

**ASTHMA**

Diagnostics

# ASTHMA DEFINITION

*The new definition of asthma.* “Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation. It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation.” The term “asthma” is now deliberately used as an umbrella term like “anaemia”, “arthritis” and “cancer”; these terms are very useful for communication with patients and for advocacy, and they facilitate clinical recognition of heterogeneous diseases that have readily recognisable clinical features in common. By contrast with anaemia, arthritis and cancer, evidence about the underlying mechanisms in asthma is much less well-established, with most existing evidence coming from patients with long-standing and clinically severe asthma; further research in broader populations is needed. *However, an overarching principle in the new GINA report is the importance of individualising patient management not only by using genomics or proteomics, but also with “humanomics” [19], taking into account the behavioural, social and cultural factors that shape outcomes for individual patients.*

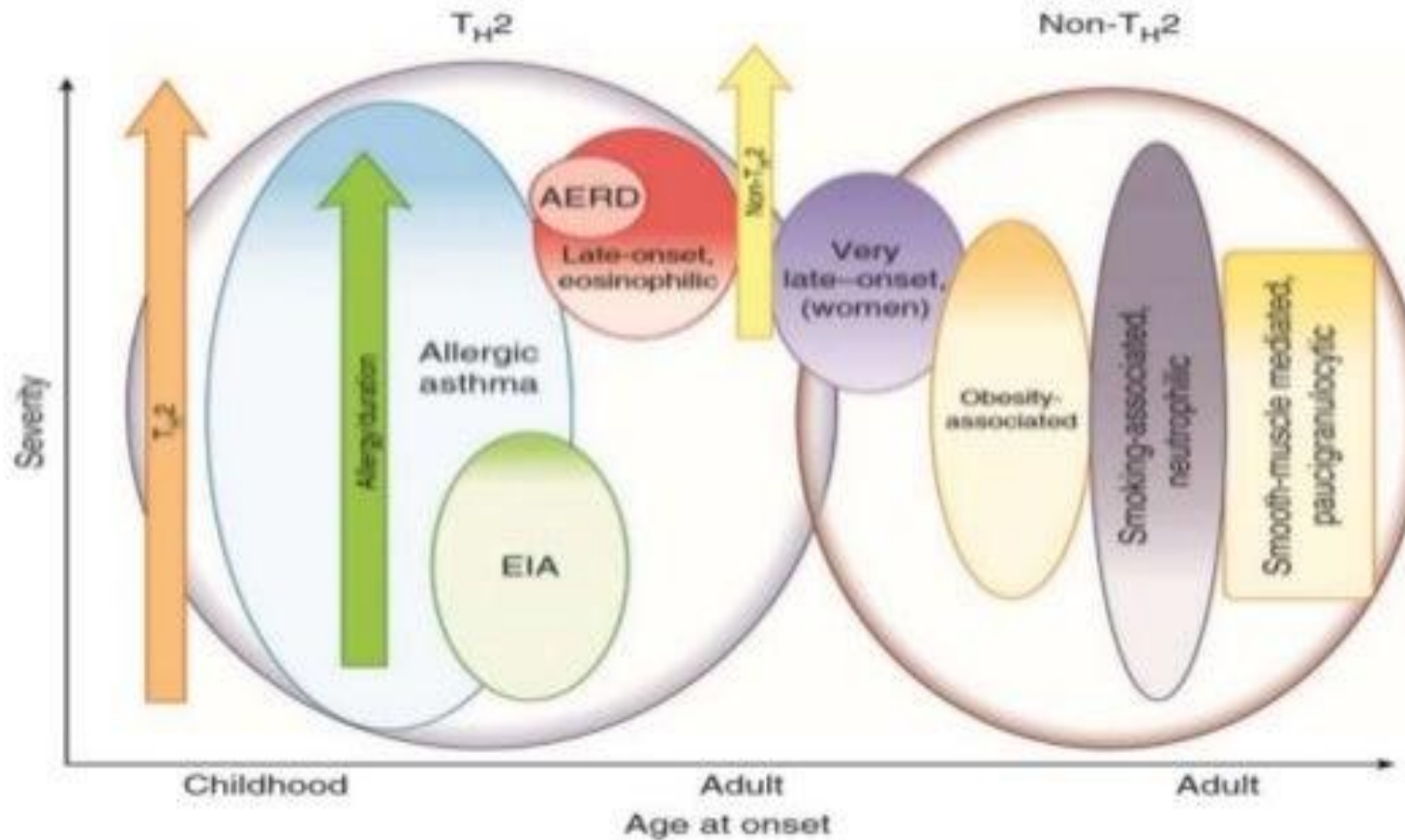
# ASTHMA

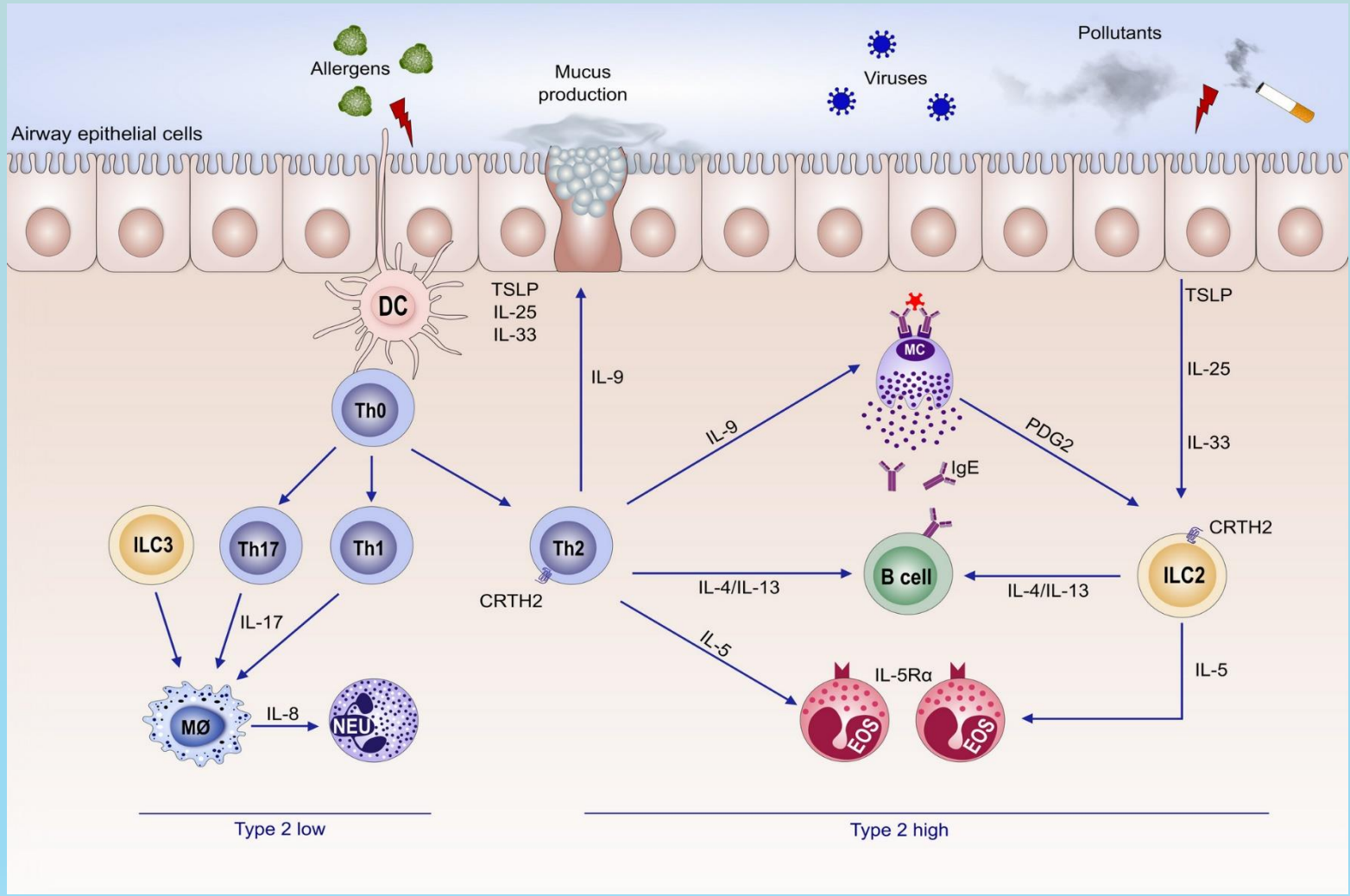
The term asthma is now considered an umbrella diagnosis for several diseases with distinct mechanistic pathways (endotypes) and variable clinical presentations (phenotypes). The precise definition of these endotypes is central to asthma management due to inherent therapeutic, diagnostic and prognostic implications.

Endotype- subtype of a condition defined by a distinct functional or or pathobiological mechanism

Phenotype- an observable or characteristic trait of a disease without any implication of mechanism

# PHENOTYPE AND ENDOTYPE: CLINICAL CLASSIFICATION

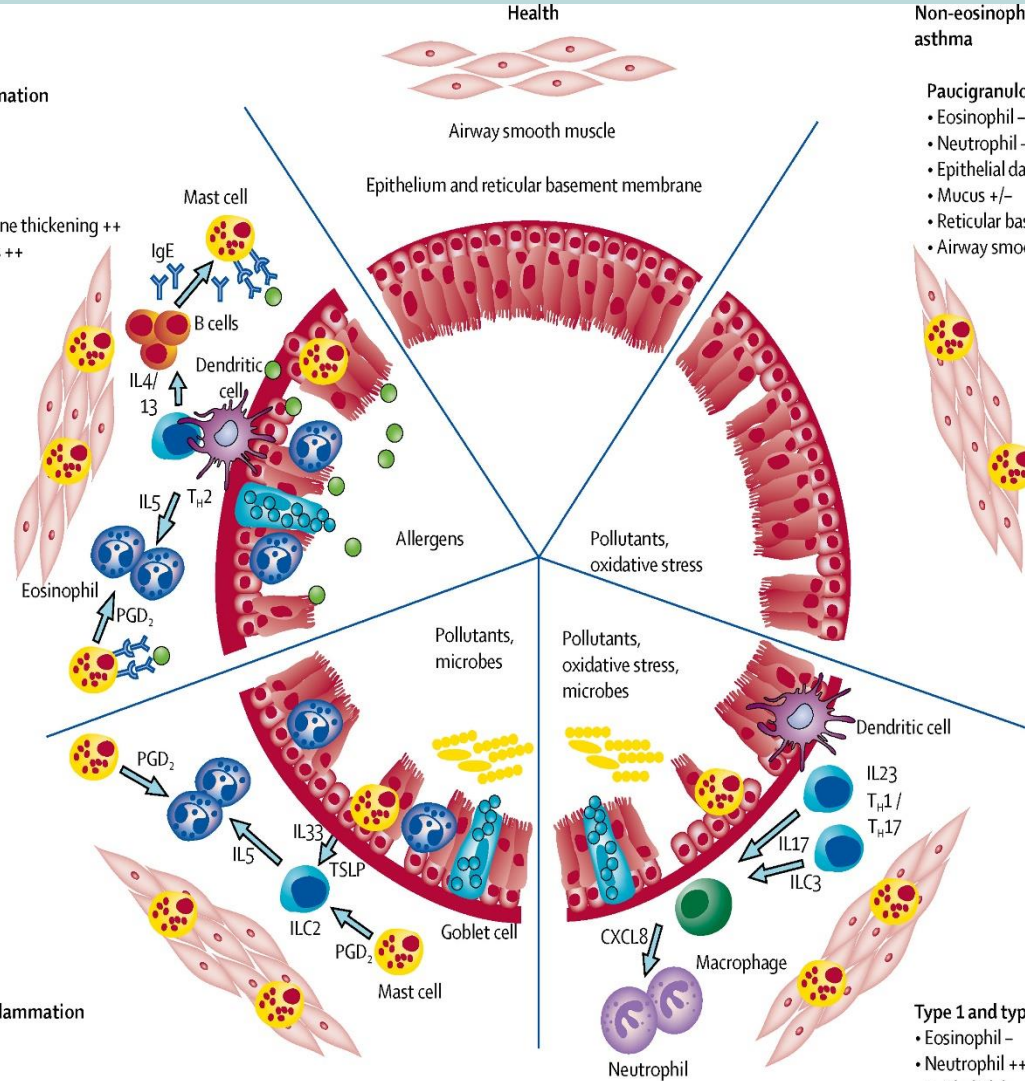




**Eosinophilic asthma**

**Allergic eosinophilic inflammation**

- Eosinophil ++
- Neutrophil -
- Epithelial damage ++
- Mucus +
- Reticular basement membrane thickening ++
- Airway smooth muscle mass ++



