Asthma in Children

Asthma in children

Asthma affects 1.1 million children in the UK and is the most common long-term condition of childhood. The prevalence of childhood asthma symptoms in the UK is amongst the highest worldwide and this contributes to the estimated £1 billion annual cost of asthma care to the NHS. Children still die from asthma despite advances in management and mortality rates have changed very little over the past 20 years. The recent national review of asthma deaths provided a stark reminder of "why asthma still kills" and made key recommendations for children with asthma. However, evidence-based recommendations are still poorly implemented. This article seeks to enthuse the next generation of GPs to prioritise the improvement of asthma care in children.

The GP curriculum and asthma in children

Clinical module 3.19: Respiratory health requires GPs to:

- Know the diagnostic and treatment guidelines for common respiratory diseases (asthma, COPD, lung cancer) in primary care
- Know the boundaries of primary care management and the role of specialist services in supporting the patient
- Explain, encourage and support self-management strategies for different respiratory diseases, according to the differing wishes and expectations of patients

Clinical module 3.04 :Care of children and young people requires GPs to:

- Provide information on medicines to patients in a clear way that is appropriate to their understanding as children, young people and parents

Asthma is characterised by bronchial hyper-reactivity, chronic inflammation and obstructive airways disease that varies over time. The associated respiratory symptoms of wheeze, breathlessness, cough and chest tightness can also vary over time and in severity.

An estimated 1 in 11 children in the UK has asthma and the prevalence of asthma is one of the highest in the world (Asthma UK, 2014). Boys aged 5-14 years present most frequently to primary care with 95 consultations for every 1000 registered patients (Information Services Division (ISD) Scotland, 2013). However, from age 15 years onwards female patients consult more frequently than male patients (ISD Scotland, 2013).

In the UK, over a third of all asthma attacks requiring hospital admission in 2011/12 were for children. Moreover, in 2012/13, 28 children and young people (including 10 under 10 year

olds) died from asthma in the UK (Levy *et al*., 2014). Asthma remains a 'killer disease', with deaths occurring even in children with mild disease. In primary care there is a clear duty to attend promptly to acute asthma attacks but the prevention of asthma attacks also deserves attention and determined effort if mortality and morbidity are to be improved. Now that practice nurses complete more consultations for asthma than GPs (ISD Scotland, 2013), doctors may have become less confident, or even complacent, in the routine management of asthma.

Perhaps a change of mindset is needed in general practice. An exacerbation of asthma should be viewed as a treatment failure. Failure can occur for different reasons including: deficiencies in treatment, patient education or understanding; a lack of supported self-management or regular review; poor adherence and poor inhaler technique. Every effort should be made to prevent treatment failure but in addressing such failures of treatment it is appropriate to consider first how to make the diagnosis of asthma as this precedes treatment for asthma.

Diagnosis

There is no definitive gold standard test which can categorically confirm the diagnosis of asthma. Instead, asthma is diagnosed according to evidence collected from a structured clinical assessment, together with (ideally) confirmation of variable airflow obstruction e.g. by spirometry or serial peak expiratory flow readings (British Thoracic Society / Scottish Intercollegiate Guideline Network (BTS/SIGN), 2016).

Insert figure 1

History

Suspect asthma in any child experiencing more than one of the following symptoms:

- Wheeze
- Breathlessness
- Cough or
- Episodic chest tightness.

Recurrent episodes may be triggered by exposure to allergens, viral infection, or exacerbated by exercise, cold air, emotion or laughter. Diurnal variation of symptoms is common, with symptoms being worse at night or in the early morning. Remember to ask about existing

atopic conditions, such as eczema or allergic rhinitis and a family history of atopy or asthma: if present, the likelihood of asthma is higher.

Examination

Respiratory examination may well be normal if the child is asymptomatic, so it is important not to exclude asthma solely on examination findings. Examination should not just include the respiratory system. Examine the throat for enlarged tonsils as these may be associated with obstructive sleep apnoea (snoring and noisy breathing at night), or co-exist with adenoidal enlargement (promote mouth-breathing and contribute to a dry, irritant cough during sleep). Examine the skin and nose for signs of atopy. Wheeze in asthma tends to be scattered, polyphonic and end-inspiratory. If wheeze is never heard during symptomatic episodes, alternative diagnoses should be considered. Consider the symptoms and signs which suggest diagnoses other than asthma (Table 1).

Insert Table 1

Further investigation

It is important to recognise that a structured clinical assessment should incorporate all available evidence. The history and examination are key components, but information from the child's record could help in the diagnosis of asthma. For example a past entry of wheeze heard on chest auscultation recorded by a doctor or nurse; a previous blood test showing eosinophilia; past skin prick test results showing positivity for aeroallergens (BTS/SIGN 2016).

