



# Lung Cancer: What the Primary Care Physician Needs To Know

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**MedNet21**  
Center for Continuing Medical Education

 **THE OHIO STATE UNIVERSITY**  
WEXNER MEDICAL CENTER

## Case history & physical exam

### History:

- 46 year old banker
- 2 month history of non-productive cough
- 15 pound weight loss
- Smoked 1 PPD for 30 years

### Physical Exam:

- Decreased breath sounds over right lower lobe
- Dullness to percussion lower right lung

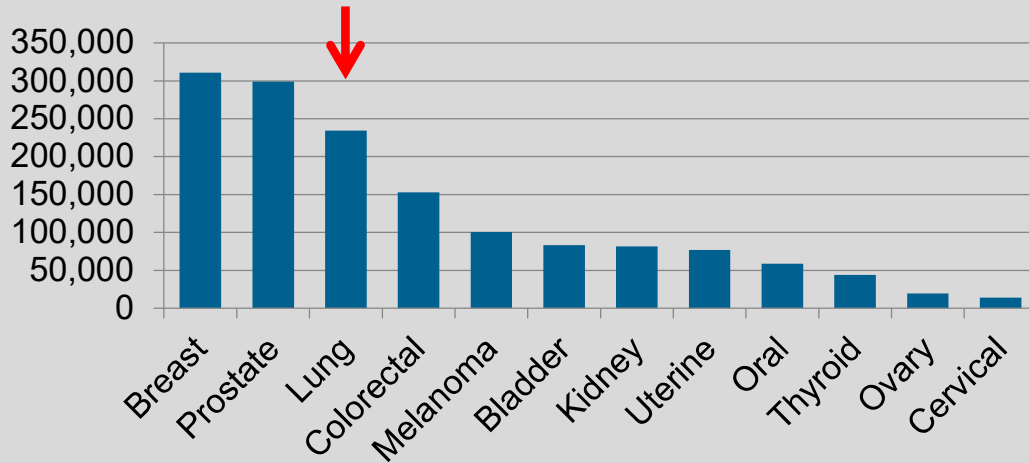


## Lung Cancer Epidemiology

- 238,340 new cases per year
- 127,070 U.S. deaths annually
- Lifetime risk:
  - 1:15 men
  - 1:17 women

## Incidence Of Common Cancers

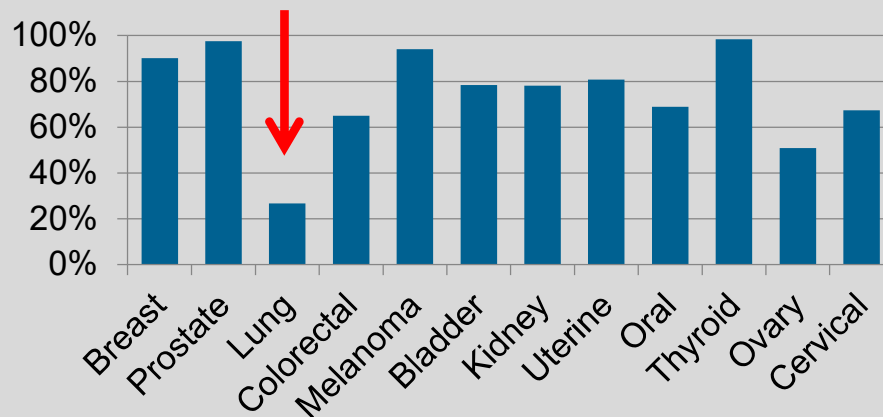
Estimated Number Of New Cancer Cases,  
U.S. 2024



National Cancer Institute SEER Data

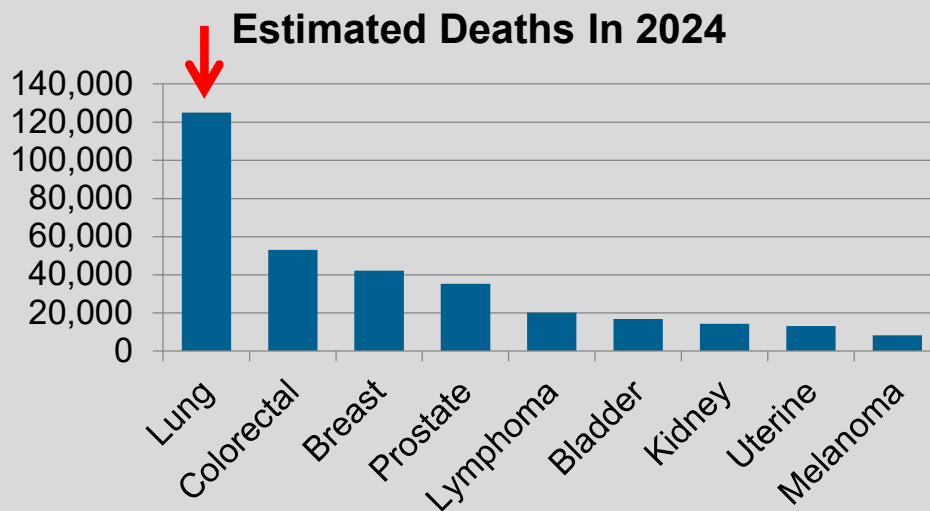
## Five-Year Survival Rates Of Common Cancers

