

Lung Physiology Masterclass

Josh Burrough BSc (Hons), MPhil, MSc.

Highly Specialist Respiratory Clinical Scientist

Honorary Lecturer – Manchester Academy for
Healthcare Scientist Education (MAHSE)

North West Lung Centre – Wythenshawe Hospital

Manchester University NHS Foundation Trust





In this talk...

Excuse me
doctor

So what is a Respiratory

No Nurse



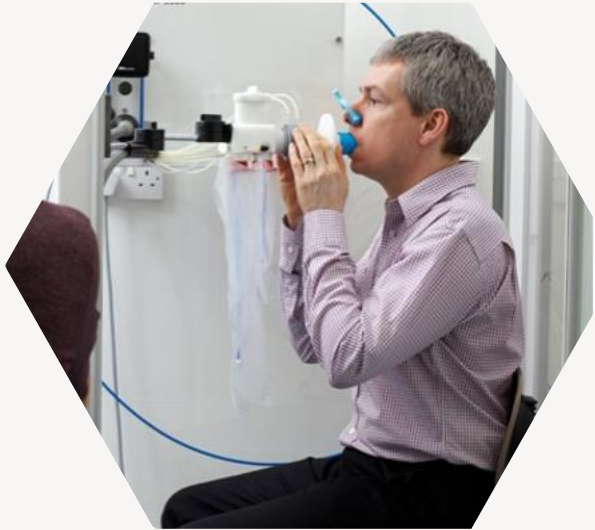
You're
one of
ever me

work in a
atory then?



What is a Physiologist/Clinical Scientist?

A day in the life...



