



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



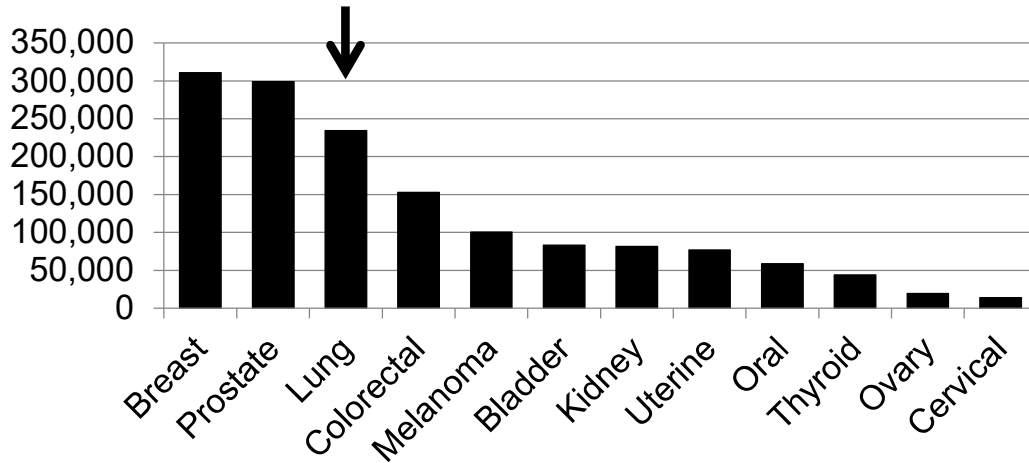
3

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

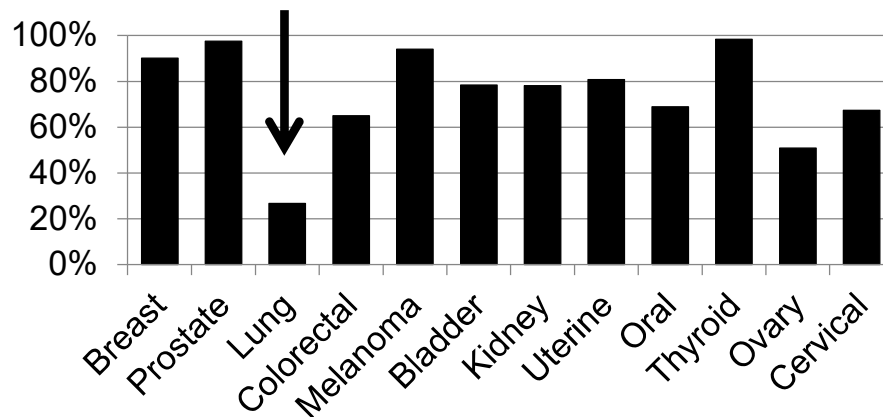
Estimated Number Of New Cancer Cases,
U.S. 2024



National Cancer Institute SEER Data

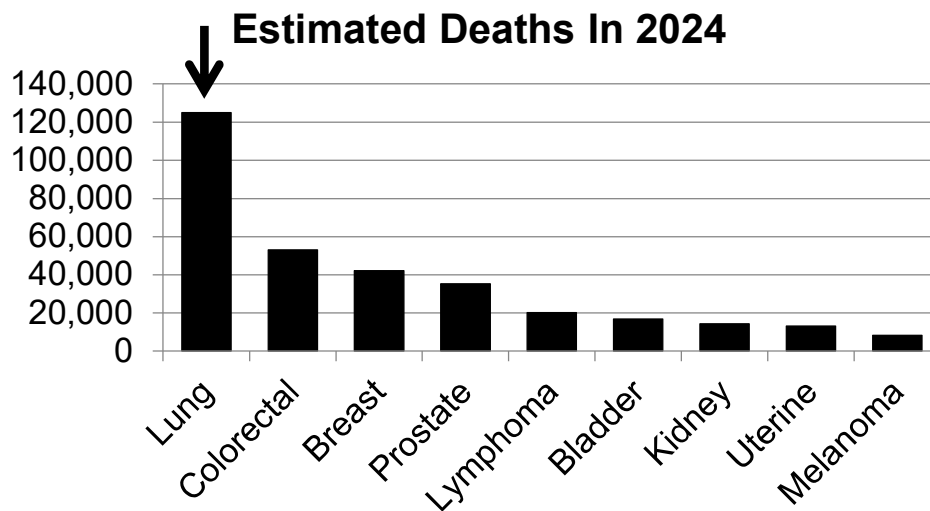
Five-Year Survival Rates Of Common Cancers

Percent Surviving At Five Years:
2014-2020



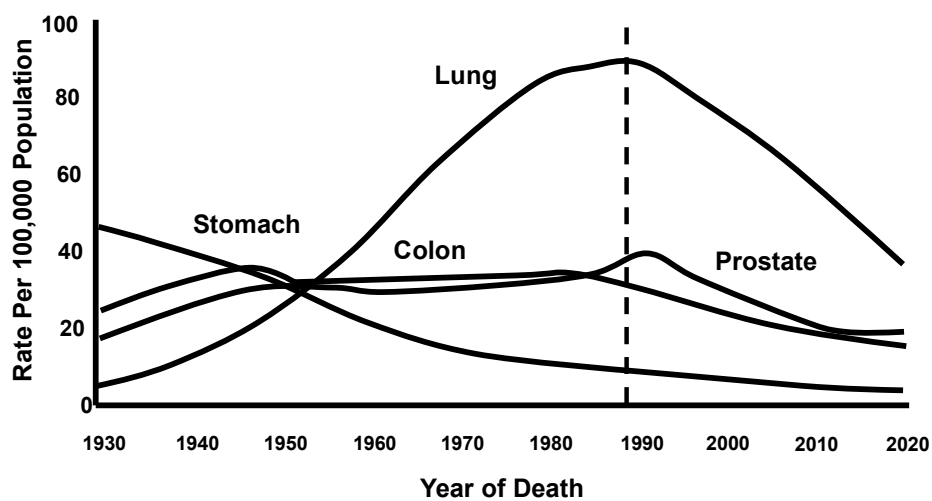
National Cancer Institute SEER
Data

Lung Cancer Kills More Americans Than Any Other Type Of Cancer



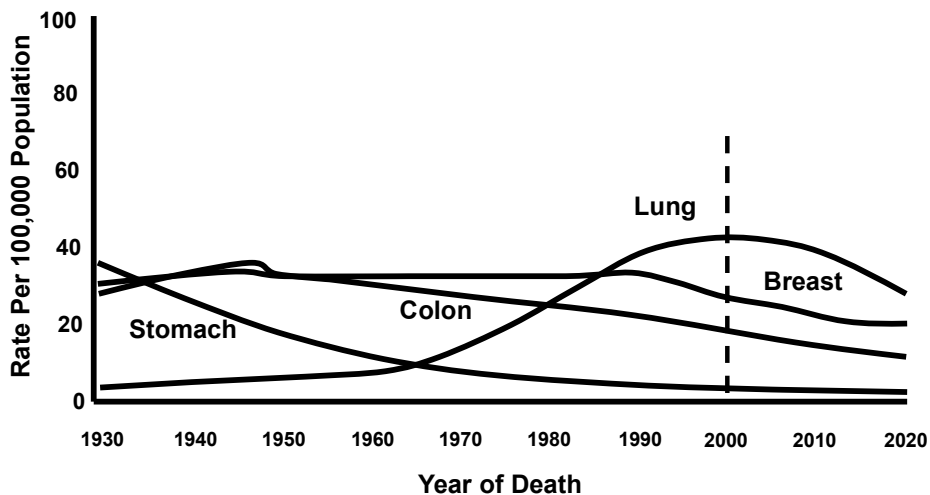
National Cancer Institute SEER Data

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



Data from CDC

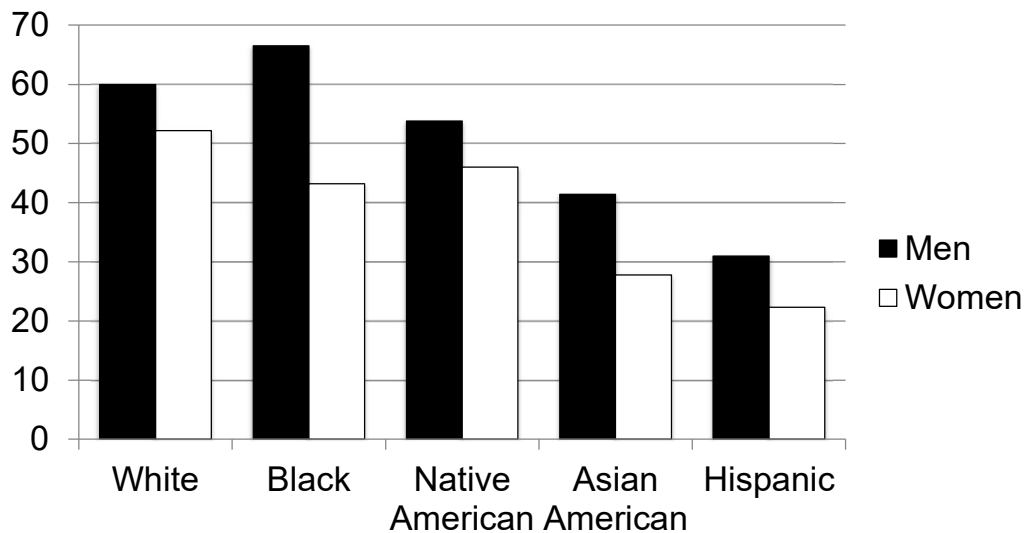
Trends in Age-adjusted Cancer Death Rates by Site, Females, U.S., 1930-2020



