Spirometry Testing in Primary Care

Associate Professor Robert Young
BMedSc, MBChB, DPhil (Oxon), FRACP, FRCP

University of Auckland,
New Zealand

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

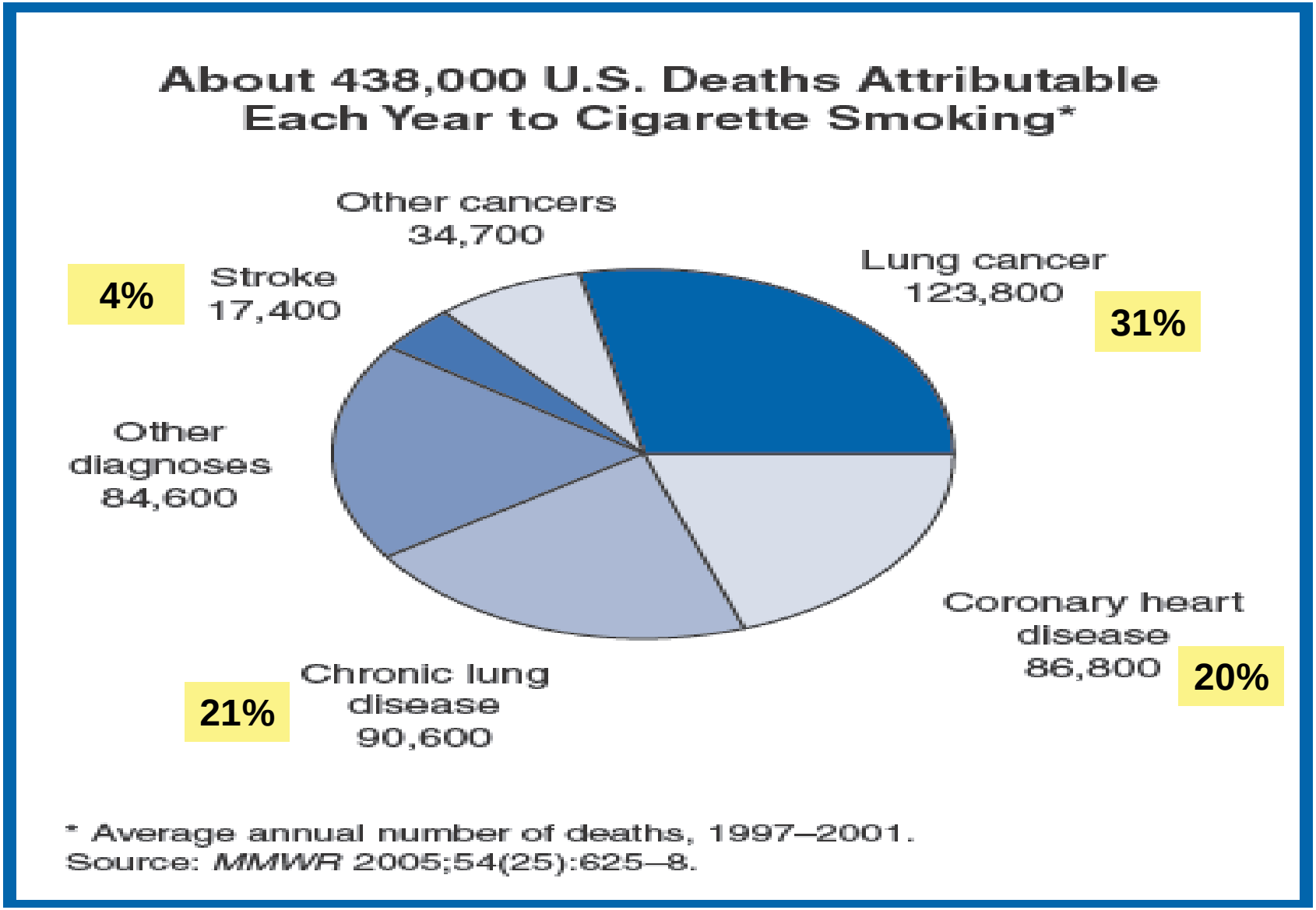
Why test with spirometry?

- Essential in screening, diagnosis and assessment of airways disease
- Used in conjunction with a patients clinical history is often the only test that is required
- Is an objective measure giving a quantitative assessment of severity of airflow obstruction
- Assists in monitoring disease severity and progression
- Provides differentiation between asthma and COPD
- Is more accurate and comprehensive than peak flow

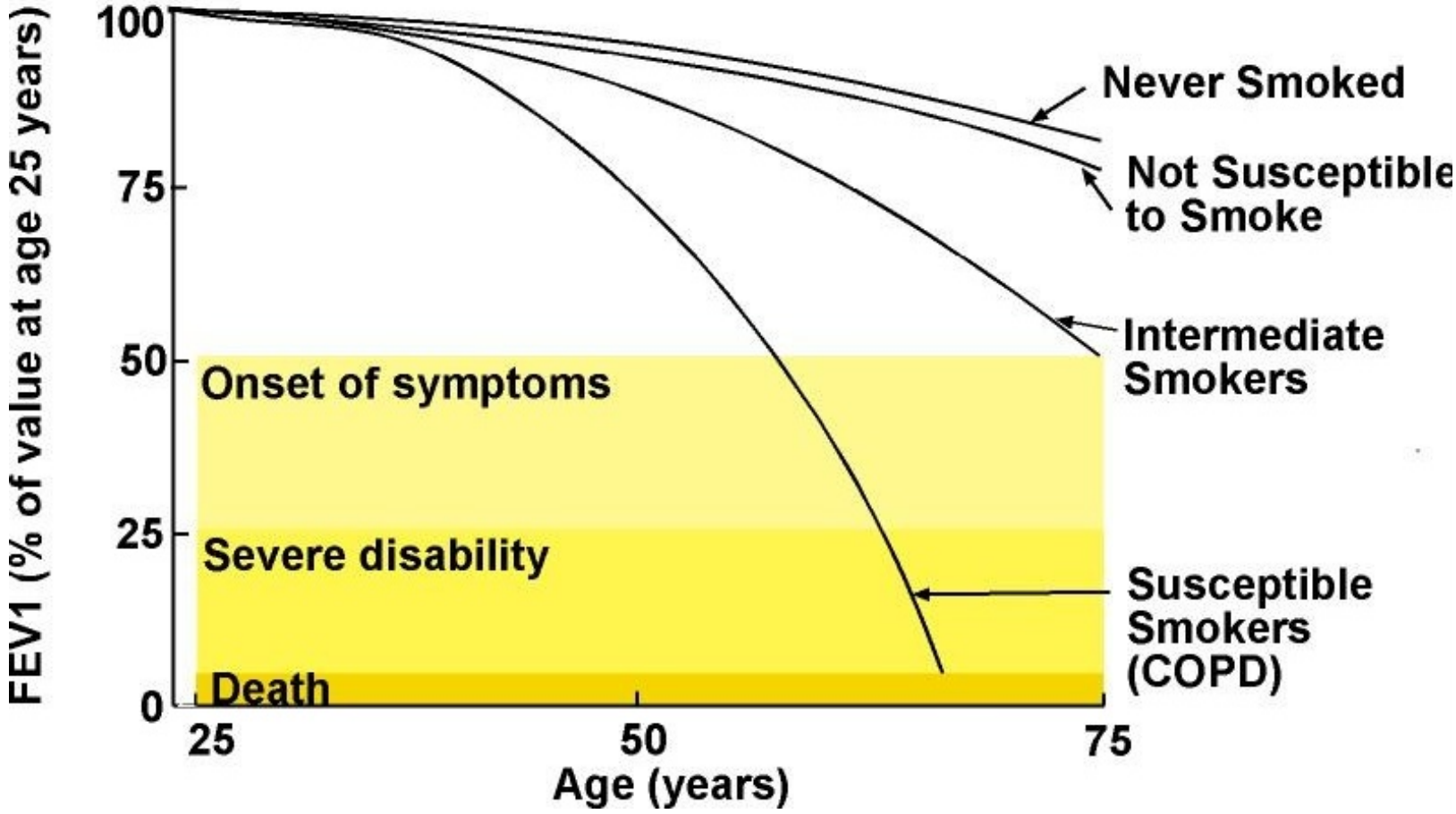
Public Health and epidemiological surveys

- 10 -20% of older adults have COPD
- Only approximately 30% of patients who have airway obstruction under care of a primary physician have had spirometry
- 70% of COPD patients do not have a confirmed diagnosis based on measurement (significant under-diagnosis)
- 70% are not being monitored to optimise treatment

Lung Cancer & Tobacco Mortality

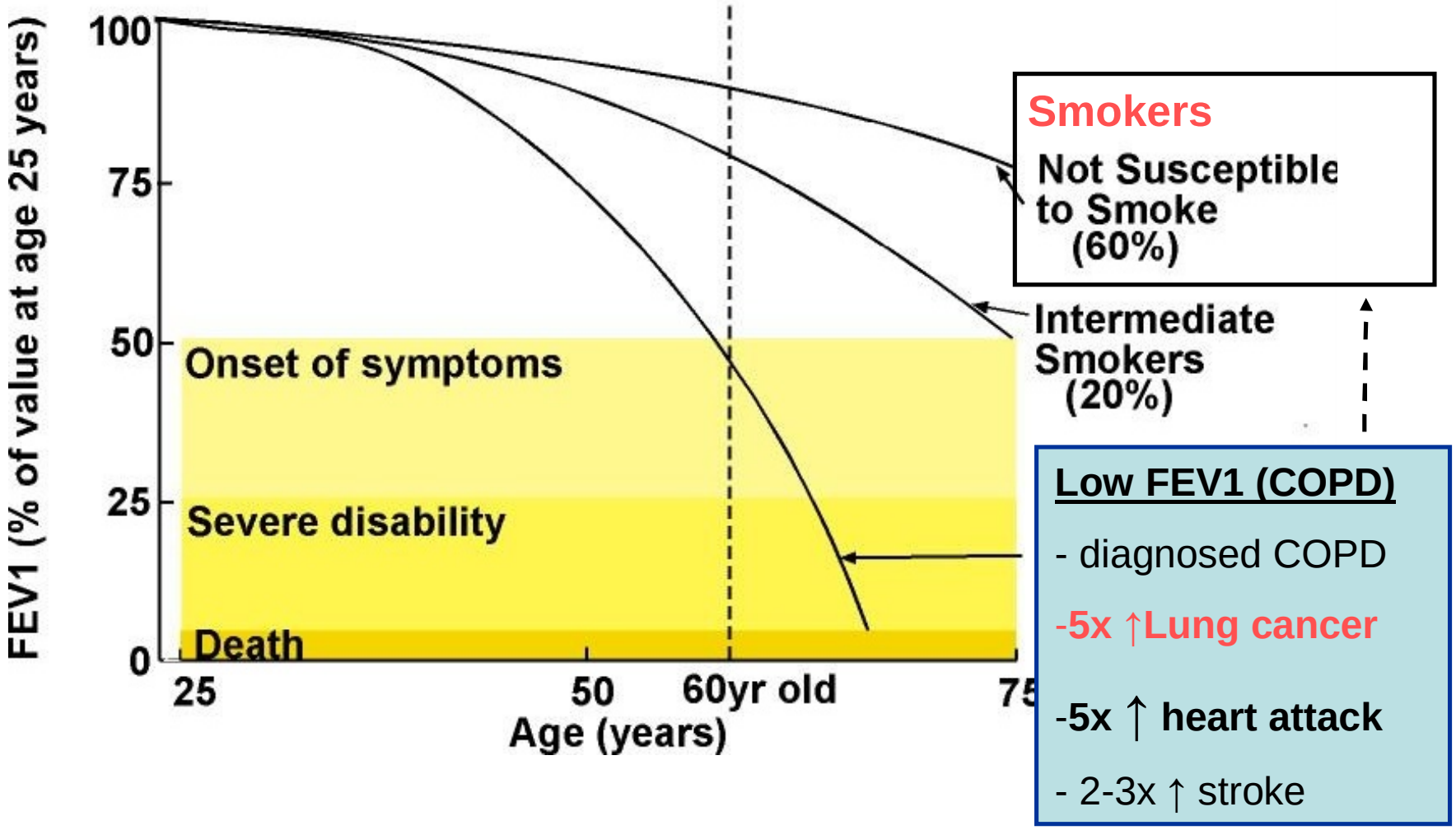


Decline of Lung Function: Not Homogeneous



Lung function in smokers who get COPD

Reduced FEV_1: linked to all cause mortality



Case presentation

Male 53 yo

- PC: 9 months of dry cough and SOBOE
- HPc: Initially treated as a chest infection with antibiotics
- PHx: Peptic ulcer 5 yrs ago

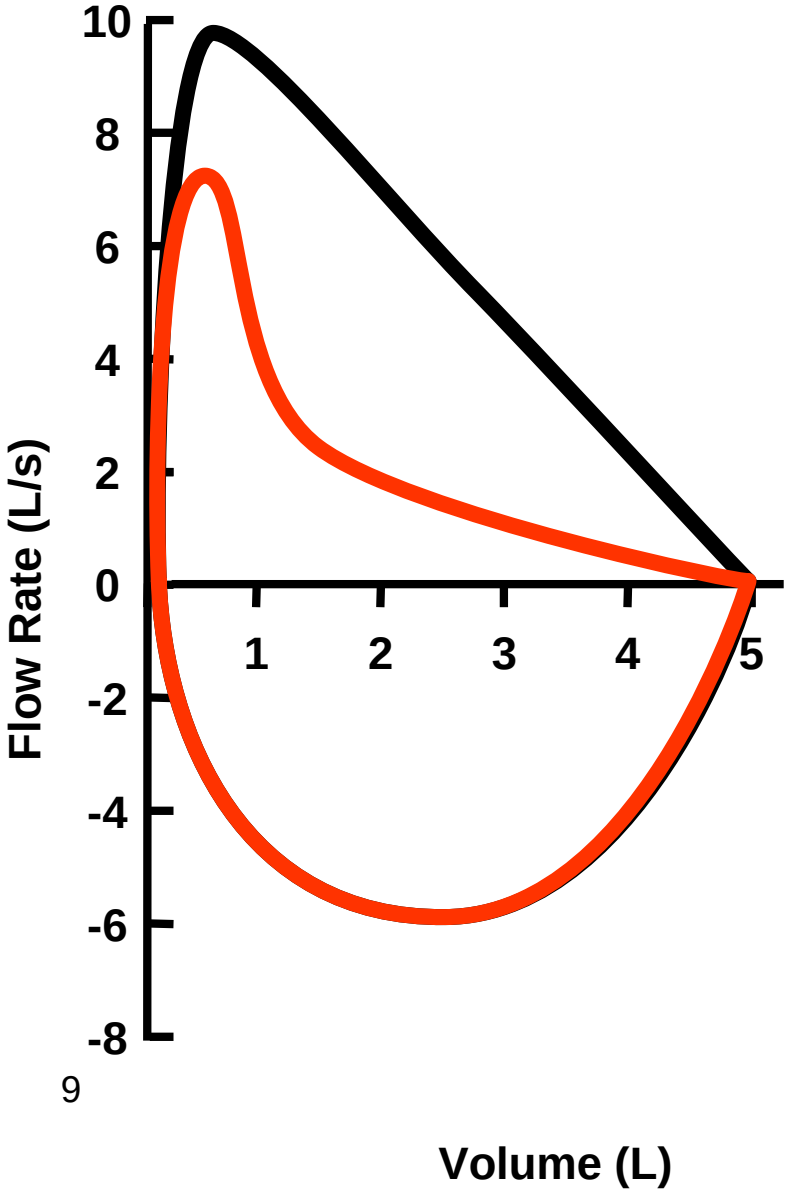
  Benign colon polyps
- SHx Lives with wife, café owner/operator

