Common respiratory problems in children and young people

Steve Holmes (GP, Shepton Mallet)

Thur 7th December 2023

South West Region Clinical Champions Session

Steve Holmes Declaration of Interests (1)

- **General practitioner, Park Medical Practice, Shepton Mallet**
- **Somerset ICB Clinical Respiratory Lead / Integrated Care Lead**
- **NHS England (National CVD and Respiratory Programme Board)**
- **NHS England (Educational Supervisor (trainer) and Appraiser)**
- **Primary Care Respiratory Society (Policy Lead; Service development and Conference committees)**
- **International Primary Care Respiratory Group (IPCRG) Education Committee Chair**
- **RCGP (Chair Severn Faculty Board) RCGP Rep for Taskforce for Lung Health and National Respiratory Audit Programme)**
- **Recent guideline involvement (Air Travel, Asthma, COPD, Respiratory disease in athletic individuals, Spirometry, Tobacco Dependency)**

Declarations of Interest (2)

Speaker engagements, educational projects, conference attendance, advisory board work (in the last three years)

Academic work

University College, London; Universities of Birmingham, Cambridge, Edinburgh

Other providers

Asthma and Lung UK, Best Practice, Doctorology, Education for Health, EQUIP, Guidelines in Practice, InterYem, MedAll, Mediconf, MIMS, Omniamed, Pulse, RCGP Conferences, Respiratory Professional Care, Somerset GP Education Trust

Pharmaceutical / device companies

Aide Health, Astra Zeneca, Boehringer Ingelheim, Chiesi, Pulmonx, Sanofi, Teva, Trudell Medical International

No tobacco shares.

The Primary Care Respiratory Society

Your primary resource for best practice in respiratory care.

Cough in children – many not associated with chest symptoms / signs

- For example:
- Common cold[1]
- Sore throat / pharyngitis[2]
- Coronavirus (COVID 19)[3]
- Otitis media[4]
- Croup[4]

1. National Institute for Clinical Excellence. Common Cold (Clinical Knowledge Summary). 2022 2. National Institute for Clinical Excellence. Sore Throat (Clinical Knowledge Summary). 2022. 3. National Institute for Clinical Excellence. Coronavirus - COVID 19 (Clinical Knowledge Summary). 2022 4. National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022.

Cough - acute with chest signs in children

Viral-induced wheeze

Infective exacerbations of asthma

Bronchiolitis

Pneumonia

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022.

Differential diagnoses of cough with chest signs

- **Bronchiectasis**
  - Frequent chest infections, childhood pneumonia, copious sputum, coarse crepitations
- **Ciliary dyskinesia**
  - Persistent moist cough present from birth (rare)
- **Cystic fibrosis**
  - Persistent moist cough and gastrointestinal symptoms that are often present from birth, and failure to thrive in children.
- **Foreign body aspiration**
  - Sudden-onset cough, stridor (upper airway) or reduced chest wall movement on the affected side, bronchial breathing, and reduced or diminished breath sounds (lower airway).
- **Pertussis**
  - Paroxysms of coughing. There may be vomiting after coughing, or an inspiratory whoop (especially in children, although this may be absent in infants). Occasionally the cough may persist for several months

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022.

Viral induced wheeze

- Age 6mths – 5 years
- wheezing associated with infection only.

- Note: viral-induced wheeze is a distinct diagnosis from asthma, and is caused by a different underlying mechanism.

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022 (NHS Image used in whooping cough).

Exacerbation of asthma

- Suggestive if :
- children with a previous asthma diagnosis[1,2]
- history of wheeze occurring in the absence of infection, and in response to typical stimuli such as exercise or exposure to pollen[1,2]

- Note:
- Infective exacerbations of asthma and viral-induced wheeze are often indistinguishable in children under 5 years of age who present with wheeze and a respiratory tract infection, unless there is a history of wheeze in the absence of infection[1]
- Infective exacerbations are primarily viral[2]

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022 1. British Thoracic Society, Scottish Intercollegiate Guideline Network. SIGN 158 British Guidelines for the Management of Asthma. Guideline. 2019. (Image courtesy of IPCRG)

Bronchiolitis

- Children under 2 years
- peak incidence 3 – 6 mths
- Often URTI for 1-3days followed by persistent cough and tachypnoea / chest recession *and*
- Either wheeze or crackles on chest auscultation (or both).

- Other common symptoms include:
- Fever (in around 30% of cases, usually of less than 39°C).
- Poor feeding (typically after 3 to 5 days of illness).
- Apnoea without other clinical signs in young infants (in particular those under 6 weeks of age).

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022 Image from Southampton Foundation Trust.