Data from CDC

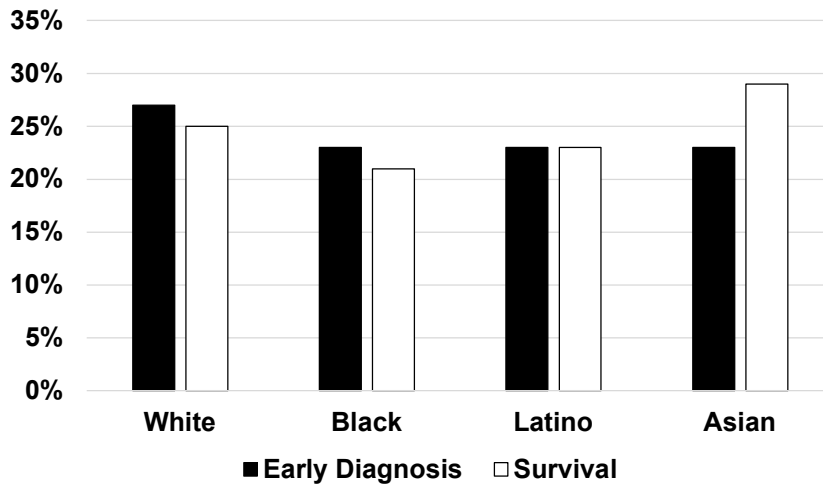
9

Incidence of lung cancer (per 100,000 population)

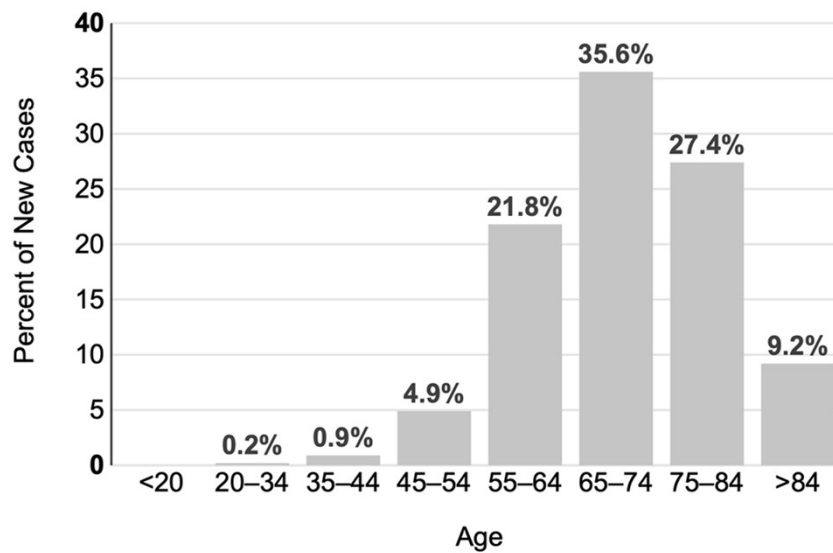


National Cancer Institute SEER Data (2017-2021)

There are racial differences in lung cancer diagnosis and survival



Age of diagnosis of lung cancer:



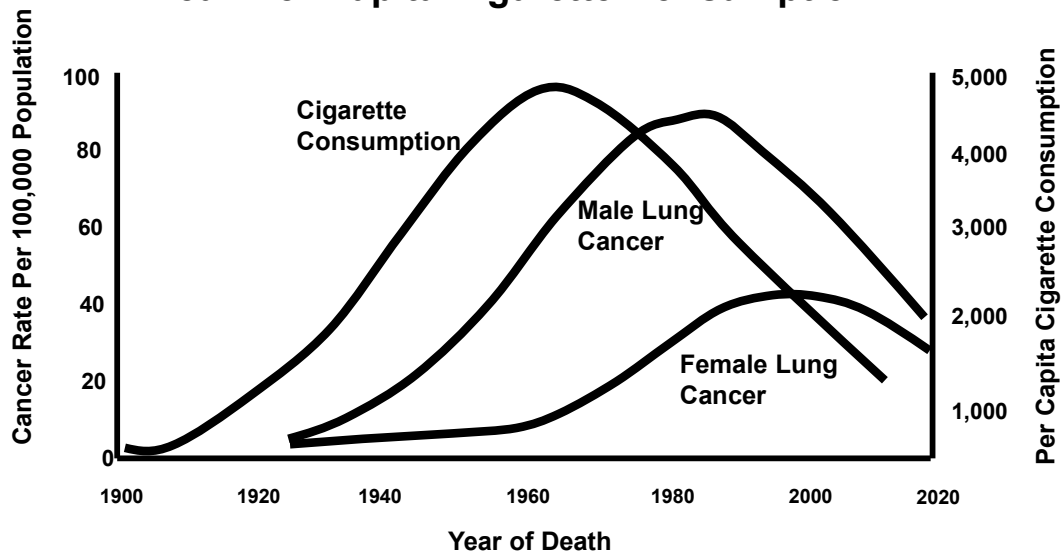
National Cancer Institute SEER data 2024 (2017-2021)

Risk Factors For Lung Cancer

• Smoking

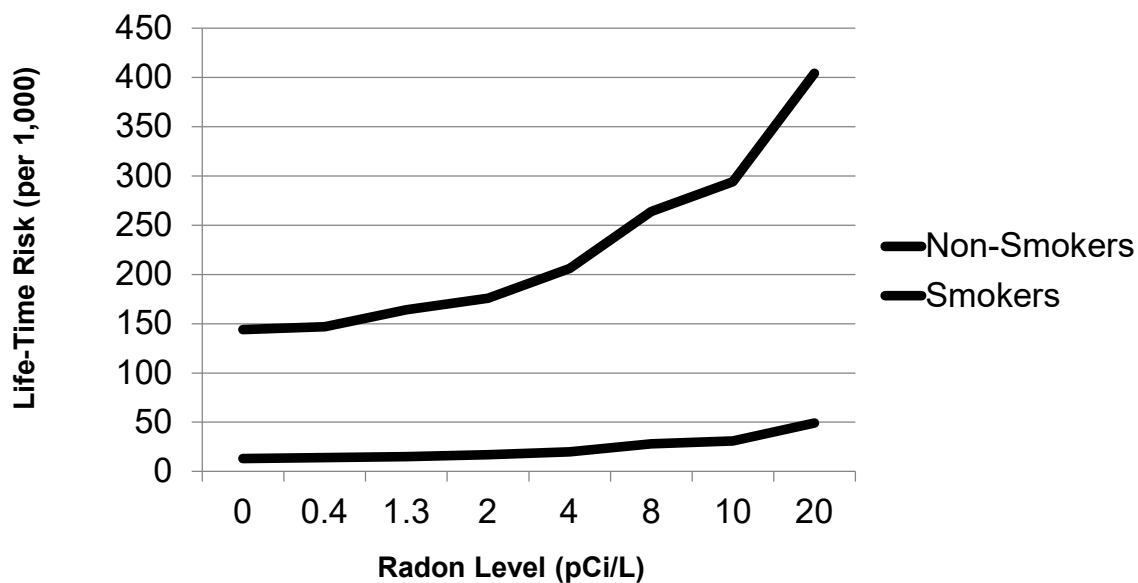
- Environmental tobacco smoke
- Genetics
- Radon
- Asbestos
- Radiation therapy
- Emphysema
- Pulmonary fibrosis

