  - Represents 30% of all lung cancers
  - Tend to be more central, often within or adjacent to airways (up to 82% can cavitate)
  - Bronchoscopic evaluation may reveal endobronchial disease +/- segmental lobar collapse due to obstruction
- Adenosquamous
  - Represents 2% of all lung cancers
  - Scar or fibrosis can be seen within or adjacent to the lesion in up to ½ the cases

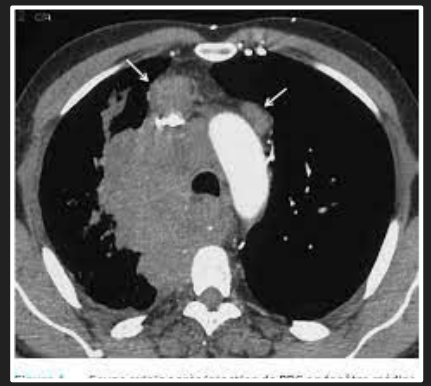


- Small cell carcinoma
  - Represents 18% of all lung cancers
  - Neuroendocrine class of tumors
  - Aggressive and often discovered in advanced stages
  - Bulky hilar/mediastinal adenopathy, sometimes causing airway obstruction due to external compression
  - If caught early on screening, can often times appear as a lobulated, central lesion

Typical Carcinoid

Small Cell Carcinoma





Size of Lesion

Nodule size and growth rate remain the most widely used predictors to assess probability of nodule malignancy

Management however cannot rely solely on size

The National Lung Screening Trial (NLST) demonstrated a < 1% malignancy risk in nodules < 5 mm

The Mayo Clinic CT Screening Trial found that 80% of malignant nodules > 8 mm

Typically, nodules > 1 cm are considered pathologic until proven otherwise

Location of the Nodule

Strongly influences the diagnostic approach

Peripheral nodules make a bronchoscopic approach difficult, unless advanced technology such as navigation is employed. These nodules tend to be more amenable to percutaneous biopsies

Central and hilar nodules can be accessed easier with bronchoscopy, and make a percutaneous approach more risk due to the length of lung needed to traverse

Presence of Metastatic Lesions

The aim of every biopsy should be to upstage the patient

The location of choice will ideally provide the highest stage for the patient

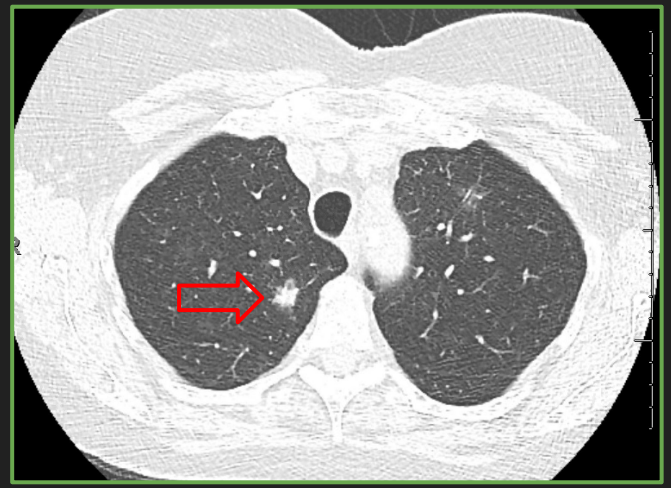
This approach leads to fewer invasive procedures and faster time to treatment

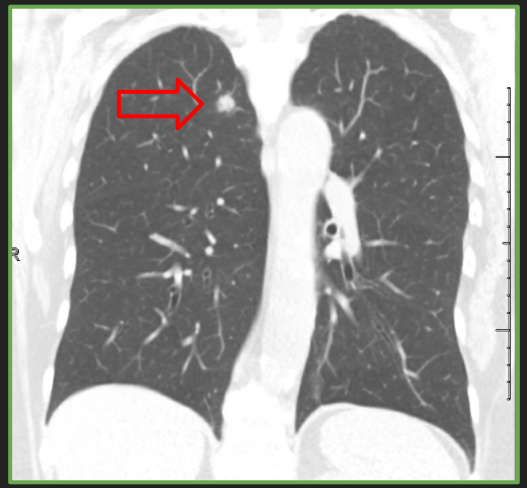
For example, a patient who is found to have a renal mass with multiple, bilateral new pulmonary nodules should go for a lung biopsy first. If the histopathology shows renal cell origin, the staging has been completed. If the patient goes for a renal biopsy first, there will perhaps be a need for a secondary biopsy of the lung to confirm metastatic disease.

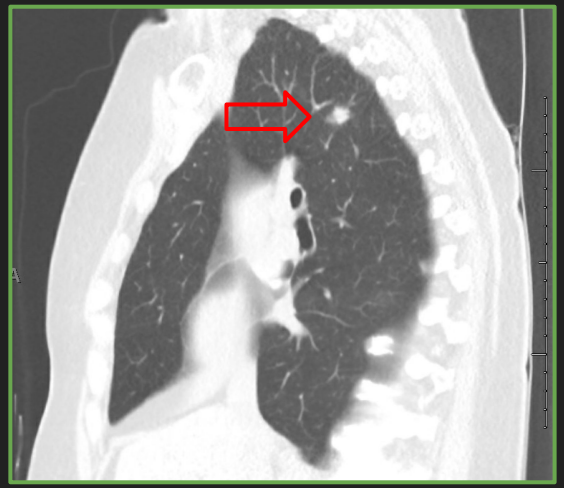
Clinical Status of the Patient

- Pre-existing lung disease?
- Age of the patient
- Performance status
- Significant comorbid conditions

Back To Our Patient…







Solid, spiculated nodule in the medial aspect of the right upper lobe
Bronchus sign +

What is the next step?

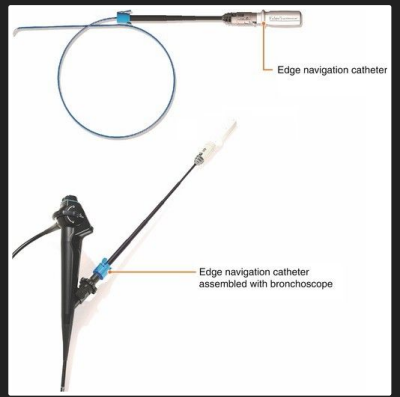
Select the diagnostic modality that will yield the best results with the least amount of testing, both invasive and non-invasive

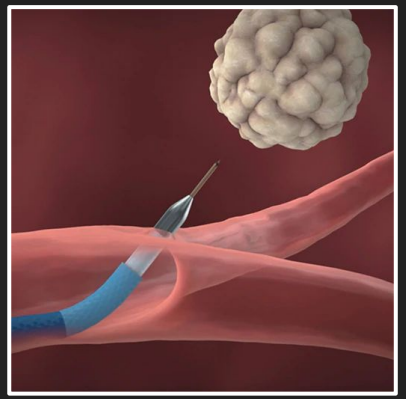
1. PET? ✘
2. Watchful waiting? ✘
3. Percutaneous core needle biopsy? ✔
4. Flexible bronchoscopy? ✘
5. Navigational bronchoscopy? ✔

Electromagnetic Navigational Bronchoscopy (ENB)

Image-guided, minimally invasive approach that uses a flexible catheter to access peripheral pulmonary nodules

Once the lesion has been reached, the ENB locator guide is removed and the working guide sheath is left in place through which standard biopsy instruments can be passed





ENB Data

Pilot Study by Gildea in 2006 (prospective)

- N = 60; Avg nodule size 24 mm; diagnostic yield 67%

Systematic Review & Meta-Analysis, Respiration 2014

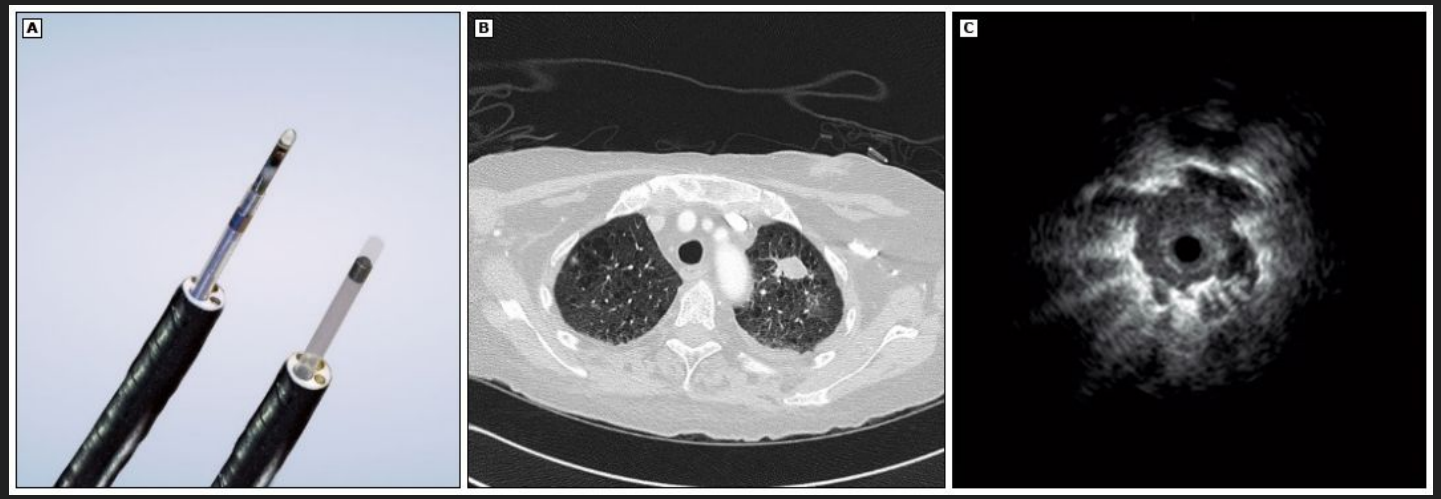
- Total of 15 trials involving 1,033 lung nodules
- Overall diagnostic yield 64.9%
- Overall diagnostic accuracy 73.9%
- Sensitivity to detect lung cancer 71.1%

Variables that improve diagnostic yield:

- Nodule size > 2 cm
- Upper or middle lobe location
- Low registration error
- Presence of bronchus sign
- Sampling lesion with catheter suction technique
- General anesthesia
- ROSE (rapid on-site evaluation)
- Combined use with radial probe EBUS

Radial Probe Endobronchial Ultrasound (RP-EBUS)

Miniature ultrasound probe that can be advanced through the working channel of a flexible bronchoscopy, providing 360-degree view of lung parenchyma

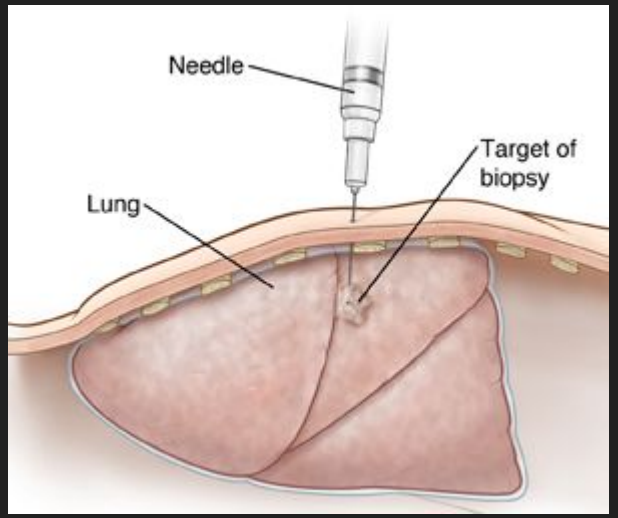


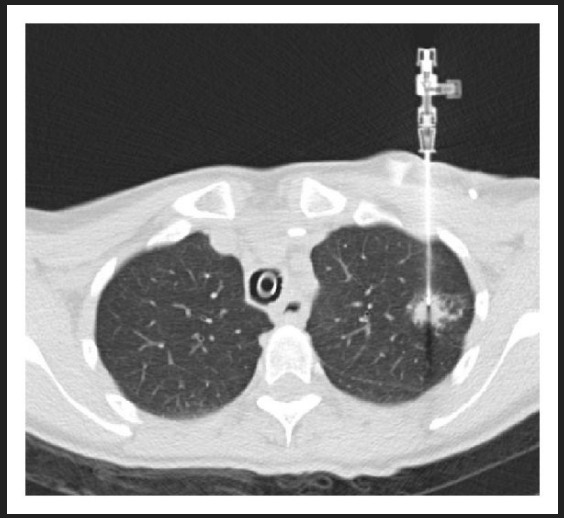
Combined use of ENB + RP-EBUS improves diagnostic yield

