Lung Cancer: From Prevention & Screening to Robotic Lung Preserving Surgery

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A Lethal Disease!

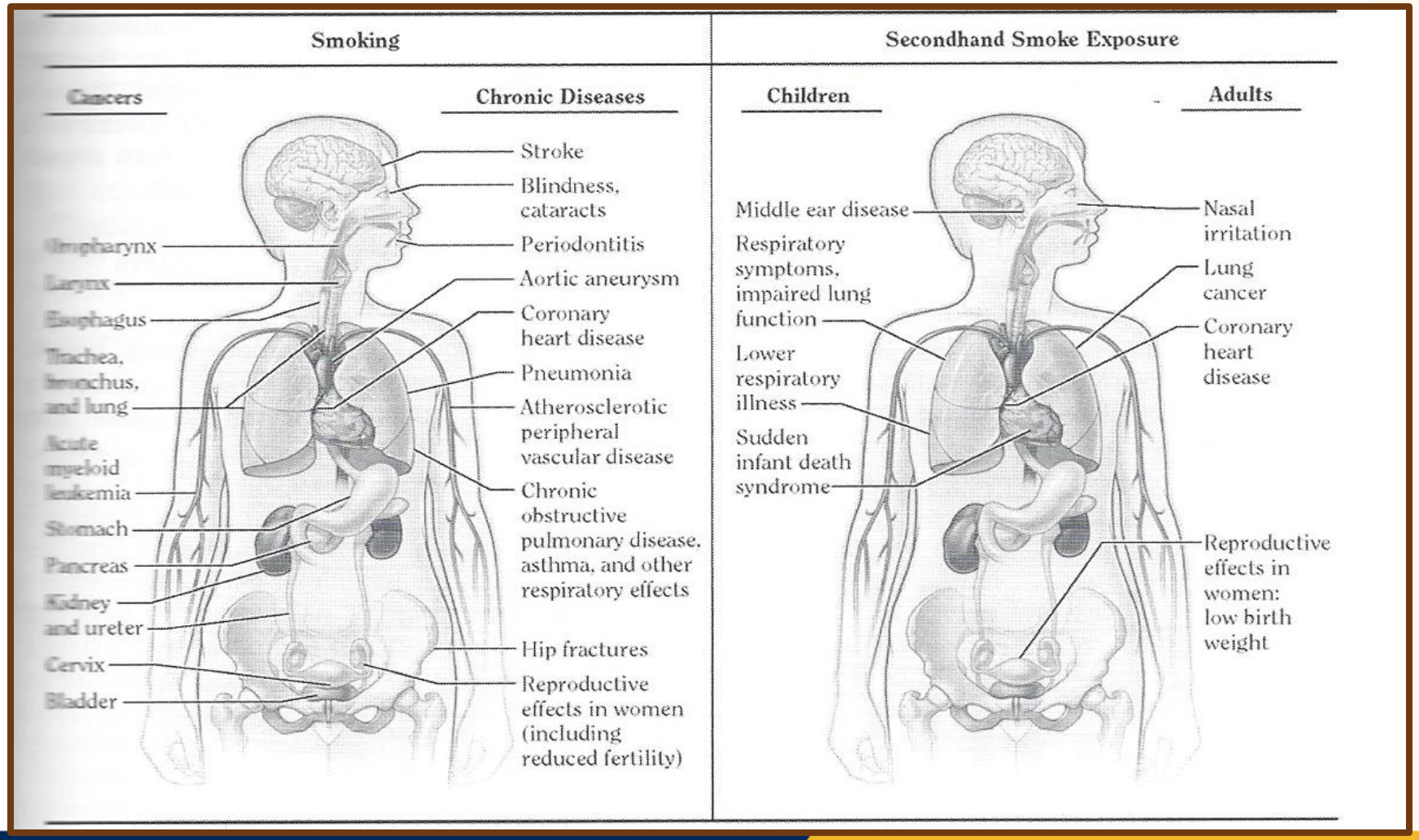
- 1.6 Millions death per year worldwide
- 170 k death in US per year

22% of All Cancer Deaths are related to Tobacco Abuse

Smoking and Lung Cancer

Product that, when used as intended, Kills

Tobacco Smoking: Cause of various Cancers and chronic Conditions



Tobacco Smoking: Historical Background

- Native Americans used for ceremonial purposes
- Columbus brought it to Europe
- Philip Morris: London early1800s
- James B Duke of North Carolina late 1800s

Tobacco Smoking: Historical Background

" In UK, the 1962 report of the Royal College of Physicians concluded that smoking was a cause of lung cancer and bronchitis, and a contributing factor for coronary artery disease"

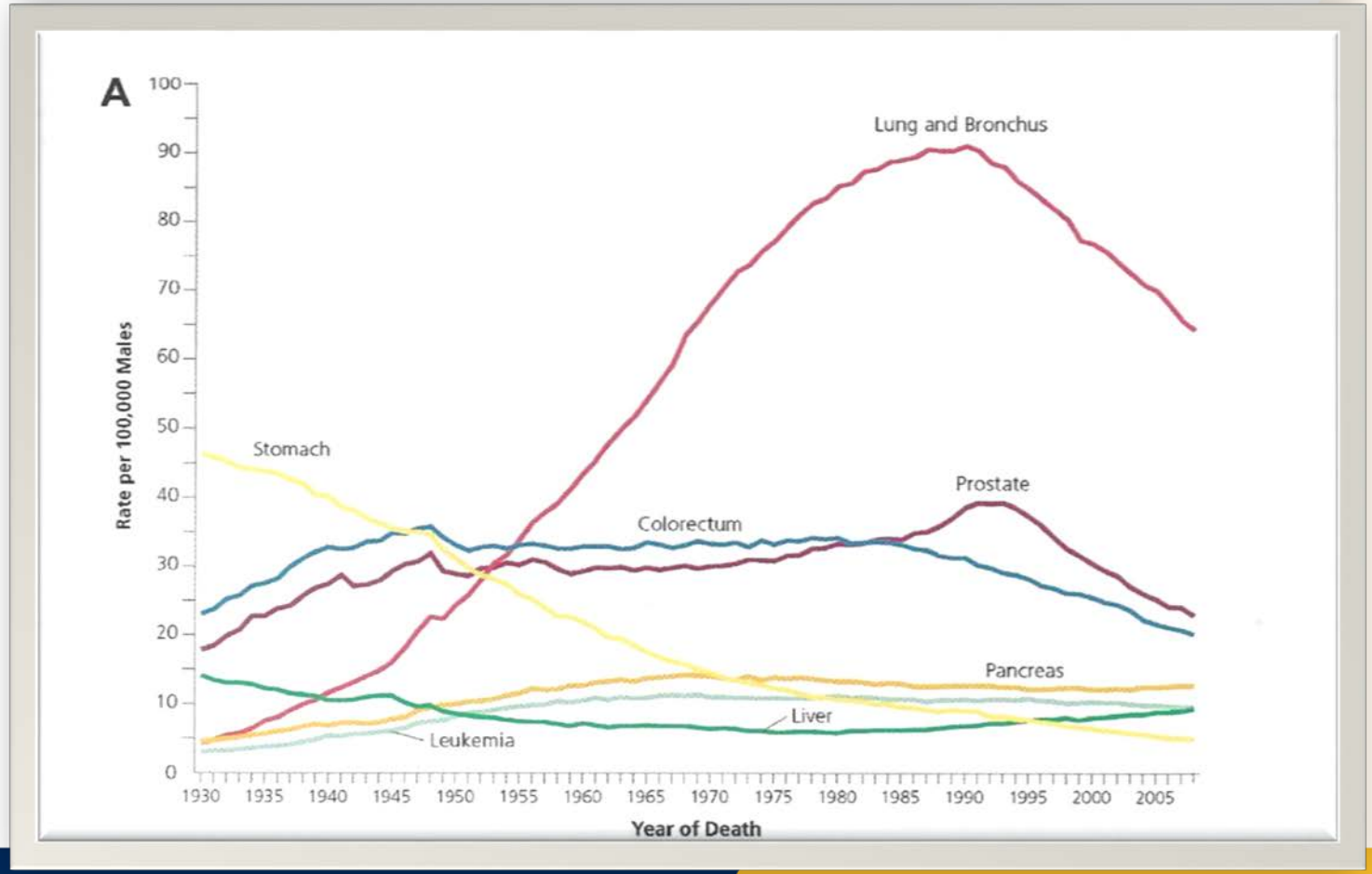
Tobacco Smoking: Historical Background

"In US, 1964 landmark report of the Advisory Committee to the Surgeon General concluded that smoking was a cause of lung cancer in men and of chronic bronchitis"