Percent Surviving At Five Years:  
2014-2020



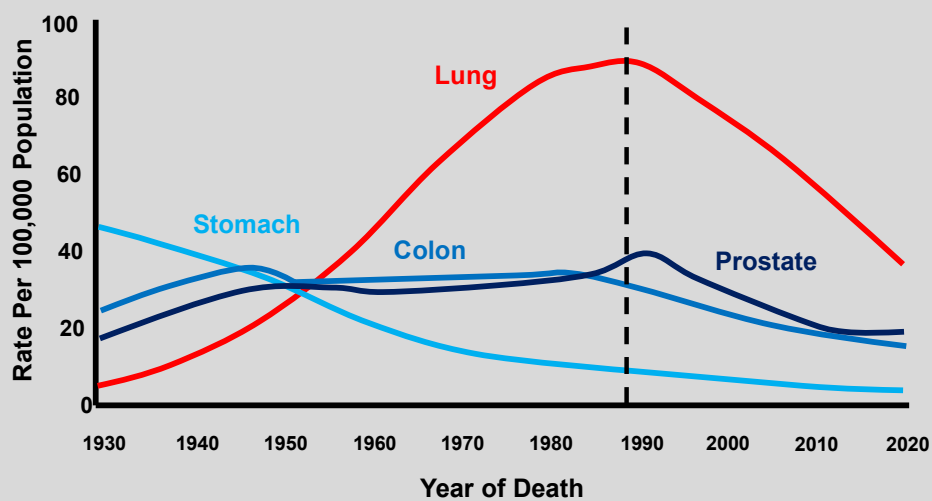
National Cancer Institute SEER  
Data

## Lung Cancer Kills More Americans Than Any Other Type Of Cancer



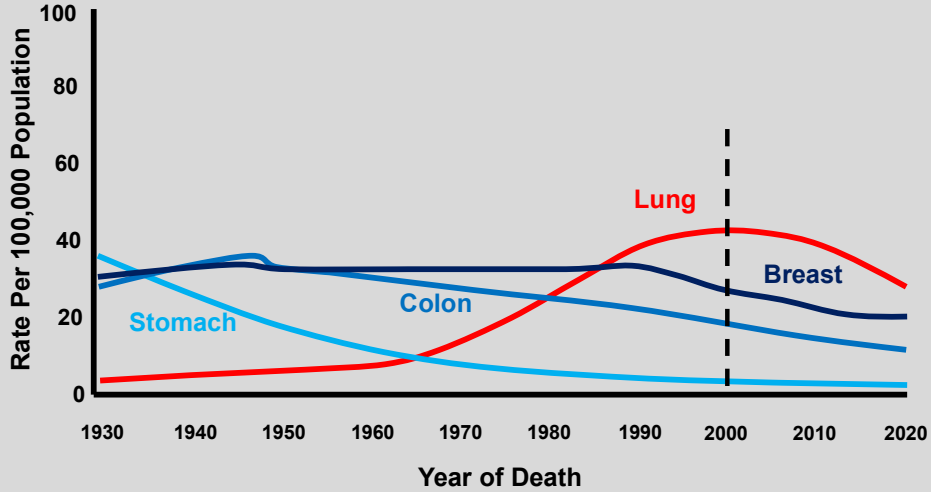
National Cancer Institute SEER Data

## Trends in Age-adjusted Cancer Death Rates by Site, Males, U.S., 1930-2021



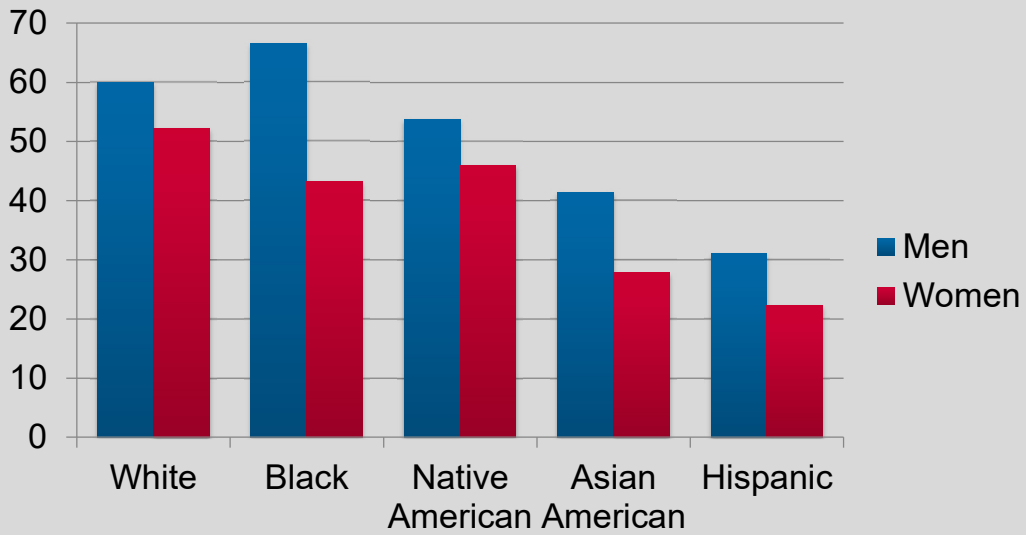
Data from CDC

### Trends in Age-adjusted Cancer Death Rates by Site, Females, U.S., 1930-2020



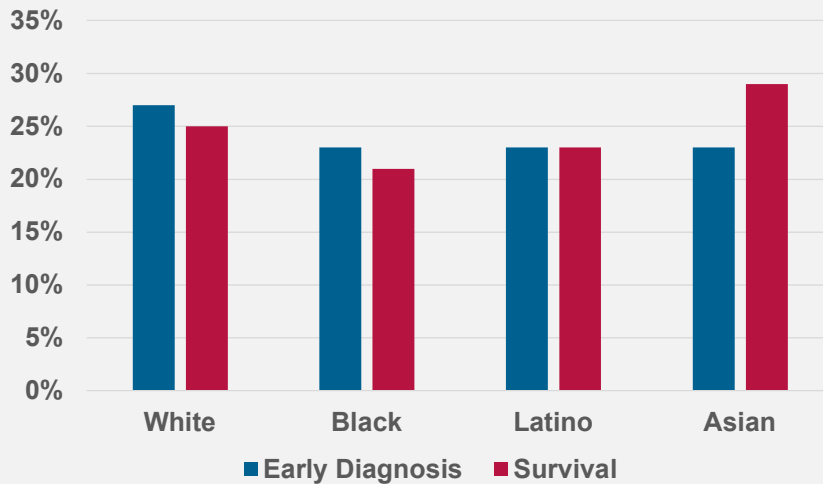
Data from CDC

### Incidence of lung cancer (per 100,000 population)

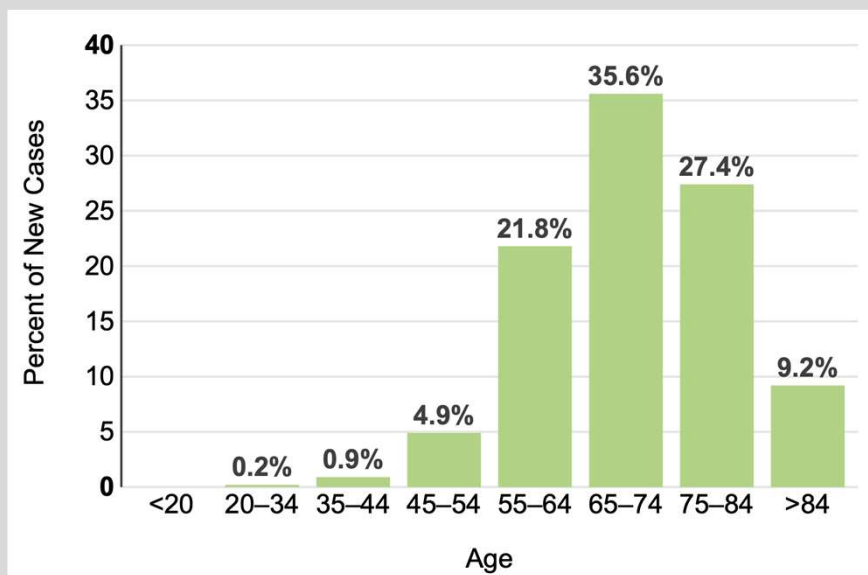


National Cancer Institute SEER Data (2017-2021)

## There are racial differences in lung cancer diagnosis and survival



## Age of diagnosis of lung cancer:



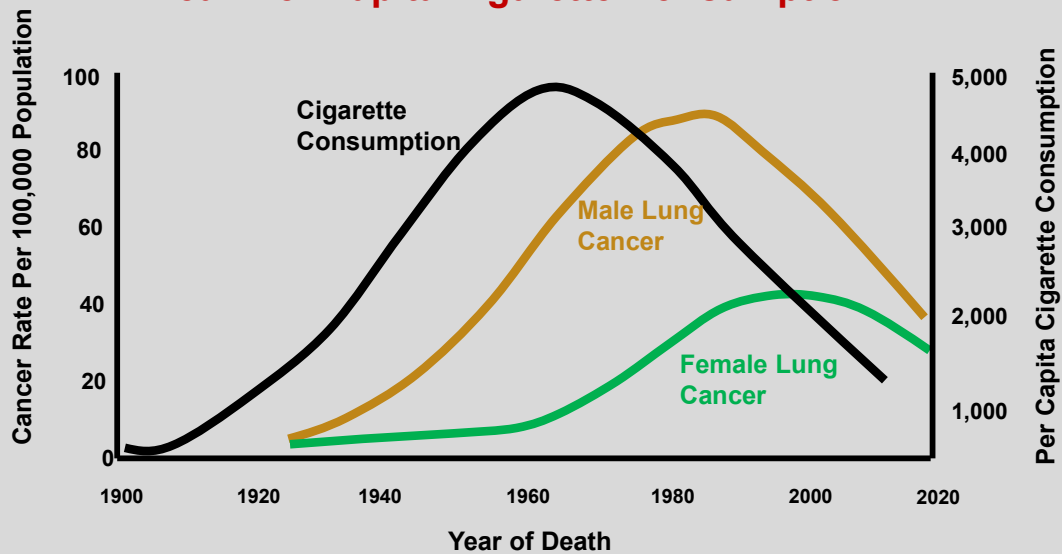
National Cancer Institute SEER data 2024 (2017-2021)

## Risk Factors For Lung Cancer

### ● Smoking

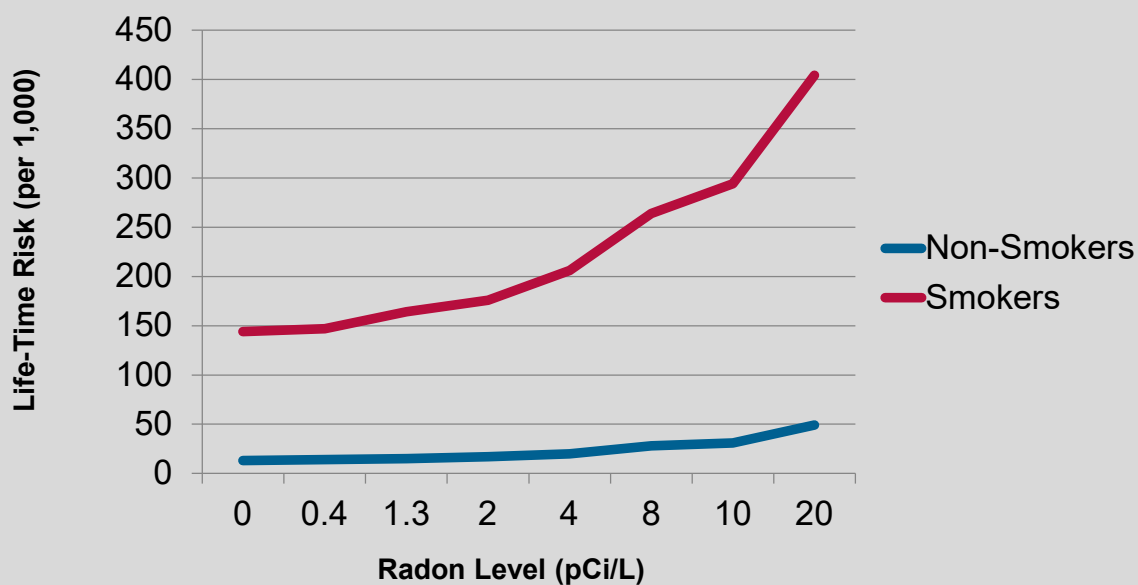
- Environmental tobacco smoke
- Genetics
- Radon
- Asbestos
- Radiation therapy
- Emphysema
- Pulmonary fibrosis

### Peak Lung Cancer Rate Is 30-40 Years After Peak Per Capita Cigarette Consumption



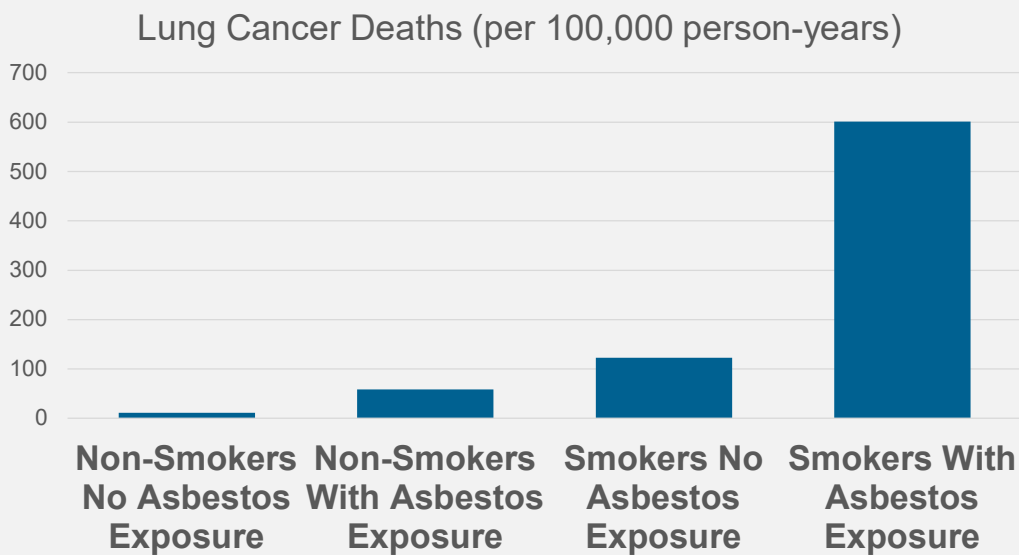
Data from CDC & U.S. Department of Agriculture