Transthoracic Needle Biopsy (TTNB)

Needle is passed percutaneously (most commonly) under CT-guidance

Meta-analysis of 46 studies showed an overall sensitivity of 90%





ENB versus TTNB

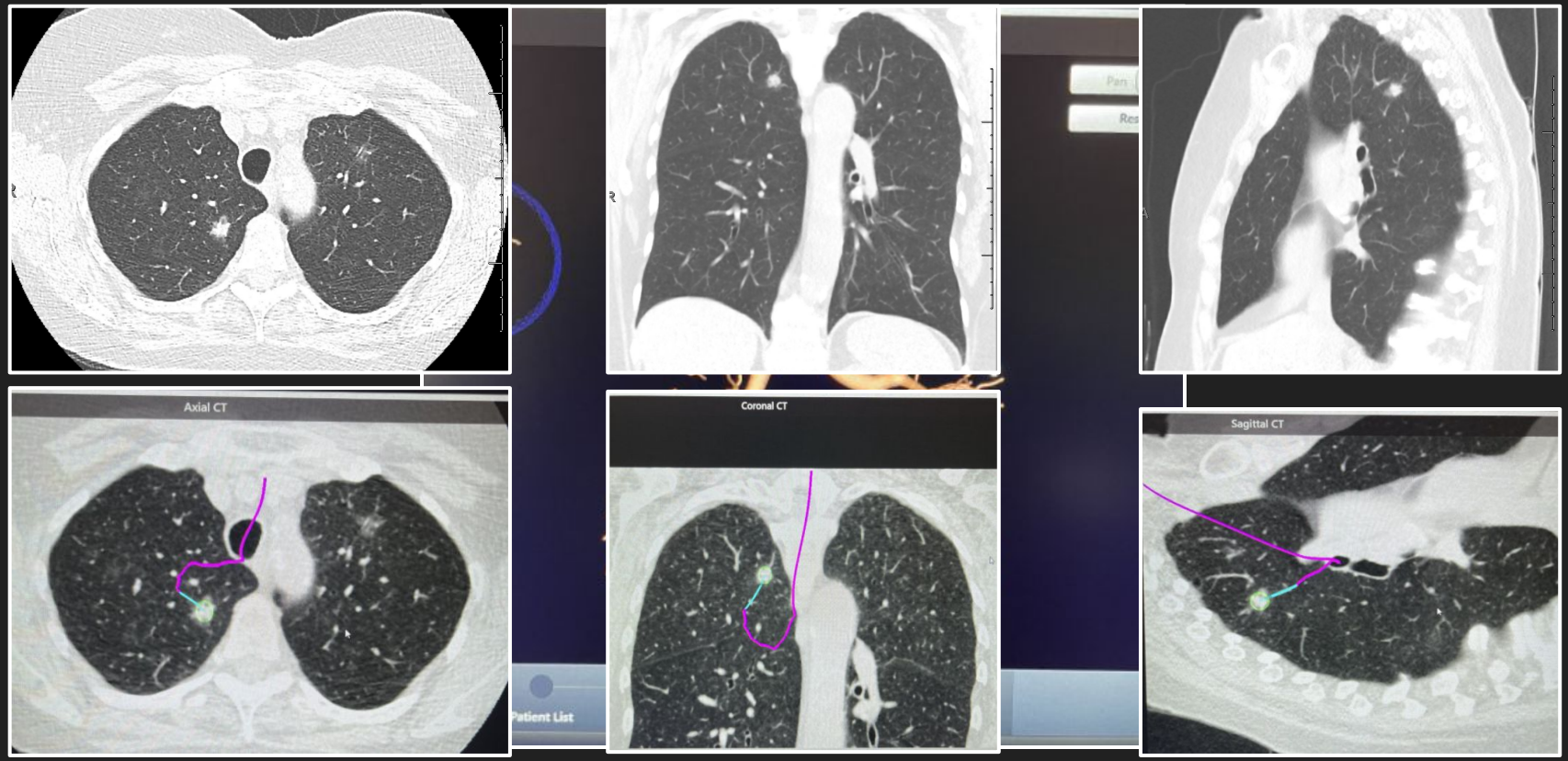
Advantages

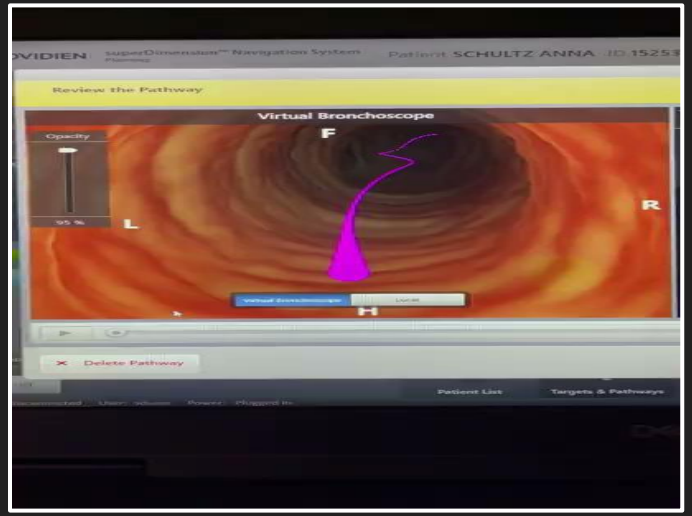
- Lower rates of pneumothorax*
  - Data is highly variable
  - Approximately 5-10% for TTNB versus < 5% ENB
  - Affected by length of parenchyma being traversed, degree of emphysema, etc
- Ability to combine with EBUS to diagnose and stage in single procedure
- Ability to directly visualize the airways

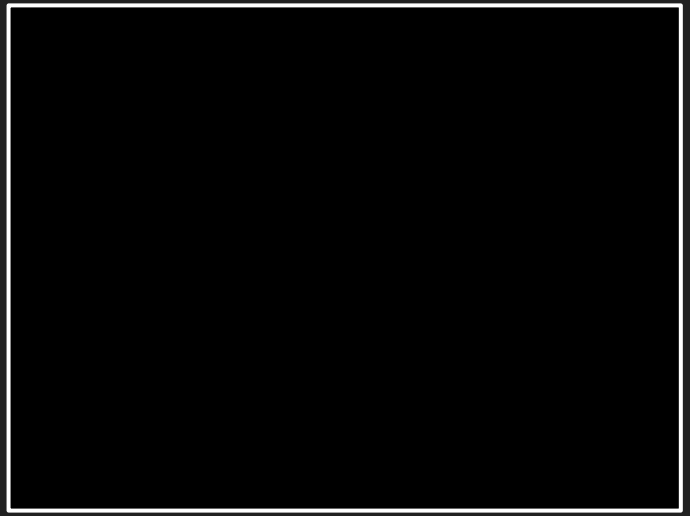
Disadvantages

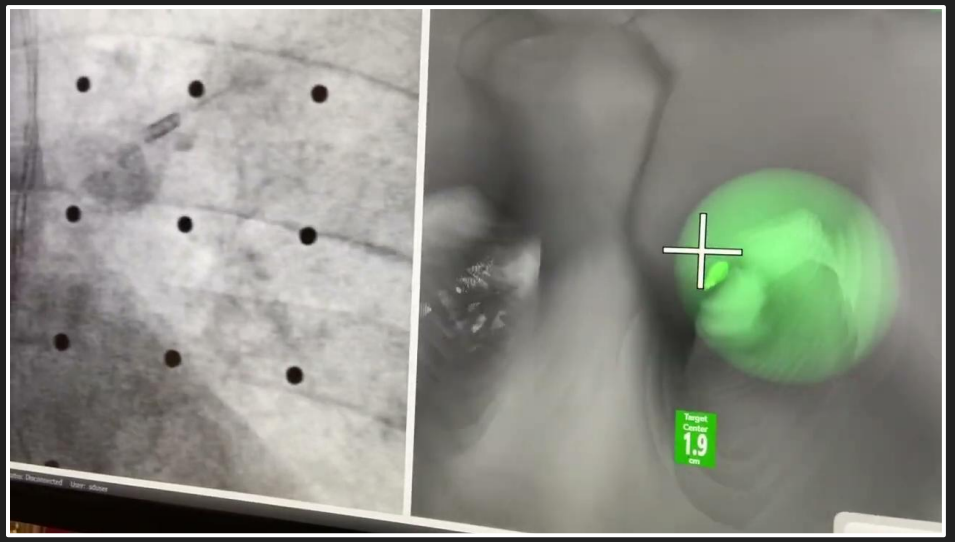
- Lower diagnostic yield
- Adequacy of biopsy samples
- Use of general anesthesia
- Length of procedure time

Back to our patient…




Review the Pathway
Virtual Bronchoscope
Opacity
95 %
F
L
R
H
Delete Pathway
Patient List
Targets & Pathways




Target
Center
1.9
cm

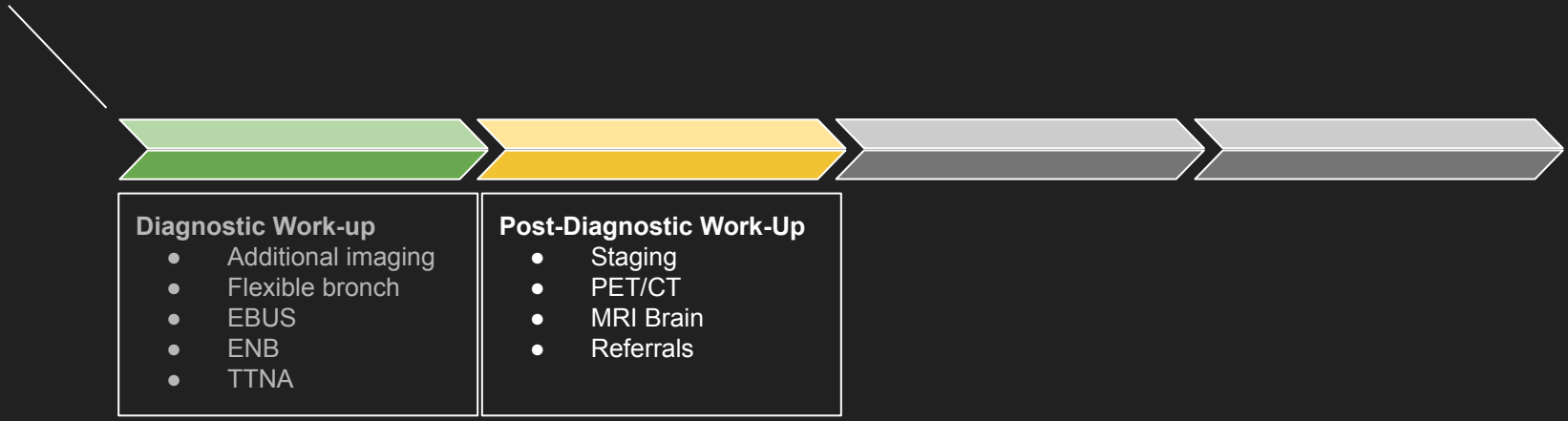
Diagnosis

- TTNA (21 gauge needle): + adenocarcinoma
- TTBx (forceps): + adenocarcinoma, TTF-1 and CK7 positive

The Post-Diagnostic Stage

Abnormal Imaging Study

- Incidental on chest x-ray or CT scan
- LDCT



Diagnostic Work-up

- Additional imaging
- Flexible bronch
- EBUS
- ENB
- TTNA

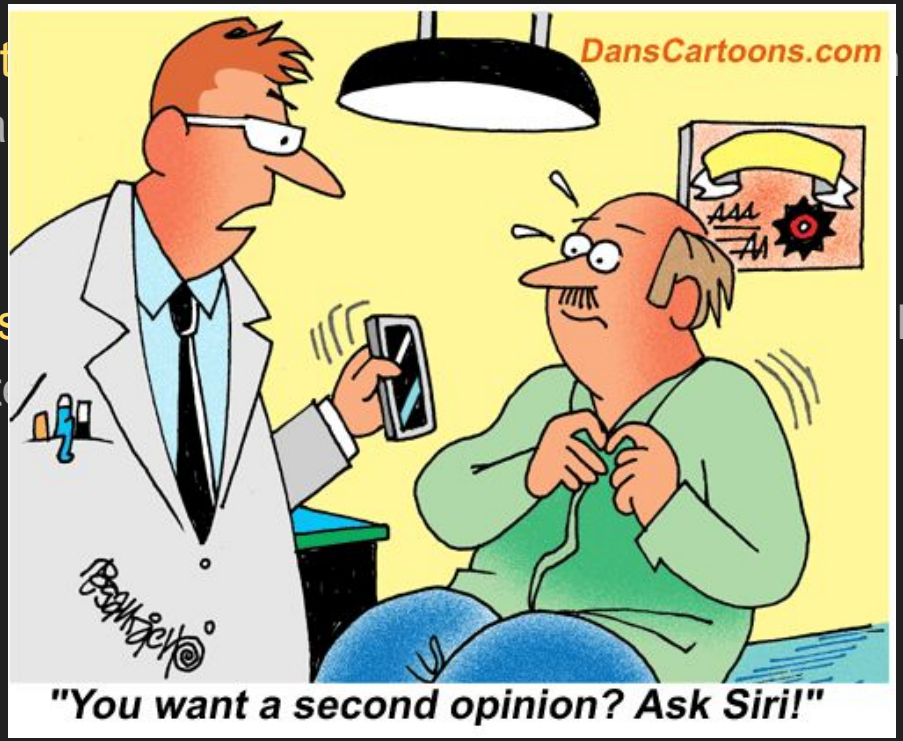
Post-Diagnostic Work-Up

- Staging
- PET/CT
- MRI Brain
- Referrals

How Do We Stage Lung Cancer?