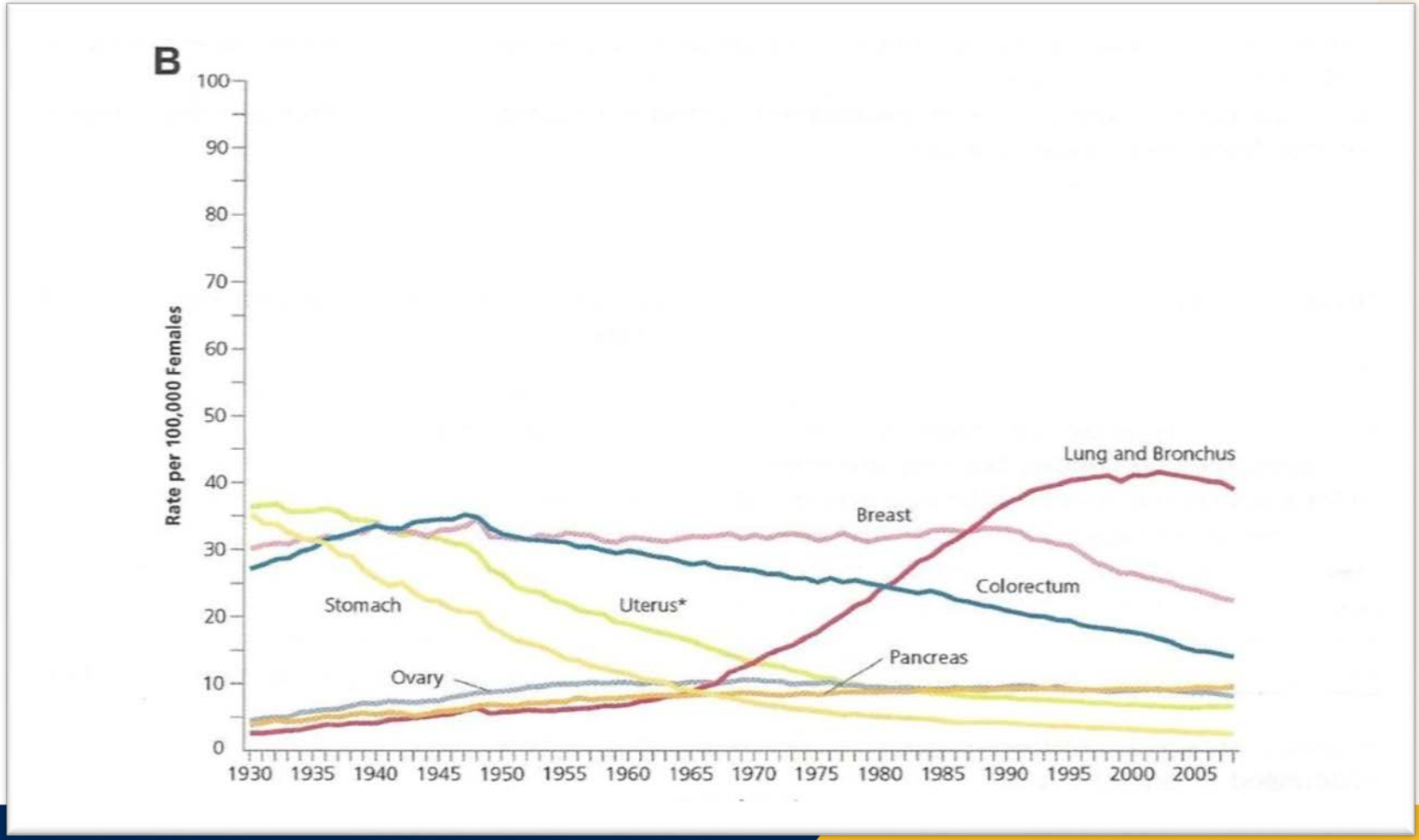
Tobacco Smoke Leading to Cancer

- Burning of Tobacco along with the various additives and paper, at a very high temperature.
- Produces 7000 compounds
- Well known Toxins:
  - Benzene (a leukemogen)
  - Formaldehyde
  - Benzopyerene
  - Carbon monoxide
  - Cyanide
  - Acrolein
  - Polonium

Lung Cancer Related Deaths in US Males

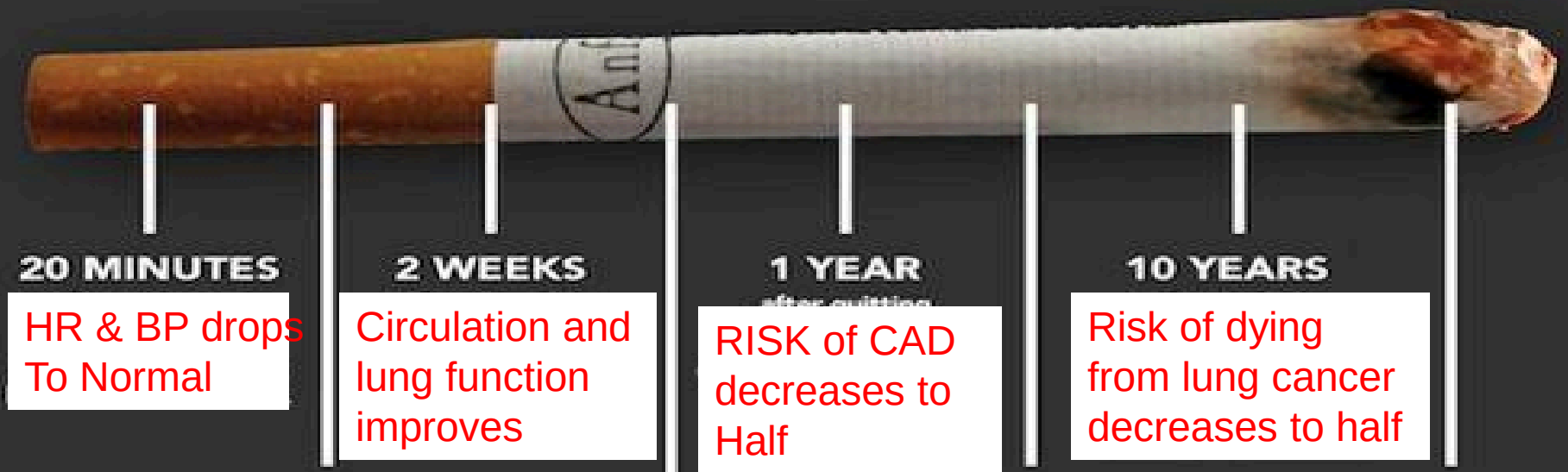


Lung Cancer Related Deaths in US Females



WHAT HAPPENS WHEN A SMOKER QUITS

A 15 YEAR TIMELINE



20 MINUTES

HR & BP drops To Normal

12 HOURS

The Level of CO Drops to normal

2 WEEKS

Circulation and lung function improves

1-9 WEEKS

after quitting

Cough and Bronchitis improves

1 YEAR

RISK of CAD decreases to Half

5 YEARS

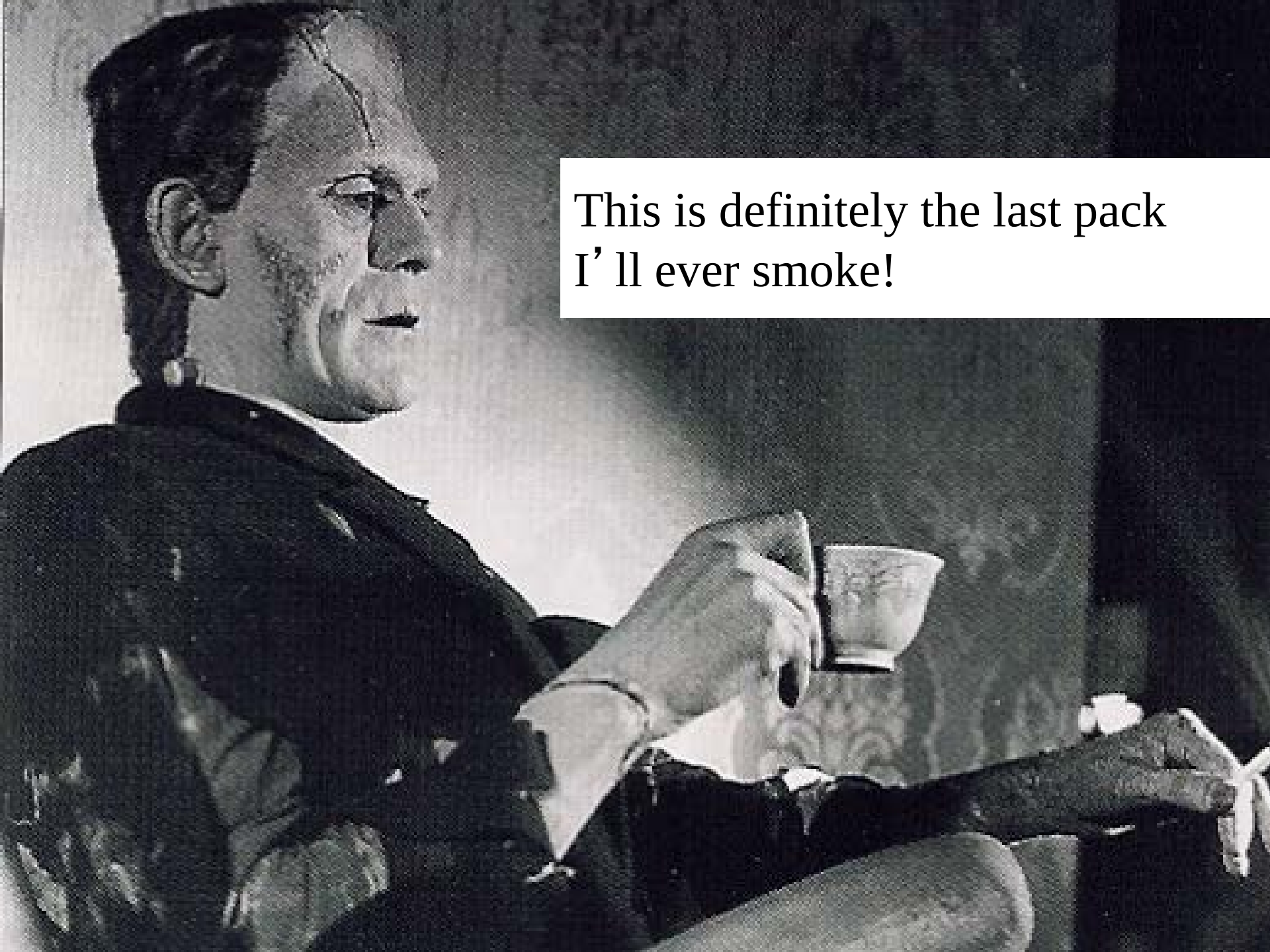
Risk of H & N, esophageal, bladder ca decreases

