Diagnosis and management of asthma in children

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Asthma is a condition characterised clinically by recurrent episodes of wheeze, cough, and breathlessness, and physiologically by variable airflow obstruction. Airway inflammation is sometimes added to the definition, but it is rarely measured in clinical practice; some groups would consider episodic viral wheeze in preschool children as a separate condition. This review gives a practical perspective on the basic steps of diagnosis and management of asthma in school age children for non-specialists in primary and secondary care.

Who gets asthma?
There is wide geographical variation in the prevalence of asthma, with wheeze in 13 and 14 year olds varying from less than 1% (Tibet) to more than 30% (New Zealand), and in 6 and 7 year olds from less than 3% (India) to nearly 40% (Costa Rica).1 Whereas in the United Kingdom atopy is a major factor associated with asthma, this is not the case in resource poor areas. In the developed world, the risk of asthma is increased by a positive family history of asthma and atopy, maternal smoking in pregnancy, and early sensitisation to aeroallergens. Numerous “asthma genes” have been discovered, and clearly asthma is a complex polygenic disease. In the developing world, atopy is often not associated with asthma; instead, the use of biomass fuels, tobacco smoking, and viral infections seem to be more important.

THE BOTTOM LINE

- In problematic cases of childhood asthma, rather than escalating treatment, a systematic approach is needed, including a review of the diagnosis; adherence, including ability to take drugs correctly; and the child’s environment
- If diagnostic doubt still exists, including a failure to respond adequately to a low to medium dose of inhaled corticosteroids, referral should be made to a specialist team
- Asthma is a disease that kills, even in children with “mild” asthma, and care must be seen in that context
- Any emergency visit to hospital, regardless of whether admission occurs, is a marker of future risk, and should prompt a focused and urgent review of what trigger factors led to the attack and whether the attack was appropriately managed
- Non-adherence to treatment, overuse of bronchodilators, and underuse of inhaled corticosteroids are common problems that should be routinely tackled
- Failure of annual asthma review is a factor in asthma related deaths and for children a review should be routine at least every three months; these should be conducted by doctors or nurses with training in asthma and not seen as “tick box” exercises
- When specialist services are also involved, good communication is essential; this is particularly true after an acute asthma attack

What are the clinical features?
All children have intermittent respiratory symptoms, but most do not have asthma. The first prerequisite for managing asthma is knowledge of the range of normal childhood illnesses. Typically, children may have more than 10 viral related colds a year, with symptoms lasting for more than two weeks; non-specific respiratory infections may also last for two weeks or more.

The process of establishing a diagnosis of asthma should extend over at least two consultations. The first step is to take a detailed history and carry out a physical examination, focused on excluding other causes of respiratory symptoms (box 1). Asthma is suggested by reports of wheeze, dry cough, and breathlessness. Symptoms are typically worse at night and in association with specific triggers such as viral upper respiratory tract infections, exercise, and exposure to smoke and aeroallergens. Parents use the word “wheeze” to describe a wide range of respiratory noises.2 Parental report of wheeze correlates poorly with objectively recorded wheeze.3 Thus until a doctor has heard and documented the presence of true polyphonic (musical) expiratory wheeze, an open mind should be kept about the nature of the sound described. A video questionnaire may be helpful to clarify what is being described.4

“Cough variant” asthma is a controversial topic. Although a few children may have cough and no wheeze as a manifestation of asthma, these presentations are rare. Isolated chronic dry cough in a community setting is rarely if ever due to asthma.2 We will not diagnose asthma unless there is a history of considerable breathlessness, as well as either or both of cough and wheeze.

Box 2 lists the indications for referral to secondary care. If there are features suspicious of a non-asthmatic condition, then referral to secondary care is indicated. Referral should be expedited when children are systemically unwell or there is concern about a serious condition.
How is the diagnosis confirmed?

The figure shows a proposed diagnostic algorithm. If asthma is suspected, it is good practice to document variable airflow obstruction with a peak flow meter using the best of three attempts:

- If peak flow is below age appropriate normal ranges (www.lungfunction.org/), then improvement by 12% or more 20 minutes after administering a short acting β2 agonist (for example, 400 µg salbutamol given with a metered dose inhaler and spacer) is a useful test to confirm variable airflow obstruction.
- If peak flow is normal, then a two week period of home monitoring may confirm the diagnosis; if the peak flow chart is a flat line (or variability is within normal limits) despite ongoing symptoms, it is difficult to attribute the findings to asthma. Peak flow variability of 15% or more is strongly suggestive of asthma; likewise, if children are given a β2 agonist at home, an improvement by 12% or more 20 minutes later is also supportive of a diagnosis of asthma. However, it is acknowledged that compliance with peak flow monitoring is often poor.
- If peak flow is normal, consider getting children to run for 10 minutes, either on the flat or up and down steps. None of these tests is sensitive to the diagnosis of asthma; however, it is a safe principle that the more practitioners try and fail to identify airflow obstruction, the less likely is a diagnosis of asthma. Routine chest radiography is not needed; and indeed a normal radiograph cannot exclude a serious condition.