Basic Lung Function Testing

Diagnostics
Monitoring

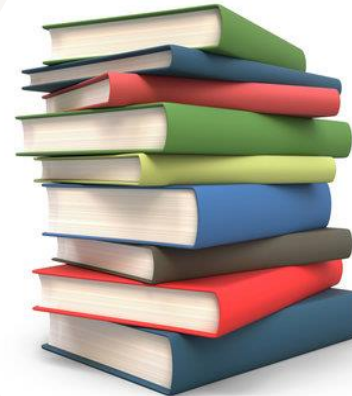


Advanced Lung Function Testing

Flight Assessments

O2 Assessments

Cardiopulmonary Exercise Testing



Audit/Quality Improvement

Accuracy of Testing

Implementing new guidelines



Teaching / Education

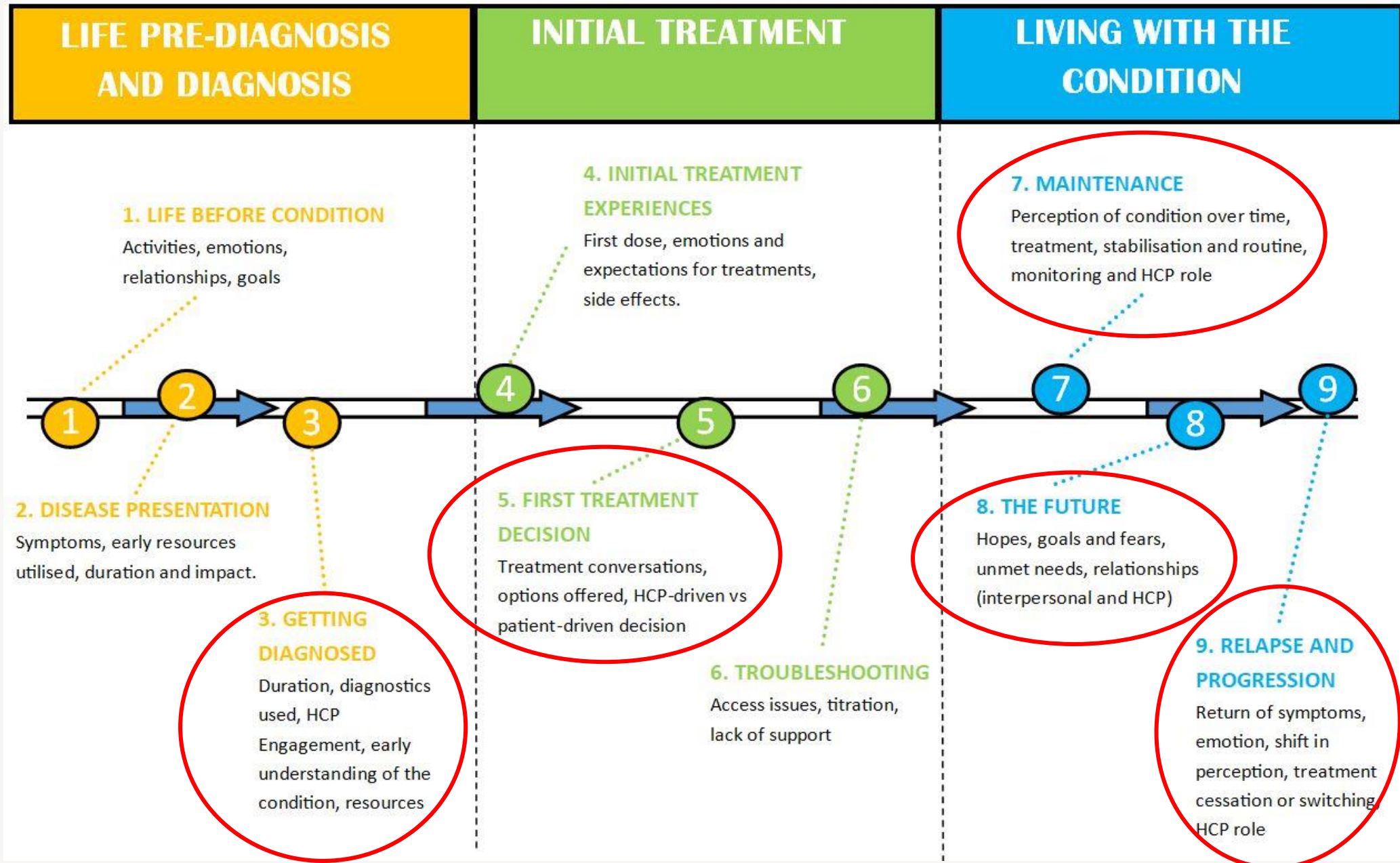
Junior staff

University Lecturing

Outreach

Trust wide

INVOLVEMENT IN THE TYPICAL ILD PATIENT PATHWAY



Core Lung Function Assessments in the ILD Patient



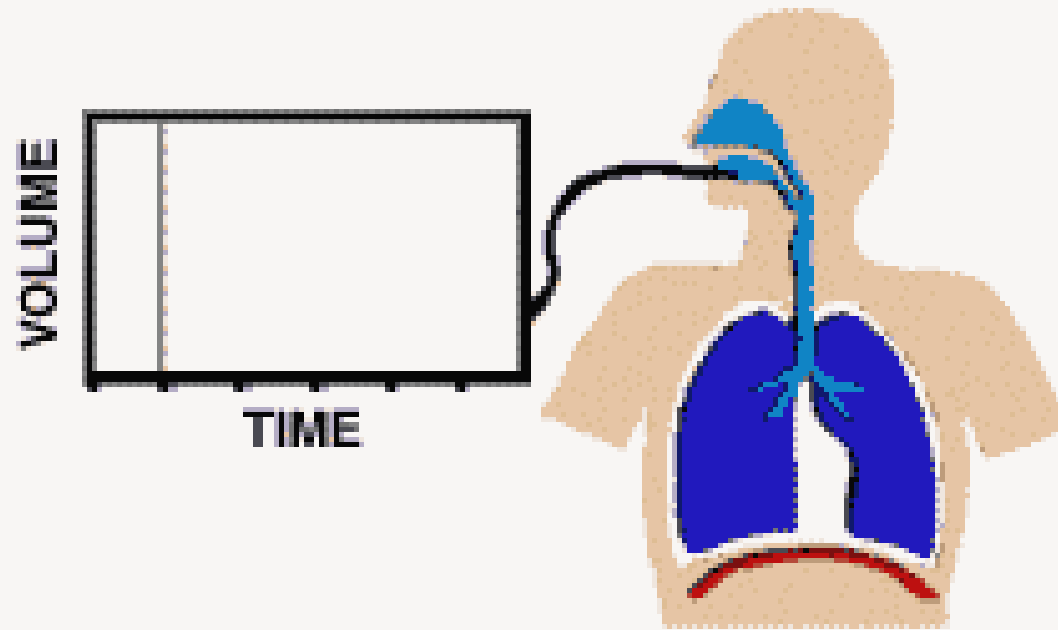
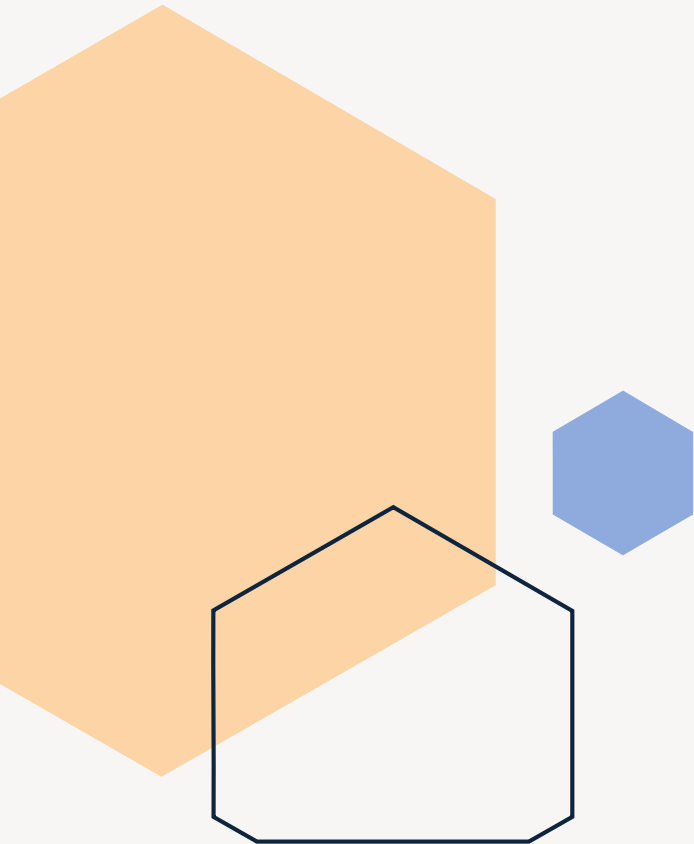
Spirometry

Lung capacity and
airways obstruction

Gas Transfer

Efficiency of gas
exchange

Spirometry



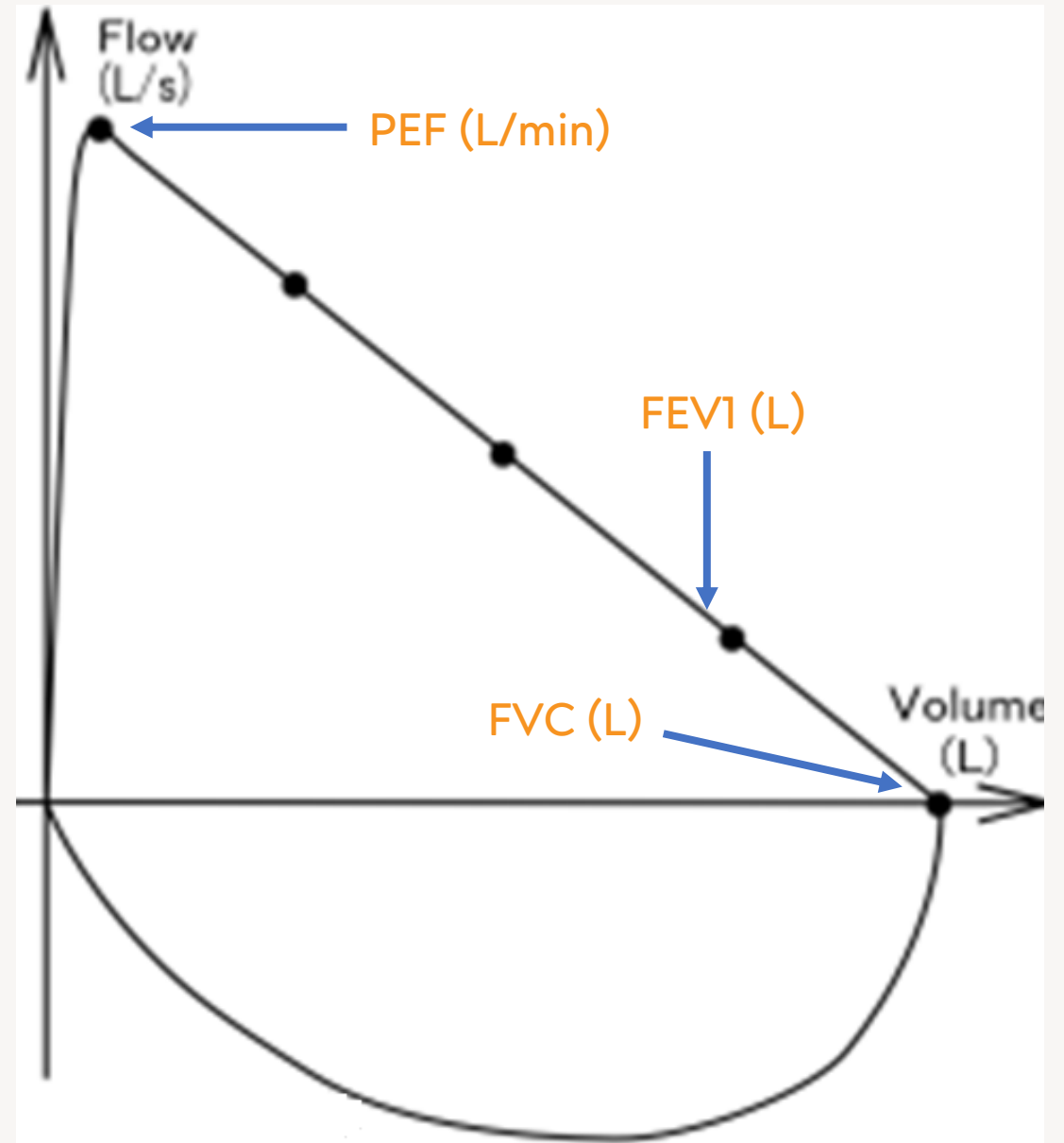
Spirometry

Forced Expiratory Volume in 1 Second (FEV1): The amount of air that a person can force out of their lungs in the first second of a forced spirometry manoeuvre.