Pneumonia

- high fever (over 39°C) and/or
- Cyanosis.
- Raised respiratory rate (greater than 60 breaths per minute, age 0–5 months; greater than 50 breaths per minute, age 6–12 months; greater than 40 breaths per minute, age older than 12 months).
- Signs of increased work of breathing, such as chest indrawing and nasal flaring.
- Persistently focal crackles.
- Oxygen saturation of 95% or less in air.
- Absent breath sounds with a dull percussion note (possibility of pneumonia complicated by an effusion).

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022.

	Pneumonia	Bronchiolitis	Viral-induced wheeze	Exacerbation of asthma
Age	Any age	Under 2 years, peak incidence between 3 and 6 months of age	Under 5 years	Any age
Respiratory rate	Usually increased	Usually increased	May be normal or increased	May be normal or increased
Hyperinflation	Not present	Often present (but difficult to detect in infants aged <6 months)	May be present	May be present
Wheeze	Not usually present	May be present	Present	Present
Crackles	Coarse crackles, usually focal	Fine crackles present throughout lung fields	Not usually present	Not usually present

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022; 1. Fleming DM, Elliot AJ. The management of acute bronchitis in children. Expert Opin Pharmacother. 2007;8(4):415-26; 1. Harris M, Clark J, Coote N, Fletcher P, Harnden A, McKean M, et al. British Thoracic Society guidelines for the management of community acquired pneumonia in children: update 2011. Thorax. 2011;66 Suppl 2:ii1-23; 1. Ricci V, Nunes VD, Murphy MS, Cunningham S. Bronchiolitis in children: summary of NICE guidance. Bmj. 2015;350.

Potential red flag clinical features

- Haemoptysis.
- Hoarseness.
- Peripheral oedema with weight gain.
- Prominent dyspnoea, especially at rest or at night.
- Systemic symptoms, such as fever or weight loss.
- Trouble swallowing.
- Vomiting.

National Institute for Clinical Excellence. Cough (Clinical Knowledge Summary). 2022
NHS Image on red flags.

How should I manage a child with viral-induced wheeze or an infective exacerbation of asthma?

- **Determine the severity of the attack, bearing in mind that children in a severe or life-threatening condition sometimes do not appear to be distressed.**
  - Level of conscious and agitation (agitation and behaviour changes can be linked to hypoxia
  - Exhaustion (inability to complete sentences?), cyanosis (bluish lips or extremities), and involvement of accessory muscles of respiration while the child is at rest.
  - Examine the child's chest, and record their respiratory rate, pulse, and blood pressure.
  - Peak expiratory flow rate (if they are old and well enough to comply)
    - use best of three recordings compared to their best or predicted PEFR value.
  - Measure the child's oxygen saturation in room air using pulse oximetry (if available).

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022.