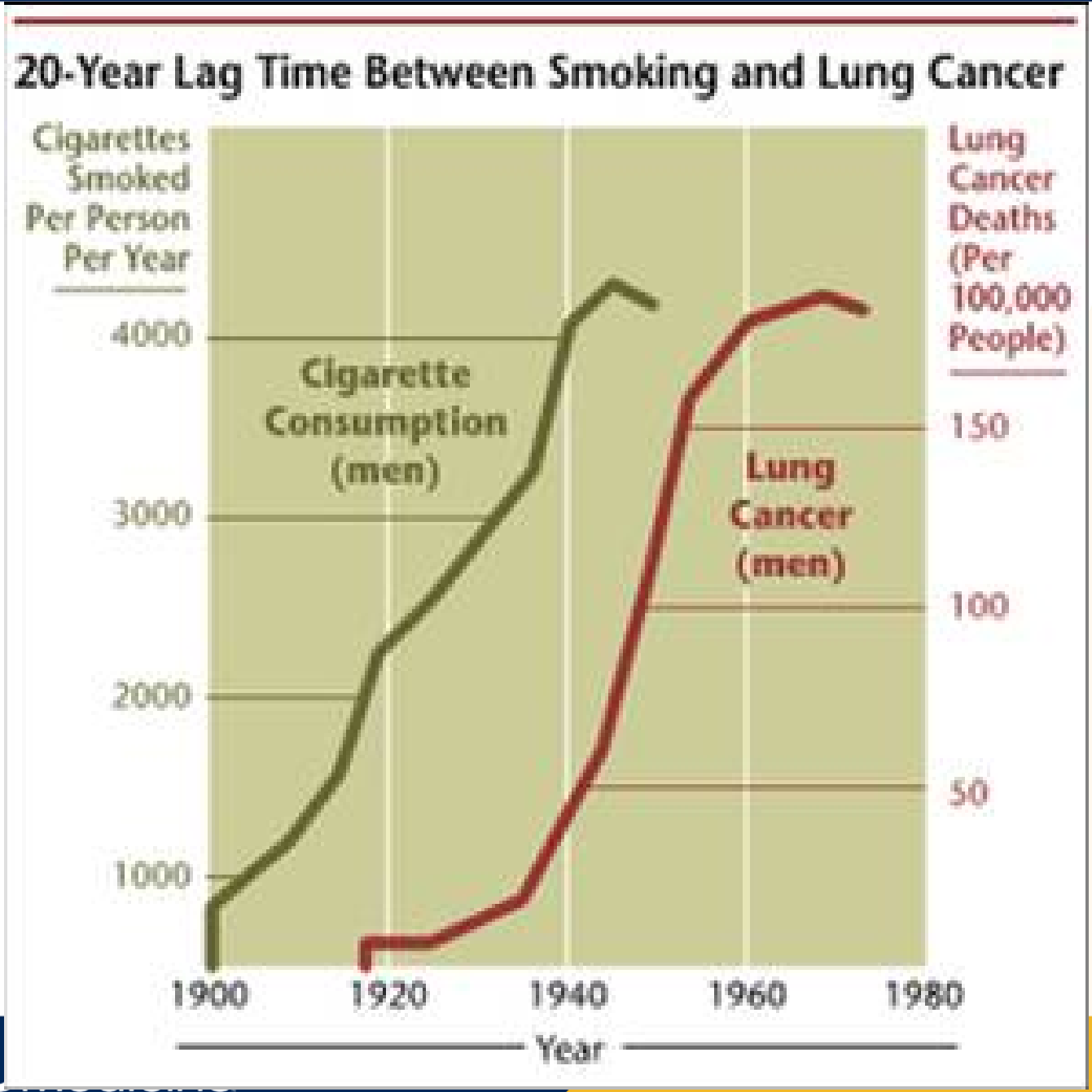
10 YEARS

Risk of dying from lung cancer decreases to half

15 YEARS

Risk of heart diseases decrease to level of non smo


This is definitely the last pack
I’ll ever smoke!


20-Year Lag Time Between Smoking and Lung Cancer
Cigarettes Smoked Per Person Per Year
4000
3000
2000
1000
Cigarette Consumption (men)
Lung Cancer (men)
Lung Cancer Deaths (Per 100,000 People)
150
100
50
1900
1920
1940
1960
1980
Year

Lung Cancer Screening

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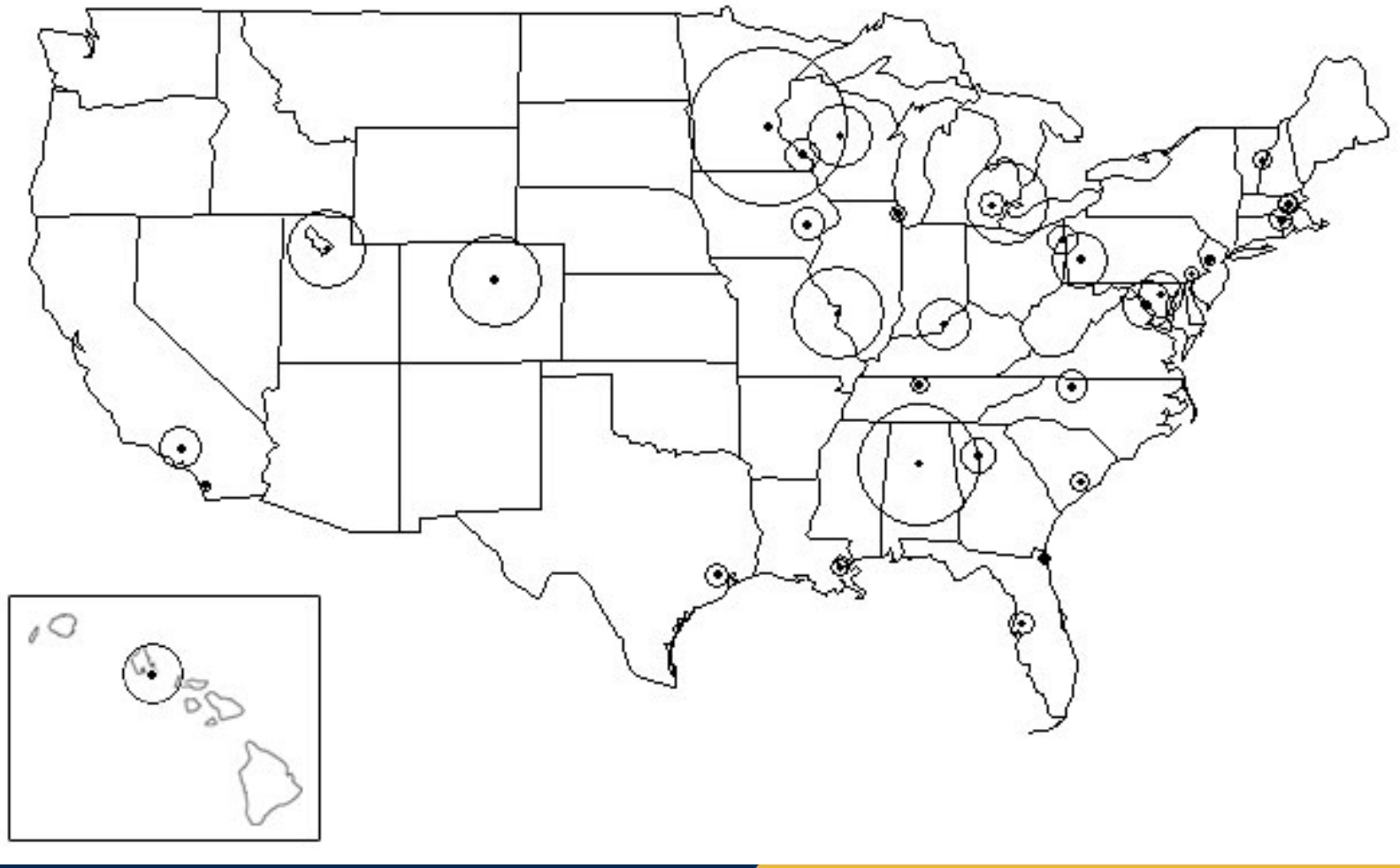
NLST Design

Prospective, randomized trial comparing low-dose helical CT screening to chest x-ray screening with the endpoint of lung cancer specific mortality in high risk participants

- Ages 55 – 74
- 30 pack year smoking history
- If former smoker have quit within 15 years

33 participating sites



Results of Interim Analysis of Primary Endpoint Reported on Oct. 20, 2010

Arm	Person years (py)	Lung cancer deaths	Lung cancer mortality per 100,000 py	**Reduction** in lung cancer mortality	Value of test statistic	**Efficacy boundary**
CT	144,097	354	245.7	**20.3**	-3.21	-2.02
CXR	143,363	442	308.3			

