Dr Rob Young

General Physician
Auckland City Hospital

Effective Spirometry - Concurrent Workshop

Saturday, 22 June 2013	Start 8:30am	Duration: 55mins	Van Gogh
	Start 9:35am	Duration: 55mins	Van Gogh

Spirometry testing in primary care

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GP CME Rotorua, 2013

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

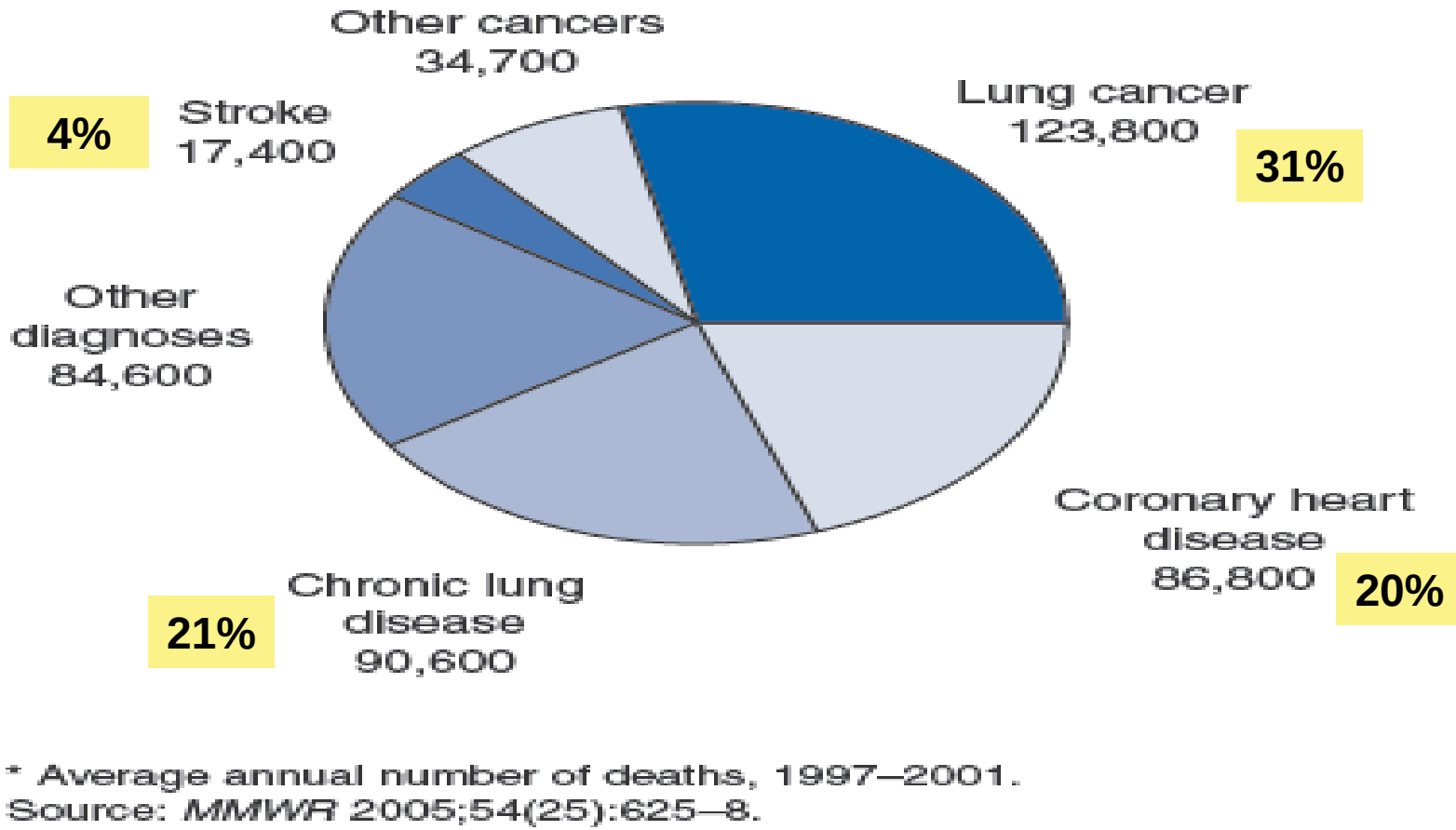
Why test with spirometry?

- 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



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

Diagnosis, **A**ssess & **M**anagement of COPD

- Diagnose - assess expiratory flow (spirometry, PEFR)
- Assess
  - symptoms (CAT and MRC score)
  - exacerbation risk (PHx of exacerbation, FEV_1%pred)
  - COPD co-morbidities (anxiety/depression, muscle wasting/fatigue) and COPD-related co-morbidities (CHD/CHF, lung cancer, osteoporosis)
- Manage – reduce risk and reduce symptoms

Diagnosis, **A**ssess & **M**anagement of COPD

- Diagnose - a… …pirometry, PEFR)
- Assess
  - symptoms
  - exacerbati… …FEV_1%pred)
  - COPD co-r… …on, muscle wasting/fatigue… …-morbidities (CHD/CHF, lu…
- Manage – reduce risk and reduce symptoms

Diagnose

Assess

Manage

Diagnosis, Assess & Manage COPD

Diagnose

Assess

Manage

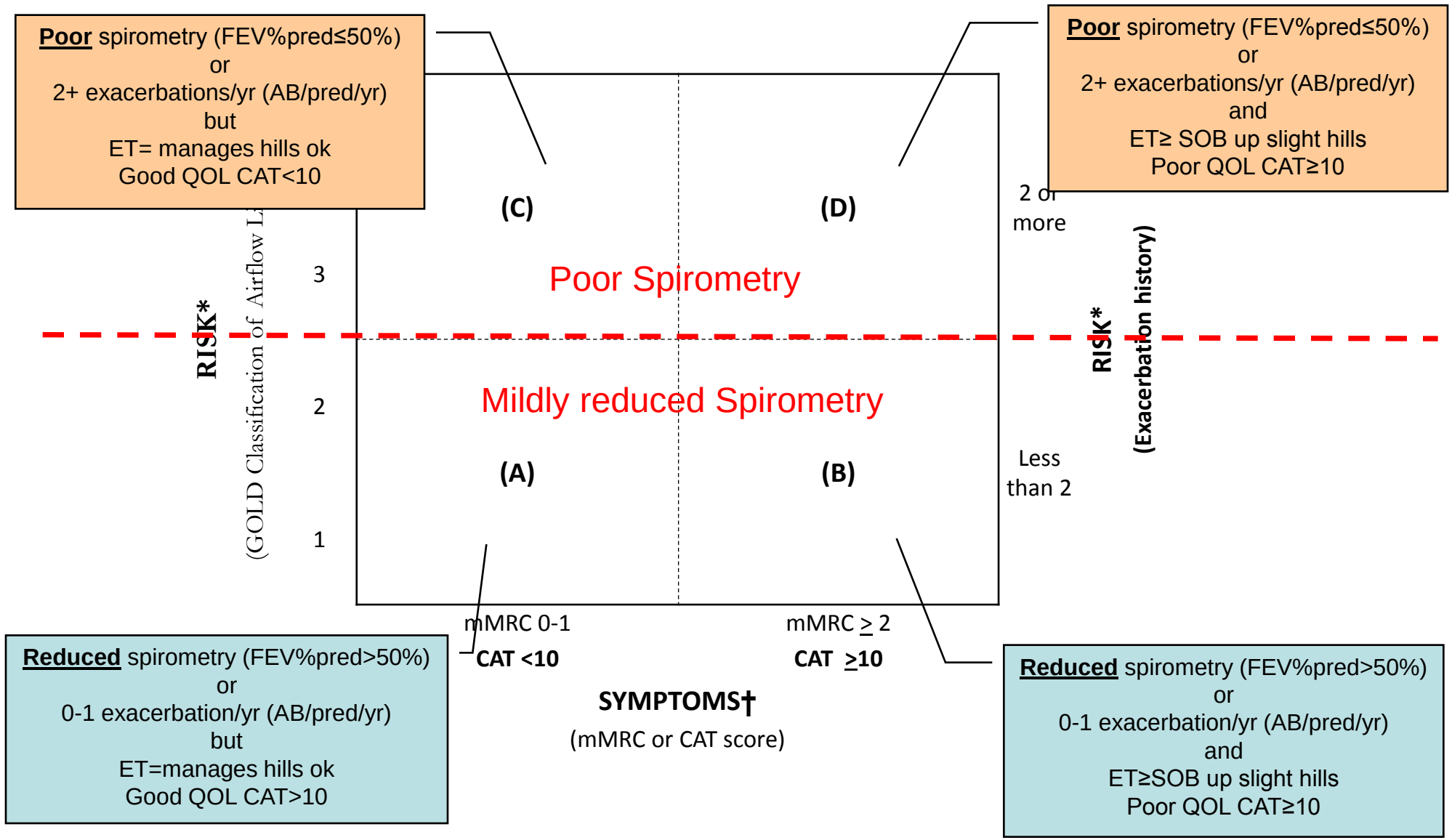
Symptom score

Expiratory flow

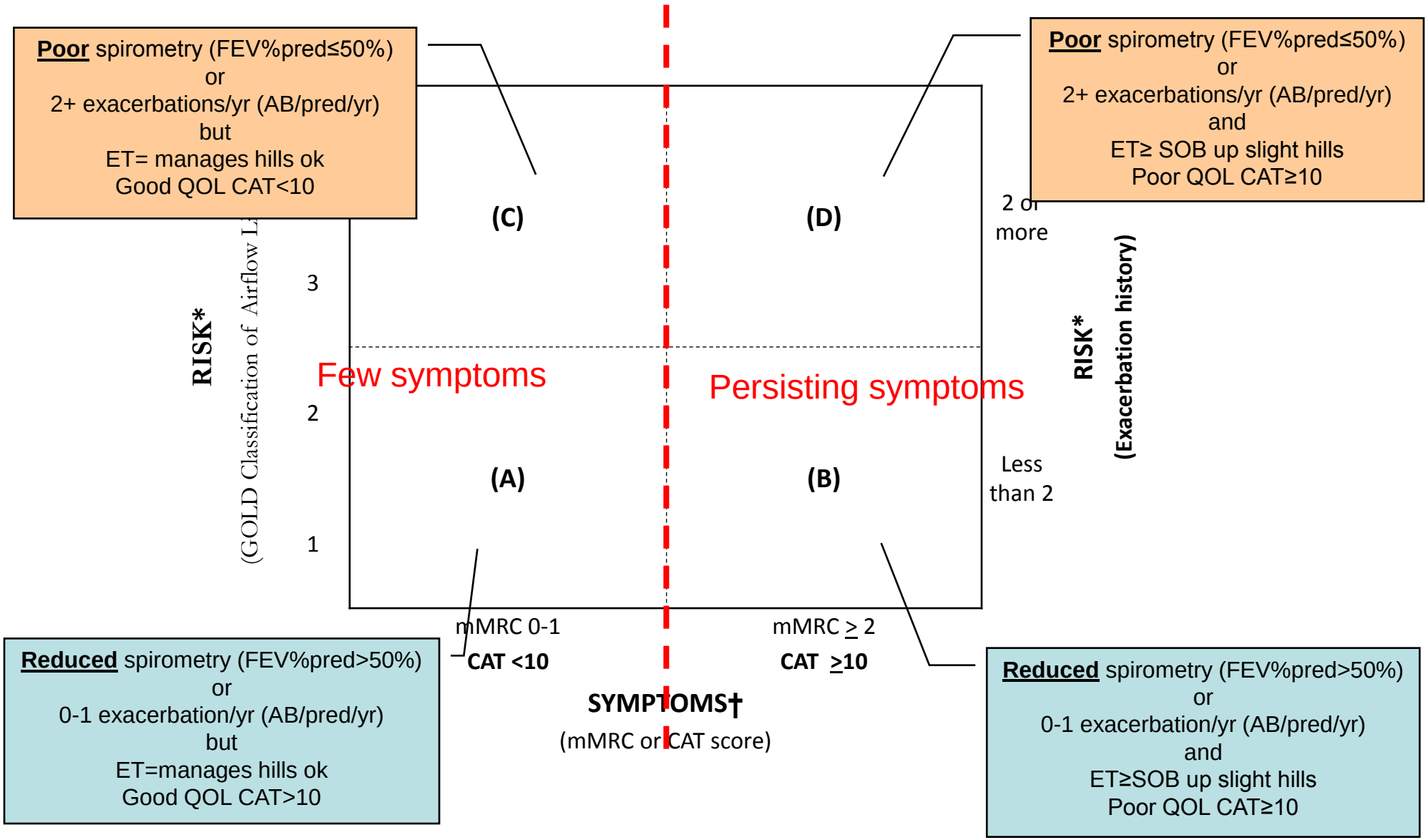
Xacerbation risk

- Manage – reduce risk and reduce symptoms

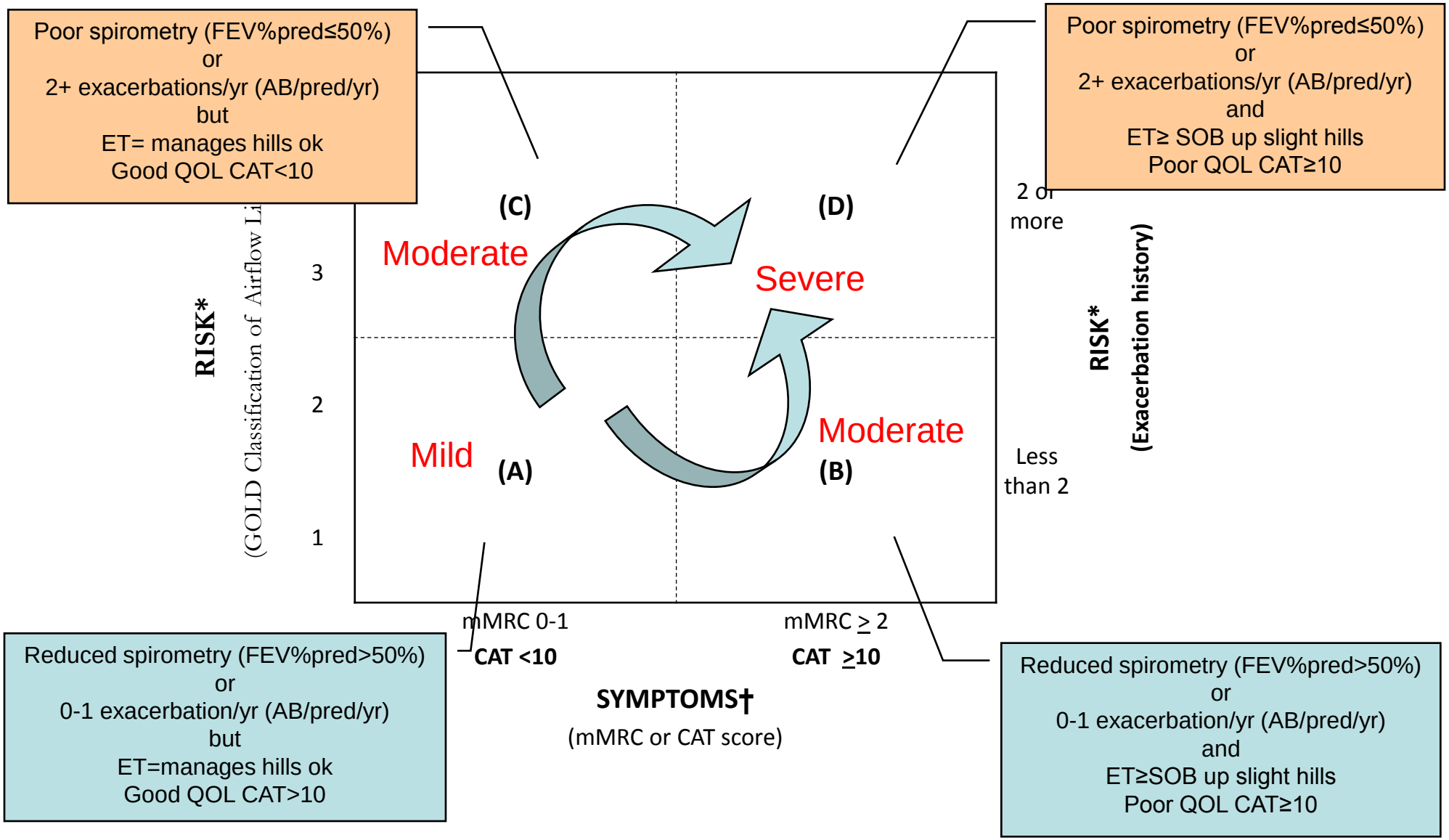
New GOLD-defined patient groups



New GOLD-defined patient groups



New GOLD-defined patient groups



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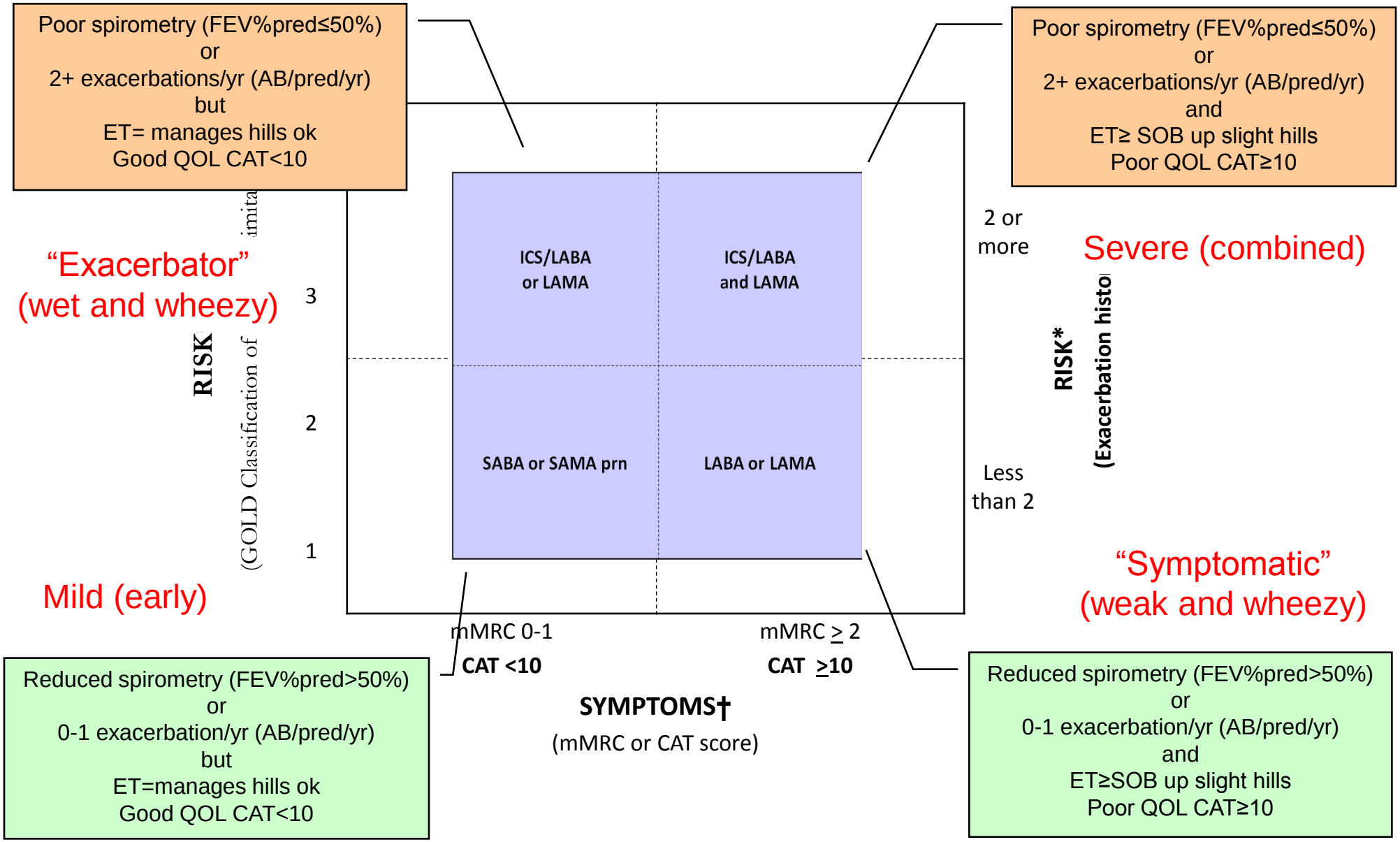


Role of Spirometry

Symptom score

Expiratory flow

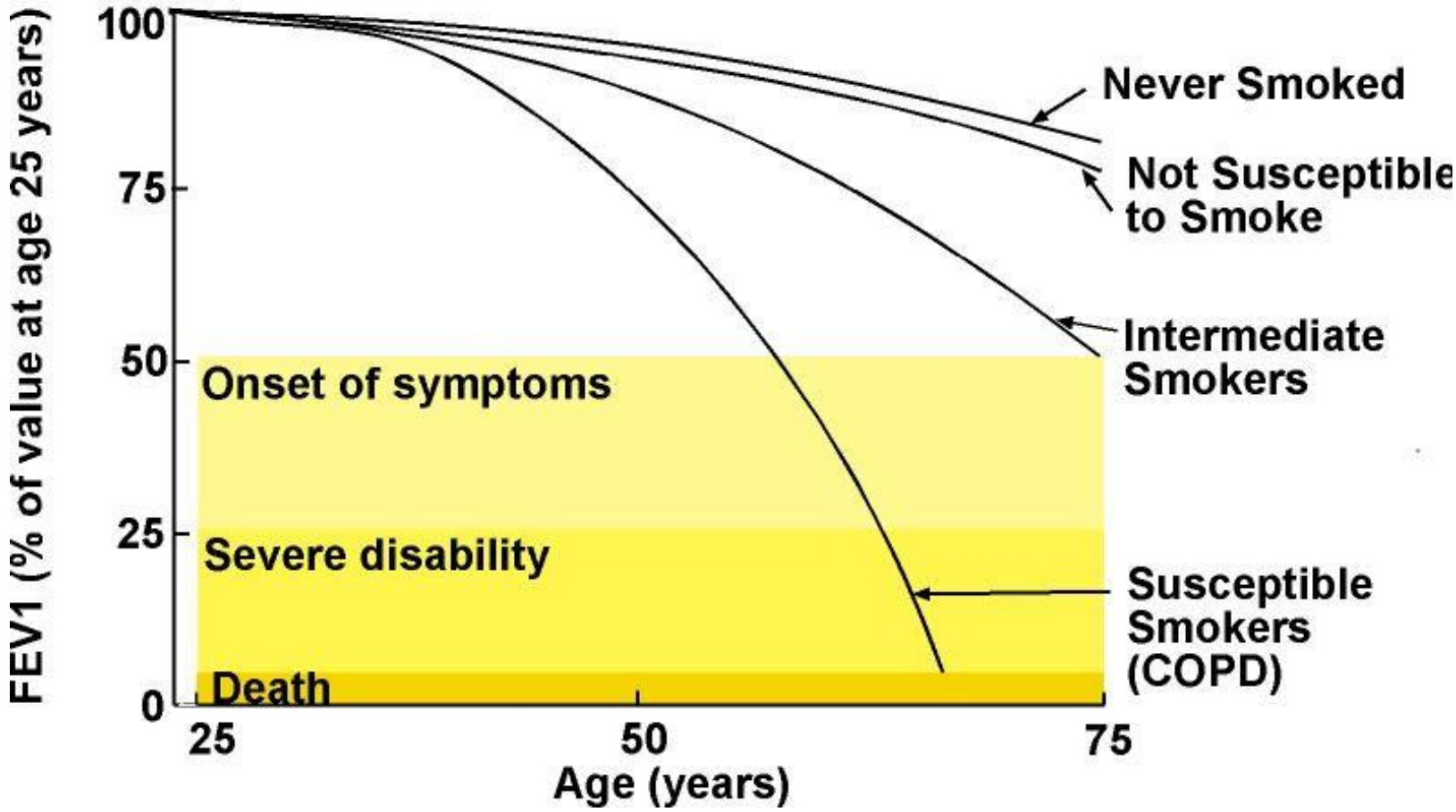
Xacerbation risk

Clinical cases – at risk patients

- Patient >40 years old with
  - respiratory symptoms of LRTI **and/or**
  - Past smoking history or equivalent dust/occupational Hx