## Radon And Lung Cancer Risk



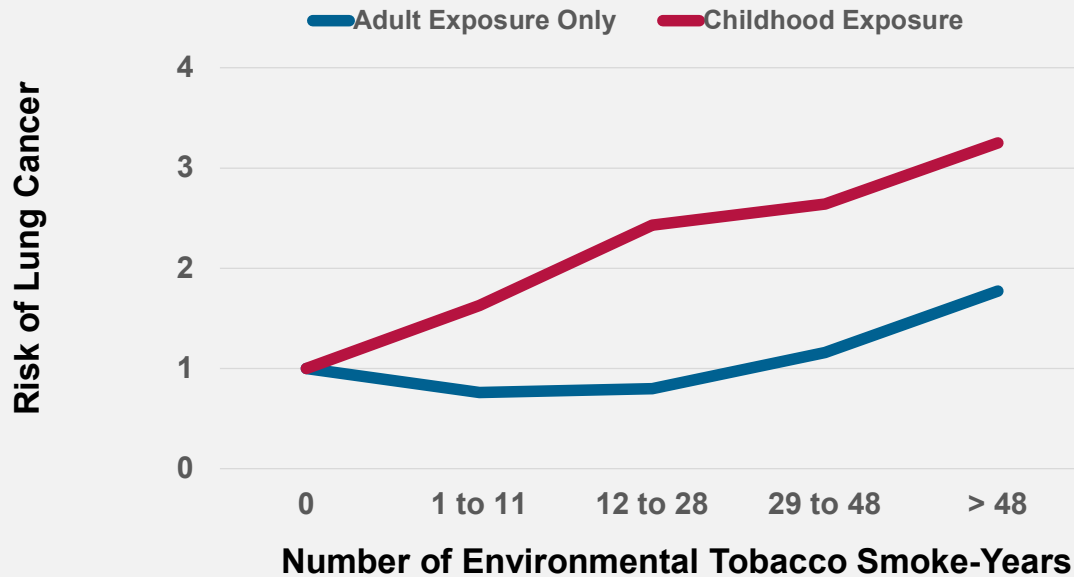
Data: CDC Agency for Toxic Substances & Disease Registry

## The Relation Between Asbestos and Lung Cancer

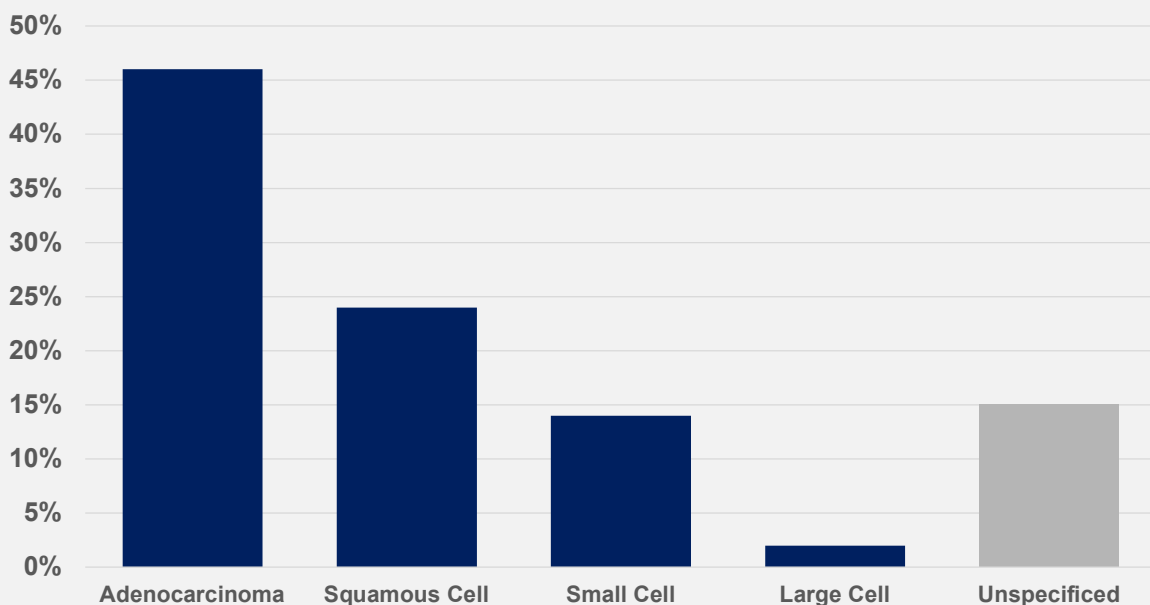




## Environmental Tobacco Smoke Causes Lung Cancer



## Histologic Types of Lung Cancer (U.S.)



## Common presenting symptoms of lung cancer:

- Cough
- Hemoptysis
- Chest pain
- Hoarseness
- Dyspnea
- Malaise/anorexia

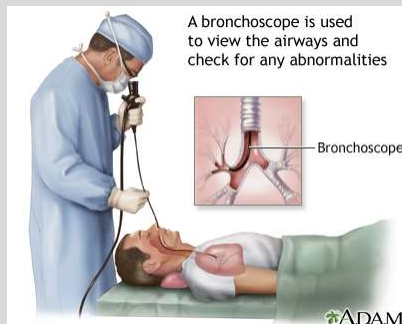
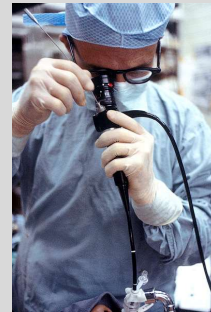
## Clubbing



## Making A Tissue Diagnosis:

	<u>When Used</u>	<u>How Used</u>
Sputum cytology	Rarely	Large central lesions
Bronchoscopy	Commonly	Lesions > 2 cm
CT-guided needle biopsy	Occasionally	Peripheral lesions
Thoracentesis	Occasionally	Pleural effusion
Endobronchial ultrasound	Occasionally	Large lymph nodes
Mediastinoscopy	Occasionally	Large lymph nodes
Thoracotomy/VATS	Commonly	Other tests indeterminate

## Bronchoscopy



### Diagnostic Utility:

If endobronchial lesion visible: 94%

If peripheral nodule > 2 cm: 40-50%

If peripheral nodule < 2 cm: 10%

Image Courtesy of the National Library of Medicine

## Case Bronchoscopic Findings



- Endobronchial tumor involving RML and RLL
- Biopsy = large cell undifferentiated lung cancer

## Staging System For Lung Cancer

- T = Tumor
  - 0-4; subcategorized as “a”, “b”, & “c”
  - based on size & location
- N = Nodes
  - 0-3
  - based on location of involved lymph nodes
- M = Metastases
  - 0-1; subcategorized as “a”, “b”, & “c”
  - Based on presence or absence of metastases