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



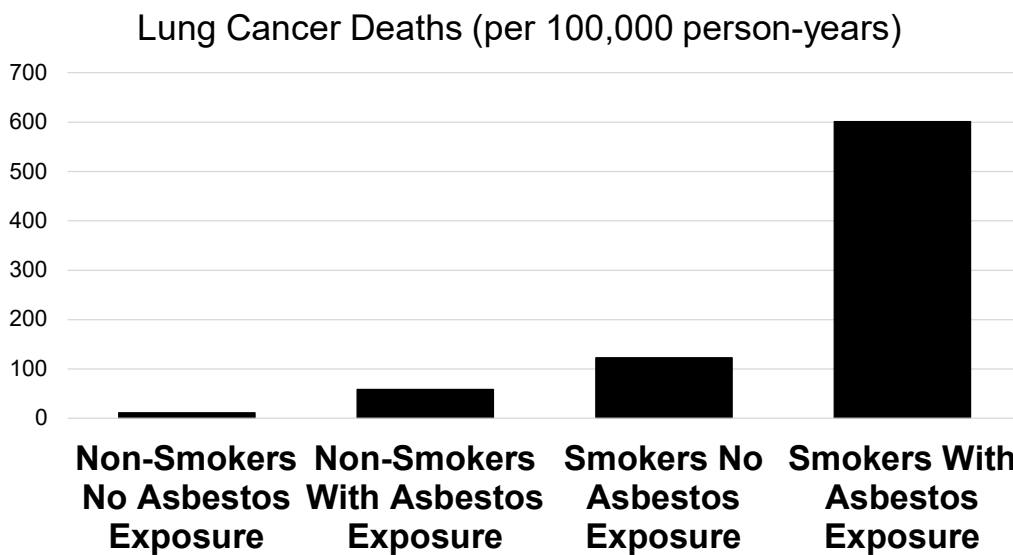
Data from CDC & U.S. Department of Agriculture

Radon And Lung Cancer Risk

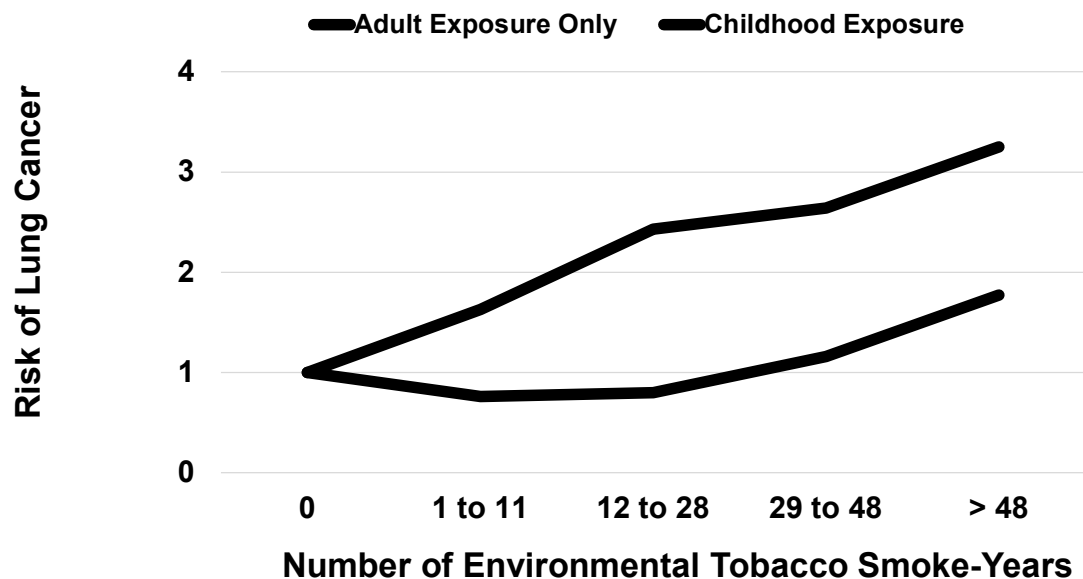


Data: CDC Agency for Toxic Substances & Disease Registry

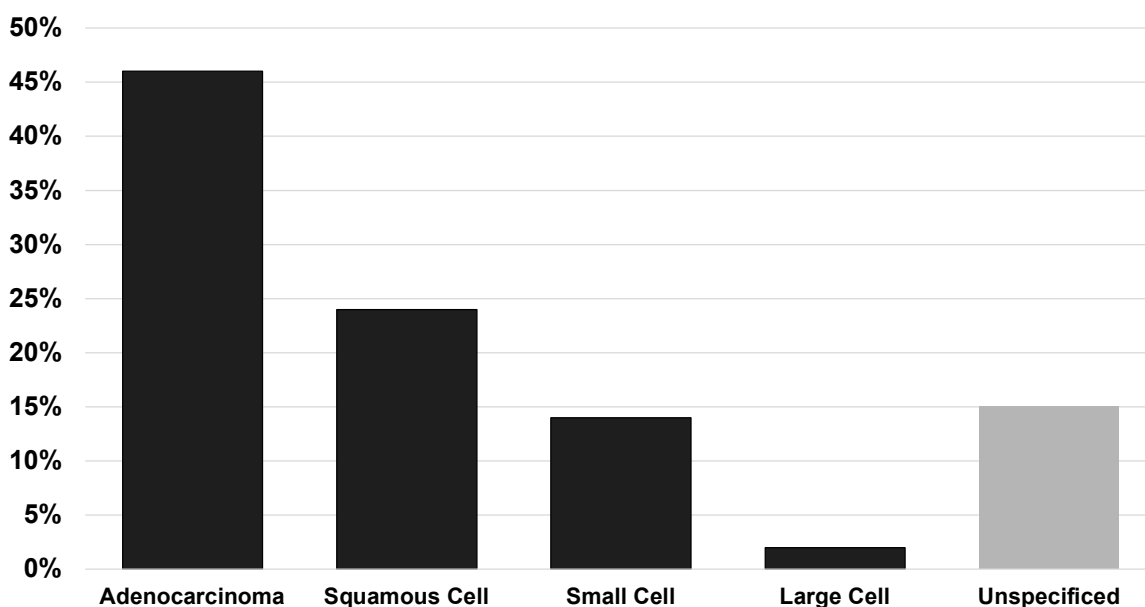
The Relation Between Asbestos and Lung Cancer



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

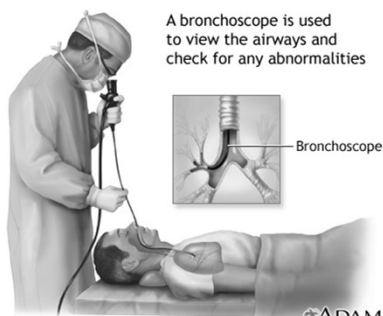


Making A Tissue Diagnosis:

	<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

21

Bronchoscopy



Diagnostic Utility:

If endobronchial lesion visible: 94%

If peripheral nodule > 2 cm: 40-50%

If peripheral nodule < 2 cm: 10%

22

Image Courtesy of the National Library of Medicine

Case Bronchoscopic Findings



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

23

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

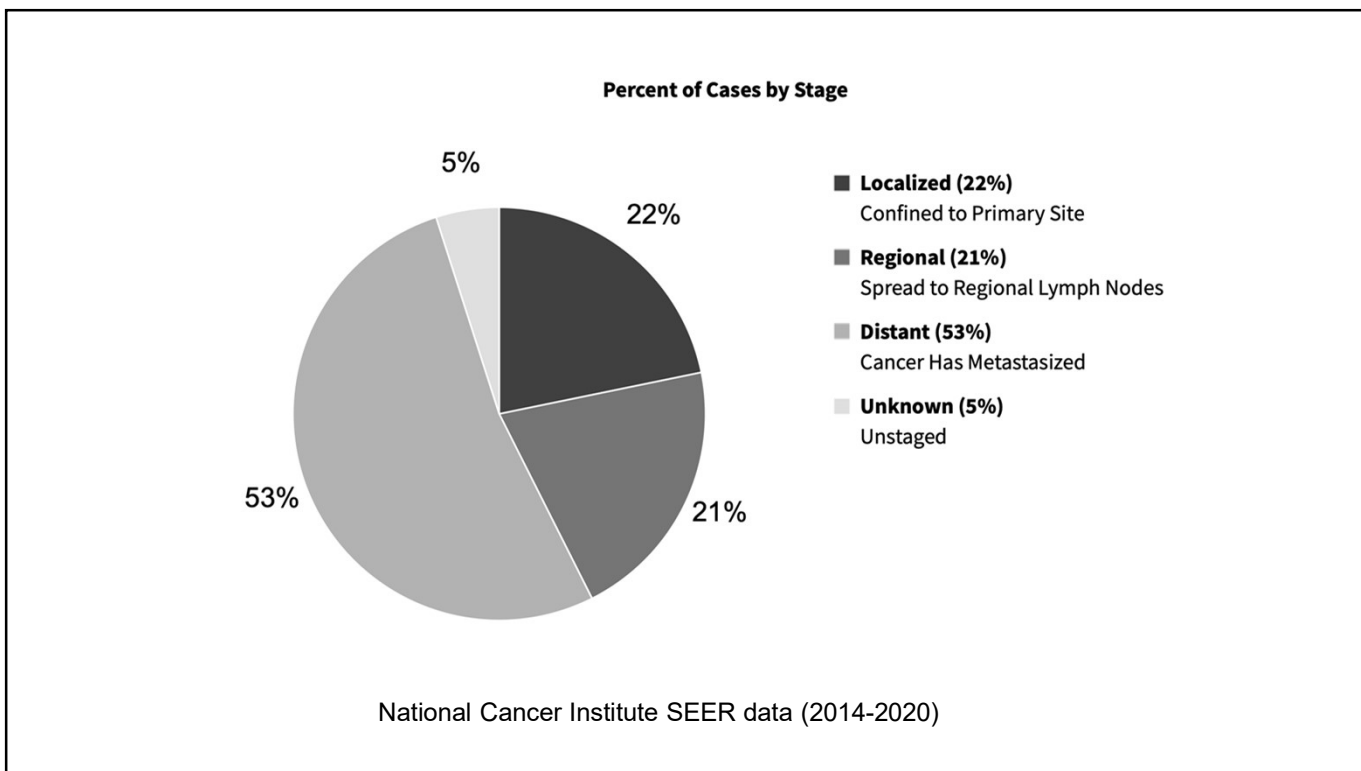
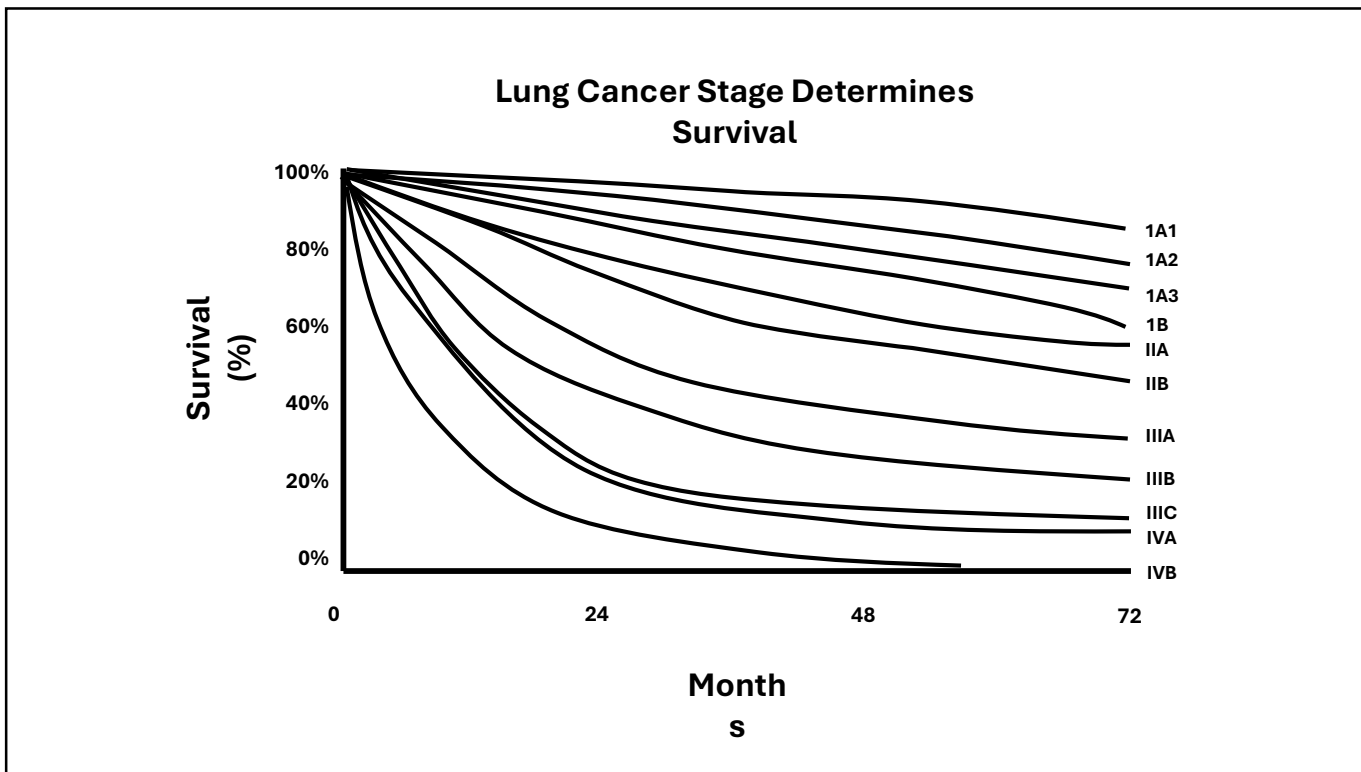
T/M	N0	N1	N2	N3
T1a	IA1	IIB	IIIA	IIIB
T1b	IA2	IIB	IIIA	IIIB
T1c	IA3	IIB	IIIA	IIIB
T2a	IB	IIB	IIIA	IIIB
T2b	IIA	IIB	IIIA	IIIB
T3	IIB	IIIA	IIIB	IIIC
T4	IIIA	IIIA	IIIB	IIIC
M1a/b	IVA	IVA	IVA	IVA
M1c	IVB	IVB	IVB	IVB

But... There's an app for that

The image displays four screenshots from a mobile application used for lung cancer staging. The app guides the user through selecting the appropriate TNM category for each component of the staging system.

- Primary Tumour:** The user has selected **T1**. The description for T1 is: "Tumor ≤3 cm in greatest dimension, surrounded by lung or visceral pleura, without bronchoscopic evidence of invasion more proximal than the lobar bronchus (i.e., not in the main bronchus)".
- Regional Lymph Nodes:** The user has selected **N1**. The description for N1 is: "Metastasis in ipsilateral peribronchial and/or ipsilateral hilar lymph nodes and intrapulmonary nodes, including involvement by direct extension".
- Distant Metastasis:** The user has selected **M0**. The description for M0 is: "No distant metastasis".
- Lung Cancer Summary:** The final stage is **IIIB**. The app also shows the selected categories: Primary Tumour (T1), Regional Lymph Nodes (N1), and Distant Metastasis (M0).

The app interface includes a "can^oer Integrated Cancer Research" logo and a "Contact us" link.



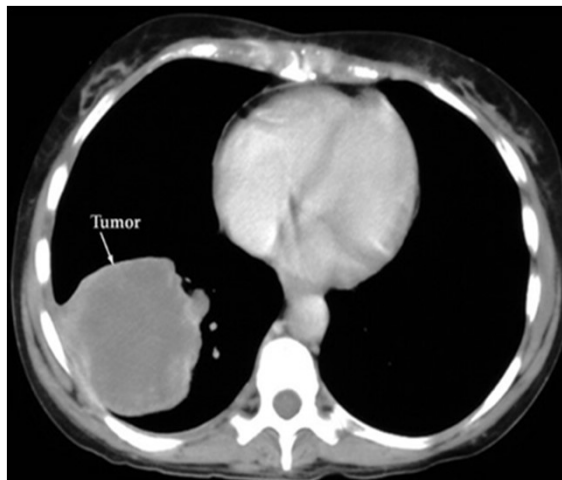
Staging approach for non-small cell lung cancer