Occasionally a blind trial of asthma treatment may be considered justifiable; in that case it is essential to have a trial period of discontinuation of treatment to ensure that any apparent benefit is related to the treatment rather than arising spontaneously. No evidence base exists to recommend a particular trial regimen; we would use a three stage protocol, preferably combined with peak flow measurements at home to document improvement:

- Initiate treatment with beclometasone equivalent 200 µg twice daily using a metered dose inhaler and spacer
- Reassess at six weeks; if no benefit then the diagnosis is unlikely to be asthma, stop treatment and consider referral for investigations; if the symptoms have disappeared, stop treatment and reassess six weeks later
- If symptoms have recurred by six weeks, restart inhaled corticosteroid in a low dose (100 µg beclometasone equivalent twice daily using a metered dose inhaler and spacer), and continue to adjust dose depending on response.

How is it managed?

A recent report of asthma related deaths in adults and children in the United Kingdom has highlighted that nearly half of those who died from asthma could have been saved by attention to several components of basic management (box 3, see thebmj.com).

Pharmacotherapy

The basic management steps for asthma are well summarised in national and international guidelines. All guidelines agree that first line preventive treatment should be with inhaled corticosteroids. There is no evidence to support the use of combination inhalers as first line treatment in children, indeed the reverse is the case, and their increasing prescription in this role is to be discouraged. Importantly, the Best Add-on Therapy Giving Effective Responses (BADGER) study showed that the plateau of the dose-response curve to inhaled corticosteroids for most children with asthma is 200 µg/day fluticasone or equivalent, and few children benefited from a step up to 500 µg/day. The best response was a long acting β2 agonist, and some children also responded to a leucotriene receptor antagonist. We recommend that those children with asthma who do not respond to fluticasone 200 µg/day plus any one additional treatment should be managed as treatment failures and not by escalating pharmacotherapy.

No inhaled drug is effective unless delivery to the airways is optimised. Children must be shown how to use inhalers and their technique checked repeatedly. Spacers for school aged children should always be used with a mouthpiece, not with a mask.

Adverse environmental factors

It must be highlighted that any tobacco smoking has an adverse effect on asthma outcomes. Cotinine levels (an objective measure of exposure to nicotine in tobacco) are just as high in those who smoke “but not in front of the children.” Exposure to household mould is also likely to be detrimental. Skin prick testing to identify allergy to household
Asthma suspected in a school age child

Evidence of variable airflow obstruction?
Yes
- Give inhaled short acting β2 agonist and see if peak flow increases ≥15% from baseline 20 minutes later
- Give the parent or carer a peak flow meter and ask for peak flow to be measured twice daily at home, including improvement if β2 agonist is given
- Check for bronchoconstriction in a field exercise test — for example, 5-10 minutes vigorous running

No
- Consider alternative diagnoses
- Consider blind trial of treatment — for example, low dose inhaled corticosteroids

Trial of asthma treatment — for example, low dose inhaled corticosteroids

Asthma management
- Consider home visits — have the drugs been removed during the morning rush for school
- In a sensitive way, find out if carers actually supervise their children taking the drug or if it is left to the children to remember
- Consider home visits — have the drugs been removed from the wrapper, are they in date, and are they readily accessible?
- Consider electronic monitoring of treatment uptake (usually in secondary care)

Box 4 | Methods for assessing adherence
Check how many prescriptions for inhaled corticosteroids have been dispensed over the previous year
If feasible, and there is only one local pharmacist, check how many prescriptions have actually been dispensed
Ask the child to demonstrate how the inhaler is used
Ask questions sensitively, such as “Most patients and all doctors find it difficult to remember to take treatment; how often do you think you/your child forgets?” or “Most patients and all doctors find it difficult to remember to take treatment; do you think you forget at least once a day?”, acknowledging that adherence can be difficult and encouraging patients to share their experiences
Explore whether there are particularly difficult times for children or parents to remember the treatment, such as during the morning rush for school
In a sensitive way, find out if carers actually supervise their children taking the drug or if it is left to the children to remember
Consider home visits — have the drugs been removed from the wrapper, are they in date, and are they readily accessible?
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Comorbidities
In childhood, comorbidities such as obesity, rhinosinusitis, food allergy, dysfunctional breathing, and psychosocial problems may contribute to respiratory symptoms. Gastroesophageal reflux is often found if sought, but treatment does not affect asthma outcomes. Obesity may lead to breathlessness, which is not asthma related, causing confusion about the diagnosis. Whether treatment of rhinosinusitis improves lower airway inflammation is controversial, but upper airway symptoms certainly should be treated on their independent merits. Food allergy is associated with severe asthma in particular; whether allergy causes increased asthma severity is controversial, and in the United Kingdom is not recommended in the most recent guidelines from the British Thoracic Society/Scottish Intercollegiate Guidelines Network. However, multifaceted interventions may be considered in those with severe disease.