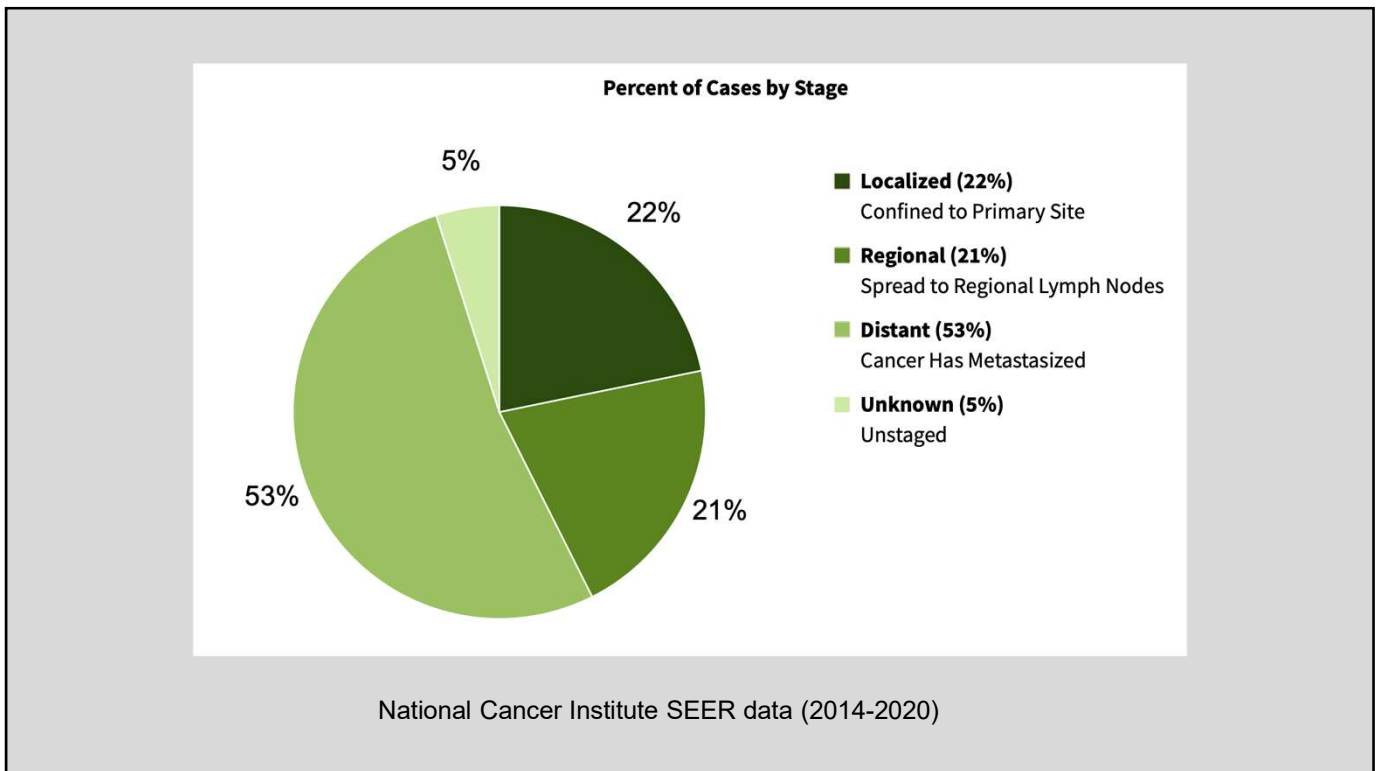
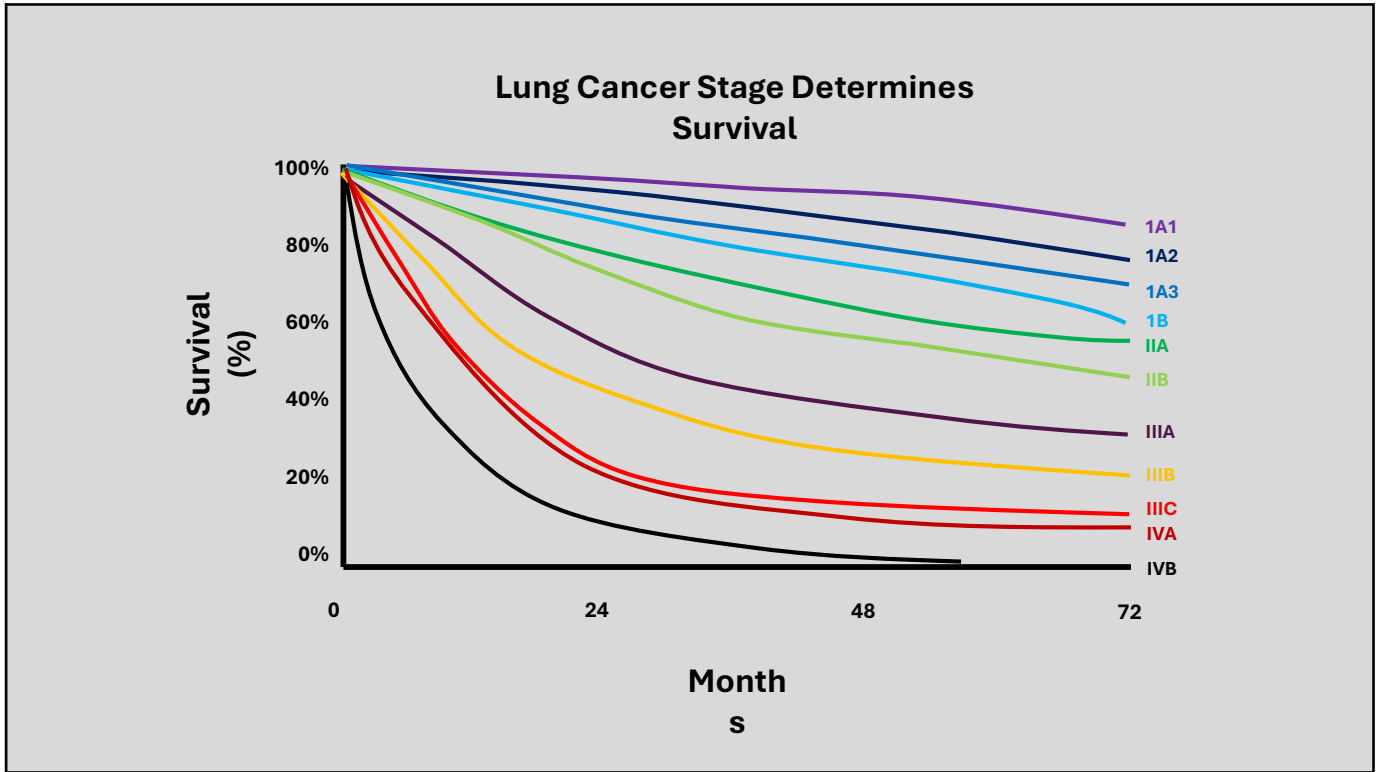
## TNM Score Determines Stage

T/M	N0	N1	N2	N3
T1a	IA1	IIB	IIIA	IIIB
T1b	IA2	IIB	IIIA	IIIB
T1c	IA3	IIB	IIIA	IIIB
T2a	IB	IIB	IIIA	IIIB
T2b	IIA	IIB	IIIA	IIIB
T3	IIB	IIIA	IIIB	IIIC
T4	IIIA	IIIA	IIIB	IIIC
M1a/b	IVA	IVA	IVA	IVA
M1c	IVB	IVB	IVB	IVB

## But... There's an app for that

The app interface consists of four main screens:

- Primary Tumour:** Lists options from TX to T1b. T1mi is selected with a checkmark. Description: "Minimally invasive adenocarcinoma: adenocarcinoma (<math>\leq 3\text{ cm}</math> in greatest dimension) with a predominantly lepidic pattern and <math>\leq 5\text{ mm}</math> invasion in greatest dimension."
- Regional Lymph Nodes:** Lists options from NX to N3. N1 is selected with a checkmark. Description: "Metastasis in ipsilateral peribronchial and/or ipsilateral hilar lymph nodes and intrapulmonary nodes, including involvement by direct extension."
- Distant Metastasis:** Lists options from M0 to M1c. M0 is selected with a checkmark. Description: "No distant metastasis."
- Summary Screen:** Shows the final stage as **IIB**. Includes the canOer logo and "Integrated Cancer Research".



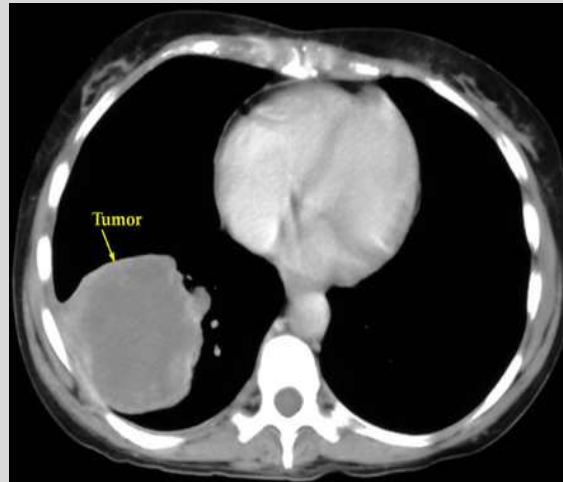
## Staging approach for non-small cell lung cancer

- History & physical examination
- Labs: CBC, chemistry profile, calcium, liver enzymes
- Chest CT
- PET scan (in clinical stage IB, IIA, and IIB)
- Other imaging studies if metastases suspected
- Bronchoscopy with EBUS or mediastinoscopy if lymph nodes are large
- Biopsy abnormal sites if it will affect management

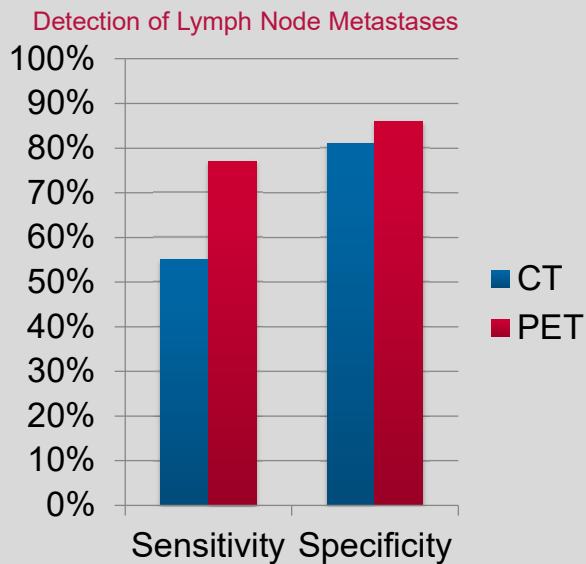
## Chest CT

- **Advantages:**
  - Excellent determination of calcification patterns
  - Provides guide to bronchoscopy & mediastinoscopy
- **Disadvantages:**
  - Large number of false positive adrenal masses (approximately 2/3 of adrenal masses will be benign)
  - Large number of false positive lymph nodes

## Case CT



## PET-CT Scans In Lung Cancer Staging



Chest. 2013;143(5 Suppl):e211S

### Disadvantages:

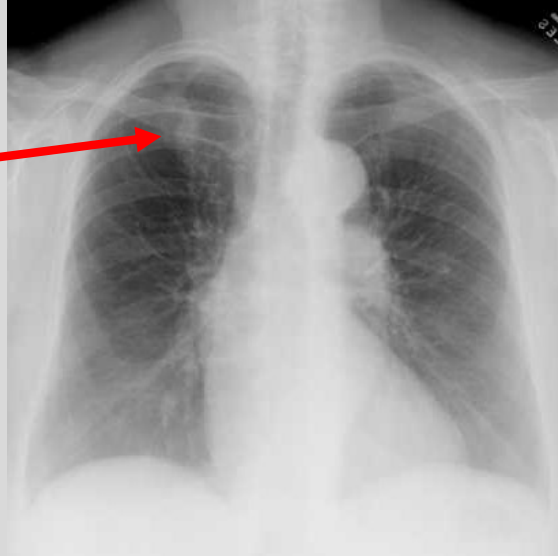
- Poor for "T" staging
- Poor for brain metastases
- False positives common

