

British Guideline on the Management of Asthma

A national clinical guideline

British Thoracic Society
Scottish Intercollegiate Guidelines Network



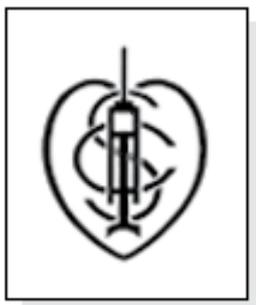
Revised edition July 2007

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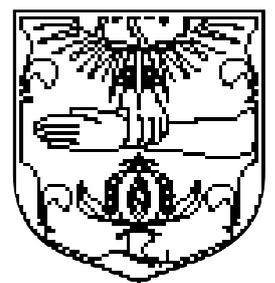
British Association for Accident
and Emergency Medicine



General Practice
Airways Group



Royal College of Paediatrics
and Child Health
British Paediatric
Respiratory Society



Royal College of Physicians
of London

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1 Introduction

The first British guidelines on asthma management in adults were published in the British Medical Journal in 1990 after a joint initiative between the British Thoracic Society (BTS), the Royal College of Physicians of London, the King's Fund Centre, and Asthma UK.^{1,2} These were updated in 1993 with the addition of guidelines on childhood asthma³ and further updated in 1995.⁴ The Scottish Intercollegiate Guidelines Network (SIGN) published its first asthma guideline in 1996⁵ and has subsequently published on primary care management of asthma in 1998⁶ and management of acute asthma in 1999.⁷

Both the BTS and SIGN have recognised the need to update their asthma guidelines, using evidence-based methodology, to cover all aspects of asthma care. It was agreed that the two organisations should jointly produce a comprehensive new guideline, the process being further strengthened by collaboration with Asthma UK, the Royal College of Physicians of London, the Royal College of Paediatrics and Child Health, General Practice Airways Group, and the British Association of Accident & Emergency Medicine. The outcome of these efforts is this new British Guideline on the Management of Asthma.

2004

The new guideline has been developed using SIGN methodology, adapted for UK-wide development.⁸ The electronic searches extended to 1995, although some sections required literature searches to go as far back as 1966. The Pharmacology section utilised the North Of England Asthma Guideline to address any key questions on adult pharmacological management covered by that document. The North of England Guideline¹⁵⁷ literature search covered a period from 1984 to December 1997, and SIGN augmented this with a search from 1997 onwards.

The levels of evidence and grades of recommendation used in this guideline are detailed in Table 1.⁹ Users should note that the grade of recommendation relates to the strength of the evidence and not necessarily to the clinical importance of the recommendation. Where there are only low grade recommendations in important clinical areas, this should be seen as a stimulus to further rigorous research.

The aim of the guideline is to provide comprehensive advice on asthma management for patients of all ages in both primary and secondary care, that will be of use to all health professionals involved in the care of people with asthma.

2005

The changes to the April 2004 version of the guideline were based on a literature search dating up to and including March 2003, and the September 2005 changes are based on a search up to and including March 2004 with additional searches for section 4 carried out in August 2004. The changes to section 8 were developed using a comprehensive evidence based guideline on occupational asthma published by the British Occupational Health Research Foundation, developed using methodology similar to SIGN's.⁵⁷⁰ The BTS/SIGN occupational asthma subgroup were represented in this process and have selected those recommendations relevant to less specialised asthma management for inclusion here.

This updated version has been published in electronic format only.

1.1 STATEMENT OF INTENT

This guideline is not intended to be construed or to serve as a standard of medical care. Standards of care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge and technology advance and patterns of care evolve. These parameters of practice should be considered guidelines only. Adherence to them will not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care aimed at the same results. The ultimate judgement regarding a particular clinical procedure or treatment plan must be made by the doctor, following discussion of the options with the patient, in light of the diagnostic and treatment choices available. However, it is advised that significant departures from the national guideline or any local guidelines derived from it should be fully documented in the patient's case notes at the time the relevant decision is taken.

Table 1: Key to evidence statements and grades of recommendation

KEY TO EVIDENCE STATEMENTS AND GRADES OF RECOMMENDATIONS

LEVELS OF EVIDENCE

1 ⁺⁺	High quality meta-analyses, systematic reviews of randomised controlled trials (RCTs), or RCTs with a very low risk of bias
1 ⁺	Well conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
1 ⁻	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
2 ⁺⁺	High quality systematic reviews of case control or cohort studies High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2 ⁺	Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2 ⁻	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, eg case reports, case series
4	Expert opinion

GRADES OF RECOMMENDATION

Note: The grade of recommendation relates to the strength of the evidence on which the recommendation is based. It does not reflect the clinical importance of the recommendation.