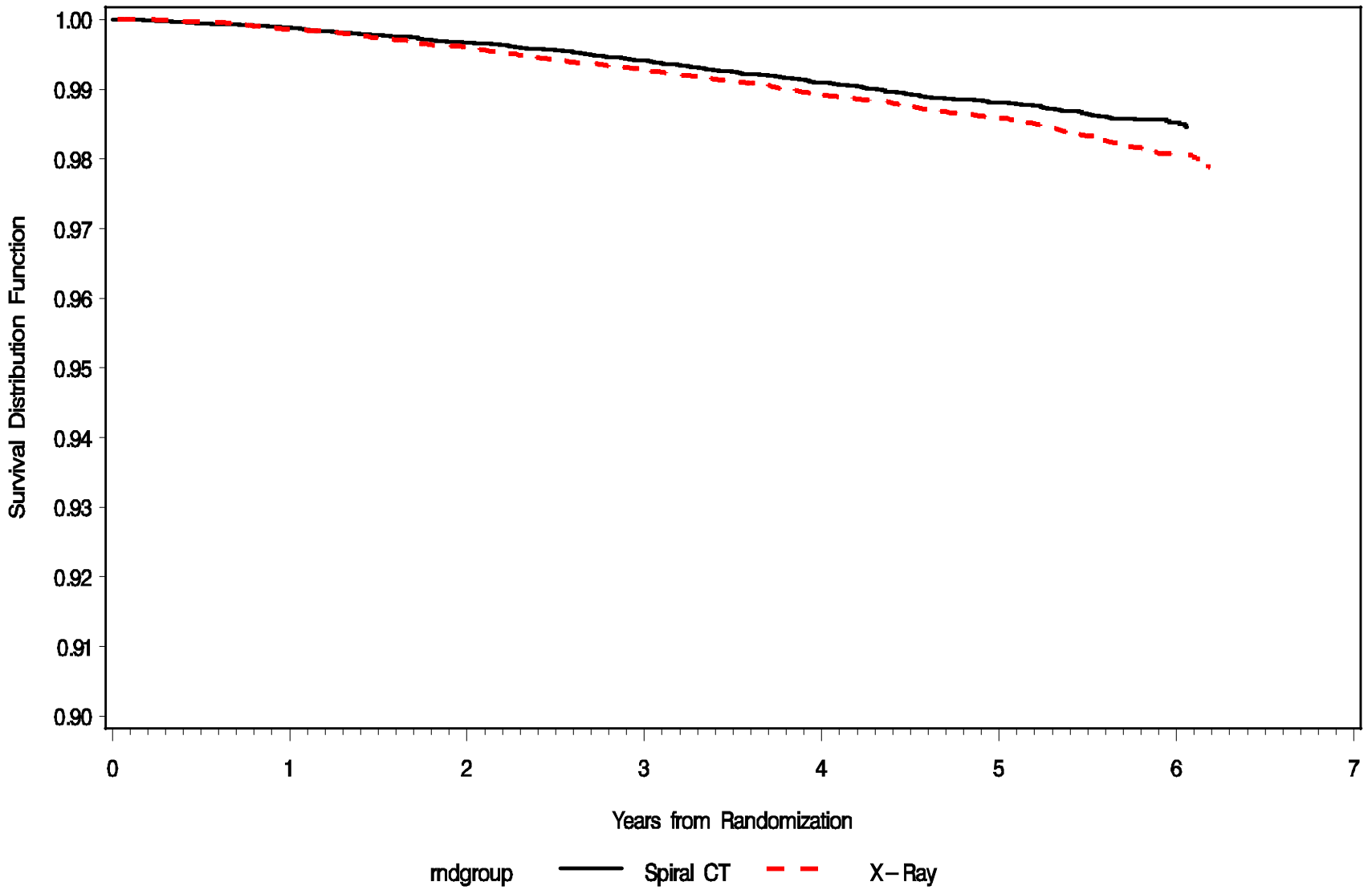
Deficit of lung cancer deaths in CT arm exceeds that expected by chance, even allowing for multiple looks at the data.

Results of Analysis of All-cause Mortality (Secondary Endpoint) Reported on Oct. 20, 2010

Arm	Person years (py)	Deaths	All-cause mortality per 100,000 py	Reduction in all-cause mortality (%)	Value of test statistic	Value for signifi-cance
CT	167,389	1870	1117.2	**6.9**	–2.27	–1.96
CXR	166,328	1996	1200.0			

Deficit of deaths in CT arm exceeds that expected by chance.

Kaplan-Meier Curves for Lung Cancer Mortality



Kaplan-Meier Curves for All-Cause Mortality

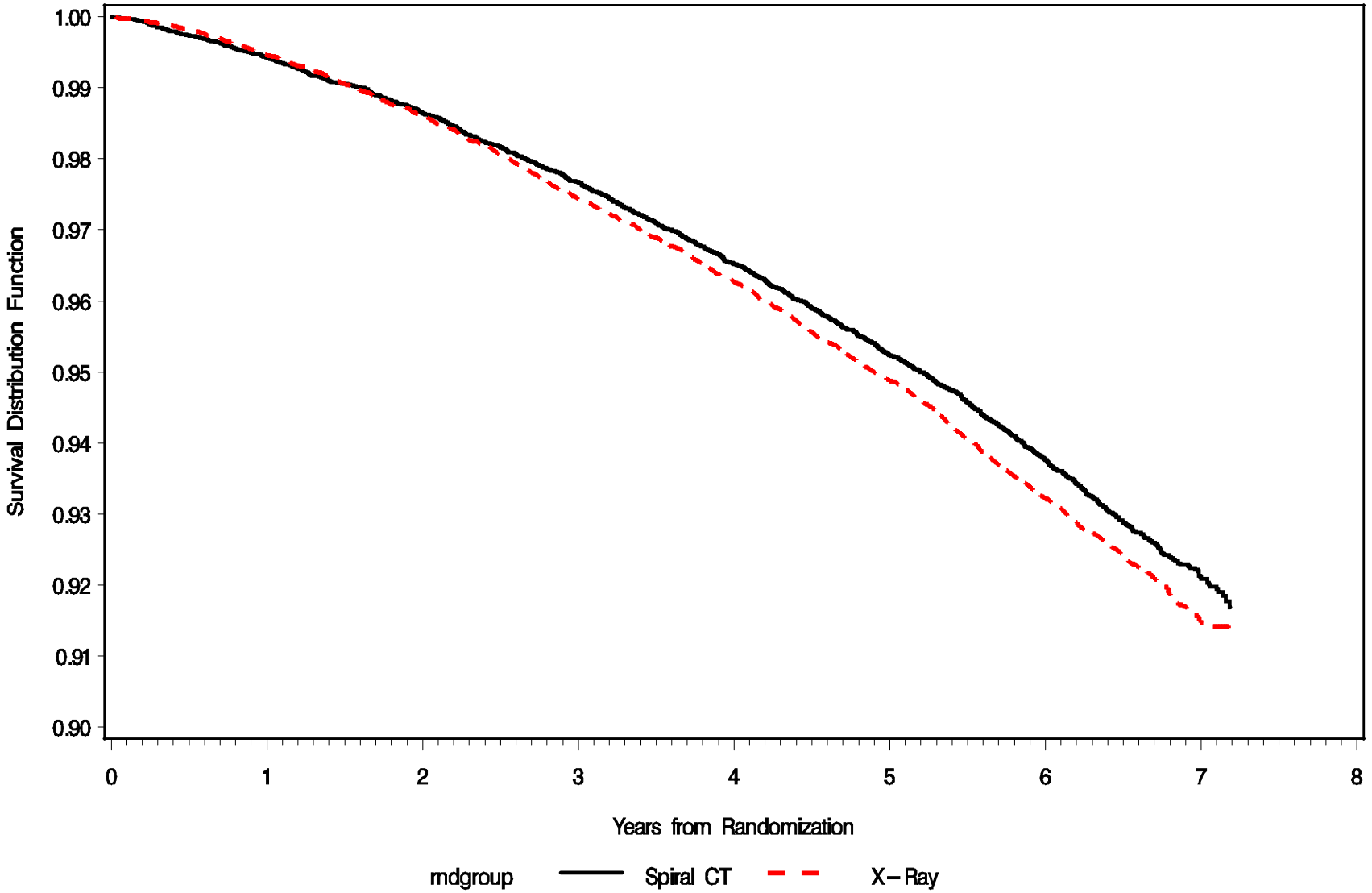


Table 11.5.6a

Kaplan-Meier Curves for Lung Cancer Case Survival (Lung Cancer Cause of Death)