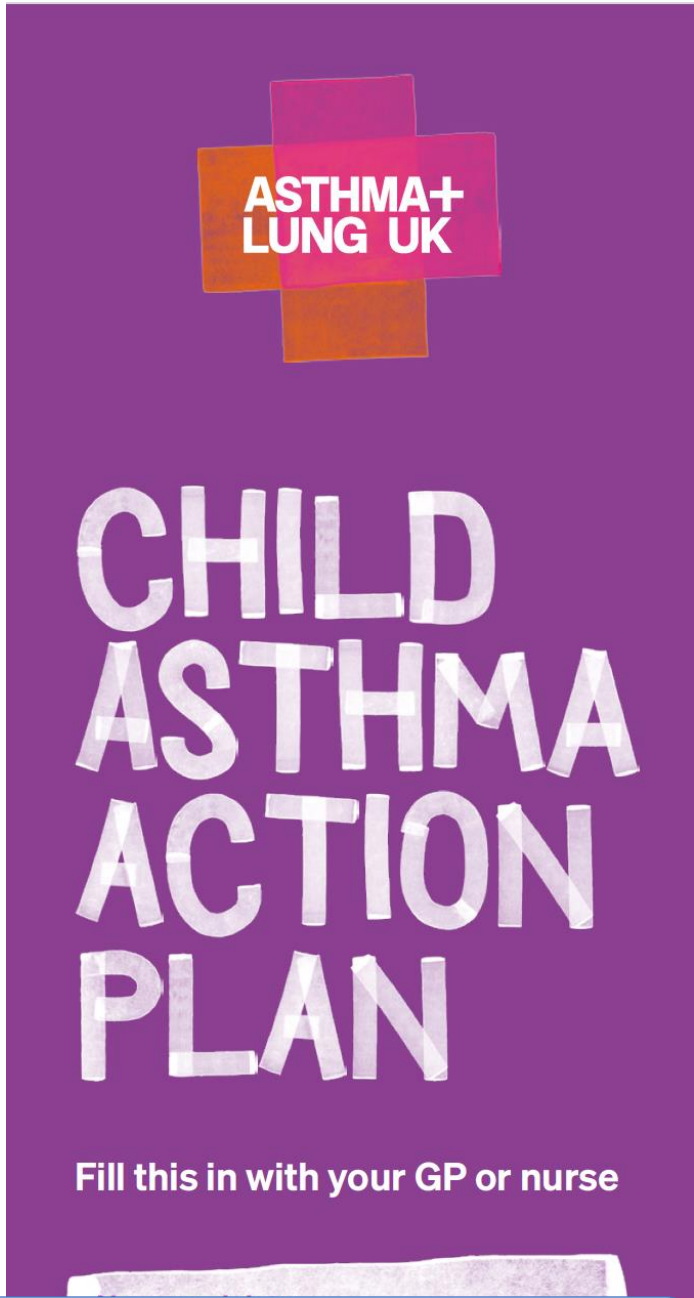
Acute severe – admit if persists

Acute severe

SpO_2 <92%

PEF 33–50% best or predicted

- Can't complete sentences in one breath or too breathless to talk or feed
- Heart rate >140/min (1-5 years) *or* >125/min (>5 years)
- Respiratory rate >40/min (1-5 years) *or* >30/min (>5 years)



British Thoracic Society, Scottish Intercollegiate Guideline Network. SIGN 158 British Guidelines for the Management of Asthma. Guideline. 2019.

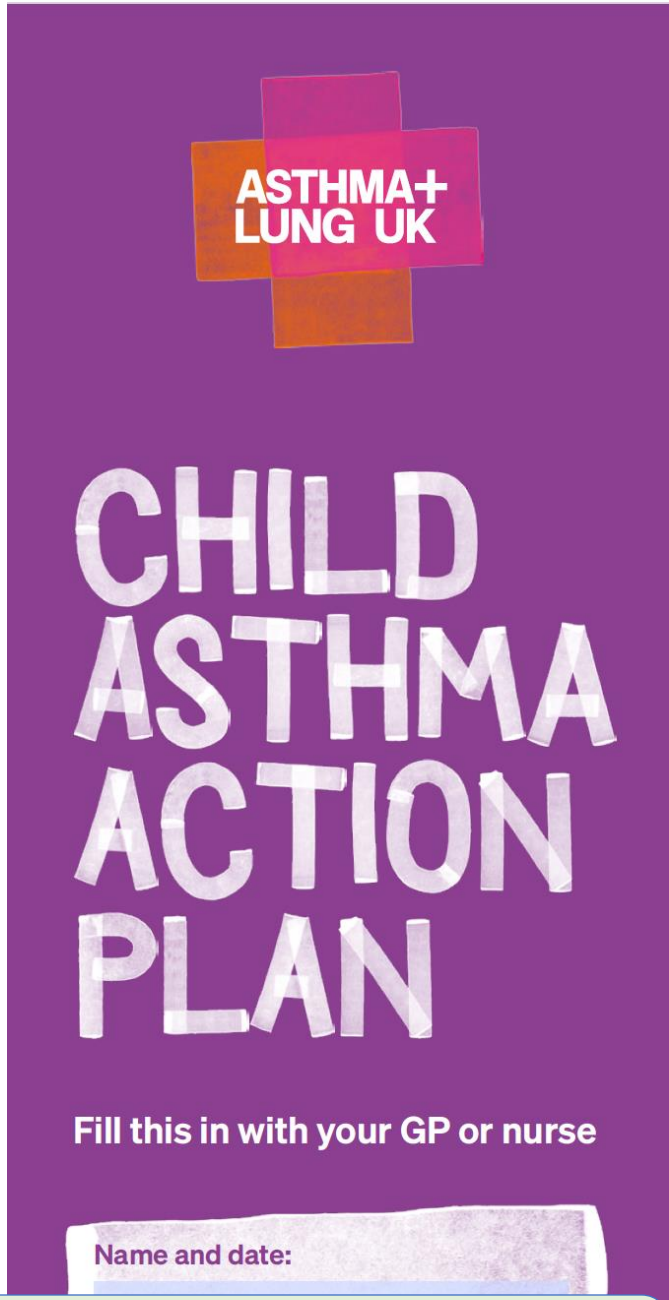
Life threatening - admit

Life-threatening

SpO_2 <92%

PEF <33% best or predicted

- Exhaustion
- Hypotension
- Cyanosis
- Silent chest
- Poor respiratory effort
- Confusion



British Thoracic Society, Scottish Intercollegiate Guideline Network. SIGN 158 British Guidelines for the Management of Asthma. Guideline. 2019.

Immediately refer children with bronchiolitis for emergency hospital care if any of following

- Apnoea (observed or reported).
- Child looks seriously unwell.
- Severe respiratory distress, for example grunting, marked chest recession, or a respiratory rate of over 70 breaths/minute.
- Central cyanosis.
- Listlessness, decreased respiratory effort

USUALLY 999 AMBULANCE

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022.
Image NHS Ambulance

Consider admission in bronchiolitis if any of following

- Respiratory rate of over 60 breaths/minute.
- Difficulty with breast feeding / oral fluid intake (50-75% of usual volume)
- Clinical dehydration (Capillary refill time more than 3 seconds, reduced urine output, dry membranes)
- Persistent oxygen saturation of less than 92% when breathing air.

