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# Diagnosing asthma in school-age children can prove challenging

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**Abstract**

**Asthma is the most common chronic respiratory condition affecting children in the UK. There is no single gold standard test to confirm the diagnosis and both overdiagnosis and underdiagnosis are common. Asthma should be suspected in any child presenting with episodes of wheeze, especially recurrent episodes of wheeze. Clinical diagnosis alone often results in misdiagnosis; all children from the age of five years under investigation for asthma in primary care should have access to spirometry, bronchodilator reversibility and FeNO testing. Abnormal spirometry with bronchodilator reversibility ≥ 12% confirms the diagnosis of asthma. Diagnosis should not be based on an abnormal FeNO value alone. A review based on symptoms alone without objective lung function monitoring may miss children at high risk of acute attacks as children with good symptom control often have abnormal lung function.**

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# Diagnosing asthma in school-age children can prove challenging

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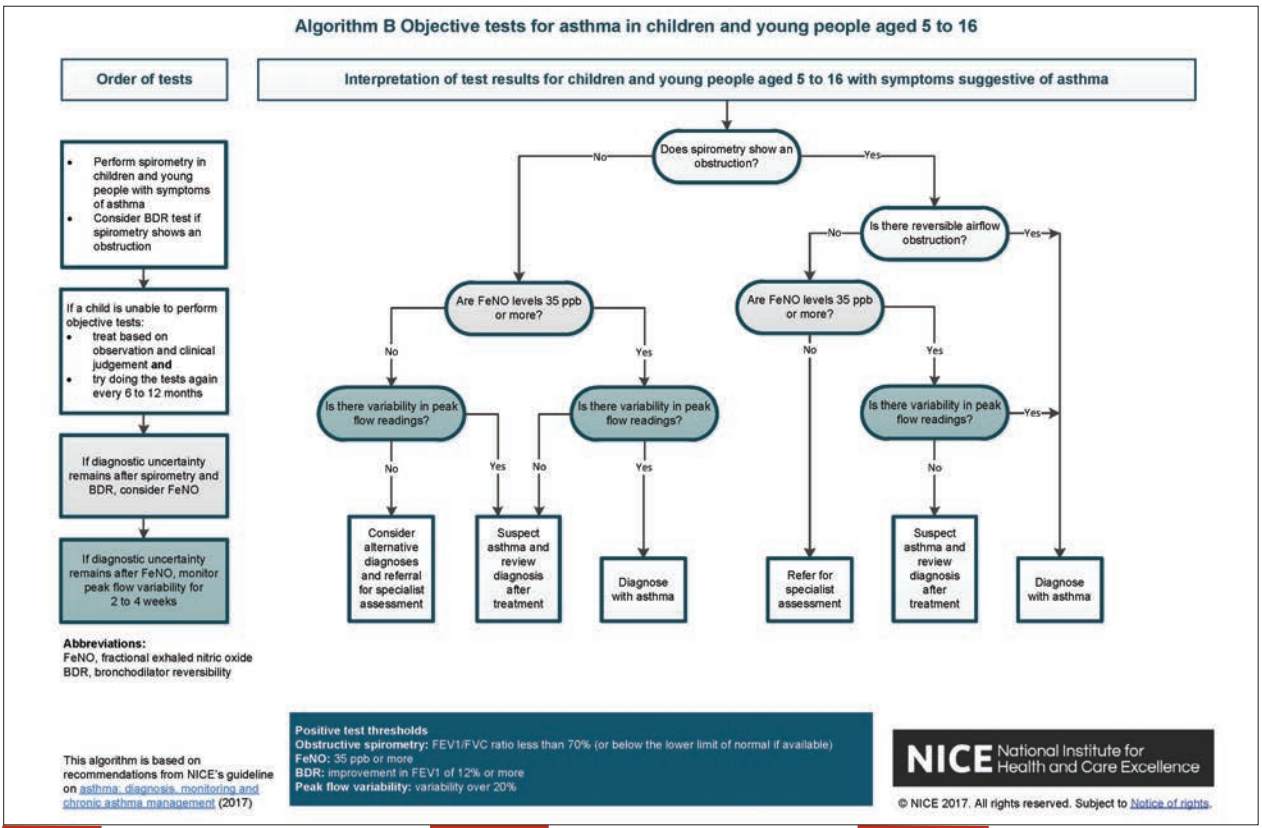