### Advantages:

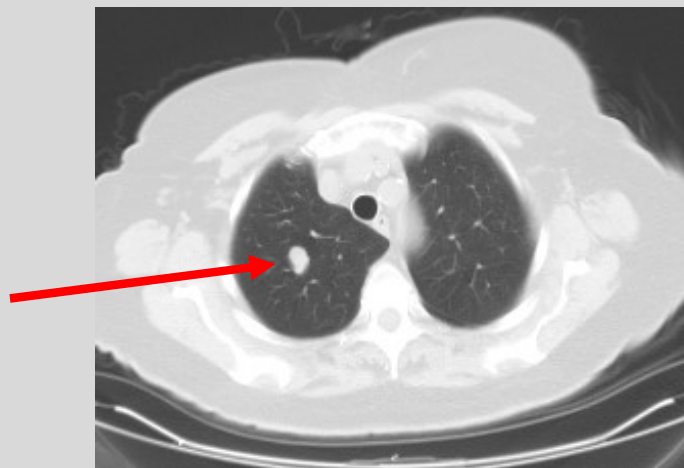
- Improved detection of mediastinal involvement
- Improved detection of distant metastases



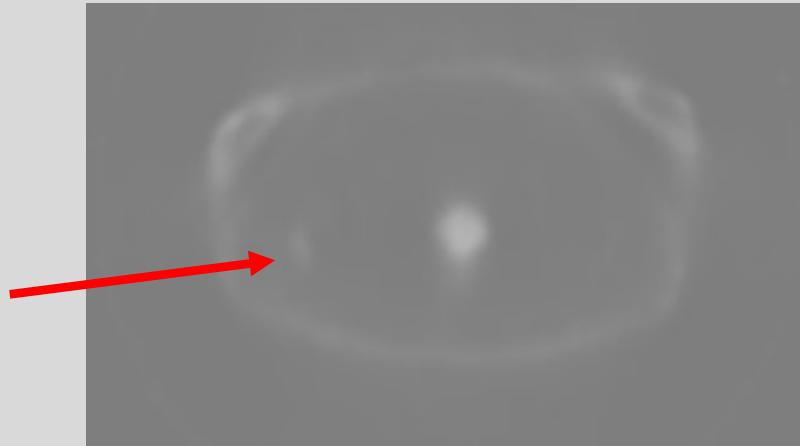
## Chest X-Ray



## Chest CT



## PET Scan



## PET CT



## Endobronchial Ultrasound (EBUS)



## Mediastinoscopy

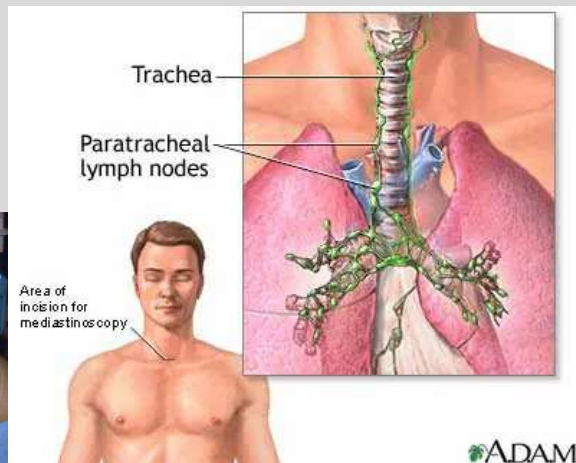


Image Courtesy of the National Library of Medicine

## Non-Small Cell Lung Cancer Treatment

Stage Ia Surgery

Stage Ib Surgery (with *possible* adjuvant chemotherapy, immunotherapy, and/or osimertinib\*)

Stage II Surgery + adjuvant chemotherapy, immunotherapy, and/or osimertinib\*

Stage III Chemotherapy ± radiation therapy followed by immunotherapy

*Possible* late surgery

Stage IV Chemotherapy ± Immunotherapy or driver-directed treatment

\*Adjuvant chemotherapy = cisplatin + second drug  
Immunotherapy if PD-L1 ≥ 1%  
Osimertinib if tumor is EGFR positive

## Pre-op evaluation\*

- PFTs: FEV1 & DLCO > 80% desirable
- If FEV1 and/or DLCO are < 80%
  - The predicted post-operative FEV1 and DLCO should be calculated, typically using quantitative ventilation/perfusions scans
  - A low tech exercise test (ability to walk up 5 flights of stairs) or high tech exercise test (cardiopulmonary exercise test) should be performed.
- ABG: PCO2 < 45 desirable (?)

**\*Never Miss An Opportunity To Refer A Surgically Curable Patient For Surgery!**

## Cardiopulmonary Exercise Testing For The Patient With A Marginal FEV1:

---

- $mVO_2 > 20$  ml/kg/min
  - Surgery
- $mVO_2 < 10$  ml/kg/min:
  - Surgery is too high risk
- $mVO_2$  10-20 ml/kg/min:
  - *Possible* surgery
  - Consider pulmonary rehabilitation first

## Case Outcome:

- Stage IIB
- Pre-op FEV1 = 2.74 liters (70% of predicted)
- Predicted post-op FEV1 = 50% of predicted
- Able to easily walk up 5 flights of stairs
- ABG:  $PCO_2 = 40$  (normal)
- Underwent right middle and lower lobe resection
- Cancer free 30 years later

## Small Cell Lung Cancer

### Limited Stage:

- 30% of patients
- Average survival = 17 months
- Treatment:
  - Stage I: surgery plus chemotherapy
  - Stage II & III: radiation plus chemotherapy
  - Prophylactic cranial radiation recommended
- Cure rate = 20%

### Extensive Stage:

- 70% of patients
- Average survival = 12 months
- Treatment: chemotherapy  $\pm$  immunotherapy
- Cure rate = 1 – 2%

Small cell lung cancer is essentially never curable by surgery alone!!!

## Staging approach to small cell lung cancer\*

- Chest CT
- Abdominal CT
- Pelvic CT
- Lab tests
- Brain MRI (or head CT)
- PET scan

\*Staging should not delay starting chemotherapy and is mainly to determine whether radiation should be given (limited stage)

## Inoperable ≠ Untreatable

### Medical Treatment of Advanced Non-Small Cell Lung Cancer in 2025

- Driver mutations can guide treatment:
  - EGFR (+) --- EGFR tyrosine kinase inhibitors such as osimertinib
  - ALK (+) --- ALK tyrosine kinase inhibitors such as alectinib
  - BRAF (+) – BRAF/MEK inhibitors such as dabrafenib and trametinib
  - ROS1 (+) – ROS1 inhibitor crizotinib
  - Others: MET, RET, NTRK, KRAS

## Medical Treatment of Advanced Non-Small Cell Lung Cancer in 2025 (continued)

- If PD-L1 (programmed death receptor-ligand 1) high (> 50%), immunotherapy with *possible* chemotherapy\*:
  - Pembrolizumab – monoclonal antibody against programmed death receptor-1 (PD-1); aka checkpoint inhibitor
- If PD-L1 low (< 50%) or negative, immunotherapy with chemotherapy:
  - Chemotherapy\* + pembrolizumab)

\*Chemotherapy is typically a platinum drug plus a second drug

**In 10 years, the preferred treatments for advanced non-small cell lung cancer will have changed... a lot**

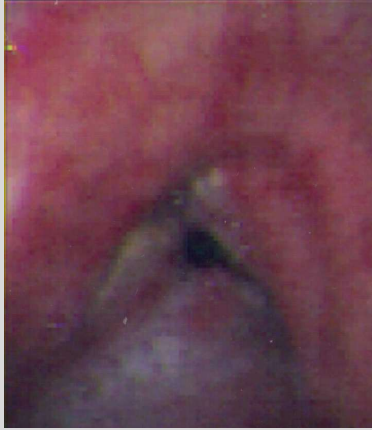


## **Tomorrow's Patients Will Owe Their Lives To Today's Patients In Clinical Trials**

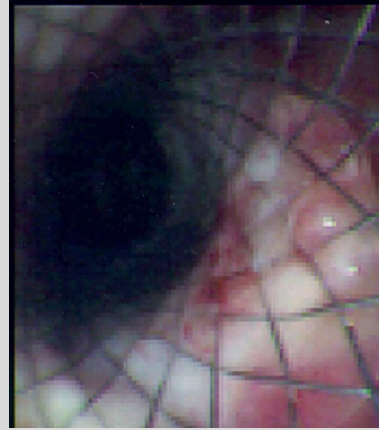
### **Palliation of Lung Cancer**

- External beam radiation
- Brachytherapy
- Cryotherapy
- Argon plasma coagulation
- Stents
- Photodynamic therapy
- Laser
- Pleurodesis

## 68 Year Old Man With Tracheal Squamous Cell Carcinoma



Trachea Pre-Stent



Trachea Post-Stent

## Argon Plasma Coagulation



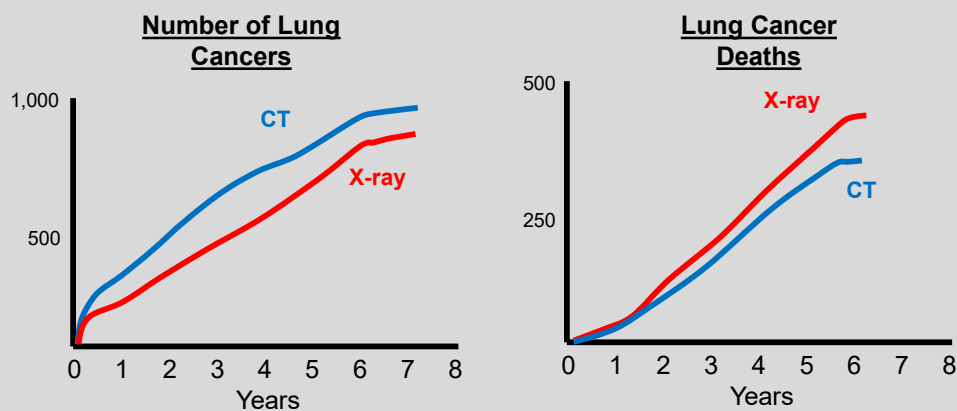
CC BY-NC 4.0: Wang Y, Li Y,  
Wang F, et al. J Inter Med  
Res 2021 49(9):1-9