Clinical-diagnostic st prior to surgical resection (clinical, la

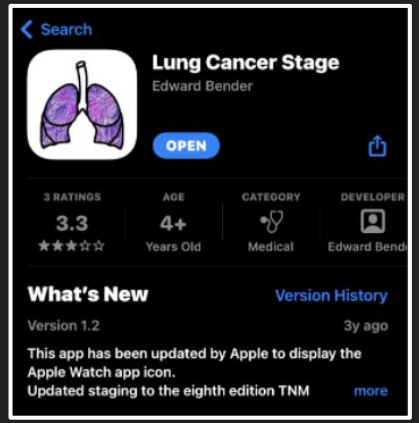
Surgical-pathologic s histopathological data from the resect

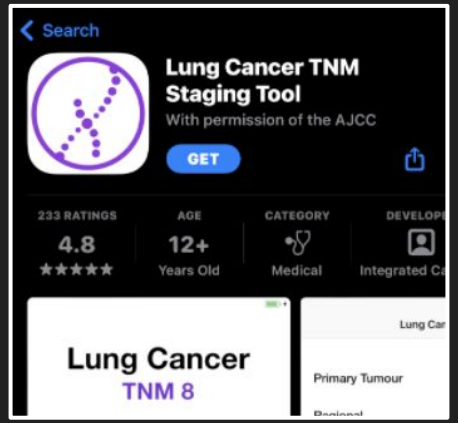


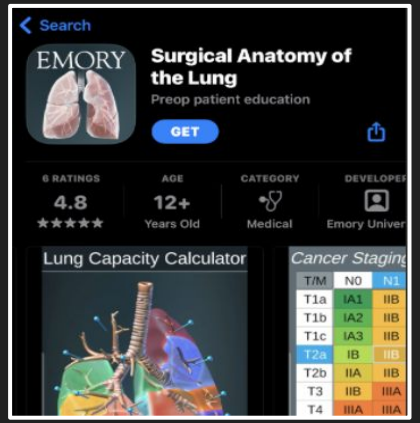
8th Edition of TNM Classification for Lung Cancer

T: Primary tumor	
Tx	Primary tumor cannot be assessed or tumor proven by presence of malignant cells in sputum or bronchial washings but not visualized by imaging or bronchoscopy
T0	No evidence of primary tumor
Tis	Carcinoma in situ
T1	Tumor ≤3 cm in greatest dimension surrounded by lung or visceral pleura without bronchoscopic evidence of invasion more proximal than the lobar bronchus (ie, not in the main bronchus)*
T1a(mi)	**Minimally invasive adenocarcinoma**¶
T1a	**Tumor ≤1 cm in greatest dimension***
T1b	**Tumor >1 cm but ≤2 cm in greatest dimension***
T1c	**Tumor >2 cm but ≤3 cm in greatest dimension***
T2	Tumor >3 cm **but ≤5 cm** or tumor with any of the following features:Δ ▪ **Involves main bronchus regardless of distance from the carina but without involvement of the carina** ▪ Invades visceral pleura ▪ **Associated with atelectasis or obstructive pneumonitis that extends to the hilar region, involving part or all of the lung**
T2a	**Tumor >3 cm but ≤4 cm in greatest dimension**
T2b	**Tumor >4 cm but ≤5 cm in greatest dimension**
T3	**Tumor >5 cm but ≤7 cm in greatest dimension** or associated with separate tumor nodule(s) in the same lobe as the primary tumor or directly invades any of the following structures: chest wall (including the parietal pleura and superior sulcus tumors), phrenic nerve, parietal pericardium
T4	**Tumor >7 cm in greatest dimension** or associated with separate tumor nodule(s) in a different ipsilateral lobe than that of the primary tumor or invades any of the following structures: **diaphragm**, mediastinum, heart, great vessels, trachea, recurrent laryngeal nerve, esophagus, vertebral body, and carina

N: Regional lymph node involvement	
Nx	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Metastasis in ipsilateral peribronchial and/or ipsilateral hilar lymph nodes and intrapulmonary nodes, including involvement by direct extension
N2	Metastasis in ipsilateral mediastinal and/or subcarinal lymph node(s)
N3	Metastasis in contralateral mediastinal, contralateral hilar, ipsilateral or contralateral scalene, or supraclavicular lymph node(s)
M: Distant metastasis	
M0	No distant metastasis
M1	Distant metastasis present
M1a	Separate tumor nodule(s) in a contralateral lobe; tumor with pleural or pericardial nodule(s) or malignant pleural or pericardial effusion[◇]
M1b	**Single extrathoracic metastasis**[§]
M1c	**Multiple extrathoracic metastases in one or more organs**







Back to our patient…

Tumor size: 1.3 cm

EBUS: negative

PET: no definitive radioactive uptake in hilum/mediastinum. No evidence of distant metastatic disease

Clinical-diagnostic stage: cT1bN0M0

Staging the mediastinum

TNM Classification

T: Tumor (size)

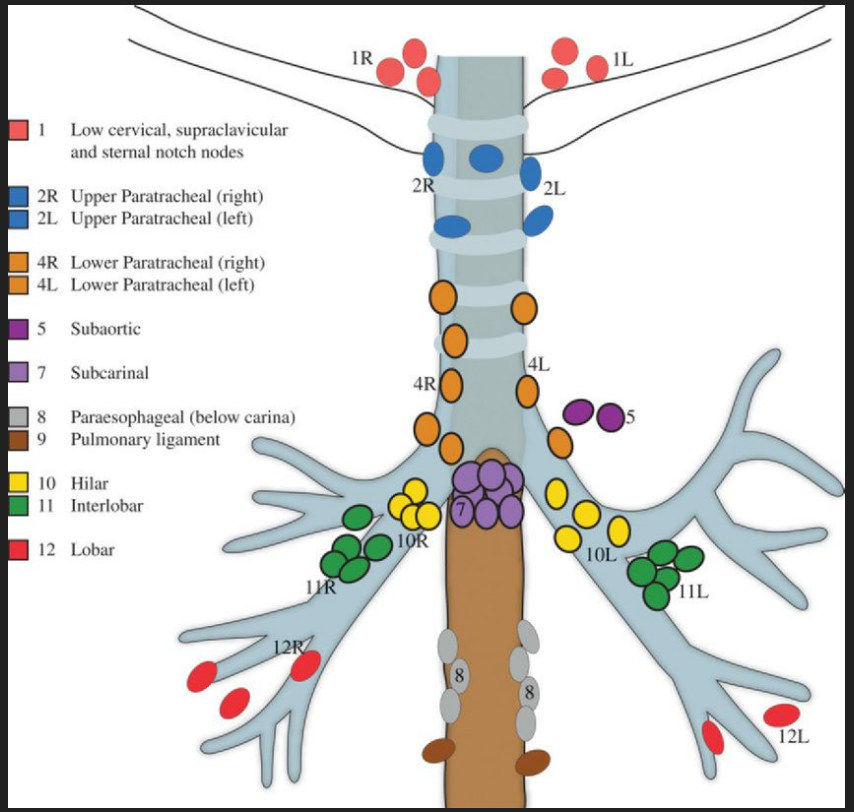
N: Nodes (regional)

M: Metastasis (extrathoracic)

The mediastinum is separated into 3 regions:

- N1 → Ipsilateral Hilar Lymph Node Stations
- N2 → Ipsilateral Mediastinal & Subcarinal Lymph Node Stations
- N3 → Contralateral Mediastinal/Hilar, Scalene, & Supraclavicular

Mediastinal Lymph Node Stations



Accessibility of different lymph node stations depends on the diagnostic modality

What are the diagnostic modalities used to sample the lymph nodes in the chest?

Hilar/Mediastinal Lymph Node Sampling

Mediastinoscopy

- Surgical approach allowing access to LN stations 2,4,7
- Extended mediastinoscopy can access pre-aortic (6) and AP window (5)

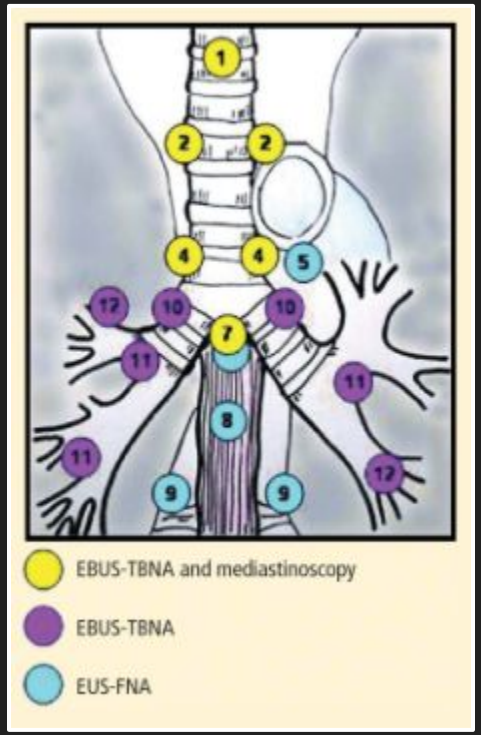
CT guided percutaneous biopsy

- Can access most stations with good accuracy
- Rarely performed due to complications of PTX

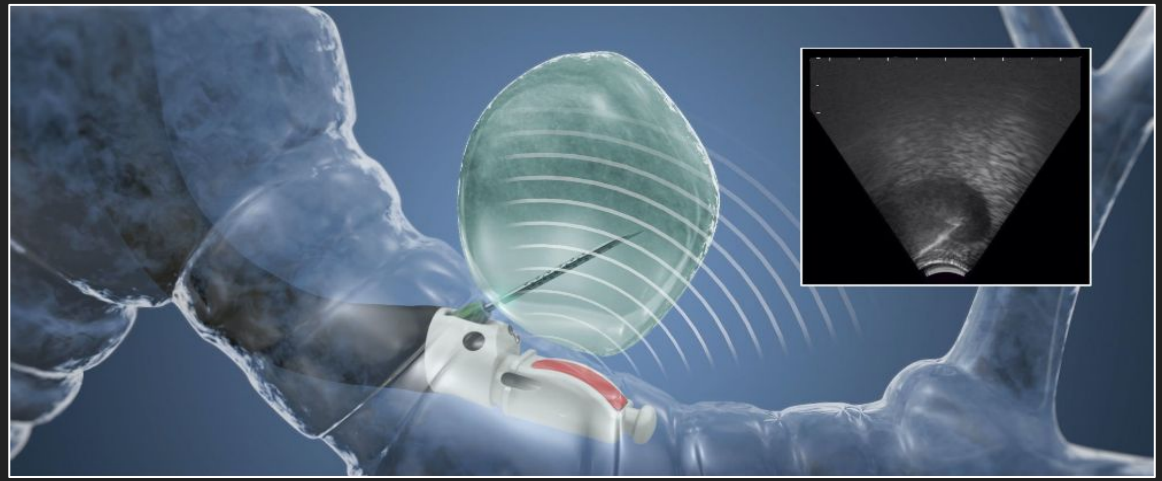
Endobronchial ultrasound (EBUS)