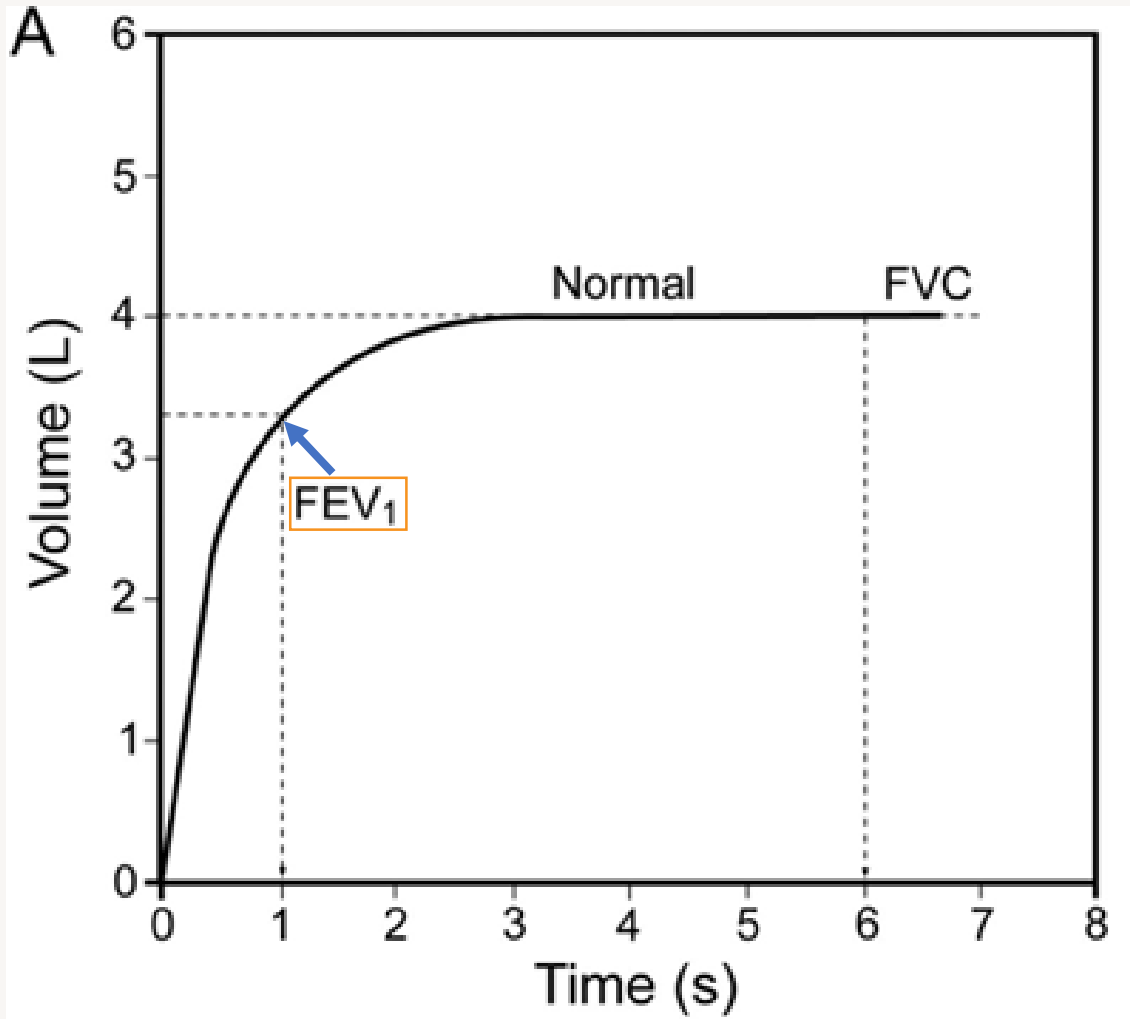
Forced Vital Capacity (FVC): The total amount of air exhaled at the end of a forced spirometry manoeuvre.

Peak Expiratory Flow (PEF): The maximum level of flow generated during a forced spirometry manoeuvre.

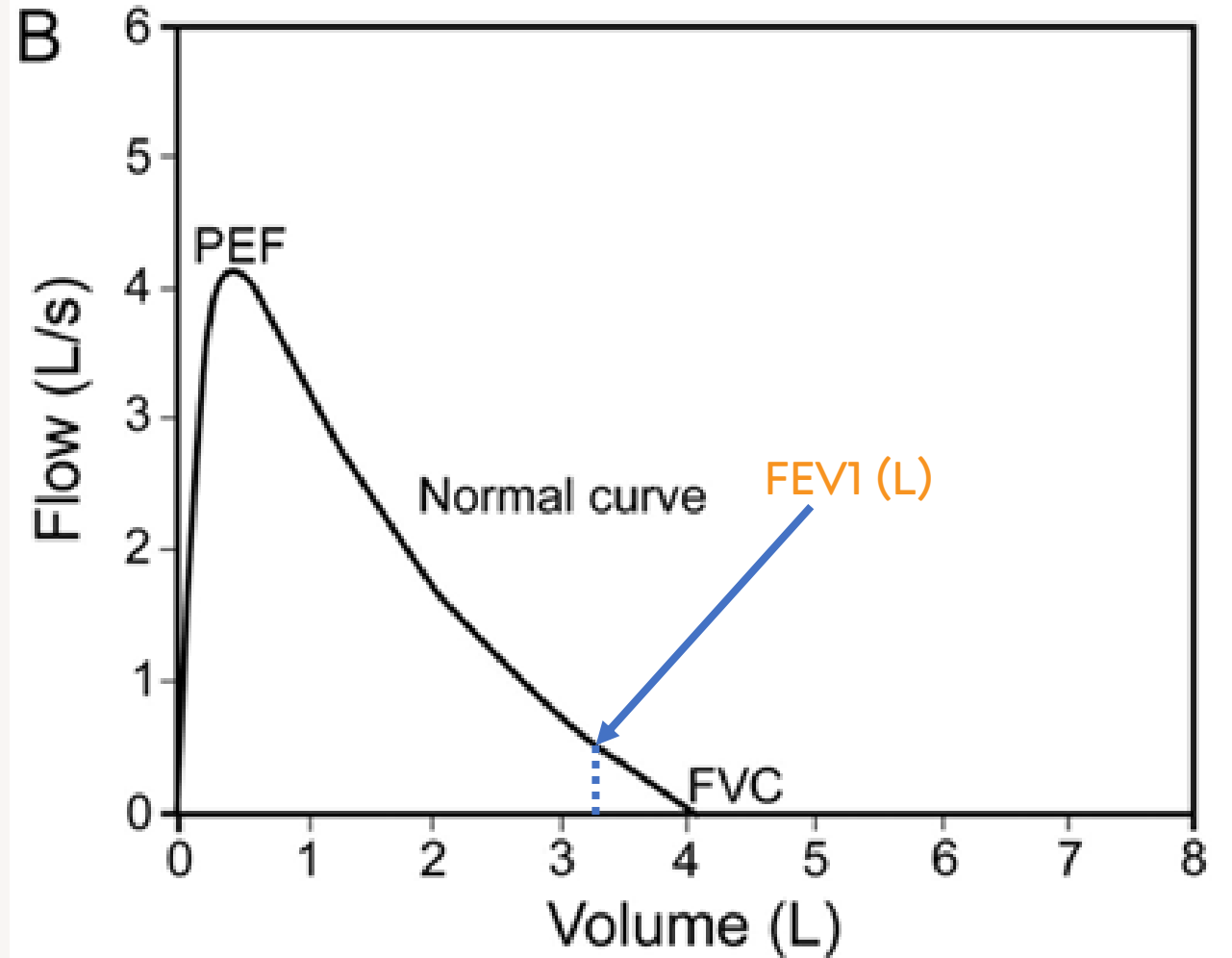
FEV1/FVC: Relationship between FEV1 and FVC