**Non-allergic eosinophilic inflammation**

- Eosinophil ++
- Neutrophil -
- Epithelial damage ++
- Mucus +
- Reticular basement membrane thickening ++
- Airway smooth muscle mass ++

**Mixed granulocytic asthma**

- Eosinophil +
- Neutrophil +
- Epithelial damage ++
- Mucus ++
- Reticular basement membrane thickening +
- Airway smooth muscle +

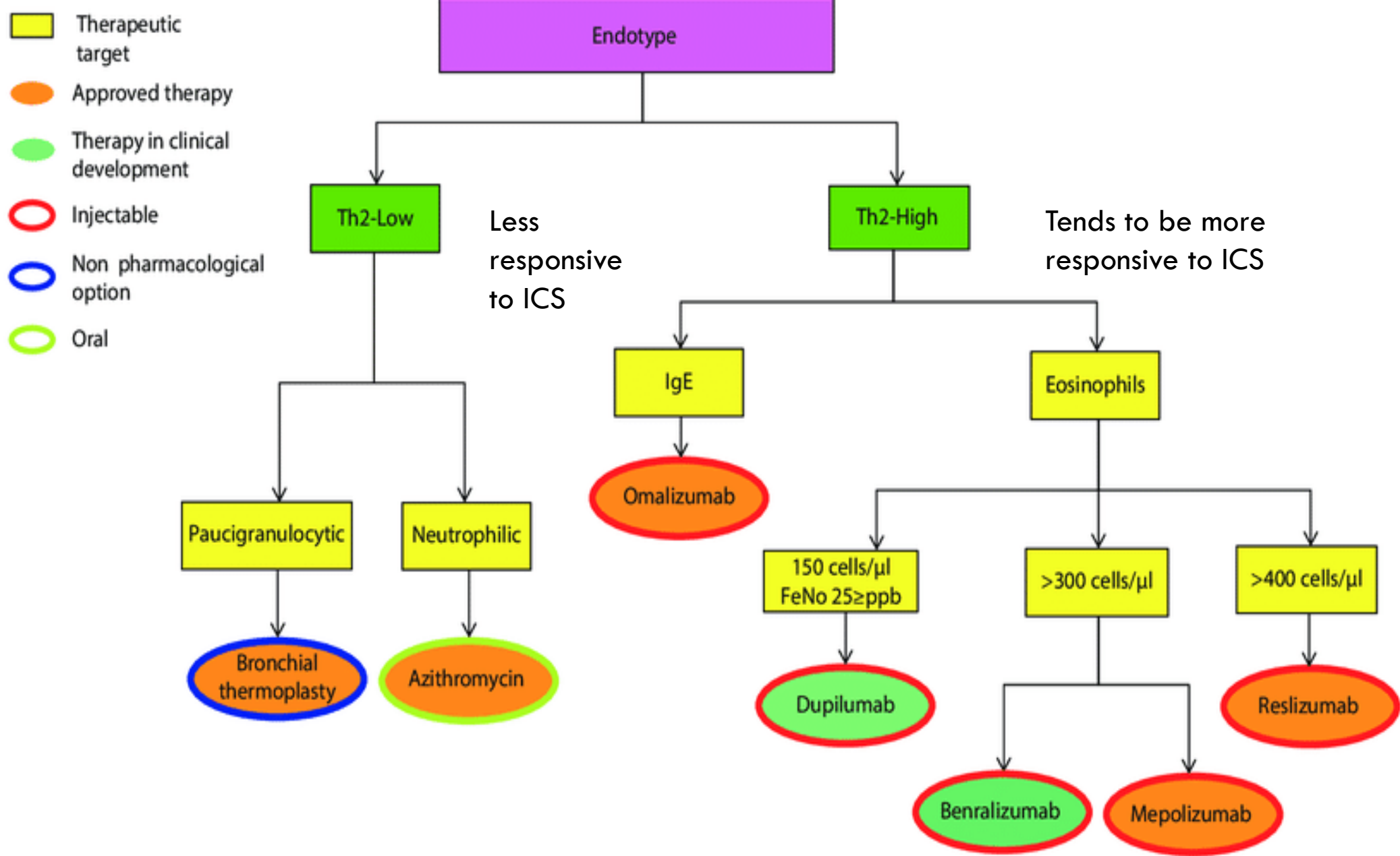
**Non-eosinophilic asthma**

**Paucigranulocytic**

- Eosinophil -
- Neutrophil -
- Epithelial damage +
- Mucus +/-
- Reticular basement membrane thickening +/-
- Airway smooth muscle mass +

**Type 1 and type 17 neutrophilic inflammation**

- Eosinophil -
- Neutrophil ++
- Epithelial damage ++
- Mucus ++
- Reticular basement membrane thickening +
- Airway smooth muscle mass +



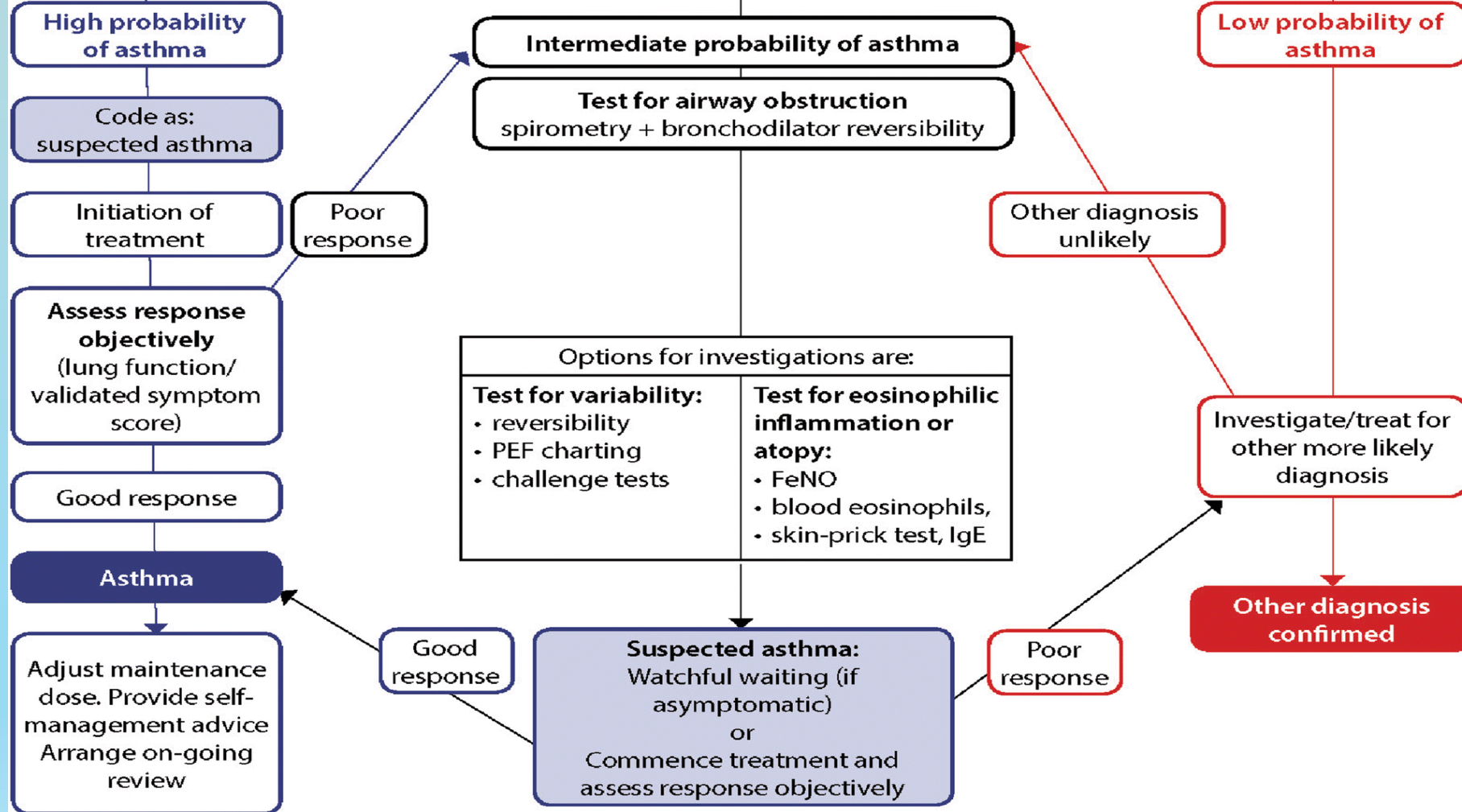
IgE, immunoglobulin E; Th2, T helper 2.

**Presentation with respiratory symptoms: wheeze, cough, breathlessness, chest tightness<sup>1</sup>**

**Structured clinical assessment (from history and examination of previous medical records)**

Look for:

- recurrent episodes of symptoms
- symptom variability
- absence of symptoms of alternative diagnosis
- recorded observation of wheeze
- personal history of atopy
- historical record of variable PEF or FEV<sub>1</sub>



<sup>1</sup> In children under 5 years and others unable to undertake spirometry in whom there is a high or intermediate probability of asthma, the options are monitored initiation of treatment or watchful waiting according to the assessed probability of asthma.



# ASTHMA TESTING

## Blood markers

- IgE
- Eosinophils  $> 150$  mcg/L i.e.  $> 0.15$

## Sputum

- Less widely used, eosinophil, neutrophil counts. Requires induced sputum and specialised cytologist
- Sputum eosinophilia  $> 2\%$

PEF- highly variable, importance of trends, 15% drop in PEF from baseline suggestive of asthma

Spirometry, pre and post bronchodilator spirometry

Bronchial challenge testing

Fraction of exhaled nitric oxide

# ASTHMA. SPIROMETRY, PRE AND POST BRONCHODILATOR

## Spirometry

- May be possible in children from the age of 6
- Patient dependent to an extent although more reliable measure of airflow obstruction than PEF
- May show airflow obstruction
  - Reduced FEV1 / FVC ratio
  - Scooped out flow volume curve
  - Evidence of air trapping
- Value of serial spirometry measurements

Useful in children as other forms of obstructive lung disease are very rare

In adults ongoing controversy re COPD with reversibility

## Post bronchodilator reversibility

- 12% improvement in FEV1 or 25% improvement in FEV 25-75

# ASTHMA- BRONCHIAL CHALLENGE TESTING

## Indirect challenge testing

- Hypertonic saline
- Mannitol
- Exercise testing
- Eucapnic hyperapnea

## Direct Challenge testing

- Methacholine

Can do both in children above the age of 8

# BRONCHIAL CHALLENGE TESTING- CONTRAINDICATIONS

## Airflow limitation

- FEV1 < 60% predicted (adults and children) or < 1.5 L (adults)
- FEV1 < 75% predicted (adults and children) for an exercise challenge

## Spirometry quality

- Unable to perform acceptable and repeatable spirometry

## Cardiovascular problems

- AMI or CVA within 3 months
- Uncontrolled hypertension
- Known aortic aneurysm
- Recent eye surgery or intracranial pressure elevation risk

## Pregnancy

- Methacholine safety unclear in pregnant and breastfeeding mothers

# DIRECT CHALLENGE TESTING

Methacholine mimics acetylcholine and acts via muscarinic receptors to initiate smooth muscle constriction

Very high negative predictive value

more sensitive but less specific than indirect challenge testing. i.e good at ruling out the diagnosis

Looking for the provocative dose that causes a fall in FEV1 by 20%

PD doses  $>$  400 mcg normal, the lower the dose the more AHR present

# INDIRECT CHALLENGE TESTING

Act via exercise or other stimuli to the airway that act indirectly to cause airway narrowing ( via bronchoconstriction, oedema)

Exercise, eucapnic hyperventilation, mannitol and hypertonic saline initiate osmolar changes in the airway epithelium secondary to water loss. This initiates inflammatory cascade