## Cryotherapy

- Bronchoscopic probe placement
- Nitrous oxide
- Probe tip =  $-40^{\circ}\text{C}$



## Screening Chest CT Scans For Lung Cancer



N = 53,454

N Engl J Med 2011. 365:395-409

## Results of screening chest CTs:

- Lung cancers found in earlier stages
- Overall, 20% reduction in mortality
- High false positive rate:
  - Overall 30% of CT scans were abnormal
  - A suspicious abnormality was 27 times more likely to be benign than malignant
- Screening CTs plus follow-up CTs are very expensive

## Medicare Lung Cancer Screening Requirements:

- Age 50-80
- Asymptomatic
- More than 20 pack-year smoking history
- Current smoker or quit in the past 15 years
- Counseling session that includes risks/benefits of screening and includes smoking cessation counseling

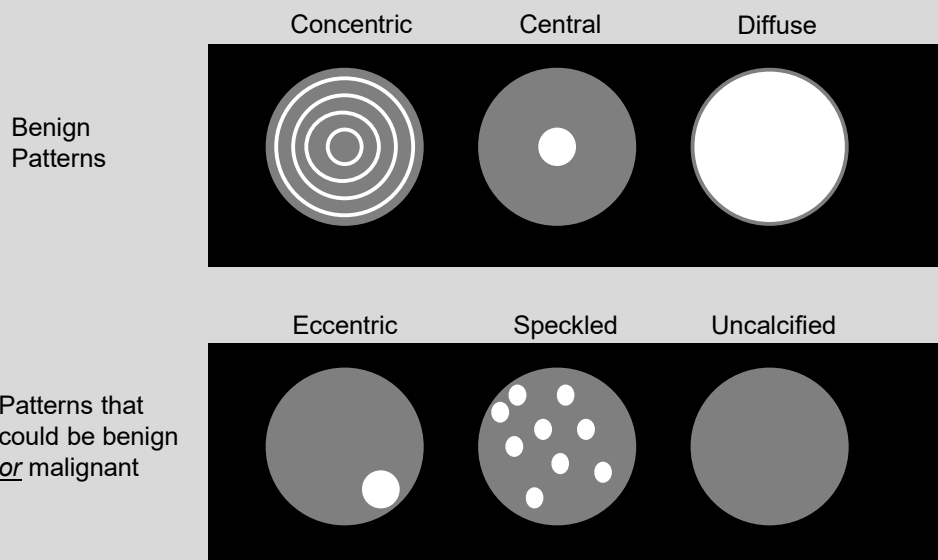
\*Continue screening annually until > 15 years since quit smoking

## **What do you do about the incidentally identified solitary pulmonary nodule?**

### **Indicators of benign pulmonary nodules**

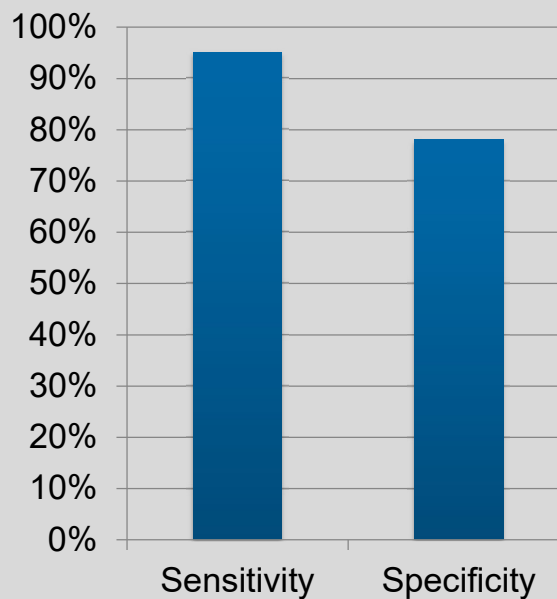
- Calcification patterns
- Age
- Smoking history
- Size
- History of cancer
- Radiographically stable over time

## Calcification Patterns In Solitary Pulmonary Nodules

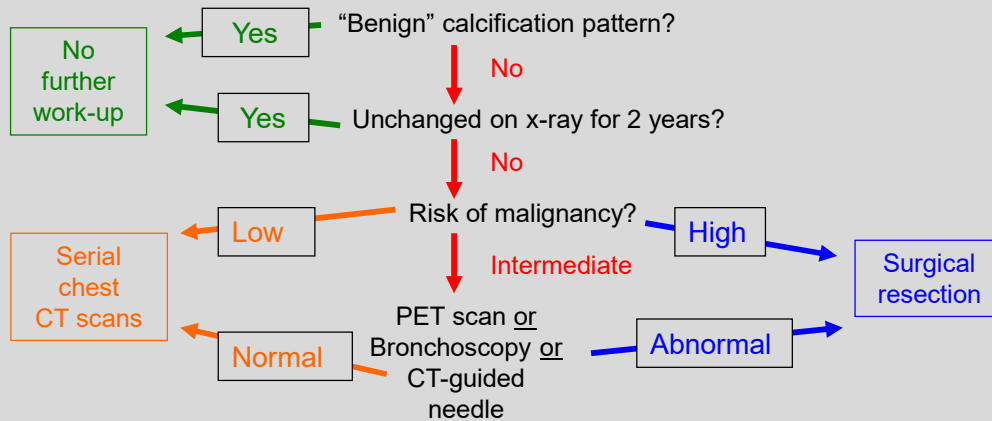


## PET Scan And The Solitary Pulmonary Nodule

- **False negatives in:**
  - Well-differentiated adenocarcinomas
  - Carcinoid tumors
  - Hyperglycemia
  - Tumors < 8 mm
- **False positives in:**
  - Tuberculosis
  - Fungal infections
  - Sarcoidosis



## Clinical Approach To The Solitary Pulmonary Nodule



**Camel Advertisement:**

Here are the facts you need to know. While the average cigarette has 2 to 4 mg of tar, Camels have only 1 mg. Think of it as a doctor's prescription, a diplomat, and a friendly competitor. There's nothing all around the cigarette but the good stuff.

Think of it as a doctor's prescription, a diplomat, and a friendly competitor. There's nothing all around the cigarette but the good stuff.

*According to a recent Nationwide survey:*  
**MORE DOCTORS SMOKE CAMELS THAN ANY OTHER CIGARETTE**

Dr. [Name] has been a member of the American Medical Association since 1915. He has been a member of the American Society of Surgeons since 1920. He has been a member of the American Society of Physicians since 1925. He has been a member of the American Society of Obstetricians and Gynecologists since 1930. He has been a member of the American Society of Ophthalmologists since 1935. He has been a member of the American Society of Dermatologists since 1940. He has been a member of the American Society of Pathologists since 1945. He has been a member of the American Society of Microscopists since 1950. He has been a member of the American Society of Experimental Biologists since 1955. He has been a member of the American Society of Zoologists since 1960. He has been a member of the American Society of Entomologists since 1965. He has been a member of the American Society of Botany since 1970. He has been a member of the American Society of Geologists since 1975. He has been a member of the American Society of Chemists since 1980. He has been a member of the American Society of Physicists since 1985. He has been a member of the American Society of Astronomers since 1990. He has been a member of the American Society of Meteorologists since 1995. He has been a member of the American Society of Climatologists since 2000. He has been a member of the American Society of Oceanographers since 2005. He has been a member of the American Society of Atmospheric Scientists since 2010. He has been a member of the American Society of Environmental Scientists since 2015. He has been a member of the American Society of Environmental Engineers since 2020. He has been a member of the American Society of Environmental Health Engineers since 2025.

**L&M Advertisement:**

*Fredric March says... THIS IS IT*  
 "L&M FILTERS ARE JUST WHAT THE DOCTOR ORDERED!"

When I read Dr. [Name]'s letter I read L&M Filters. I'm really enthusiastic about them. They're a wonderful smoke—with a filter that really does the job. I'm sure you'll like them as much as I do.

*Fredric March*

Dr. [Name] writes: "I have been a member of the American Medical Association since 1915. I have been a member of the American Society of Surgeons since 1920. I have been a member of the American Society of Physicians since 1925. I have been a member of the American Society of Obstetricians and Gynecologists since 1930. I have been a member of the American Society of Ophthalmologists since 1935. I have been a member of the American Society of Dermatologists since 1940. I have been a member of the American Society of Pathologists since 1945. I have been a member of the American Society of Microscopists since 1950. I have been a member of the American Society of Experimental Biologists since 1955. I have been a member of the American Society of Zoologists since 1960. I have been a member of the American Society of Entomologists since 1965. I have been a member of the American Society of Botany since 1970. I have been a member of the American Society of Geologists since 1975. I have been a member of the American Society of Chemists since 1980. I have been a member of the American Society of Physicists since 1985. I have been a member of the American Society of Astronomers since 1990. I have been a member of the American Society of Meteorologists since 1995. I have been a member of the American Society of Climatologists since 2000. I have been a member of the American Society of Oceanographers since 2005. I have been a member of the American Society of Atmospheric Scientists since 2010. I have been a member of the American Society of Environmental Scientists since 2015. I have been a member of the American Society of Environmental Engineers since 2020. I have been a member of the American Society of Environmental Health Engineers since 2025."