- Factors which should lower the threshold for hospital admission include (chronic lung disease, congenital heart disease, neuromuscular disorders, immunodeficiency, aged under 3 months, prematurity, adverse social circumstances or concern regarding carer's capacity to care)

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022.

Suspected pneumonia - Immediately refer children for emergency hospital care if any of following

- Persistent oxygen saturation of less than 92% when breathing air.
- Grunting, marked chest recession, or a respiratory rate of over 60 breaths/minute.
- Cyanosis
- Absent breath sounds / dull percussion (effusion)
- Child looks seriously unwell, does not wake, or if roused does not stay awake, or does not respond to normal social cues.
- A temperature of 38°C or higher in a child aged three months or less.

USUALLY 999 AMBULANCE

National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022.
Image NHS Ambulance

Suspected pneumonia -consider referral to hospital if.

- Temp 39°C or higher in a child aged 3–6 months.
- Tachycardia (more than 160 beats/minute if less than 1y, more than 150 beats/minute if 1-2y old and more than 140 beats/minute if aged 2-5y)
- Inadequate oral fluid intake (50-75% of usual volume)
- Pallor of skins, lips or tongue
- Abnormal response to social cues, waking only with prolonged stimulation, decreased activity
- Clinical dehydration (indicated by reduced skin turgor and/or a capillary refill time of more than three seconds, and/or dry mucous membranes, and/or reduced urine output)
- Factors that should lower the threshold for hospital admission include:
  - Chronic lung disease
  - Parental / carer factors

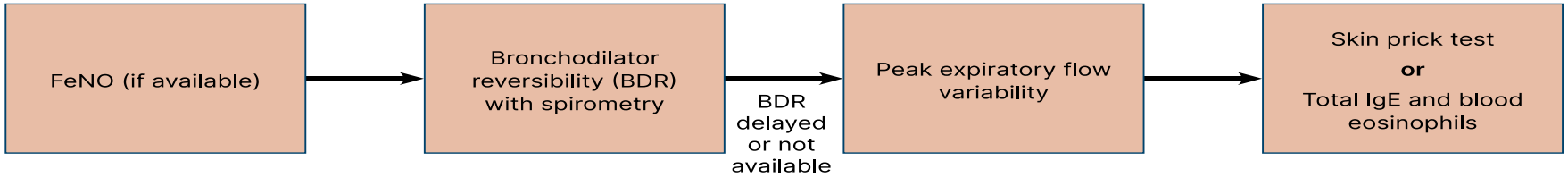
National institute for Clinical Excellence. Cough - acute with chest signs in children (Clinical Knowledge Summary). 2022.

The diagnosis of asthma

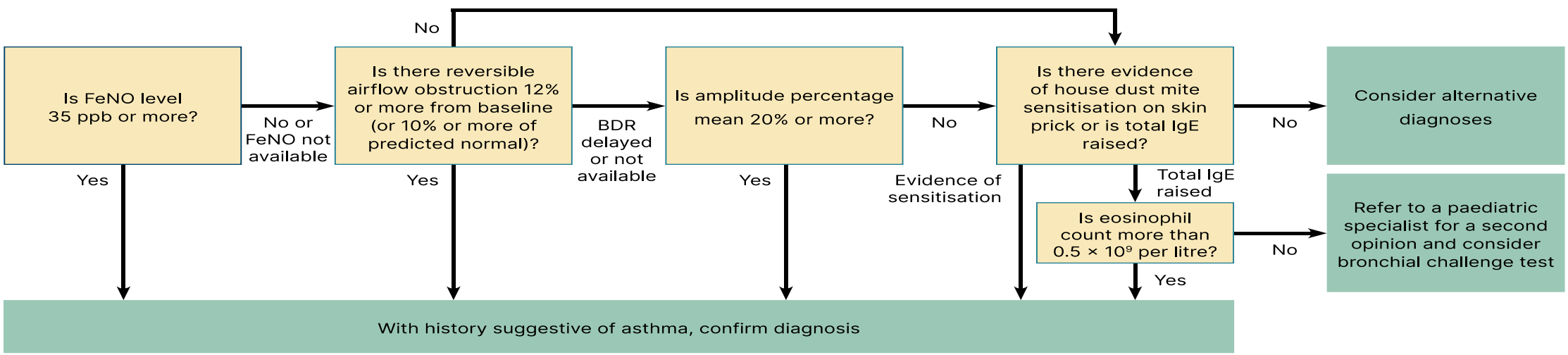
Algorithm B: Objective tests for diagnosing asthma in children aged 5 to 16 with a history suggesting asthma

BTS, NICE and SIGN guideline on asthma

Order of tests



Interpretation of test results



British Thoracic Society | NICE National Institute for Health and Care Excellence | Healthcare Improvement Scotland | SIGN

BTS ISBN: 978-1-917619-27-1. NICE ISBN: 978-1-4731-6638-7. SIGN ISBN: 978-1-909103-96-2.