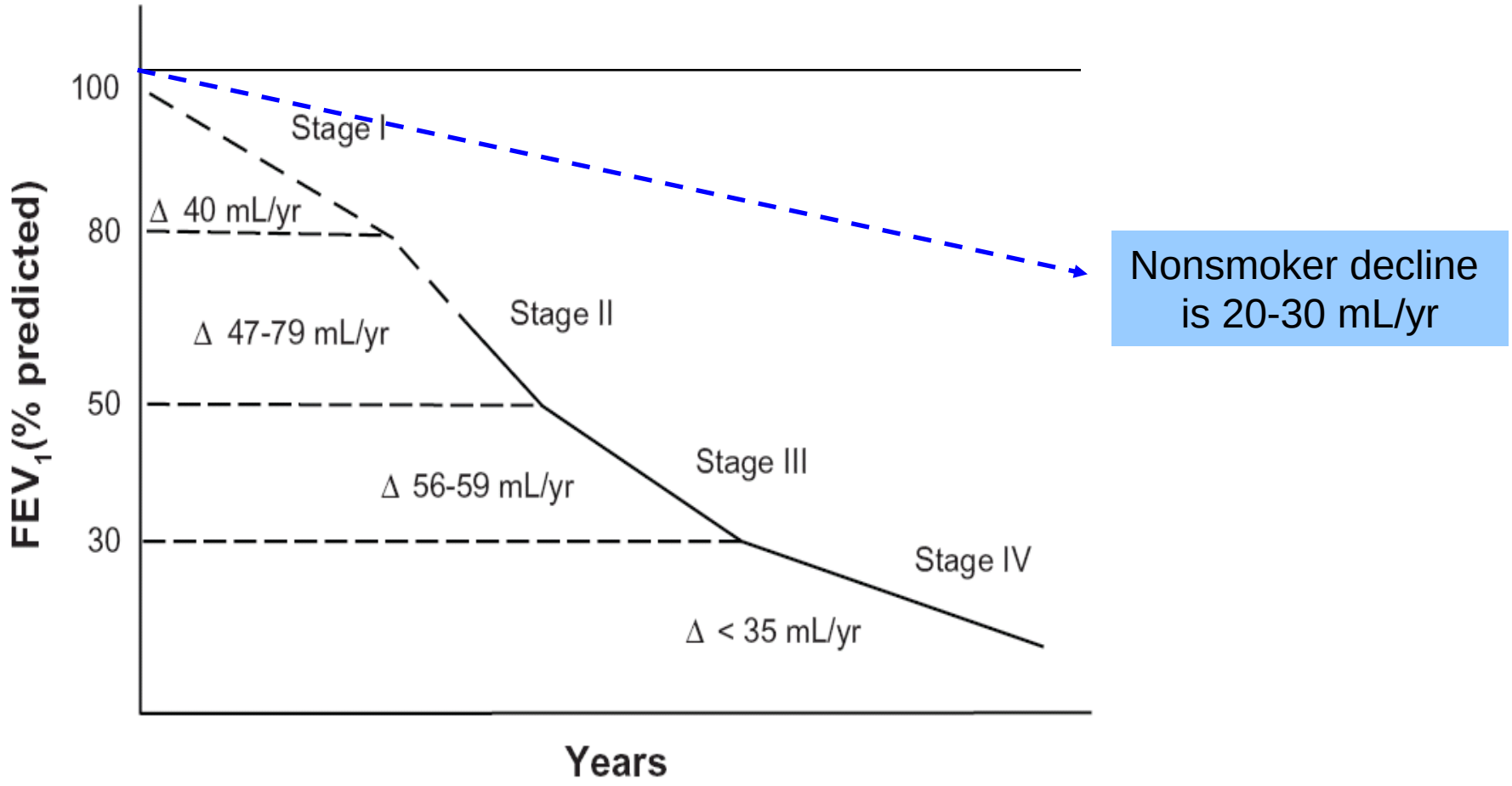
- Requires assessment to
  - Identify the presence of COPD (spirometry)
  - Identify other undisclosed symptoms relevant to QOL
  - Quantify risk of disease progression/exacerbations
  - Facilitate directed therapy and lifestyle changes

Decline of Lung Function: Not Homogeneous

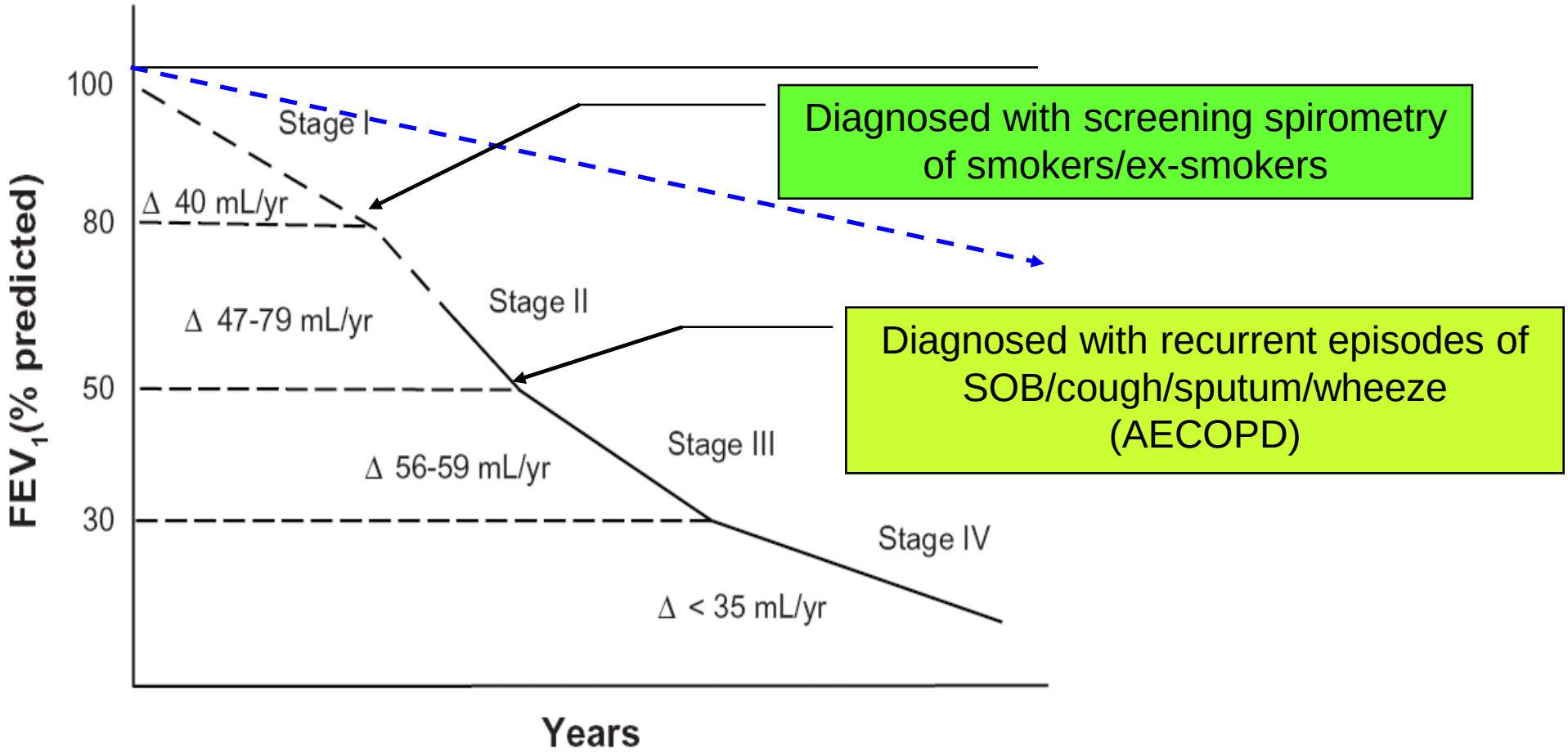


Lung function in smokers who get COPD

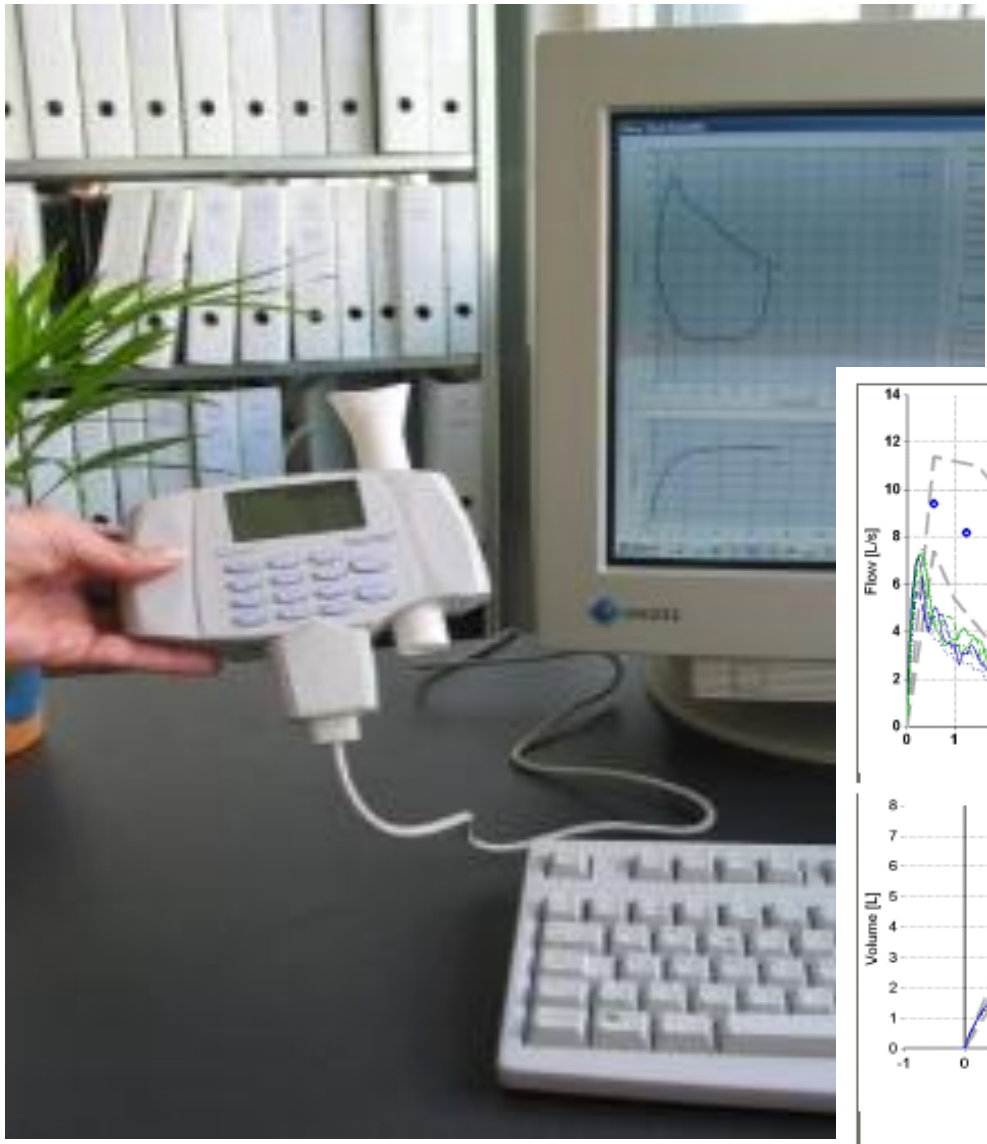
Decline in lung function with COPD severity

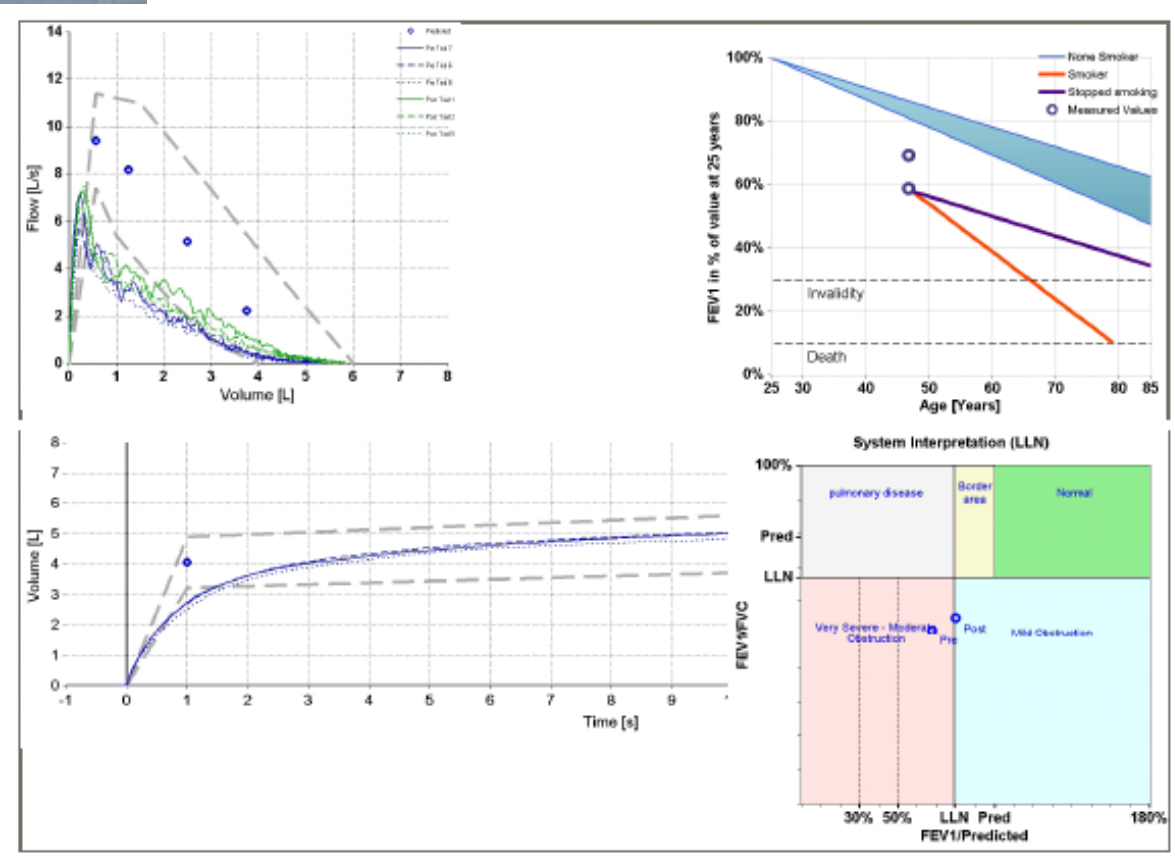


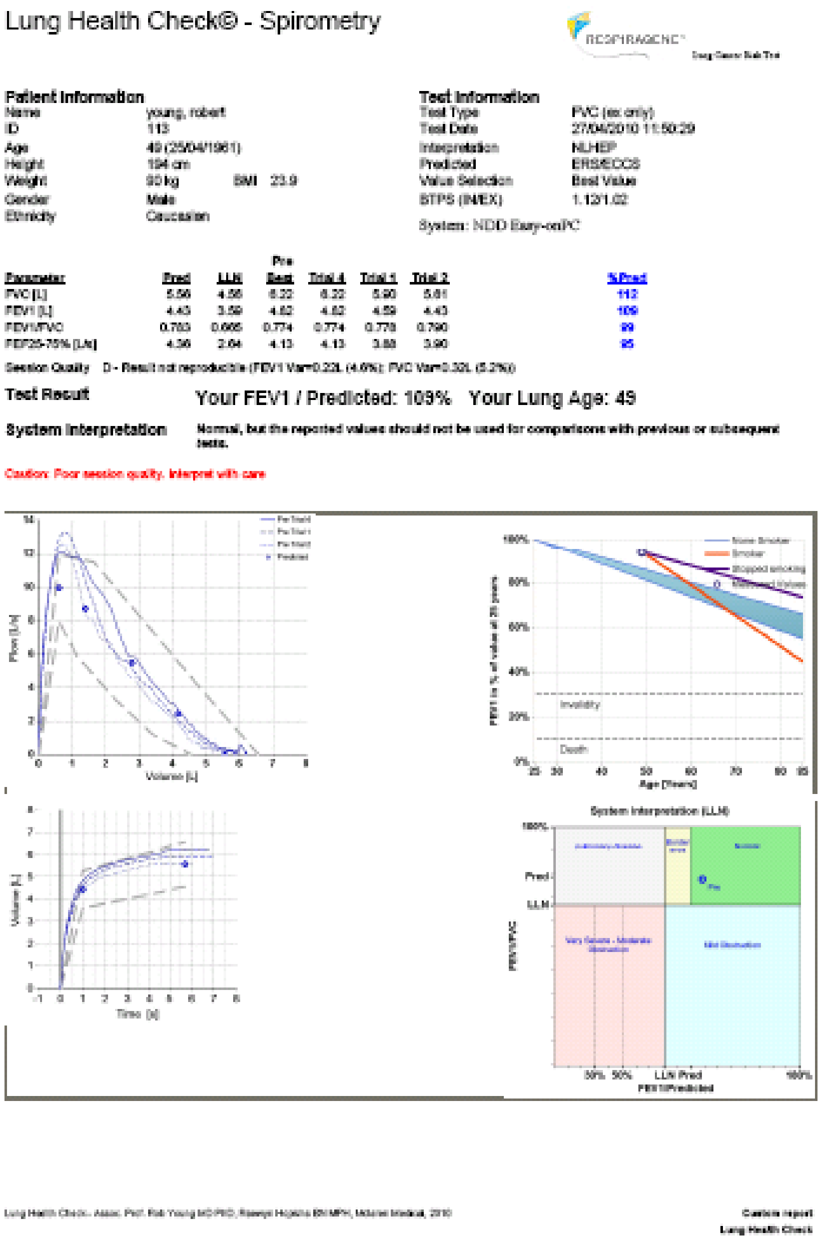
Decline in lung function with COPD severity



Spirometry Quality







Lung Health Check© - Spirometry

Patient Information

Name	young, robert
ID	113
Age	49 (25/04/1961)
Height	194 cm
Weight	90 kg BMI 23.9
Gender	Male
Ethnicity	Caucasian

Test Information

Test Type	FVC (ex only)
Test Date	27/04/2010 11:50:29
Interpretation	NLHEP
Predicted	ERS/ECCS
Value Selection	Best Value
BTPS (IN/EX)	1.12/1.02

System: NDD Easy-onPC

Parameter	Pred	LLN	Pre Best	Trial 4	Trial 1	Trial 2	%Pred
FVC [L]	5.56	4.56	6.22	6.22	5.90	5.61	112
FEV1 [L]	4.43	3.59	4.82	4.82	4.59	4.43	109
FEV1/FVC	0.783	0.665	0.774	0.774	0.778	0.790	99
FEF25-75% [L/s]	4.36	2.64	4.13	4.13	3.88	3.90	95

Session Quality D - Result not reproducible (FEV1 Var=0.22L (4.6%); FVC Var=0.32L (5.2%))

Test Result Your FEV1 / Predicted: 109% Your Lung Age: 49

System Interpretation Normal, but the reported values should not be used for comparisons with previous or subsequent tests.

Caution: Poor session quality. Interpret with care

Spirometry result from the Easy One spirometer

Full record of all results

% predicted in easy to see format

Lung Age

Flow-Volume Curve – Quality/Interpretation

Volume-Time Curve – Quality

Interpretation of result

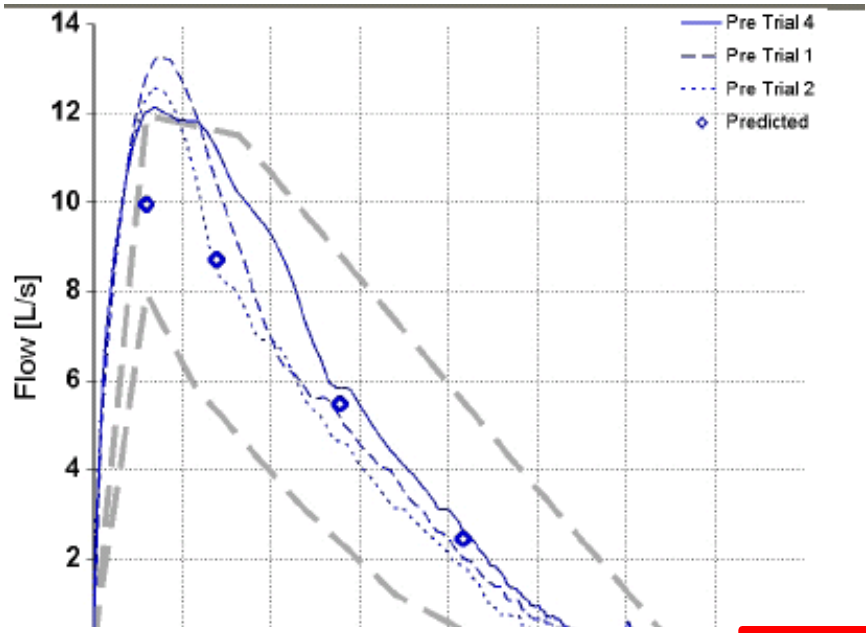
Individual effect on lung function with quitting