- 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

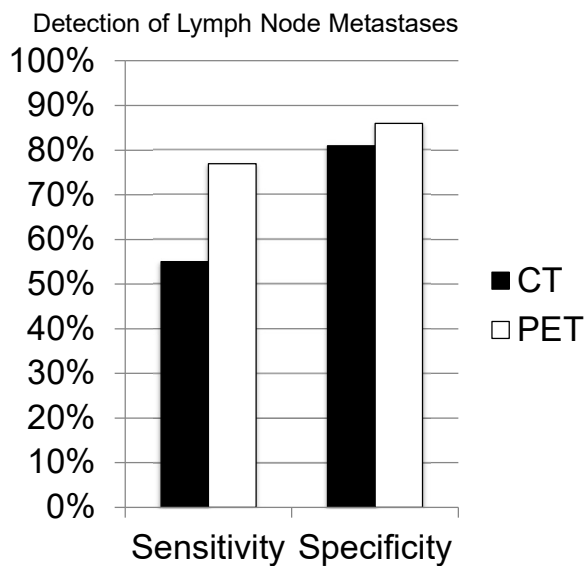
- Advantages:
 - Excellent determination of calcification patterns
 - Provides guide to bronchoscopy & mediastinoscopy
- Disadvantages:
 - Large number of false positive adrenal masses (approximately 2/3 of adrenal masses will be benign)
 - Large number of false positive lymph nodes

Case CT



31

PET-CT Scans In Lung Cancer Staging



Chest. 2013;143(5 Suppl):e211S

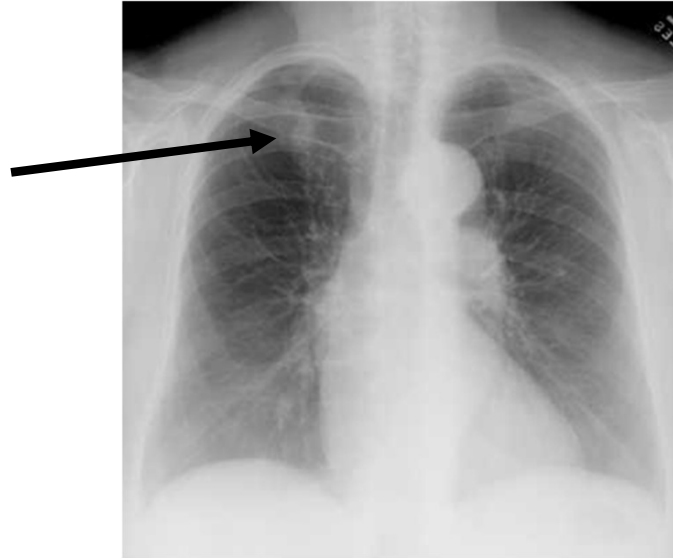
Disadvantages:

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

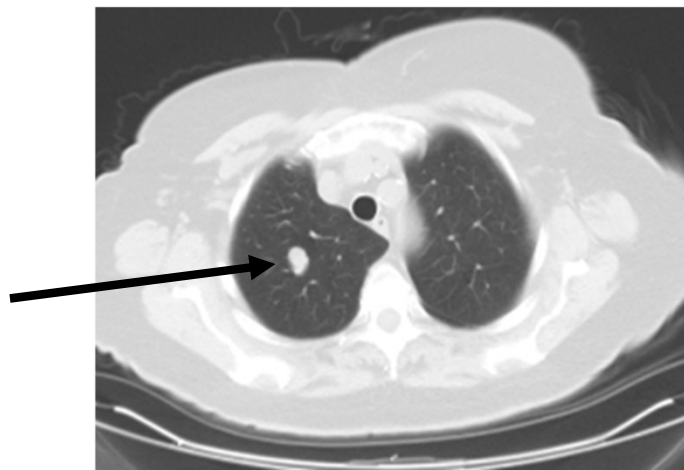
Advantages:

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

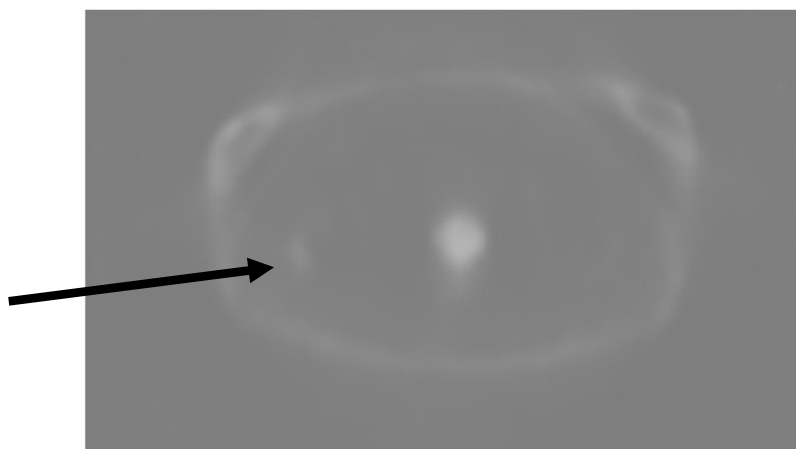
Chest X-Ray



Chest CT



PET Scan



PET CT

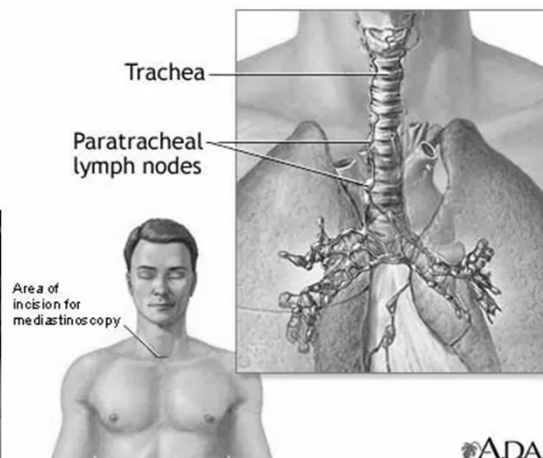


Endobronchial Ultrasound (EBUS)



37

Mediastinoscopy



ADAM.

Image Courtesy of the National Library of Medicine

38

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!!!

43

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

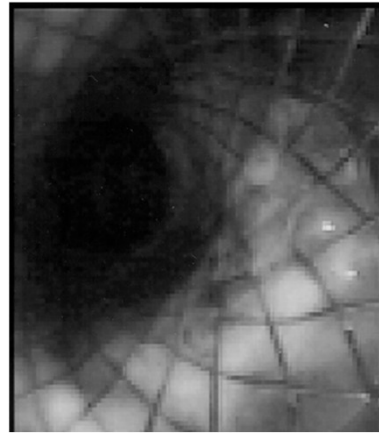
Palliation of Lung Cancer

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

68 Year Old Man With Tracheal Squamous Cell Carcinoma



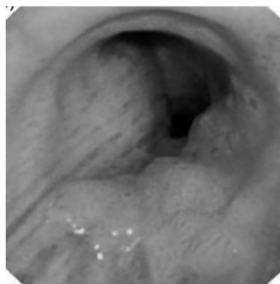
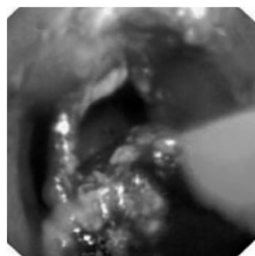
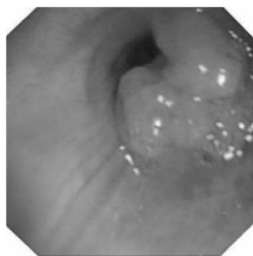
Trachea Pre-Stent