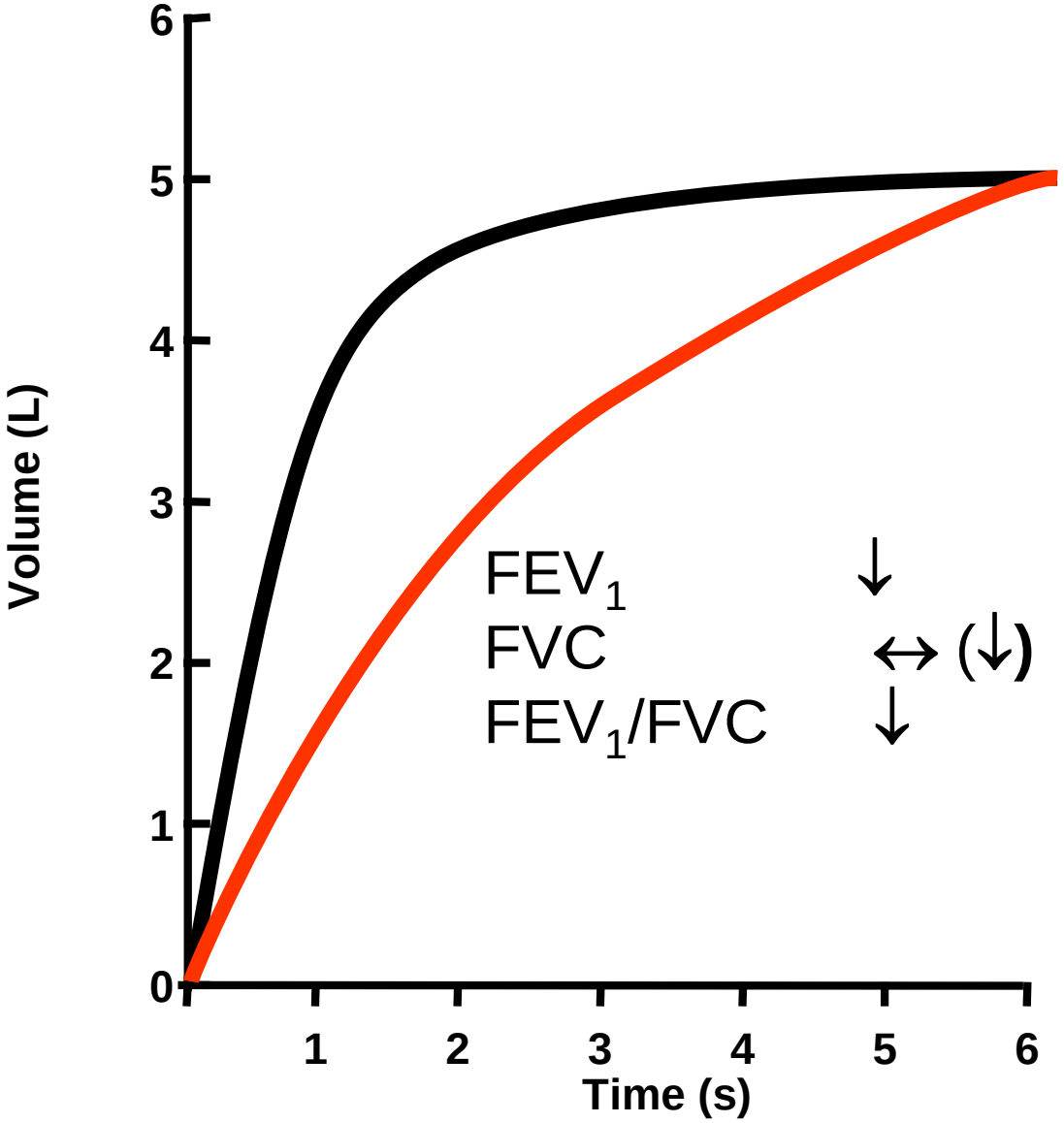
  34 pk yrs (25/day for 27 yrs)

- Occ Hx: No dust/asbestos exposure
- Exam Not clubbed, no lymphadenopathy
  Bilateral wheeze, otherwise normal
- Invest Spirometry: FEV1=2.4 (60%), FEV/FVC=60%

  Diagnosed with asthma and treated with inhalers

Spirometry: Obstructive





- Occ Hx: No dust/asbestos exposure

- Exam Not clubbed, no lymphadenopathy
  Bilateral wheeze, otherwise normal

- Invest Spirometry: FEV1=2.4 (60%), FEV/FVC=60%

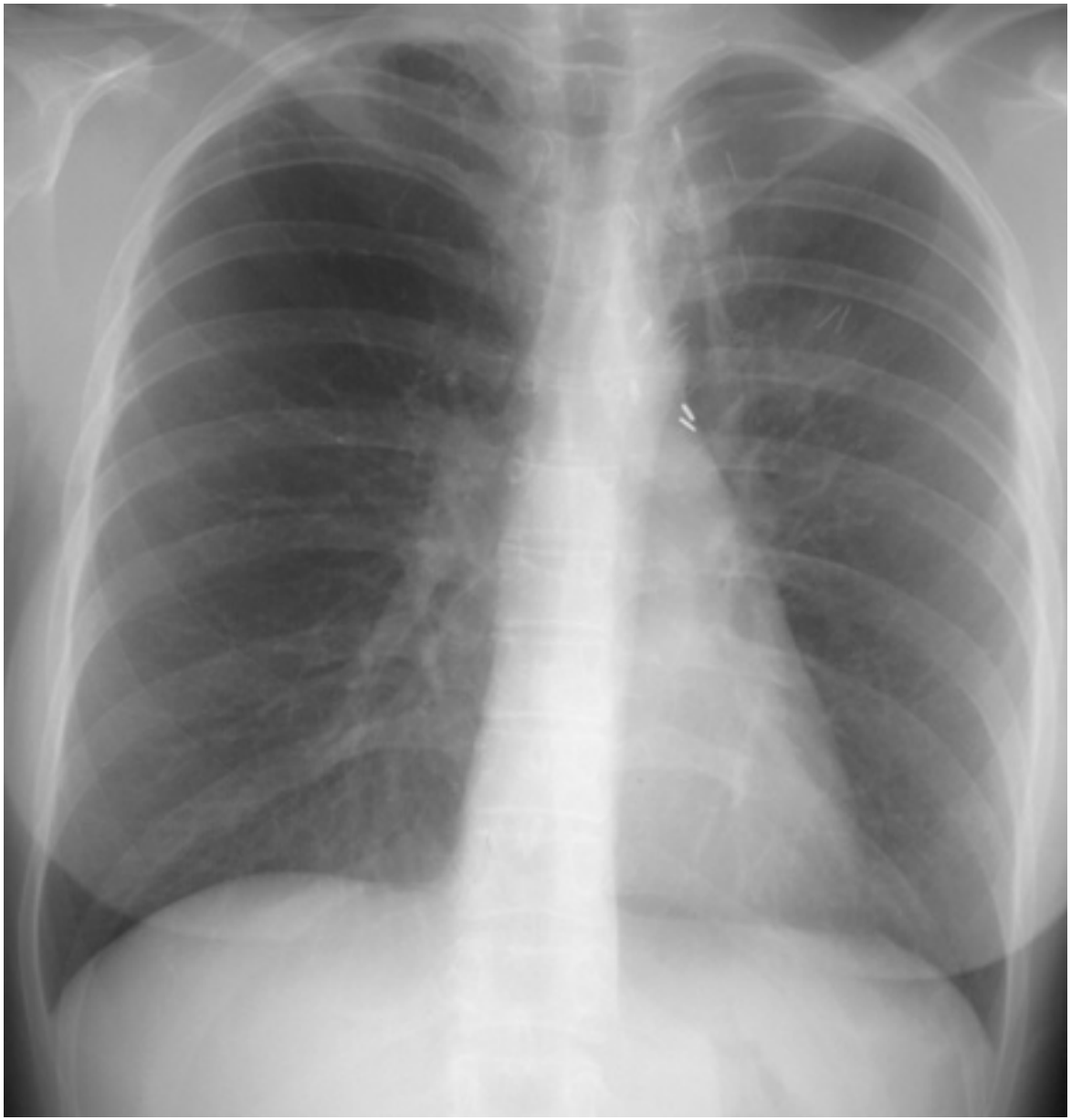
  Diagnosed with asthma and treated with inhalers…..
  but cough persisted for 6 months

Diagnosed with asthma and treated with inhalers…..

but cough persisted for 6 months

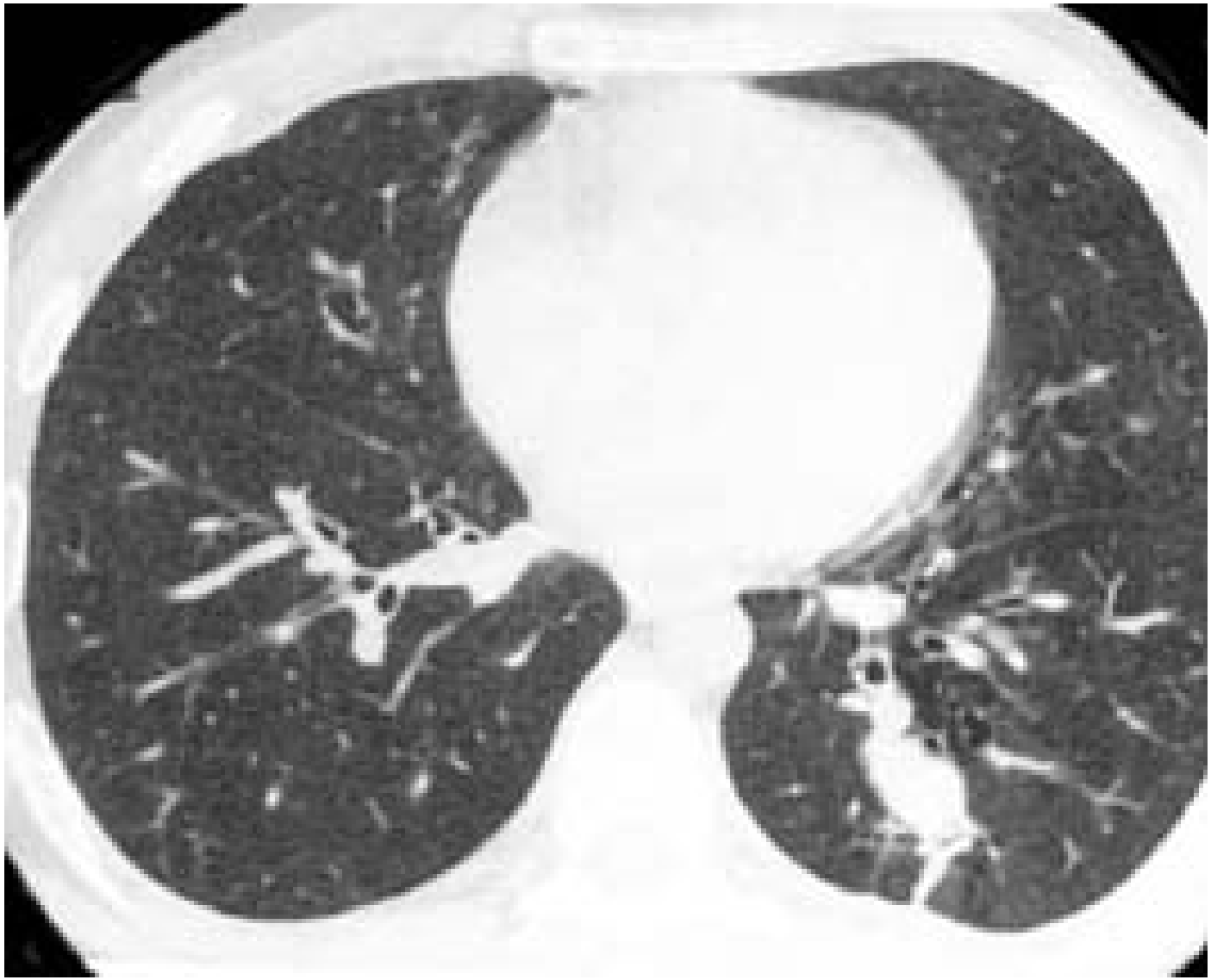
CXR showed an opacity and **CT confirmed 3 cm LUL mass with +nodes**

Bronchoscopy confirmed squamous cell LC



CXR

Low sensitivity for detecting non-Ca pulmonary nodules

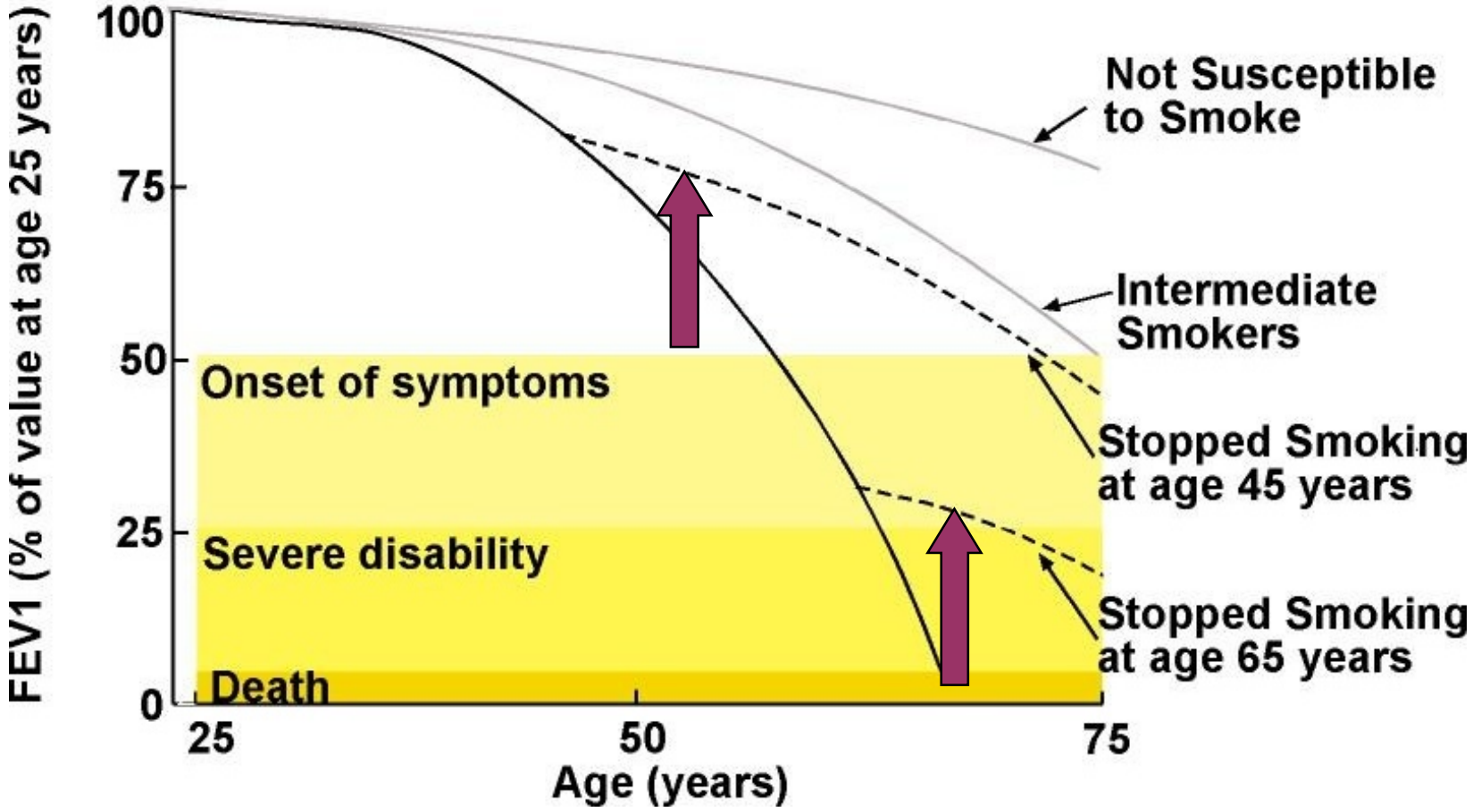


- Progress: Patient underwent several courses of chemotherapy with small effect
- Died 18 months later

- Reflections: Patients express
  - have feeling of guilt and regret
  - acknowledge they should have given up sooner
  - acceptance they are “to blame” although some identify other “exposures” that might have been relevant

Recent studies report that over 50% of smokers and ex-smokers who get lung cancer did not think they were at risk!