More specific but less sensitive than direct challenge tests. i.e good at ruling in but not good at ruling out . Indirect tests correlate better with airway inflammation and are useful to confirm asthma or assess response to therapy

Useful when exercise or cold or other inflammatory processes such as viral URTIs seem to initiate symptoms

# INDIRECT CHALLENGE TESTING

## Exercise challenge

- 2-3 minutes of intense exercise followed by 6 minutes of steady exercise
- Aim to reach 60% of MV or 85% predicted heart rate
- Measure FEV1 serially for 30 minutes
- 15% drop in FEV1 significant

## Hypertonic saline challenge

- Graded exposure
- Hypertonic saline via nebuliser for increasing periods of time up to 8 minutes
- Positive result is a 15 % drop in FEV1
- Generally used in children ( good at ruling asthma in)

# FRACTION OF EXHALED NITRIC OXIDE (FENO)

Nitric oxide (NO) produced by airway epithelial cells

Presence in low quantities may act as a smooth muscle relaxant

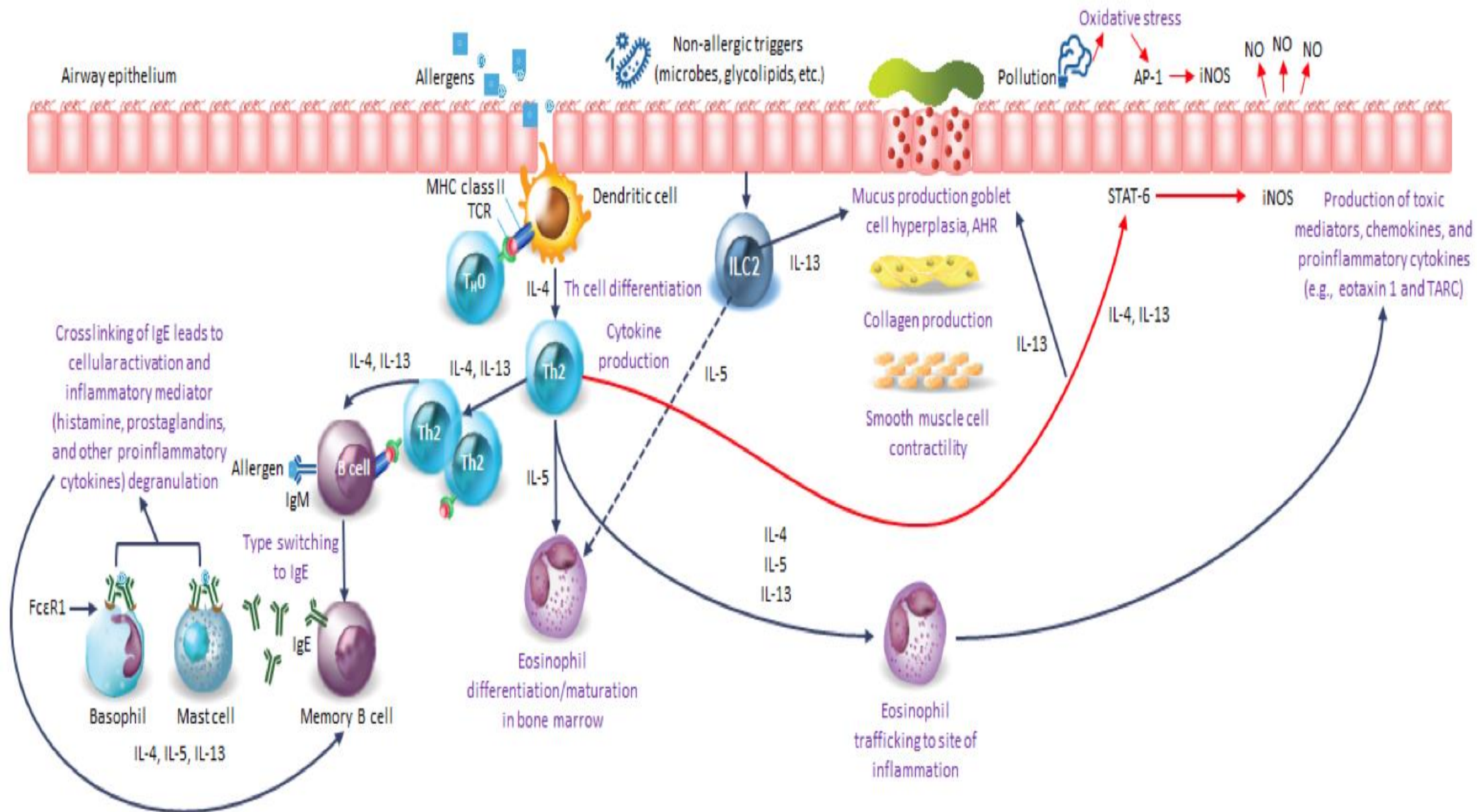
Higher concentrations have been shown to be related to eosinophilic airway inflammation, causing a direct reduction in bronchodilator proteins ( nitrosthols) and excess reactive nitric oxide species that are directly toxic to airway epithelium and smooth muscle

May assist in the diagnosis of TH2 asthmatic (eosinophilic) airways disease

Can be used to predict response to corticosteroids

May be used a guide to therapy





AHR, airway hyperresponsiveness; AP, activator protein; FcεR1, high-affinity IgE receptor; Ig, immunoglobulin; IL, interleukin; ILC2, type 2 innate lymphoid cells; iNOS, inducible nitric oxide synthase; MHC, major histocompatibility complex; NO, nitric oxide; STAT, signal transducer and activator of transcription; TARC, thymus- and activation-regulated chemokine (i.e., CCL17); TCR, T cell receptor.

# FENO

A FENO of less than 25 ppb in adults and 20 ppb in children < 12 years of age implies the presence of eosinophilic airway inflammation

A FENO of greater than 50 ppb in adults and 35 ppb in children suggests eosinophilic airway inflammation

Values of FENO between 25 and 50 ppb in adults and 20- 35 ppb in children should be treated with caution

Increases in FENO of greater than 20% and more than 25 ppb or 20 ppb in children suggests worsening airway inflammation

A decrease in FENO of greater than 20% for values over 50 or more than 10 ppb for values less than 50 ppb may be clinically important.

# FENO

GINA guidelines and ATS guidelines advise against the use of FENO for a diagnosis of asthma ( due to non eosinophilic forms) but are suggestive

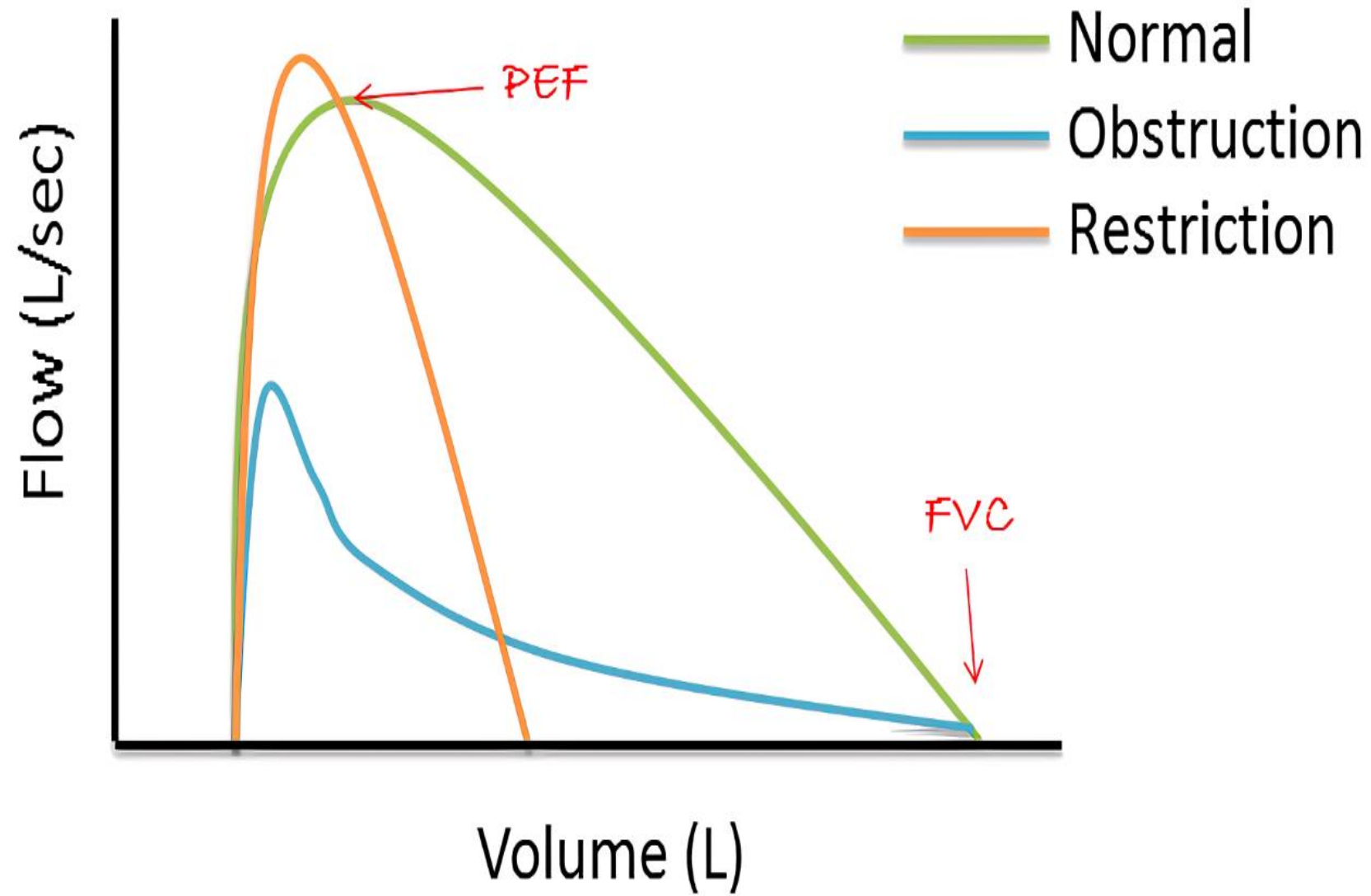
Should also not be used to decide against ICS or glucocorticoid treatment

Not necessary for the management of asthma, just as reasonable to make management decisions on symptoms, PEF

In children the Cochrane Library review suggests FENO measurements:

- can reduce the number of children who experience exacerbations by monitoring rising FENO levels  
BUT\_
- No impact on asthma severity as measured by day to day symptoms
- No effect on inhaled corticosteroid dose

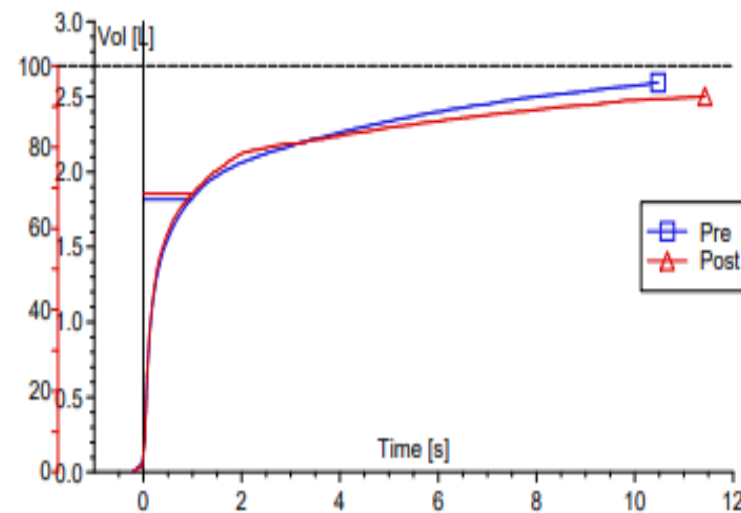
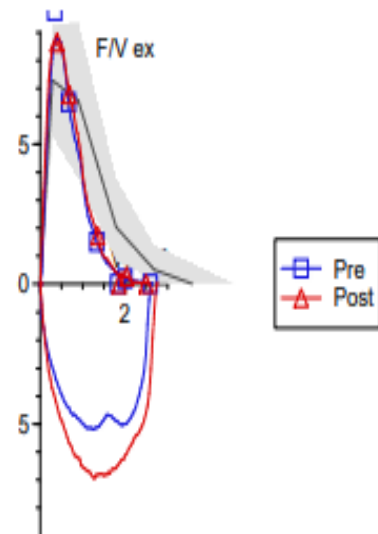
Simple to perform requires exhalation of at least 4 seconds to at a constant flow rate