Trachea Post-Stent

51

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

52

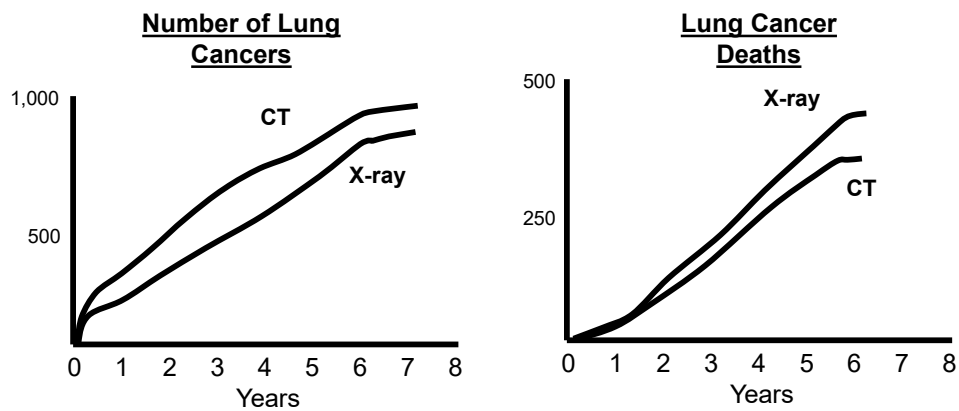
Cryotherapy

- Bronchoscopic probe placement
- Nitrous oxide
- Probe tip = -40°C



53

Screening Chest CT Scans For Lung Cancer



N = 53,454

N Engl J Med 2011. 365:395-409

54

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

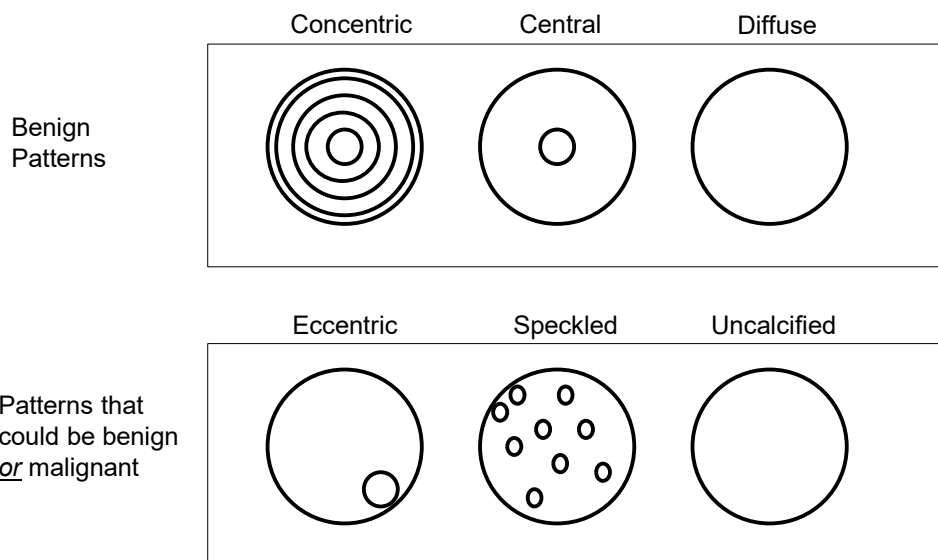
*Continue screening annually until > 15 years since quit smoking

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

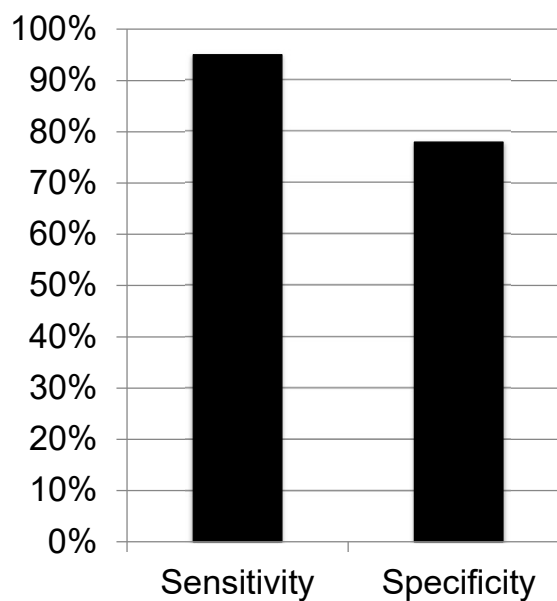
Calcification Patterns In Solitary Pulmonary Nodules



59

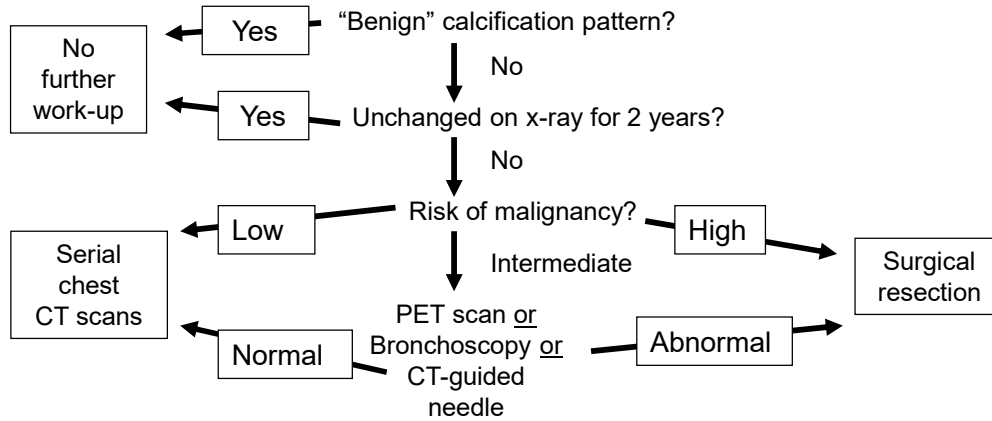
PET Scan And The Solitary Pulmonary Nodule

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



60

Clinical Approach To The Solitary Pulmonary Nodule



61



He's one of the best we ever do know. While his show may say that he smokes 2 or 3, he's actually only had 24 hours a day.

Think about it, doctor, a physician, and a family companion like an angel, all in one, the superior being and best of his world.

According to a recent *Nationwide survey*:

MORE DOCTORS SMOKE CAMELS THAN ANY OTHER CIGARETTE

DOCTORS (Survey based on 111,000 in all-over period in the nationwide study of cigarette preferences. Then, taking account in percentages made the survey. The gist of the query was: What cigarette do you smoke, Doctor?)

The brand named next was Camel!

The only full flavor and mild nicotine of Camel's superb blend of choice tobacco seems to have the same appeal in the smoking terms of doctors as to millions of other smokers. If you use a Camel brand, the preference among doctors will hardly surprise you. If you're not a real, big Camel smoker.

Your "Z-Zees" Will Tell You...

If you smoke...
 ...your eyes grow gray...
 ...your throat gets sore...
 ...your lungs get weak...
 ...your health gets worse...
 ...your life gets shorter...
 ...your family gets sicker...
 ...your doctor gets worried...
 ...your friends get away from you...
 ...your life gets miserable...
 ...your death gets nearer...
 ...your soul gets damned...
 ...your God gets angry...
 ...your heaven gets lost...
 ...your eternity gets ruined...
 ...your life gets a hell...
 ...your death gets a pain...
 ...your soul gets a torment...
 ...your God gets a curse...
 ...your heaven gets a punishment...
 ...your eternity gets a damnation...
 ...your life gets a curse...
 ...your death gets a pain...
 ...your soul gets a torment...
 ...your God gets a curse...
 ...your heaven gets a punishment...
 ...your eternity gets a damnation...

CAMELS *Crestler Tobacco*

Fredric March says... **THIS IS IT**

"L&M FILTERS ARE JUST WHAT THE DOCTOR ORDERED!"

When I read Dr. Darkin'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. Darkin's letter:

Dr. Darkin, I have been a smoker for 30 years. I have tried many different brands of cigarettes, but I have never found one that I like as much as L&M Filters. I have read your letter and I am very glad to hear that you are a smoker. I am sure you will like L&M Filters as much as I do. I am sure you will like them as much as I do.

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

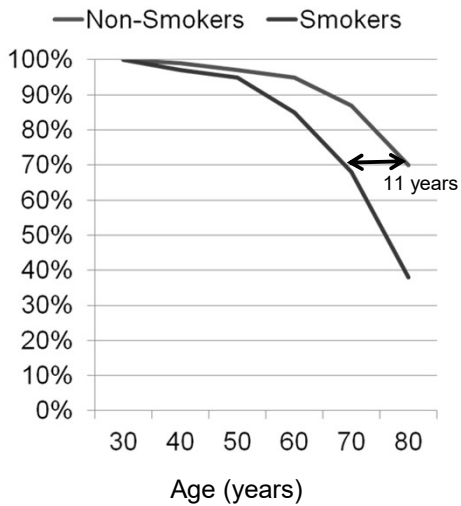
1. Effective filtration, from a Single New World Filter. Maximum Alpha-Globulin. It filters out L&M Filters, and really give you and your family health.
2. Much less nicotine like L&M Filters. Nicotine is the main cause of addiction. L&M Filters have much less nicotine than other brands. L&M Filters are just what the doctor ordered. L&M Filters are just what the doctor ordered.
3. Maximum Flavor—the L&M Filter allows and preserves the heavy particles, leaving you a light and mild smoke.
4. Much less tar and smoke. L&M Filters are just what the doctor ordered. L&M Filters are just what the doctor ordered.
5. L&M Filters are just what the doctor ordered. L&M Filters are just what the doctor ordered.