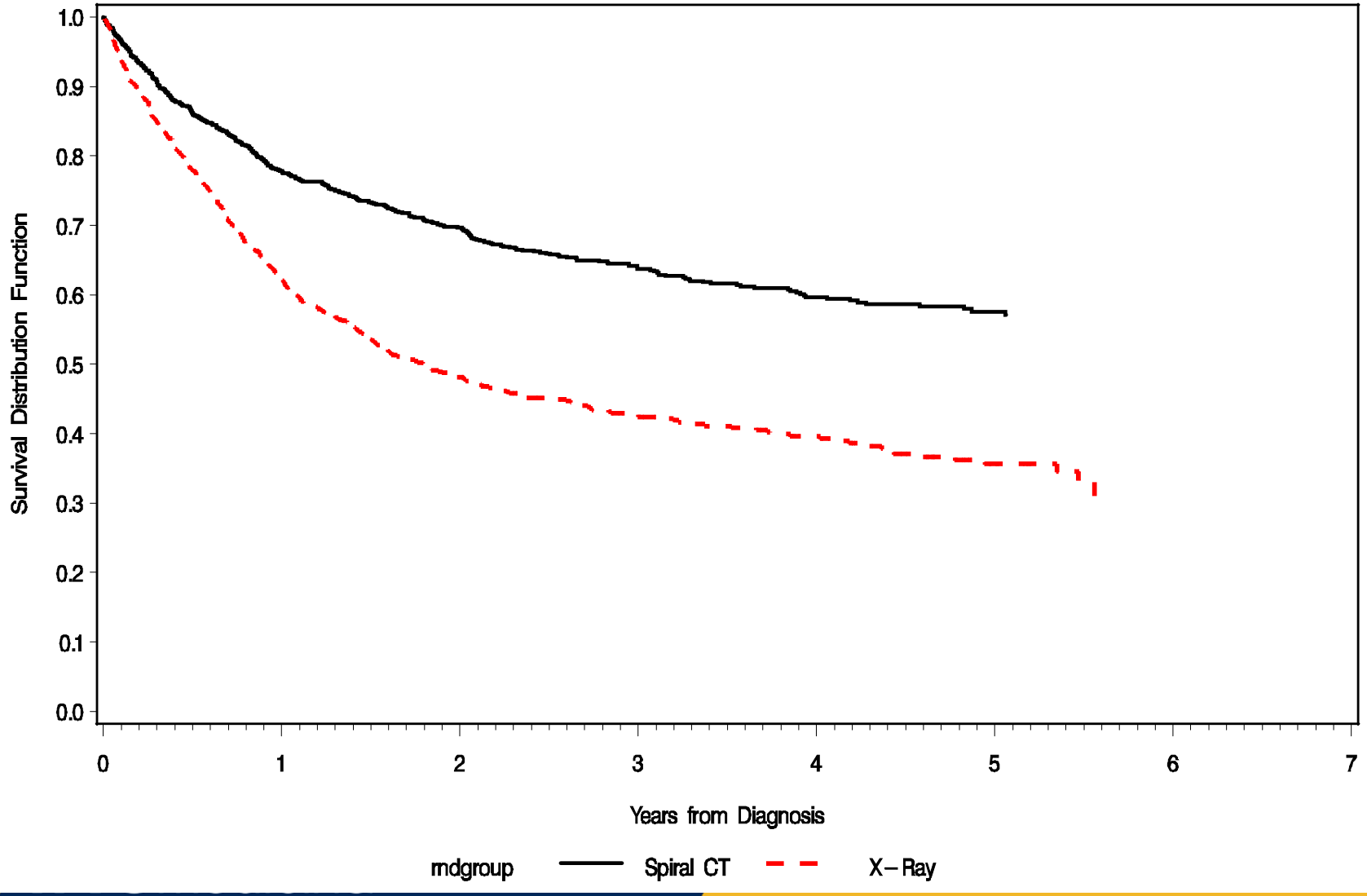


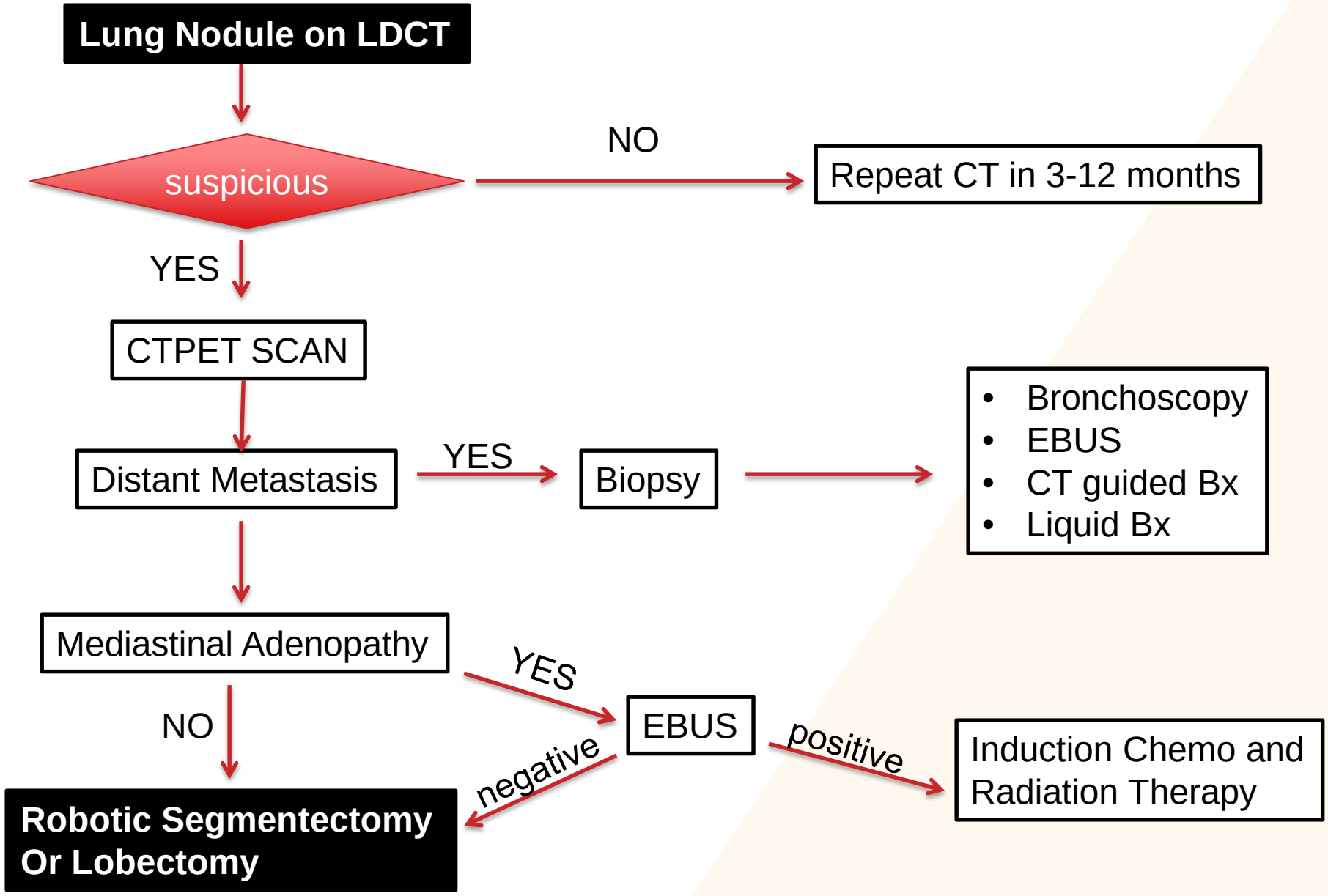
Table 11.5.3d

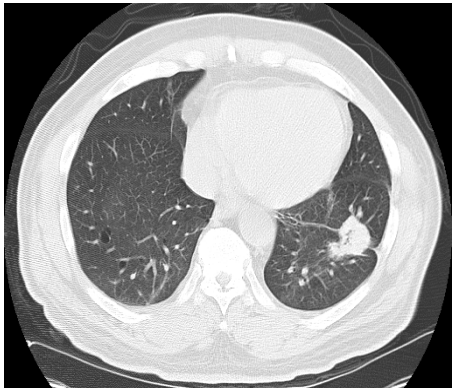
Nelson Trial

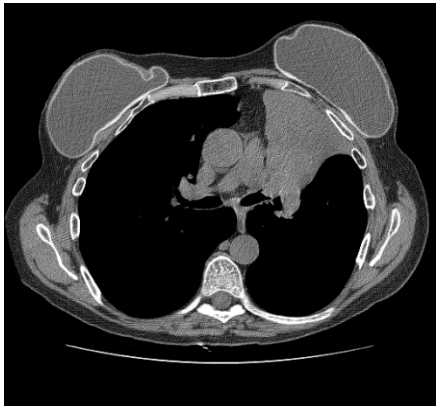
WCLC 2018

- Population-based, Randomized controlled trial
- 50-74 years age, high risk group
- CT scans at baseline, 1, 3 and 5.5 years after randomization
- 10 year follow up
- 26% reduction in the lung cancer related deaths
- 69 percent of screen-detected lung cancers were detected at Stage I.
- Curative surgical resection was three times more prevalent in study group

Low Dose CT shows a lung nodule. What to do Know?

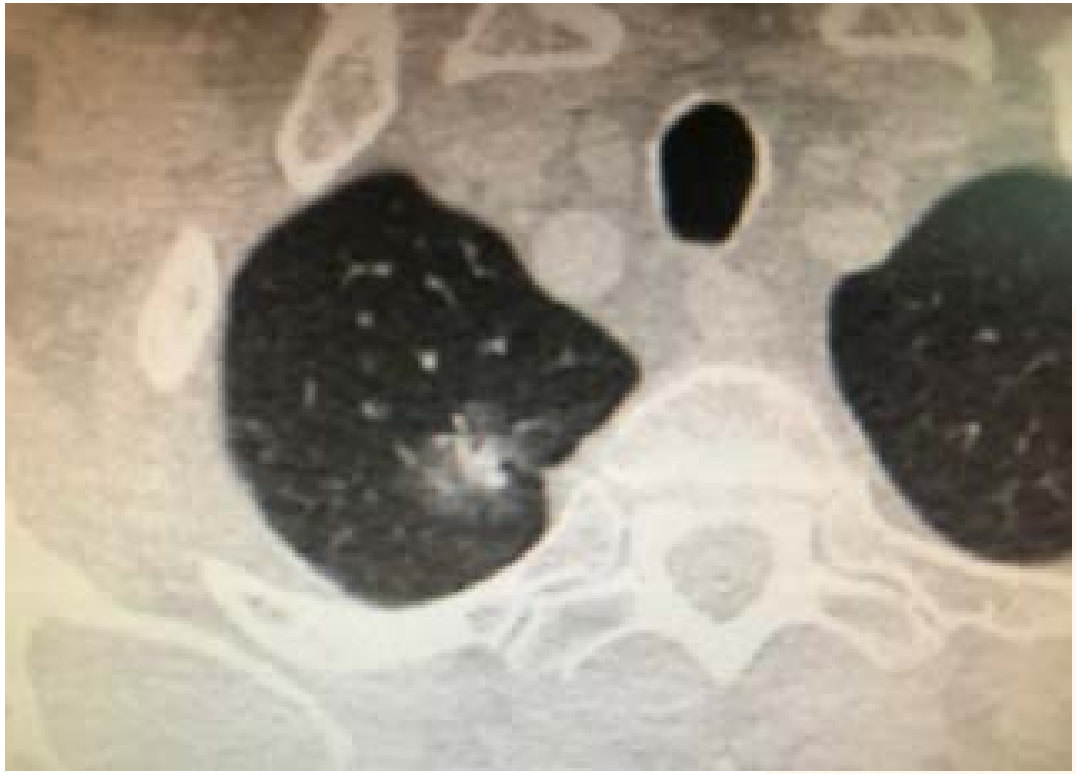

Lung Nodule on LDCT
suspicious
NO
Repeat CT in 3-12 months
YES
CTPET SCAN
Distant Metastasis
YES
Biopsy
• Bronchoscopy
• EBUS
• CT guided Bx
• Liquid Bx
Mediastinal Adenopathy
YES
EBUS
positive
Induction Chemo and Radiation Therapy
NO
negative
Robotic Segmentectomy Or Lobectomy