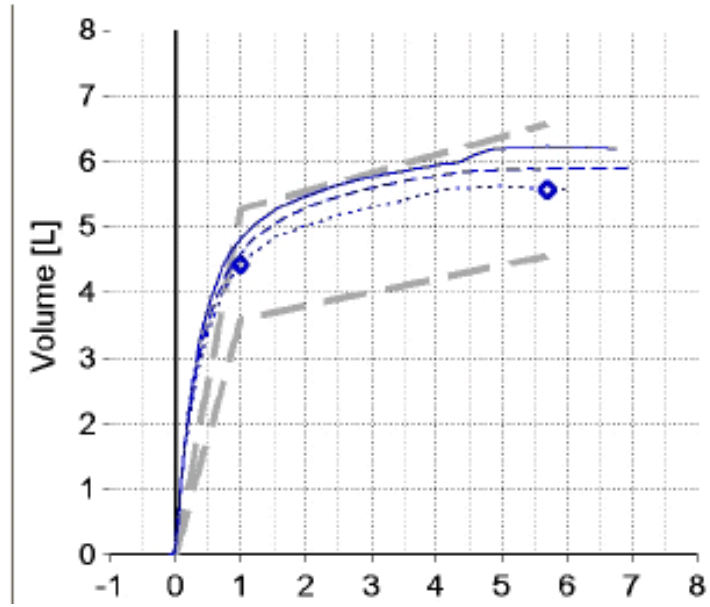
Performing Spirometry

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

Spirometry - Examples





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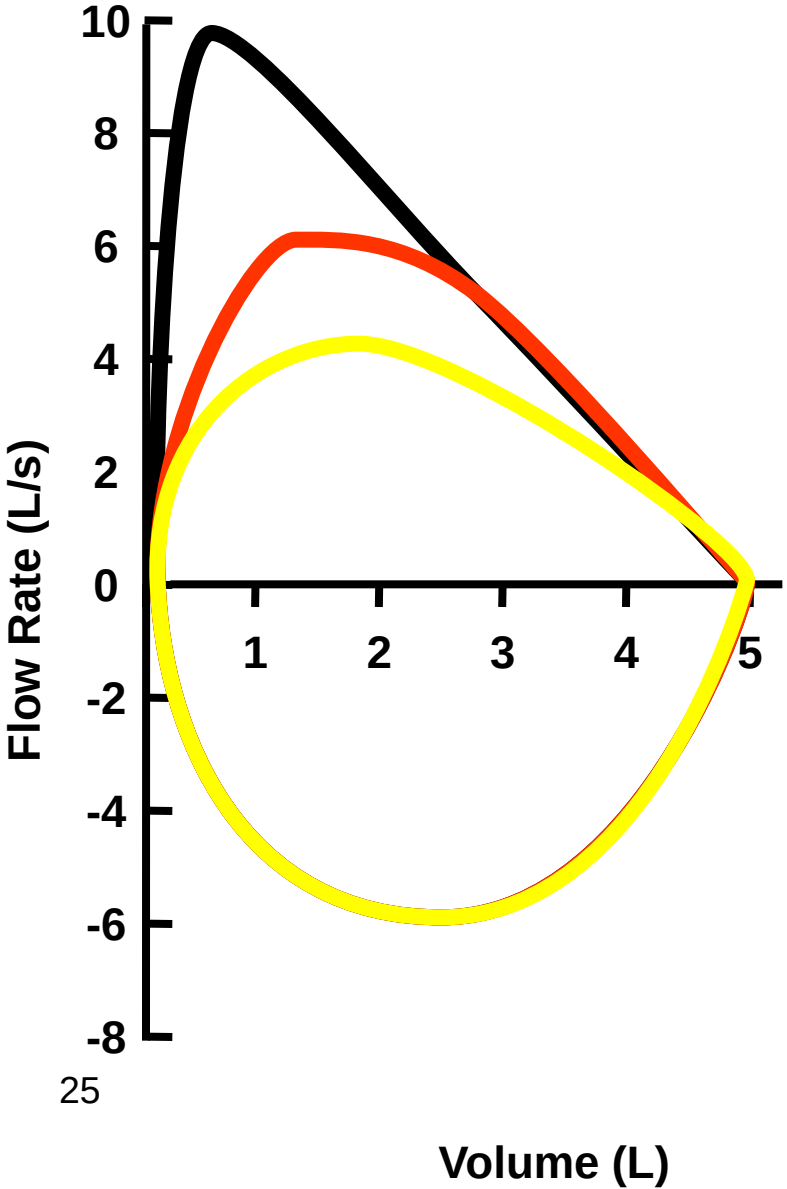
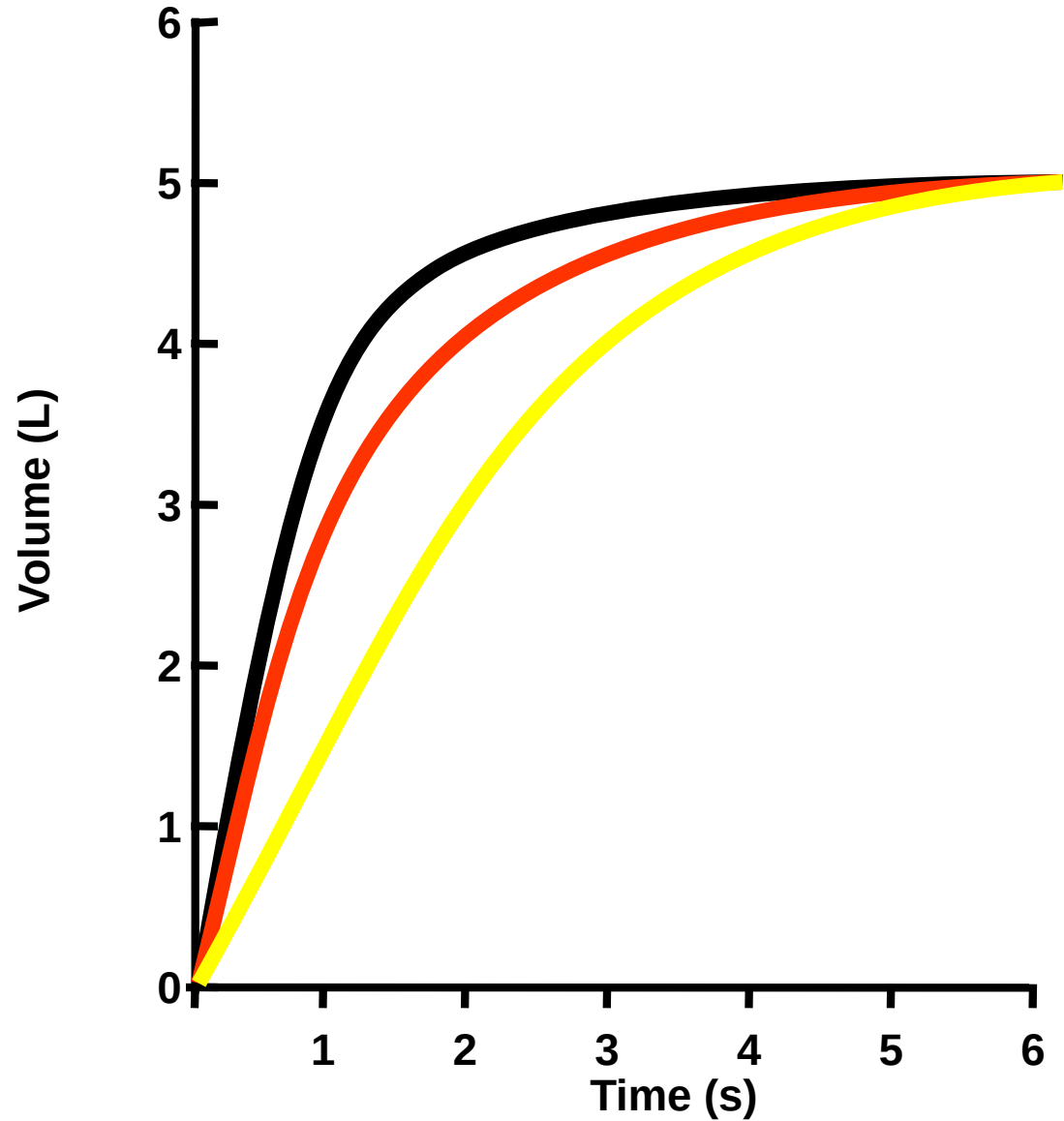
Session Quality D - Result not reproducible (FEV1 Var=0.22L (4.6%); FVC Var=0.32L (5.2%))

Test Result

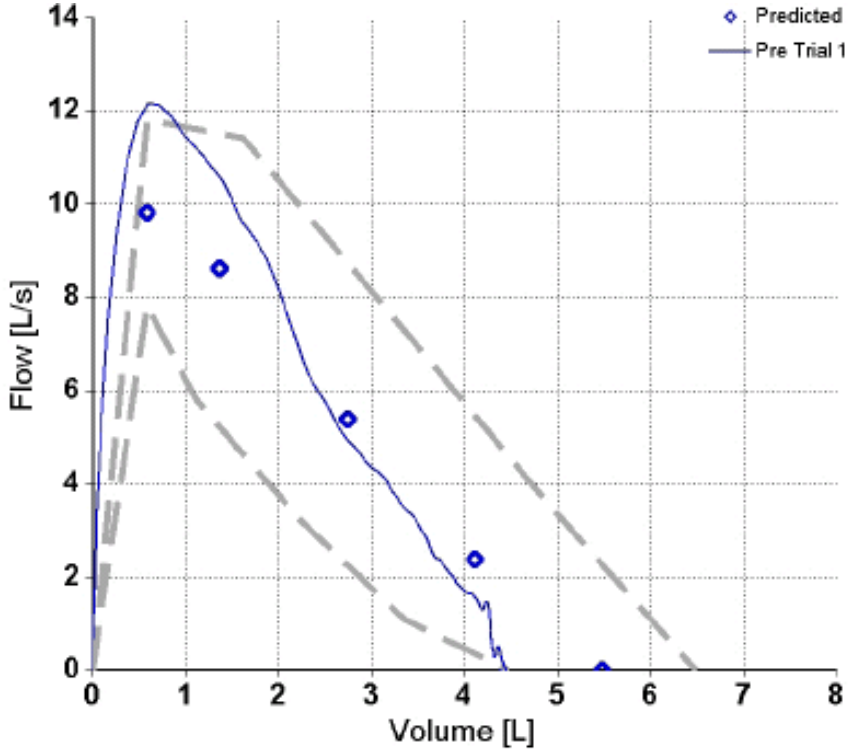
Your FEV1 / Predicted: 109% Your Lung Age: 49

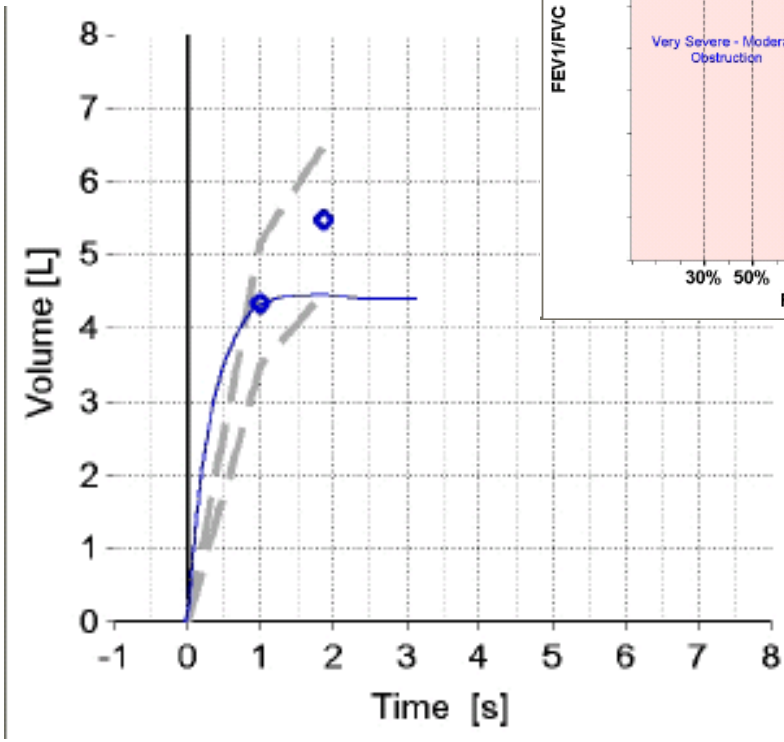
Variable Effort

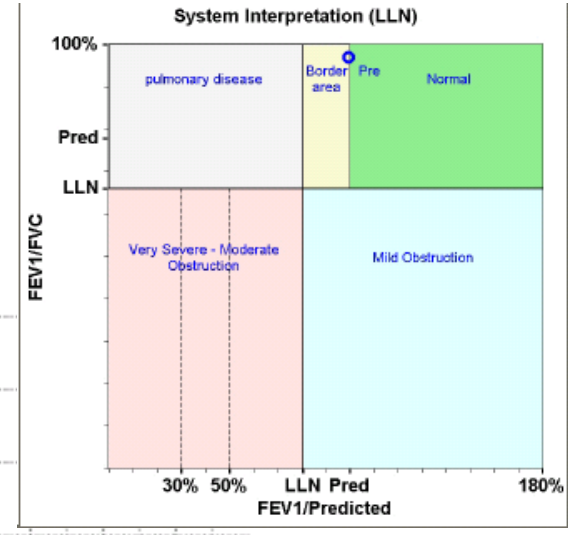




Spirometry - Examples







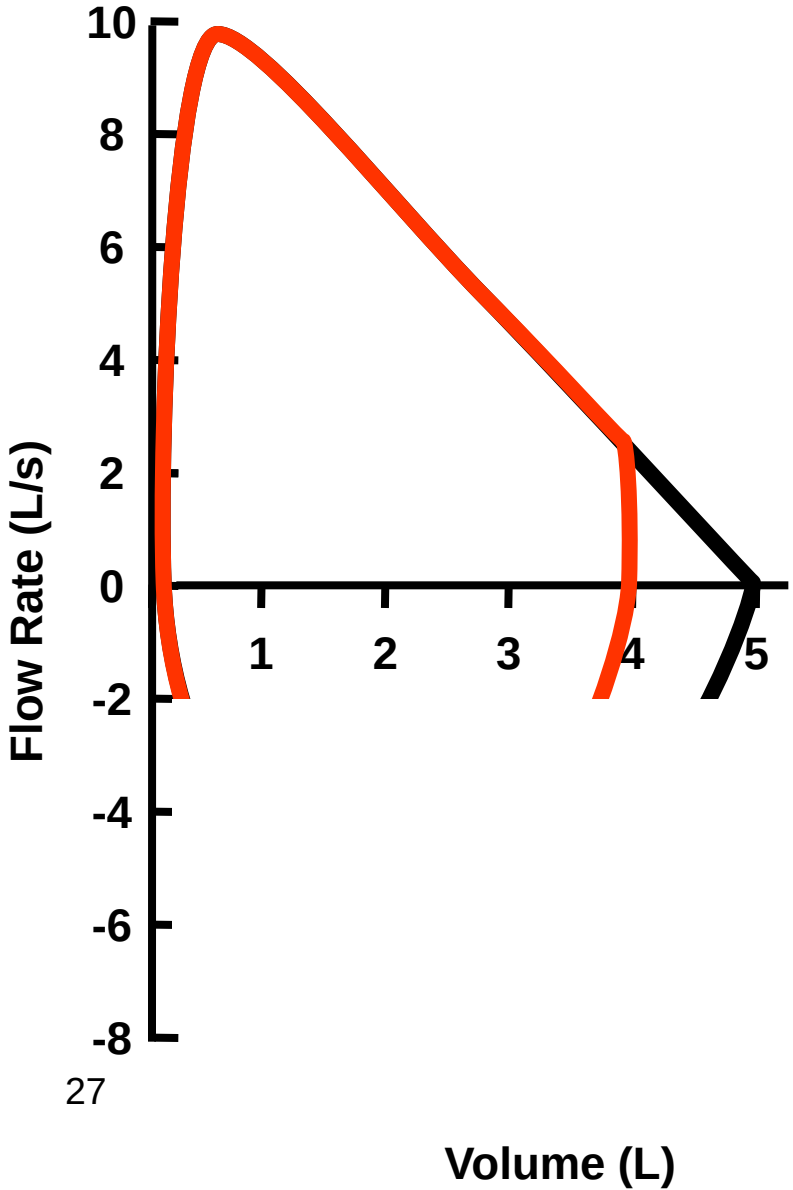
Parameter	Pred	LLN	Pre Best	~~Trial 1~~	%Pred
FVC [L]	5.48	4.48	4.46*	~~4.46*~~	81
FEV1 [L]	4.34	3.50	4.32	~~4.32~~	99
FEV1/FVC	0.778	0.660	0.969	~~0.969~~	125
FEF25-75% [L/s]	4.23	2.52	6.28	~~6.28~~	148

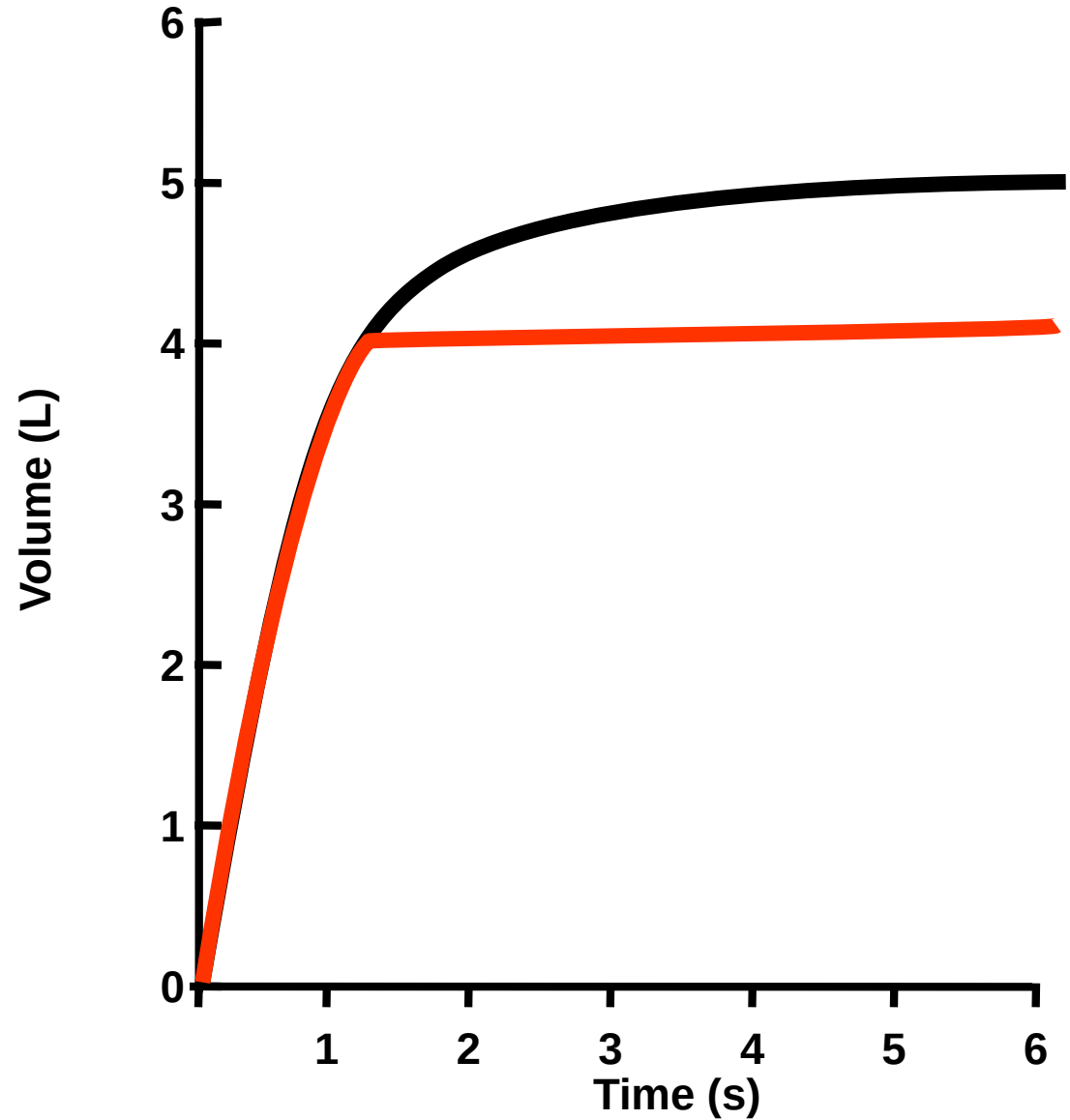
Session Quality F

Test Result

Your FEV1 / Predicted: 99% **Your Lung Age: 53**

Not full expiration





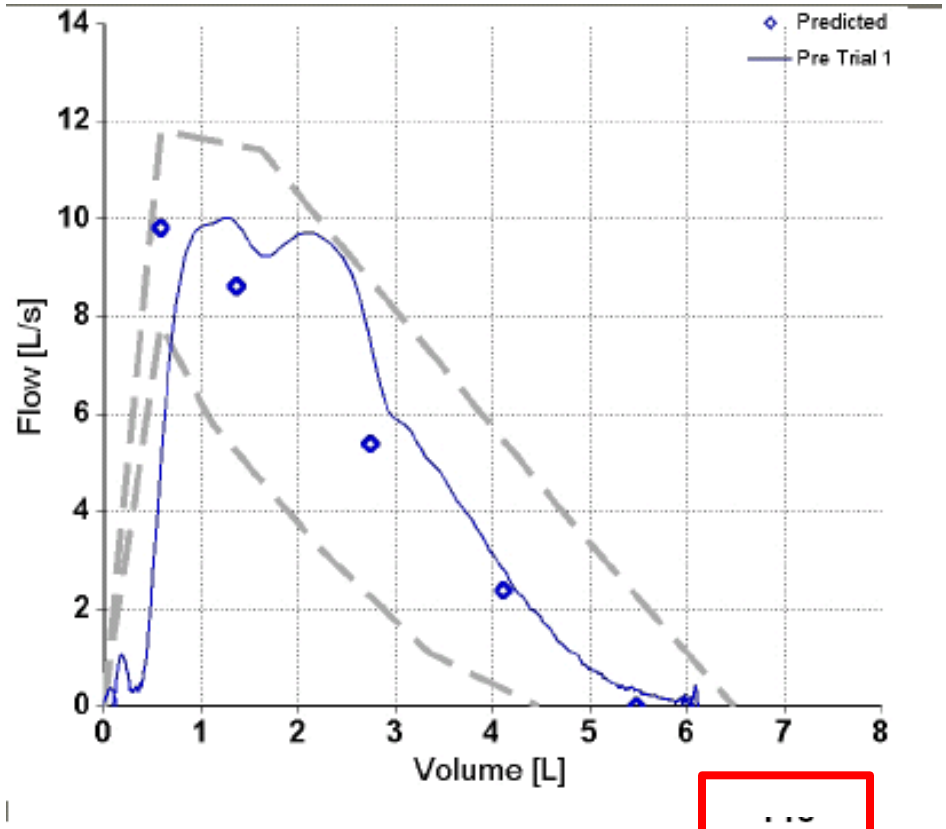
Pitfalls of spirometry

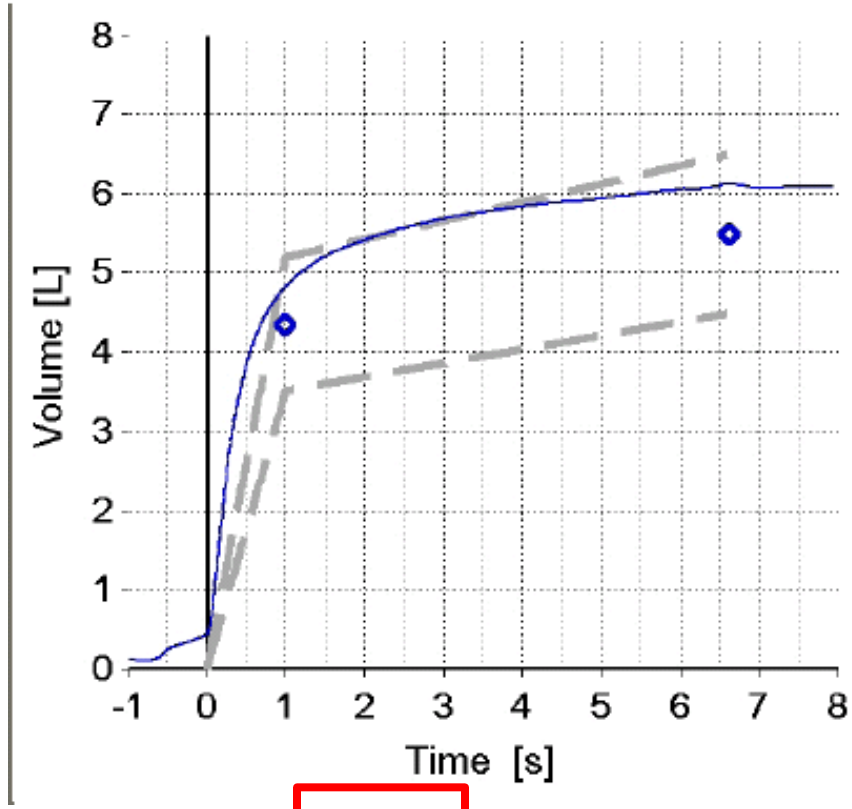
- Early termination of forced expiration (Overestimates the FEV1/FVC ratio which under-diagnoses COPD).
- Slow or false start
- Cough, glottic closure, tongue obstruction, teeth (dentures)
- Poor posture, inadequate seal around mouth piece, extra breaths
- Inadequate inspiration, maintain maximal effort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