L&M FILTER TIP Cigarettes

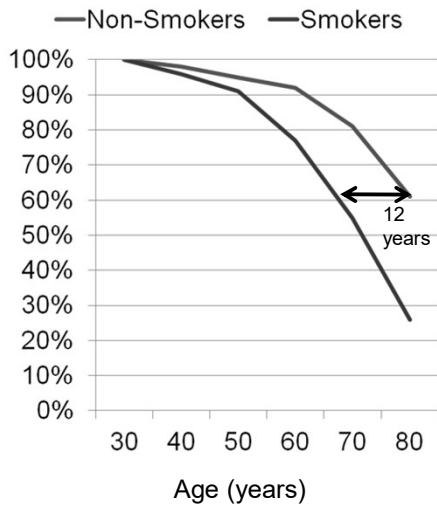
63

Life expectancy for smokers and non-smokers

Women



Men



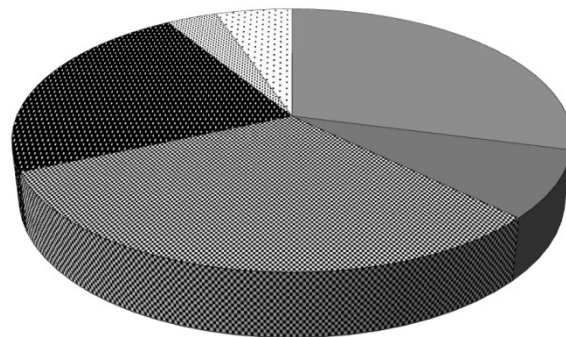
N Engl J Med 2013; 368:341-50

64

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



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

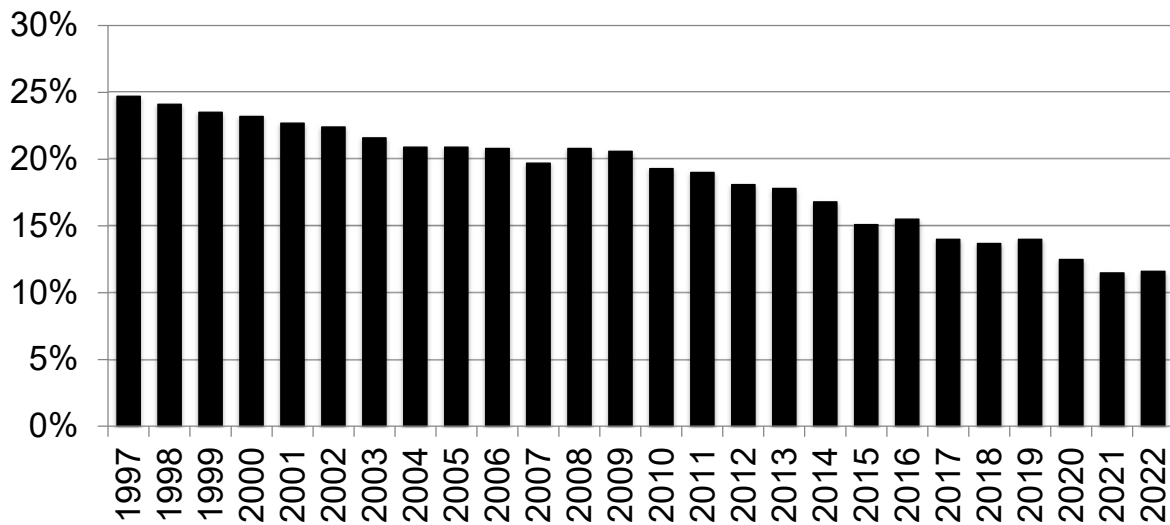


- Lung cancer
- Other cancers
- Cardiovascular disease
- COPD
- Stroke
- Other

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

Data source: CDC

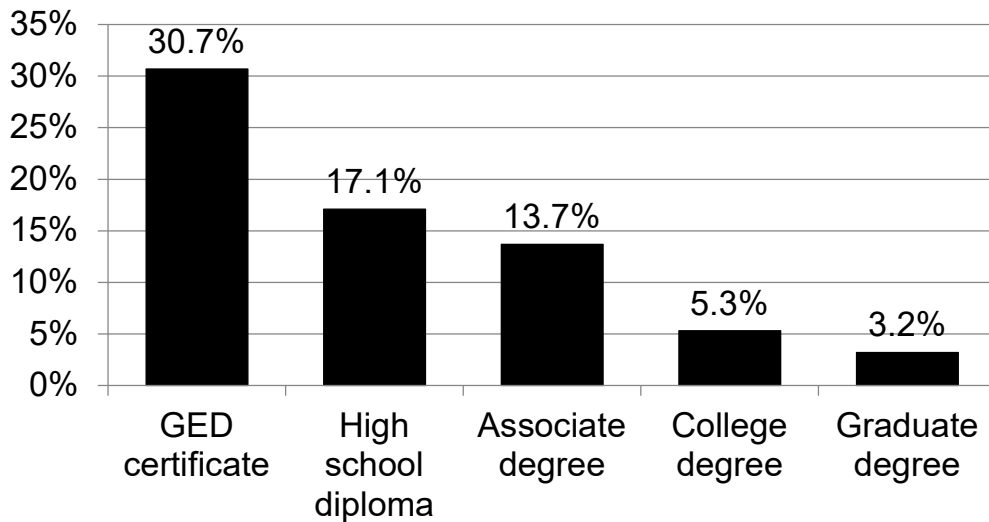
Prevalence of Adult Smokers In The U.S.



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

Data: Centers for Disease Control 2025

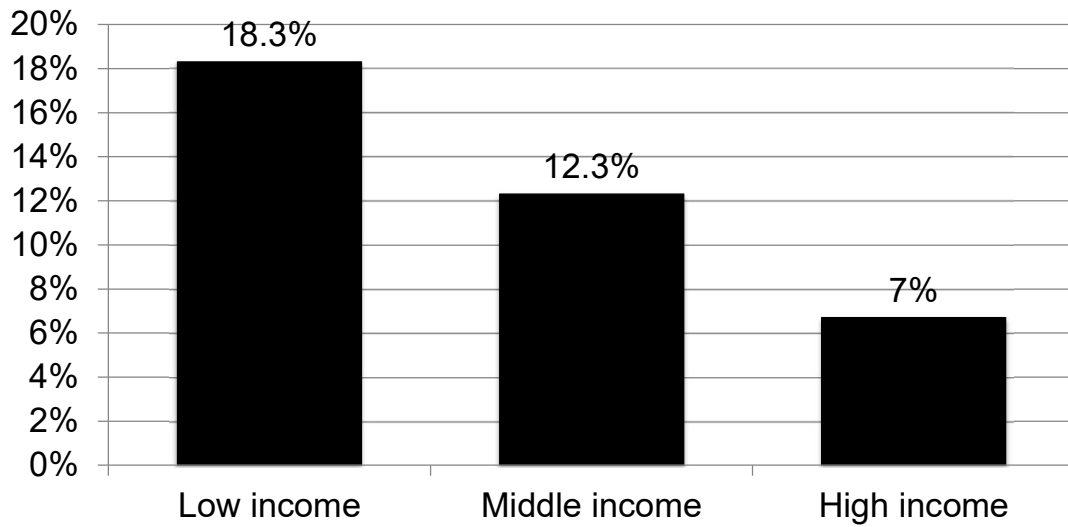
Who Smokes In The United States?



Centers for Disease Control 2024

Who Smokes In The United States?