Ground Glass Opacity (GGO)

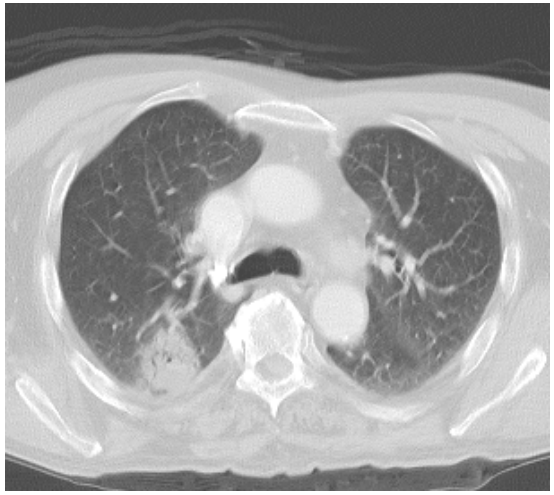
- Pure GGO
- GGO with Solid Component
- Carcinoma in situ
- Minimally Invasive carcinoma

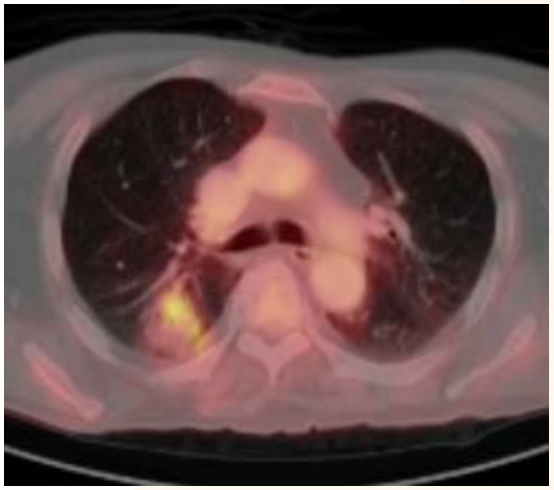


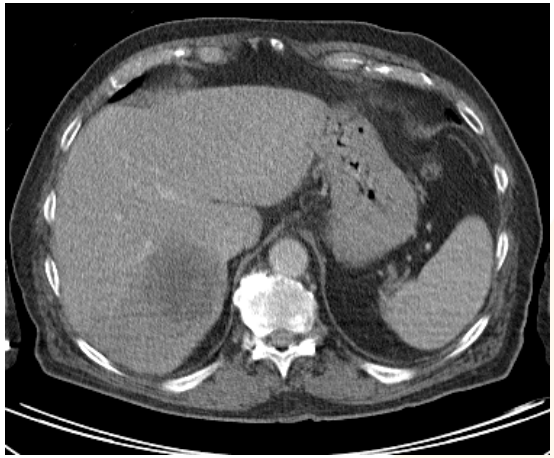
NSCLC Staging

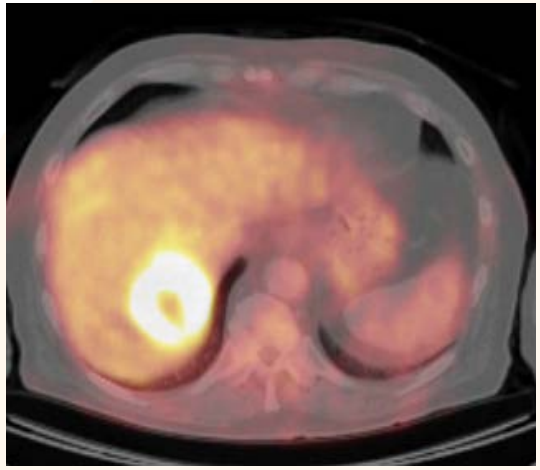
PET/CT

- Excellent sensitivity
- Limited PPV
- False positives common
- Better than CT or PET alone in detecting LN involvement or mets

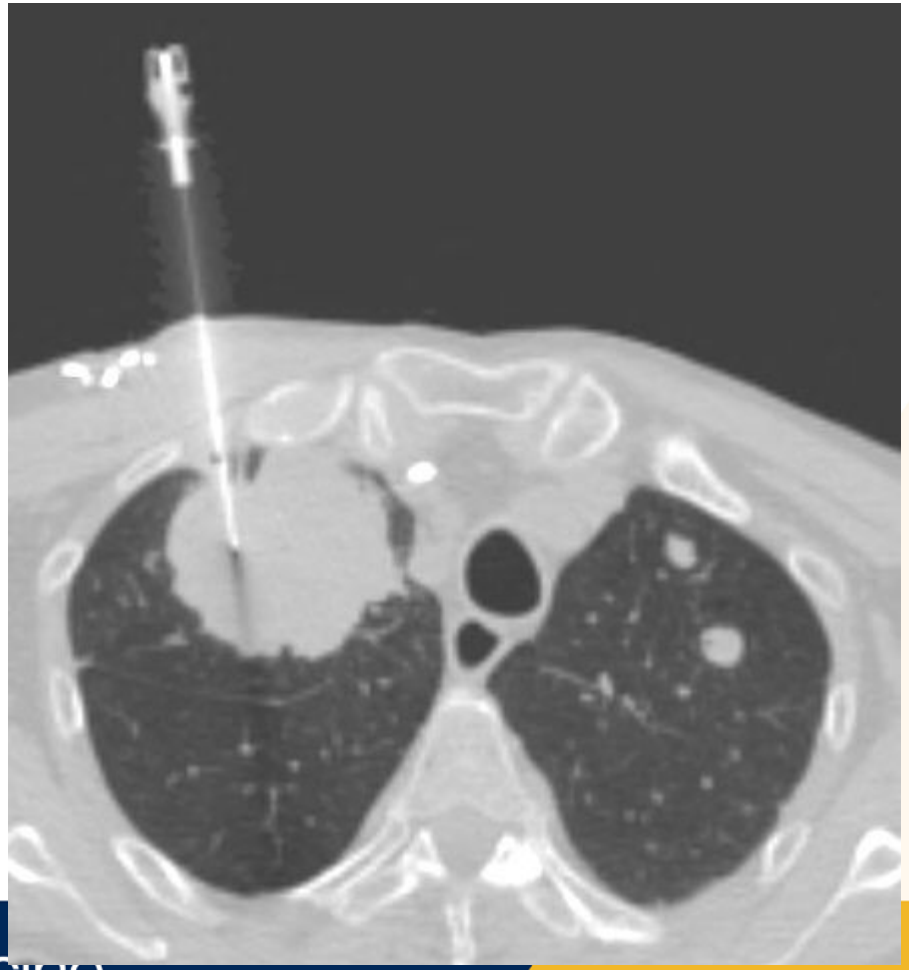








CT Guided Biopsy



ENB PROCESS

CT Scan : →

DICOM CD

PLANNING: →

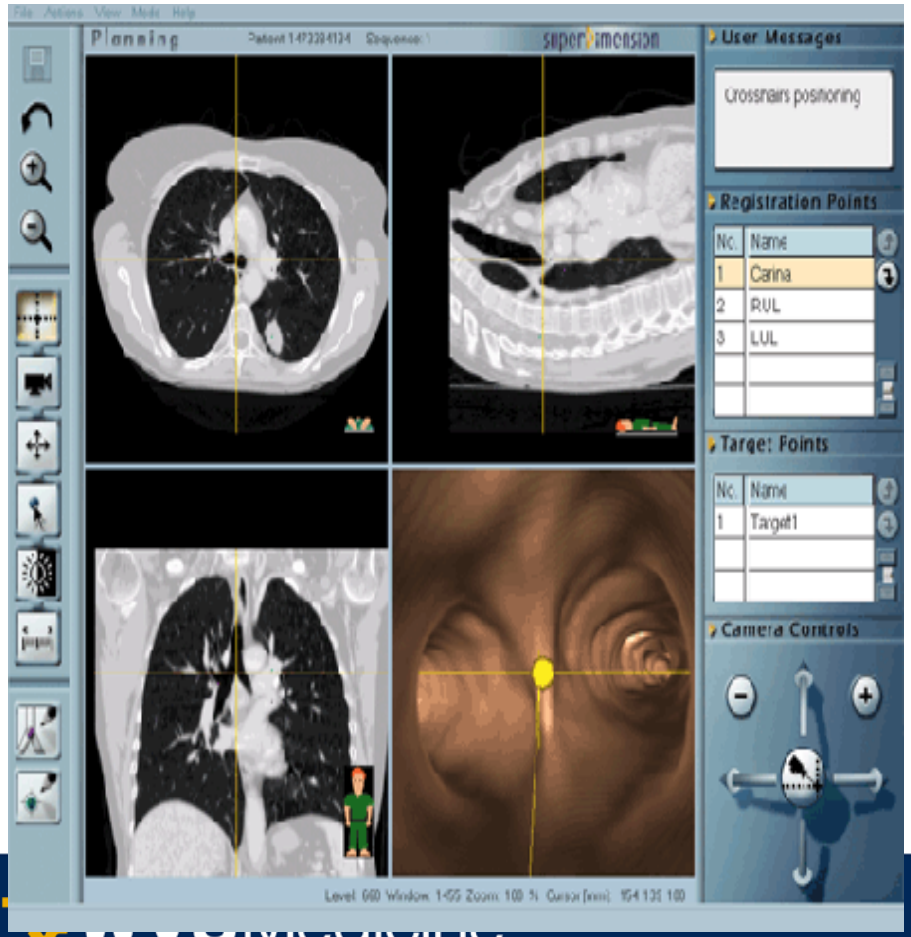
Prepare for the procedure and learn the patient's anatomy