Regular follow-up
As with all conditions in childhood, regular and focused follow-up is essential. Basic child health should be assessed, including height and weight, and immunisations, especially against influenza. Day to day asthma control should be assessed, including the number of dispensed prescriptions for short acting β2 agonists and whether the child has had an emergency visit for asthma. The possibility of a missed or wrong diagnosis, no matter how eminent the health professional who initiated treatment, should always be considered. Above all, adherence to treatment, including adequacy of inhaler technique, should be checked. Assessing adherence is difficult and needs to be done with sensitivity (box 4 lists some approaches that may be useful).

How are acute asthma attacks managed?
Asthma attacks can be immediately fatal, can be predictive of future clinical course and subsequent attacks, and may be associated with impairment in normal airway growth. The term “exacerbation” has been criticised as too benign. The key steps in recognising and managing an acute asthma attack are summarised in Box 5.

Evidence in the United Kingdom suggests that most deaths related to asthma occur in those who are not receiving specialist care. Primary care clinicians must be alert to detecting patients with high risk “mild” asthma (box 6), and those with unscheduled hospital visits and admissions.

How is treatment failure managed?
A serious error of judgement is to escalate treatment in those children with asthma who are unresponsive to basic assessment and management of alcohol use disorders (BMJ) 2015;350:h715
- Management of chronic pain in older adults (BMJ) 2015;350:h532
- Cancer induced bone pain (BMJ) 2015;350:h315
- Managing patients with multimorbidity in primary care (BMJ) 2015;350:h176

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- Managing patients with multimorbidity in primary care (BMJ) 2015;350:h176

Previous articles in this series
- Multidrug resistant tuberculosis (BMJ) 2015;350:h882
- Assessment and management of alcohol use disorders (BMJ) 2015;350:h715
- Management of chronic pain in older adults (BMJ) 2015;350:h532
- Cancer induced bone pain (BMJ) 2015;350:h315
- Managing patients with multimorbidity in primary care (BMJ) 2015;350:h176

The term “exacerbation” has been criticised as too benign. The key steps in recognising and managing an acute asthma attack are summarised in Box 5.
Box 5 | Key steps in recognising and managing a moderate attack of asthma (full version on thebmj.com)

Children/families should be aware of the following signs of an asthma attack

- Difficulty talking or walking
- Unable to feed
- Little relief with salbutamol
- Drop in peak flow
- Hard and fast breathing
- Coughing and wheezing a lot

Personal action plan

- Give up to 10 puffs of salbutamol
- If symptoms improve see a doctor or nurse that day
- If relief lasts for four hours or less seek urgent medical attention
- If severe symptoms persist despite 10 puffs of salbutamol call an ambulance and continue to give salbutamol while waiting for the ambulance (up to 10 puffs every 15 minutes)

Moderate attack

- Able to talk in sentences
- Peripheral capillary oxygen saturation ≥92%
- Peak expiratory flow ≥50% best or predicted
- Heart rate ≤125/min in children aged >5 years (≤140/min in children aged 2-5 years)
- Respiratory rate ≤30/min in children aged >5 years (≤40/min in children aged 2-5 years)
- Mild-moderate recession and wheeze

Action plan

- Give up to 10 puffs of salbutamol through a spacer
- If poor response, add ipratropium bromide and repeat salbutamol with or without ipratropium every 20 minutes
- Prednisolone, 30-50 mg for children aged >5 years, 20 mg for children aged 2-5 years (but not if episodic viral wheeze); a three day course is usually sufficient
- Discharge with action plan when stable and requiring salbutamol 3-4 hourly
- Advise review by general practitioners within 48 hours

Box 6 | Key questions for identifying “at risk” children

The following information should easily be accessible electronically, and none requires special expertise. If any question cannot be answered satisfactorily, then an urgent review is mandatory.

- Has the child been taken to an emergency department or admitted with asthma? If so, has there been follow-up?
- Does the child have an asthma plan and was the last annual review within the past year?
- How many prescriptions for preventive and reliever drugs are being collected for the child?
- Is the child brought to review appointments? When was the child last seen?
- Do you know what triggers this child’s asthma?