## Spirometry [BTPS]

		Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
Visit date		10.10.22	10.10.22		10.10.22			10.10.22
Visit time		02:27PM	02:27PM		02:27PM			02:27PM
FEV 1	L	2.70	1.82	67.4	1.86	68.8	2.1	1.91
FVC	L	3.57	2.58	72.4	2.49	69.7	-3.7	2.61
FEV1/FVC		0.76	0.70		0.75			0.62
FEF 25-75%	L/s		0.99		1.25			0.82
FET	sec		10.47		11.47			
FIVC	L		2.65		2.71			

GLI (Quanjer) 2012 predicted values used for spirometry parameters



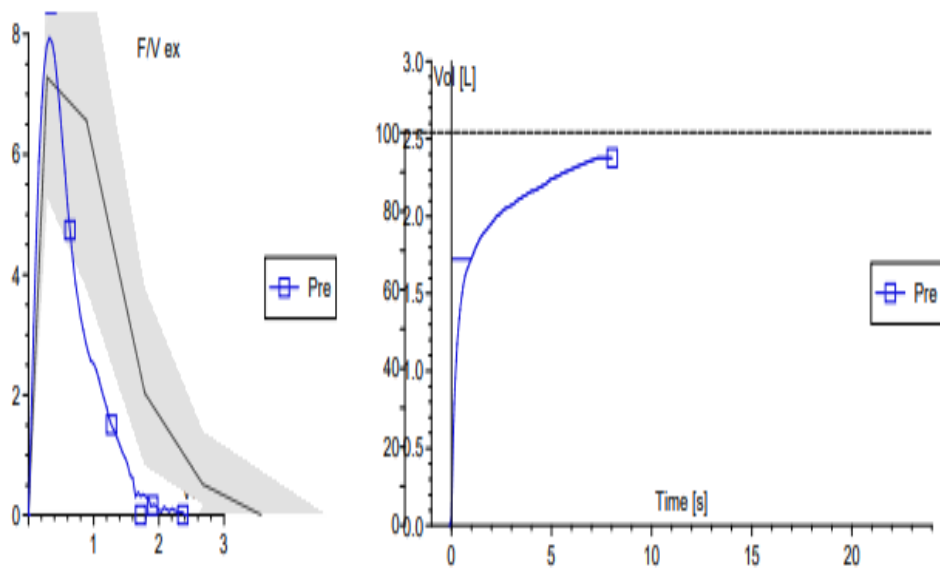
### Comment

Testing performed 20 hrs post Trimbaw. Patient consistently had FIVC > FVC during Spirometry efforts. Best result pre BD was acceptable, however no acceptable results post BD. A single FeNO measurement made using Vivatmo pro with an average flow rate of 50mL/sec. FeNO = 46 ppb (Normal <20-25ppb, Elevated 20/25-50ppb, High >50ppb). Tested

## Spirometry [BTPS]

	Pred	Pre Challenge	%Pred	LLN
Visit date	18.10.22	18.10.22		18.10.22
Visit time	01:51PM	01:51PM		01:51PM
FEV1	L 2.70	1.72	63.8	1.91
FVC	L 3.57	2.37	66.3	2.61
FEV1/FVC	0.76	0.73		0.62
FEF 25-75%	L/s	1.09		0.82

GLI (Quanjer) 2012 predicted values used for spirometry parameters

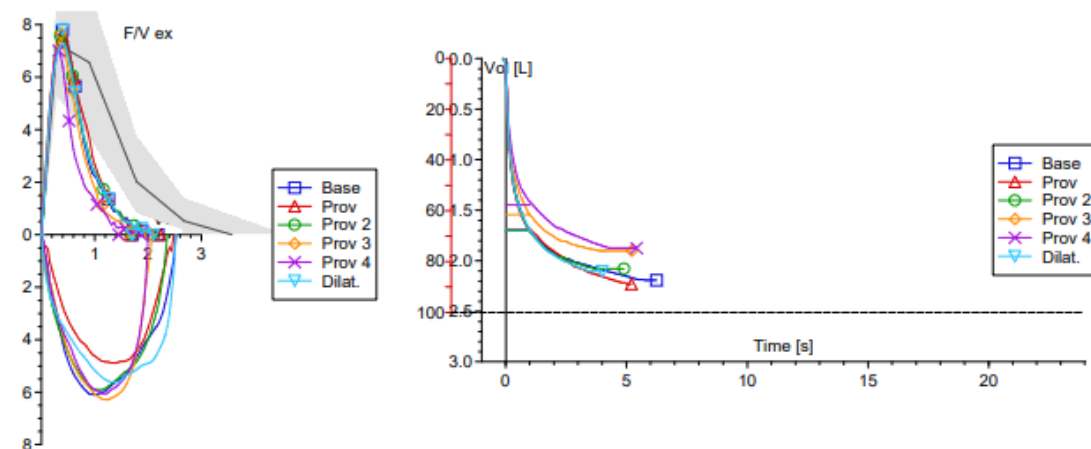
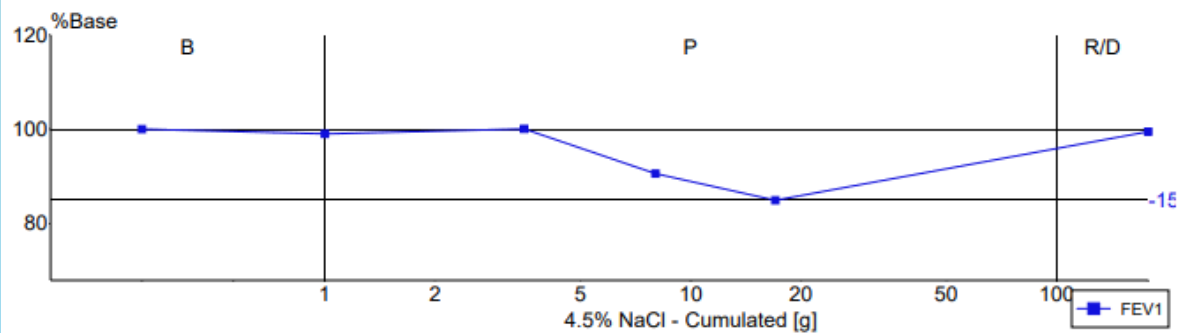


Comment

Positive indirect challenge

## 4.5% Saline Provocation Test

	Visit time	Dose	Cum. Dose	FEV1
Predicted	01:51PM			2.70
Baseline	01:51PM			1.71
Prov 1	01:51PM	1.000	1.000	1.69
%Change				-1
Prov 2	01:51PM	2.500	3.500	1.71
%Change				0
Prov 3	01:51PM	4.500	8.000	1.54
%Change				-9
Prov 4	01:51PM	9.000	17.000	1.45
%Change				-15
Prov 5	01:51PM	400.000	400.000	1.70
%Change				-1



## Spirometry [BTPS]

		Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
Visit date		09.09.22	09.09.22		09.09.22			09.09.22
Visit time		02:44PM	02:44PM		02:44PM			02:44PM
FEV1	L	1.67	1.58	94.7	1.67	100.3	5.9	1.14
FVC	L	2.21	1.71	77.2	1.76	79.4	2.9	1.51
FEV1/FVC		0.77	0.93		0.95			0.61
FEF 25-75%	L/s		1.98		2.44			0.52
FET	sec		1.53		1.32			
FIVC	L		1.64		1.95			

GLI (Quanjer) spirometry predicted values used for spirometry parameters

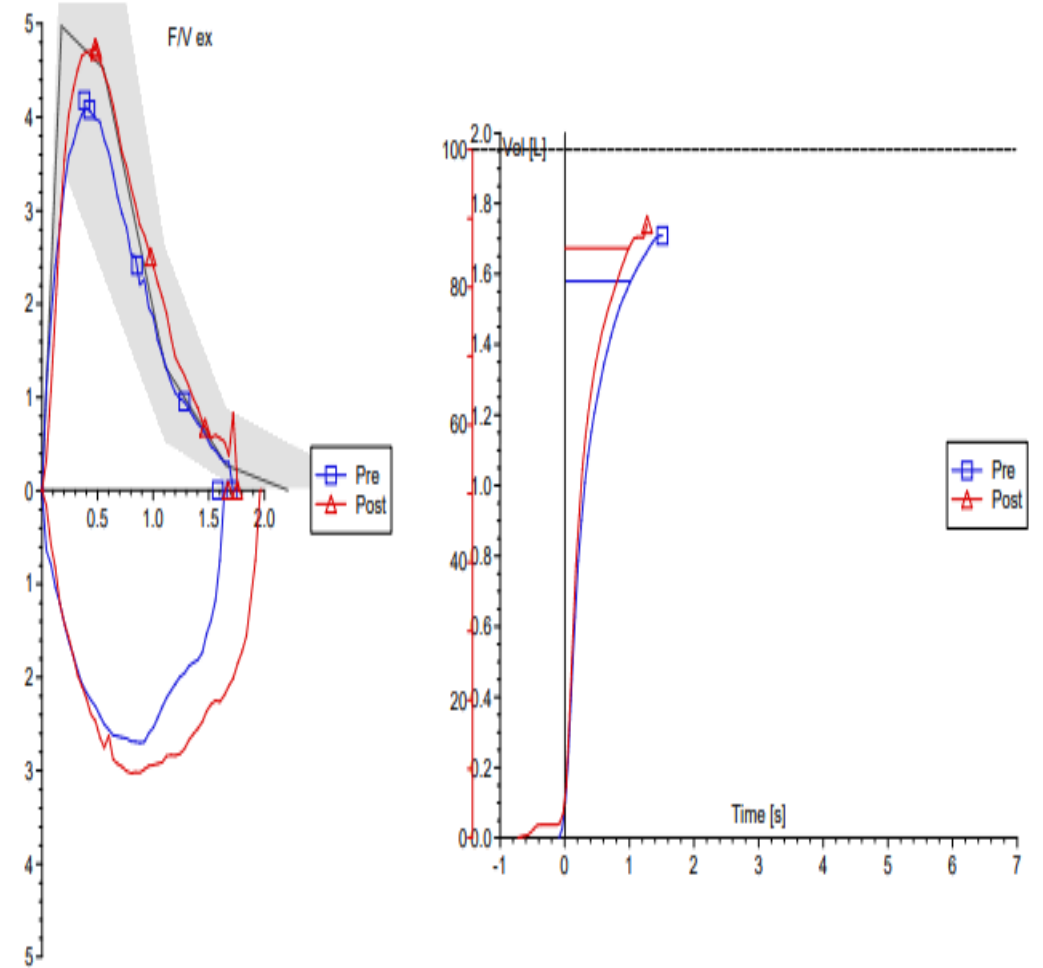
## Gas Transfer [volumes at BTPS, gases at STPD]

		Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
DLCO_SB	ml/(min*mmHg)	17.71	11.09	62.6				11.97
Hb	g(Hb)/dL		13.00					
DLCOc_SB	ml/(min*mmHg)	17.71	11.23	63.4				11.97
VA_SB	L	4.45	3.59	80.6				4.45
KCOc_SB	ml/(min*mmHg*L)	3.84	3.13	81.3				2.35
BHT	sec		8.50					
Barometric Pressure	mmHg		757.56					
SpO2	%		95					

GLI (Stanojevic) 2017 predicted values used for gas transfer parameters

Comments:

??asthma

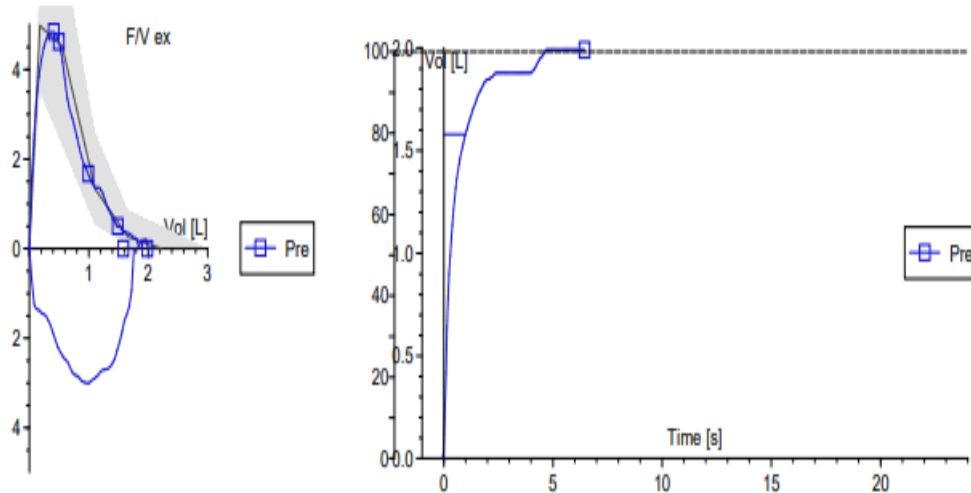


Report:

## Spirometry [BTPS]

		Pred	Pre Challenge	%Pred	LLN
Visit date		06.10.22	06.10.22		06.10.22
Visit time		12:57PM	12:57PM		12:57PM
FEV1	L	1.67	1.58	94.7	1.14
FVC	L	2.21	1.98	89.7	1.51
FEV1/FVC		0.77	0.80		0.61
FEF 25-75%	L/s		1.42		0.52

GLI (Quanjer) 2012 predicted values used for spirometry parameters



### Comment

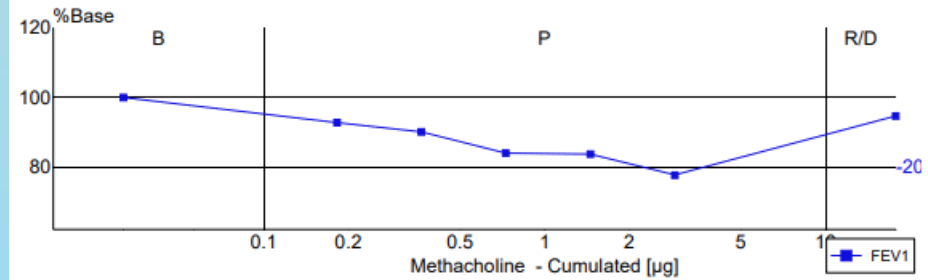
Patient does not currently use inhalers regularly (PRN Ventolin used 7 days ago). Patient consistently had early termination to expiratory effort with glottic/upper airway involvement during pre challenge Spirometry. This did not affect FEV1 or bronchial challenge though. Tested by: Joel Patterson.

G2V

Positive Meth challenge

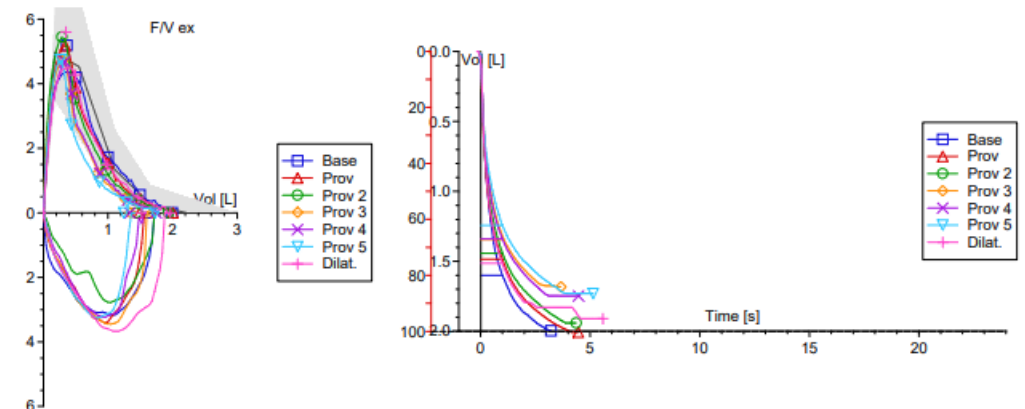
## Methacholine Provocation Test

	Visit time	Dose	Cum. Dose	FEV1
Pred	12:57PM			1.67
Baseline	12:57PM			1.60
Prov 1	12:57PM	0.182	0.182	1.49
%Change				-7
Prov 2	12:57PM	0.181	0.363	1.44
%Change				-10
Prov 3	12:57PM	0.363	0.726	1.35
%Change				-16
Prov 4	12:57PM	0.726	1.452	1.34
%Change				-16
Prov 5	12:57PM	1.452	2.904	1.24
%Change				-22
Prov 6	12:57PM	400.000	400.000	1.52
%Change				-5



Note: Methacholine dose unit is umol not ug as reported

PD[-20] FEV1 Cumulated: = 2.22 ug Methacholine

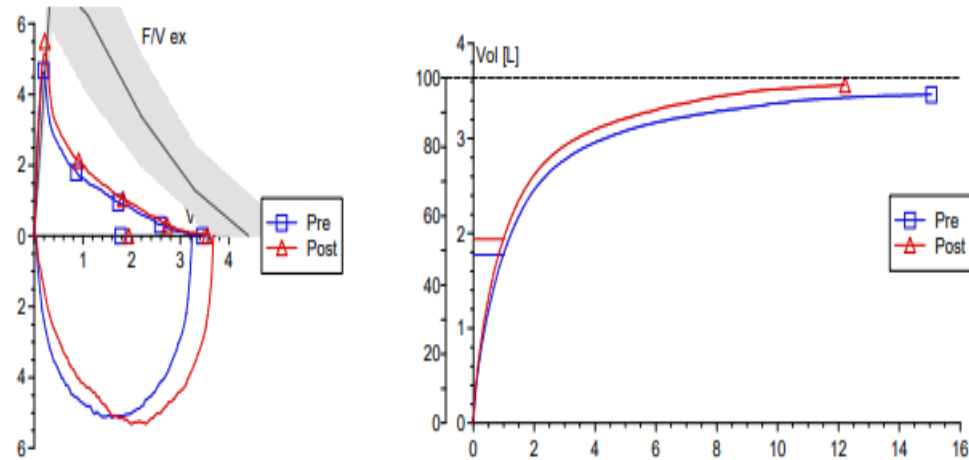




## Spirometry [BTPS]

		Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
Visit date		09.12.19	09.12.19		09.12.19			09.12.19
Visit time		11:19AM	11:19AM		11:19AM			11:19AM
FEV1	L	3.51	1.77	50.5	1.94	55.2	9.4	2.78
FVC	L	4.40	3.45	78.5	3.55	80.8	2.9	3.48
FEV1/FVC	%	81	51	63.7	55	67.7	6.3	70
FEF 25-75%	L/s	3.38	0.83	24.7	0.94	27.9	13.2	1.98
FEF 50 % FIF 50	%		18		20		8.7	

GLI (Quanjer) 2012 predicted values used for spirometry parameters



## Comment

Well performed spirometry. A single FeNO measurement made using Vivatmo pro with an average flow rate of 50mL/sec.

FeNO = 42ppb (Normal <20-25ppb, Elevated 20/25-50ppb, High >50ppb).

Spirometry pre and post Grade A.

Tested by: Cathy Schultz C.R.F.S.

Measurement Parameter		Spiro FEV1 (L)	FVC (L)	Body TLC (L)	RV (L)	Diff SB DLCOc_ (ml/(m...))	KCOc_S (ml/(m...))
Date	Time						
12/02/2014	11:00:19 AM	1.82	3.66				
12/02/2014	11:10:10 AM	1.95	3.79			17.47	3.70
21/05/2014	1:54:58 PM	2.31	3.92			23.82	4.43
23/07/2014	11:26:40 AM	1.86	3.98			18.68	3.63
1/10/2014	11:36:49 AM	1.45	3.55				
1/10/2014	11:47:51 AM	2.01	3.93			18.94	3.85
3/12/2014	2:21:50 PM	2.68	4.39			22.02	3.89
6/02/2015	8:37:35 AM	2.57	4.37			23.10	3.89
6/02/2015	9:18:48 AM	2.83	4.54				
10/04/2015	9:03:56 AM	2.17	4.18				
10/04/2015	9:47:33 AM	2.53	4.46			22.91	4.14
11/11/2015	1:40:20 PM	1.69	3.42			21.36	4.56
19/02/2016	12:12:15 PM	2.24	4.04				
19/02/2016	12:16:49 PM	2.44	4.24			21.89	4.08
29/04/2016	10:37:08 AM	1.82	3.76				
29/04/2016	10:51:00 AM	2.46	4.18			21.80	4.03
29/07/2016	10:38:49 AM	1.52	3.43			18.49	4.39
23/09/2016	9:58:01 AM	1.60	3.55				
23/09/2016	10:03:33 AM	2.30	4.28			21.87	3.83
6/12/2016	2:04:36 PM	2.55	4.16				
6/12/2016	2:44:38 PM	2.65	4.14			20.81	3.98
24/02/2017	9:11:32 AM	2.10	3.86				
24/02/2017	9:27:42 AM	2.47	4.14			20.79	3.79
28/04/2017	10:37:41 AM	2.21	4.03				
28/07/2017	10:36:43 AM	2.17	3.95			19.53	3.81
1/11/2017	10:22:07 AM	1.73	3.55				
1/11/2017	10:34:47 AM	1.86	3.79			18.70	3.90
6/02/2018	9:09:32 AM	2.07	3.92			20.14	4.21
27/04/2018	10:29:00 AM	2.11	3.84			19.93	3.99
3/08/2018	12:01:59 PM	1.80	3.44			20.07	3.88
3/08/2018	12:17:00 PM	2.19	3.93				
9/11/2018	11:33:06 AM	1.72	3.63			18.50	4.06
7/12/2018	11:24:11 AM	1.88	3.67			19.53	3.57
7/12/2018	12:03:37 PM	2.40	4.09				
15/02/2019	12:04:24 PM	1.83	3.68				
15/02/2019	12:09:31 PM	2.14	3.91				
29/03/2019	9:57:49 AM	1.79	3.76				
29/03/2019	10:18:43 AM	2.31	4.09				
14/06/2019	10:44:42 AM	1.99	3.85				
14/06/2019	11:03:02 AM	2.21	3.94				
4/09/2019	9:57:50 AM	1.69	3.90				
4/09/2019	10:16:13 AM	1.97	4.16				
9/12/2019	11:19:10 AM	1.77	3.45				

## Spirometry [BTPS]

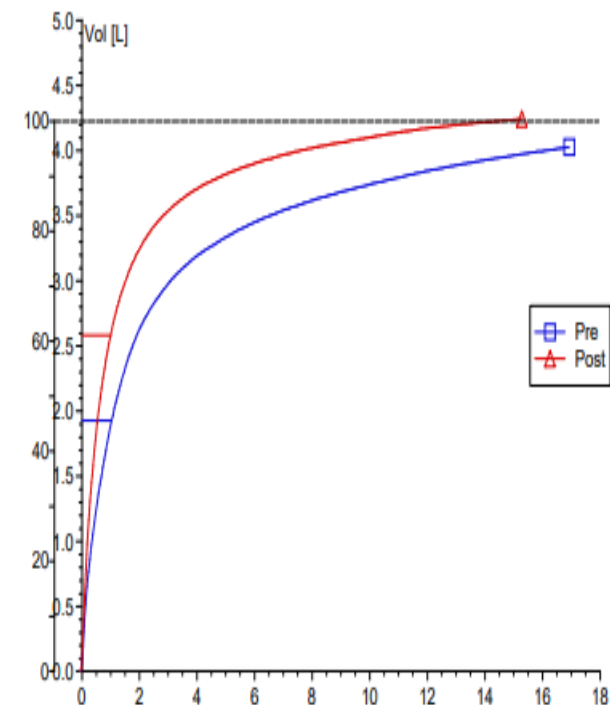
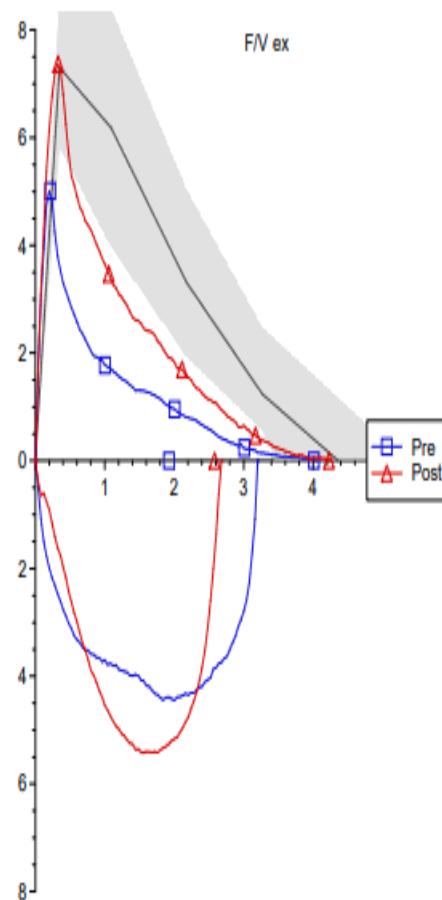
		Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
Visit date		20.05.21	20.05.21		20.05.21			20.05.21
Visit time		11:14AM	11:14AM		11:14AM			11:14AM
FEV1	L	3.47	1.92	55.5	2.58	74.4	34.1	2.73
FVC	L	4.36	4.01	92.0	4.23	97.0	5.5	3.44
FEV1/FVC	%	80	48	59.8	61	76.0	27.1	69
FEF 25-75%	L/s	3.30	0.71	21.6	1.28	38.7	79.3	1.92
FEF 50 % FIF 50	%		23		32		42.3	