- Performed using a specialized bronchoscope with an ultrasound probe at the tip
- Allows access to LN stations 2, 4, 7, 10, 11, 12 with high sensitivity
- Needle does not enter the lung, hence PTX risk is negligible
- Complications include minor bleeding and pneumomediastinum (uncommon)

EBUS vs EUS vs Mediastinoscopy



EBUS



EBUS-TBNA versus Mediastinoscopy Mediastinal Nodal Staging of NSCLC

Journal of Thoracic Oncology, 2015

EBUS-TBNA: 138 patients

EBUS-TBNA + Mediastinoscopy: 127 patients

	Sensitivity	Specificity	Accuracy	PPV	NPV
EBUS-TBNA	88%	100%	92.9%	100%	85.2%
Mediastinoscopy	81.3%	100%	89%	100%	78.8%

EBUS-TBNA Take-Home Points

Allows for **more complete staging of both the hilum and mediastinum** compared to mediastinoscopy

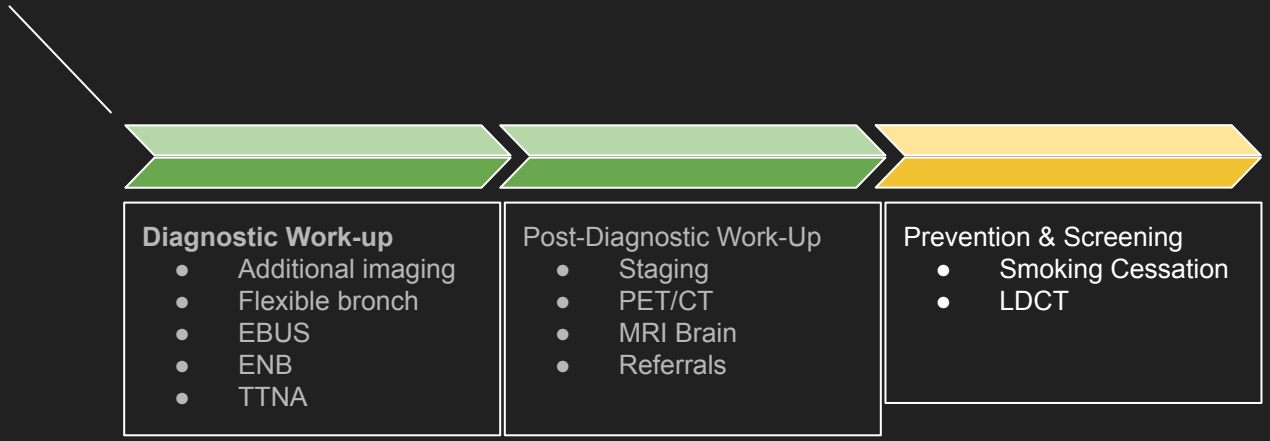
Always start on the contralateral side (N3 nodes)

- Eliminates the possibility of cross-contamination
- When ROSE is employed, a positive N3 node essentially ends the procedure

Prevention & Screening

Abnormal Imaging Study

- Incidental on chest x-ray or CT scan
- LDCT



Smoking Cessation

Single most important modifiable risk factor in the development of lung cancer

Evidence-based approach

Clinician involvement increases the likelihood that the patient will successfully quit

The 5 A's Approach

Intervention	Technique
Ask	Implement an office system that ensures every patient is questioned about their tobacco-use status at every visit
Advise	Strongly urge all tobacco users to quit in a clear and personalized manner
Assess	Determine the patient's willingness to quit within the next 30 days
Assist	Provide resources and aid for the patient to quit
Arrange	Schedule close follow-up

Fiore MC, Jaen C, Baker T, et al. Treating tobacco use and dependence; 2008

Assisting Patients With Smoking Cessation

- Help the patient estab
  - Set a quit date
  - Remove tobacco proc
- Provide practical cour
  - Total abstinence is es
  - Anticipate triggers and
  - Encourage housemat
- Social support system
  - Encouraging clinical e
  - Support from spouse/
- Approved pharmacoth
- Provide supplementa
  - Middlesex Health Sm
  - Outpatient
  - Free teleph

20

"Cold turkey" may not be a realistic option for most patients

FDA-Approved Pharmacotherapy

Nicotine Replacement

- Nicotine patch (Nicoderm)
  - 21 mg for > 10 cigarettes/day
  - 14 mg for < 10 cigarettes/day
    - Apply 1 patch daily; rotate application site
- Nicotine gum (Nicorette)
  - 2 mg if first cigarette is > 30 minutes after waking
  - 4 mg if first cigarette is < 30 minutes after waking
    - 1 piece every hour PRN; maximum < 24 pieces/day
- Nicotine lozenge (same dosing as gum)
    - 1 piece every 1-2 hours PRN; maximum 5 lozenges/6 hours
- Nicotine inhaler (Nicotrol)
  - 10 mg per cartridge
    - Inhale PRN every 1-2 hours; maximum 16 cartridges/day
- Nicotine nasal spray (Nicotrol NS)
  - 0.5 mg per spray (10 mg/mL)
    - 1 spray to each nostril every 1-2 hours PRN; maximum 10 sprays/hour

Available OTC
Available Rx Only

FDA-Approved Pharmacotherapy

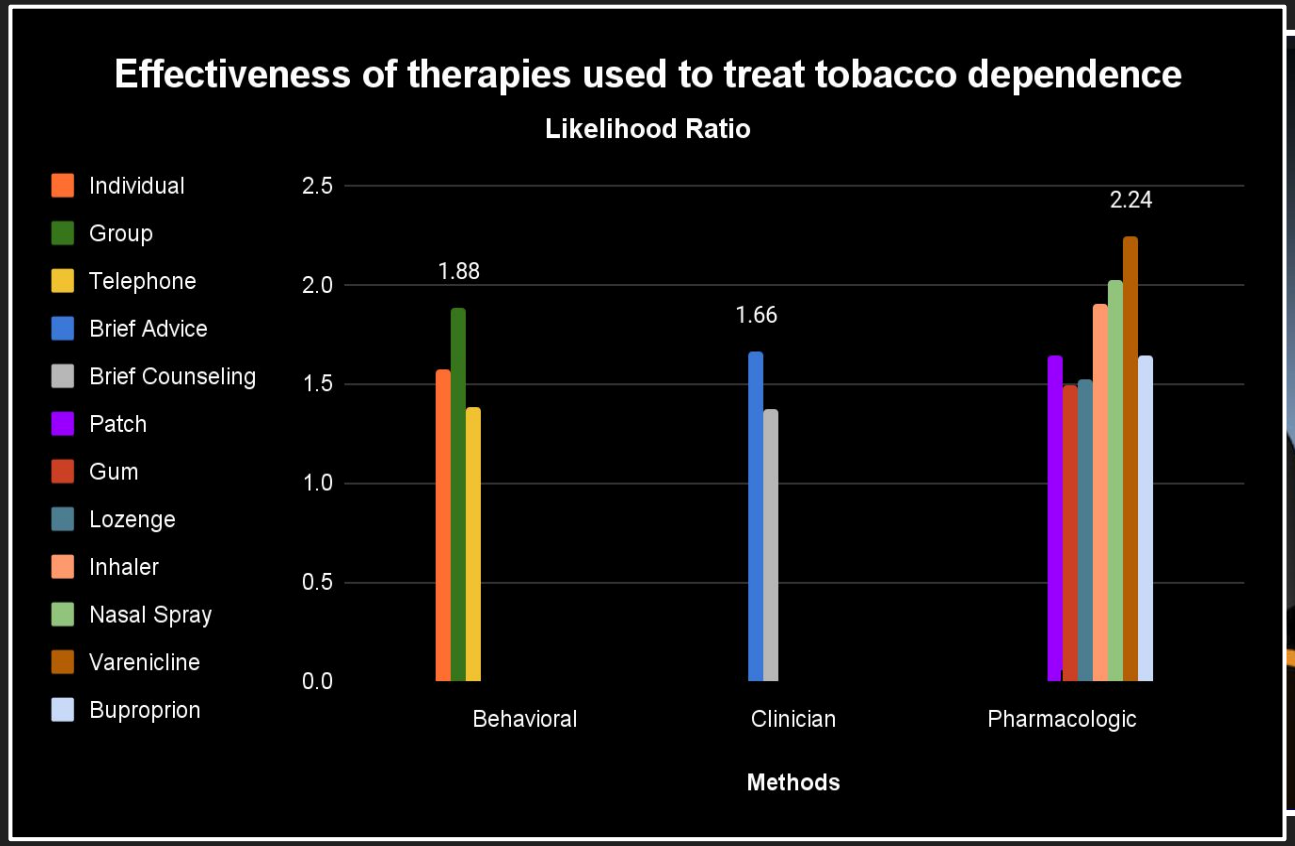
Varenicline (Chantix)

- 0.5 mg x 3 days; 0.5 mg BID x 3 days; 1 mg daily
- Start 1-2 weeks before quit date (may start up to 5 weeks prior)
- Abruptly quitting is preferred but gradual reduction is acceptable
- Patients who are unable to gradually reduce consumption, or fail to entirely quit by 12 weeks should stop taking Varenicline
- MOA: binds 5-HT3 receptor with moderate affinity to stimulate DA activity resulting in decreased craving and withdrawal symptoms
- Should avoid in patients with unstable psychiatric status or history of SI and PTSD
- Can cause vivid, strange, and unusual dreams

Bupropion (Wellbutrin)

- 150 mg/day x 3 days; 150 mg BID
- Start 1-2 weeks before quit date
- Abruptly quitting is preferred but gradual reduction is acceptable
- Contraindicated in patients with seizure disorder

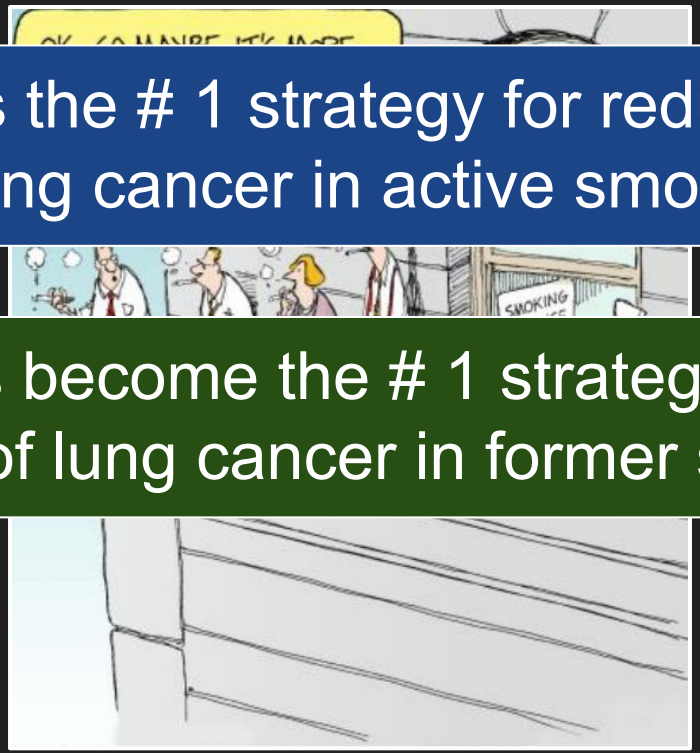
So What's The Verdict?