**FIGURE 1**
Objective tests for asthma in children and young people aged 5 to 16 with symptoms suggestive of asthma NICE NG80[6]

## How should asthma be diagnosed in children?

**ASTHMA IS THE MOST COMMON CHRONIC RESPIRATORY CONDITION AFFECTING CHILDREN IN** the UK, with an estimated 1.1 million children receiving treatment for asthma.[1]

Despite the common nature of the condition diagnosing asthma in children represents an important clinical challenge. There is no single gold standard test to confirm the diagnosis and overdiagnosis and underdiagnosis are common.[2]

Asthma is characterised by reversible airflow obstruction. Children are often wrongly diagnosed with asthma because cough and other non-specific respiratory symptoms are common in this age group caused by lingering viral respiratory tract infections. Overdiagnosis results in overtreatment with inhaled corticosteroids, with the risk of side effects, and sometimes, a delay in making the correct diagnosis. On the other hand, some children with asthma are not identified and treated for the condition. This is sometimes the result of confusing diagnostic labels such as 'viral wheeze' or 'viral-induced wheeze'. These terms are descriptive but rarely helpful and often confuse parents and healthcare professionals alike. Underdiagnosis and undertreatment of asthma results in unnecessary ill health, poor quality of life and the risk of severe asthma attacks.[2]

## What are the differential diagnoses?

Asthma should be suspected in any child presenting with episodes of wheeze, especially recurrent episodes of wheeze and particularly in cases where wheezing is witnessed by a healthcare professional. Sometimes children present with chest tightness and signs of respiratory distress, ranging from mild to severe, including tachypnoea, tracheal tug and or subcostal and intercostal recessions. These episodes are often triggered by viral respiratory tract infections starting with a cold and progressing to wheeze and chest tightness. Exercise and exposure to aeroallergens can also trigger attacks.[3,4] It would be unusual for children to have a significant fever with such an episode.

## When should children be referred?

### CONFIRMING DIAGNOSIS

Clinical diagnosis alone often results in misdiagnosis. For respiratory conditions the goal stated in the 2019 NHS Long Term plan[5] is to ensure that patients have access to objective testing, such as spirometry, in order to diagnose and treat respiratory conditions earlier and with the most appropriate medication.