British Thoracic Society, National Institute for Clinical Excellence, Scottish Intercollegiate Guideline Network. NG245 Asthma: diagnosis, monitoring and chronic asthma management (BTS, NICE, SIGN). 2024.

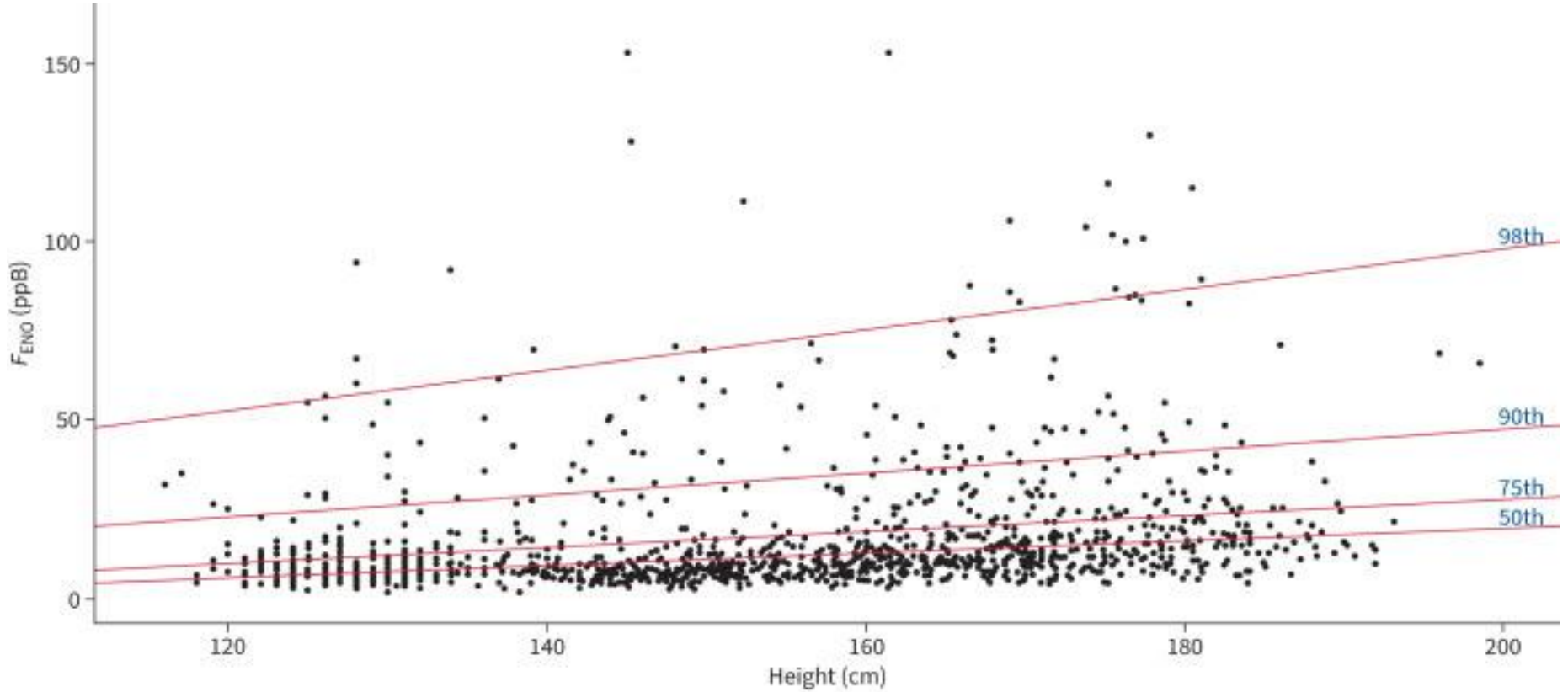
Children and Young People (5-16y)

- FeNO (35ppb)
- Bronchodilator reversibility
- Peak flow variability
- Skin Prick test or blood eosinophils

Asthma in children

Age at presentation	Early onset – has better prognosis Most who start before 2y settle by mid childhood
Sex	Male – more likely to present before puberty Female – more likely to present in adolescence Male – more likely to “grow out” in adolescence
Severity and frequency	More severe and frequent makes more asthma more likely
Atopy	More likely to be asthma
Family history of atopy	More likely to develop asthma

British Thoracic Society, Scottish Intercollegiate Guideline Network. SIGN 158 British Guidelines for the Management of Asthma. Guideline. 2019.



Wang R, Fowler SJ, Turner SW, Drake S, Healy L, Lowe L, et al. Defining the normal range of fractional exhaled nitric oxide in children: one size does not fit all. ERJ Open Res. 2022;8(3).