- Versus "minimal" or usual care
- Behavioral + Pharmacotherapy **RR 1.83**

“Old Habits Die Hard”

PREVENTION is the # 1 strategy for reducing the burden of lung cancer in active smokers



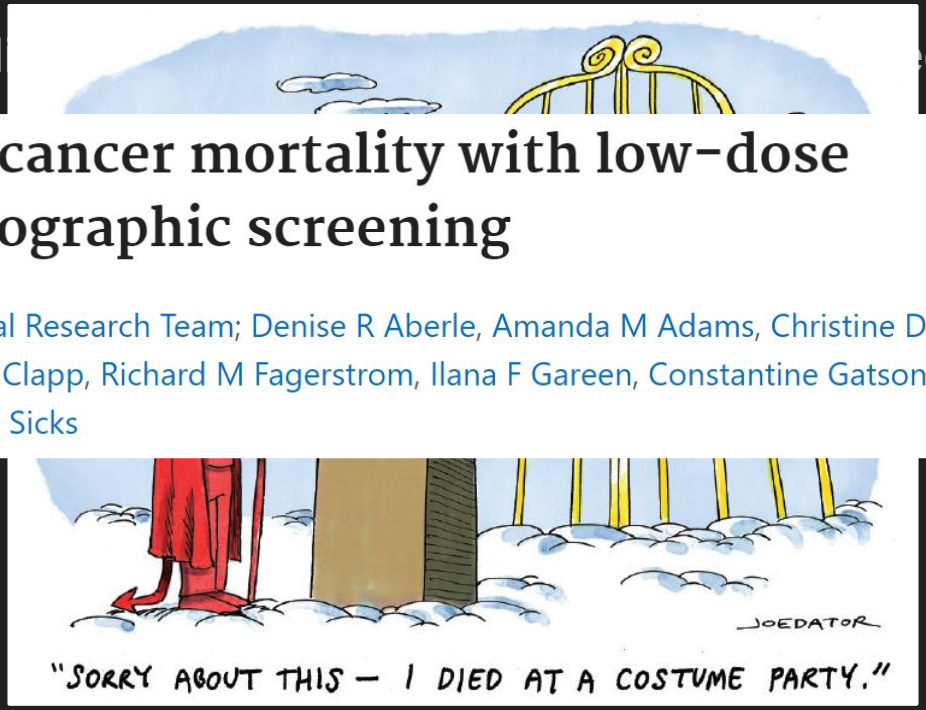
SCREENING has become the # 1 strategy for reducing the burden of lung cancer in former smokers

Who Is Invited Into This Exclusive Society?

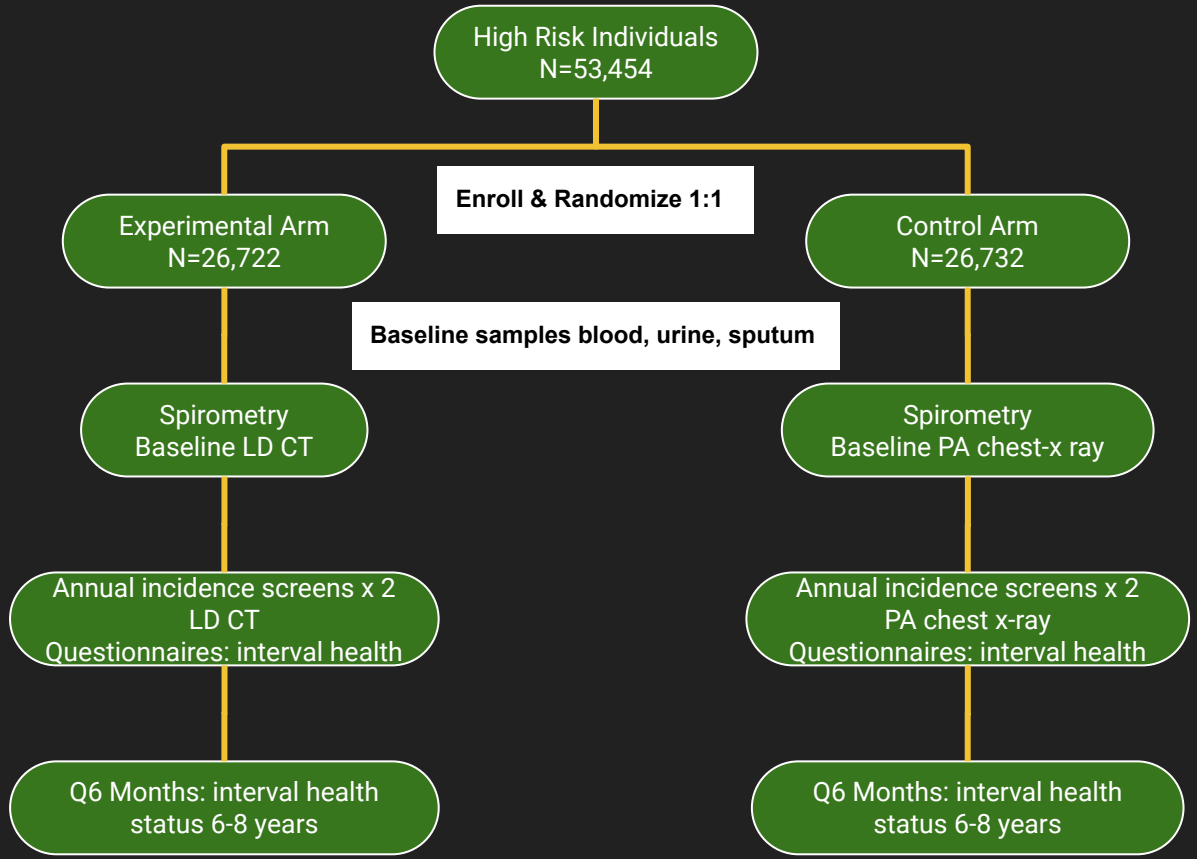
In 2011, NEJM publ… …ening Trial”

Reduced lung-cancer mortality with low-dose computed tomographic screening

National Lung Screening Trial Research Team; Denise R Aberle, Amanda M Adams, Christine D Berg, William C Black, Jonathan D Clapp, Richard M Fagerstrom, Ilana F Gareen, Constantine Gatsonis, Pamela M Marcus, JoRean D Sicks



National Lung Screening Trial



Eligibility

- 55-74 years of age
- Current + Former, > 30 pack-year
- Smoked within last 15 years
- No prior history of lung ca
- No present symptoms of lung ca
- No medical conditions that pose significant risk of mortality during trial period

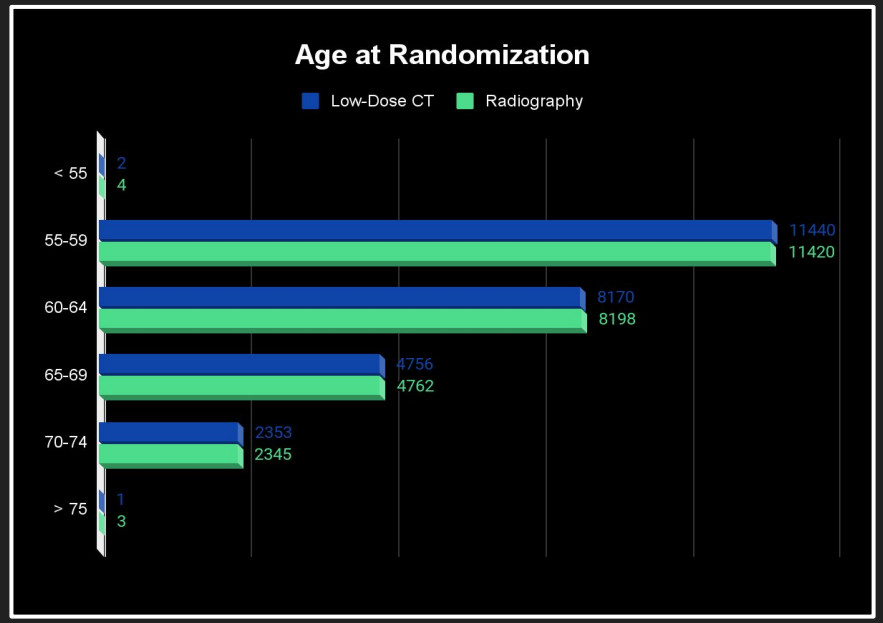
Primary analysis was a comparison of lung-cancer mortality between the two groups (intention-to-screen)

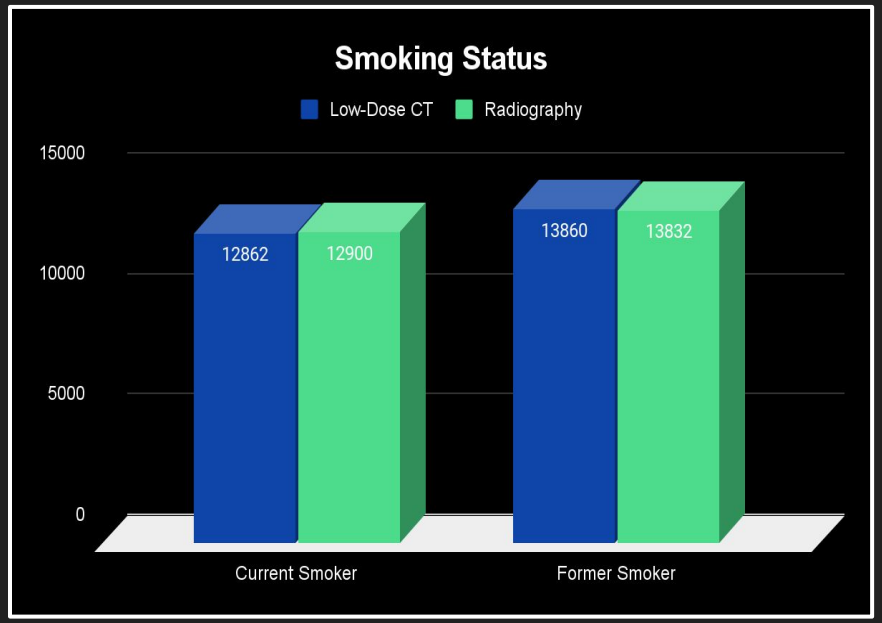
Study was powered to detect a **21% decrease in mortality**

National Lung Screening Trial
Baseline Characteristics

Sex
- Male 59% both groups
- Female 41% both groups

Race
- White 90% both groups
- Black 4.5% both groups
- Asian 2% both groups





So What Did The Results Show…

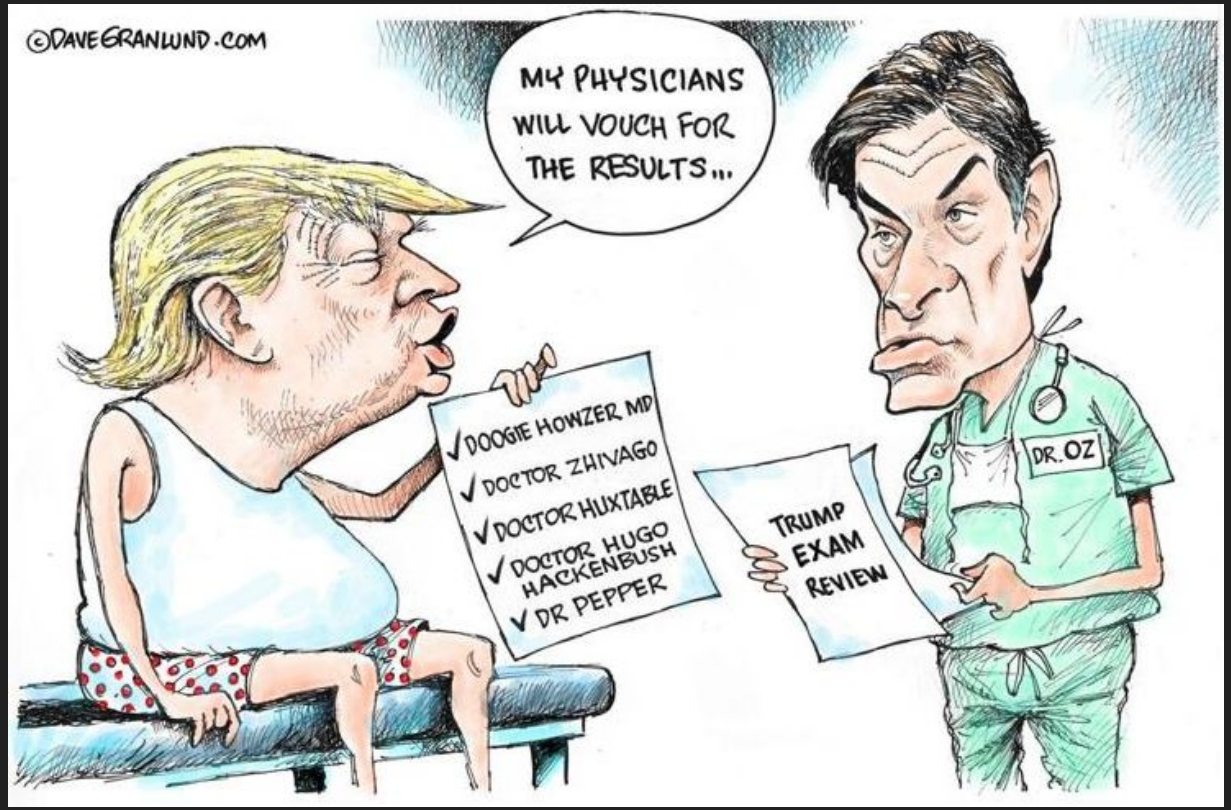
Positive Result
CT: at least 4 m
X-ray: nodule of any size