A	At least one meta-analysis, systematic review of RCTs, or RCT rated as 1 ⁺⁺ and directly applicable to the target population; or A body of evidence consisting principally of studies rated as 1 ⁺ , directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2 ⁺⁺ , directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1 ⁺⁺ or 1 ⁺
C	A body of evidence including studies rated as 2 ⁺ , directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2 ⁺⁺
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2 ⁺

GOOD PRACTICE POINTS

<input checked="" type="checkbox"/>	Recommended best practice based on the clinical experience of the guideline development group
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2 Diagnosis and natural history

The diagnosis of asthma is a clinical one; there is no confirmatory diagnostic blood test, radiographic or histopathological investigation. In some people, the diagnosis can be corroborated by suggestive changes in lung function tests.

The clinical diagnosis of asthma is not always simple (*see Figure 1*) and the absence of an agreed definition of the disease is a problem, with many descriptions existing.¹⁰ The International Consensus Report describes asthma as “*a chronic inflammatory disorder of the airways in susceptible individuals, inflammatory symptoms are usually associated with widespread but variable airflow obstruction and an increase in airway response to a variety of stimuli. Obstruction is often reversible, either spontaneously or with treatment*”.¹¹

2.1 DIAGNOSIS OF ASTHMA IN ADULTS

Some of the symptoms of asthma are shared with diseases of other systems. Even when the symptom of breathlessness is thought to be due to lung disease, there are numerous relatively common lung diseases and differentiation of an airway disorder needs to be made from both infections, and pulmonary thromboembolic disease and restrictive lung disorders. Features of an airway disorder such as cough, wheeze and breathlessness should be corroborated where possible by measurement of airflow limitation.⁵²² They may be due either to a localised airway obstruction (e.g. tumour, foreign body, vocal cord dysfunction or post tracheostomy stenosis), or to a generalised problem (such as asthma, chronic obstructive airways disease (COPD), bronchiectasis, cystic fibrosis or obliterative bronchiolitis).

2.1.1 SYMPTOMS OF ASTHMA

To avoid misdiagnosis it is essential to remember that people with asthma may suffer from a variety of symptoms, none of which is specific for asthma:

- wheeze
- shortness of breath
- chest tightness
- cough.

The hallmark of asthma is that these symptoms tend to be:

- variable
- intermittent
- worse at night
- provoked by triggers including exercise

When cough is the predominant symptom without wheeze, this is often referred to as cough variant asthma.

2.1.2 SIGNS OF ASTHMA

During exacerbations, the patient will often have wheeze and reduced lung function, either reduced peak flow or an obstructive pattern on spirometry. The presence of wheeze (usually diffuse, polyphonic, bilateral and particularly expiratory) is a cardinal sign of asthma and, if present, should be documented in clinical notes. Outside acute episodes, there may be no objective signs of asthma (*see section 2.1.4*). Patients who present with chronic asthma may have signs of hyperinflation with or without wheeze.

- ✓ Record the presence of wheeze in the patient’s notes.

2.1.3 ADDITIONAL INFORMATION

Additional information which may contribute towards a clinical suspicion of asthma includes:

- personal or family history of asthma or other atopic condition (eczema, allergic rhinitis)
- worsening of symptoms after exposure to recognised triggers such as pollens, dust, feathered or furry animals, exercise, viral infections, chemicals, and environmental tobacco smoke
- worsening of symptoms after taking aspirin/non-steroidal anti-inflammatory medication or use of β -blockers.

2.1.4 OBJECTIVE TESTS

Obstructive airways disease produces a decrease in peak expiratory flow (PEF) and forced expiratory volume in one second (FEV_1). One or both of these should be measured, but may be normal if the measurement is made between episodes of bronchospasm. If they are repeatedly normal in the presence of symptoms, then a diagnosis of asthma must be in doubt.