Fractional Exhaled Nitric Oxide (FeNO)

A positive FeNO test suggests eosinophilic inflammation and provides supportive but not conclusive evidence for an asthma diagnosis.
There is overlap between the levels seen in normal non-asthmatic populations and in people with atopic asthma.

FENO level increased

- Allergic rhinitis exposed to allergen (even without respiratory symptoms
- Rhinovirus in healthy individiuals (variable in people with asthma)
- Men, tall people
- High dietary nitrates (21% increase[2])

FENO level decreased

- Children
- Cigarette smokers
- Caffeine[3] / alcohol consumption[4]
- Inhaled or oral steroids.

1. British Thoracic Society, Scottish Intercollegiate Guideline Network. SIGN 158 British Guidelines for the Management of Asthma. Guideline. 2019.
2. Kroll JL, Werchan CA, Rosenfield D, Ritz T. Acute ingestion of beetroot juice increases exhaled nitric oxide in healthy individuals. PLOS ONE. 2018;13(1):e0191030.
3. Yurach MT, Davis BE, Cockcroft DW. The effect of caffeinated coffee on airway response to methacholine and exhaled nitric oxide. Respir Med. 2011;105(11):1606-10.
4. Afshar M, Poole JA, Cao G, Durazo R, Cooper RC, Kovacs EJ, et al. Exhaled Nitric Oxide Levels Among Adults With Excessive Alcohol Consumption. Chest. 2016;150(1):196-209.

FeNO

- In steroid-naive adults, a FeNO level of 40 parts per billion (ppb) or more is regarded as positive
- Schoolchildren a FeNO level of 35 ppb or more is regarded as a positive test.

- In eight studies in adults recruited from secondary care with symptoms suggestive of asthma, sensitivities for FeNO ranged from 43–88% and specificities from 60–92%. The PPV and NPV ranged from 54–95% and 65–93%. (No primary care studies)
- This means **one in five people with a positive FeNO test will not have asthma (false positive) and one in five people who have a negative FeNO test will have asthma**.

British Thoracic Society, Scottish Intercollegiate Guideline Network. SIGN 158 British Guidelines for the Management of Asthma. Guideline. 2019.

Wheezing under 5 years

- My child is always wheezing – someone has said this is likely to be asthma and I've needed to go to the hospital too. What is it ? What should I do?

- The prevalence of asthma among children ranges from 8.3% to 12.3% in westernized countries with 80% of paediatric asthma patients manifesting symptoms before the age of 6 years.

- Preschool wheeze affects approximately one-third of children in the first 3 years of life

Yang CL, Gaffin JM, Radhakrishnan D. Question 3: Can we diagnose asthma in children under the age of 5 years? Paediatr Respir Rev. 2019;29:25-30.

Why do specialists not diagnose under 5 years of age?

- The Tucson Children's Respiratory Study found that that the majority of children who wheezed at a young age were no longer wheezy by the age of 6 years[1]
- From 6 years onwards, only 1 in 5 children outgrow their symptoms by the age of 19 years[2]

1- Martinez FD, Wright AL, Taussig LM, Holberg CJ, Halonen M, Morgan WJ. Asthma and wheezing in the first six years of life. The Group Health Medical Associates. N Engl J Med. 1995;332(3):133-8. 2- Rakes GP, Arruda E, Ingram JM, Hoover GE, Zambrano JC, Hayden FG, et al. Rhinovirus and respiratory syncytial virus in wheezing children requiring emergency care: IgE and eosinophil analyses. American journal of respiratory and critical care medicine. 1999;159(3):785-90.

High Variability using Episodic Viral Wheeze (EVW) and Multiple Trigger Wheeze (MTW) as "Phenotypes"

n=132 (2-6yr) followed for 1 yr

Table 2 Retrospective phenotype determined at start of study compared with phenotype determined prospectively

		Retrospective phenotype determined at start of study		
		EVW	MTW	Total
Phenotype determined prospectively	No wheeze	13 (34.2%)	11 (15.5%)	24 (22.0%)
	EVW	12 (31.6%)	22 (31.0%)	34 (31.2%)
	MTW	13 (34.2%)	38 (53.5%)	51 (46.8%)
	Total	38 (100%)	71 (100%)	109 (100%)

EVW = Episodic viral wheeze; MTW = Multiple trigger wheeze.
Numbers in brackets indicate percentage of phenotype at the start of the study.

In only one year of follow-up the "phenotype classification" switched in 54%

Schultz A, Devadason SG, Savenije OE, Sly PD, Le Souef PN, Brand PL. The transient value of classifying preschool wheeze into episodic viral wheeze and multiple trigger wheeze. Acta Paediatr. 2010;99(1):56-60.