	Low-Dose CT	Radiography
Rate of Positive Screening	24.2%	6.9%
Incidence of Lung Cancer	645 per 100,000 person years (1060)	572 per 100,000 person years (941)
Deaths from Lung Cancer	247 per 100,000 person years	309 per 100,000 person years

Relative Reduction in mortality from lung cancer in low-dose CT was 20.0%

The rate of death from any cause was reduced in the low-dose CT by 6.7%

Screening with the use of low-dose CT reduces mortality from lung cancer


©DAVEGRANLUND.COM
MY PHYSICIANS WILL VOUCH FOR THE RESULTS...
✓DOOGIE HOWZER MD
✓DOCTOR ZHIVAGO
✓DOCTOR HUXTABLE
✓DOCTOR HUGO HACKENBUSH
✓DR PEPPER
TRUMP EXAM REVIEW
DR. OZ

Lung Screening

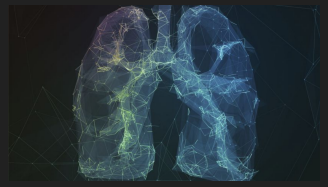
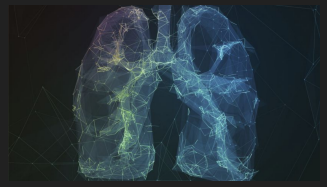
Organization	Recommendation	Year
American Association of Thoracic Surgery	Recommends annual low-dose CT scan screening for high-risk individuals (ages 55 to 79 years with ≥30 pack-year history of smoking and current smoker or quit within past 15 years; ages 50 to 79 years with ≥20 pack-year history and cumulative risk >5% over next 5 years; or lung cancer survivors with no incidence of disease for ≥4 years).	2012
American Cancer Society	Recommends annual low-dose CT scan screening for high-risk individuals (ages 55 to 74 years with ≥30 pack-year history of smoking and current smoker or quit within past 15 years).	2013
American College of Chest Physicians	Recommends annual low-dose CT scan screening for high-risk individuals (ages 55 to 77 years with ≥30 pack-year history of smoking and current smoker or quit within past 15 years).	2018
American Society of Clinical Oncology	Recommends annual low-dose CT scan screening for high-risk individuals (ages 55 to 74 years with ≥30 pack-year history of smoking and current smoker or quit within past 15 years).	2019
Canadian Task Force on the Periodic Health Examination	Recommends screening asymptomatic adults aged 55 to 74 years with at least a 30 pack-year smoking history who smoke or quit smoking <15 years ago with low-dose CT every year for 3 consecutive years.	2016
National Comprehensive Cancer Network	Recommends annual low-dose CT scan screening for high-risk individuals (ages 55 to 74 years with ≥30 pack-year history of smoking or if no longer smoking, smoking cessation within 15 years, or age ≥50 years with a ≥20 pack-year history of smoking with 1 additional risk factor*).	2018
US Preventive Services Task Force	Recommends annual low-dose CT scan screening for high-risk individuals (ages 50 to 80 years with a 20 pack-year history of smoking and current smoker or quit within past 15 years). Discontinue when person has not smoked for 15 years or if limited life expectancy.	2021
Centers for Medicare and Medicaid Services	Recommends annual low-dose CT scan screening after completion of a shared decision-making visit for high-risk individuals (ages 55 to 77 years with ≥30 pack-year history of smoking and current smoker or quit within the past 15 years).	2015
American Academy of Family Physicians	Concludes that evidence is insufficient to recommend for or against low-dose CT scan screening in persons at high risk for lung cancer based on age and smoking history.	2013

US Preventative Task Force

Recommendations for LDCT
Published March 2021

- Adults 50-80 years of age
- At least 20 pack year smoking history (active or former)
- Must have quit within the last 15 years
- No signs/symptoms of active lung ca
- Without comorbidity that substantially reduces life-expectancy
- Shared decision making must be documented

https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/lung-cancer-screening

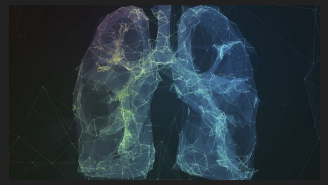
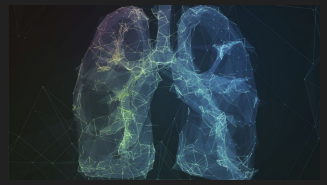



American College of Radiology™

Lung-RADS® v2022

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 oflungs 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 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 slowly growing (see note 7)	
		Airway nodule, subsegmental - at baseline, new, or stable (see note 11)	
		Category 3 lesion that is stable or decreased in size at 6-month follow-up CT **OR** Category 4B lesion proven to be benign in etiology following appropriate diagnostic workup	
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 lesion that is stable or decreased in size at 3-month follow-up CT (excluding airway nodules)	

4A	**Suspicious** Estimated Population Prevalence: 4%	**Solid nodule:** • ≥ 8 to < 15 mm (≥ 268 to < 1,767 mm^3) at baseline **OR** • Growing < 8 mm (< 268 mm^3) **OR** • New 6 to < 8 mm (113 to < 268 mm^3)	3-month LDCT; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm^3) solid nodule or solid component
		Part solid nodule: • ≥ 6 mm total mean diameter (≥ 113 mm^3) with solid component ≥ 6 mm to < 8 mm (≥ 113 to < 268 mm^3) at baseline **OR** • New or growing < 4 mm (< 34 mm^3) solid component	
		Airway nodule, segmental or more proximal - at baseline (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 - stable or growing (see note 11)	Referral for further clinical evaluation
		Solid nodule: • ≥ 15 mm (≥ 1767 mm^3) at baseline **OR** • New or growing ≥ 8 mm (≥ 268 mm^3)	Diagnostic chest CT with or without contrast; PET/CT may be considered if there is a ≥ 8 mm (≥ 268 mm^3) 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 mm^3) at baseline **OR** • New or growing ≥ 4 mm (≥ 34 mm^3) 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)	
S	**Significant or Potentially Significant** Estimated Population Prevalence: 10%	**Modifier:** May add to category 0-4 for clinically significant or potentially clinically significant findings unrelated to lung cancer (see note 15)	As appropriate to the specific finding

Lung RADS 2022 Updates/Changes

- RADS 0 for findings suggestive of an inflammatory process
- “Step down” approach
  - Previous guidelines for RADS 3 and 4 lesions, if stable on short interval follow up, was assigned a RADS 2, and 12 month follow up was recommended.
  - Updated guidelines, a stable follow up on a RADS 4 lesion gets assigned a RADS 3, and a stable follow up for a RADS 3 lesion is assigned a RADS 2 with 12 month follow up.

Patients who are recommended to return to annual (12-month) screening should have their next LDCT ordered from the date of the follow-up scan.
<u>NOT</u> the original date

Middlesex Health

MH Total Lung Care Center (TLCC)

Established in 2012

Underwent major restructuring in Fall 2018

- Justin Goralnik named medical director of the TLCC
- Jessica Poetzsh named lung cancer nurse navigator and TLCC coordinator
- Implemented the high risk lung nodule pathway
  - Incidental and/or screening CT scans with suspicious findings were flagged for review
- Aim of the high risk nodule pathway was primarily to:
  - Identify suspicious lung findings in patients
  - Reduce the length of time from suspicious findings on CT to diagnosis
  - Create a multidisciplinary team that consists of primary care, pulmonary, radiology, thoracic surgery, radiation oncology, medical oncology
  - Ensure patients have the appropriate diagnostic testing and follow up

Middlesex Health Cancer Center

Middlesex Health Total Lung Care Center

Middlesex Health Radiology Department

Cancer Center Director
Justin Drew, MSN, RN, NEA-BC

Cancer Center Nurse Manager
Ryann Nocereto, MSN, RN, OCN

Diagnostic Imaging Director
Jason Bohn, MBA, RT(R)(CT)

Total Lung Care Center Medical Director
Justin Goralnik, MD

- Oversight of all Programmatic Decisions; works collaboratively with TLCC Coordinator/Nurse Navigator
- Reviews High Risk Lung Cases with the Nurse Navigator & Makes Recommendations for Management
- Sees Patients in High Risk Lung Clinic on a Prioritized Scheduling basis in the Pulmonary Office

Physician Champion
Ricardo Perez, MD

Lung Cancer Nurse Navigator/ TLCC Coordinator
Jessica Poetzsch, MSN, RN-BC

- Provides Oncology Nurse Navigation Services to Lung Cancer Patients
- Manages High Risk Lung Pathway & Clinic (EPIC High Risk Lung Pathway Dashboard, Provider Referrals)
- Manages Lung Cancer Screening Center of Excellence Status and Program Statistics; Manages High Risk Lung Screening Cases (RADS 4)
- Chairs TLCC Committee. Plans and facilitates quarterly Interdisciplinary programmatic meetings.

Administrative Staff
Erica Cove

- Provides Administrative Support to the TLCC coordinator on an as needed basis; Provides support for special initiatives/projects

- Advises on Programmatic Decisions on an as Needed Basis

Radiology Chairman
Nancy Rini, MD

Physician Advocate
Michael Crain, MD

- Manages Low Risk Lung Nodule Pathway (PACS Lung Nodule Folder, Epic BPAs)
- Delegates to Radiology Facilitators Any Grady, Jeneen Pylant, & Jessica Braun for assistance on an as needed basis

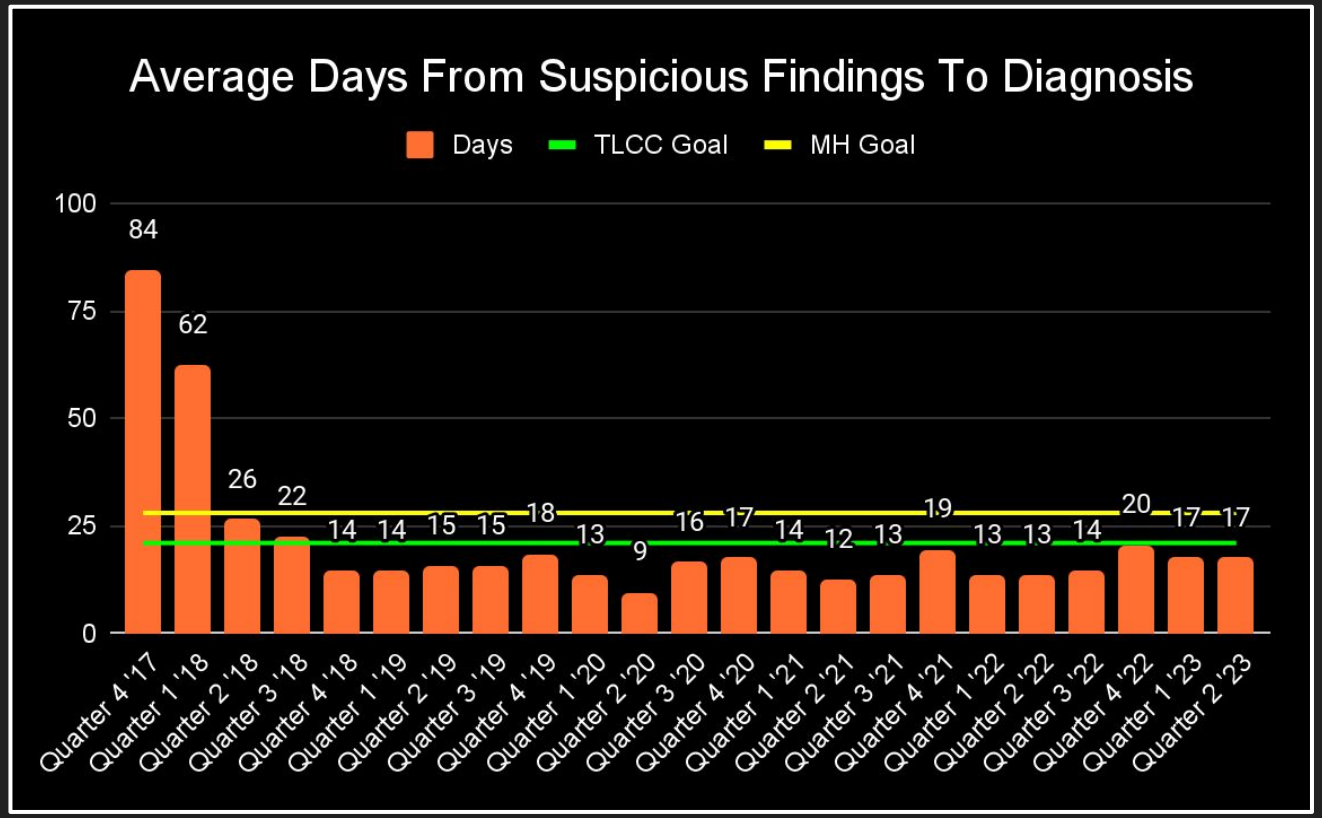
Radiology Administrative Supervisor
Jennifer McQueeney