Variability of PEF and FEV_1 , either spontaneously over time or in response to therapy is a characteristic feature of asthma. Although the normal level of diurnal variability is open to question, sequential measurement of PEF may be useful in the diagnosis of asthma. Calculating variability may be done in one of several ways and the method used should always be stated. A 20% or greater variability in amplitude % best (see Box 1) with a minimum change of at least 60 l/min, ideally for three days in a week for two weeks seen over a period of time, is highly suggestive of asthma.^{12-18, 523}

Many patients with asthma will demonstrate variability below 20%, making this a reasonably specific, but insensitive diagnostic test. That is, marked variability of peak flow and easily demonstrated reversibility confirms a diagnosis of asthma, but smaller changes do not necessarily exclude the diagnosis.⁵²⁴

Box 1: Diagnosis of asthma using PEF

Diagnosis of asthma using PEF

amplitude % best = (highest - lowest) / highest x 100

Highest PEF = 400 l/min

Lowest PEF = 300 l/min

Amplitude = 400 l/min - 300 l/min = 100 l/min

Percentage PEF variability = (400-300)/400 x 100 = 25%

Alternative methods for measuring variable airflow limitation are:

- an increase after inhalation of a short-acting β_2 agonist (e.g. salbutamol 400 mcg by metered dose inhaler (pMDI) + spacer or 2.5 mg by nebuliser)
- an increase after a trial of steroid tablets (prednisolone 30 mg/day for 14 days)
- a decrease after six minutes of exercise, e.g. running. Take a resting measurement, ask the patient to exercise for six minutes, take a further reading and then every 10 minutes for 30 minutes. As this procedure may rarely induce significant asthma, facilities for immediate treatment should be available.

- ✓ Objective tests should be used to try to confirm a diagnosis of asthma before long-term therapy is started.

Each of the above methods can be used, measuring either PEF (look for a 20% change from baseline and at least 60 l/min) or FEV_1 (15% change and at least 200 ml).¹⁹

Increased bronchial responsiveness demonstrated by methacholine or histamine challenge is associated with symptomatic asthma, but is also common in the general population and in patients with COPD. However, failure to demonstrate hyper-responsiveness in an untreated person with suspected asthma should prompt reconsideration of the diagnosis.⁵²⁵

2.1.5 OTHER TESTS

Lung function tests may show changes suggestive of an alternative lung disease. For example COPD may be suspected in the presence of obstructive spirometry, reduced diffusing capacity (CO uptake) and pressure dependent airway collapse on flow volume curves, but these changes are not diagnostic and do not exclude asthma, which may anyway coexist with other conditions.

- ✓ ■ Failure to respond to asthma treatment should prompt a search for an alternative, or additional, diagnosis.
- Perform chest x-rays in all patients with atypical symptoms.

Figure 1: Diagnosis of asthma in adults

Consider the diagnosis of asthma in patients with some or all of the following:	
<p>Symptoms</p> <p>Episodic / variable</p> <ul style="list-style-type: none"> ▪ wheeze ▪ shortness of breath ▪ chest tightness ▪ cough 	<p>Signs</p> <ul style="list-style-type: none"> ▪ none (<i>common</i>) ▪ wheeze – diffuse, bilateral, expiratory (\pm <i>inspiratory</i>) ▪ tachypnea
<p>Helpful additional information</p> <ul style="list-style-type: none"> ▪ Personal or family history of asthma or atopy (<i>eczema, allergic rhinitis</i>) ▪ History of worsening after use of aspirin/NSAID ingestion, use of β blockers (<i>including glaucoma drops</i>) ▪ Recognised triggers – pollens, dust, animals, exercise, viral infections, chemicals, irritants ▪ Pattern and severity of symptoms and exacerbations 	
<p>Objective measurements</p> <ul style="list-style-type: none"> ▪ > 20% diurnal variation on ≥ 3 days in a week for two weeks on PEF diary or FEV₁ $\geq 15\%$ (and 200 ml) increase after short acting β_2 agonist (e.g. salbutamol 400 mcg by pMDI + spacer or 2.5 mg by nebuliser) or FEV₁ $\geq 15\%$ (and 200 ml) increase after trial of steroid tablets (prednisolone 30 mg/day for 14 days) or FEV₁ $\geq 15\%$ decrease after six minutes of exercise (running) ▪ Histamine or methacholine challenge in difficult cases 	
<p>Indications for referral for specialist opinion/further investigation*</p> <ul style="list-style-type: none"> ▪ Diagnosis unclear or in doubt ▪ Unexpected clinical findings <i>e.g. crackles, clubbing, cyanosis, heart failure</i> ▪ Spirometry or PEFs don't fit the clinical picture ▪ Suspected occupational asthma ▪ Persistent shortness of breath (not episodic, or without associated wheeze) ▪ Unilateral or fixed wheeze ▪ Stridor ▪ Persistent chest pain or atypical features ▪ Weight loss ▪ Persistent cough and/or sputum production ▪ Non-resolving pneumonia 	<p>Differential diagnoses include:</p> <ul style="list-style-type: none"> ▪ COPD ▪ cardiac disease ▪ tumour <ul style="list-style-type: none"> - laryngeal - tracheal - lung ▪ bronchiectasis ▪ foreign body ▪ interstitial lung disease ▪ pulmonary emboli ▪ aspiration ▪ vocal cord dysfunction ▪ hyperventilation
<p>* Consider chest x-ray in any patient presenting atypically or with additional symptoms</p>	