Spirometry



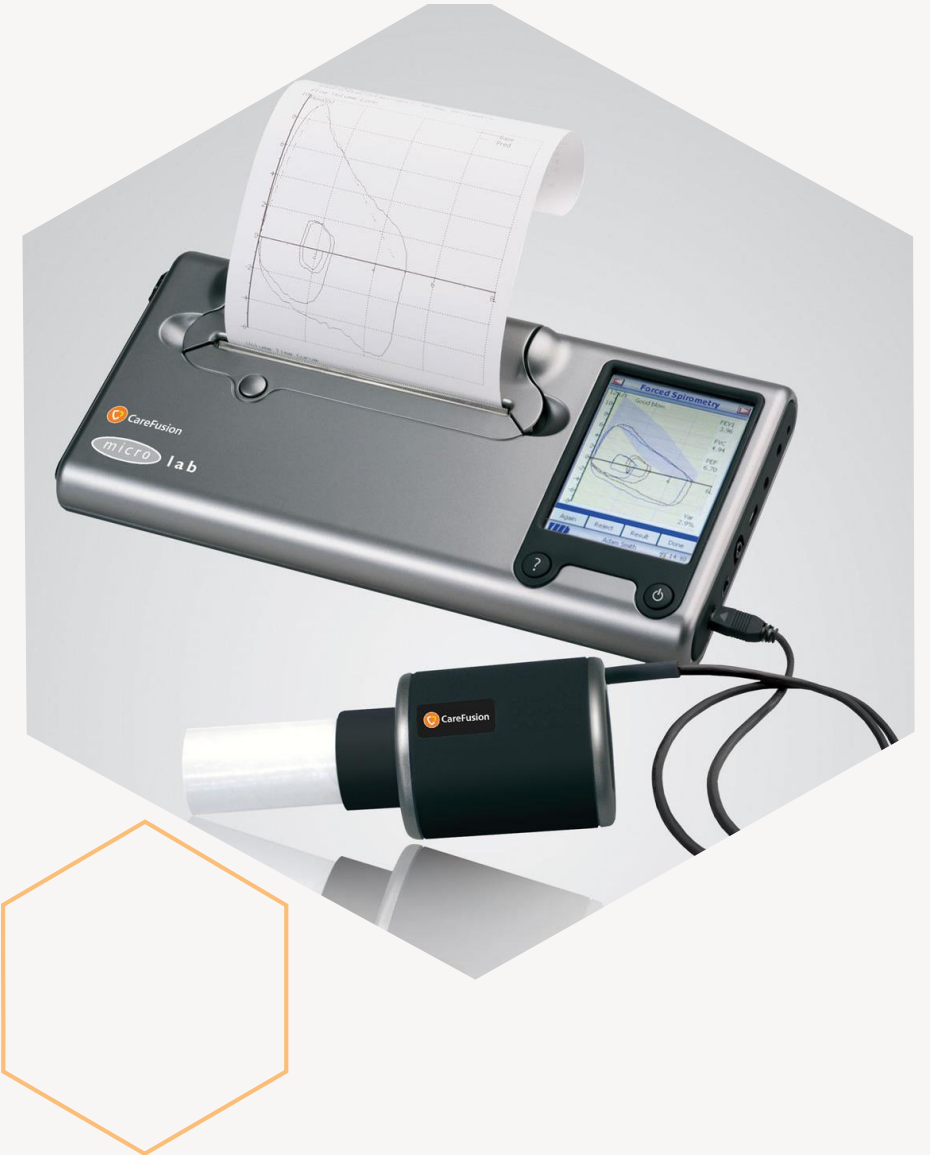
Volume-Time Curve



Flow-Volume Loop

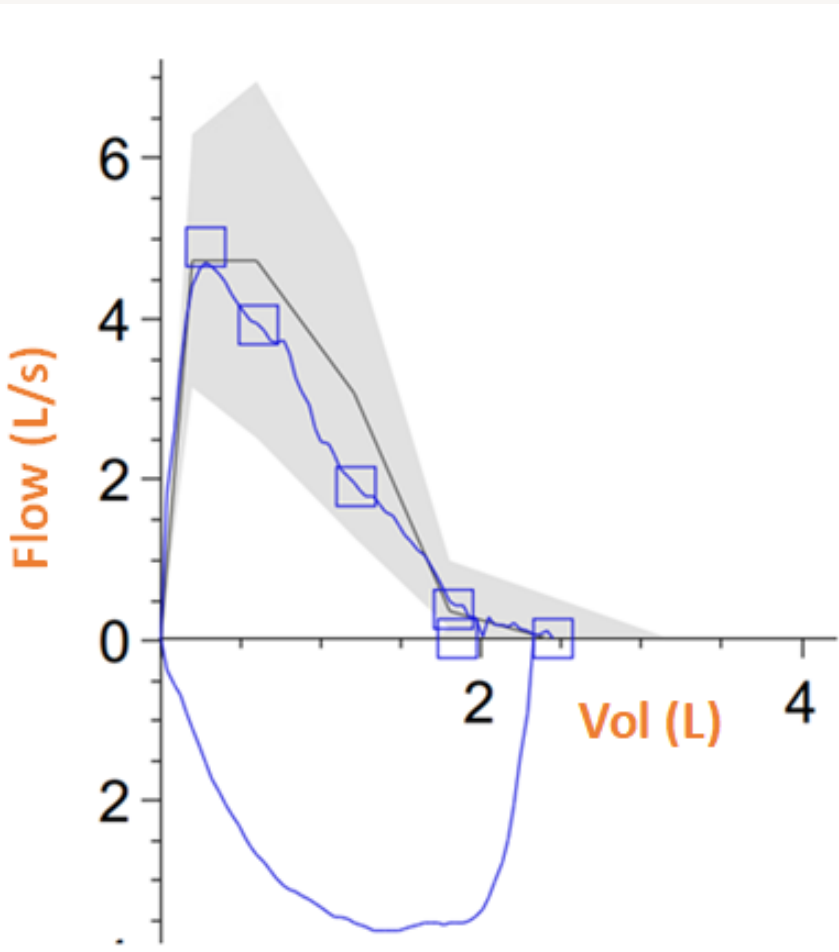
Why is Spirometry useful?

- Differentiate obstructive or restrictive (or both!) lung diseases
- Give the level of impairment a severity grading
- Monitor change in data over time
- Used as cut offs for prescribing/discontinuing medications such as anti-fibrotics.



When Spirometry indicates pathology...