- Manages ACR Lung Cancer Screening Registry

CT Supervisor
Bridget Hill, B.S., R.T. (R) (CT)

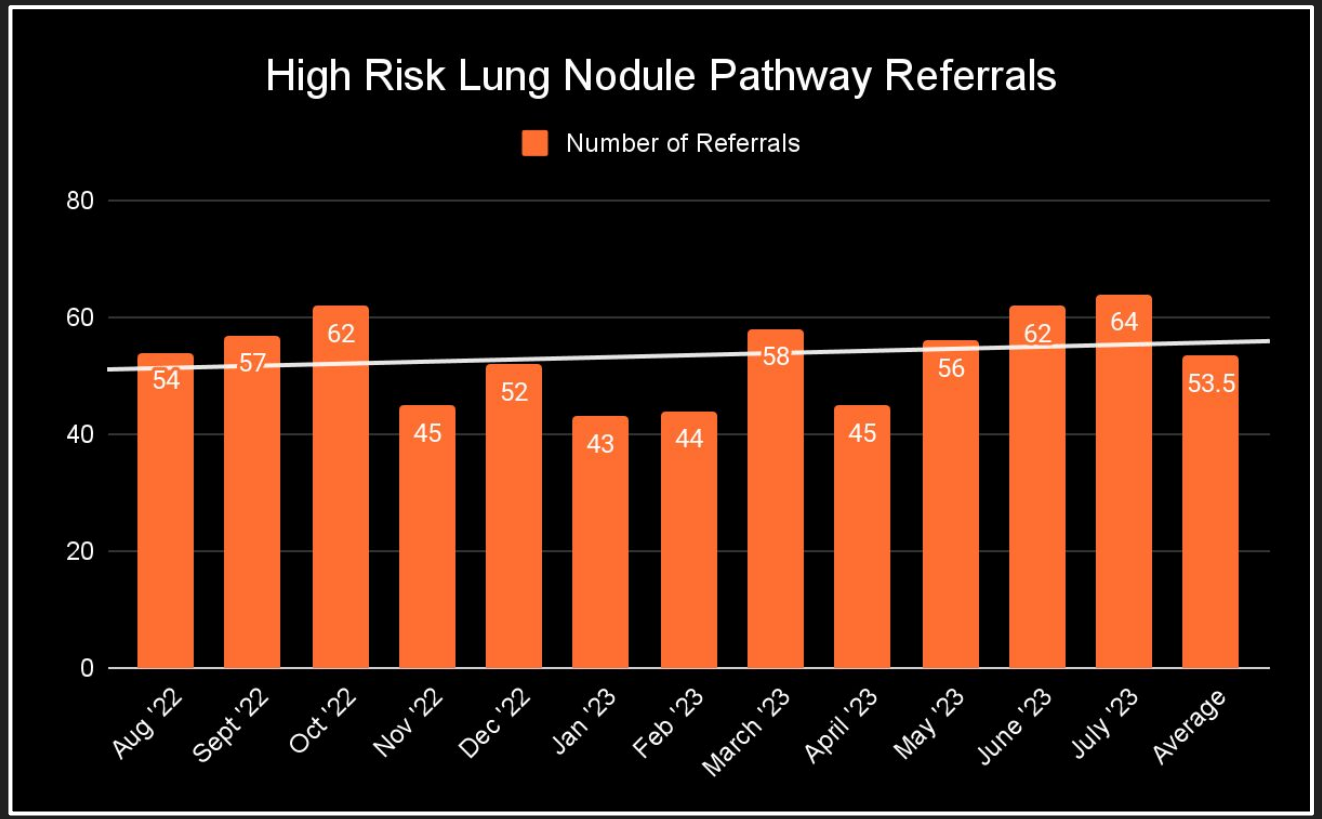
Updated Nov 2021

MH Data Reporting

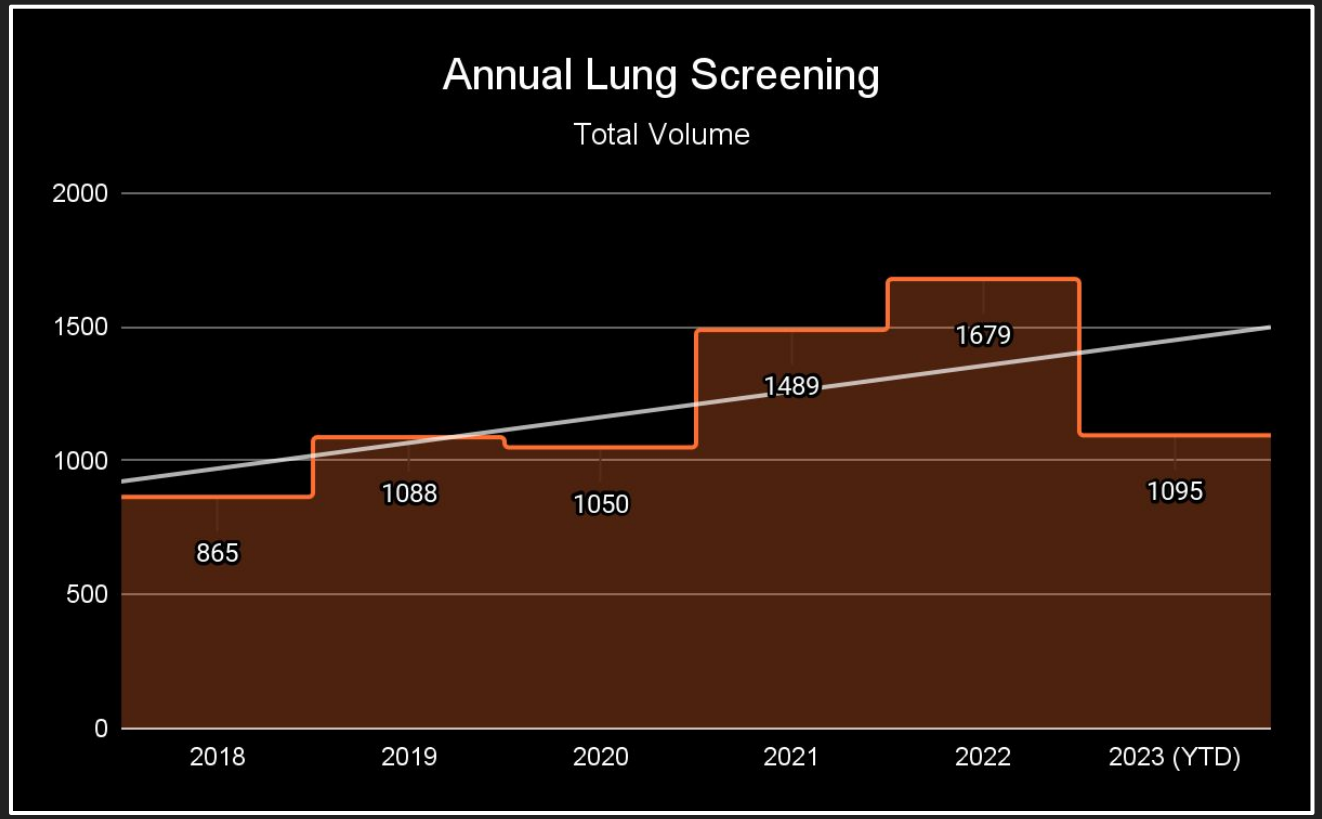


Since the inception of the high risk lung nodule pathway, we have reduced the average days from findings to diagnosis to below both MH and TLCC goals

MH Data Reporting: High Risk Pathway



MH Data Reporting: Lung Cancer Screening



MIDDLESEX HEALTH remains a

Screening Center of Excellence

&

ACR Screening Center

- Committed to responsible, high quality screening practices
- Multidisciplinary approach dedicated to achieving the best outcomes for our patients
- Utilization of comprehensive diagnostic procedures and advanced treatment technology

https://middlesexhealth.org/cancer-center/cancer-types/lung-cancer

Middlesex Health Community Benefit

Lung Cancer Screening

$99 Self-Pay Fee

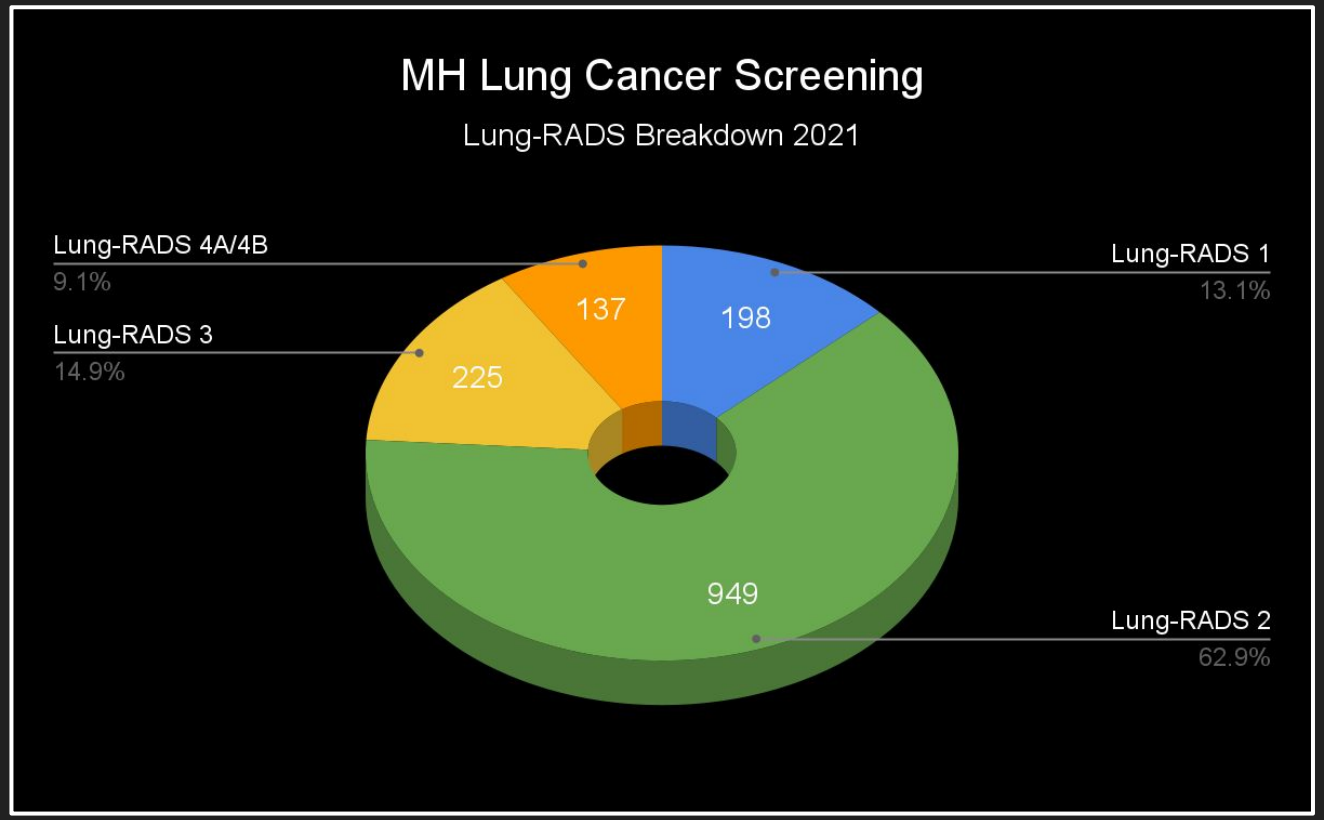
Per policy, patients must arrange payment with MH billing dept ext. 4870