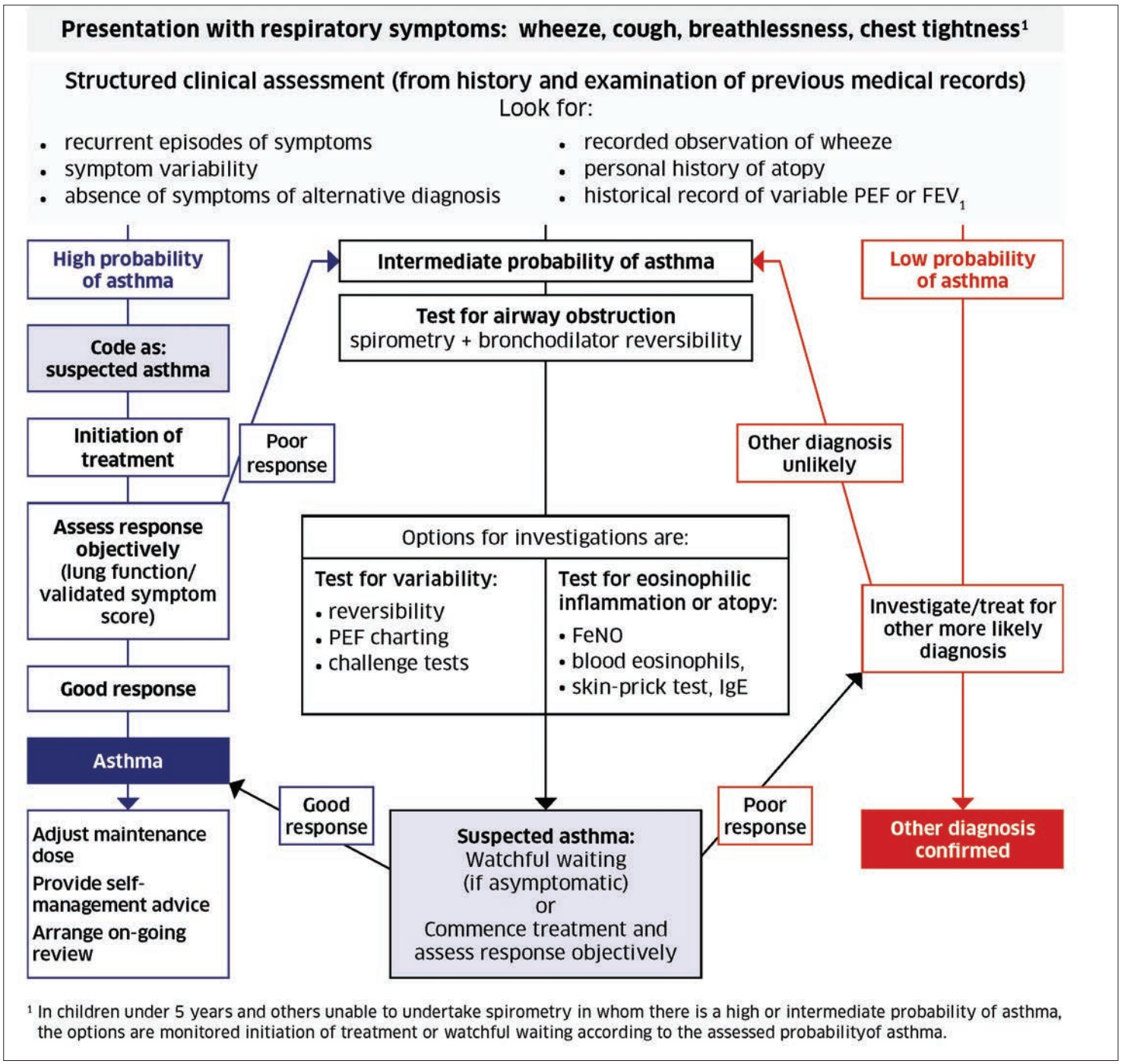
This recommendation is supported by the NICE asthma guideline NG80[6] and the NICE asthma quality standards.[7] »

The NICE guideline states that every individual from five years of age where the diagnosis of asthma is being considered should have access to spirometry and bronchodilator reversibility (BDR) testing (see figure 1, p17). NICE recommends immediate treatment of children who are unwell at presentation. Objective testing should be carried out if available and if testing will not compromise treatment of the acute episode; otherwise objective testing should be carried out once the acute symptoms have been controlled.

Abnormal spirometry with BDR ≥ 12% confirms the diagnosis of asthma. However, most children with suspected asthma attending for routine testing do not have abnormal spirometry and BDR ≥ 12%.[3] Fraction of exhaled nitric oxide (FeNO) testing or two-week peak flow diary testing should be considered in patients where the diagnosis is not confirmed with spirometry and BDR testing. An FeNO ≥ 35 parts per billion (ppb) should be considered abnormal. Spirometry is also recommended by the BTS/SIGN guidelines for all patients with diagnostic uncertainty as shown in the diagnostic algorithm (see figure 2, below).[8] Currently BTS/SIGN and NICE are working on the development of joint asthma guidelines.

More recently, the European Respiratory Society published guidelines for the diagnosis of asthma in children[9] and adults.[10] These robust, evidence-based guidelines also recommend spirometry, BDR and FeNO testing as first-line tests in the asthma diagnostic pathway. It is worth noting that recently published population

**FIGURE 2**
Diagnostic algorithm. British guideline on the management of asthma. SIGN 158[8]




[1] 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 probabilityof asthma.

## Table 1

**Differential diagnoses in asthma in children**

**< 5 years old***
- Inhaled foreign body
- Congenital heart disease
- Cystic fibrosis
- Bronchopulmonary dysplasia

*Difficult to diagnose asthma in this age group

**5-12 years**
- Inhaled foreign body
- Congenital heart disease
- Cystic fibrosis
- Bronchopulmonary dysplasia

**> 12 years**
- Chronic upper airway cough syndrome
- Vocal cord dysfunction
- Bronchiectasis
- Cystic fibrosis
- Alpha-1-antitrypsin
- Congenital heart disease
- Inhaled foreign body

data not available to NICE suggest that an FeNO cut-off of 25 ppb identifies children with asthma with reasonable sensitivity and specificity although asthma should not be diagnosed based on an abnormal FeNO value alone.[9]

Although spirometry testing in young children can be difficult it has been shown that with training acceptable results can be obtained from 80% of children aged five years tested in primary care rising to nearly 100% from eight years of age.[11] Asthma is a variable condition, so it is important to remember that spirometry is often normal in patients with asthma if carried out while the patient is well.