Under 5 wheezing – two patterns (but grey inbetween)

Episodic Viral Wheeze

- Isolated wheezing episodes
- Often with evidence of viral cold
- Well between episodes
- No history of atopy in child or family

Multiple Trigger Wheeze

- Episodes of wheezing
- More triggers than just colds
- Symptoms of cough / wheeze between episodes
- Personal or family history of asthma/eczema/hay fever / allergy

Brand P. New guidelines on recurrent wheeze in preschool children: implications for primary care. Primary Care Respiratory Journal. 2008;17(4):243-5.

Brand PLP, Caudri D, Eber E, Gaillard EA, Garcia-Marcos L, Hedlin G, et al. Classification and pharmacological treatment of preschool wheezing: changes since 2008. European Respiratory Journal. 2014;43(4):1172-7.

Treatment of under 5 wheezing - acute

- No treatment if mild[1]
- Salbutamol by spacer better than placebo and nebuliser (but weak evidence)[1]
- Montelukast [1] (evidence weak) but review suggests not effective [2]
- Systemic corticosteroids
  - Only useful in children with acute severe wheeze in hospital; number needed to treat (NNT) to avoid 1 hospitalisation is 3 (meta analysis)[1]
  - One trial in primary care with benefit[3]
- No evidence of benefit in children < 1 year of age

1 - Brand P. New guidelines on recurrent wheeze in preschool children: implications for primary care. Primary Care Respiratory Journal. 2008;17(4):243-5.
2 - Brodlie M, Gupta A, Rodriguez-Martinez CE, Castro-Rodriguez JA, Ducharme FM, McKean MC. Leukotriene receptor antagonists as maintenance or intermittent treatment in pre-school children with episodic viral wheeze. Paediatric respiratory reviews. 2016;17:57-9
3 - Foster SJ, Cooper MN, Oosterhof S, Borland ML. Oral prednisolone in preschool children with virus-associated wheeze: a prospective, randomised, double-blind, placebo-controlled trial. The Lancet Respiratory Medicine. 2018;6(2):97-106

Treatment of under 5 - chronic symptoms

- Use the BTS / SIGN guideline advice[1]
- Inhaled corticosteroid good evidence (less if under one year in age) and montelukast has some evidence[2] though review suggests not effective [3]

1 - British Thoracic Society, Scottish Intercollegiate Guideline Network. SIGN 158 British Guidelines for the Management of Asthma. Guideline. 2019 ; 2 - Brand P. New guidelines on recurrent wheeze in preschool children: implications for primary care. Primary Care Respiratory Journal. 2008;17(4):243-5.; 3 - Brodlie M, Gupta A, Rodriguez-Martinez CE, Castro-Rodriguez JA, Ducharme FM, McKean MC. Leukotriene receptor antagonists as maintenance or intermittent treatment in pre-school children with episodic viral wheeze. Paediatric respiratory reviews. 2016;17:57-9

Paradigms for the diagnosis of asthma in pre-school children

- **Symptoms that persist into childhood = true asthma**
- **Multi-trigger wheeze = true asthma**
- **Asthma symptoms that respond to asthma medication = asthma**

Yang CL, Gaffin JM, Radhakrishnan D. Question 3: Can we diagnose asthma in children under the age of 5 years? Paediatr Respir Rev. 2019;29:25-30.

Paradigms for the diagnosis of asthma in pre-school children

- **Symptoms that persist into childhood = true asthma X**
- **Multi-trigger wheeze = true asthma X**
- **Asthma symptoms that respond to asthma medication = asthma X**

Yang CL, Gaffin JM, Radhakrishnan D. Question 3: Can we diagnose asthma in children under the age of 5 years? Paediatr Respir Rev. 2019;29:25-30.

Top Clinical Tips in children

- "… if it doesn't respond to asthma treatment.. Chances are it isn't asthma"
  - Dr Vincent McGovern

- "And if it does respond, try stopping the asthma treatment after an interval to rule out natural resolution[1]"
  - Professor Andy Bush

1 - Bush A. Diagnosis of asthma in children under five. Primary Care Respiratory Journal. 2007;16(1):7-15

The diagnosis of asthma in children ?

Figure 1: Asthma cardinal symptoms - wheeze, cough, chest tightness, breathlessness