Currently not widely available in UK general practice, fractional exhaled nitric oxide (FeNO), is quick and can be performed by children aged 5 or older. A positive FeNO test can demonstrate airways inflammation and increases the probability of asthma, however, a negative test does not exclude asthma (BTS/SIGN, 2016).

With the initial assessment complete, decide how to proceed based on the probability that the child has asthma. The pathways are outlined in table 2.

Insert table 2

Chest X-ray

A chest X-ray is not necessary in the diagnostic work up of a child with suspected asthma. However, it may be considered for cases where an alternative condition is suspected or in severe disease (BTS/SIGN, 2016).

Avoiding over-diagnosis

Wrongly labelling children with a diagnosis of asthma can lead to unnecessary treatment and anxiety (Looijmans-van den Akker, van Luijn & Verheij, 2016). The variable nature of asthma can mean that individuals may experience long periods without symptoms and it is not infrequent that asthma in children remits (Strachan, Butland, & Anderson, 1996). To discern between over-diagnosis and 'inactive' asthma, it is essential to record the basis on which a diagnosis was made so that, if questioned later, it can be reviewed (BTS/SIGN, 2016). Secondly, prescription of asthma treatment should always be accompanied by on-going review and reassessment, with a view to reducing or ultimately stopping medication if a child remains symptom-free.

If a child is commenced on a trial of treatment (usually inhaled corticosteroids), it should be for a maximum of 6 weeks, and stopped at the end of the trial, regardless of the clinical picture (Bush & Fleming, 2016). If the child has had no response to treatment (ideally based on objective results), the diagnosis of asthma is unlikely. If, however, symptoms improve with inhaled corticosteroids but recur when stopped and then settle again with reintroduction of treatment, a diagnosis of asthma can be made. If a trial of treatment is started it is important to ensure that the dosage is correct and that the treatment is given correctly. This can be achieved by early referral to the practice or respiratory nurse for education on inhaler technique and other aspects of self-management.

Management

The goal of asthma management is disease control. This is defined as no day or night symptoms, leading an unrestricted lifestyle (including being able to exercise freely), having no need for rescue medication, experiencing no asthma attacks and achieving the best possible lung function, with the fewest medication side-effects possible (BTS/SIGN, 2016).

Intermittent reliever therapy

Short acting β_2 agonists (salbutamol) should be prescribed as a short-term reliever of symptoms. In a minority of children with mild intermittent asthma or mild exercise-induced asthma, it may be possible to treat with occasional reliever therapy only (BTS/SIGN, 2016).

Children with good asthma control should need little or no short acting β_2 agonists. If children are being issued with regular repeat prescriptions for salbutamol inhalers then this raises questions about their asthma management. Is their asthma poorly controlled? Are they using their inhaler(s) correctly? Overuse of short acting β_2 agonists and underuse of inhaled

corticosteroids is common, and was highlighted as a key action point by the national review of asthma deaths (Levy *et al*., 2014). Children requesting more than one short acting β_2 agonists a month should be contacted to clarify their usage and have their asthma assessed (BTS/SIGN, 2016).

Suspected asthma: monitored initiation of treatment

Following diagnosis of asthma or as a trial of treatment with a suspicion of asthma, a very-low-to-low dose inhaled steroid should be commenced (Figure 2). To bring clarity to the comparative strengths of different inhalers, the BTS/SIGN (2016) update has listed doses of inhaled corticosteroids as very low (usually paediatric doses), low, medium and high. Clenil Modulite can be prescribed by trade name as it is currently the only pressurised metered dose inhaler (pMDI) CFC-free product with a paediatric licence. A dose of 100 microgram twice daily would be a recommended starting point, with follow up arranged at 6 weeks.

Insert figure 2 here

Regular preventer

If the initiation period is successful, treatment should be continued as regular preventer therapy. The dose of inhaled corticosteroids can be optimised over time up to a maximum of 200 microgram twice daily. Remember that long-term inhaled corticosteroid of 400microgram (budesonide diproprionate and equivalent) or more a day may lead to systemic side-effects such as growth failure and adrenal suppression (BTS/SIGN, 2016); children on these doses long term should be reviewed by a hospital specialist. At each increase of dose, children should be reviewed and the response to treatment assessed, with height and weight monitored annually. Ultimately, the aim is to achieve disease control at the lowest possible dose of inhaled corticosteroid.

Initial add-on preventer

Long acting bronchodilators are licensed for use in children aged 5 years and above, as add-on therapy. Evidence from Weatherall *et al.* (2010) cautions against the use of long-acting beta agonist (i.e. salmeterol) as a monotherapy due to the increased risk of asthma mortality. Accordingly, and particularly as adherence with any long-term condition is a challenge, all long-acting bronchodilators should be prescribed as a combination therapy.

Montelukast is an alternative add on therapy for the over 5s or can be considered for use as a monotherapy in the under 5s (BTS/SIGN, 2016). As an oral preparation, it is generally well

tolerated with relatively few side-effects and is given at bedtime. Montelukast should be discontinued if there is no perceived clinical benefit after a trial period of 3 months.