COPD/LC – Early cessation mitigates risk



Lung function in smokers who quit aged 45 and 65 years old

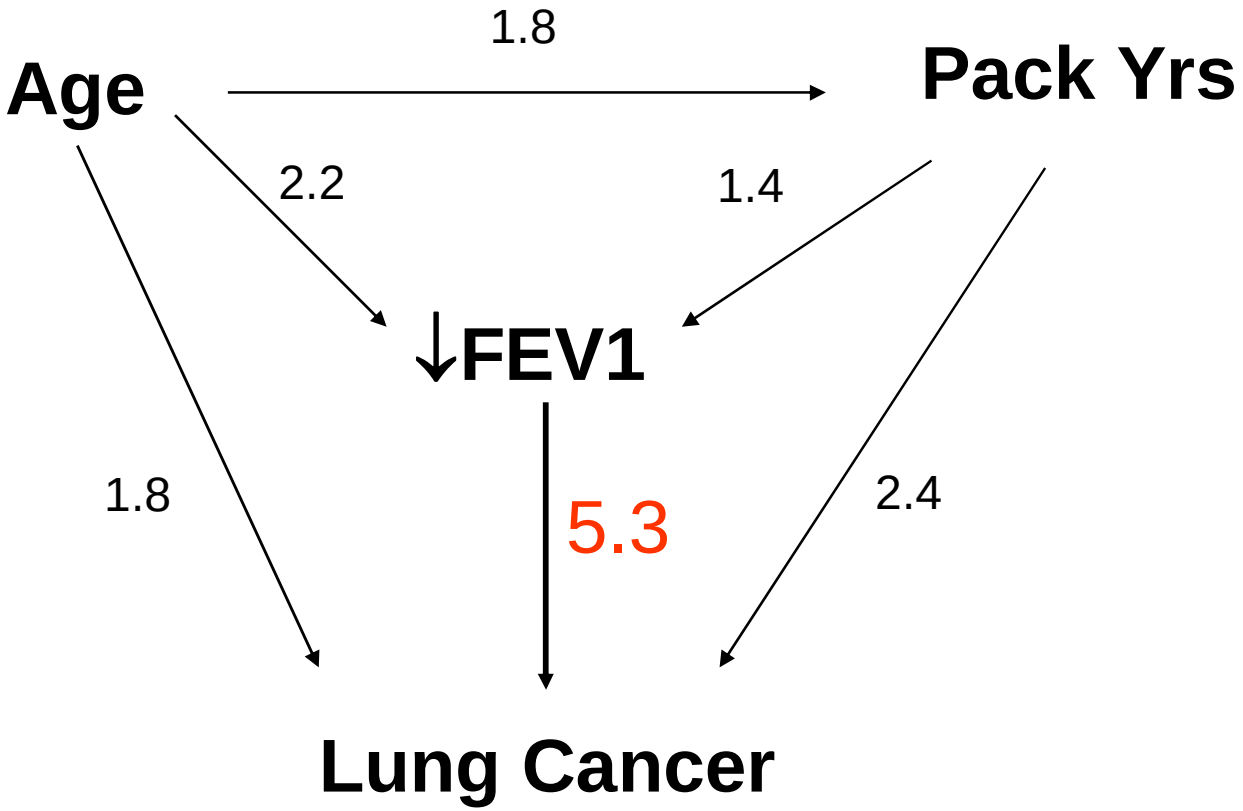
Key messages

- Smokers with COPD present late
- By the time they note exertional breathlessness as much as 50% of lung function is irreversibly lost!
- COPD is the most important risk factor for the development of lung cancer and diagnosis is delayed as early symptoms are attributed to COPD/asthma/chest infection

Lung Function and Lung Cancer

Consistently reported risk of 3-6x for lung cancer in smokers with impaired lung function

Lung cancer	
Age	**RR 2.8**
↓FEV1	**RR 6.4**
Pk yrs	**RR 3.1**



Lung cancer

- Accounts for 30% of all cancer deaths
- 170,000 deaths per annum (more than combined deaths from breast, colon, ovary and prostate)
- 10-15% survival out to 10 years (unchanged for last 20-30years)
- “preventable” in that smoking accounts for 90%
- World wide affecting all populations in keeping with their smoking patterns (>1 mill deaths /yr)

Discussion

Second Case

- 55 year old patient with a smoking history
- Presented with URTI initially treated with antibiotics
- Productive cough and wheeze persisted 2 weeks after finishing AB course
- **Differential diagnosis?**

Studies show……..

Gender effect

- Female patient - 52% of doctors diagnosed asthma and 48% diagnosed COPD
- Male patient – 35% of doctors diagnosed asthma and 65% diagnosed COPD

- However… female smokers are at greater risk of COPD and lung cancer than males

Second Case

- 55 year old female with a smoking history
- Presented with URTI initially treated with antibiotics
- Productive cough and wheeze persisted
- Differential diagnosis?

- **What investigations?**

Studies show…….

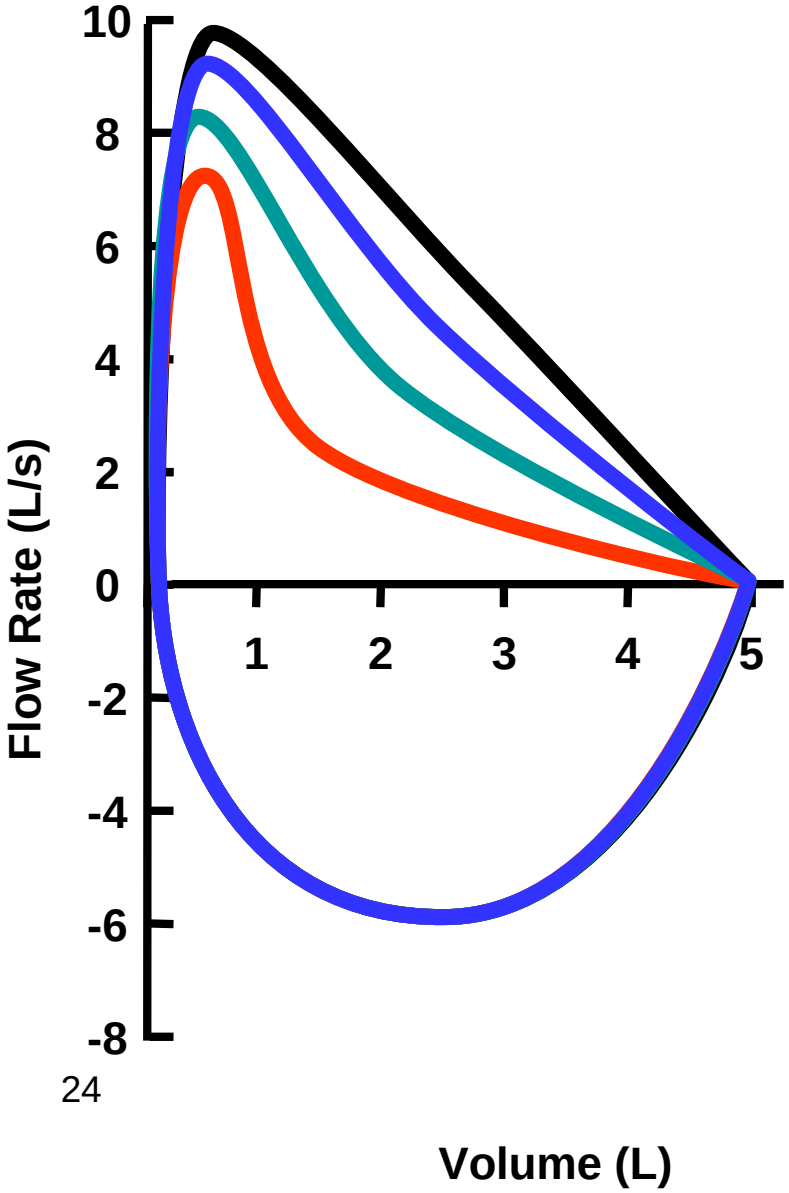
Investigations ordered were……

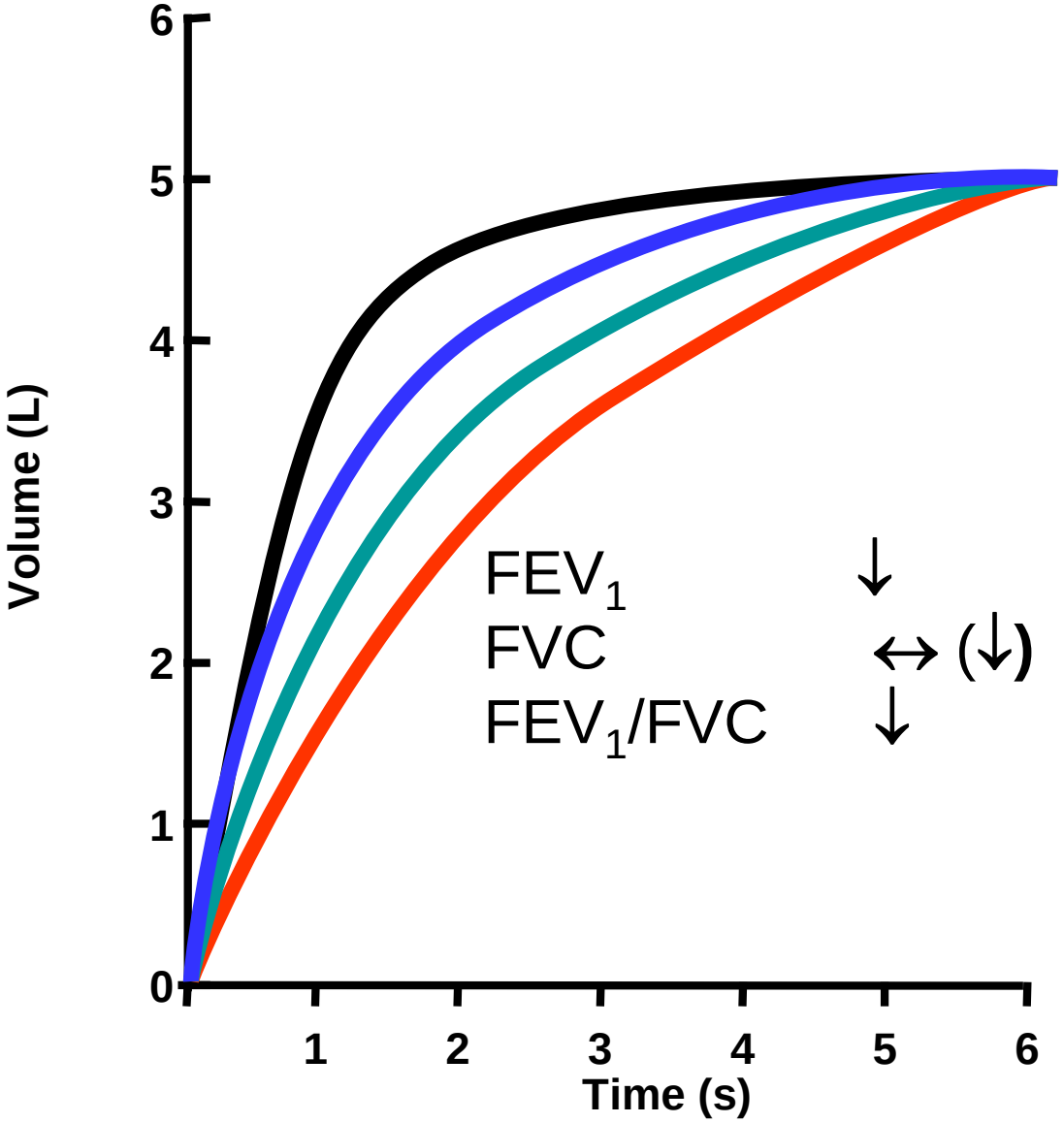
- 80% chose CXR
- 50% sputum culture
- 5% ordered lung function testing

CXR does not distinguish asthma from COPD

Sputum culture – questionable value?

Obstruction – with reversibility





Treatment implications: asthma vs COPD

- Inhaled corticosteroids – early use in asthma important but role in mild –mod COPD less clear (?increased risk of pneumonia)
- Treatment for asthma is inhalers but treatment for COPD is quitting smoking
- Risks associated with irreversible airways obstruction (COPD) is increased risks for CAD, stroke and lung cancer (?statins beneficial)

Risk assessment - lung age

- Backed up by several studies showing that including spirometry in smoking cessation improves quit rates

- Based on study in BMJ showing in a RCT the benefit of lung age over absolute FEV_1 showed a two fold increase in 1 year quit rates

FEV_1 and Lung Age

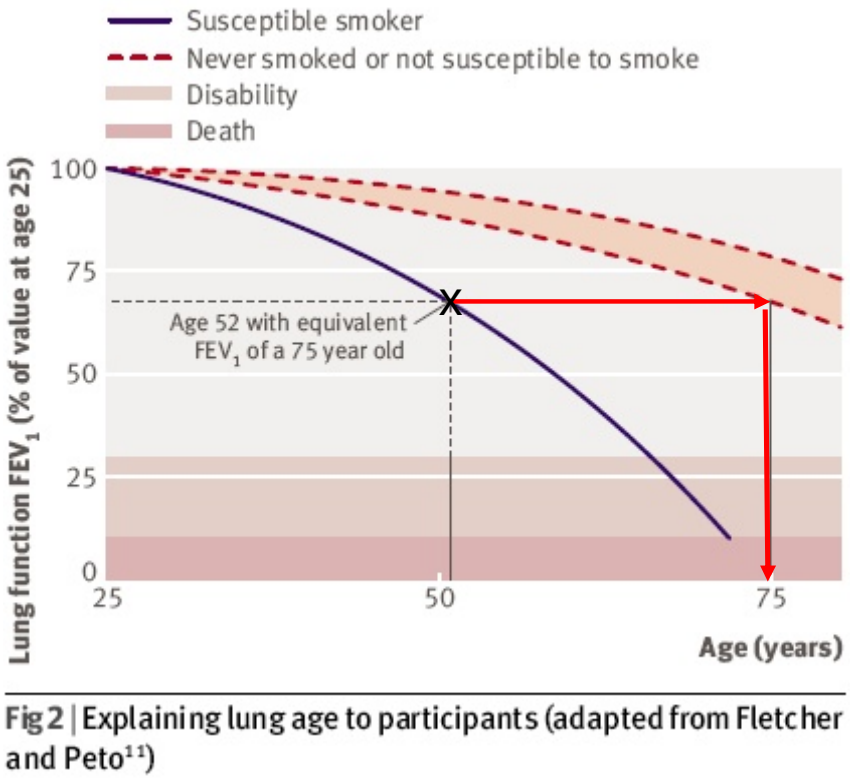


Fig 2 | Explaining lung age to participants (adapted from Fletcher and Peto[11])

Lung Age is the chronological age at which a person's measured pulmonary function is normal for the person's sex and height.