Qualifications

- 50-80 years old
- 20 pack year smoking history
- Current or former smoker, quit within last 15 years

*Must meet all lung screening guidelines and not have insurance coverage option

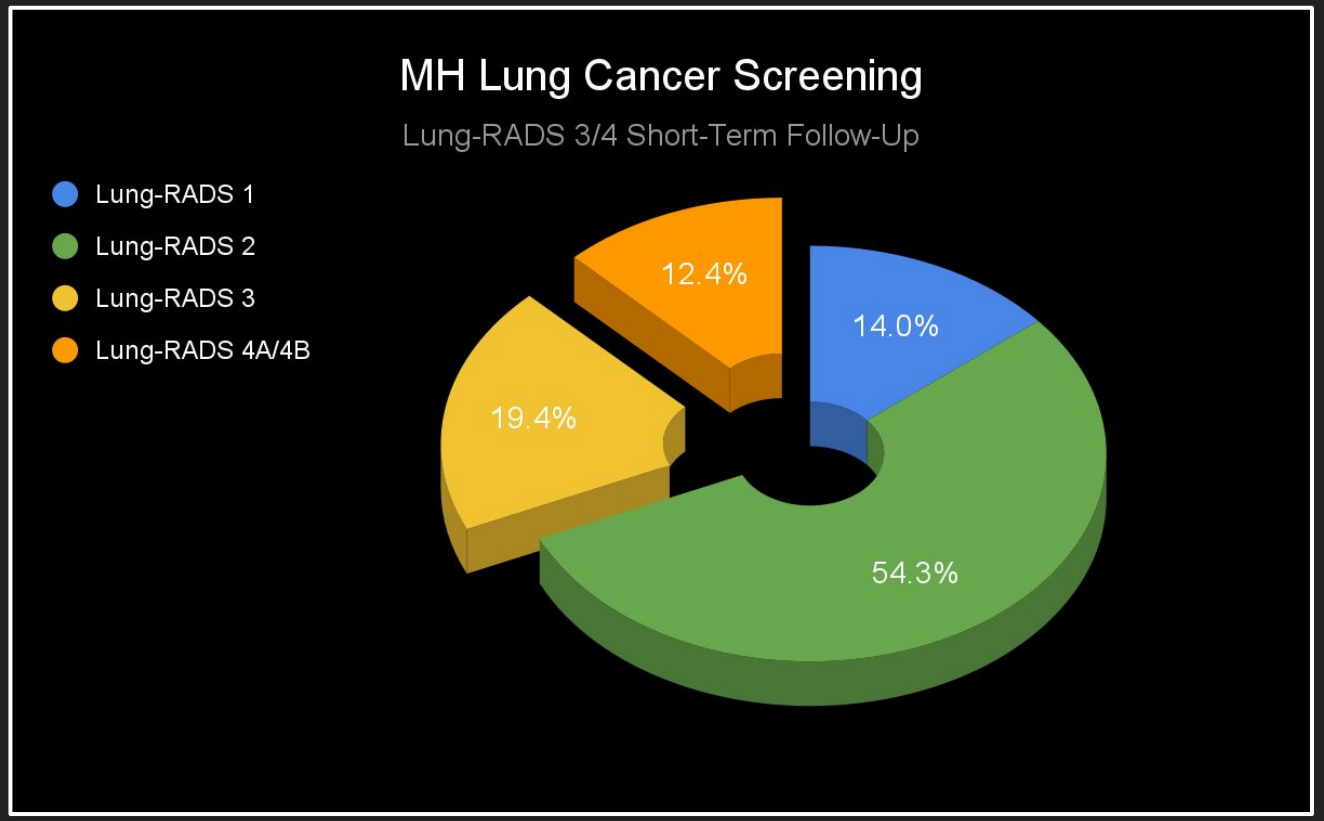
MH Data Reporting: 2021 Lung-RADS Results



186 patients completed the recommended short-interval follow up CT scans

RADS 4B: 1 month OR tissue sampling vs PET
RADS 4A: 3 month
RADS 3: 6 month

MH Data Reporting: 2021 Short-Term Follow-up



⅓ **patients** went on to have additional short-interval follow up or tissue sampling

⅔ **patients** returned to annual screening

Category 3 and 4A nodules that are unchanged on short interval follow up are coded as Lung-RADS 2, and thus return to annual follow up.

The TLCC Improves Patient Care

Since November 2020, > 200 bronchoscopies have been performed on patients who have been “flagged” through the high risk lung nodule pathway

In 2023 alone, > 160 lung biopsies have been performed (bronchoscopic and percutaneous combined)

Jan 1 – Aug 8, 2023	62
BRONCHOSCOPY WITH EBUS AND NAVIGATION	24
BRONCHOSCOPY	29
BRONCHOSCOPY WITH ULTRASOUND	9
None of the above	0

Jan 1 – Aug 8, 2023	98
CT GUIDED NEEDLE BIOPSY LUNG	98
None of the above	0

ENB Data for MH

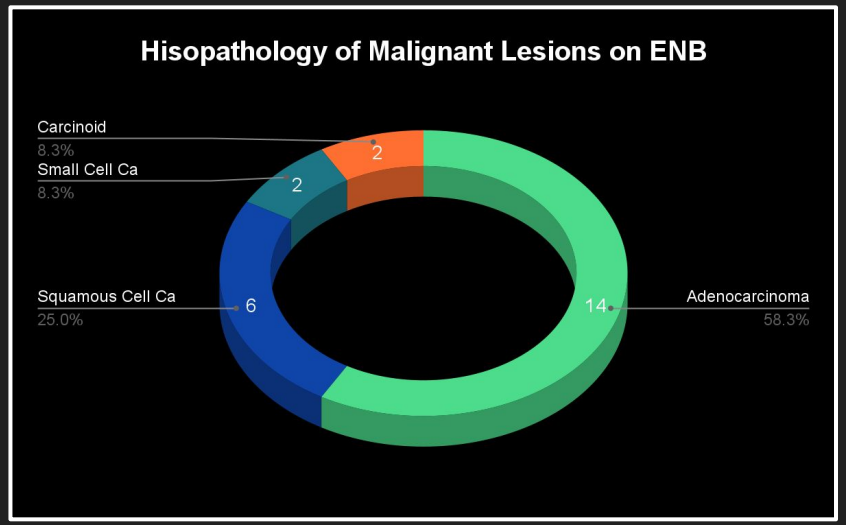
Total of 65 cases to date:

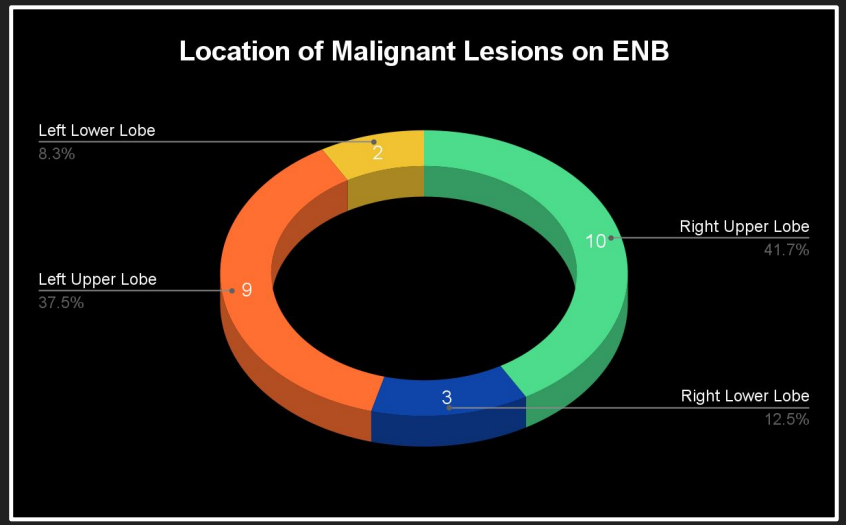
- **24 Cases** with biopsy-proven malignancy
- **35 Cases** of benign pathology including hamartoma, sarcoidosis, organizing pneumonia, chondroma, “chronic inflammation”, “acute inflammation”, and hemosiderin laden macrophages
- **2 Cases** of benign pathology on ENB, however EBUS confirmed malignancy
  - 1 small cell carcinoma
  - 1 metastatic renal cell carcinoma
- **2 Cases** of benign pathology on ENB, follow up TTNB + sarcoid and + NSCLC
- **2 Cases** of “atypical cells” on ENB went on to have TTNB showing fibrosis and chondroma

Of the 35 benign findings, multiple patients are still awaiting follow up CT imaging

As of today, **ENB yield is > 90%**

Characteristics of Malignant Lesions on ENB





Middlesex Health
Lung Nodule Clinic

Opened March 4th, 2021

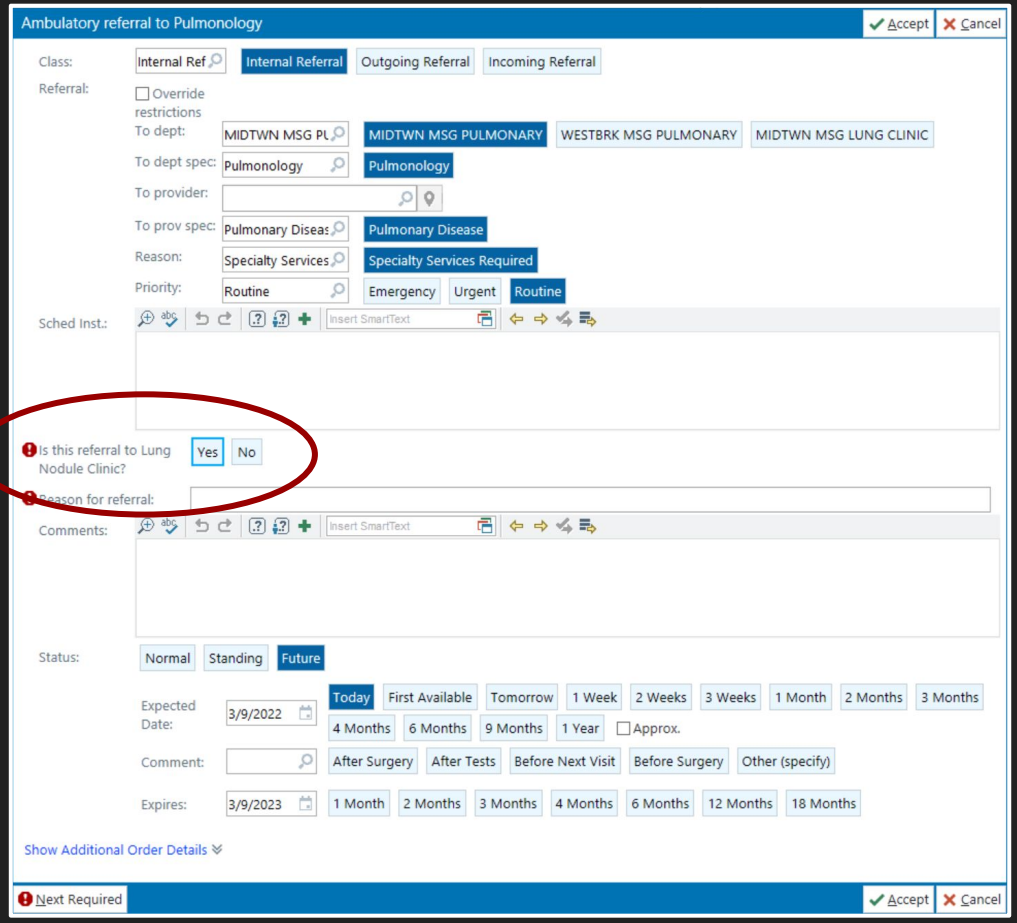
> 150 patients seen in 2023

Referrals can be made through Epic

Aim is to provide carefully coordinated, high quality care to patients through a collaborative, multidisciplinary approach

All patients with incidental nodules and lesions discovered on screening are welcome.

Lung Nodule Clinic Referral Process



THANK YOU.

LOLA

FRED

RIO

VIBBY