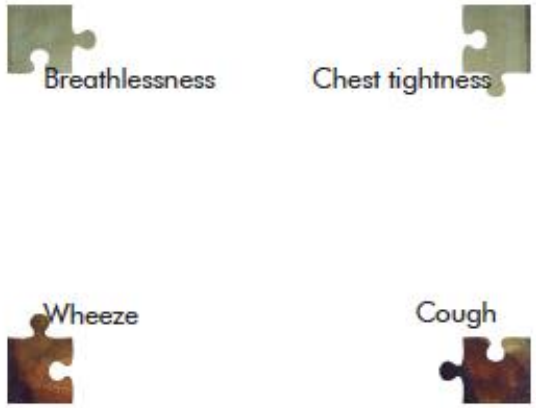


Figure 2: Pieces that do not fit the diagnosis of asthma

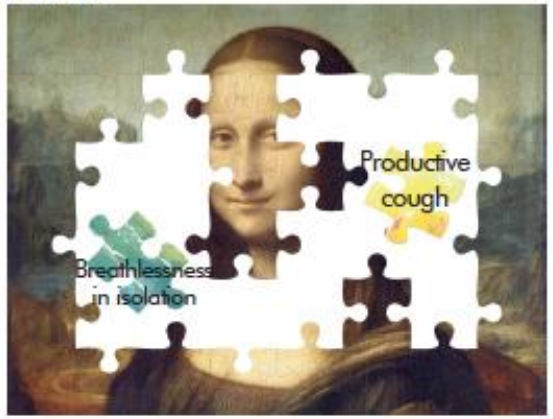


Figure 3: Available tests of airways dysfunction confirm our reasoning

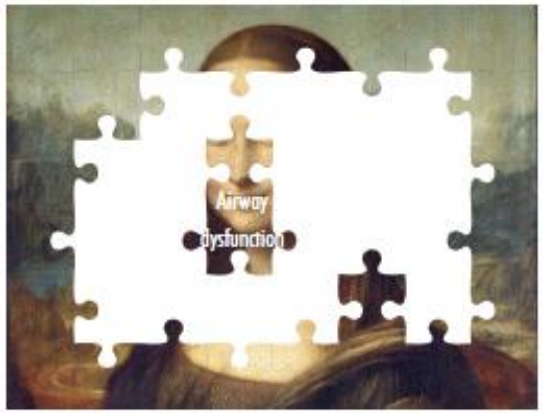
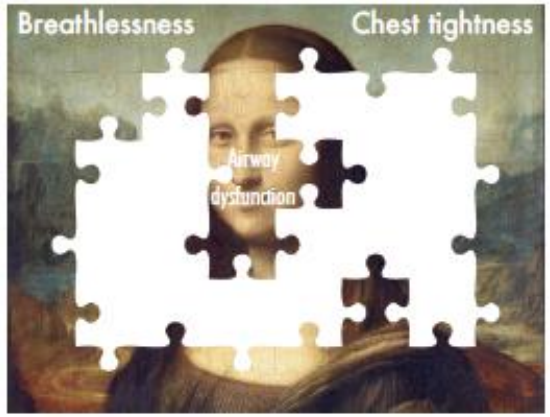


Figure 4: A clear picture



It takes time and patience to do a jigsaw puzzle correctly and get the right picture !

IPCRG Desktop Helper

Algorithm E: Pharmacological management of asthma in children under 5

BTS, NICE and SIGN guideline on asthma

Take into account and try to address the possible reasons for uncontrolled asthma before starting or adjusting medicines for asthma. For example: alternative diagnoses or comorbidities; suboptimal adherence; suboptimal inhaler technique; passive smoking (including e-cigarettes); seasonal factors; environmental factors (such as air pollution and indoor mould exposure)

Symptom relief

Maintenance therapy

Children under 5 with suspected asthma and symptoms indicating need for maintenance therapy or severe acute episodes of difficulty breathing and wheeze

Consider 8 to 12 week trial of twice daily paediatric low-dose ICS — With a SABA

For guidance on dosages for paediatric low-dose ICS, see inhaled corticosteroid doses for the BTS, NICE and SIGN asthma guideline

If symptoms do not resolve during trial

Check inhaler technique and adherence, whether there is an environmental source of their symptoms and review if an alternative diagnosis is likely

Refer the child to a specialist in asthma care if none of these explain treatment failure

If symptoms resolve during trial

Consider stopping ICS and SABA treatment after 8 to 12 weeks and review symptoms after a further 3 months

If symptoms recur after review or acute episode requires systemic corticosteroids or hospitalisation

Restart regular ICS. Begin at a paediatric low dose and titrate up to a paediatric moderate dose if needed — With a SABA

Consider a further trial without treatment after reviewing the child within 12 months

If asthma is uncontrolled

Consider an LTRA in addition to the ICS for a trial of 8 to 12 weeks, then stop if ineffective or side effects — With a SABA

If asthma is uncontrolled

Stop the LTRA and refer the child to a specialist in asthma care for further investigation and management

Uncontrolled asthma: Any exacerbation requiring oral corticosteroids **or** frequent regular symptoms (such as using reliever inhaler 3 or more days a week or night-time waking 1 or more times a week)

ICS, inhaled corticosteroid; **LTRA**, leukotriene receptor antagonist; **SABA**, short-acting beta$_2$ agonist.

British Thoracic Society

NICE National Institute for Health and Care Excellence

Healthcare Improvement Scotland | SIGN

BTS ISBN: 978-1-917619-30-1. NICE ISBN: 978-1-4731-6641-7. SIGN ISBN: 978-1-909103-99-3.

Thank you any questions?