It is calculated from predicted values.

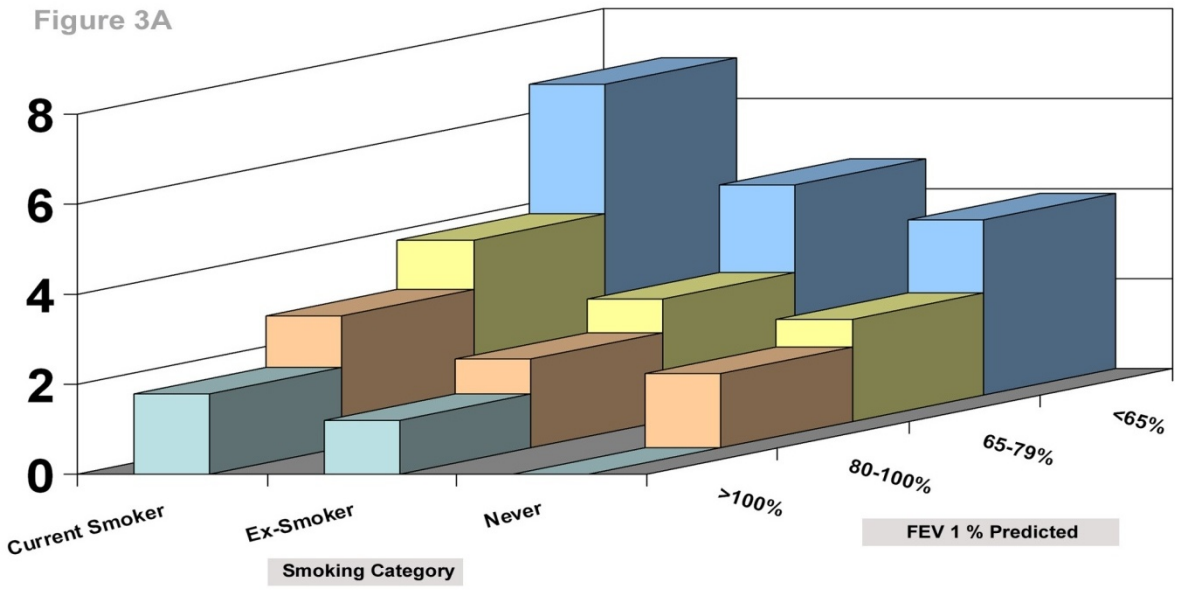
Gary Parkes, et al. BMJ 336(7644):598-600

Spirometry as a tool for smoking cessation

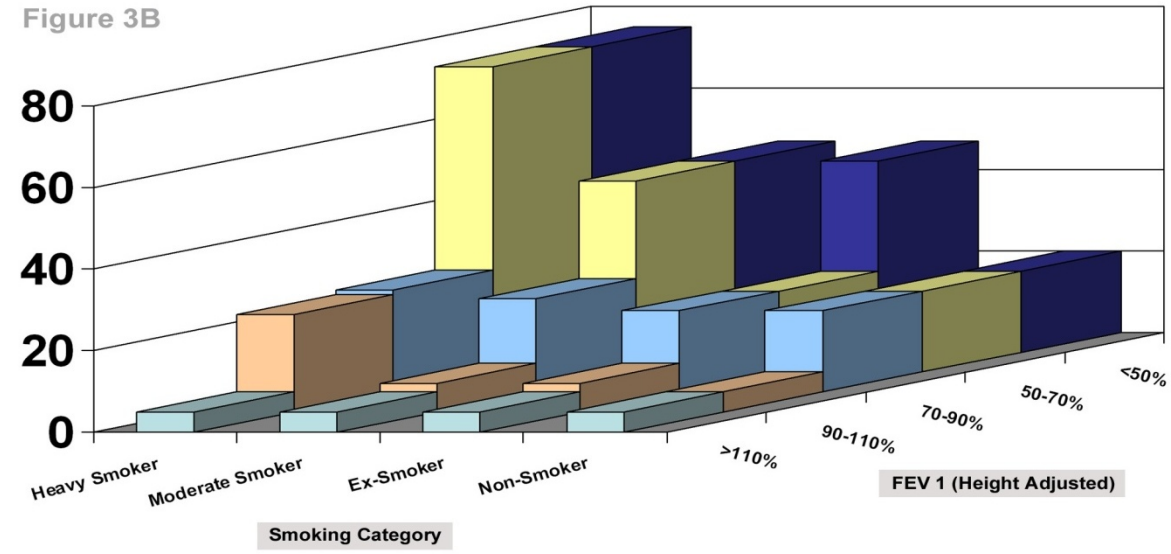
Powerful educative tool

Shown in some studies to improve quit rates compared to no lung function testing

CAD mortality



All cause mortality



↓FEV_1 and mortality

- predicts CAD and all cause mortality
- independent of smoking status
- additive with smoking status

Young et al. ERJ 2007

Discussion

Case presentation

Male 63 yo

- PC: 1 month of exertional breathlessness
- HPc: Progressive breathlessness on exertion over 1 year but no orthopnea, PND or ankle swelling (ET down to 1 flight of stairs)
- PHx: Whooping cough as a child
- Treated for Pulm Tb in early 20's
- SHx Lives with wife, retired plumber

  50 pk yrs (20/day since 13 yo)

Investigations

- Spirometry: FEV1=3.4 (80%), FEV1/FVC=75%

- COPD excluded on spirometry

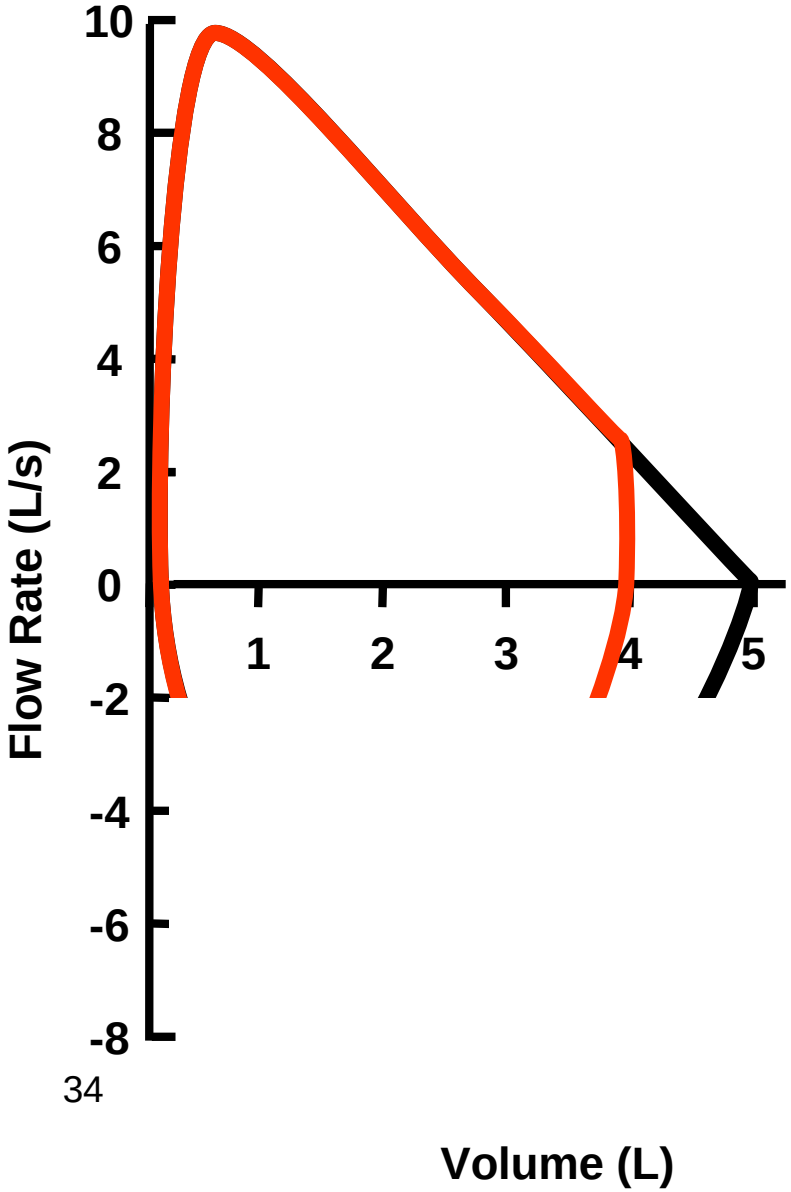
Investigations

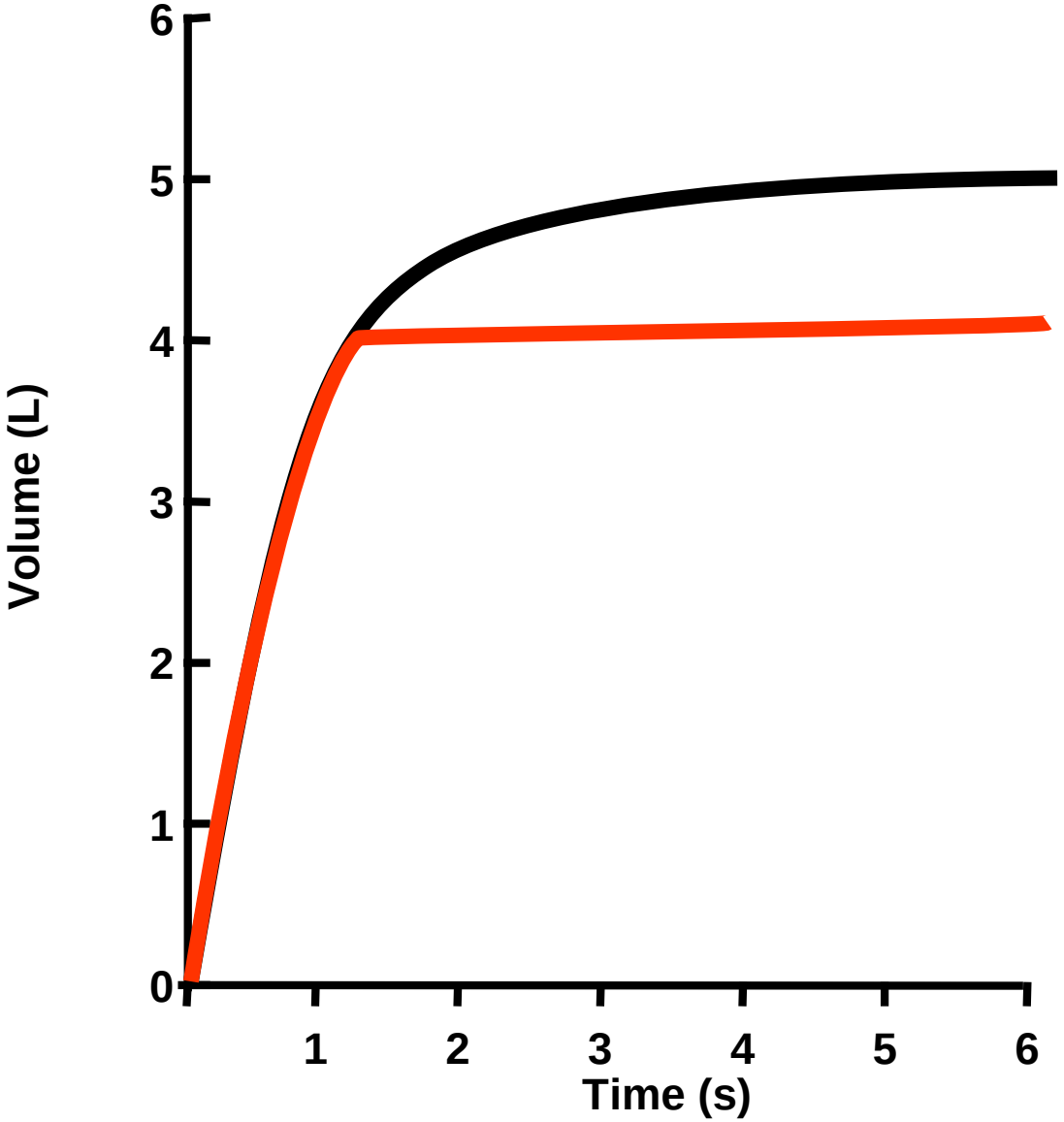
- Spirometry: FEV1=2.4 (70%), FEV1/FVC=75%

- COPD excluded on spirometry

Pitfalls of spirometry…….