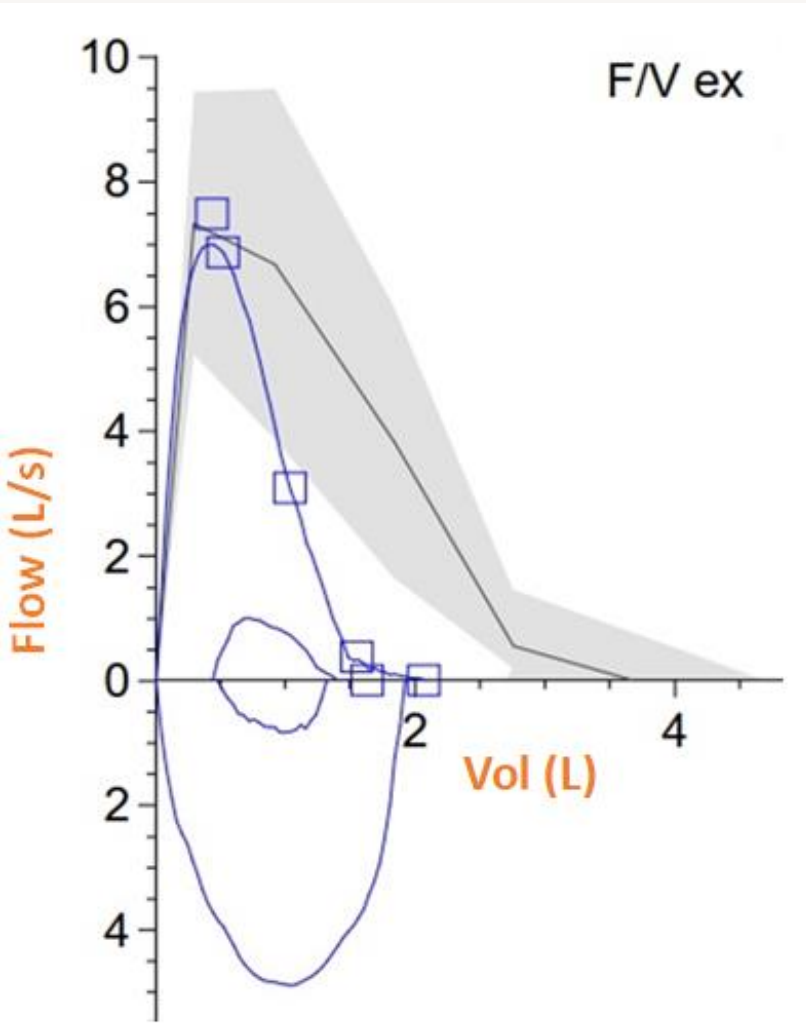
Normal Spirometry – Healthy patient



		Ref	Pre	%Pred	SR	Z-Score
Spirometry [BTPS] ref:GLI_2012						
FEV 1	L	1.84	1.85	100	0.02	-1
FVC	L	2.40	2.44	101	0.08	-1
VC MAX	L	2.40	2.44	101	0.08	-1
FEV 1 % FVC	%	77.59	75.96	98	-0.20	-1
FEV 1 % VC MAX	%	77.59	75.96	98	-0.20	-1
Flow Volume Loop						
PEF	L/min	282	293	104	0.19	-1

When Spirometry indicates pathology...

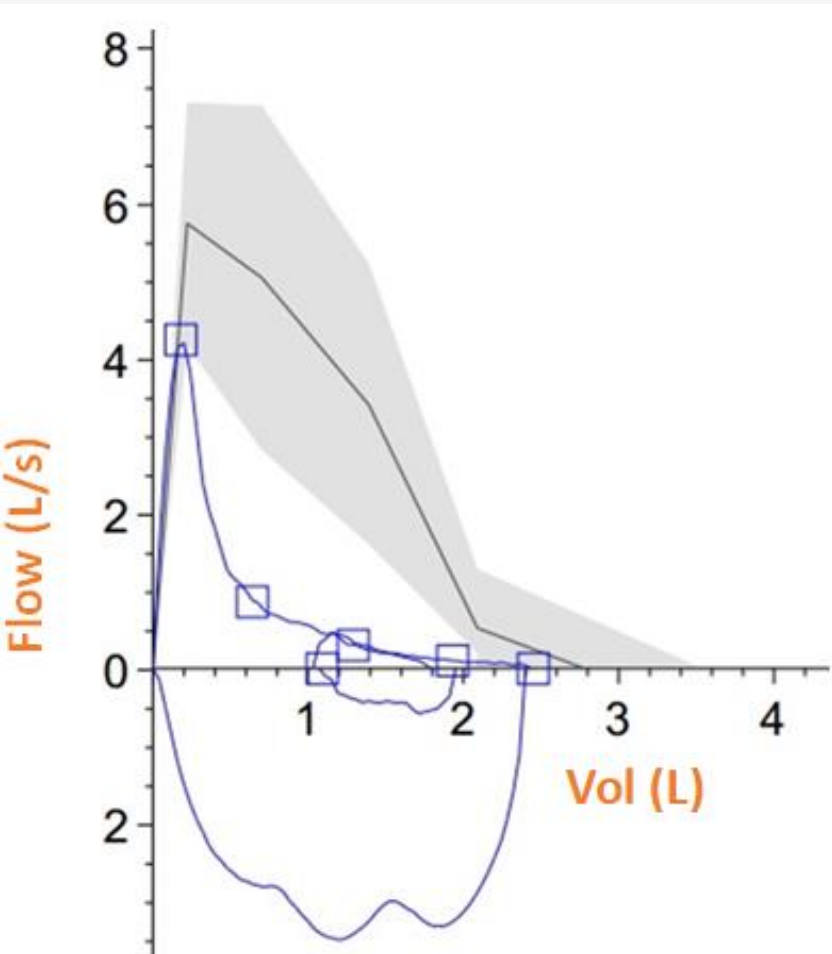
Restrictive Spirometry – I.e. ILD



	Ref	Pre	%Pred	SR	Z-Score
Spirometry [BTPS] ref:GLI_2012					
FEV 1	L	2.78	1.62	58	-2.33
FVC	L	3.67	2.06	56	-2.74
VC MAX	L	3.67	2.06	56	-2.74
FEV 1 % FVC	%	76.08	78.81	104	0.35
FEV 1 % VC MAX	%	76.08	78.81	104	0.35
Flow Volume Loop					
PEF	L/min	440	449	102	0.12

When Spirometry indicates pathology...