GLI (Quanjer) spirometry predicted values used for spirometry parameters

## Gas Transfer [volumes at BTPS, gases at STPD]

		Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
DLCO_SB	ml/(min*mmHg)	26.03	20.14	77.4				20.11
Hb	g(Hb)/dL		11.70					
DLCOc_SB	ml/(min*mmHg)	26.03	21.35	82.0				20.11
VA_SB	L	6.24	5.24	83.9				5.08
KCOc_SB	ml/(min*mmHg*L)	4.23	4.08	96.5				3.30
BHT	sec		8.90					
Barometric Pressure	mmHg		768.82					
SpO2	%		98					

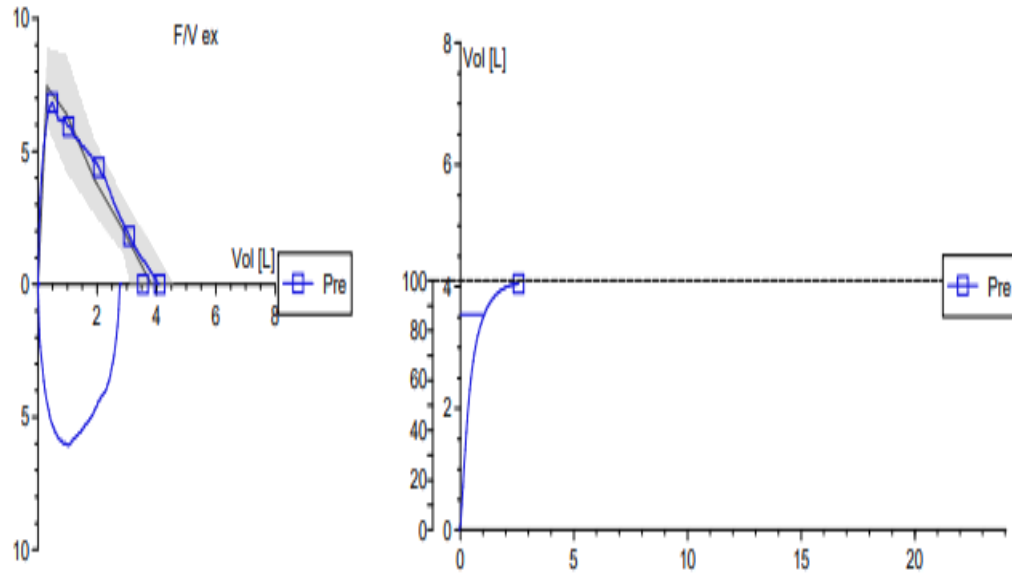
GLI (Stanojevic) 2017 predicted values used for gas transfer parameters



Report:

## Spirometry [BTPS]

		Pred	Pre Challenge	%Pred	LLN
Visit date		17.05.21	17.05.21		17.05.21
Visit time		09:10AM	09:10AM		09:10AM
FEV 1	L	3.36	3.54	105.1	2.70
FVC	L	3.82	4.10	107.2	3.10
FEV1/FVC	%	89	86	97.4	78
FEF 25-75%	L/s	3.92	3.88	99.1	2.60
FEF 50 % FIF 50	%		78		

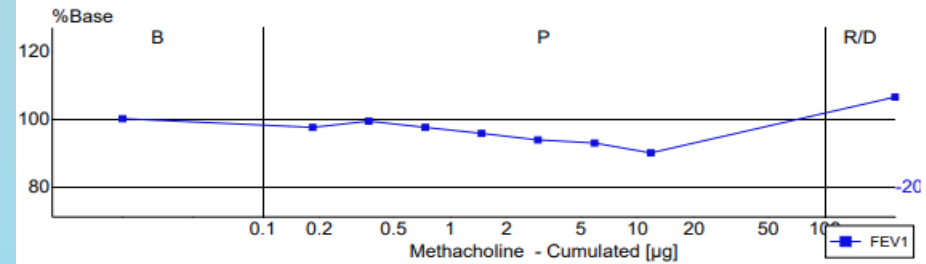


### Comment

Tested by: A Pazeski  
BDs withheld for 72 hours before testing

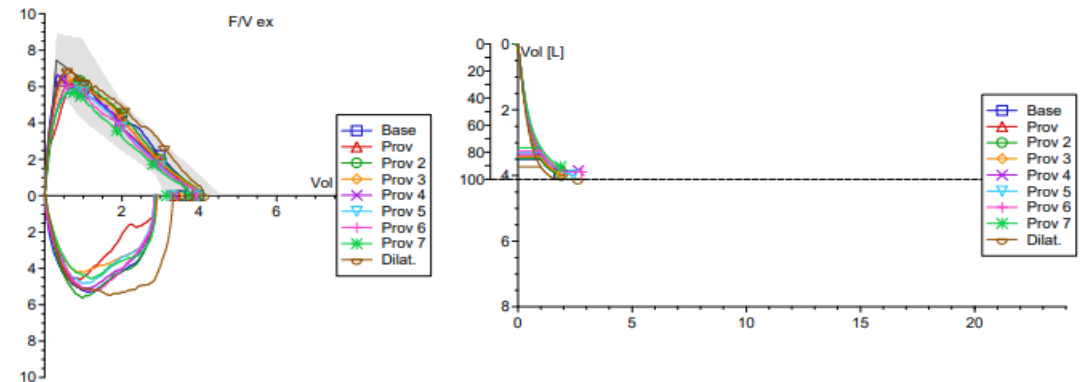
## Methacholine Provocation Test

	Visit time	Dose	Cum. Dose	FEV1
Pred	09:10AM			3.36
Baseline	09:10AM			3.52
Prov 1	09:10AM	0.184	0.184	3.43
%Change				-3
Prov 2	09:10AM	0.183	0.367	3.49
%Change				-1
Prov 3	09:10AM	0.368	0.735	3.43
%Change				-3
Prov 4	09:10AM	0.734	1.469	3.37
%Change				-4
Prov 5	09:10AM	1.469	2.938	3.30
%Change				-6
Prov 6	09:10AM	2.939	5.877	3.26
%Change				-7
Prov 7	09:10AM	5.873	11.750	3.16
%Change				-10
Dilatation	09:10AM	400.000	400.000	3.74
%Change				6



Note: Methacholine dose unit is umol not ug as reported

PD/PC[-20] FEV1 Cumulated: not reached

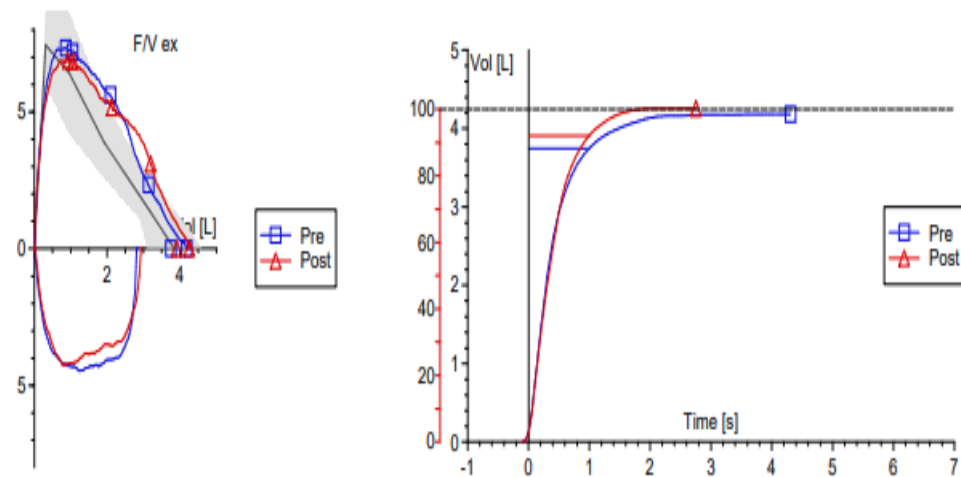


Negative challenge?

## Spirometry [BTPS]

		Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
Visit date		10.10.22	10.10.22		10.10.22			10.10.22
Visit time		03:34PM	03:34PM		03:34PM			03:34PM
FEV1	L	3.35	3.74	111.7	3.90	116.6	4.4	2.69
FVC	L	3.83	4.18	109.0	4.25	110.9	1.7	3.10
FEV1/FVC		0.88	0.90		0.92			0.77
FEF 25-75%	L/s		4.83		5.11			2.56
FET	sec		3.07		2.80			
FIVC	L		2.85		2.92			

GLI (Quanjer) 2012 predicted values used for spirometry parameters



## Comment

Well performed Pre BD spirometry (Grade A). Patient unable to achieve Pre BD expiratory peak during post BD Spirometry, however results were repeatable.

Testing performed 16hrs post BD Symbicort.

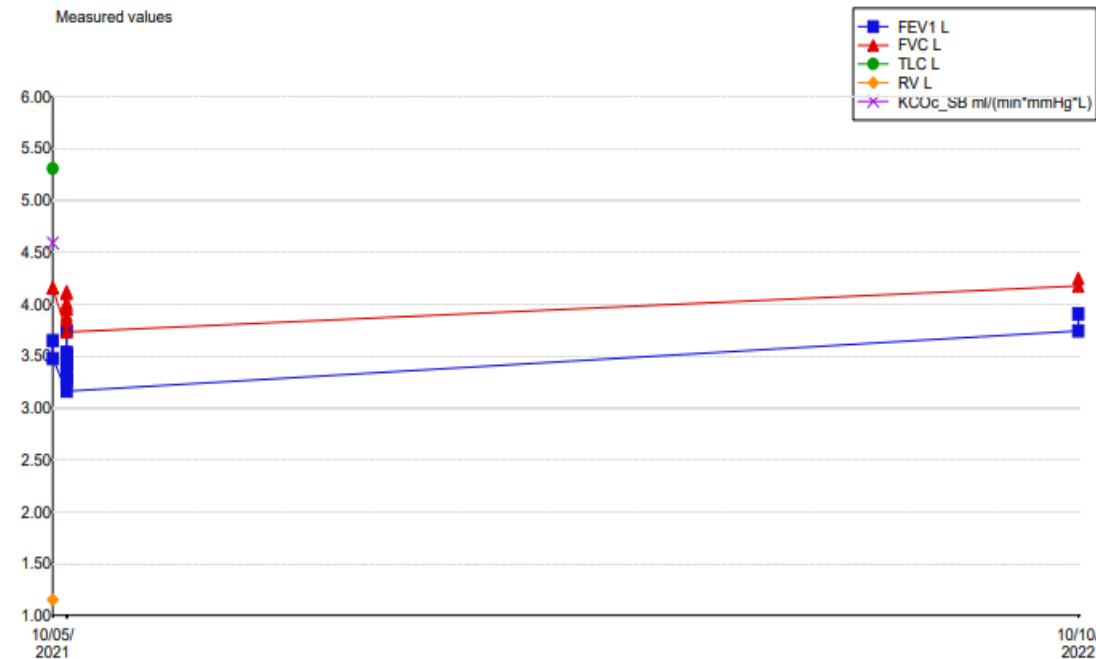
A single FeNO measurement made using Vivatmo pro with an average flow rate of 50mL/sec.