Not full expiration

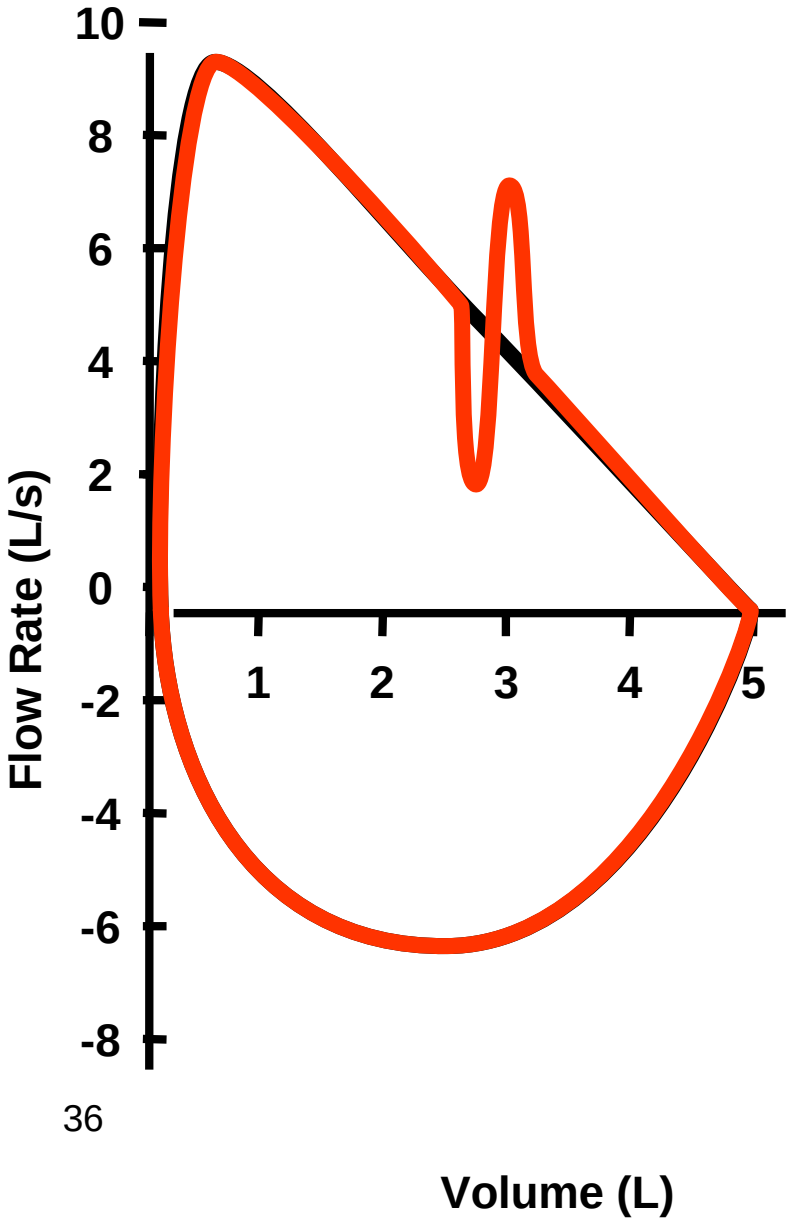


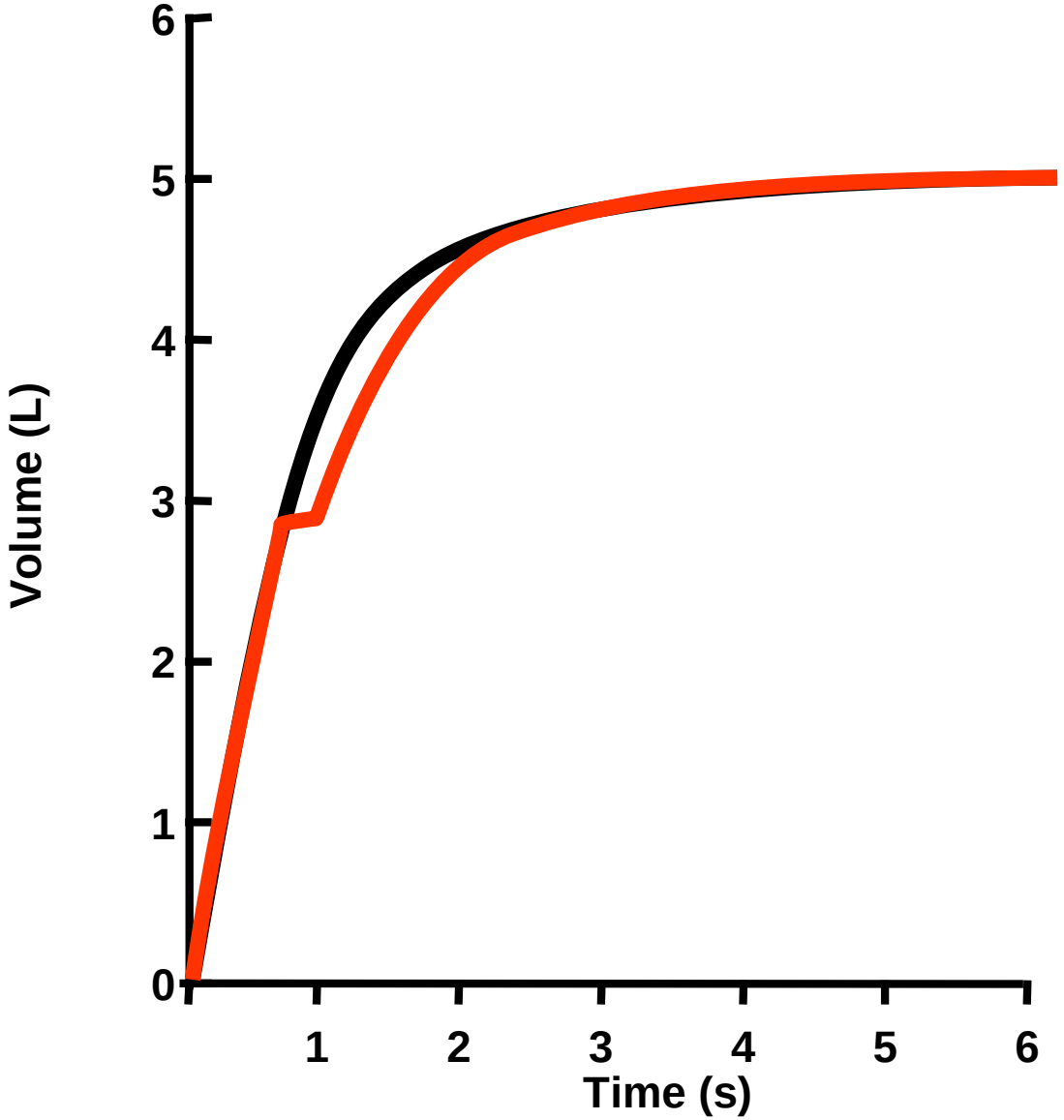


Pitfalls of spirometry

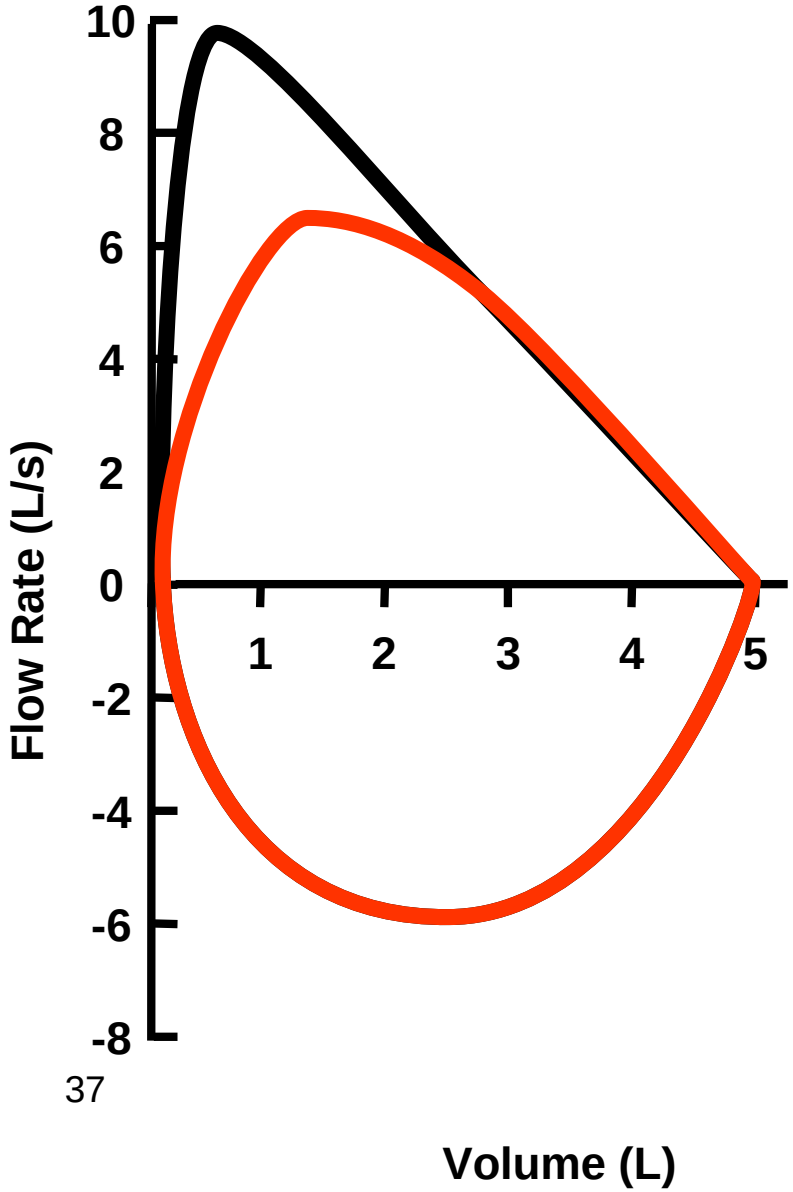
- Early termination of forced expiration (Overestimates the FEV1/FVC ratio which under-diagnoses COPD).
- Slow or false start
- Cough, glottic closure, tongue obstruction, teeth (dentures)
- Poor posture, inadequate seal around mouth piece, extra breaths
- Inadequate inspiration, maintain maximal effort throughout

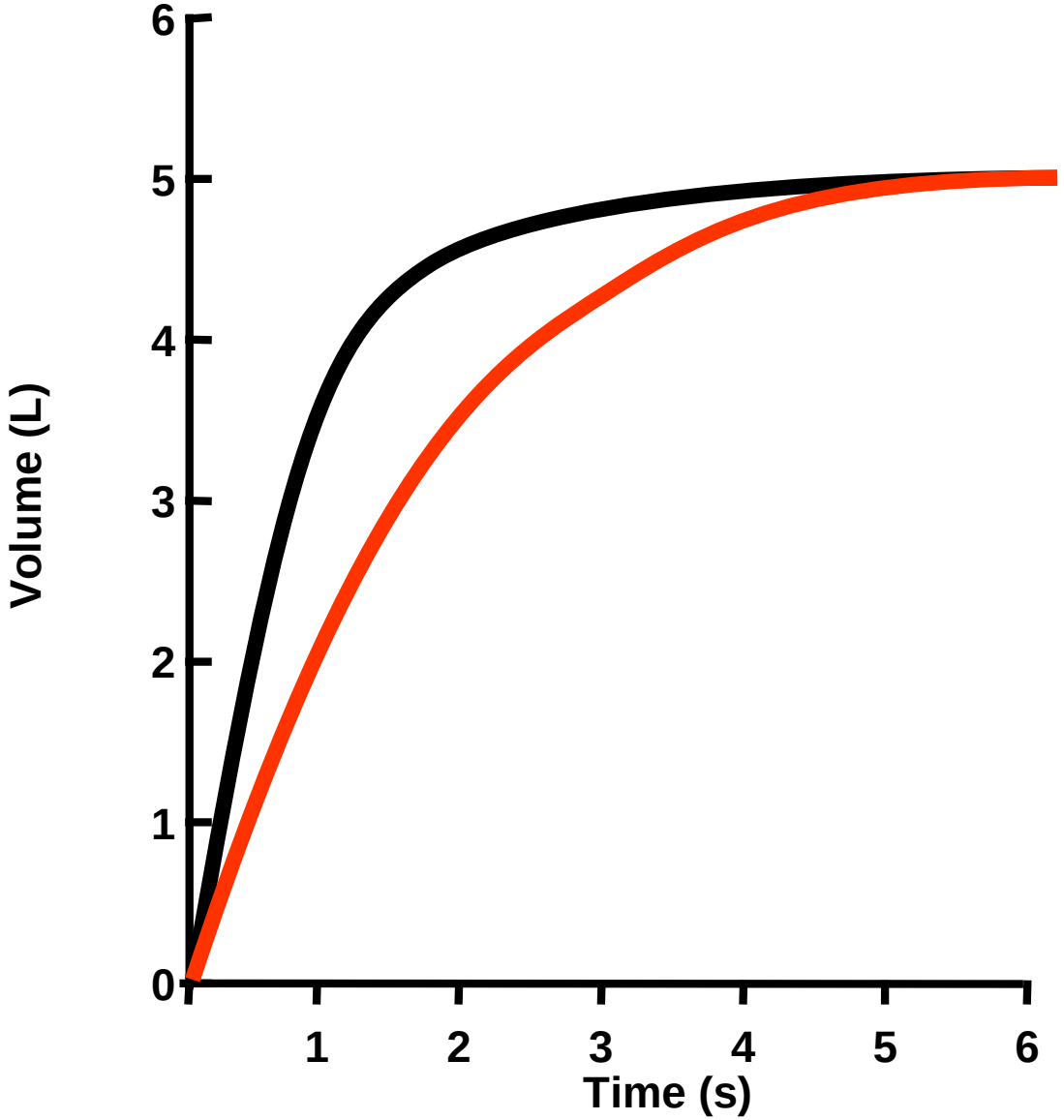
Cough


10
8
6
4
2
0
-2
-4
-6
-8
Flow Rate (L/s)
1
2
3
4
5
Volume (L)

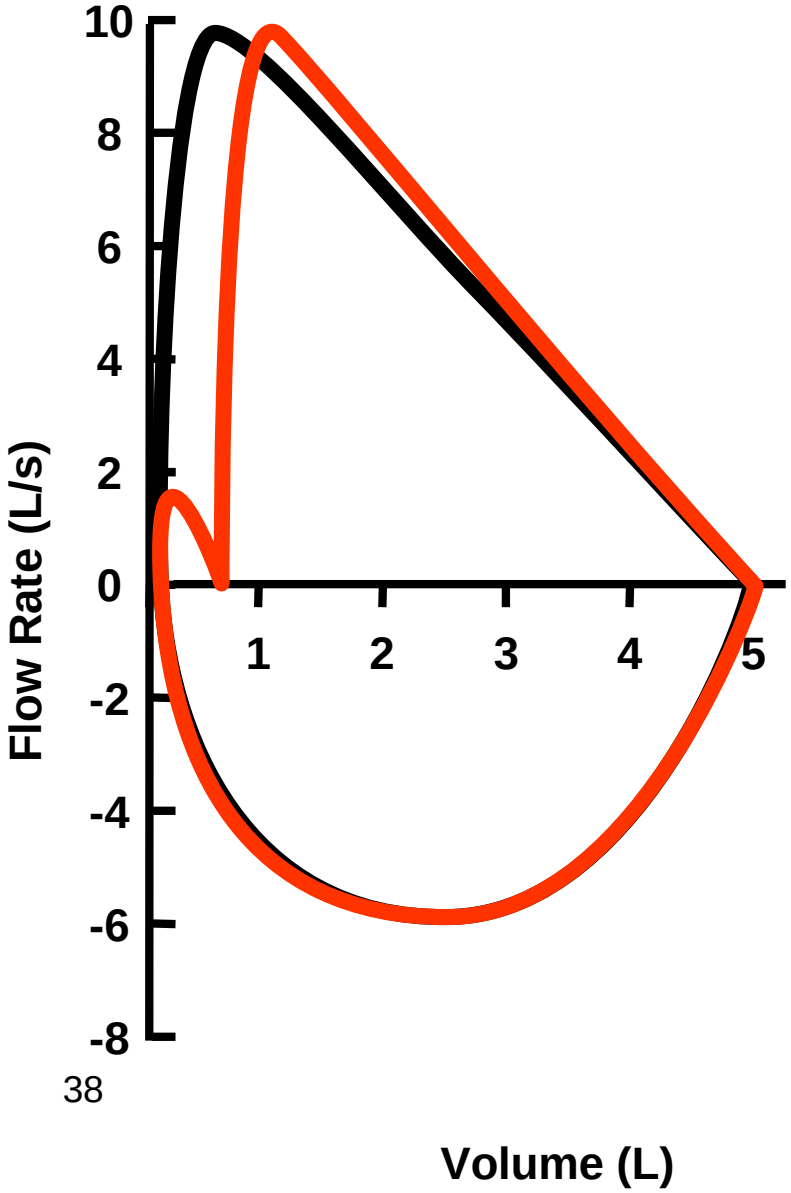

6
5
4
3
2
1
0
Volume (L)
1
2
3
4
5
6
Time (s)