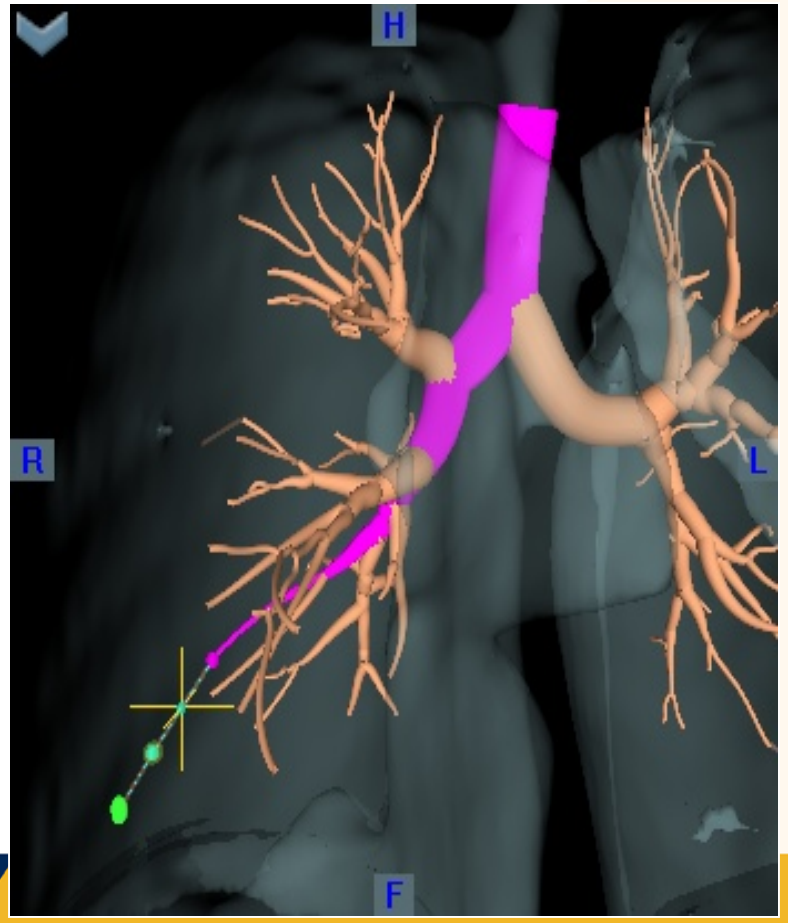
PROCEDURE:

Navigate, biopsy, and plan for treatment

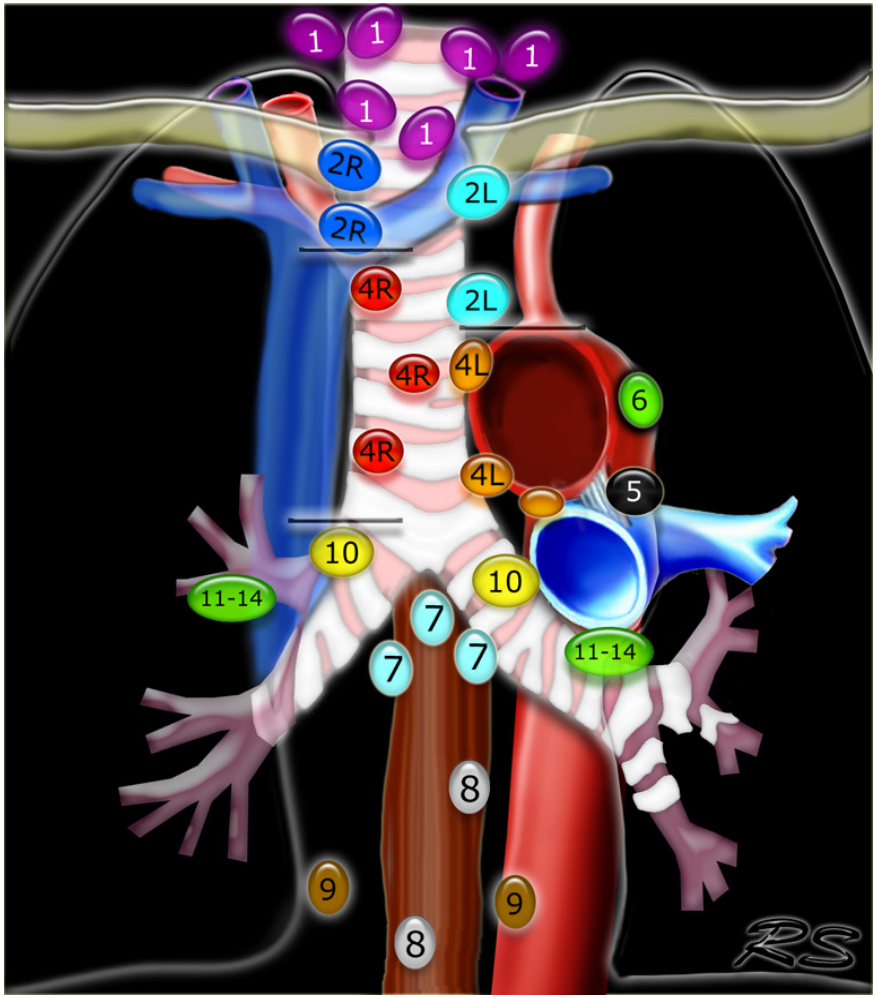
Pre-Operative Procedure Planning

Choose Your Target (destination)

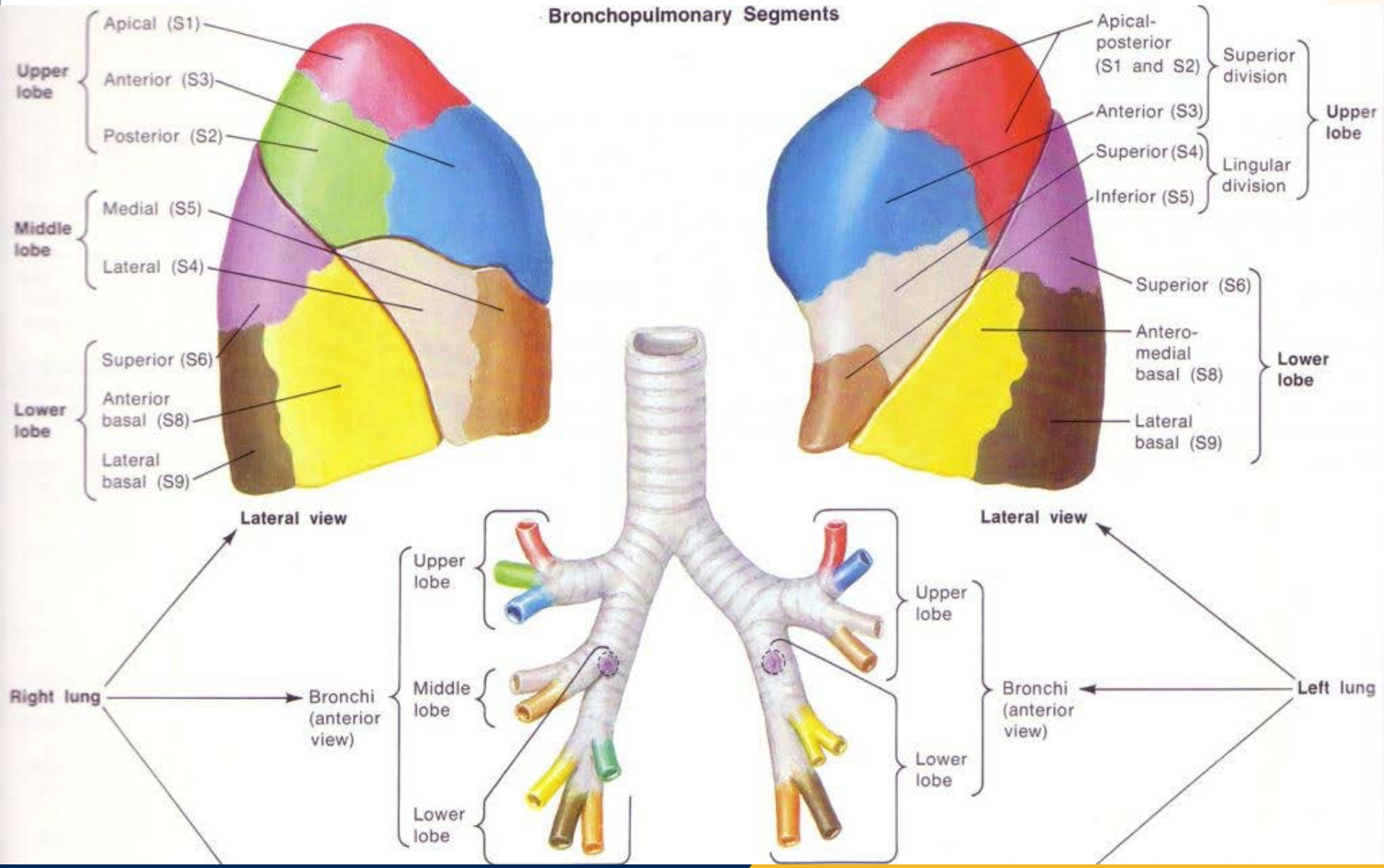




EBUS/Mediastinoscopy



Robotic Lung Preserving Resection: Robotic Segmentectomy


Bronchopulmonary Segments
Upper lobe
Apical (S1)
Anterior (S3)
Posterior (S2)
Middle lobe
Medial (S5)
Lateral (S4)
Lower lobe
Superior (S6)
Anterior basal (S8)
Lateral basal (S9)
Lateral view
Apical-posterior (S1 and S2)
Anterior (S3)
Superior division
Superior (S4)
Inferior (S5)
Lingular division
Upper lobe
Superior (S6)
Antero-medial basal (S8)
Lateral basal (S9)
Lower lobe
Lateral view
Right lung
Bronchi (anterior view)
Upper lobe
Middle lobe
Lower lobe
Upper lobe
Lower lobe
Bronchi (anterior view)
Left lung

Background - Segmentectomy

- **Churchill et al. (1939)** – Anatomic segmentectomy for bronchiectasis

  "The bronchopulmonary segment may replace the lobe as the surgical unit of the lung"

- **Jensik, Faber et al. (1973)** Anatomic segmentectomy for lung cancer
- **Lung Cancer Study Group (1995)** – threefold increase in recurrence rate for sublobar resection (17.2% vs. 6.4%), 2.4-fold increase after segmental resection
- **Yoshikawa et al. (2002)** – Extended segmentectomy – 82% 5-year survival for tumors less than 2 cm
- **Okada et al. (2005)** – Equivalent 5 yr disease-free survival (≤ 2 cm)
  – 96.7 vs. 92.4%
- **Schuchert, Landreneau, Abbas. (2007)** – Equivalent recurrence-free and overall survival for pathologic Stage I NSCLC.