FeNO = 44ppb (Normal <20-25ppb, Elevated 20/25-50ppb, High >50ppb).

## Trend Report

Measurement Parameter		Spiro FEV1 (L)	FVC (L)	Body TLC (L)	RV (L)	Diff SB DLCOc_SB (ml/...)	KCOc_SB (ml/...)	Patient Height (cm)	Weight (kg)
Date	Time								
10/05/2021	2:57:45 PM	3.48	4.15	5.31	1.15	22.55	4.59	169.0	68.5
10/05/2021	3:32:18 PM	3.65	4.16					169.0	68.5
17/05/2021	9:10:24 AM	3.54	4.10					169.0	68.5
17/05/2021	9:29:56 AM	3.52	3.95					169.0	68.5
17/05/2021	9:31:45 AM	3.43	3.85					169.0	68.5
17/05/2021	9:34:37 AM	3.49	4.01					169.0	68.5
17/05/2021	9:37:10 AM	3.43	3.95					169.0	68.5
17/05/2021	9:40:09 AM	3.37	3.85					169.0	68.5
17/05/2021	9:42:50 AM	3.30	3.98					169.0	68.5
17/05/2021	9:46:47 AM	3.26	3.89					169.0	68.5
17/05/2021	9:50:24 AM	3.16	3.73					169.0	68.5
17/05/2021	10:03:54 AM	3.74	4.12					169.0	68.5
10/10/2022	3:34:30 PM	3.74	4.18					169.0	73.9
10/10/2022	4:06:26 PM	3.90	4.25					169.0	73.9

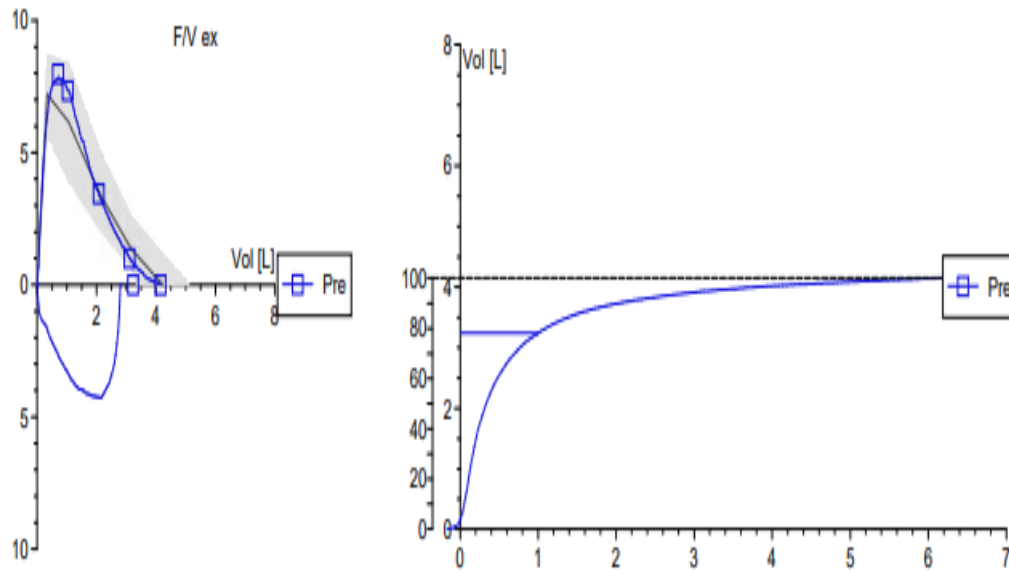
Measured values



FeNO, FEV1

## Spirometry [BTPS]

		Pred	Pre Challenge	%Pred	LLN
Visit date		22.10.18	22.10.18		22.10.18
FEV1	L	3.42	3.23	94.5	2.72
FVC	L	4.22	4.15	98.3	3.37
FEV1/FVC	%	82	78	95.4	71
FEF 25-75%	L/s	3.44	2.82	82.1	2.08
FEF 50 % FIF 50	%		88		

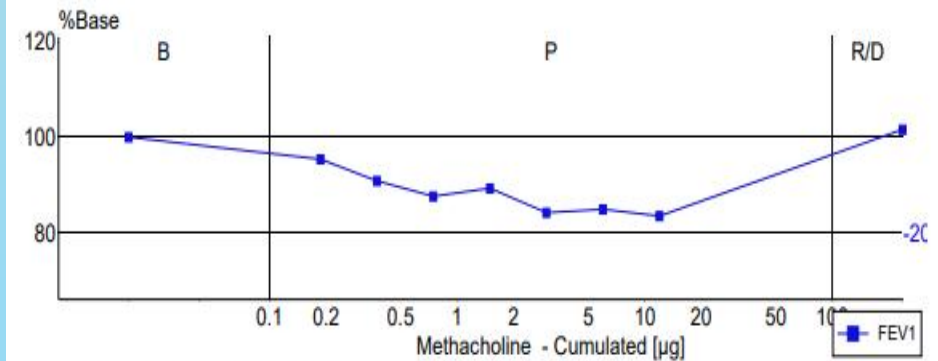


### Comment

Testing by: Jenn Taylor

## Methacholine Provocation Test

	Visit time	Dose	Cum. Dose	FEV1
Pred	02:56PM			3.42
Baseline	02:56PM			3.22
Prov 1	02:56PM	0.187	0.187	3.07
%Change				-5
Prov 2	02:56PM	0.187	0.374	2.92
%Change				-9
Prov 3	02:56PM	0.373	0.747	2.82
%Change				-12
Prov 4	02:56PM	0.748	1.495	2.87
%Change				-11
Prov 5	02:56PM	1.494	2.989	2.71
%Change				-16
Prov 6	02:56PM	2.990	5.979	2.73
%Change				-15
Prov 7	02:56PM	5.981	11.960	2.69
%Change				-16
Dilatation	02:56PM	400.000	400.000	3.27
%Change				2



Note: Methacholine dose unit is umol not ug as reported

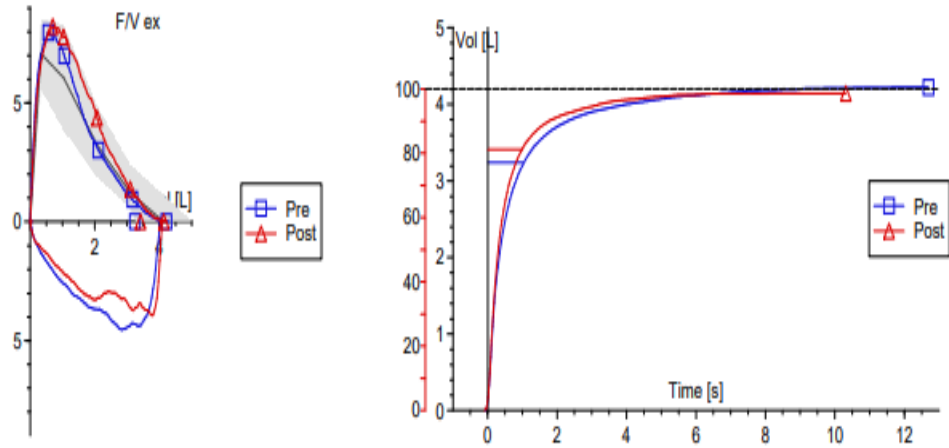
PD/PC[-20] FEV1 Cumulated: not reached

Is this asthma?

## Spirometry [BTPS]

		Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
Visit date		09.09.22	09.09.22		09.09.22			09.09.22
Visit time		08:34AM	08:34AM		08:34AM			08:34AM
FEV1	L	3.30	3.24	98.1	3.41	103.3	5.3	2.61
FVC	L	4.11	4.21	102.3	4.13	100.4	-1.8	3.26
FEV1/FVC		0.81	0.77		0.83			0.70
FEF 25-75%	L/s		2.53		3.54			1.91
FET	sec		12.70		10.31			
FIVC	L		4.17		4.07			

GLI (Quanjer) 2012 predicted values used for spirometry parameters



## Comment

Testing performed 26hrs post Symbicort.

Well performed spirometry (Grade A).

A single FeNO measurement made using Vivatmo pro with an average flow rate of 50mL/sec.

FeNO = 39ppb (Normal <20-25ppb, Elevated 20/25-50ppb, High >50ppb).

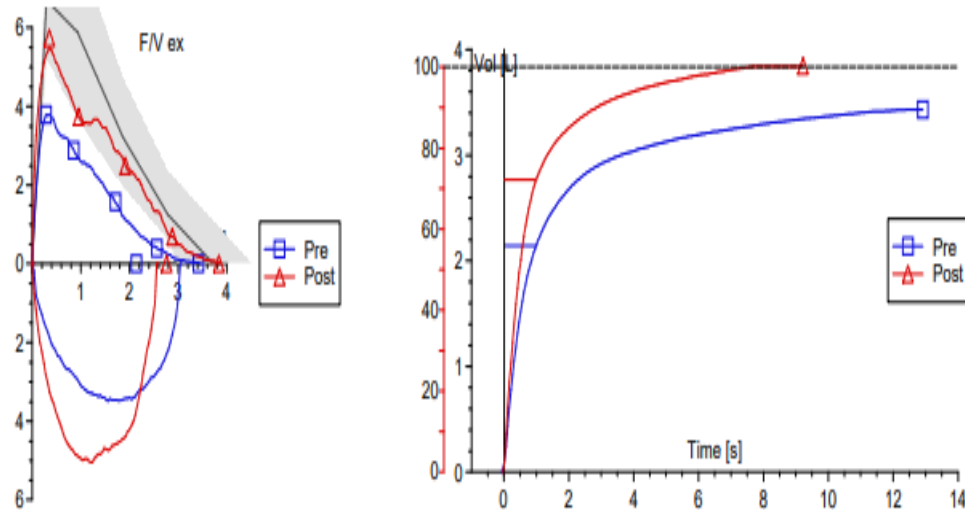
## Trend Report

Measurement Parameter		Spiro		Body		Diff SB		Patient	
Date	Time	FEV1 (L)	FVC (L)	TLC (L)	RV (L)	DLCOc_SB (ml/...	SBKCOc_SB (ml/...	Height (cm)	Weight (kg)
24/09/2018	2:54:57 PM	3.18	4.07	5.87	1.79			173.0	68.0
24/09/2018	3:18:52 PM	3.32	4.04			21.98	4.07	173.0	68.0
22/10/2018	2:56:07 PM	3.23	4.15					173.0	68.0
22/10/2018	3:17:28 PM	3.22	3.60					173.0	68.0
22/10/2018	3:19:20 PM	3.07	3.57					173.0	68.0
22/10/2018	3:21:19 PM	2.92	3.37					173.0	68.0
22/10/2018	3:23:11 PM	2.82	3.30					173.0	68.0
22/10/2018	3:25:52 PM	2.87	3.42					173.0	68.0
22/10/2018	3:27:50 PM	2.71	3.07					173.0	68.0
22/10/2018	3:31:33 PM	2.73	3.18					173.0	68.0
22/10/2018	3:34:04 PM	2.69	3.29					173.0	68.0
22/10/2018	3:37:00 PM	3.27	4.22					173.0	68.0
12/11/2018	10:48:14 AM	3.22	4.24					173.0	68.0
12/11/2018	10:54:58 AM	3.49	4.27			19.26	3.58	173.0	68.0
4/03/2019	10:21:08 AM	3.30	4.29					173.0	69.0
4/03/2019	10:30:41 AM	3.43	4.19			22.54	4.22	173.0	69.0
15/07/2019	9:33:12 AM	3.31	4.35					173.0	70.2
15/07/2019	9:44:42 AM	3.45	4.26					173.0	70.2
2/12/2019	9:15:16 AM	3.08	4.04					173.0	69.8
2/12/2019	9:34:14 AM	3.32	4.05					173.0	69.8
6/01/2021	9:28:15 AM	3.26	4.32			24.36	4.48	173.0	70.2
6/01/2021	9:49:19 AM	3.54	4.30					173.0	70.2
23/04/2021	10:05:39 AM	3.00	4.03			22.94	4.28	173.0	69.7
23/04/2021	10:27:37 AM	3.35	4.08					173.0	69.7
18/06/2021	10:30:15 AM	3.04	4.01			22.04	4.25	172.7	70.5
18/06/2021	11:00:20 AM	3.41	4.20					172.7	70.5
12/11/2021	10:00:16 AM	3.20	4.20					172.7	64.9
12/11/2021	10:12:55 AM	3.39	4.09					172.7	64.9
9/09/2022	8:34:37 AM	3.24	4.20					172.7	71.0
9/09/2022	9:05:49 AM	3.41	4.13					172.7	71.0

## Spirometry [BTPS]

	Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
Visit date	21.06.22	21.06.22		21.06.22			21.06.22
Visit time	08:44AM	08:44AM		08:44AM			08:44AM
FEV1	L 3.05	2.14	70.2	2.77	90.6	29.0	2.43
FVC	L 3.72	3.42	91.8	3.84	103.0	12.3	2.97
FEV1/FVC	0.82	0.63		0.72			0.71
FEF 25-75%	L/s	1.15		2.01			1.96
FET	sec	12.92		9.22			
FIVC	L	3.00		2.64			

GLI (Quanjer) 2012 predicted values used for spirometry parameters



## Comment

Well performed spirometry (Grade A)

A single FeNO measurement made using Vivatmo pro with an average flow rate of 50mL/sec.