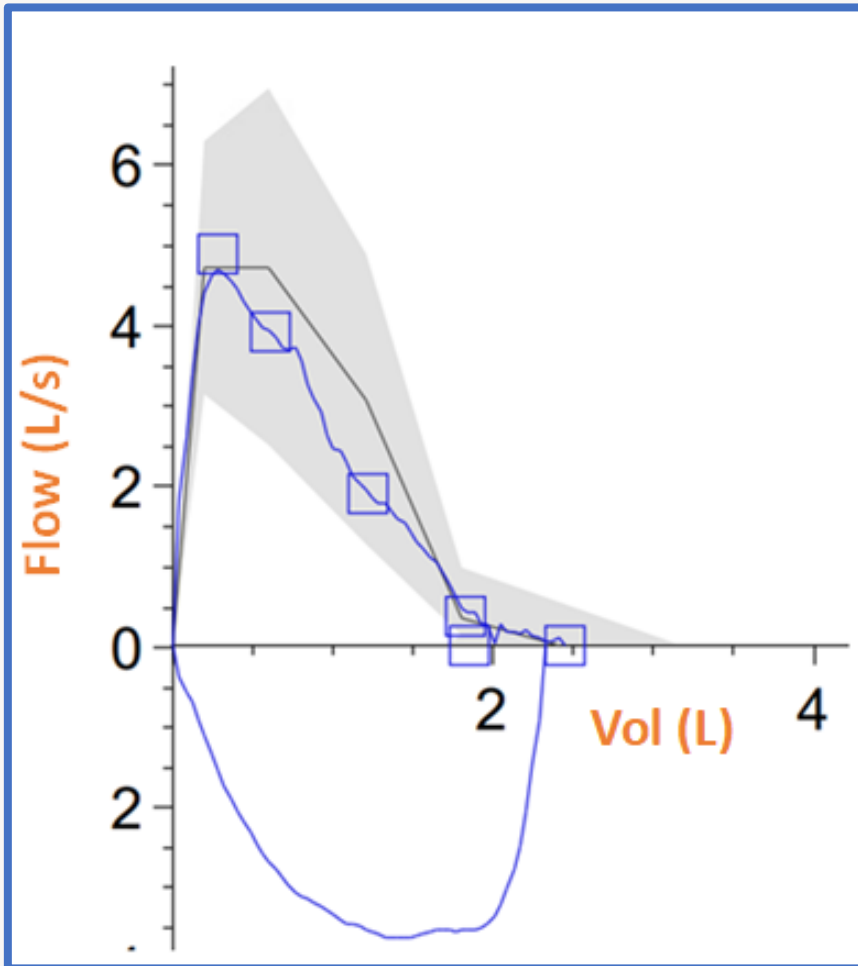
Obstructive Spirometry – i.e. COPD



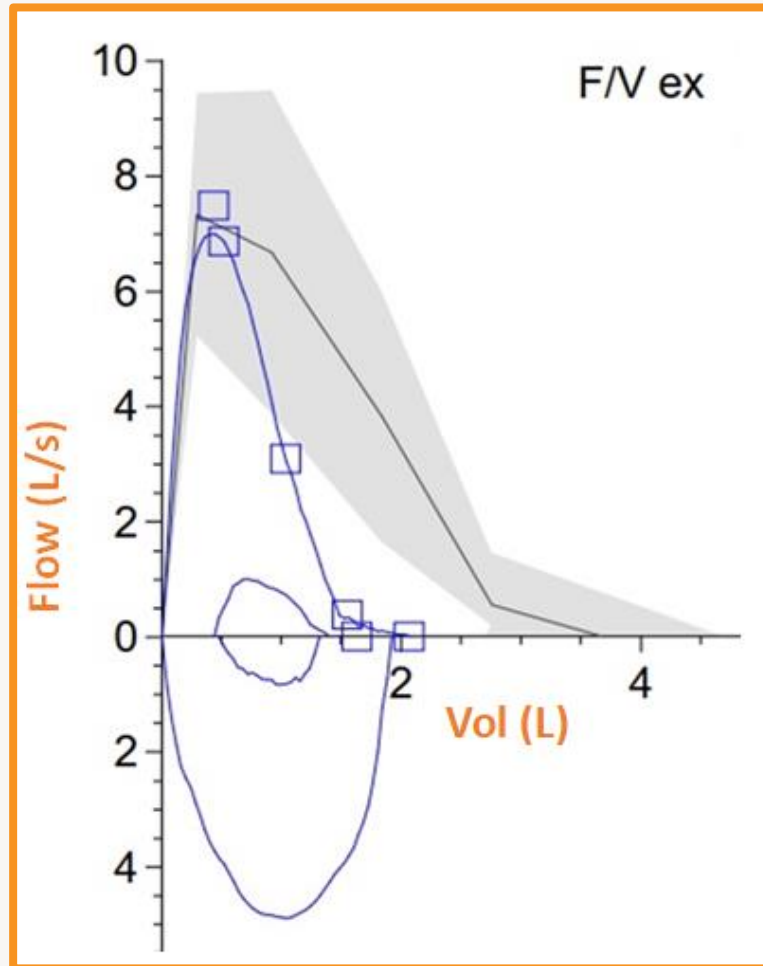
		Ref	Pre	%Pred	SR	Z-Score
Spirometry [BTPS] ref:GLI_2012						
FEV 1	L	2.19	1.09	50	-3.19	-3.19
FVC	L	2.78	2.45	88	-0.78	-0.78
VC MAX	L	2.78	2.57	92	-0.49	-0.49
FEV 1 % FVC	%	79.27	44.46	56	-3.85	-3.85
FEV 1 % VC MAX	%	79.27	42.31	53	-4.01	-4.01
Flow Volume Loop						
PEF	L/min	344	254	74	-1.56	-1.56

When Spirometry indicates pathology...