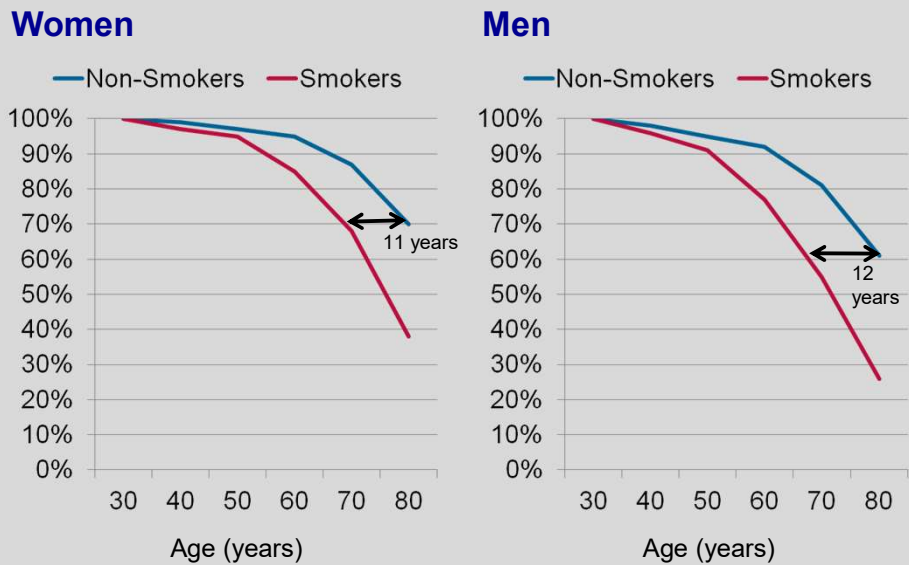
**Light and Mild MUCH MORE FILTER MUCH LESS NICOTINE**

**ONLY L&M FILTERS GIVE YOU ALL THIS...**

1. Effective Tar/Nicotine Ratio - Only L&M Filters have the lowest tar/nicotine ratio.
2. Mouth Feel - Mouth feel is the most important factor in determining the quality of a cigarette.
3. Intensive Filter - The L&M Filter is the most intensive filter available.
4. Mouth Feel - Mouth feel is the most important factor in determining the quality of a cigarette.

**L&M FILTER TIP Cigarettes**

## Life expectancy for smokers and non-smokers



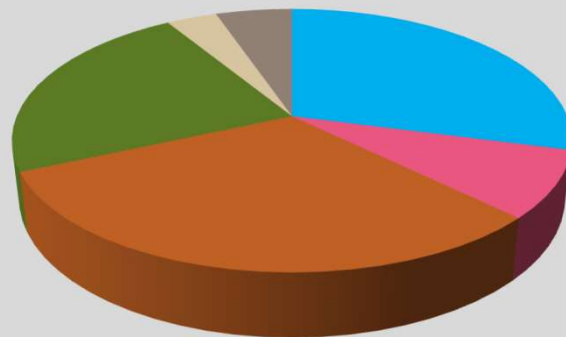
N Engl J Med 2013; 368:341-50



The average smoker loses 14 minutes of life for every cigarette smoked



Cigarette smoking causes > 480,000 U.S. deaths per year\*

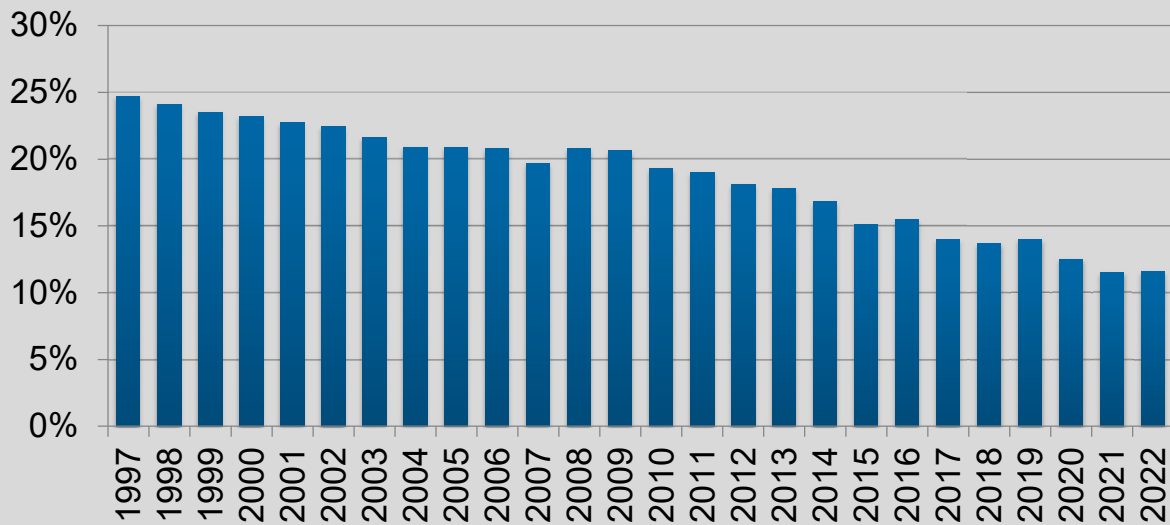


- Lung cancer
- Cardiovascular disease
- Stroke
- Other cancers
- COPD
- Other

1 out of 5 U.S. deaths are attributable to cigarette smoking

Data source: CDC

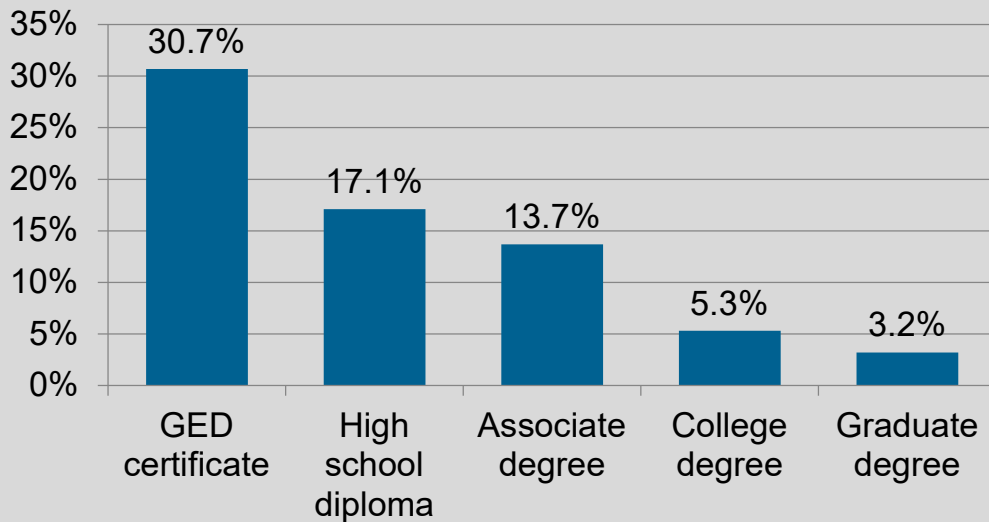
## Prevalence of Adult Smokers In The U.S.



In 2022: Male adult smokers = 13.2%; Female adult smokers = 10.0%

Data: Centers for Disease Control 2025

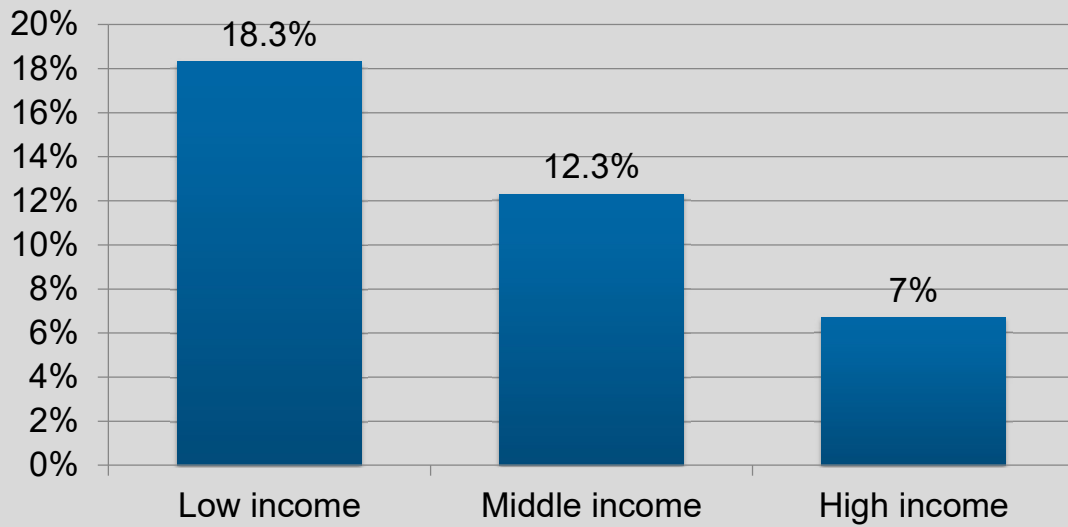
## Who Smokes In The United States?