2.2 DIAGNOSIS OF ASTHMA IN CHILDREN

A definitive diagnosis of asthma can be difficult to obtain in young children (see *Figure 2*). It is often not possible to measure airway function in order to confirm the presence of variable airway obstruction.

- ✓ Asthma should be suspected in any child with wheezing, ideally heard by a health professional on auscultation, and distinguished from upper airway noises.

In schoolchildren, bronchodilator responsiveness, PEF variability or tests of bronchial hyper-reactivity may be used to confirm the diagnosis, with the same reservations as in adults (see *section 2.1.4*).

Allergy tests may be helpful in seeking causal factors, and in making a general diagnosis of atopy. The presence of allergy is not essential to the diagnosis of asthma, but its absence in a school child with symptoms suggestive of asthma should prompt consideration of alternative diagnoses.

D Base the diagnosis of asthma in children on:

- the presence of key features and careful consideration of alternative diagnoses (see table 2)
- assessment of the response to trials of treatment, and ongoing assessment
- repeated reassessment of the child, questioning the diagnosis if management is ineffective.

- ✓ Record the criteria on which the diagnosis has been made.

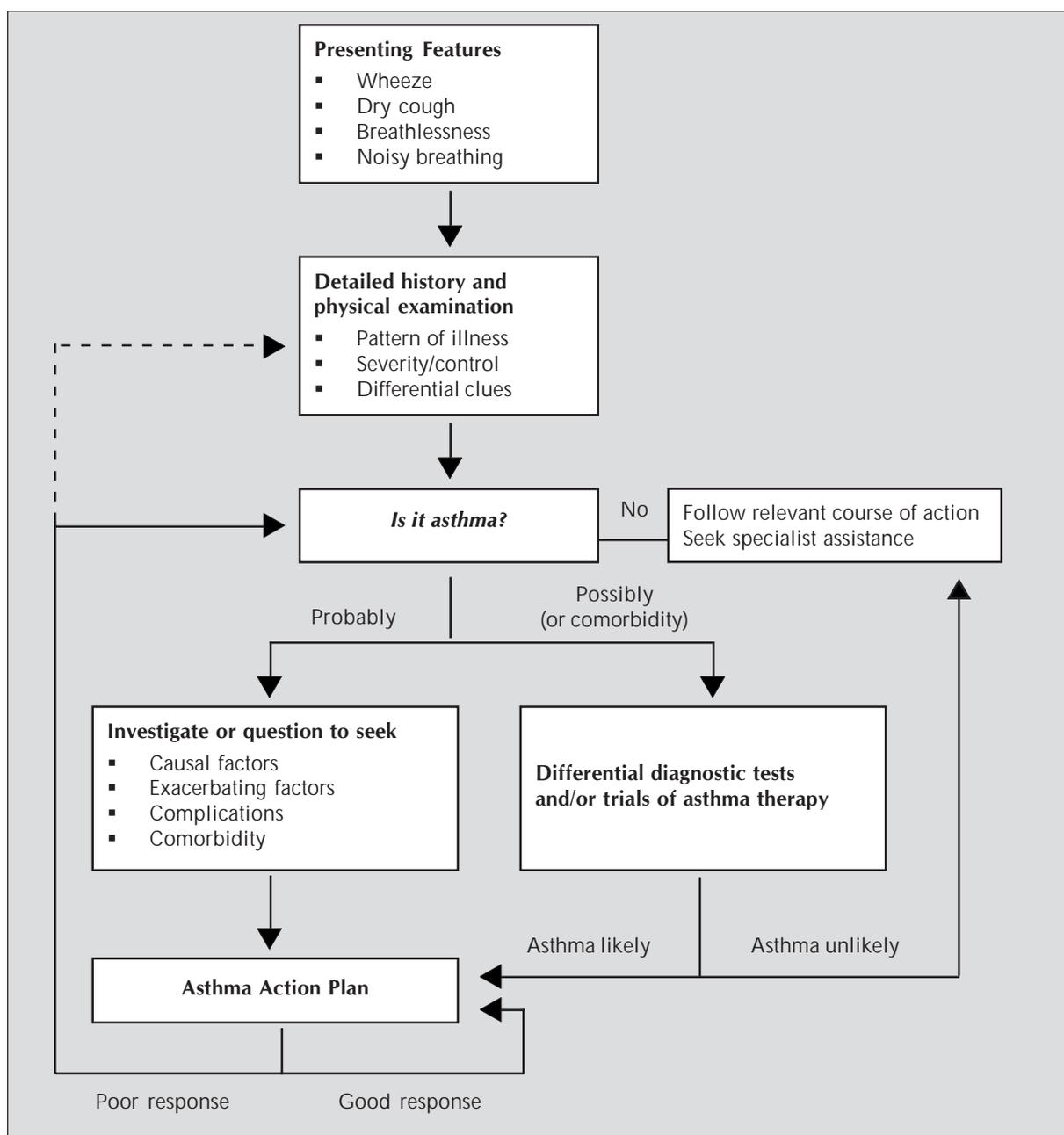
Box 2: Indications for referral for specialist opinion – further investigations in children