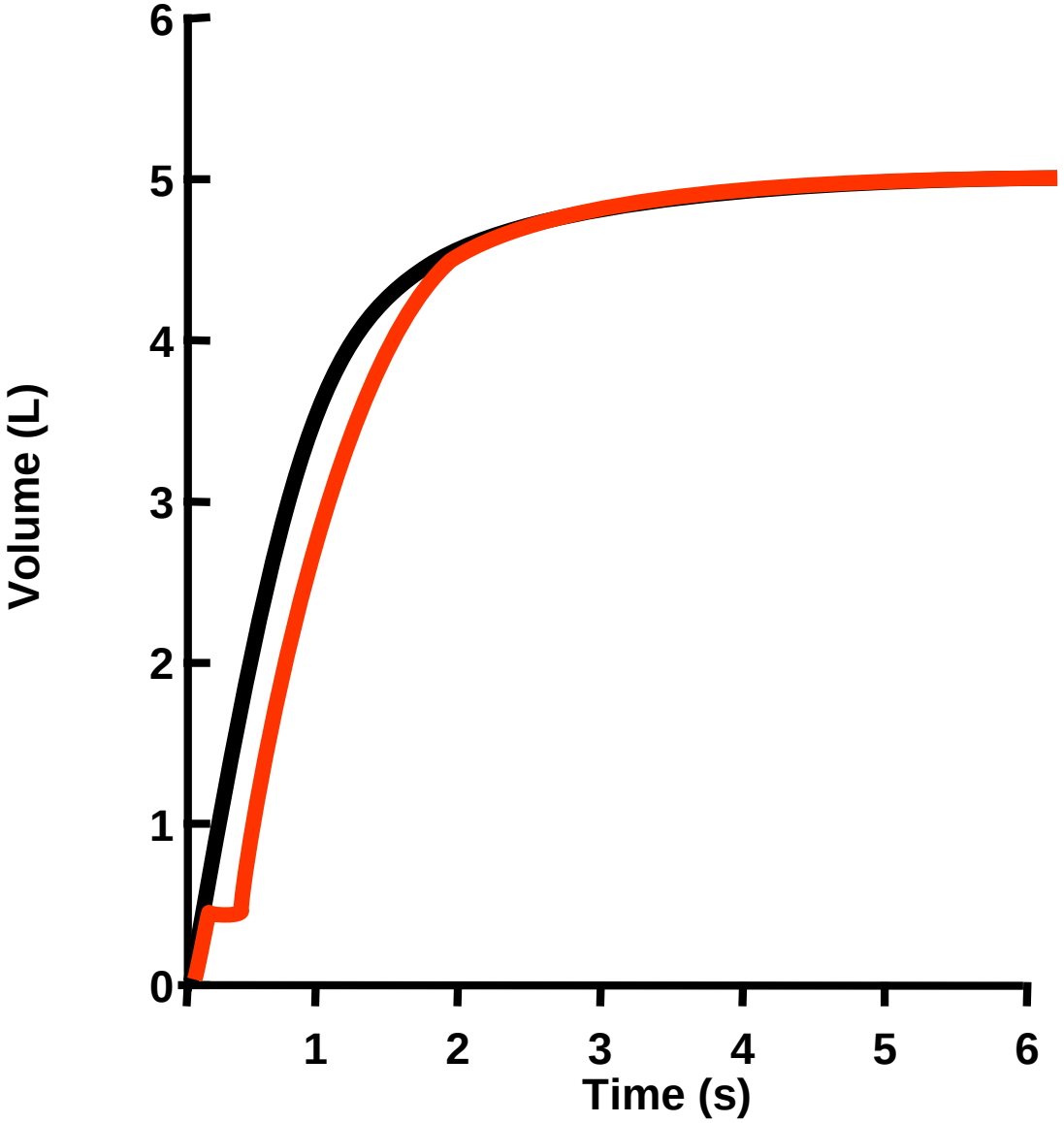
Slow Start


10
8
6
4
2
0
-2
-4
-6
-8
1
2
3
4
5
Flow Rate (L/s)
Volume (L)

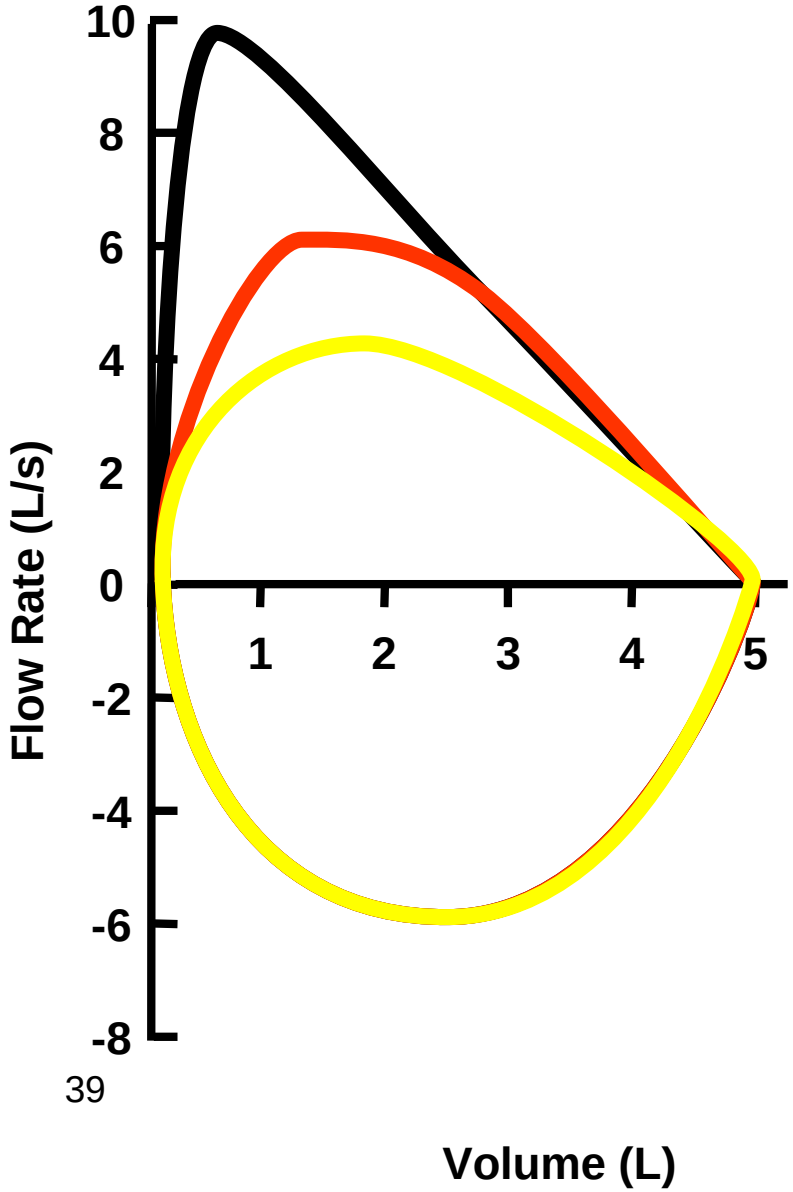

6
5
4
3
2
1
0
1
2
3
4
5
6
Volume (L)
Time (s)

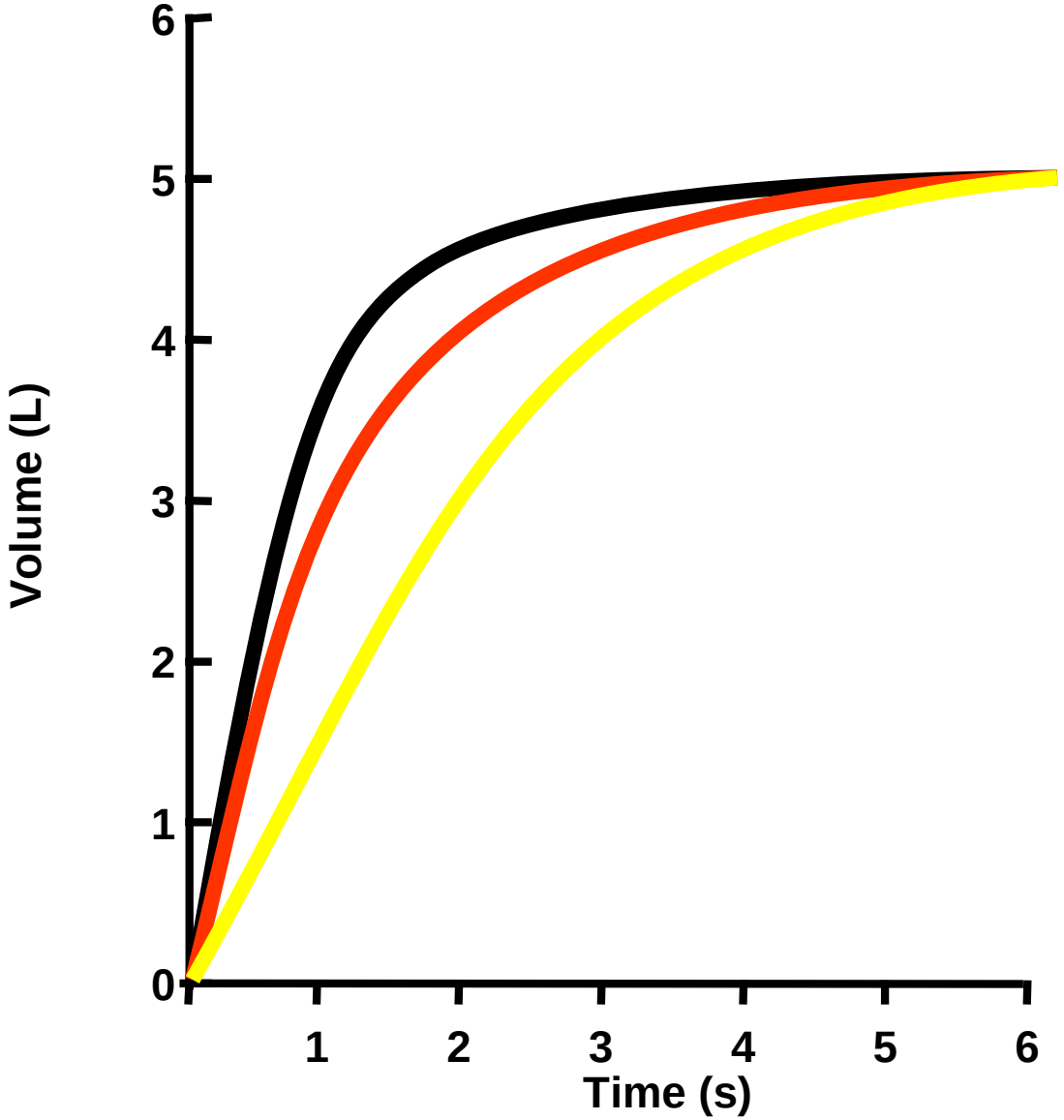
False Start


10
8
6
4
2
0
-2
-4
-6
-8
1
2
3
4
5
Flow Rate (L/s)
Volume (L)


6
5
4
3
2
1
0
1
2
3
4
5
6
Volume (L)
Time (s)

Variable Effort





Simple spirometry

- a spirometer is a device used to measure timed expired and inspired volumes.
- the forced expired manoeuvre is the measurement most commonly used to assess lung function outside a formal lung function laboratory
- Note – as good as spirometry is it can not identify all lung function abnormalities

- Simple spirometry is a measure of lung volumes from a full inspiration
- Good comprehension and cooperation from the patient regarding the technique is essential
- Clinical value placed on spirometric results depends on the accuracy of the spirometry manoeuvre

Contraindications

- After a recent heart attack, stroke, (caution in abdominal aneurysms)
- Recent eye, thoracic, abdominal surgery
- Haemoptysis of unknown cause
- If the person has a pneumothorax
- If the person has an inter-costal tube in situ
- Chest and or abdominal pain

Performing Spirometry

Instruct the patient to:-

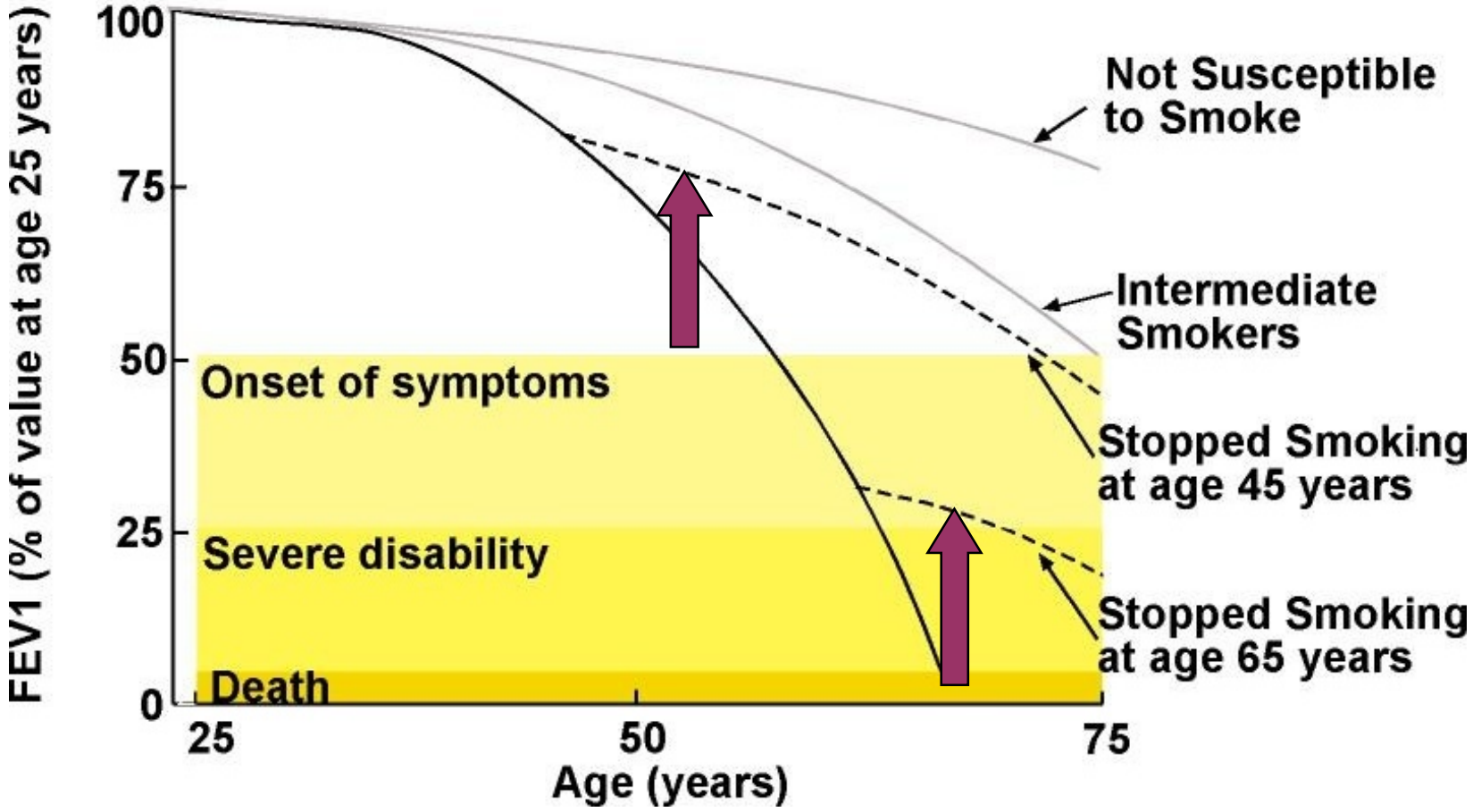
- Breath in until the lungs are completely full
- Hold the breath and seal the lips tightly around the mouthpiece and immediately blast the air out as forcibly, fast and as far as possible until the end of test criteria have been reached
- Encourage the patient throughout the manoeuvre

Watch points

- Watch the patient throughout the procedure
- Ensure adequate seal around the mouthpiece – stop blow if needed
- Check that an adequate trace has been achieved
- Repeat the test until three acceptable and reproducible results are obtained no more than eight efforts)
- Ideally 3 readings ≤ 150mls or 5% variation in FEV_1 and FVC between the two best blows