The creation of diagnostic centres or hubs has been proposed.[6] Ideally these hubs would operate as rapid access points so that children could be tested when they are acutely symptomatic which is likely to increase the diagnostic yield of first-line tests.

Spirometry testing during routine reviews in primary care has low sensitivity[11] but where spirometry is abnormal, specificity is good.[9] BDR also has low sensitivity but a BDR ≥ 12% confirms the diagnosis. A recent study in primary care found that 28% of children tested during routine reviews had abnormal spirometry with $FEV_1$ < 80% predicted and of these 32.6% had BDR ≥ 12%.[11] FeNO even at the lower cut-off of 25ppb has only moderate diagnostic accuracy.[9] This means repeat testing may be required especially when the child is symptomatic and after any acute severe asthma has been treated.

### Differential diagnoses

Differential diagnoses, which can also coexist with asthma, should be considered, see table 1, above.[12]

### Teenagers

Patient factors and clinical factors pose challenges in diagnosing asthma in this age group.

Teenagers often comply less with medication, especially steroids fearing side effects such as weight gain.[13] Positive health-seeking behaviours such as regular asthma reviews are often not sought and there is generally a lack of engagement with healthcare professionals. This can result in frequent non-attendance at routine asthma reviews.

Symptom reporting is also less likely in teenagers; lack of awareness of symptoms, difficulties accessing primary care appointments while balancing study schedules, and perceived social stigma may all be contributing factors. Teenagers want to appear healthy to their peers, symptoms of asthma are frequently ignored and teenagers often do not take their preventer medication.[14]

When teenagers attend reviews, diagnosis should be confirmed using objective tests. Diagnostic uncertainty can also be addressed with exercise or methacholine challenge testing.[9]

## REFERRAL

BTS/SIGN have recommended key indications for referral, see table 2, below.[8] However, at any point during the diagnostic process there may be a need for referral for investigations or specialist advice.[9] Any patient with an unclear diagnosis should be referred for objective testing. Parental or patient anxiety, or the need for reassurance, may also warrant referral.

NICE recommends referral of children who are repeatedly unable to perform objective tests or if first-line objective tests are repeatedly negative and symptoms persist to investigate for an alternative diagnosis.[6]

Children who remain uncontrolled despite moderate preventer treatment prescribed also need to be referred for specialist review. Before referral, a structured review should take place to assess preventer medication adherence, inhaler technique, environmental tobacco smoke exposure and caregiver/patient understanding of asthma providing education where needed. A structured 'SIMPLES' approach for adults with uncontrolled asthma has been published.[15] This approach is based on BTS/SIGN recommendations and equally valid in children. This approach along with integrated care between the primary care and specialist asthma care teams can improve the efficiency of asthma care, promote diagnostic testing and avoid »

## Table 2

**Indications for referral**[8]

**Refer for additional investigations and specialist advice**
- Unclear diagnosis
- Poor response to monitored initiation of asthma treatment
- Severe or life-threatening attack

**Red flags and indicators of other diagnoses**
- Failure to thrive
- Persistent wet or productive cough
- Nasal polyps
- Unexplained clinical findings (e.g. focal signs, abnormal voice or cry, dysphagia, inspiratory stridor)
- Severe upper respiratory tract infection
- Excessive vomiting or posseting
- Symptoms present from birth or perinatal lung problem
- Family history of unusual chest disease

## key points

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**Asthma is the most common chronic respiratory condition** affecting children in the UK, with an estimated 1.1 million children receiving treatment for asthma. There is no single gold standard test to confirm the diagnosis and both overdiagnosis and underdiagnosis are common.

**Asthma should be suspected in any child presenting with** episodes of wheeze, especially recurrent episodes of wheeze and particularly in cases where wheezing is witnessed by a healthcare professional. These episodes are often triggered by viral respiratory tract infections; exercise and exposure to aeroallergens can also trigger attacks. Clinical diagnosis alone often results in misdiagnosis; all children from the age of five years under investigation for asthma in primary care should have access to spirometry, bronchodilator reversibility and FeNO testing.