Children can often have seasonal asthma dependant on trigger factors, so it may be feasible to reduce and even discontinue therapies out of season. With any step down in therapy, parents should be given clear self-management advice on home asthma monitoring and when to increase treatment and seek medical review.

High-dose therapies

A proportion of children will continue to experience symptoms despite add on therapies. Prior to referral to secondary care (Box 1), assess adherence to treatment by reviewing repeat prescriptions, inhaler technique and the child's asthma action plan to ensure the family fully understands the plan and when to take the medication. Ensure that any under-treated rhinitis is managed with nasal steroids and antihistamines (Scadding *et al.,* 2007). Other existing co-morbidities and tobacco smoke in the household may also limit response to treatment. Finally remain open-minded – could ongoing symptoms and failure of treatment be the result of an incorrect diagnosis of asthma?

Insert Box 1

Supported self-management

Supported self-management is a key component of asthma care, that should be provided routinely for every child with asthma. Asthma self-management should include education about self-monitoring of symptoms (or peak expiratory flow), regular medical review and a personal asthma action plan (Gibson *et al.,* 2002). Education should be patient-centred and tailored to the child and parent's understanding, encompassing topics such as: recognising and responding to worsening asthma control, identifying and avoiding individual triggers, peak expiratory flow monitoring (if preferred) and inhaler use. Keep in mind the dangers of smoking for a child with asthma and, if appropriate, offer smoking cessation support to parents.

Annual review by a doctor or nurse will provide an opportunity to confirm the diagnosis, the treatment and self-management plan. Reviews may be more frequent according to individual patient needs. Any asthma attack that leads to an emergency visit to hospital is an indicator of risk in the future: the child should be reviewed in primary care within 2 days (Bush and Fleming, 2015).

Supported self-management is effective. There are benefits for the child, including better asthma control, reduced absence at school, reduced emergency department visits, hospital admissions and unscheduled appointments (Boyd *et al., 2009;* Gibson *et al.,* 2002).

Completing a personal asthma action plan

Personal asthma action plans (Figure 3) are an important aspect of self-management and have been validated for children 5 years or older (Boyd *et al., 2009*). Despite the known benefits, less than a third of asthma patients have one (Asthma UK, 2014). An asthma action plan provides written guidance of current treatment, triggers to avoid and steps to take if asthma control deteriorates. Completing an action plan together with a parent and child provides a good structure for discussing management, so it is important to be familiar with the content, and know how to access one easily either through an asthma template on general practice software or directly from a website such as Asthma UK (asthma.org.uk).

Insert figure 3 here

Monitoring asthma control can be based on parent and child recognising worsening symptoms, or in older children, a drop in peak expiratory flow. If peak expiratory flow is used, the percentage of personal best (not predicted) is best (Gibson & Powell, 2004). Widely accepted thresholds for treatment are a fall in peak flow to 80% of personal best for starting regular reliever medication for a defined period (BTS/SIGN, 2016): 4 puffs 4 times a day for 4 days is a useful guide. The recommendation to seek urgent clinical advice is based on the severity of symptoms and a fall in peak expiratory flow below 50% of personal best.

Acute management

BTS/SIGN (2016) provide clear age-appropriate guidance for the assessment and management of children presenting with an asthma attack (Figure 4). To build on the guideline, the following section considers practical points and common pitfalls.

Insert figure 4 here

Oxygen saturation monitoring - professionals *and* parents

Having access to a pulse oximeter is essential in the assessment of children with acute wheeze. However, care should be taken when using equipment not intended for paediatric use as it can produce incorrect readings.

Pulse oximeters are readily available for parents to purchase and may be used at home to make assessments regarding their own child. Whilst there is no evidence to support or refute

the use of saturation monitors as part of a personalised asthma action plan, using a monitor without the knowledge and skills to interpret and act upon results leads to risks. In particular, the importance of interpreting results in the context of the whole clinical picture and not in isolation should be stressed (Welsh and Carr, 2013).

Children under 2 years

Children under the age of 2 who present acutely wheezy are most likely to have bronchiolitis, in which case, prednisolone is unlikely to provide any clinical benefit (Fernandes *et al*., 2013). Each child, however, should be assessed individually as the child may have multi-trigger wheeze or a personal or family history of atopy that may increase the probability of an asthma diagnosis. If steroids are prescribed, it is important to document clinical response and time to resolution of symptoms.

Children over 2 years

Acute wheeze has been treated with 'multi-dose' salbutamol in the majority of secondary care settings since the early 2000s and this has increasingly become the norm in primary care. The benefits when compared to nebulised beta-agonist include a reduced length of stay in the emergency department, a lower heart rate and fewer systemic side-effects (Cates *et al.,* 2013). Additionally, parents are able to instigate emergency treatment at home as part of their asthma action plan and reinforces to them the need to seek urgent medical review if this is ineffective. BTS/SIGN (2016) advises a dose of 200 microgram (2 puffs) to 1000 microgram (10 puffs), depending on the severity of symptoms. However, the majority of hospitals in the UK consider 10 puffs as the 'multi-dose'.