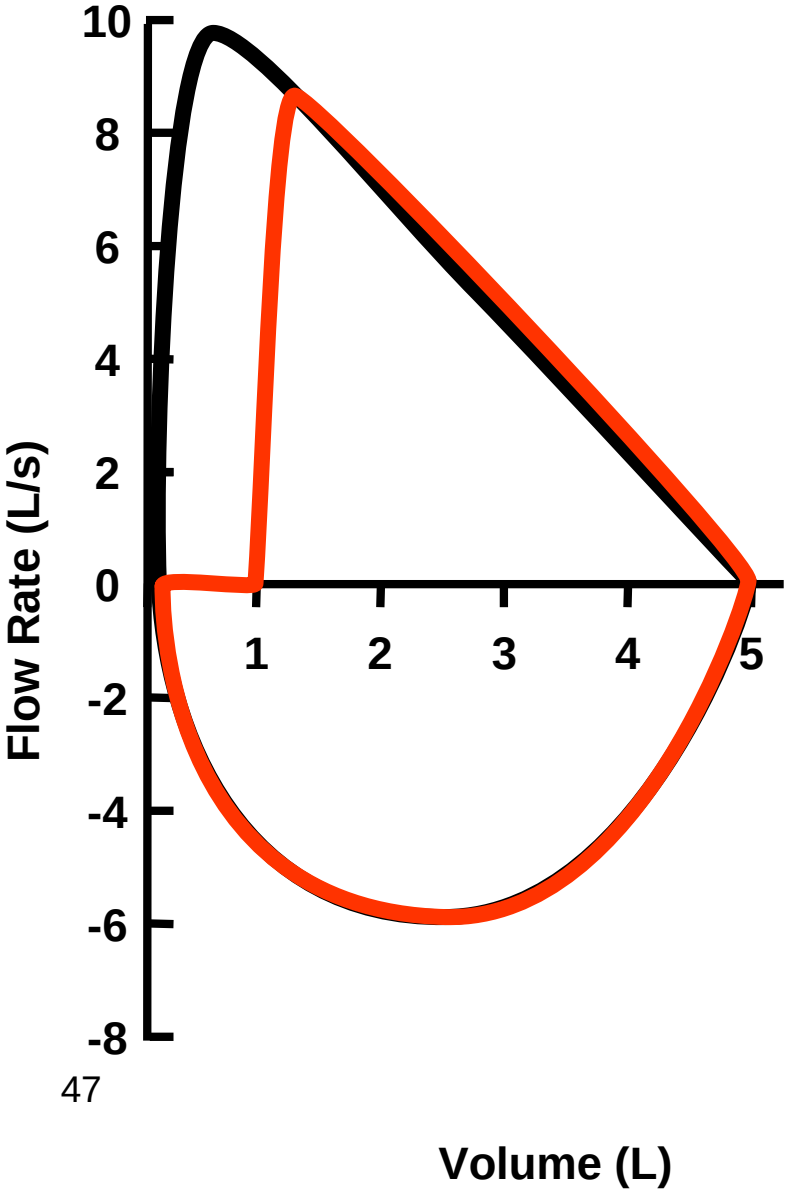
Smoking and lung disease

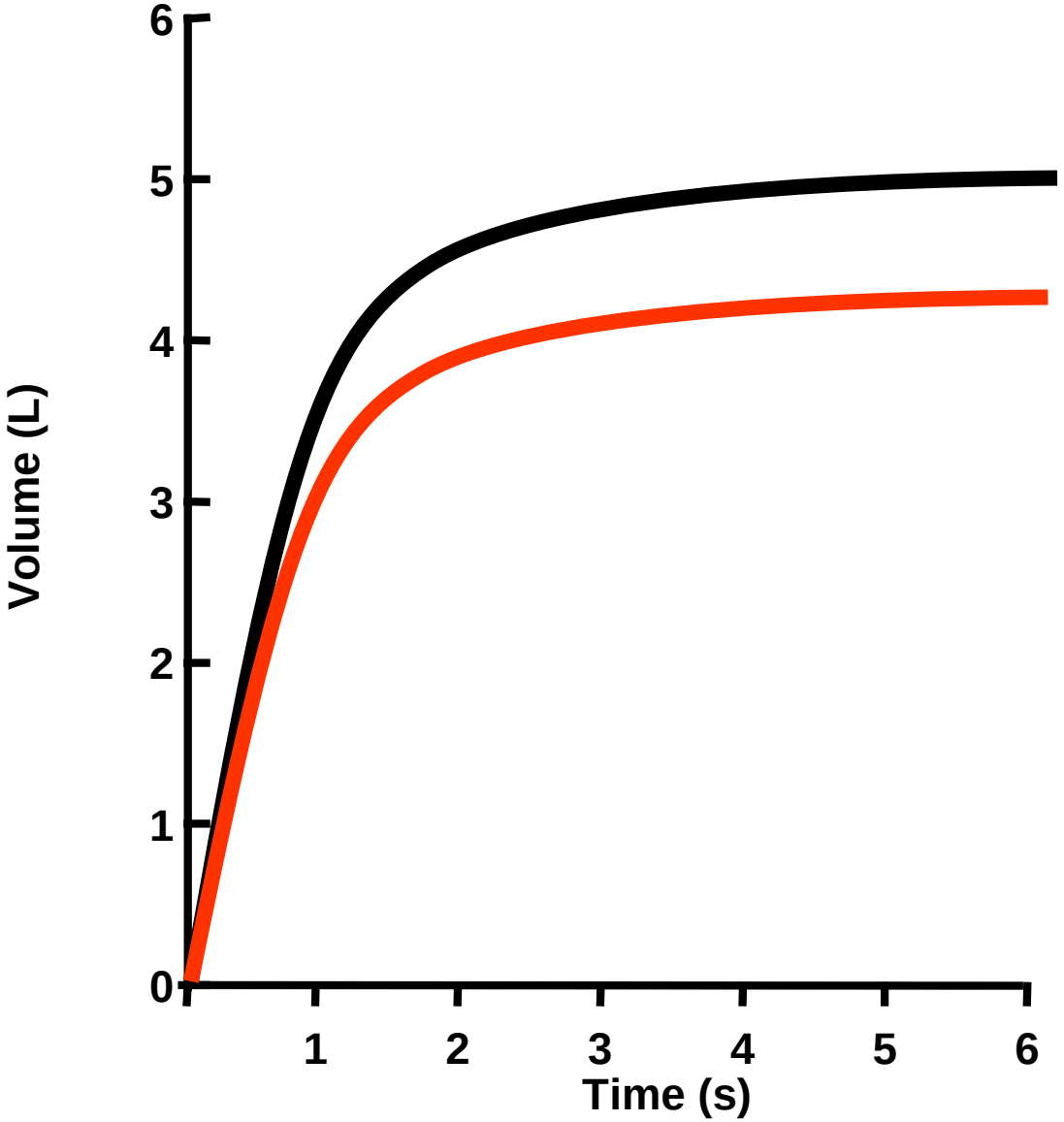
COPD/LC – Early cessation mitigates risk



Lung function in smokers who quit aged 45 and 65 years old

Not at TLC Prior to Start





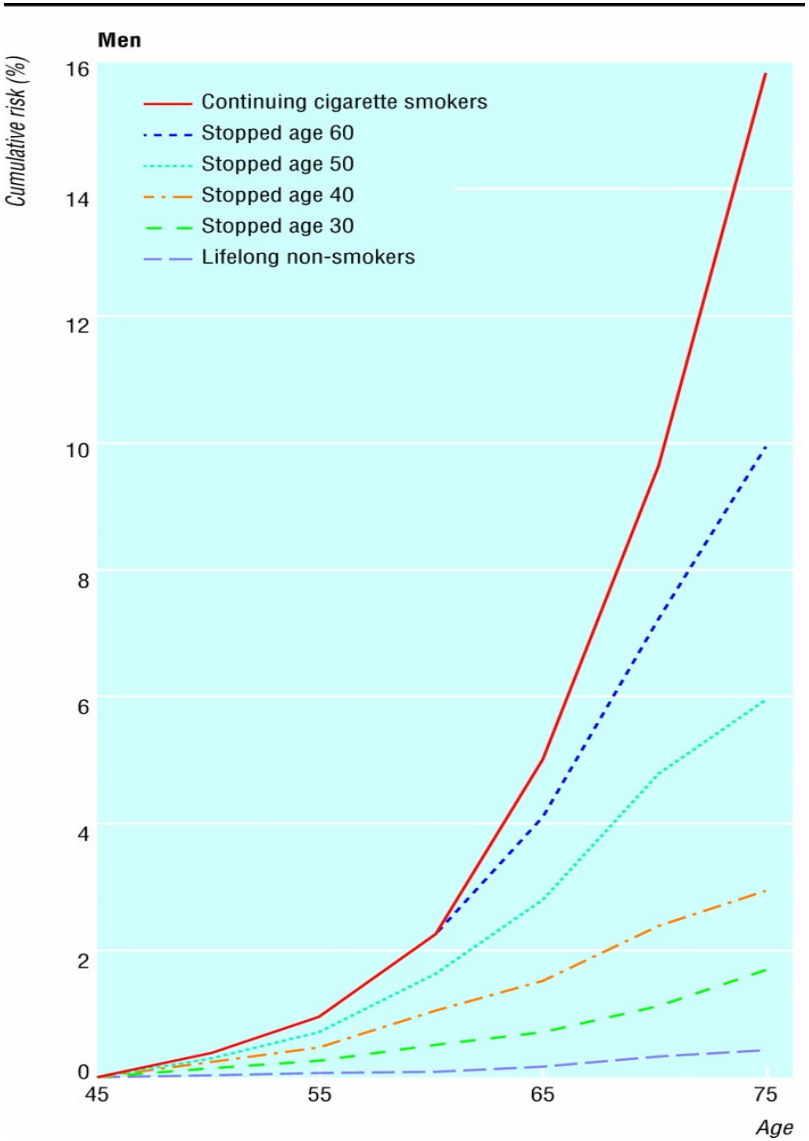
Performing Spiromtery 1

- Introduce yourself to the patient
- Provide patient privacy and ensure they are comfortable with any tight clothing loosened
- Ask if they have had a test such as this before
- Ask if they are on medication likely to affect the test and note down the time of their last dose
- Give clear explanation of the test and what is expected of them
- Demonstrate procedure
- Ensure the patient understands

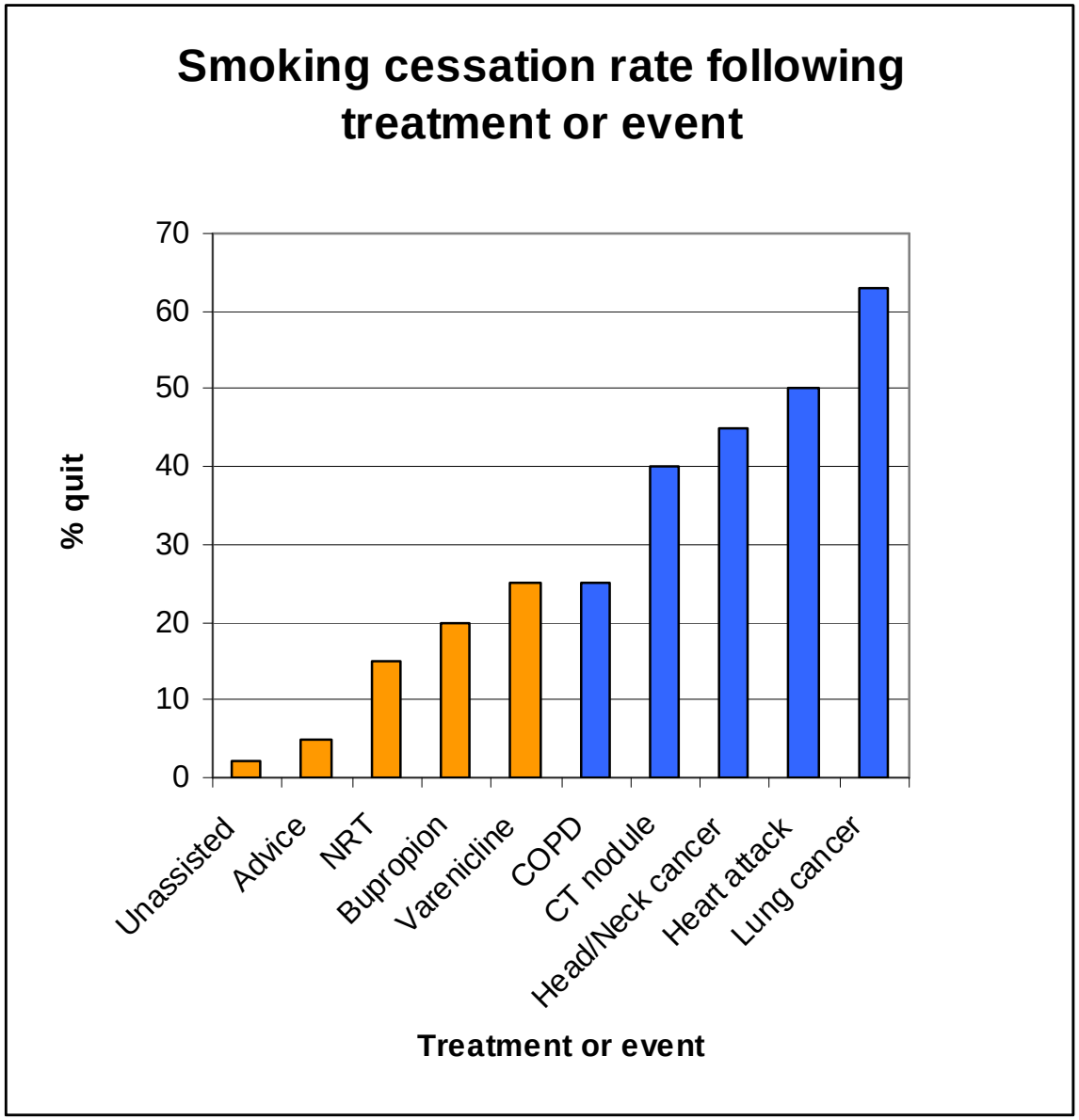
Risk of lung cancer after quitting

Physicians 50 year prospective study – Doll et al. BMJ

Cumulative % of smokers and ex-smokers diagnosed with lung cancer after quitting at 30,40,50 and 60 yrs of age



Quitting age	Risk reduction
Never stopped	0%
60 yr	33%
50 yr	66%
40 yr	80%
30 yr	95%
Never started	