**Acceptable spirometry results can be obtained in** primary care from 80% of children aged five years rising to nearly 100% from eight years of age. However, spirometry is often normal in patients with asthma if carried out while the patient is well. Abnormal spirometry with bronchodilator reversibility ≥ 12% confirms the diagnosis of asthma. Diagnosis should not be based on an abnormal FeNO value alone.

**Indications for referral include: the need for tests that** are not available in primary care e.g. when the diagnosis is unclear; a severe attack; the presence of red flags e.g. a persistent wet cough; patient or parental anxiety. Children who remain uncontrolled despite moderate preventer treatment also need to be referred for specialist review. Referral should be considered if spirometry shows airways obstruction in conjunction with absent or little bronchodilator reversibility especially if FeNO is also low as an alternative diagnosis in those children is more likely.

**A review based on symptoms alone without objective** lung function monitoring may miss children at high risk of acute attacks as children with good symptom control often have abnormal lung function. There is currently no evidence to support FeNO monitoring in children with asthma. A recent RCT showed that adding FeNO to symptom-guided asthma management did not lead to a reduction in asthma exacerbations.

## Useful information

Asthma + Lung UK
**www.asthma.org.uk**

NICE
**www.nice.org.uk/guidance/ng80**

British Thoracic Society
**www.brit-thoracic.org.uk/quality-improvement/guidelines/asthma**

Global Initiative for Asthma (GINA)
**https://ginasthma.org/pocket-guide-for-asthma-management-and-prevention**

inappropriate escalation of treatment.

Referral of children should also be considered if spirometry shows airways obstruction in conjunction with absent or little BDR especially if FeNO is also low as an alternative diagnosis in those children is more likely.

No objective tests are currently recommended for children under five years with wheezing. Children in this age group with frequent wheezing or severe attacks despite using a low-dose corticosteroid inhaler with a leukotriene receptor antagonist, should be referred for further specialist management as recommended by BTS/SIGN.[8]

## MONITORING AND FOLLOW-UP

Every patient with asthma should have an annual review. The Royal College of Physicians (RCP) questionnaire to assess asthma control is not validated for use in children. A prospective cohort study in children showed that 25% of participants were misclassified as uncontrolled with the three RCP questions.[16] Alternative tools to assess asthma control include the validated Asthma Control Test (for children ≥ 12 years) and the Children's Asthma Control Test (for children 4 to 11 years).

Inhaler technique needs to be assessed yearly and when the inhaler is changed to a different product. Adherence to preventer medications and rescue reliever usage should be reviewed as non-adherence is a major problem in chronic asthma management. Information on environmental tobacco smoke exposure, and smoking status in older children and teenagers, needs to be obtained and symptoms of associated atopic conditions such as rhinitis should be sought and treated if present. Each child should have an up-to-date personal asthma action plan and this should be updated annually or sooner if there has been a change to their clinical status and medication management.[16]

The NICE asthma quality standards recommend that children, and adults, who have been treated for an asthma attack in hospital should be followed up in primary care within 48 working hours of hospital discharge.[7]

A review based on symptoms alone without objective lung function monitoring may miss children at high risk of acute attacks[17] as children with good symptom control often have abnormal lung function. In relation to FeNO, however, there is currently no evidence to support FeNO monitoring in children with asthma. A recent randomised controlled trial[18] showed that adding FeNO to symptom-guided asthma management did not lead to a reduction in asthma exacerbations.

## CONCLUSION

All children from the age of five years under investigation for asthma in primary care should have access to spirometry, bronchodilator reversibility and FeNO testing. Barriers to implementation such as lack of equipment, training and capacity issues could be overcome by the provision of diagnostic centres or primary care paediatric asthma hubs to ensure timely asthma diagnosis with confirmation from objective tests.

**Competing interests**
Dr Erol Gaillard has carried out consultancy work for Boehringer Ingelheim with payment made to the institution (University of Leicester). He has received investigator led research grants from Circassia Group, Gilead Sciences, Chiesi and Propeller Health, undertaken research collaboration with Medimmune and Adherium (NZ), and received speaker fees from Circassia Group. Dr Pooja Devani has no competing interests

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