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

Spirometry - Examples





Parameter	Pred	LLN	Best	Trial 1
FVC [L]	5.48	4.48	6.12	6.12
FEV1 [L]	4.34	3.50	4.82	4.82
FEV1/FVC	0.778	0.660	0.788	0.788
FEF25-75% [L/s]	4.23	2.52	4.59	4.59

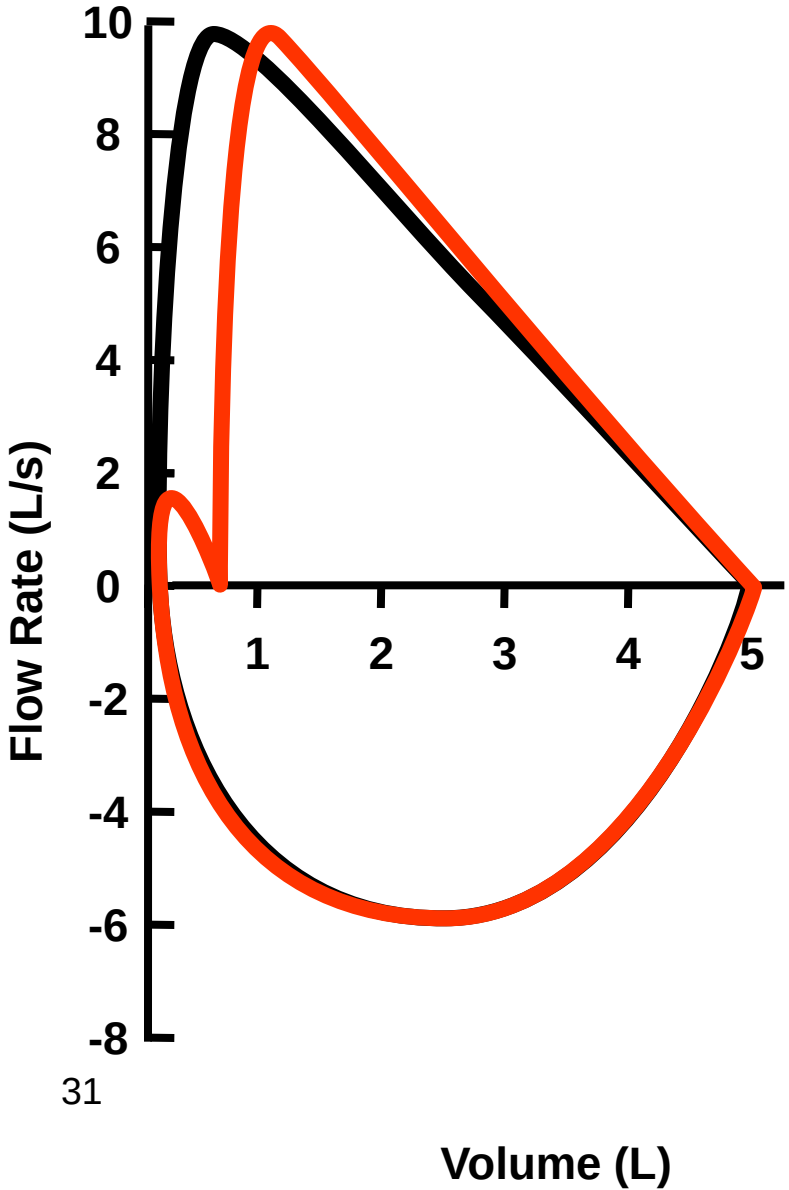
%Pred
112
111
101
109

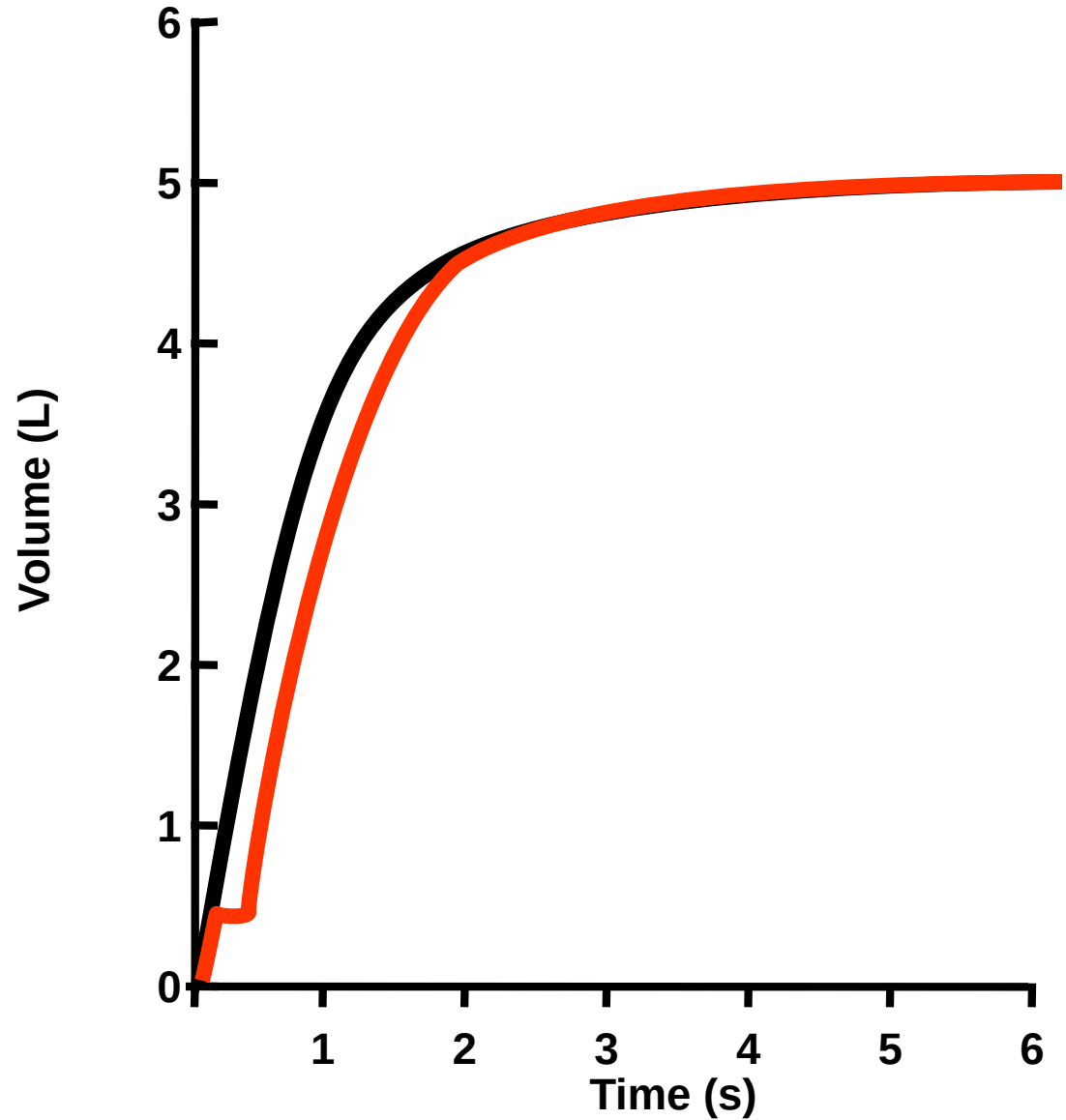
Session Quality F

Test Result

Your FEV1 / Predicted: 111% Your Lung Age: 52

False Start

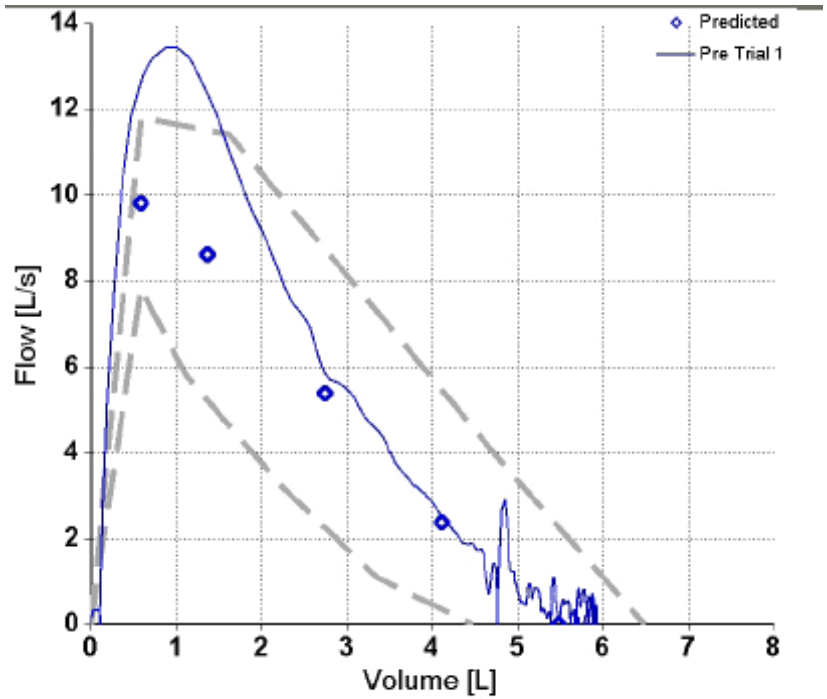

10
8
6
4
2
0
-2
-4
-6
-8
1
2
3
4
5
Flow Rate (L/s)
Volume (L)

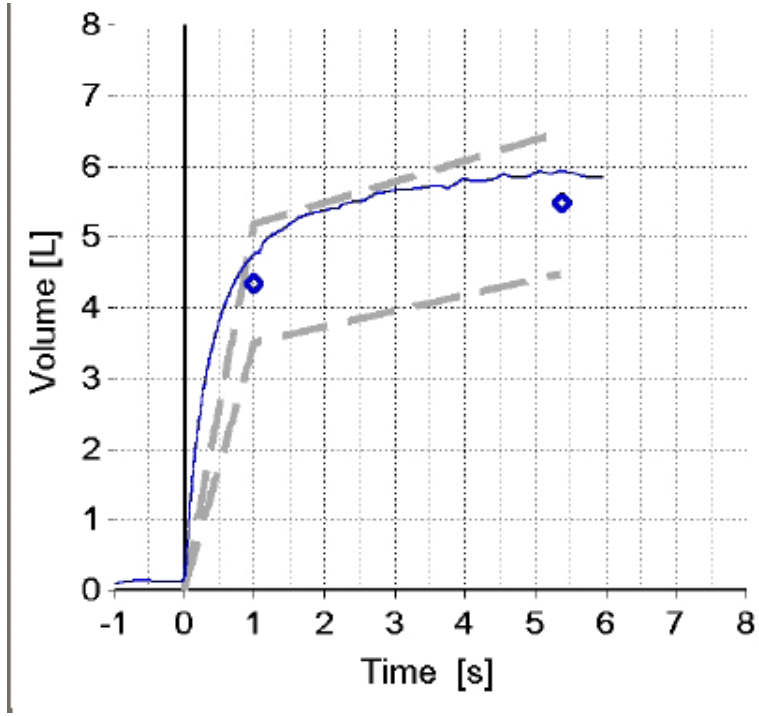

6
5
4
3
2
1
0
1
2
3
4
5
6
Volume (L)
Time (s)

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

Spirometry - Examples

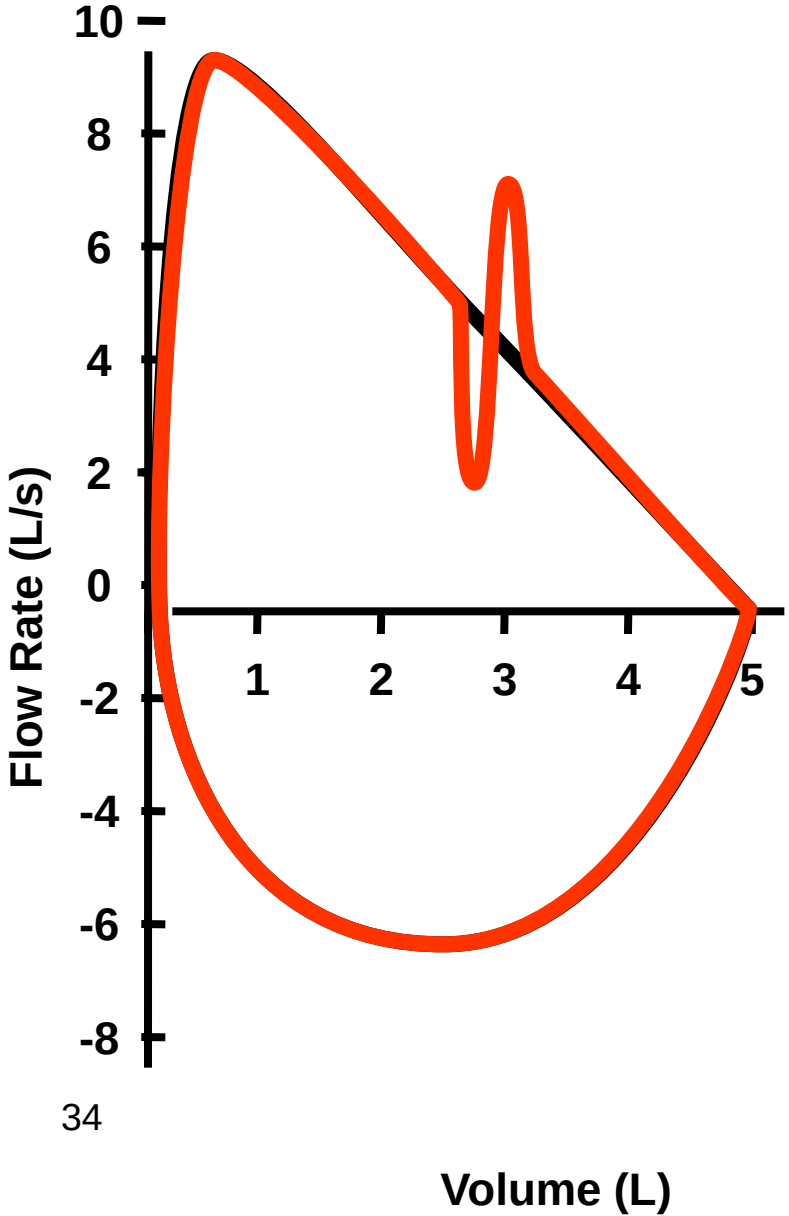


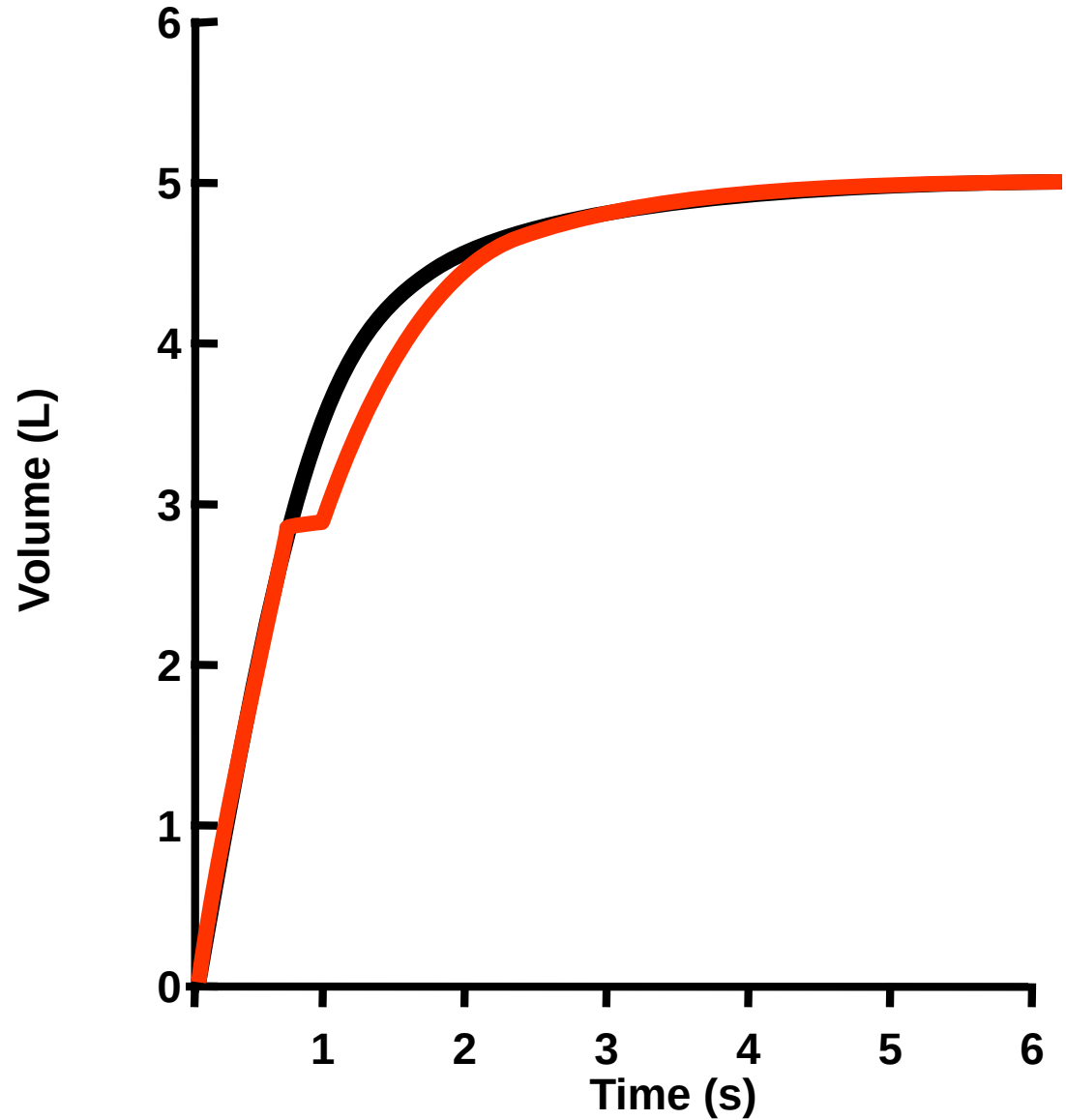


Parameter	Pred	LLN	Pre Best	Trial 1	%Pred
FVC [L]	5.48	4.48	5.93	5.93	108
FEV1 [L]	4.34	3.50	4.76	4.76	109
FEV1/FVC	0.778	0.660	0.802	0.802	103
FEF25-75% [L/s]	4.23	2.52	4.51	4.51	107

Session Quality D - Only one acceptable trial (FEV1 Var= --L (); FVC Var= --L ())

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)

Pitfalls of spirometry

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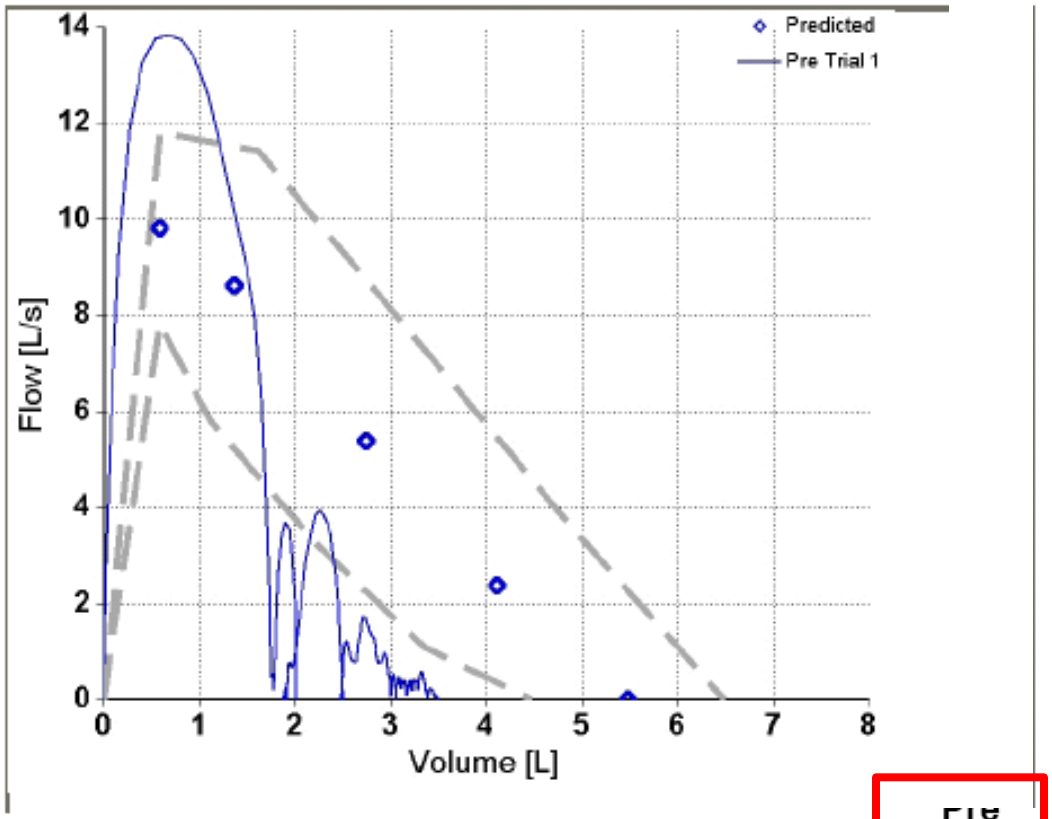
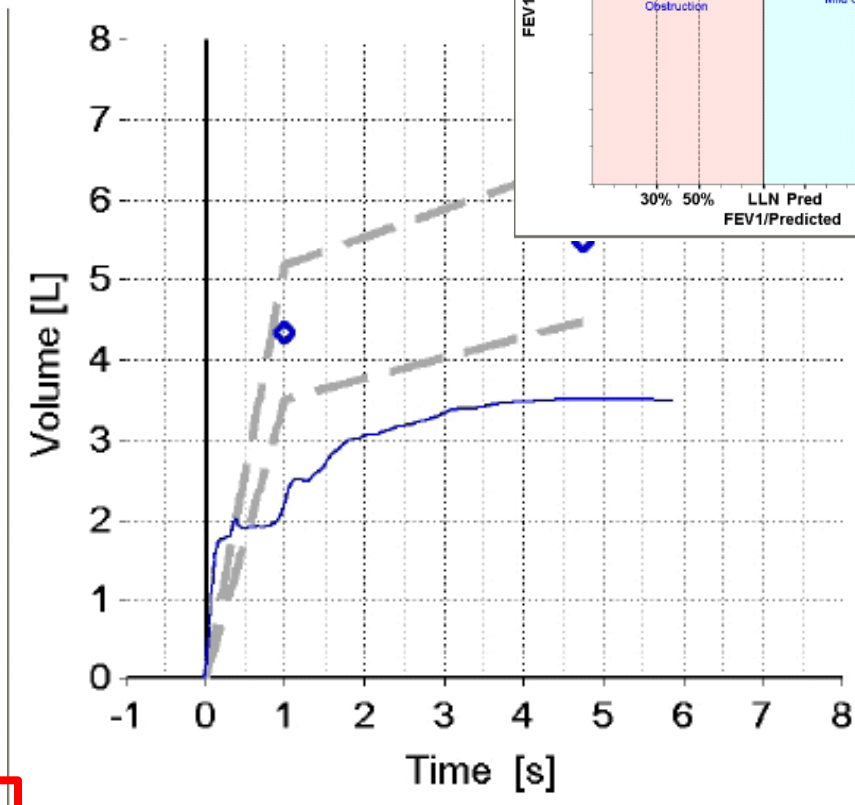
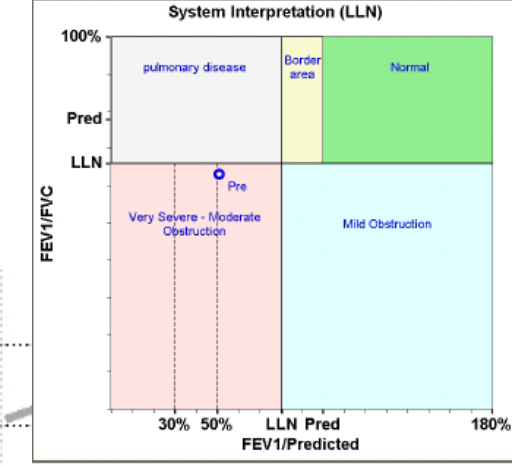
Spirometry - Examples