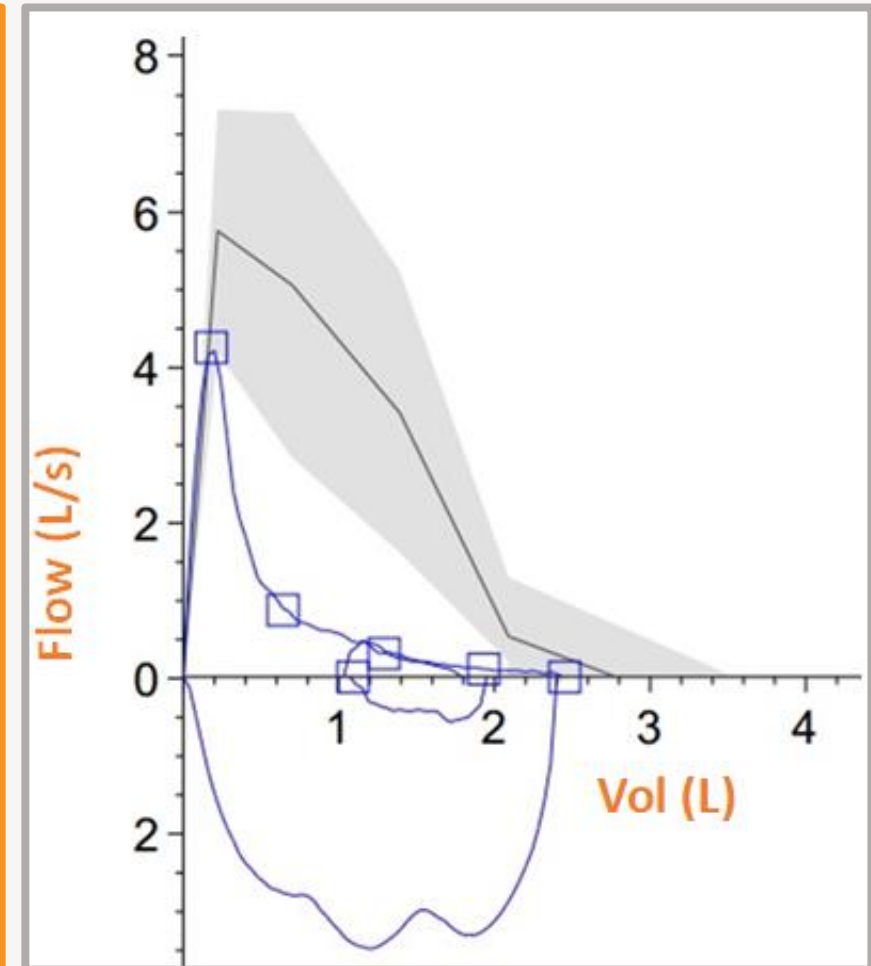
Normal



Restrictive

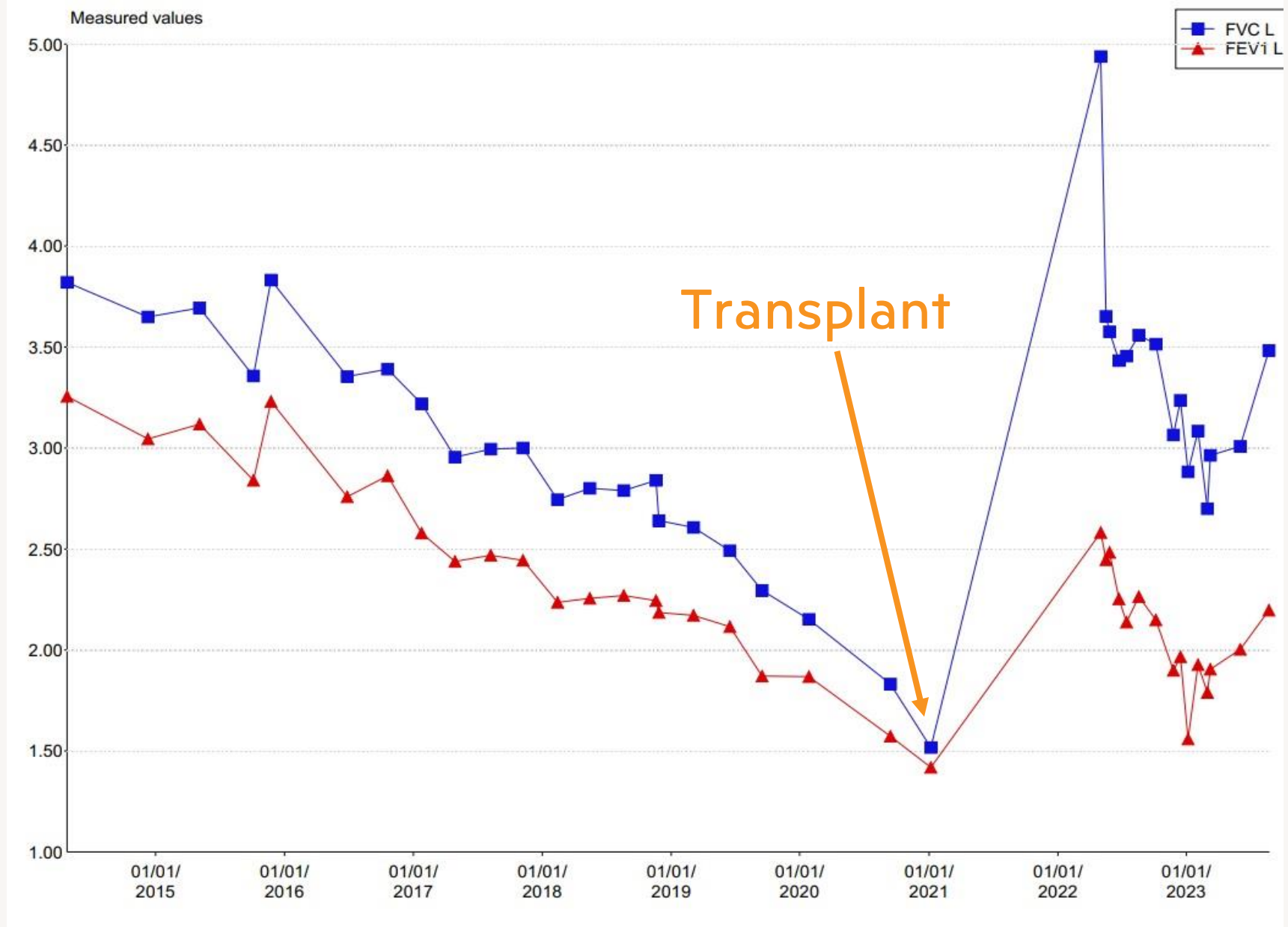
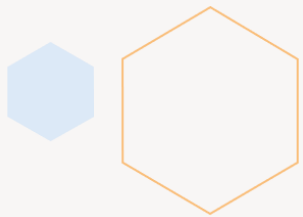


Obstructive

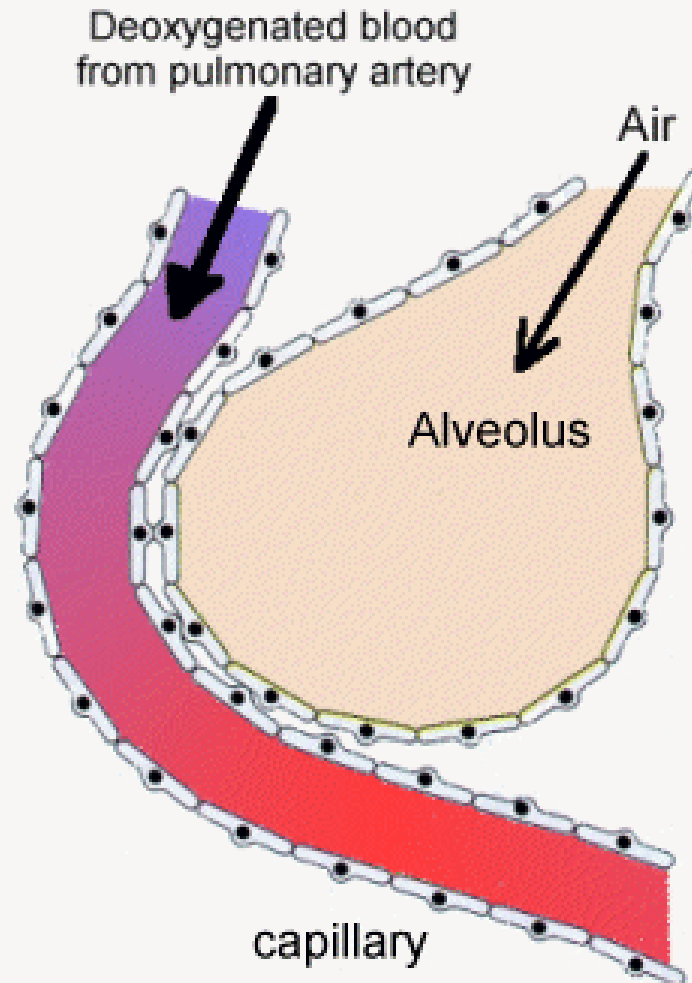
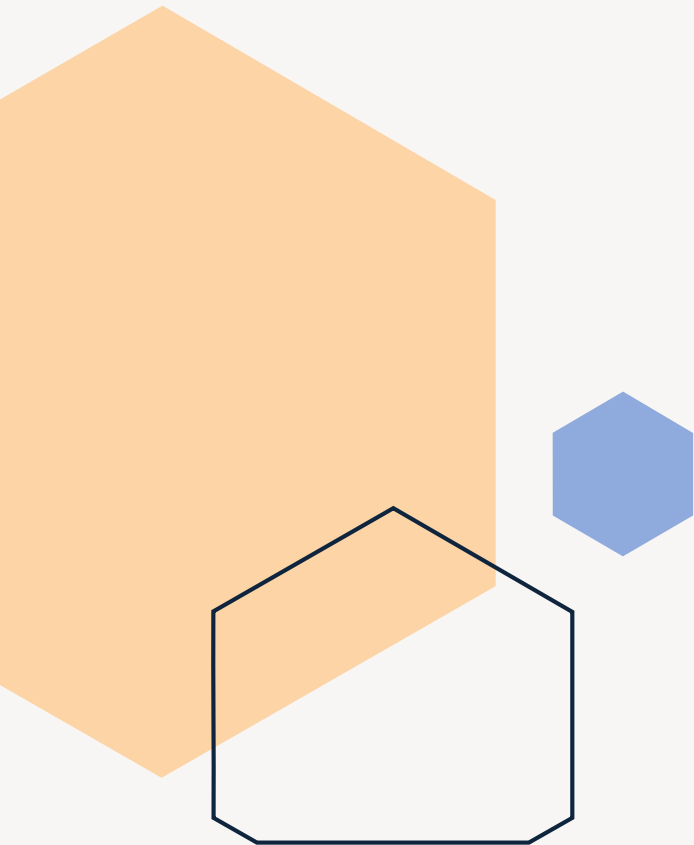


Serial Spirometry Data...

ILD Patient
Spirometry
data taken
from 2015 to
current day
Transplanted
in 2021



Gas Transfer (TLco)

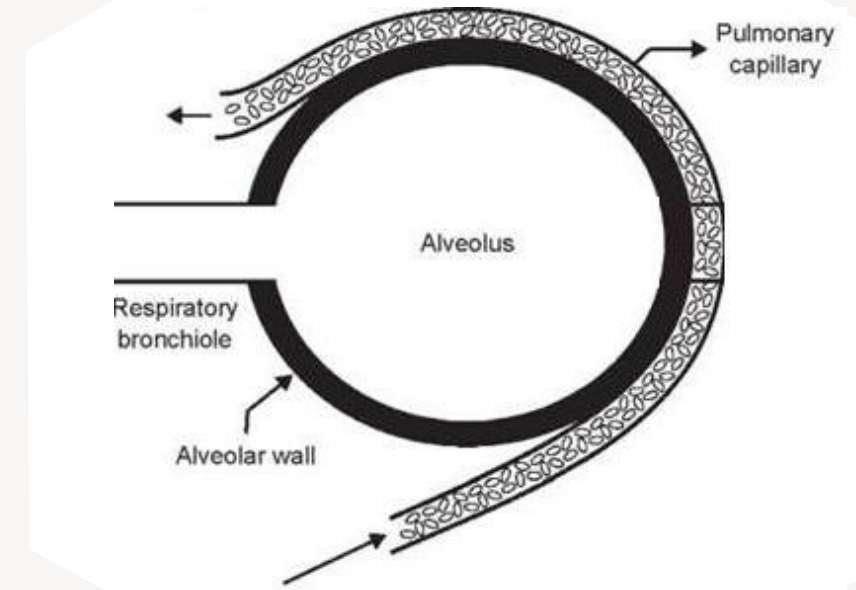


Gas Transfer – Key Terms

TL_{co}: Diffusing capacity of the lungs for carbon monoxide.
Derived from both VA and KCO.