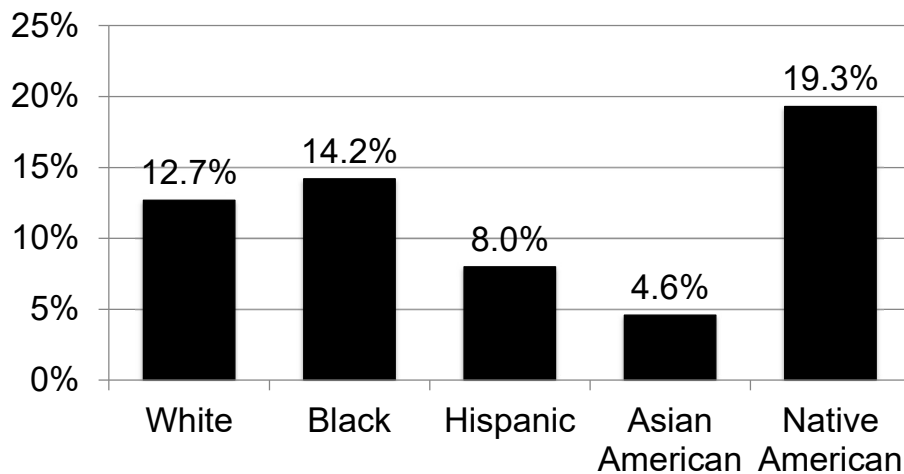
Prevalence By Income Level



Centers for Disease Control 2024

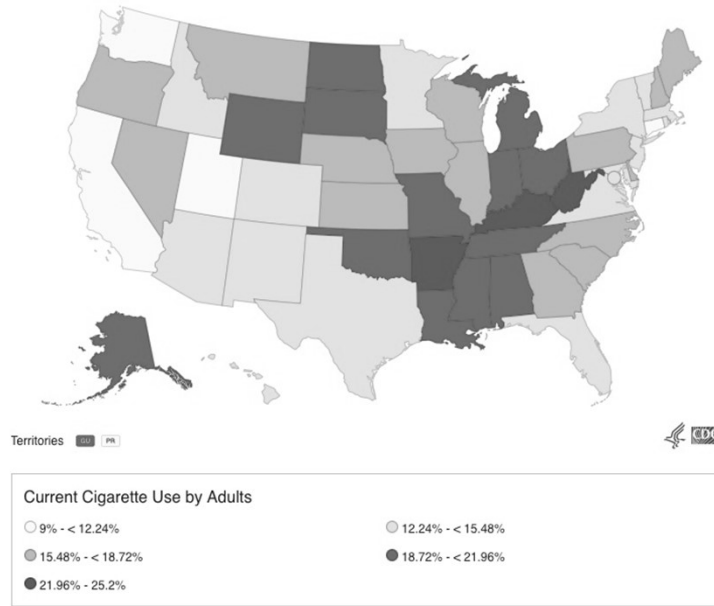
Who Smokes In The United States?

Prevalence Of Smoking By Race



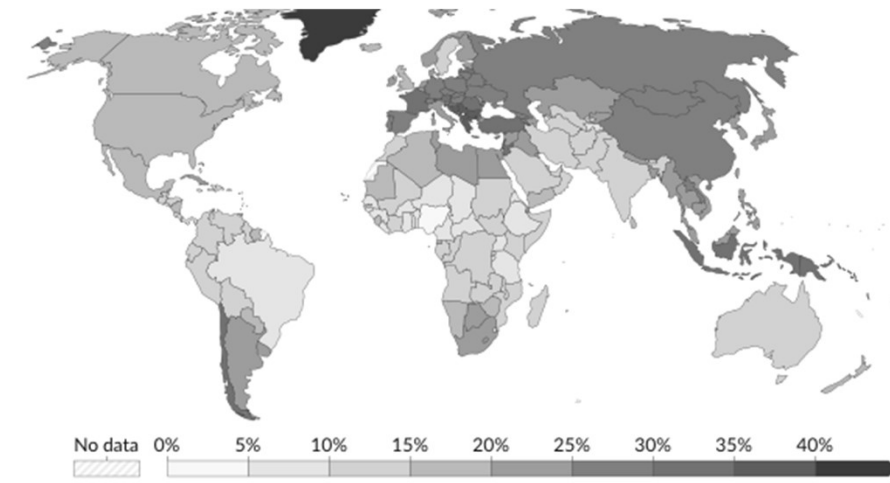
Centers for Disease Control 2025

Who Smokes In The United States?

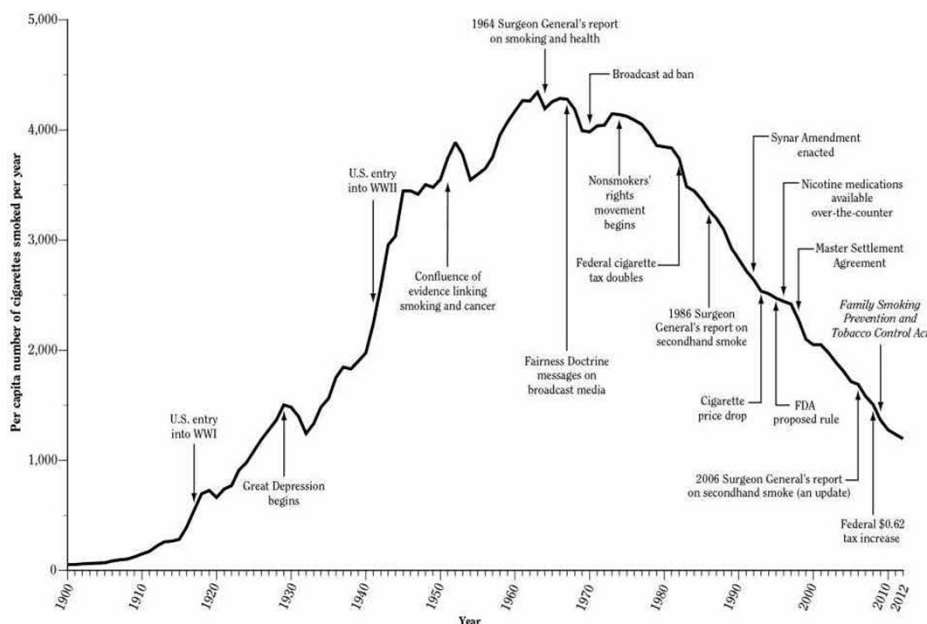


Source: CDC 2024

Who Smokes In The World?



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

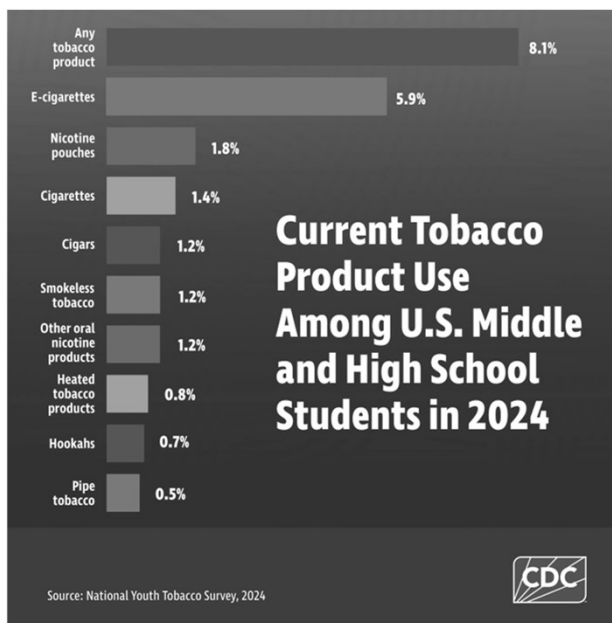


U.S. Surgeon General Report 2014

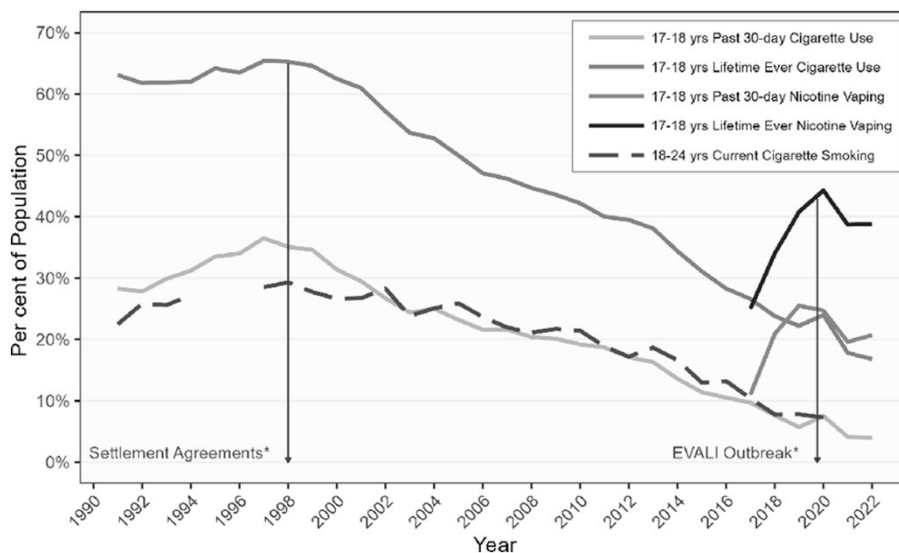
Smoking is a childhood epidemic

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



CC BY-NC 4.0: Pierce JP, Luo M, McMenamin SB, et al. Tob Control Epub ahead of print: [11/8/2023]. doi:10.1136/tc-2022-057907



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