Parameter	Pred	LLN	Pre Best	Trial 1	%Pred
FVC [L]	5.48	4.48	3.51*	3.51*	64
FEV1 [L]	4.34	3.50	2.21*	2.21*	51
FEV1/FVC	0.778	0.660	0.631*	0.631*	81
FEF25-75% [L/s]	4.23	2.52	1.27*	1.27*	30

Session Quality D - Only one acceptable trial (FEV1 Var= --L (); FVC Var= --L ())

Pitfalls of spirometry

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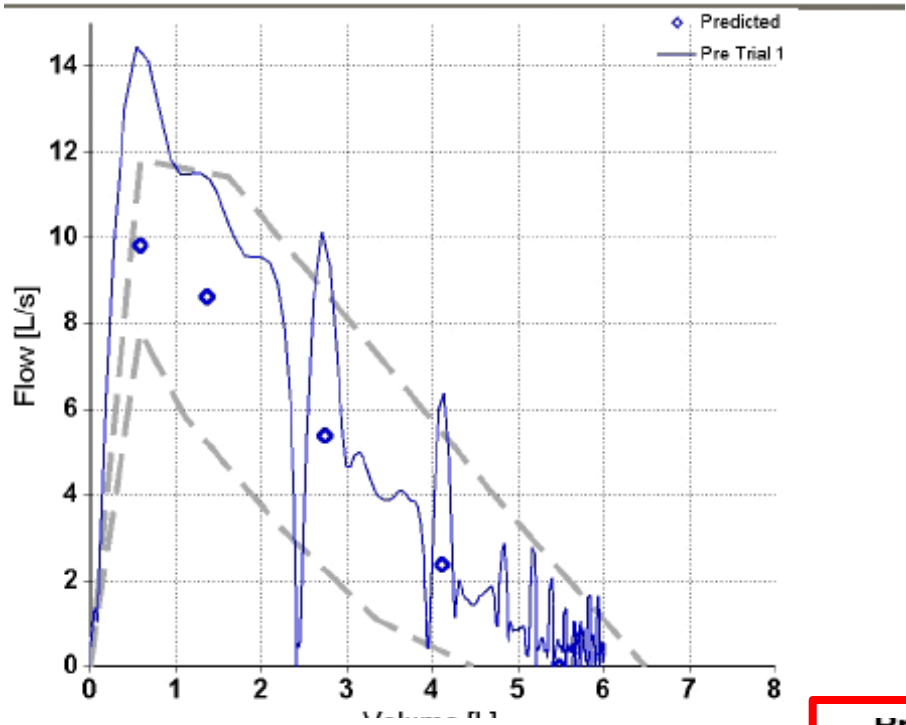
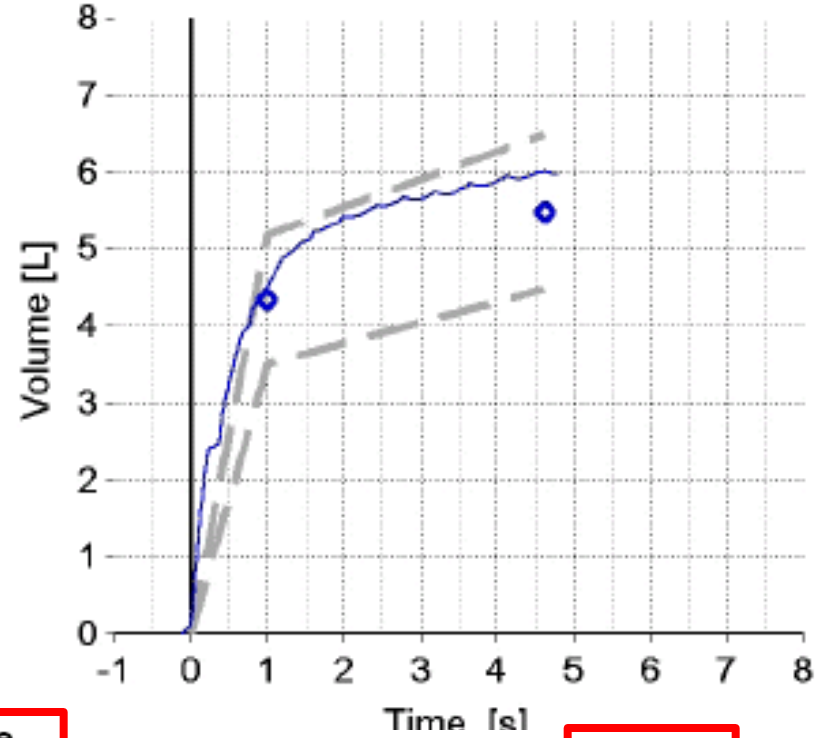
Spirometry - Examples





Parameter	Pred	LLN	Pre Best	Trial 1	%Pred
FVC [L]	5.48	4.48	6.01	6.01	110
FEV1 [L]	4.34	3.50	4.52	4.52	104
FEV1/FVC	0.778	0.660	0.753	0.753	97
FEF25-75% [L/s]	4.23	2.52	3.47	3.47	82

Session Quality F

Test Result

Your FEV1 / Predicted: 104% Your Lung Age: 52

Pitfalls of spirometry

- Early termination of forced expiration (Overestimates the FEV1/FVC ratio which under-diagnoses COPD).
- Slow or false start
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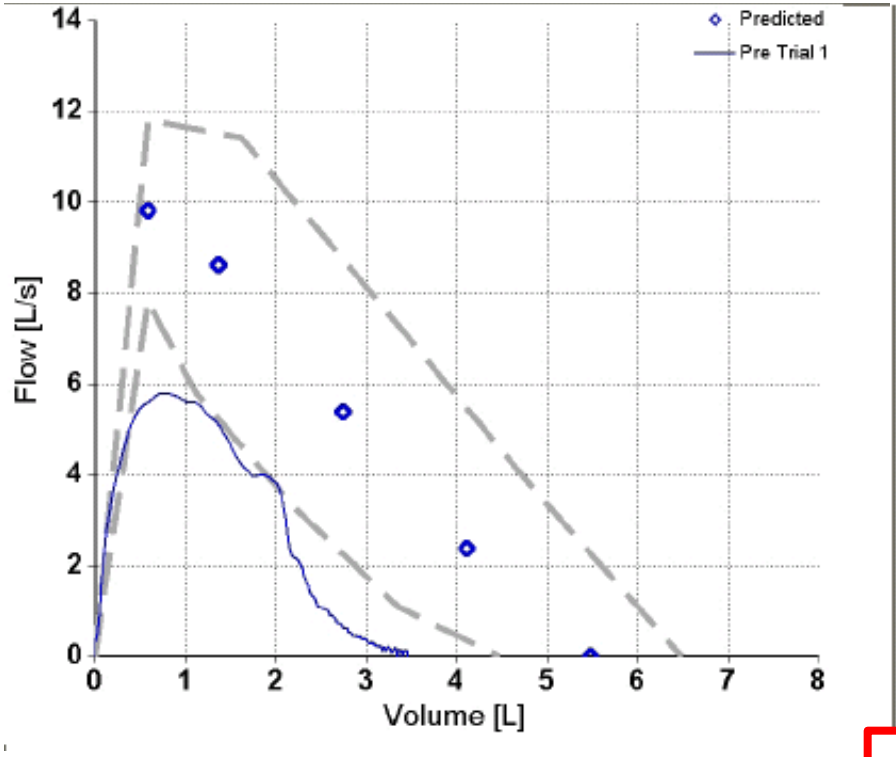
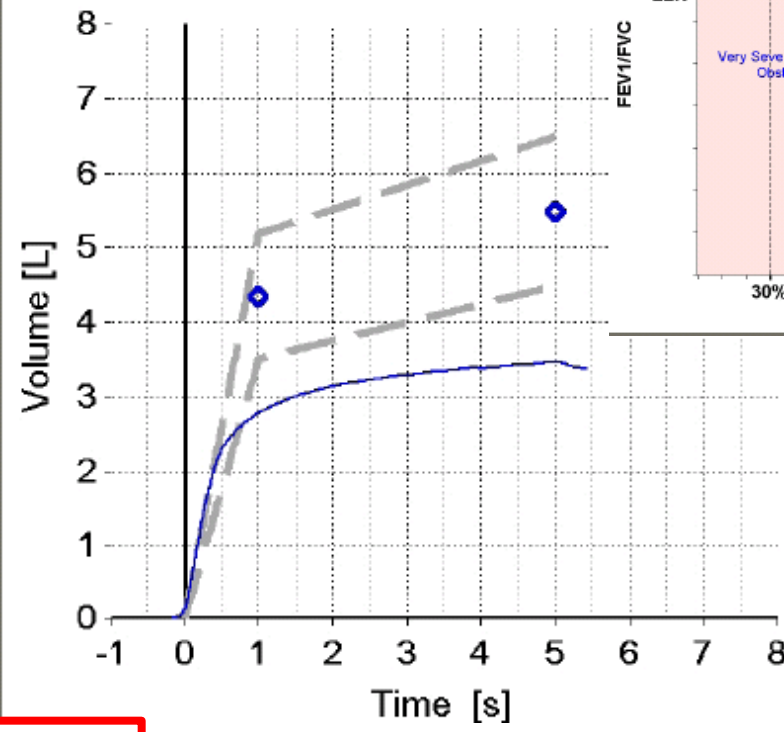
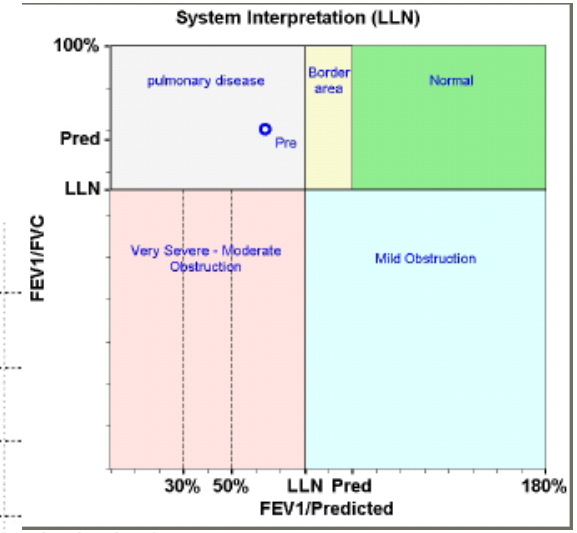
Spirometry - Examples







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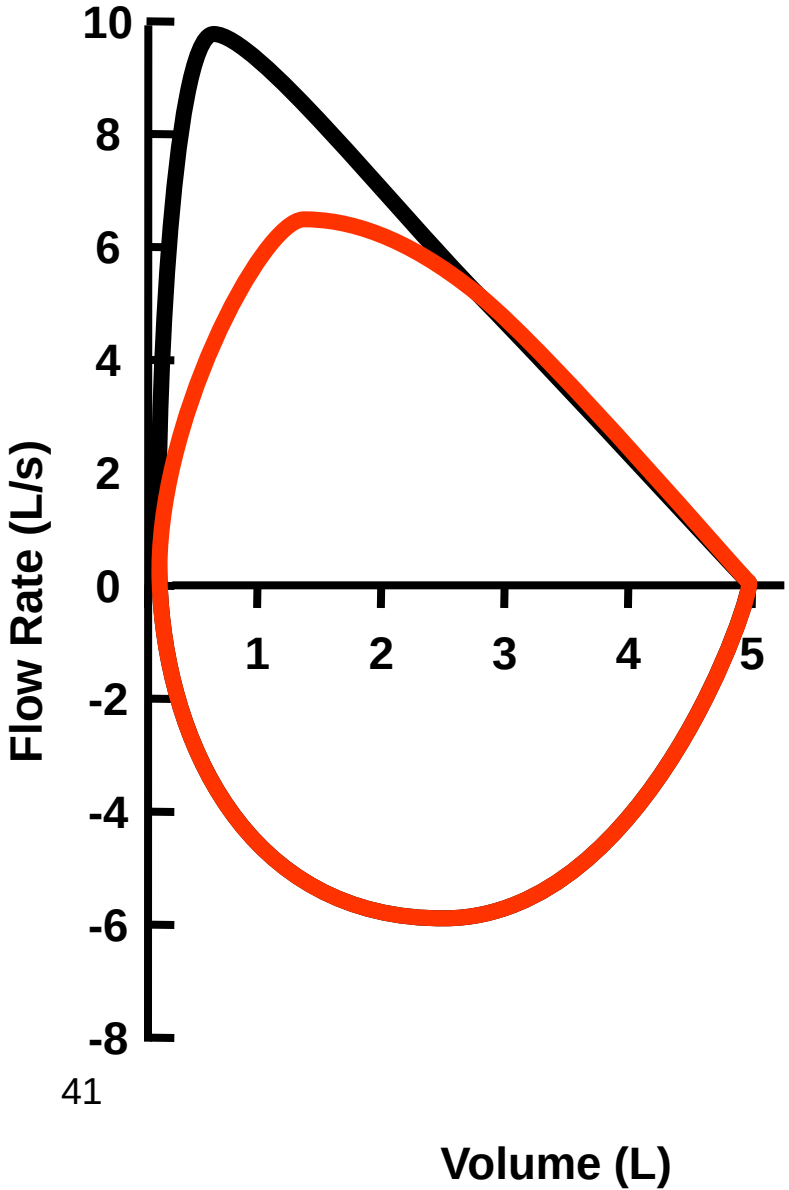
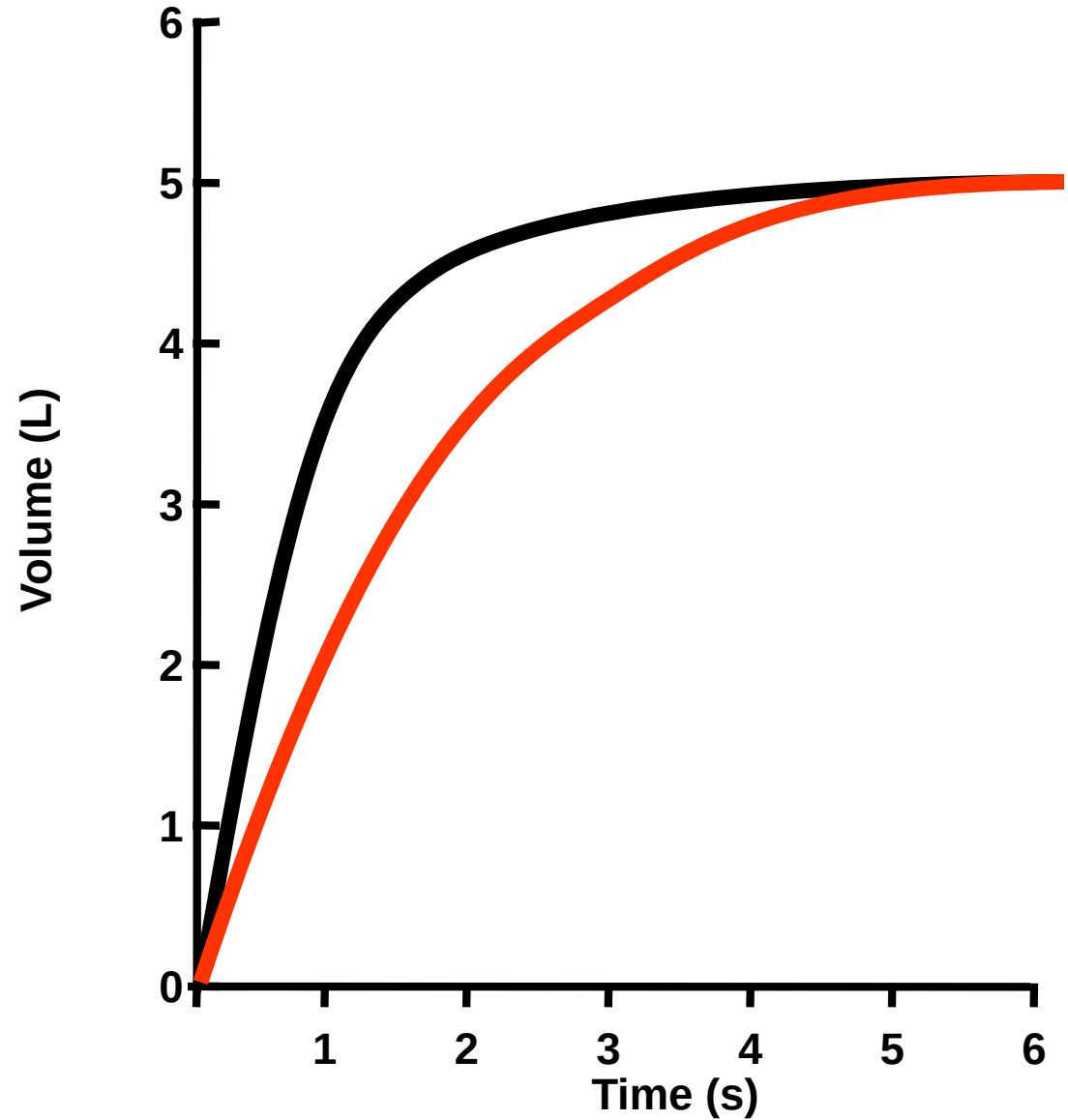
FEV1 [L]	4.34	3.50	2.78*	2.78*	64
FEV1/FVC	0.778	0.660	0.803	0.803	103
FEF25-75% [L/s]	4.23	2.52	2.87	2.87	68

Session Quality D - Only one acceptable trial (FEV1 Var= --L (); FVC Var= --L ())

Slow Start

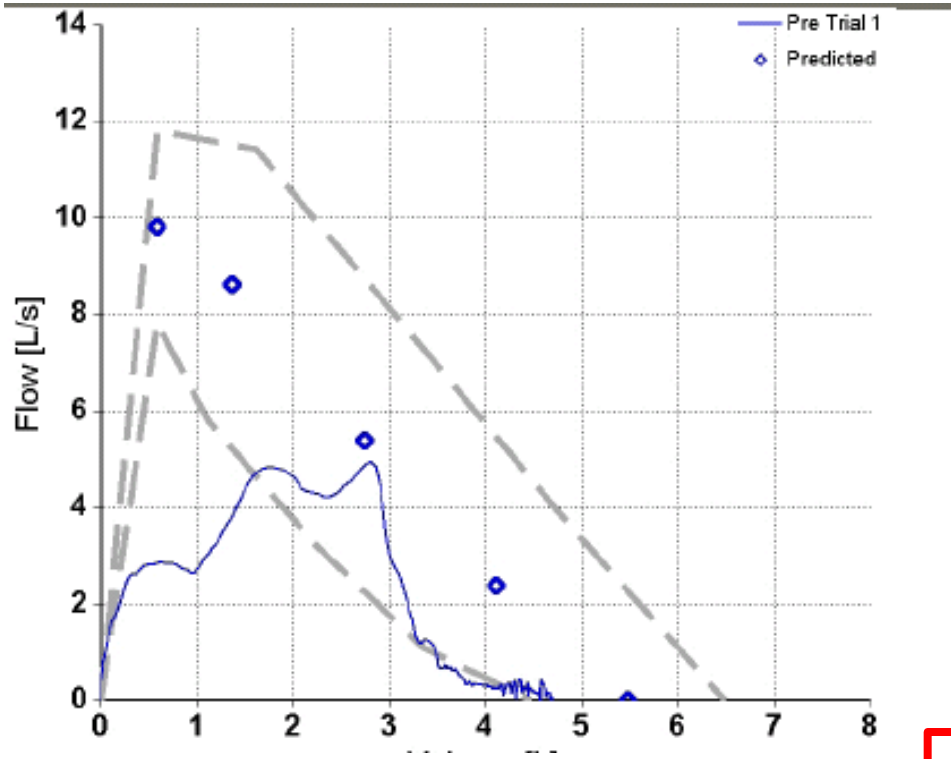

10
8
6
4
2
0
-2
-4
-6
-8
1
2
3
4
5
Flow Rate (L/s)
Volume (L)

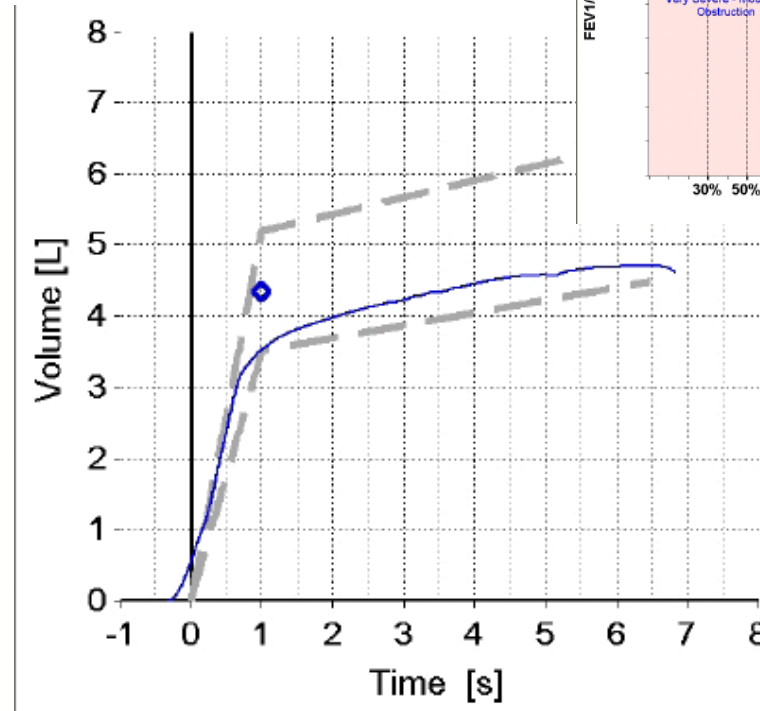

6
5
4
3
2
1
0
1
2
3
4
5
6
Volume (L)
Time (s)