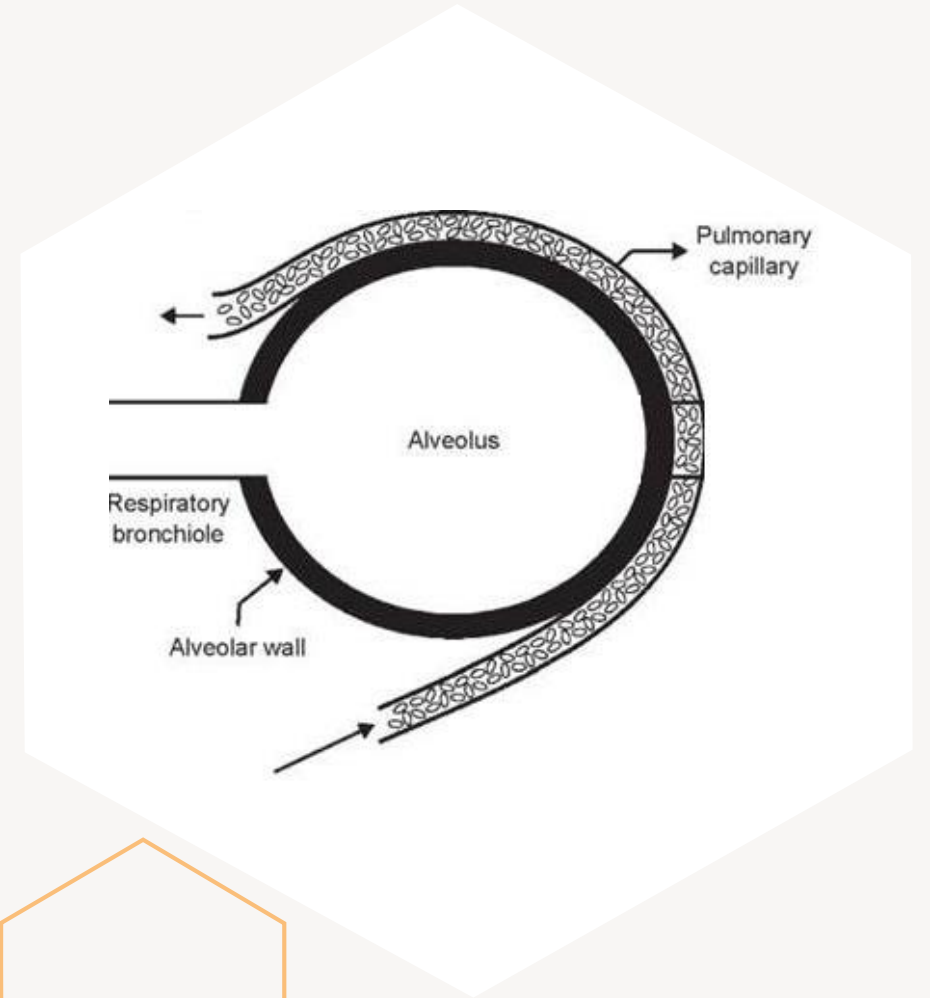
Alveolar Volume (VA): Volume (L) of alveolar units contributing to gas exchange.

KCO: The transfer co-efficient.
Indicates gas transfer efficiency of alveoli.

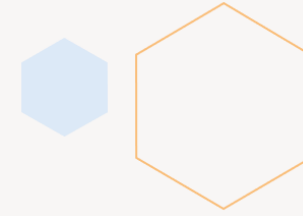


Why is Gas Transfer useful?

- Helps identify potential disease pathophysiology/phenotype
- Monitor change in data over time
- Reasonable indicator of disease impact on patient's daily activities
- Can be used to consider referral for end stage treatments/therapies



Gas Transfer (TLco or DLco)



Healthy Patient

Gas Transfer [vol BTPS gases STPD] ref: GLI_2017	Ref	Pre	%Pred	SR	Z-Score	
					-5 -4 -3 -2 -1 Pred 1 2 3	
TLCO	mmol/(min*kPa)	7.93	9.50	120	1.12	
TLCOc	mmol/(min*kPa)	7.93	9.50	120	1.12	
VA	L	5.44	5.77	106	0.50	
KCO	mmol/(min*kPa*L)	1.46	1.65	113	0.81	
KCOc SB	mmol/(min*kPa*L)	1.46	1.65	113	0.81	
Hb	g(Hb)/L		146			

Gas Transfer (TLco or DLco)

Impaired TLCO - Reduced VA and normal KCO
 e.g. extrathoracic/neuromuscular conditions

Gas Transfer [vol BTPS gases STPD] ref: GLI_2017	Ref	Pre	%Pred	SR	Z-Score	
					-5 -4 -3 -2 -1 Pred 1 2 3	
TLCO	mmol/(min*kPa)	5.91	3.07	52	-3.46	
TLCOc	mmol/(min*kPa)	5.91	3.07	52	-3.46	
VA	L	4.32	2.73	63	-3.19	
KCO	mmol/(min*kPa*L)	1.40	1.12	81	-1.30	
KCOc SB	mmol/(min*kPa*L)	1.40	1.12	81	-1.30	
Hb	g(Hb)/L		134			

Gas Transfer (TLco or DLco)


Impaired TLCO – Normal VA and Reduced KCO
 e.g. Pulmonary Hypertension

Gas Transfer [vol BTPS gases STPD] ref: GLI_2017	Ref	Pre	%Pred	SR	Z-Score
TLCO	mmol/(min*kPa)	5.81	3.20	55	-3.18
TLCOc	mmol/(min*kPa)	5.81	3.20	55	-3.18
VA	L	4.19	3.69	88	-0.89
KCO	mmol/(min*kPa*L)	1.41	0.87	62	-2.75
KCOc SB	mmol/(min*kPa*L)	1.41	0.87	62	-2.75
Hb	g(Hb)/L		134		

Gas Transfer (TLco or DLco)

Impaired TLCO – Reduced VA and Reduced KCO
 e.g. ILD with co-morbid PH or severe ILD

Gas Transfer [vol BTPS gases STPD] ref: GLI_2017	Ref	Pre	%Pred	SR	Z-Score	
					-5 -4 -3 -2 -1 Pred1 2 3	
TLCO	mmol/(min*kPa)	7.27	2.56	35	-4.51	
TLCOc	mmol/(min*kPa)	7.27	2.56	35	-4.51	
VA	L	5.57	3.30	59	-3.39	
KCO	mmol/(min*kPa*L)	1.31	0.78	59	-2.50	
KCOc SB	mmol/(min*kPa*L)	1.31	0.78	59	-2.50	
Hb	g(Hb)/L		146			



The Future of Respiratory Science in ILD...

- Advanced practice ...
Consultant Clinical Scientists?
- Greater involvement in patient
pathway - MDT
- A.I. driven analysis of data –
computer driven diagnosis of
early interstitial changes?



Thanks for listening

Questions?

Joshua.burrough@mft.nhs.uk