Nebuliser – when and how?

The use of air driven nebulisers for the treatment of acute severe wheeze should be discouraged. Salbutamol given via an air driven nebuliser results in pulmonary vasodilation, increasing perfusion to poorly ventilated lung units and ventilation-perfusion mismatch. Worsening hypoxaemia results and has led to the death of a child in a primary care setting (Inwald *et al.,* 2001). Therefore, in the event of being faced with a child presenting with severe wheeze, a nebuliser should be administered via oxygen at a flow rate of 8-10 litres for a maximum of 10 minutes per nebuliser. Oxygen should then continue through a non-rebreather mask.

Oral corticosteroids

Oral prednisolone should be administered to treat moderate to severe asthma and should be given within an hour of presentation. A 3 day course is usually sufficient with dosing suggested at 20mg for 2-5 years and 40mg for children aged 5 and above. As well as tablets, prednisolone is now available as a liquid in 1mg/1ml and 10mg/1ml dilution. Providing steroids in advance for parents to instigate in the event of a deterioration in asthma control (as part of their child's self-management plan) may be considered, particularly if the family live remotely or a previous asthma attack has been severe. Safety net advice should always be given, stressing the need for medical review if steroids have been initiated at home.

Inhalers

Essentially there are 2 types of devices used to treat asthma:

- Aerosols e.g. pMDI and breath activated devices e.g. Easibreathe
- Dry powder inhaler (DPI) e.g. Easyhaler, Accuhaler

pMDI or breath activated devices contain medication which is already in an aerosol state. A slow and steady inhalation is needed. The device needs to be rested for 30 seconds between actuations to stabilise back to room temperature. Using a pMDI without a spacer is not advisable for any child due to the difficulty with inhalation/ actuation coordination. A spacer with a mask is particularly helpful for pre-school children, though can be used aged 5 years and above if the child prefers or has difficulty with a mouthpiece.

A DPI contains medication in a powder form that needs to be made into an aerosol. A fast and forceful inhalation is needed. Children should be encouraged to carry a personal device from around 8 years of age and a DPI tends to be the most cost-effective. There are a number of devices available. Local formulary committees may recommend particular devices.

It is important for a clinician to become familiar with at least one MDI, breath-actuated MDI and DPI as it should be the prescriber's responsibility to teach and assess inhaler technique prior to commencing a new treatment (BTS/SIGN, 2016). Unfortunately, this does not always happen and assumptions are made that someone else (for example the community pharmacist) will take on this role. Children and young people's techniques can be influenced by their peers, family members, television and social media and the technique learned this way may be incorrect. Inhaler technique should therefore always be assessed at the time of issue and at every asthma review.

Addressing adherence

Adherence to maintenance asthma treatment is often poor. Addressing non-adherence can be made more difficult as causes are often multifactorial and parents often over-estimate adherence. It can be helpful to think about non-adherence in two broad categories: intentional and non-intentional adherence.

Intentional non-adherence occurs when children (or their parents) decide not to take the recommended treatment after considering the risks and benefits, the impact of their symptoms or experience of side-effects (Horne *et al.,* 2006). The term non-intentional non-adherence applies when children (or their parents) simply forget to use treatment, are unable to afford treatment or misunderstand some aspect of the treatment prescribed (Nunes *et al.,* 2008).

Asking about adherence in a non-judgemental style, using open questions and acknowledging that poor adherence is common. may open up the conversation. Prescribing records can be informative: any discrepancy between treatment issued and reported can be a helpful way to broach the subject.

To address intentional non-adherence requires understanding of the child or parents' ideas and concerns – are there doubts about the necessity of the prescribed treatment or concerns about potential side-effects? Some children may find taking regular preventer medication may not make appreciable difference to symptoms . Discussing these topics openly, providing education and making a shared decision are key steps in improving adherence. Practical solutions, such as an action plan to consolidate education, a change in inhaler type (dry powder rather than MDI) or switching to a once daily combination inhaler, are also useful treatment options.

Summary

Asthma is common and the basic principles are well-known to medics of all stages. Yet, asthma remains a disease that kills, and key evidence-based interventions are still poorly implemented. Take pride in providing high quality asthma care, which should include a structured approach to diagnosis, prescribing responsibly with clear plans for follow-up, checking and discussing adherence to treatment and prioritising regular review as part of continuing supported self-management.