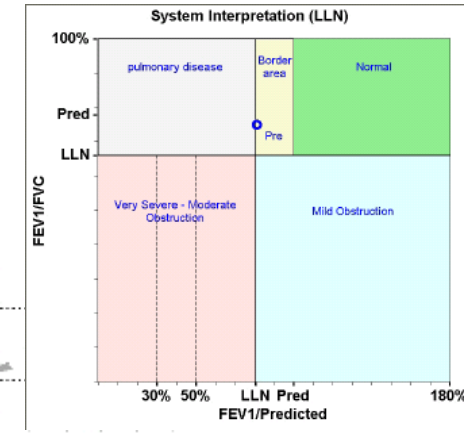
Pitfalls of spirometry

- 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

Spirometry - Examples







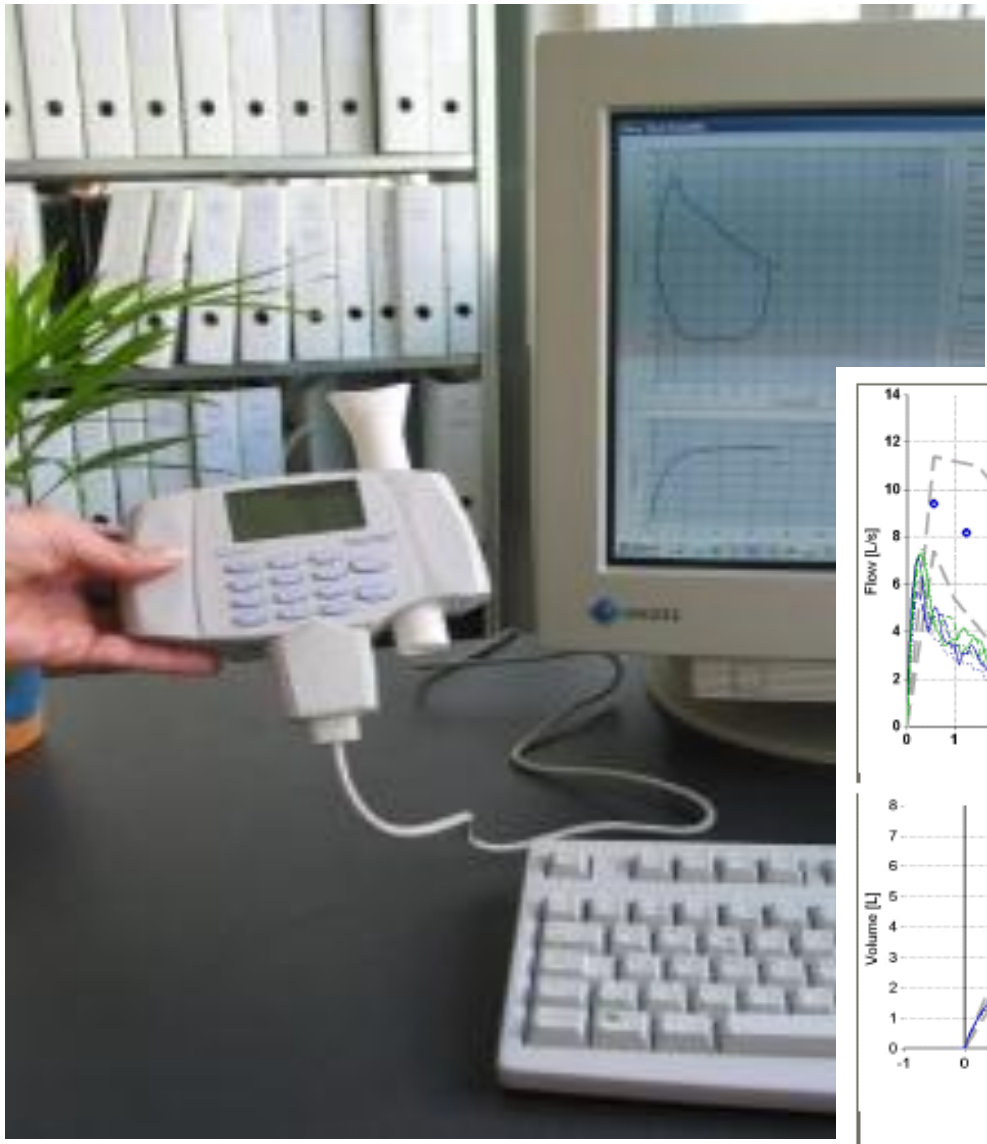
Parameter	Pred	LLN	Pre Best	Trial 1	%Pred
FVC [L]	5.48	4.48	4.70	4.70	86
FEV1 [L]	4.34	3.50	3.53	3.53	81
FEV1/FVC	0.778	0.660	0.750	0.750	96
FEF25-75% [L/s]	4.23	2.52	3.04	3.04	72

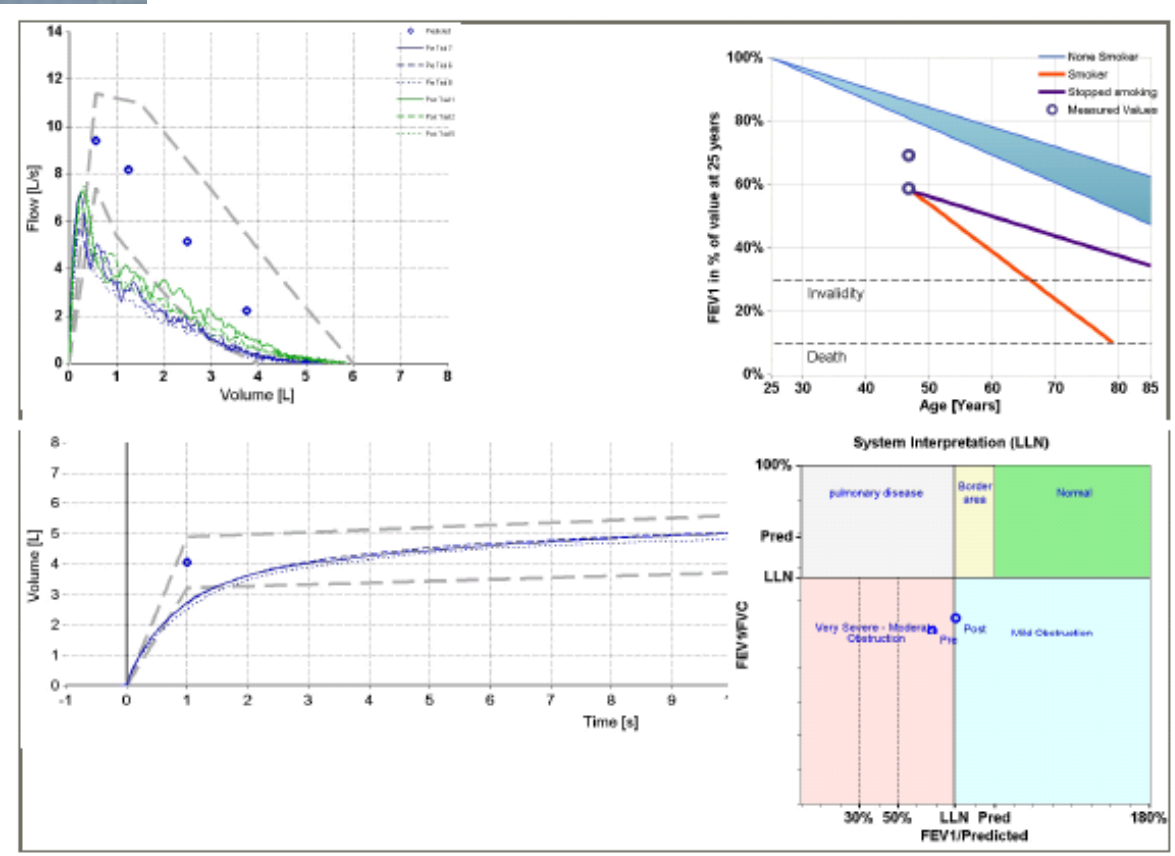
Session Quality F

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

Spirometry and lung age





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

Risk assessment - lung age

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

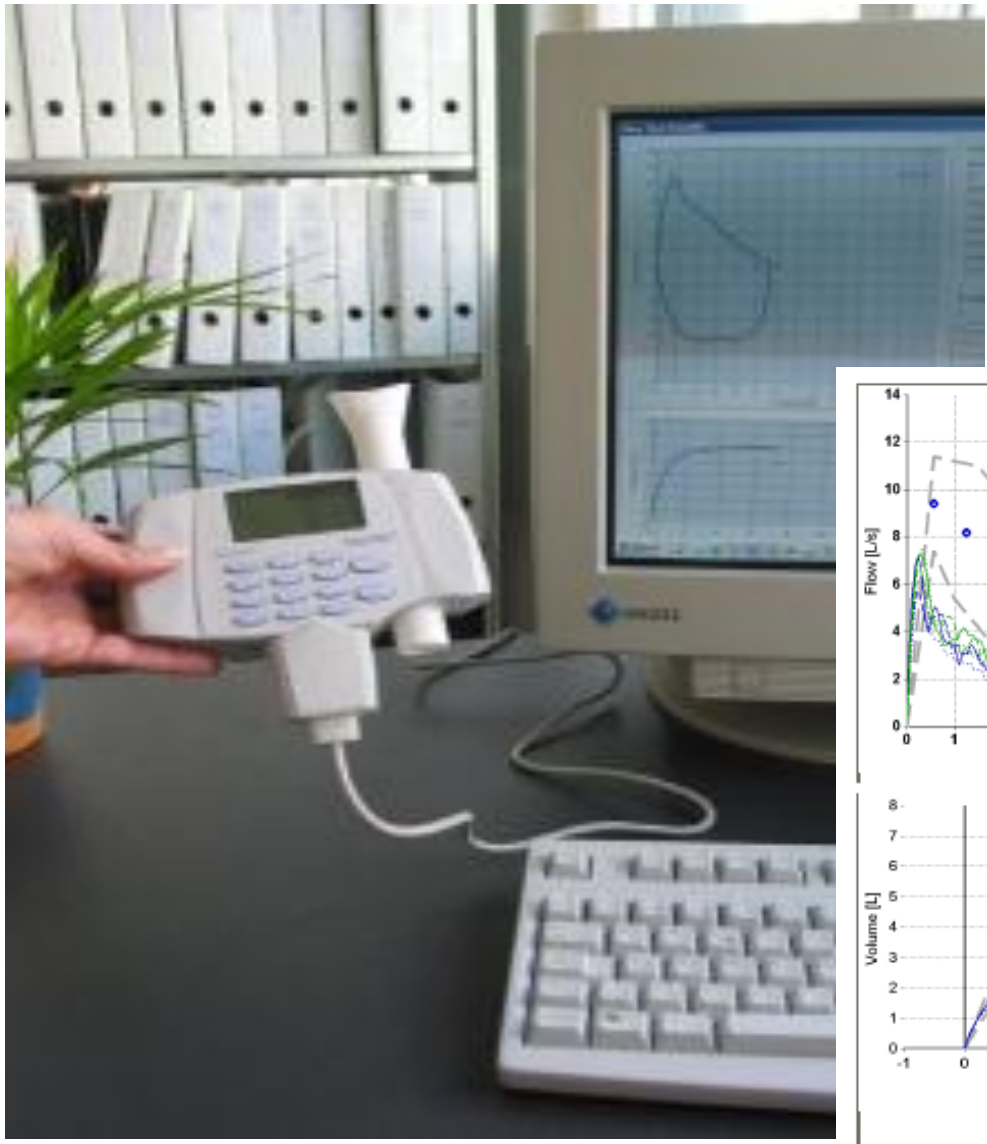
- Based on study in BMJ showing in a RCT the benefit of lung age over absolute FEV_1 showed a two fold increase in 1 year quit rates

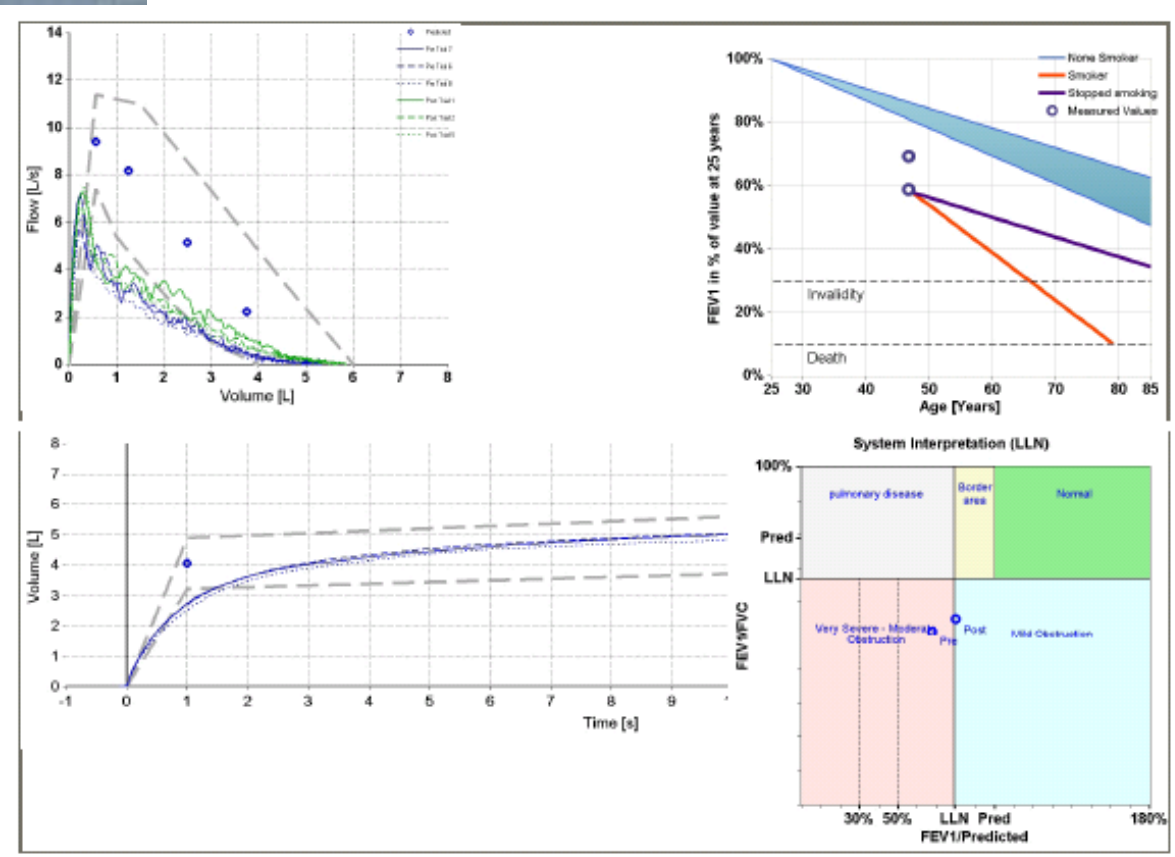
Spirometry as a tool for smoking cessation

Powerful educative tool

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

Spirometry, COPD and lung cancer

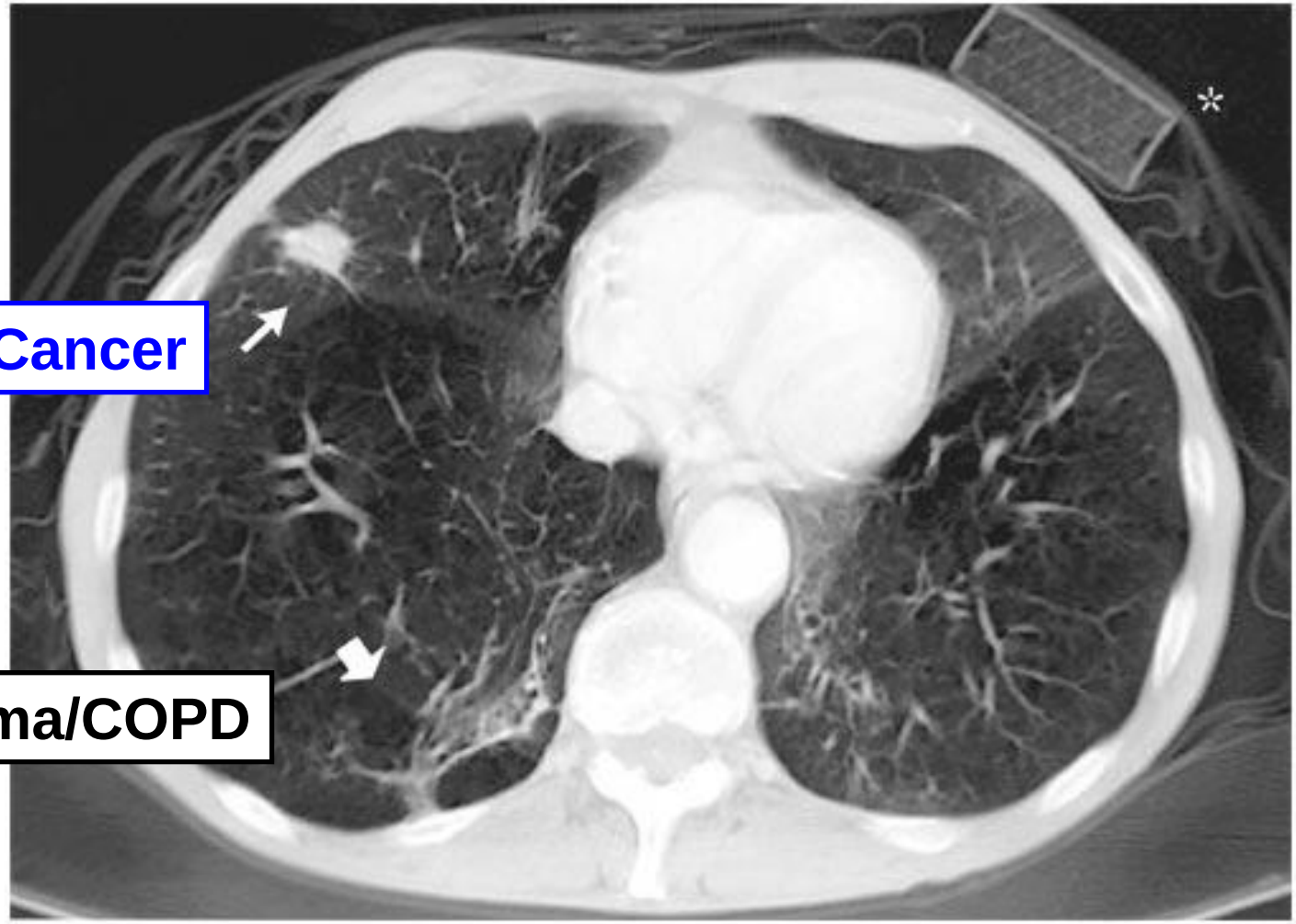




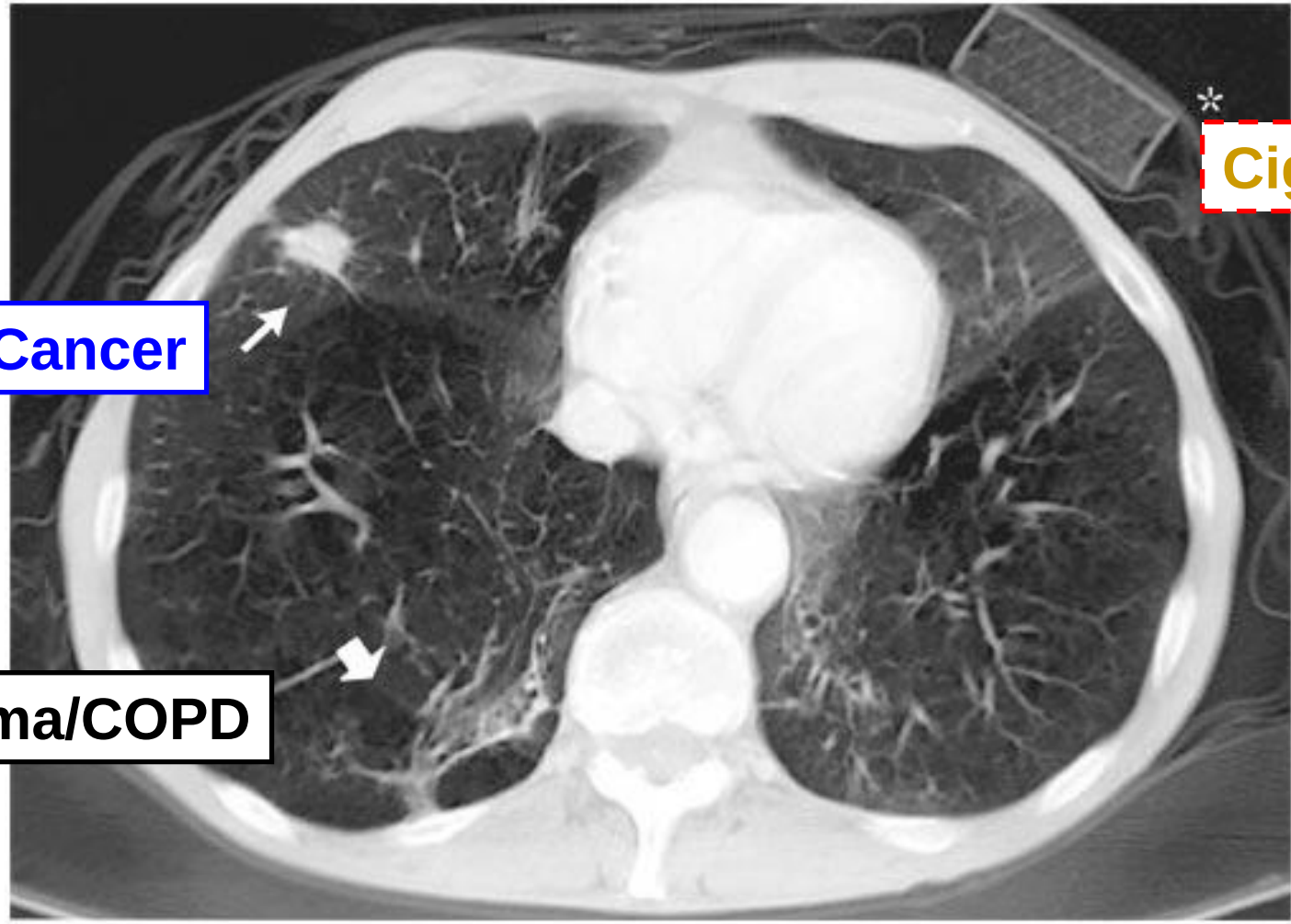
Lung cancer

- 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)

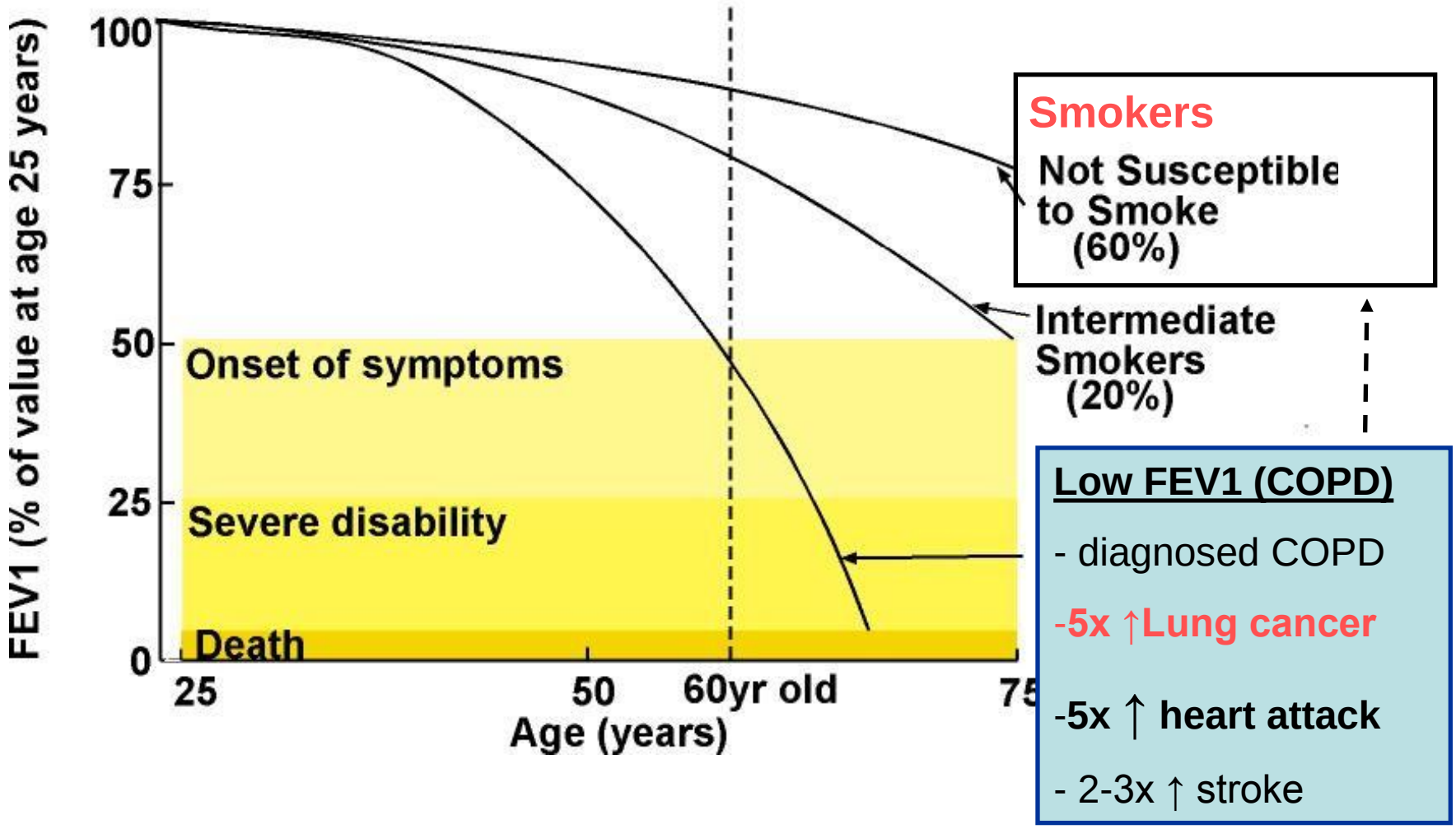
COPD and lung cancer- more than just the smoking?