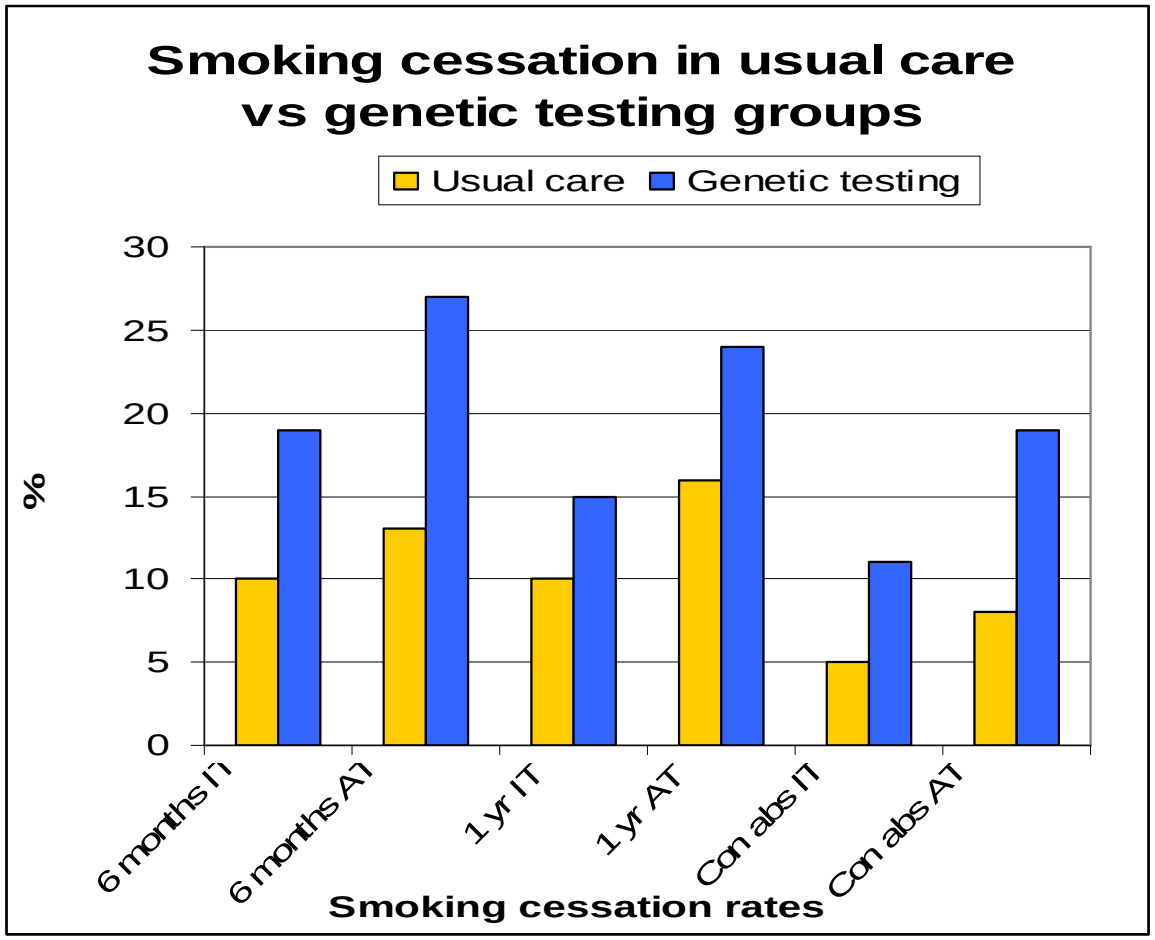


Smoking cessation

- Most smokers quit using cold turkey
- For older smokers, future poor health is the most cited reason for quitting
- Developing lung cancer and COPD are the most feared complications
- Most smokers continue to smoke on the basis the benefits outweigh the harms
- Most smokers overestimate the general risk of lung cancer but underestimate their own risk (below average risk = optimistic bias)
- Smokers quit when the motivational tension favour quitting (trigger)

Nothing Treatment Events

Genetic risk of lung cancer and quitting

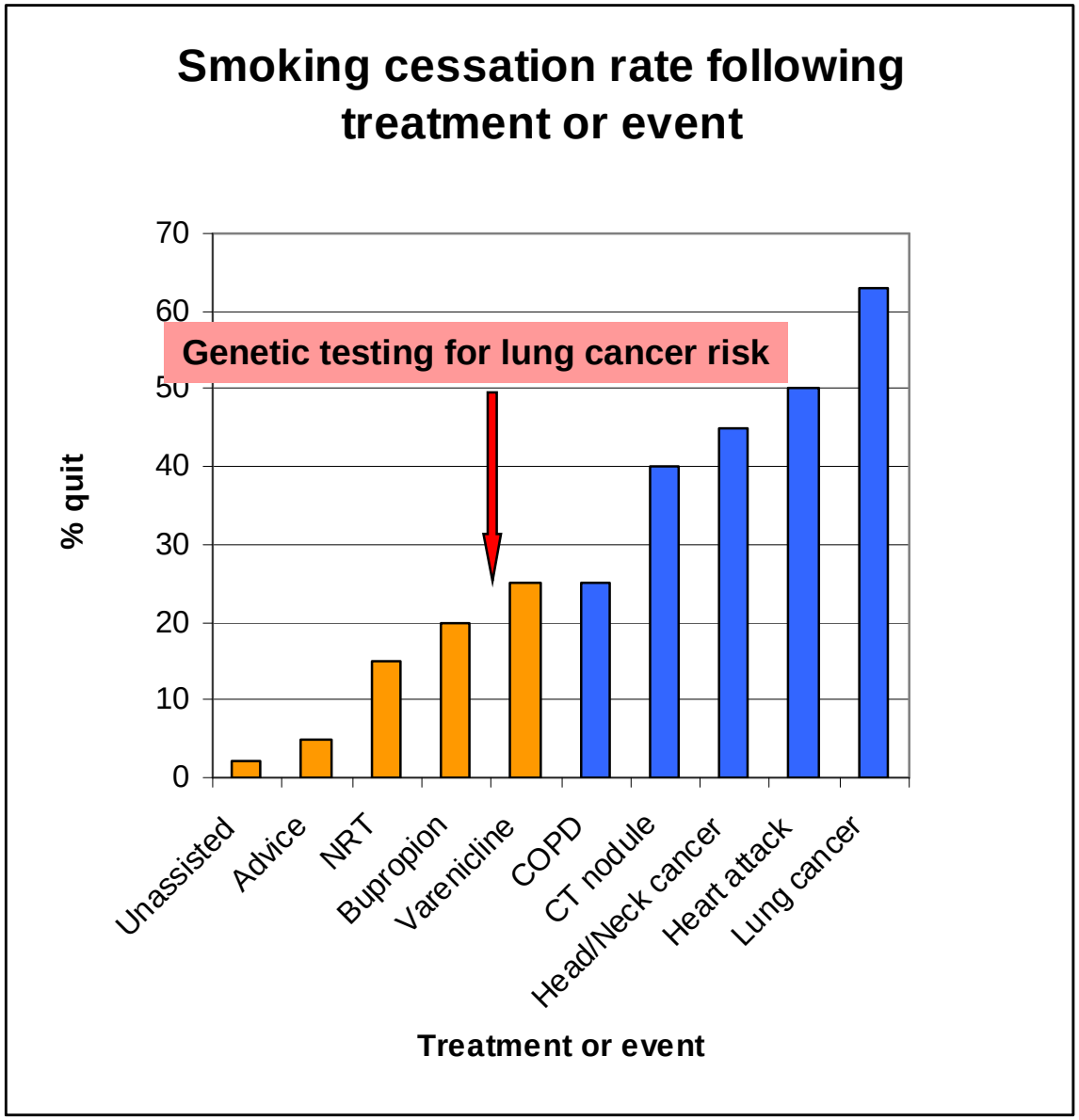


Genetic testing for risk of lung cancer helps to personalize the risk from continued smoking

Smokers who underwent genetic testing (blue bars) in a randomized trial had higher quit rates than those in a smoking cessation programme alone (yellow bars)

Personalising the risks of smoking helps people choose healthier lifestyle options (eg quitting smoking and preventing relapse)

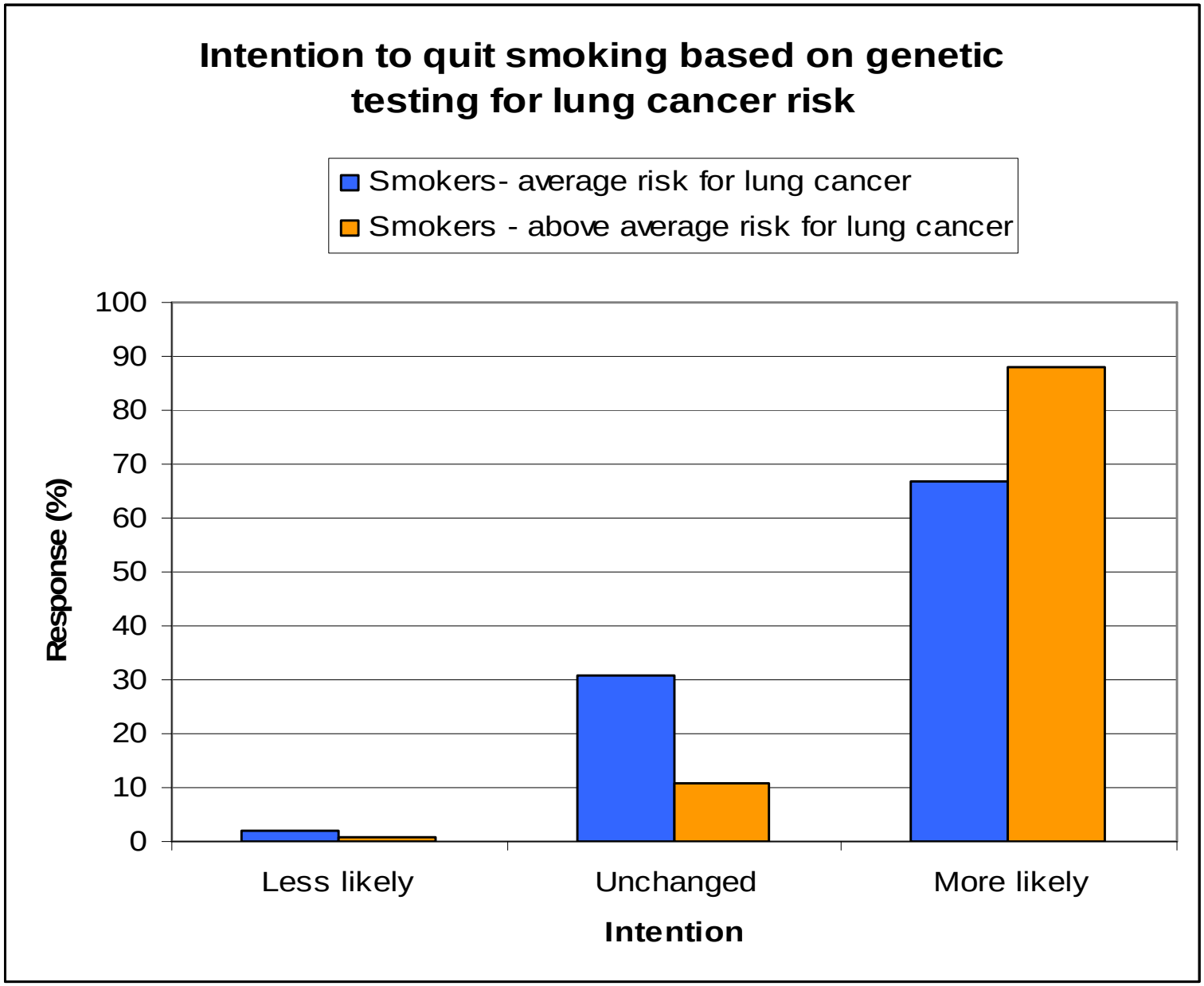
McBride,C.M., et al: Incorporating genetic susceptibility feedback into a smoking cessation program for African-American smokers with low income. *Cancer Epidemiol Biomarkers Prev.*2002, 11:521-528



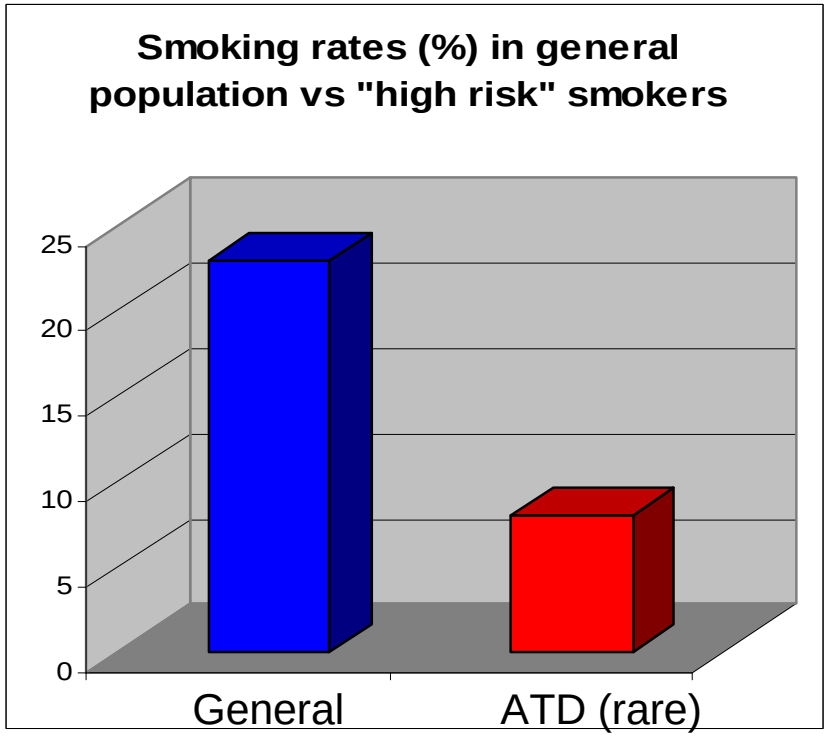
Smoking cessation

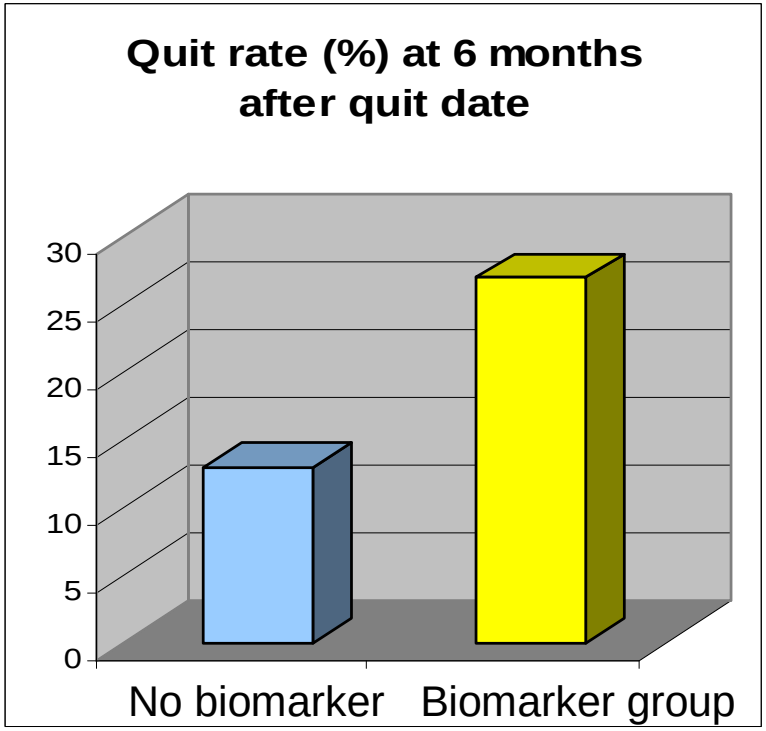
- Most smokers quit using cold turkey
- For older smokers, future poor health is the most cited reason for quitting
- Developing lung cancer and COPD are the most feared complications
- Most smokers continue to smoke on the basis the benefits outweigh the harms
- Most smokers overestimate the general risk of lung cancer but underestimate their own risk (below average risk = optimistic bias)
- Smokers quit when the motivational tension favour quitting (trigger)

Nothing Treatment Events


Intention to quit smoking based on genetic testing for lung cancer risk
Smokers- average risk for lung cancer
Smokers - above average risk for lung cancer
Response (%)
100
90
80
70
60
50
40
30
20
10
0
Less likely
Unchanged
More likely
Intention

Risk Personalization & Smoking Cessation?





Smoking rates reduced by 60% in smokers identified as “high risk” by rare α1-antitrypsin deficiency (ATD)

Strange S, et al. Genet Med 2004,6,204

Smoking cessation rates are doubled when smokers are tested with “high risk” biomarker for possible future complication

McBride CM, et al. Cancer Epidemiol Biomarker Prev. 2002,11,521