Key points

- Asthma is the most common long-term condition in childhood and remains a 'killer disease'
- Recognition of asthma as a condition that varies in severity and over time is important when making a diagnosis
- A trial of treatment should be for a maximum of 6 weeks following which, treatment should be stopped, regardless of the clinical picture, and the child reviewed
- Address the common discovery of non-adherence to asthma treatment in a non-judgemental manner
- Underuse of inhaled corticosteroids (and overuse of short-acting β_2 agonists) is common and linked to poor asthma control
- Prioritise asthma self-management in consultations with children over 5 years old

Acknowledgements

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Figure 1 Diagnostic algorithm for asthma.

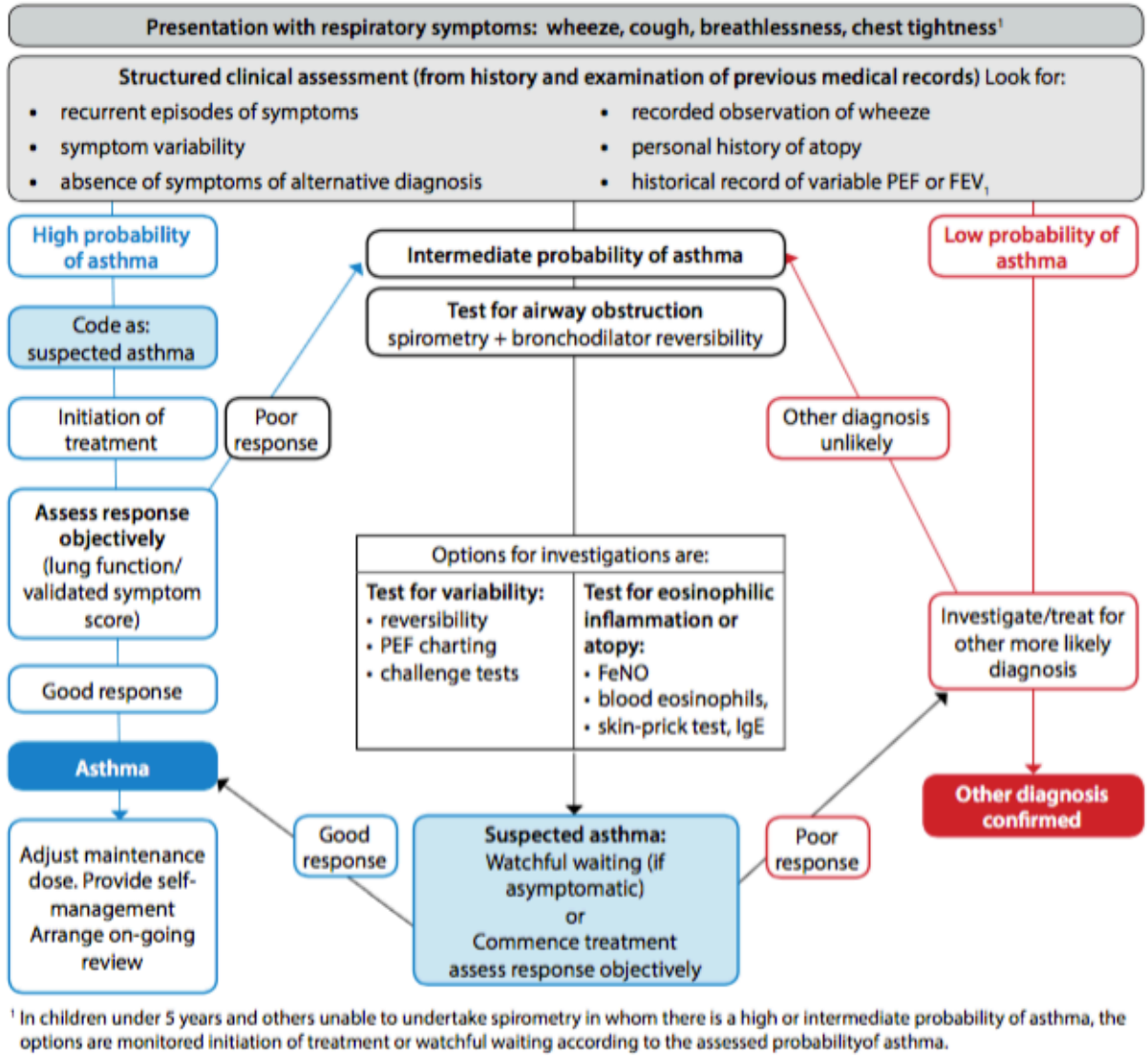

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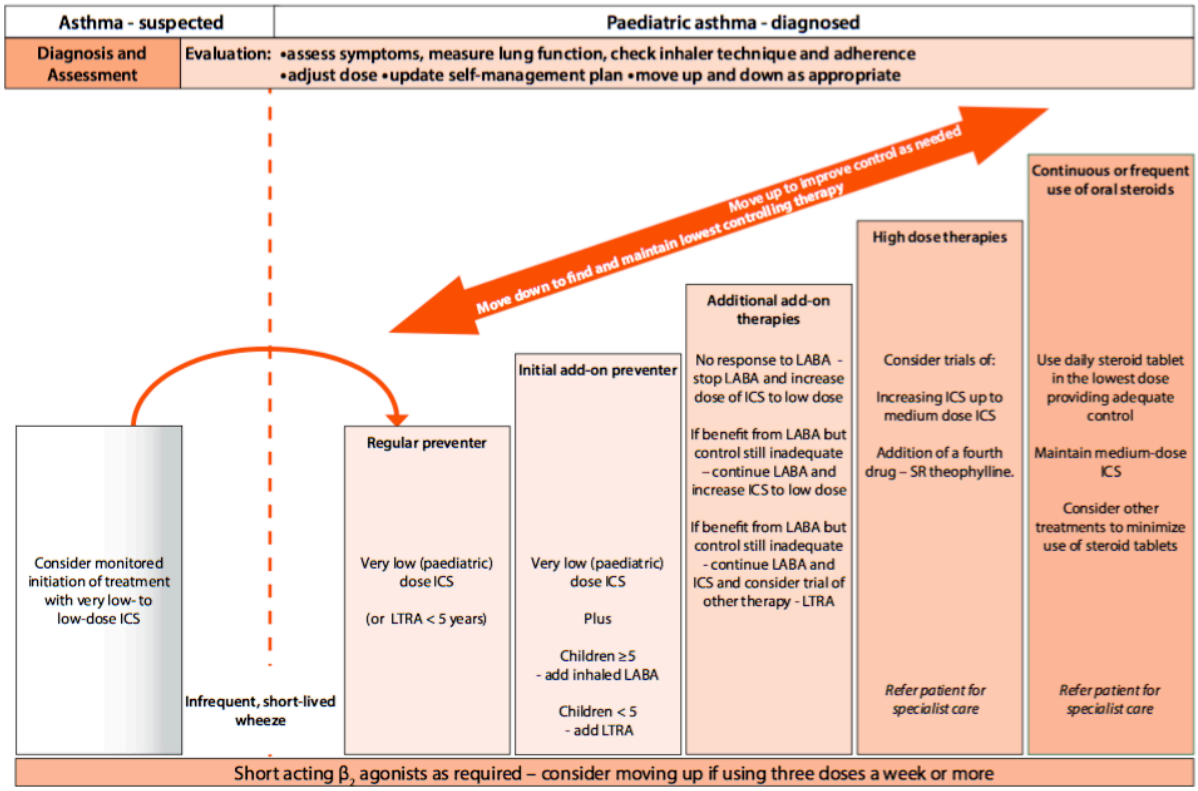
Figure 2 Summary of management in children.



Key:
ICS = Inhaled corticosteroid
LTRA = Leukotriene receptor antagonist (e.g. Montelukast)
LABA = Long acting beta agonist / bronchodilator (e.g. salmeterol)

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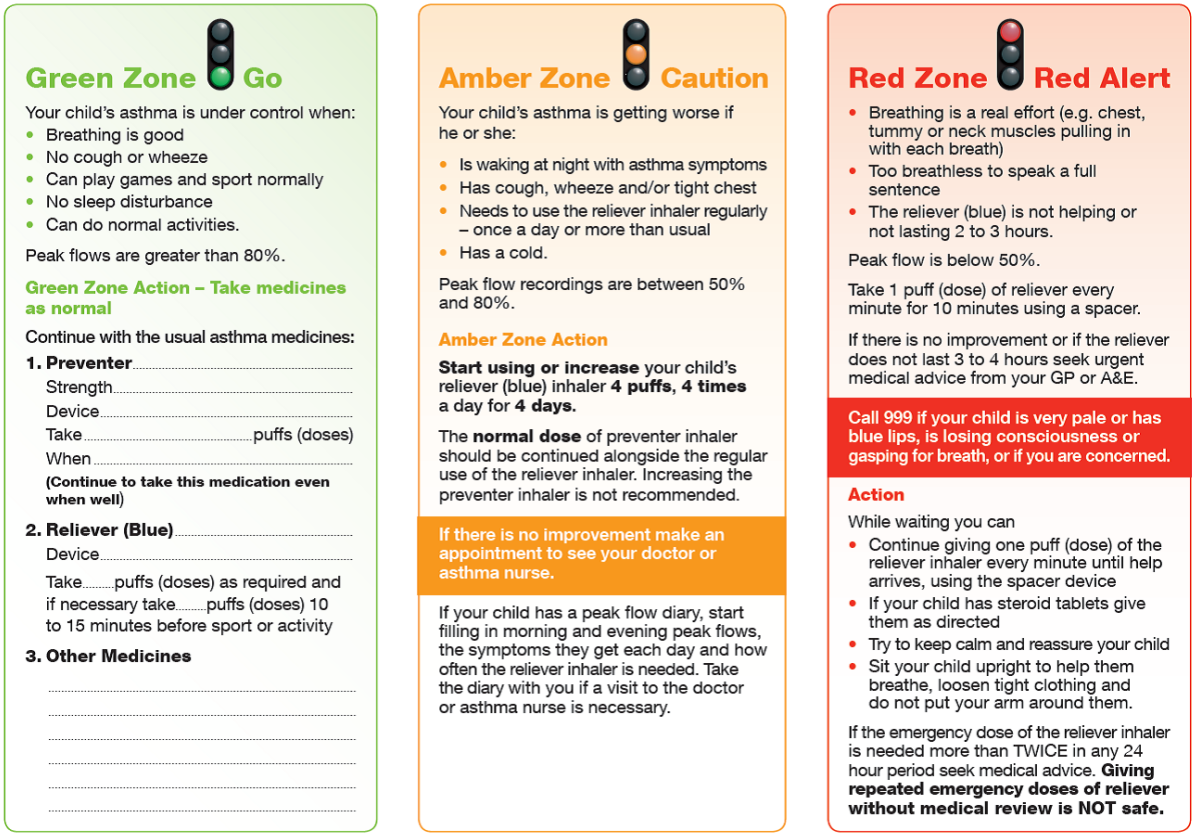
Figure 3 Personal asthma action plan for children.