COPD and lung cancer- more than just the smoking?



Reduced FEV_1: linked to all cause mortality



Lung Cancer and COPD

Risk factors for lung cancer

- Smoking implicated in 85-90% of cases
- Age – increasing risk after >45 yo
- COPD (reduced FEV_1) – **increases risk 4-6x**
- FHx of lung cancer – 2-3x

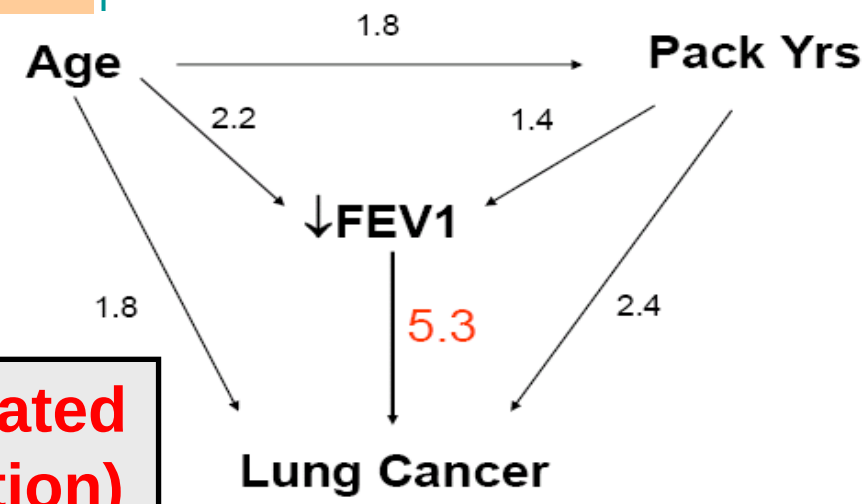
Critical observation 3#

- Aero-pollutant exposure - Asbestos, Radon, Coal
- Ethnicity, diet and gender effects

?Susceptibility to lung cancer mediated through COPD (genetic predisposition)

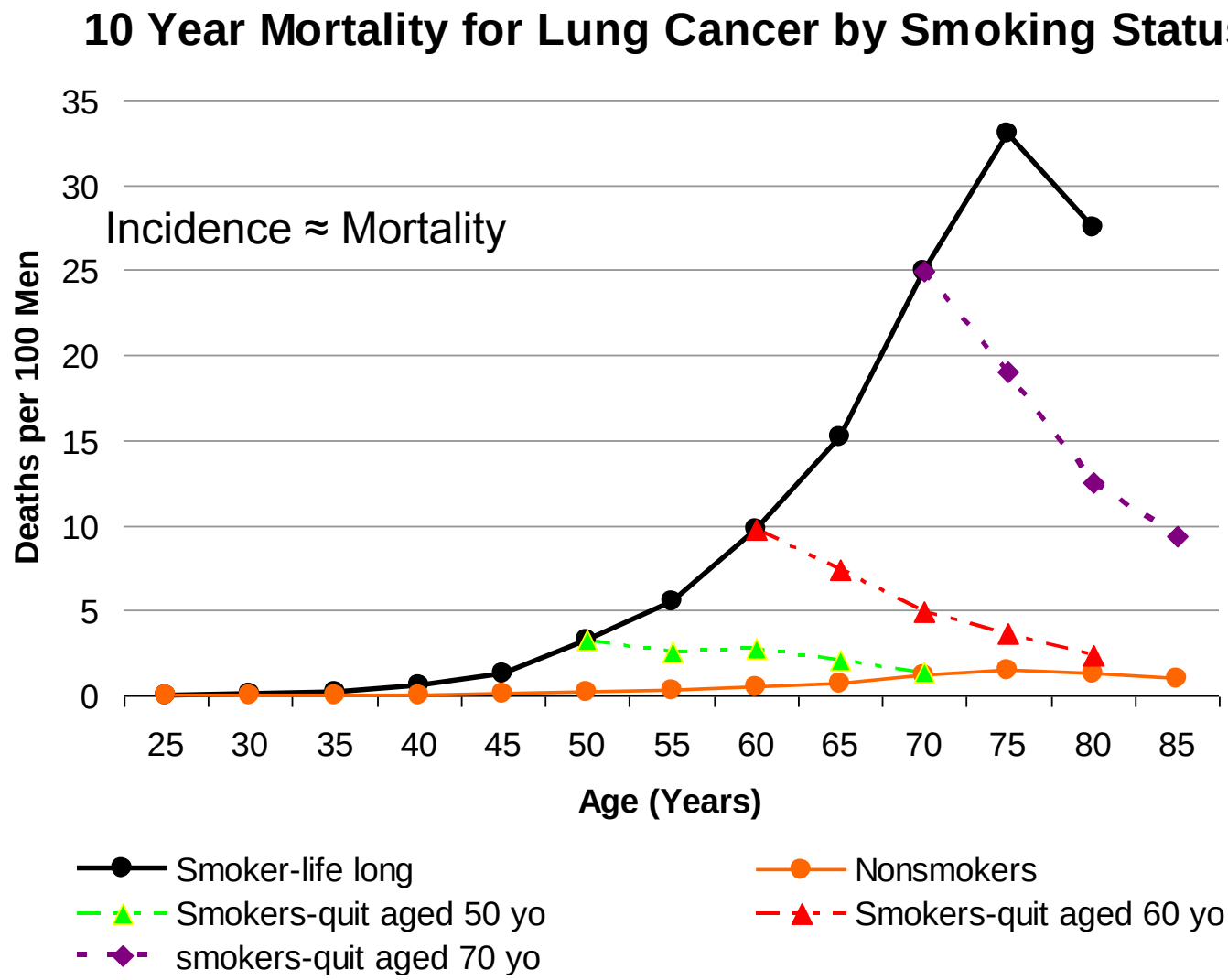
Lung cancer	
Age	RR 2.8
↓FEV1	RR 6.4
Pk yrs	RR 3.1

Univariate Analysis



Multivariate Analysis

Age: Lung cancer risk increases with age

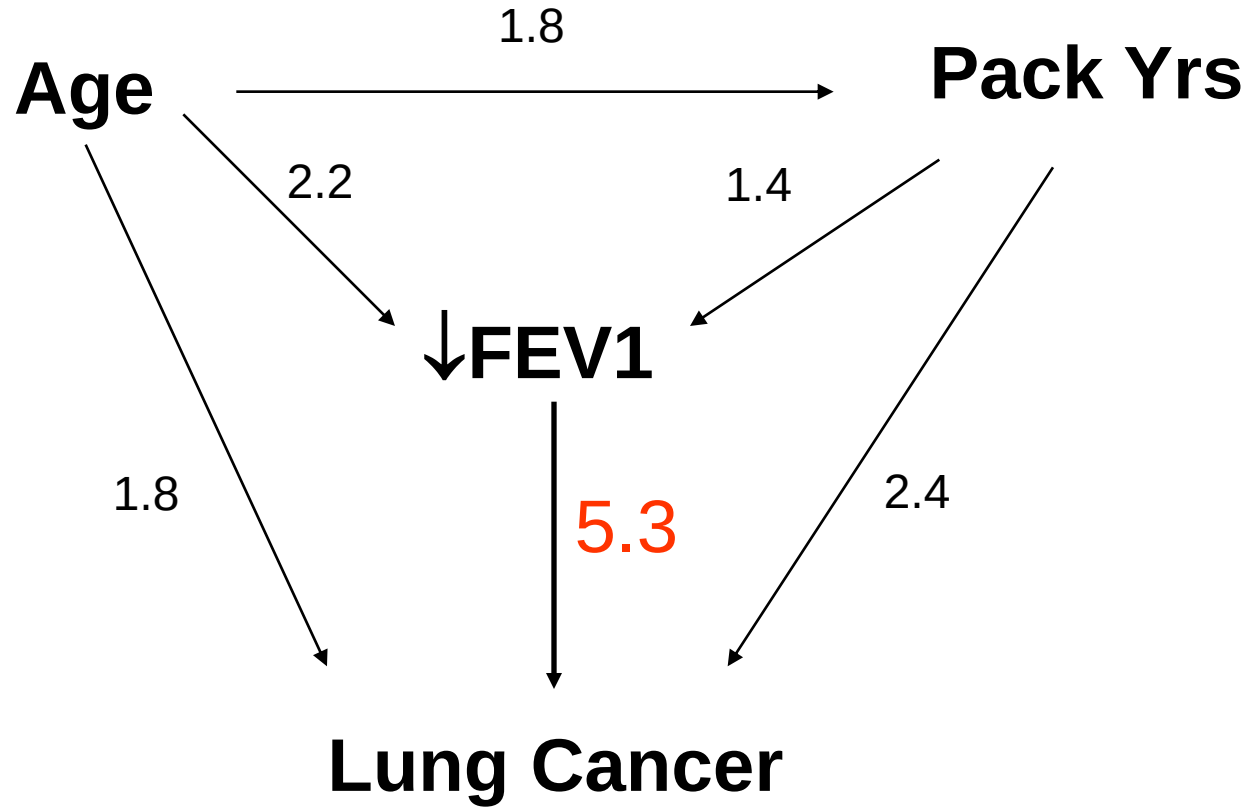


Lung Function and Lung Cancer

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**



Prevalence of COPD in lung cancer series

Author	N	% COPD	% emphysema
		(GOLD 1+)	(CT evidence)
De Torres et al - CT	23	70%	74%
Wilson et al - CT	99	67%	75%
Young et al*	**446**	**65%**	**ND**
Loganathan et al.	256	68%	ND

- **COPD prevalence unchanged by cancer stage, histology or presence of lung cancer**
- **COPD prevalence was 15% in a smoking control group matched for age, gender and pack yrs**

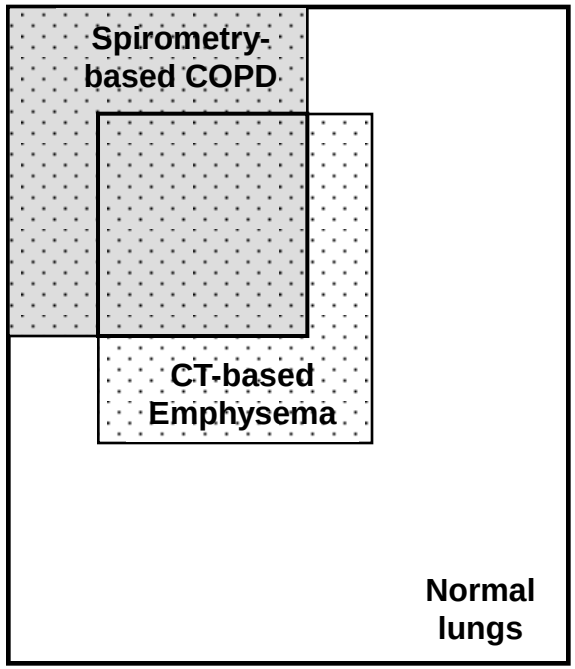
***Eur Respir J 2009; 34: 380-386**

Critical observation 4#

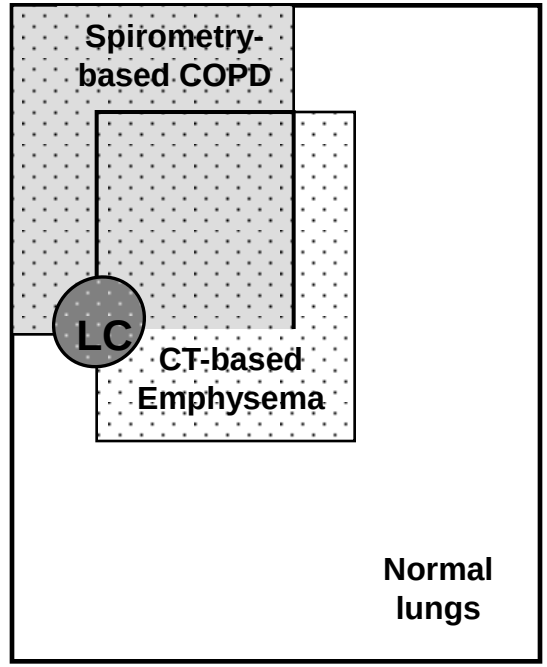
Eur Respir J 2012; 40: 1063–1064
DOI: 10.1183/09031936.00070012

CORRESPONDENCE

Diagnosing COPD and targeted lung cancer screening

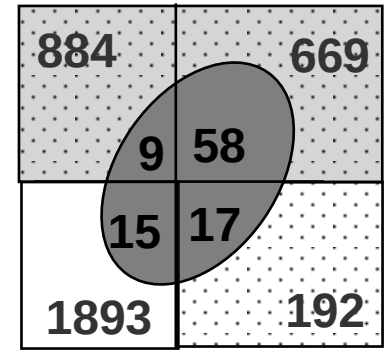


CT screen population

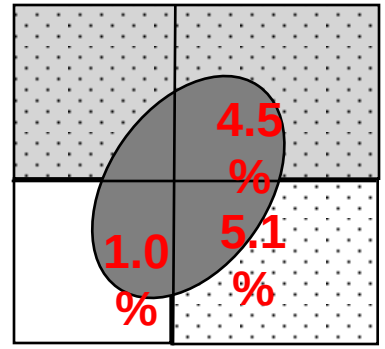


CT detected lung cancer

Absolute numbers



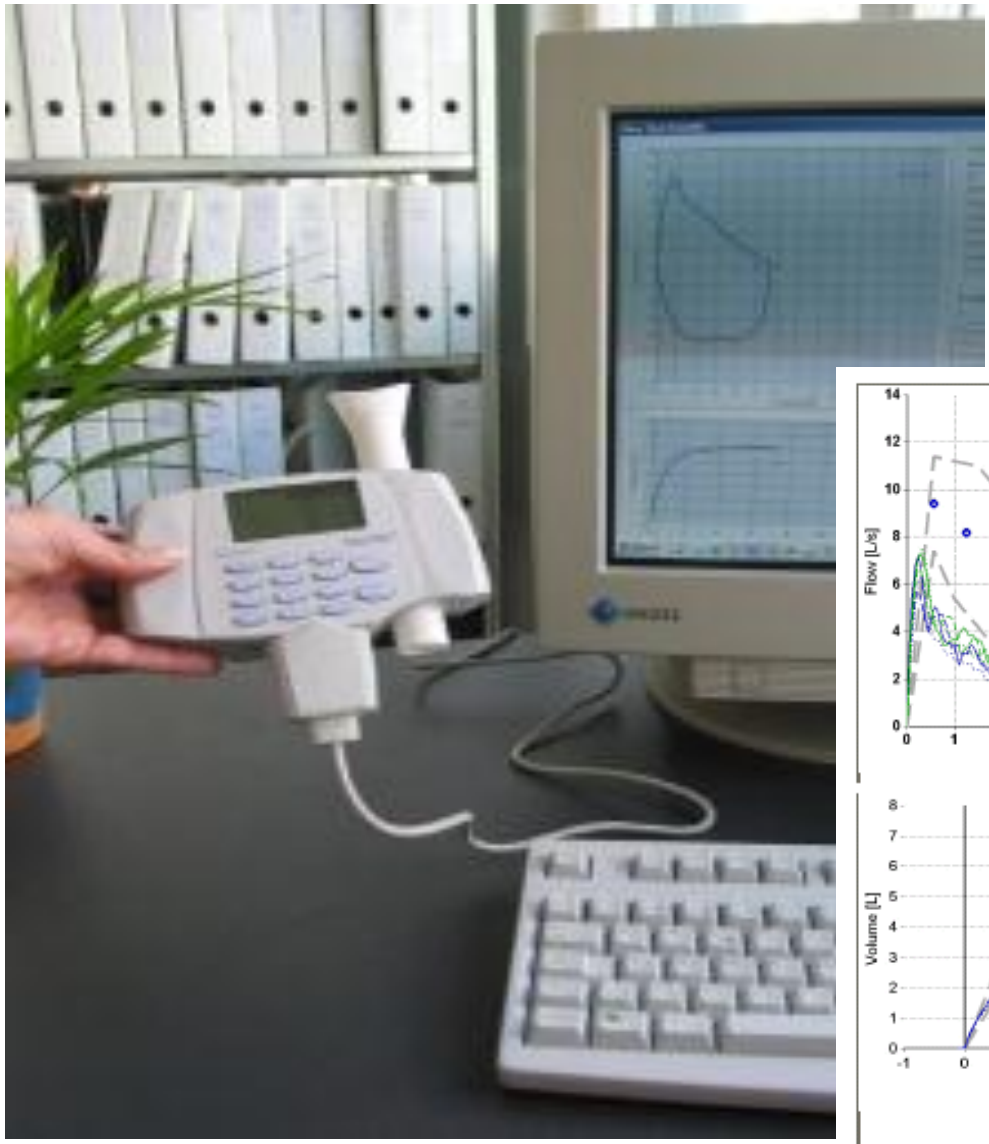
Lung cancer rates*



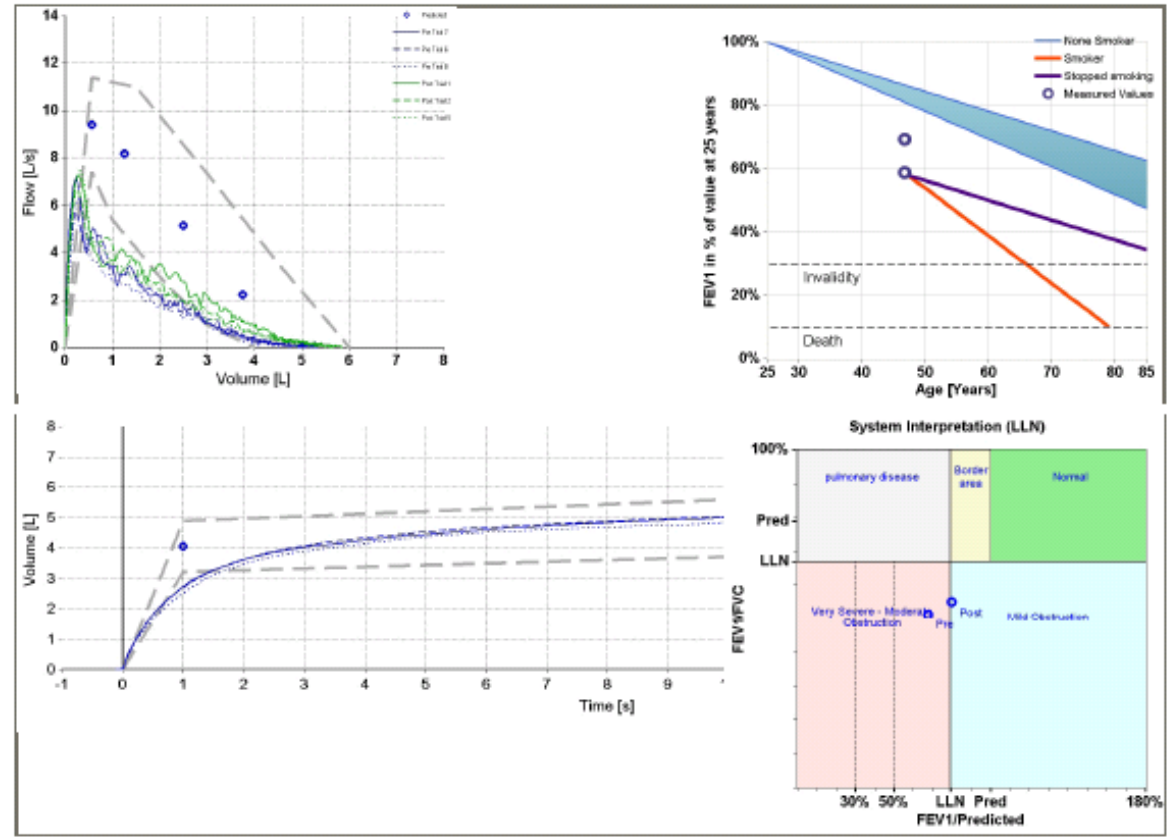
Lung Cancer detection

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



Spirometry, COPD and Coronary artery disease

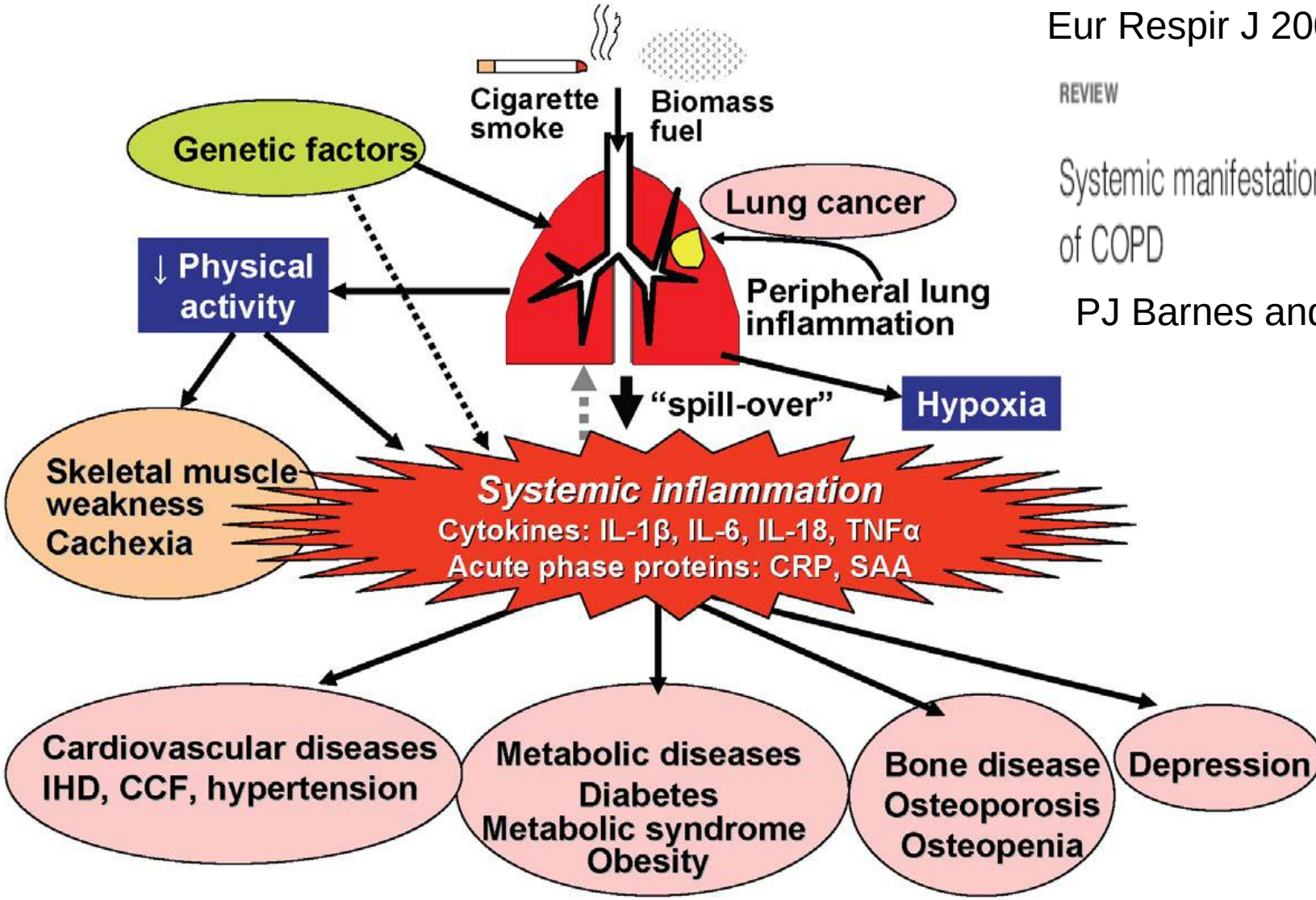


Eur Respir J 2009; 33: 1165-85.