Centers for Disease Control 2024

## Who Smokes In The United States?

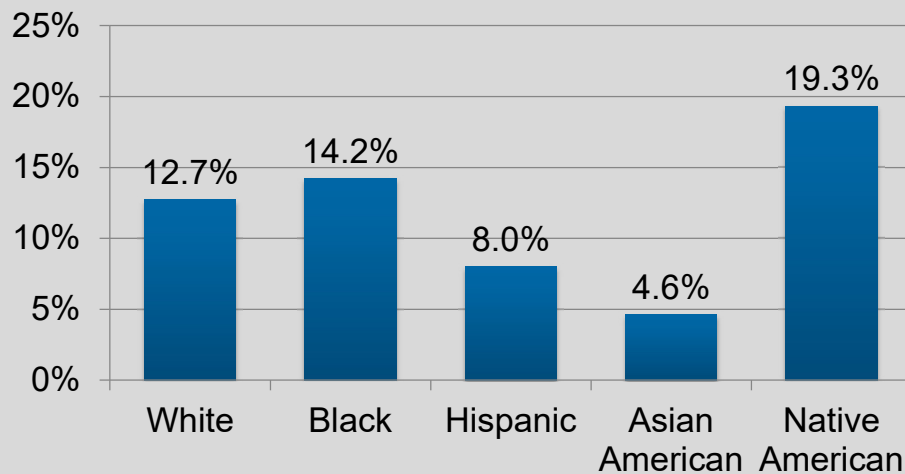
### Prevalence By Income Level



Centers for Disease Control 2024

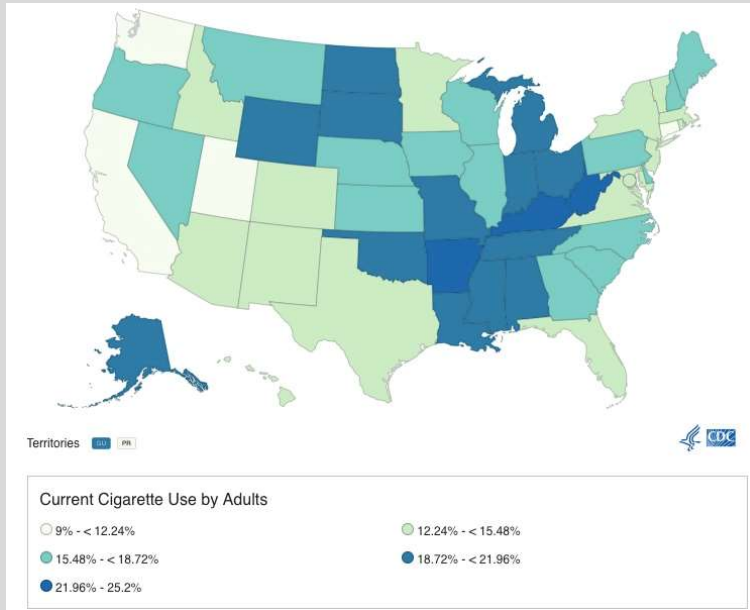
## Who Smokes In The United States?

### Prevalence Of Smoking By Race



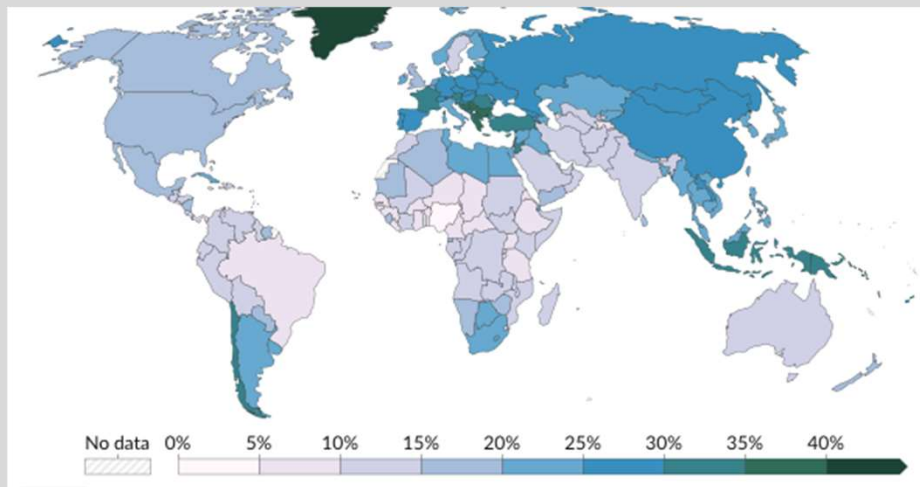
Centers for Disease Control 2025

## Who Smokes In The United States?

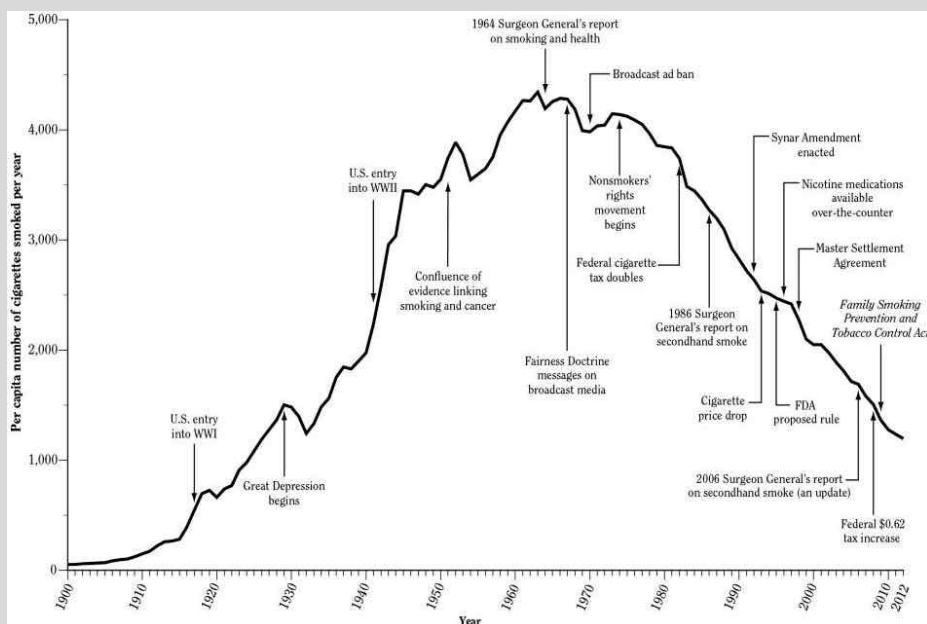


Source: CDC 2024

## Who Smokes In The World?



Multiple sources compiled by World Bank (2021) – processed by Our World in Data

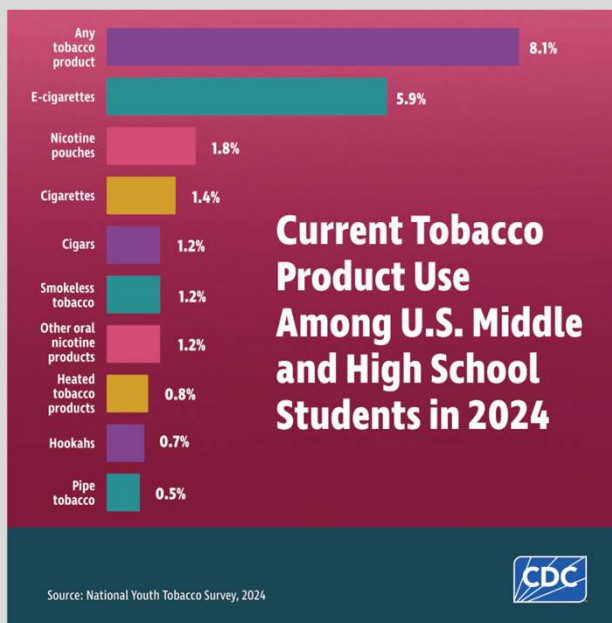


U.S. Surgeon General Report 2014

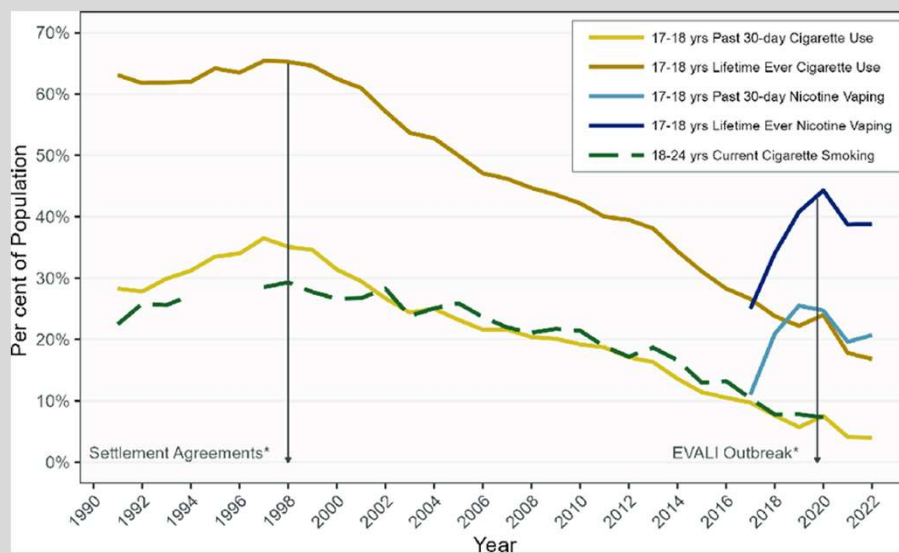
## Smoking is a childhood epidemic

**90% of smokers begin before age 18**

**10.1% of high school students and 5.4% of middle school students use tobacco products**



## 30-Day Prevalence of Daily Use of Cigarettes and Nicotine Vapes 1990 - 2022



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## Key Points About Lung Cancer

- Extremely high mortality rate
- Caused by cigarettes
- Screening chest CTs now recommended
- Stage dictates treatment and prognosis
  - Small cell - extensive/non-extensive
  - Non-small cell - TNM system