Green Zone Go

Your child's asthma is under control when:

- Breathing is good
- No cough or wheeze
- Can play games and sport normally
- No sleep disturbance
- Can do normal activities.

Peak flows are greater than 80%.

Green Zone Action – Take medicines as normal

Continue with the usual asthma medicines:

1. Preventer .....

Strength .....

Device .....

Take ..... puffs (doses)

When .....

(Continue to take this medication even when well)

2. Reliever (Blue) .....

Device .....

Take ..... puffs (doses) as required and if necessary take ..... puffs (doses) 10 to 15 minutes before sport or activity

3. Other Medicines

.....

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Amber Zone Caution

Your child's asthma is getting worse if he or she:

- Is waking at night with asthma symptoms
- Has cough, wheeze and/or tight chest
- Needs to use the reliever inhaler regularly – once a day or more than usual
- Has a cold.

Peak flow recordings are between 50% and 80%.

Amber Zone Action

Start using or increase your child's reliever (blue) inhaler **4 puffs, 4 times** a day for **4 days.**

The **normal dose** of preventer inhaler should be continued alongside the regular use of the reliever inhaler. Increasing the preventer inhaler is not recommended.

If there is no improvement make an appointment to see your doctor or asthma nurse.

If your child has a peak flow diary, start filling in morning and evening peak flows, the symptoms they get each day and how often the reliever inhaler is needed. Take the diary with you if a visit to the doctor or asthma nurse is necessary.

Red Zone Red Alert

- Breathing is a real effort (e.g. chest, tummy or neck muscles pulling in with each breath)
- Too breathless to speak a full sentence
- The reliever (blue) is not helping or not lasting 2 to 3 hours.

Peak flow is below 50%.

Take 1 puff (dose) of reliever every minute for 10 minutes using a spacer.

If there is no improvement or if the reliever does not last 3 to 4 hours seek urgent medical advice from your GP or A&E.

Call 999 if your child is very pale or has blue lips, is losing consciousness or gasping for breath, or if you are concerned.

Action

While waiting you can

- Continue giving one puff (dose) of the reliever inhaler every minute until help arrives, using the spacer device
- If your child has steroid tablets give them as directed
- Try to keep calm and reassure your child
- Sit your child upright to help them breathe, loosen tight clothing and do not put your arm around them.

If the emergency dose of the reliever inhaler is needed more than TWICE in any 24 hour period seek medical advice. **Giving repeated emergency doses of reliever without medical review is NOT safe.**

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Figure 4 Assessment and management of acute asthma attack for children.