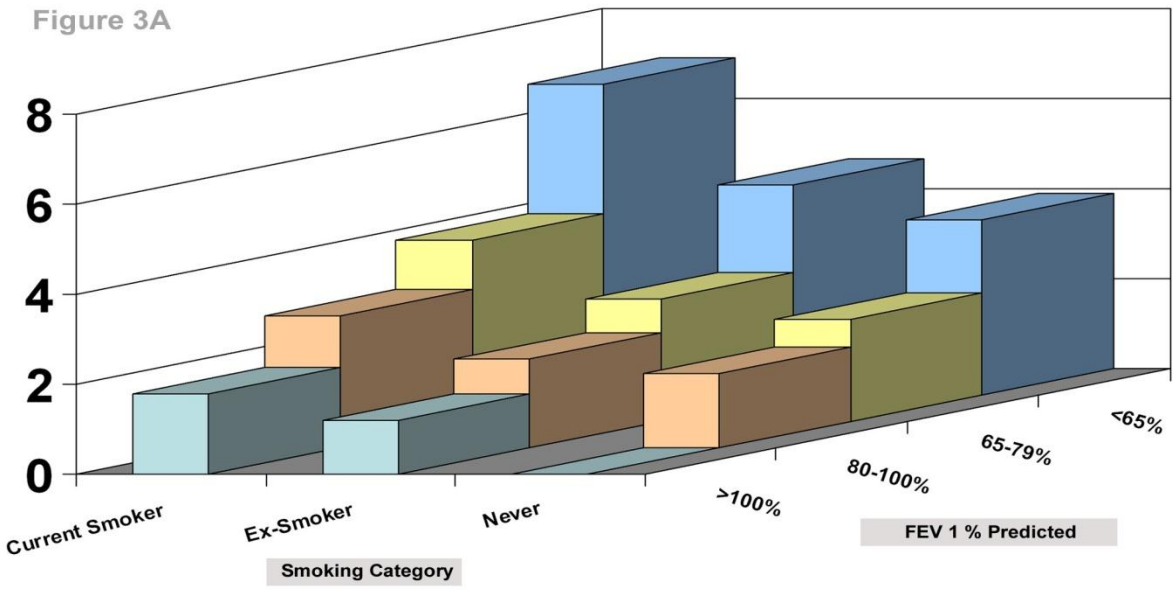
REVIEW

Systemic manifestations and comorbidities of COPD

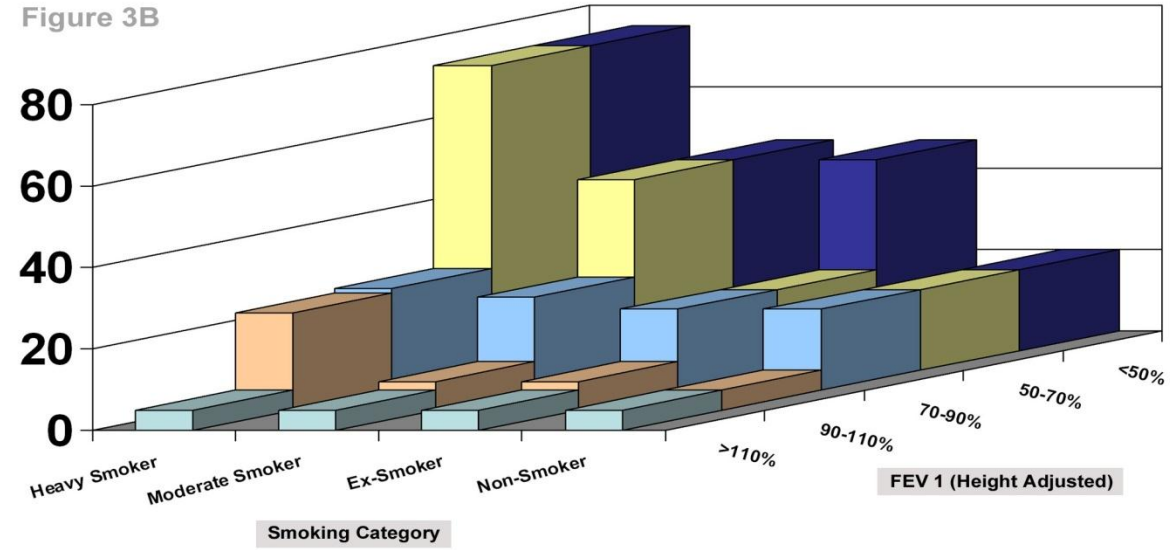
PJ Barnes and BR Celli



CAD mortality



All cause mortality



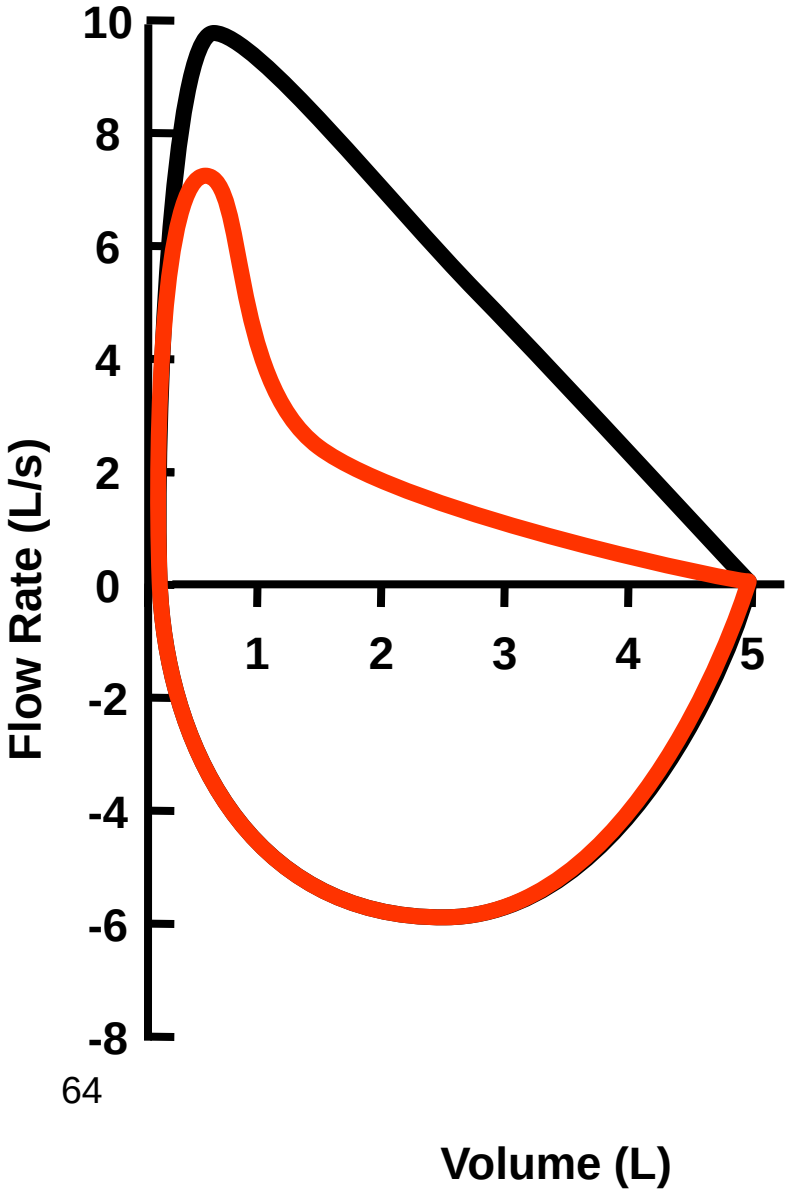
↓FEV_1 and mortality

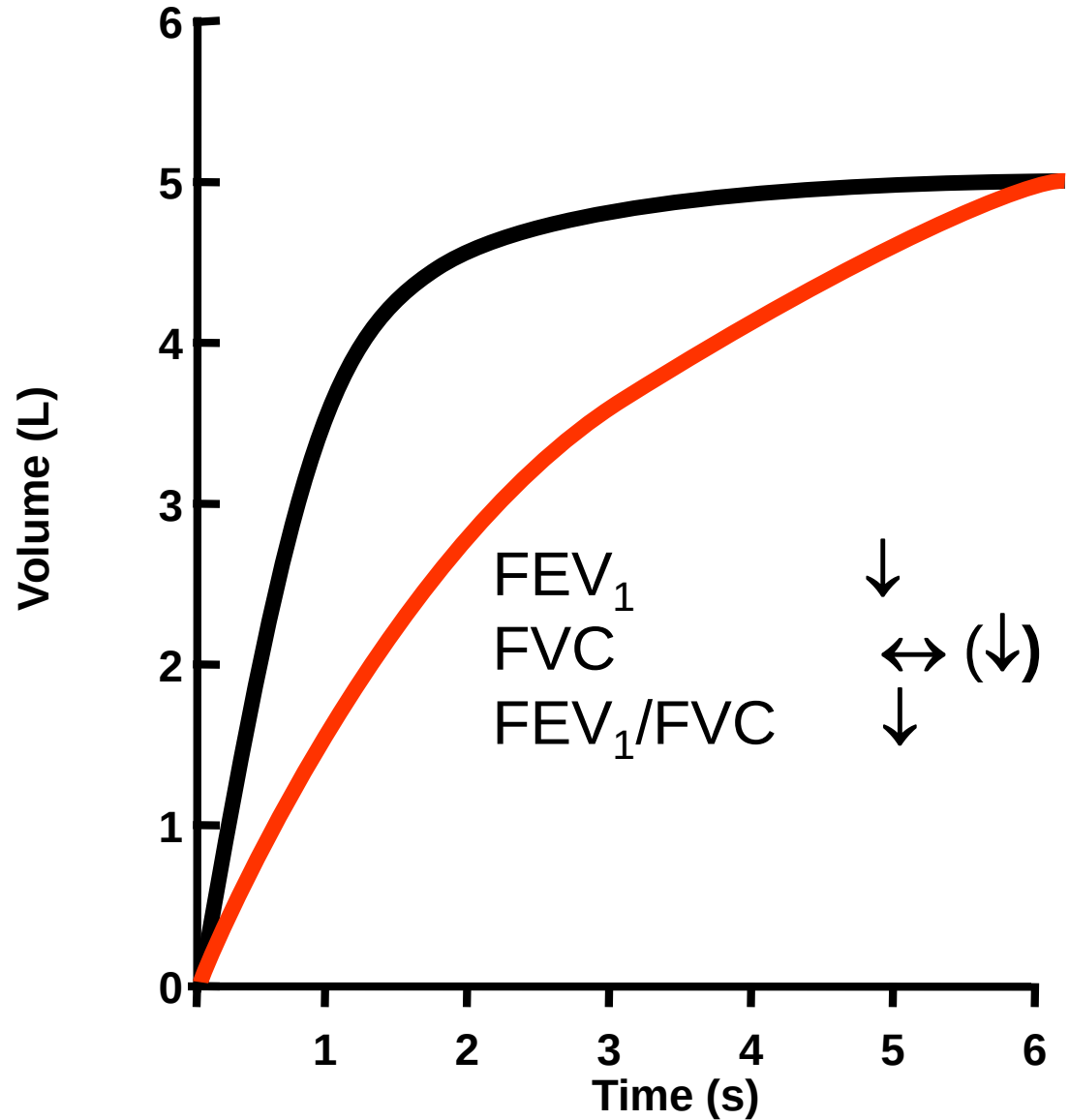
- predicts CAD and all cause mortality
- independent of smoking status
- additive with smoking status

Young et al. ERJ 2007

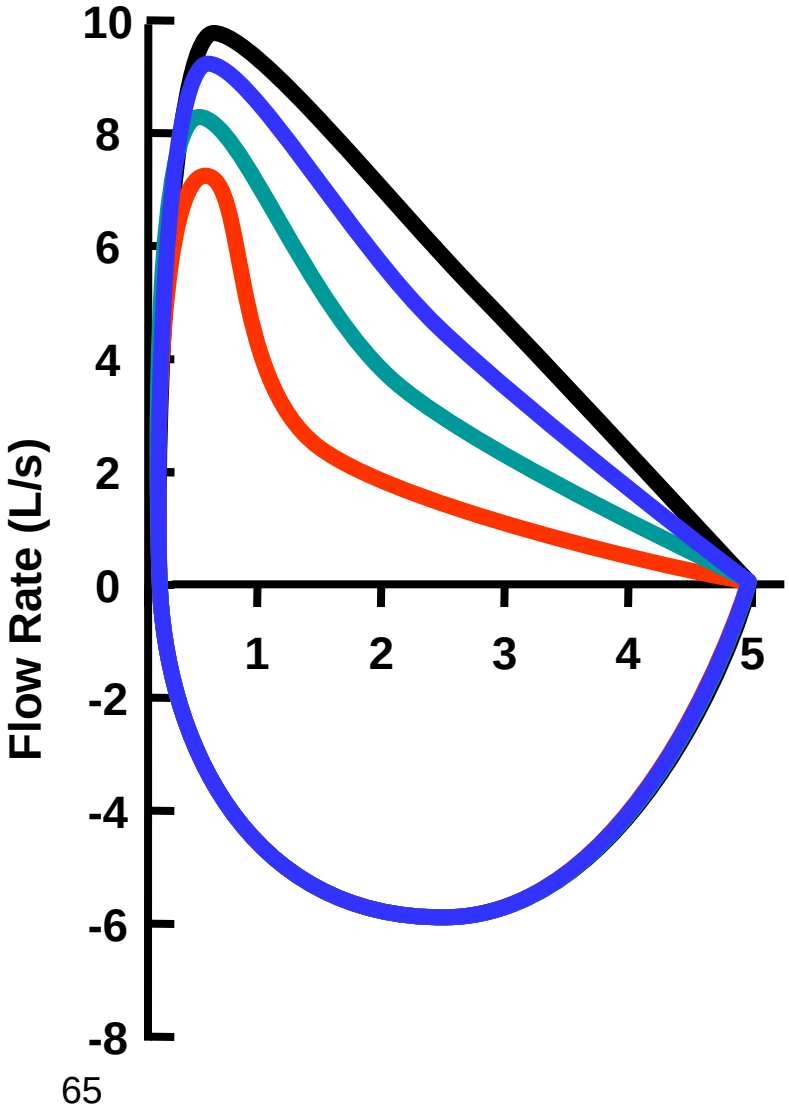
Asthma vs COPD

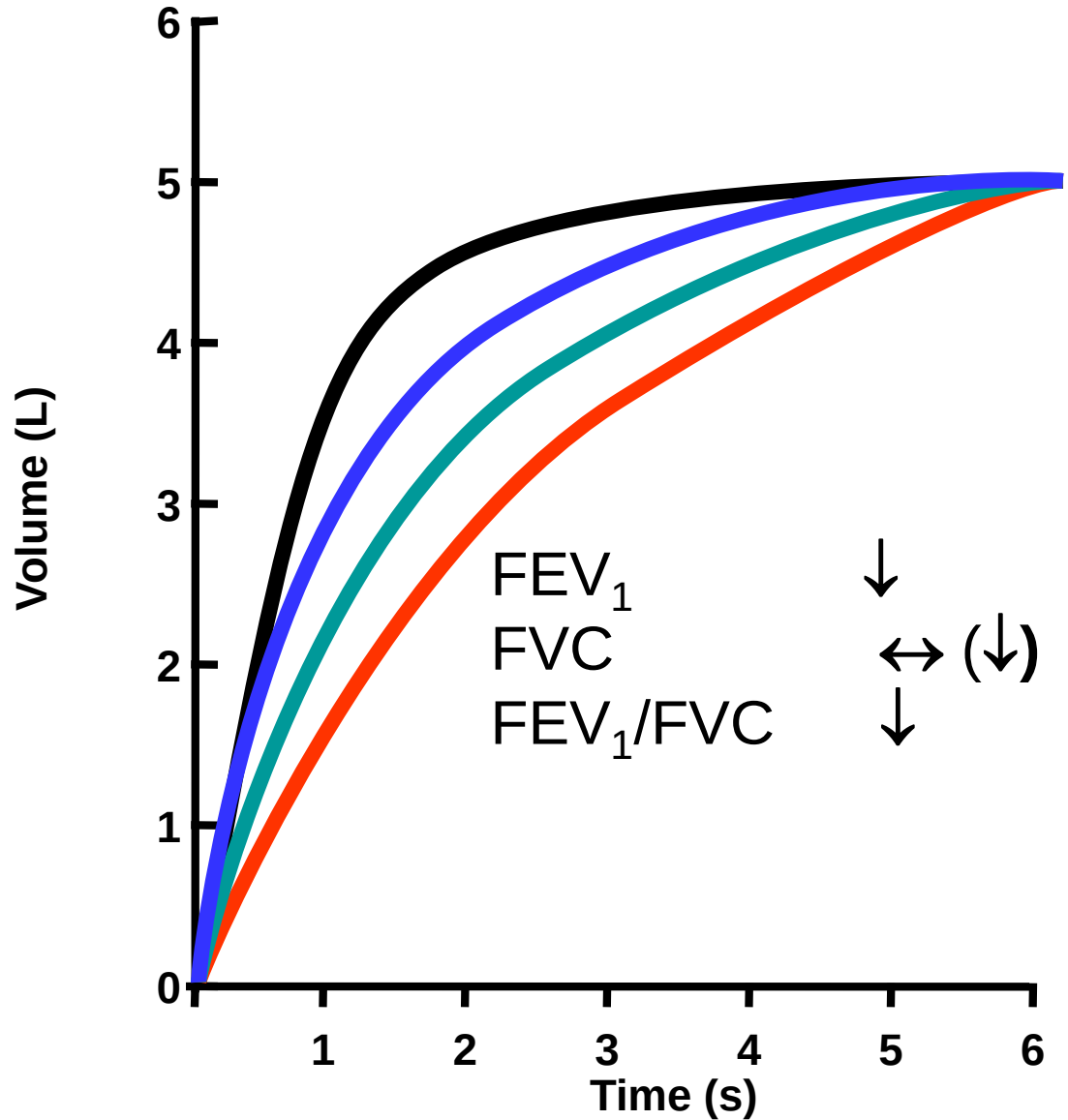
Spirometry: Obstructive





Obstruction – with reversibility

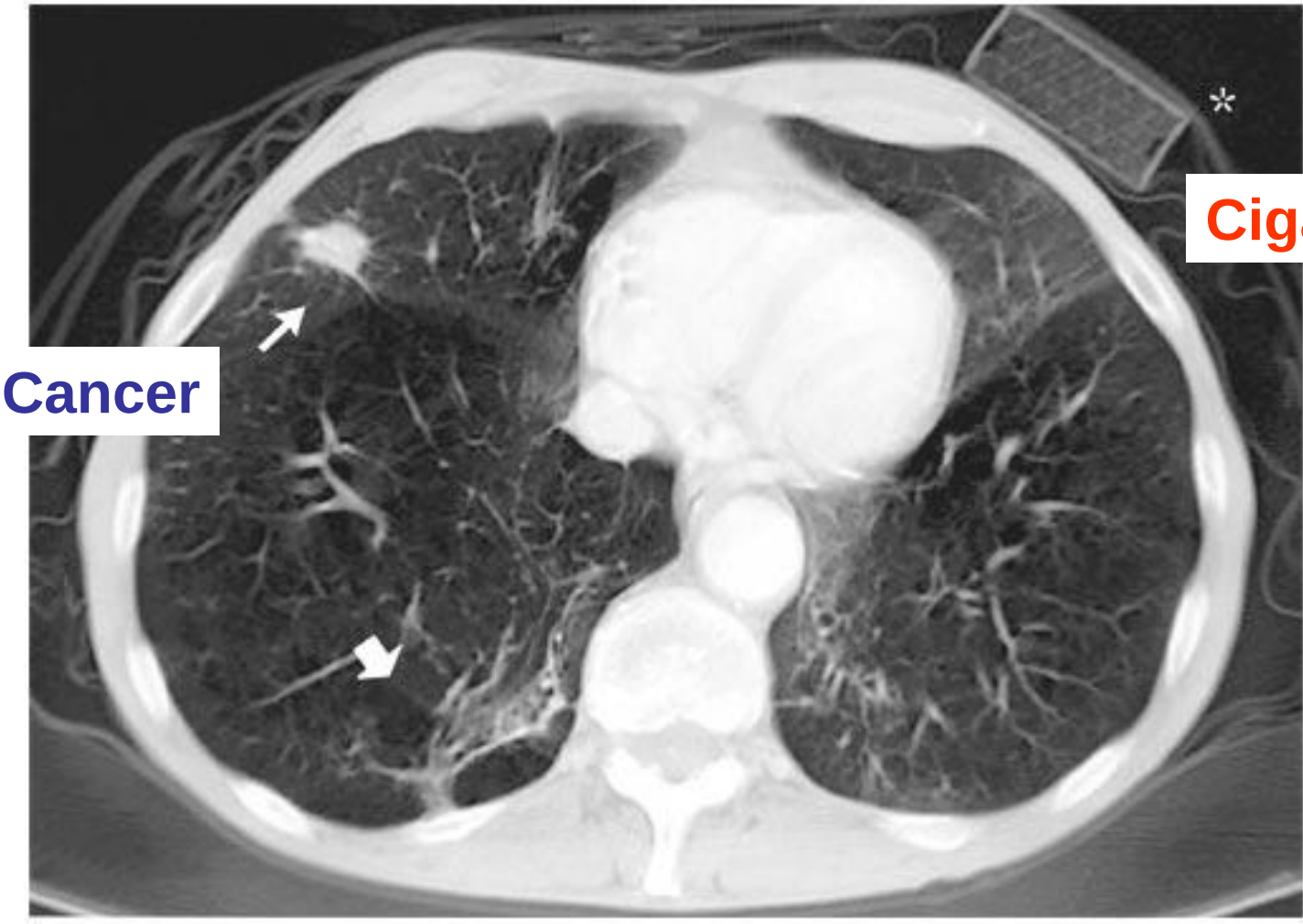




Treatment implications: asthma vs COPD

- 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)

Smoking and lung disease



Lung Cancer

Cigarettes