Lobectomy vs Sublobar Resection

5 Year Cancer Specific Survival "Stage I"

TUMOR SIZE	Segmental Resection	Lobectomy	Wedge Resection
20 mm or less	96.7	92.4	85.7
20-30 mm	84.6	87.4	39.4
More than 30 mm	62.9	81.3	0

Okada, et al J Thorac Cardiovasc Surg. 2005 Jan;129(1):87-93

WVU Experience of Robotic vs VATS Anatomical Pulmonary Segmentectomy

Clinical Characteristics

	VATS (22 pts)	Robotic (38 pts)	P value
Age	71.3 ± 10.2	68.6 ± 10.1	0.367
Female	14 (64%)	16 (57%)	0.642
BMI	27.1 ± 4.7	27.3 ± 7.0	0.904
Diabetes	4 (18%)	2 (7%)	0.385
Hypertension	17 (77%)	18 (64%)	0.320
CHF	2 (9%)	0	0.189
CAD	5 (23%)	3 (11%)	0.277
PVD	1 (5%)	3 (11%)	0.621
COPD	10 (46%)	15 (54%)	0.569
FEV1%Pred	81.9 ± 25.8	81.4 ± 17.3	0.939
Creatinine	0.8 ± 0.2	0.8 ± 0.2	0.932

Outcomes

	VATS	Robotic	P value
LOS	4 [2–5]	2 [2–4]	0.089
Complications	8 (36%)	4 (14%)	0.070
Chest tube airleak	4 (18%)	2 (7%)	0.385
Blood transfusion	0	0	
Conversion	0	0	
Pneumonia	2 (9%)	0	0.189
Atelectasis	2 (9%)	0	0.189
ARDS	1 (5%)	0	0.440
Neuro central event	1 (5%)	1 (4%)	>0.999
Unexpected ICU	1 (5%)	1 (4%)	>0.999
Readmit <30 days	1 (5%)	0	0.440
Mortality <30 days	1 (5%)	0	0.440

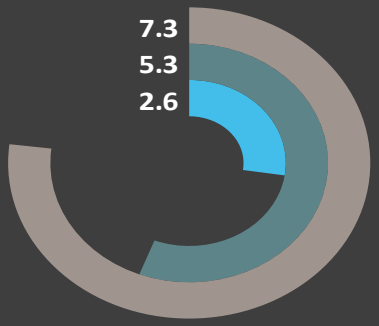
Robot Si vs Xi vs VATS: Cost Analysis

	Robot Using Manual Staplers	Robot Using Robotic Xi Staplers	VATS
Stapler handle	$350 x 1 = $350		$350 x 1 = $350
Vascular load	$150 x 2 = $300	$630	$150 x 2 = $300
Bronchus - green/blue load	$150 x 1 = $150	$315	$150 x 1 = $150
Parenchyma - green load x 3	$150 x 3 = $450	$945	$150 x 3 = $450
Robotic instrument/ports (forceps, bipolar, tip up grasper)	$600	$600	
Total	$1,850 + $350*	$2,498	$1,250 + $350*
Cost of hospital stay ($900 per day step down status)	$1,800 (2 days)	$1,800 (2 days)	$3,600 (4 days)
FINAL COST	**$3,300**	**$4,298**	**$4,500**

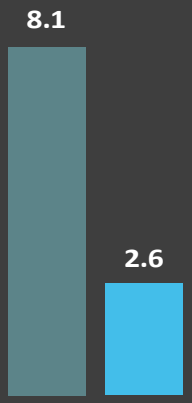
Potential Cost Offsets
Clinical Measures - Segmentectomy

OPEN (N=5,913)
LAP/VATS (N=4,612)
DAVINCI (N =38)

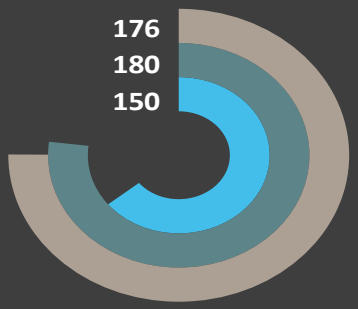
Length of Stay
(days)



Conversions
(percentage)



OR Room Time
(min.)



Cost:

$900
(per bed day)[1]

$7,812
(per conversion)[3]

$11
(per minute)[8]

Estimated Cost Savings Per Procedure

$ 4,520 vs. Open
$ 3,190 vs. Lap/VATs

Estimated Total Cost Savings

$ 171,760 vs. Open
$ 121,220 vs. Lap/VATS

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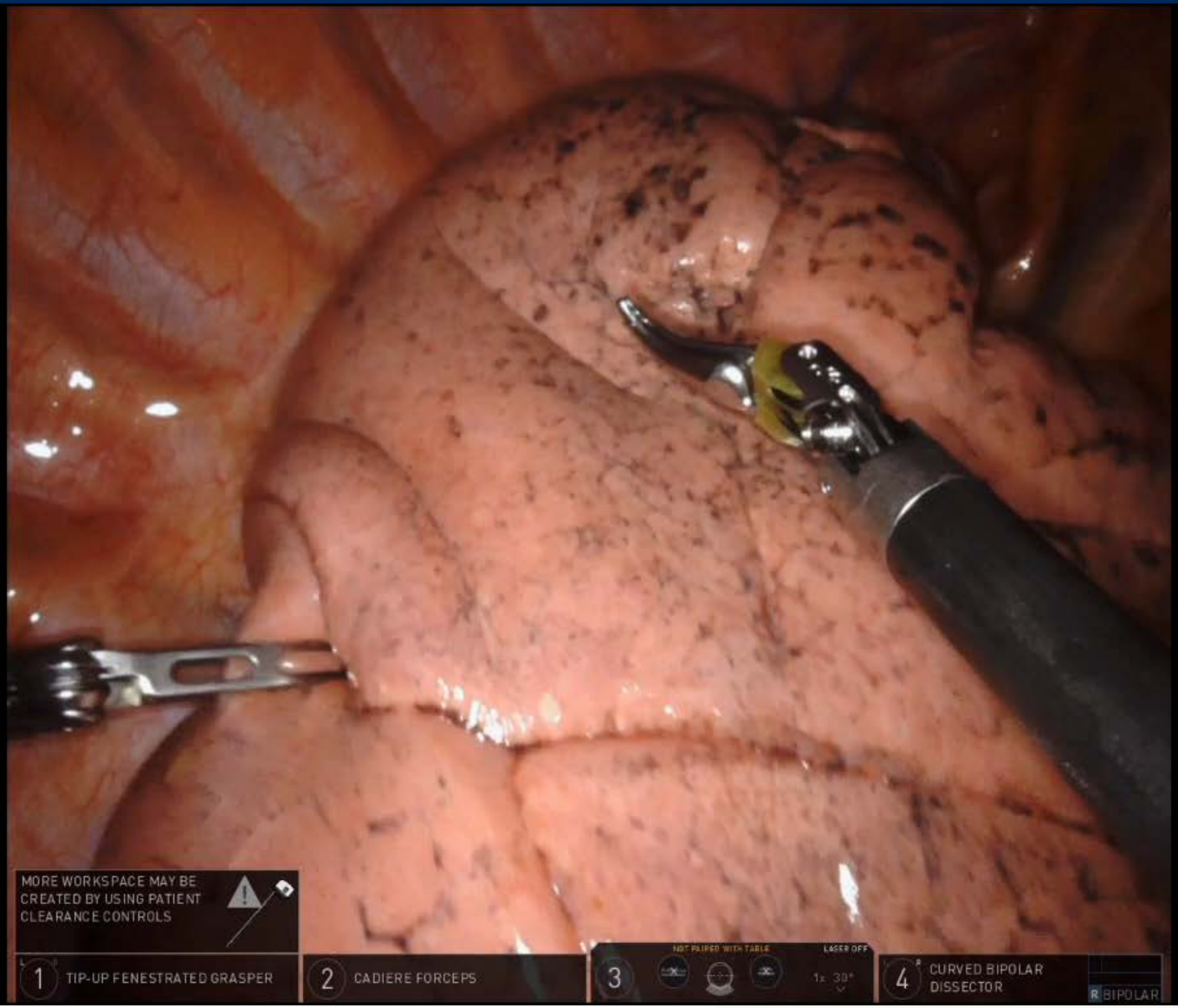
RUL Posterior segmentectomy
Using Xi stapler



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RUL S1 apical segment with abnormal vei
Xi Stapler

Thank you

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