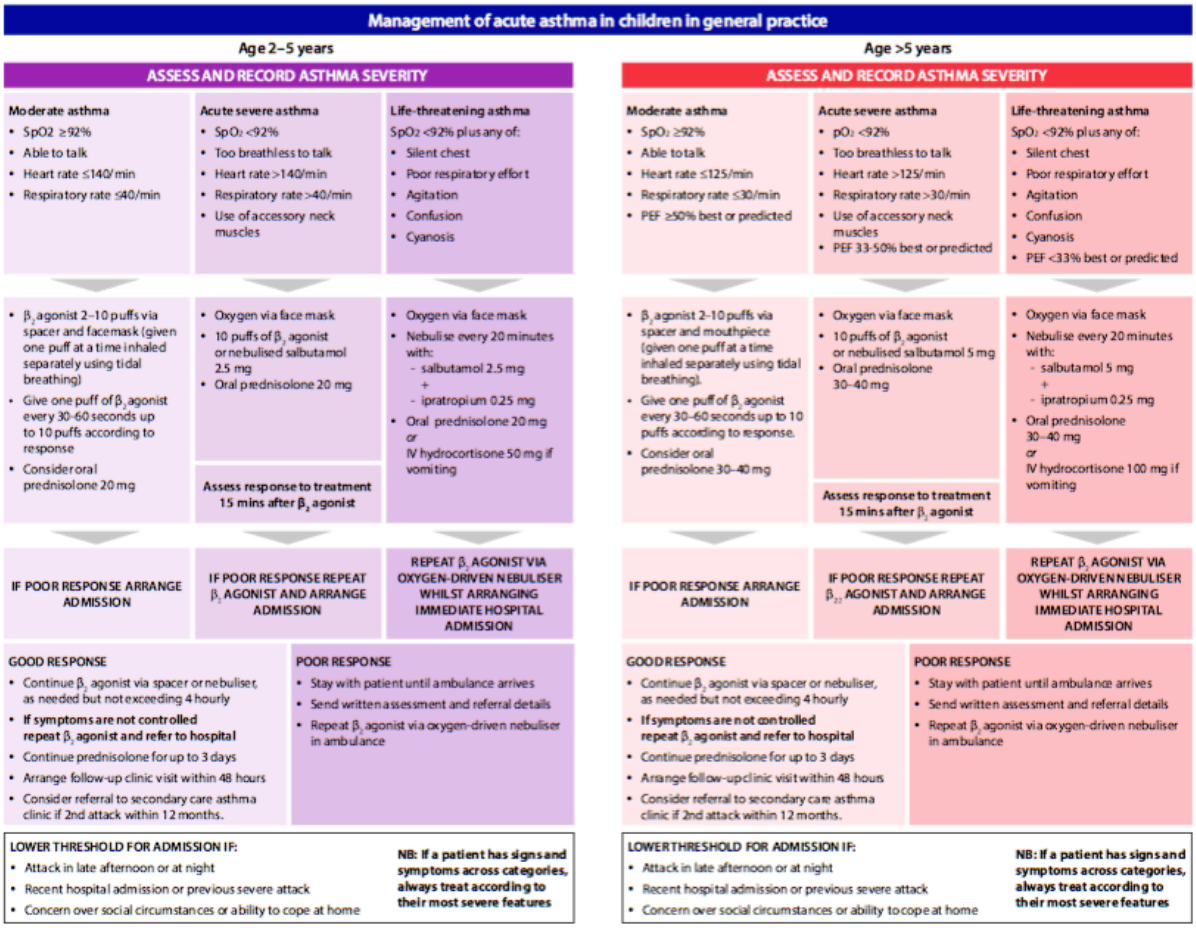

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Table 1. Symptoms and signs suggesting an alternative diagnosis in wheezy children	
Persistent moist cough	Cystic fibrosis, bronchiectasis, protracted bacterial bronchitis, recurrent aspiration, host defence disorder, ciliary dyskinesia
Excessive vomiting	Gastro-oesophageal reflux (± aspiration)
Paroxysmal coughing bouts leading to vomiting	Pertussis
Dysphagia	Swallowing problems (± aspiration)
Breathlessness, with light-headedness and peripheral tingling	Dysfunctional breathing / Panic attacks
Inspiratory Stridor	Tracheal or laryngeal disorder
Abnormal voice or cry	Laryngeal problem
Focal signs in chest	Development anomaly, post-infective syndrome, bronchiectasis, tuberculosis
Finger clubbing	Cystic fibrosis, bronchiectasis
Failure to thrive	Cystic fibrosis, host defence disorder, gastro-oesophageal reflux disease

Adapted from BTS/SIGN, 2016

Table 2. Assessing the probability of an asthma diagnosis.

High probability	Asthma diagnosis is likely, complete a trial of treatment.
Low probability	An alternative diagnosis is likely, consider further investigation and referral as clinically indicated
Intermediate probability	Diagnosis is uncertain. Additional steps are needed to further evaluate the likelihood of asthma: • a trial of treatment can be considered, reviewing after a defined period • if a child is able, seek confirmation of variable airflow obstruction which can be achieved by spirometry or (conveniently in primary care) comparing peak expiratory flow when symptomatic with readings taken when the child is well. To gain accurate spirometry readings in children the operator should have paediatric specific training – even then there is a substantial false positive rate. • If uncertainty remains despite the further steps taken, refer for a specialist opinion.

Source: BTS/SIGN (2016).

Box 1. Consider referral to secondary care

- If doubt about diagnosis remains, including failure to respond to a trial of treatment
- Failure to respond to treatment despite trial of add-on preventer therapies
- Rapid escalation through therapies
- Long term high dose (400 microgram daily) inhaled corticosteroids
- Frequent exacerbations requiring oral steroids
- Co-existing food allergy, especially to peanuts or tree nuts
- Parental concern or anxiety