FeNO = 128ppb (Normal <20-25ppb, Elevated 20/25-50ppb, High >50ppb).

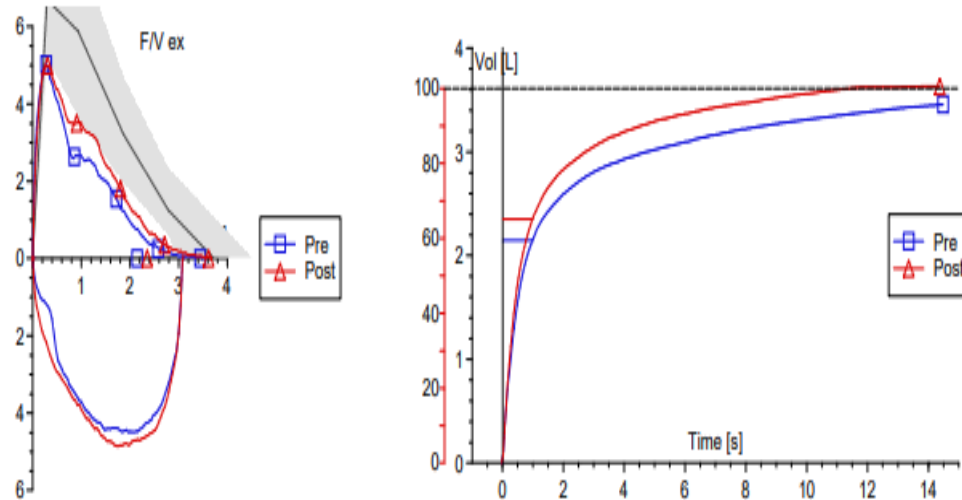
## Trend Report

Measurement Parameter		Spiro FEV1 (L)	FVC (L)	Body TLC (L)	RV (L)	Diff SB	
Date	Time					DLCOc_SB (ml/m...)	KCOc_SB (ml/m...)
2/02/2015	9:00:31 AM	1.84	3.07	5.82	2.66		
2/02/2015	9:33:18 AM	2.44	3.56			26.76	6.25
19/06/2018	12:21:35 PM	1.28	2.61				
19/06/2018	12:31:02 PM	1.45	2.93			22.91	6.08
3/05/2019	11:30:04 AM	1.21	2.60			20.64	5.24
28/08/2019	1:57:05 PM	1.21	2.60				
28/08/2019	2:20:29 PM	1.33	2.73				
11/02/2020	11:05:37 AM	1.22	2.56			23.29	6.53
24/06/2020	9:42:17 AM	1.86	3.21				
24/06/2020	10:03:24 AM	2.38	3.48				
11/08/2020	9:33:25 AM	2.25	3.29				
11/08/2020	9:48:24 AM	2.56	3.38				
8/12/2020	1:42:24 PM	1.45	2.78				
8/12/2020	1:57:32 PM	1.88	3.13				
29/01/2021	11:46:48 AM	1.77	3.10			23.95	5.17
29/01/2021	12:19:15 PM	2.28	3.44			26.06	5.63
14/05/2021	10:34:02 AM	1.42	2.84			20.99	4.94
14/05/2021	11:09:22 AM	1.90	3.23				
20/05/2021	2:04:09 PM	1.23	2.48			21.47	5.76
20/05/2021	2:27:37 PM	1.42	2.72				
7/06/2021	12:24:20 PM	1.32	2.70			21.56	5.49
7/06/2021	12:51:49 PM	1.53	2.88				
17/09/2021	11:02:17 AM	1.30	2.53			22.05	5.34
17/09/2021	11:19:18 AM	1.61	3.10				
21/12/2021	3:28:06 PM	1.52	2.99				
21/12/2021	3:43:02 PM	1.98	3.32				
21/06/2022	8:44:39 AM	2.14	3.42				
21/06/2022	9:05:42 AM	2.77	3.84				

## Spirometry [BTPS]

		Pred	PreBD	%Pred	PostBD	%Pred	%Change	LLN
Visit date		21.07.22	21.07.22		21.07.22			21.07.22
Visit time		09:07AM	09:07AM		09:07AM			09:07AM
<b>FEV1</b>	<b>L</b>	3.05	2.15	70.4	2.35	77.0	9.4	2.43
<b>FVC</b>	<b>L</b>	3.72	3.44	92.5	3.62	97.1	5.0	2.97
<b>FEV1/FVC</b>		0.82	0.62		0.65			0.71
<b>FEF 25-75%</b>	<b>L/s</b>		0.95		1.23			1.96
<b>FET</b>	<b>sec</b>		14.49		14.39			
<b>FIVC</b>	<b>L</b>		3.12		3.28			

GLI (Quanjer) 2012 predicted values used for spirometry parameters



### Comment

Testing performed 12hrs post Spiriva, Alvesco, Symbicort, Seritide, Ventolin.  
 Well performed spirometry (Grade A). A single FeNO measurement made using Vivatmo pro with an average flow rate of 50mL/sec.  
 FeNO = 173ppb (Normal <20-25ppb, Elevated 20/25-50ppb, High >50ppb).

## Trend Report

Measurement Parameter	Date	Time	Spiro		Body		Diff SB		Patient	
			FEV1 (L)	FVC (L)	TLC (L)	RV (L)	DLCOc_SBKCOc_SB (ml/...)	(ml/...)	Height (cm)	Weight (kg)
	2/02/2015	9:00:31 AM	1.84	3.07	5.82	2.66			165.0	60.8
	2/02/2015	9:33:18 AM	2.44	3.56			26.76	6.25	165.0	60.8
	19/06/2018	12:21:35 PM	1.28	2.61					163.2	63.2
	19/06/2018	12:31:02 PM	1.45	2.93			22.91	6.08	163.2	63.2
	3/05/2019	11:30:04 AM	1.21	2.60			20.64	5.24	163.2	60.3
	28/08/2019	1:57:05 PM	1.21	2.60					163.2	61.8
	28/08/2019	2:20:29 PM	1.33	2.73					163.2	61.8
	11/02/2020	11:05:37 AM	1.22	2.56			23.29	6.53	163.2	61.1
	24/06/2020	9:42:17 AM	1.86	3.21					163.2	64.7
	24/06/2020	10:03:24 AM	2.38	3.48					163.2	64.7
	11/08/2020	9:33:25 AM	2.25	3.29					163.2	65.3
	11/08/2020	9:48:24 AM	2.56	3.38					163.2	65.3
	8/12/2020	1:42:24 PM	1.45	2.78					163.2	63.9
	8/12/2020	1:57:32 PM	1.88	3.13					163.2	63.9
	29/01/2021	11:46:48 AM	1.77	3.10			23.95	5.17	163.2	65.9
	29/01/2021	12:19:15 PM	2.28	3.44			26.06	5.63	163.2	65.9
	14/05/2021	10:34:02 AM	1.42	2.84			20.99	4.94	163.2	65.9
	14/05/2021	11:09:22 AM	1.90	3.23					163.2	65.9
	20/05/2021	2:04:09 PM	1.23	2.48			21.47	5.76	163.2	65.9
	20/05/2021	2:27:37 PM	1.42	2.72					163.2	65.9
	7/06/2021	12:24:20 PM	1.32	2.70			21.56	5.49	163.2	65.9
	7/06/2021	12:51:49 PM	1.53	2.88					163.2	65.9
	17/09/2021	11:02:17 AM	1.30	2.53			22.05	5.34	163.2	64.6
	17/09/2021	11:19:18 AM	1.61	3.10					163.2	64.6
	21/12/2021	3:28:06 PM	1.52	2.99					163.2	64.6
	21/12/2021	3:43:02 PM	1.98	3.32					163.2	64.6
	21/06/2022	8:44:39 AM	2.14	3.42					163.2	64.6
	21/06/2022	9:05:42 AM	2.77	3.84					163.2	64.6
	21/07/2022	9:07:04 AM	2.15	3.44					163.2	66.8
	21/07/2022	9:32:25 AM	2.35	3.62					163.2	66.8



## Session 1 – Allergy Take 1

### Relevant HealthPathways

- Central Coast HealthPathways website – <https://centralcoast.communityhealthpathways.org/>  
Username: centralcoast Password: 1connect
- [Adverse Food Reactions in Children](#) pathway
- [Unsettled Infant](#) pathway
- [Anaphylaxis](#) pathway
- [Urgent Paediatric Assessment](#) referral page
- [Non-urgent Paediatric Assessment](#) referral page
- [Paediatric Medical Advice](#) referral page
- [Non-urgent Immunology and Allergy Assessment](#) referral page
- [Dietitian Assessment for Children](#) referral page
- [Gastroenterology Assessment](#) referral page

## Session 2 – The Vicki Burneikis Memorial Session

### Wheeze in Children

### Relevant HealthPathways

- Central Coast HealthPathways website – <https://centralcoast.communityhealthpathways.org/>  
Username: centralcoast Password: 1connect
- [Asthma in Children](#) section
  - [Acute Asthma in Children](#) pathway
  - [Non-acute Asthma in Children](#) pathway
  - [Inhalers and Techniques](#) pathway
- [Wheeze in Children Aged 1 to 5 Years](#) pathway
- [Bronchiolitis](#) pathway
- [Cough in Children](#) pathway
- Allergic Rhinitis and Nasal Obstruction in Children pathway
- [Urgent Paediatric Assessment](#) referral page
- [Non-urgent Paediatric Assessment](#) referral page
- [Paediatric Medical Advice](#) referral page
- [Non-urgent Immunology and Allergy Assessment](#) referral page

## Session 3 – Allergy Take 2

### Relevant HealthPathways

- Central Coast HealthPathways website –  
<https://centralcoast.communityhealthpathways.org/>  
Username: centralcoast Password: 1connect
- [Unsettled Infant](#) pathway
- [Adverse Food Reactions in Children](#) pathway
- [Eczema \(Atopic Dermatitis\) in Children](#) pathway
- [Non-urgent Paediatric Assessment](#) referral page
- [Paediatric Medical Advice](#) referral page
- [Non-urgent Immunology and Allergy Assessment](#) referral page



## Session 4 – Wheezy Teens Relevant HealthPathways

- Central Coast HealthPathways website – <https://centralcoast.communityhealthpathways.org/>  
Username: centralcoast Password: 1connect
- [Asthma in Children](#) section
  - [Acute Asthma in Children](#) pathway
  - [Non-acute Asthma in Children](#) pathway
  - [Inhalers and Techniques](#) pathway
- Allergic Rhinitis and Nasal Obstruction in Children pathway
- [Urgent Paediatric Assessment](#) referral page
- [Non-urgent Paediatric Assessment](#) referral page
- [Paediatric Medical Advice](#) referral page
- [Non-urgent Immunology and Allergy Assessment](#) referral page
- [Asthma in Adults](#) section
  - [Asthma in Adults – Acute](#) pathway
  - [Non-acute Asthma in Adults](#) pathway
    - [Asthma Cycle of Care](#) pathway
    - [Inhaled Corticosteroids \(ICS\)](#) pathway
    - [Combination ICS / LABA Therapy](#) pathway
    - [Inhalers and Techniques](#) pathway