- Diagnosis unclear or in doubt
- Symptoms present from birth or perinatal lung problem
- Excessive vomiting or possetting
- Severe upper respiratory tract infection
- Persistent wet cough
- Family history of unusual chest disease
- Failure to thrive
- Unexpected clinical findings e.g. *focal signs in the chest, abnormal voice or cry, dysphagia, inspiratory stridor*
- Failure to respond to conventional treatment (*particularly inhaled corticosteroids above 400 mcg/day*
- *Frequent use of steroid tablets*)
- Parental anxiety or need for reassurance

Table 2: Clues to alternative diagnoses in wheezy children
(features not commonly found in asthma)

Clinical clue	Possible diagnosis
Perinatal and family history	
Symptoms present from birth or perinatal lung problem	Cystic fibrosis; chronic lung disease; ciliary dyskinesia; developmental anomaly
Family history of unusual chest disease	Cystic fibrosis; developmental anomaly; neuromuscular disorder
Severe upper respiratory tract disease	Defect of host defence
Symptoms and signs	
Persistent wet cough	Cystic fibrosis; recurrent aspiration; host defence disorder
Excessive vomiting or possetting	Reflux (\pm aspiration)
Dysphagia	Swallowing problems (\pm aspiration)
Abnormal voice or cry	Laryngeal problem
Focal signs in the chest	Developmental disease; postviral syndrome; bronchiectasis, tuberculosis
Inspiratory stridor as well as wheeze	Central airway or laryngeal disorder
Failure to thrive	Cystic fibrosis; host defence defect; gastro-oesophageal reflux
Investigations	
Focal or persistent radiological changes	Developmental disorder; postinfective disorder; recurrent aspiration; inhaled foreign body; bronchiectasis; tuberculosis

Figure 2: Diagnosis of asthma in children



2.3 PROGNOSIS OF CHILDHOOD ASTHMA

Therapeutic decisions, particularly the introduction of prophylactic treatments may be influenced not only by the presence of persistent symptoms but by current understanding of the pathophysiology and the natural history of the disease.

If the factors associated with resolution and persistence of asthma presenting in childhood were not taken into account and every child presenting with wheeze was treated prophylactically, half of all children would be treated.

The major identifiable risk factors contributing to both the expression and persistence of asthma are considered overleaf.

2.3.1 FAMILY HISTORY OF ATOPY

A family history of atopy is the most important clearly defined risk factor for atopy in children. Asthma is linked to both parental and sibling atopy. The strongest association is with maternal atopy. A maternal history of asthma and/or rhinitis is a significant risk factor for late childhood onset asthma and recurrent wheezing throughout childhood. The association of persistence of symptoms with maternal asthma and rhinitis weakens during the transition to adulthood.²⁰⁻³³

1+

2.3.2 CO-EXISTENCE OF ATOPIC DISEASE

Markers of allergic disease at presentation, (including skin prick tests, eosinophil counts and peripheral blood markers), are related to severity of current asthma and persistence through childhood, but as yet have not been shown to be related to the outcome of respiratory symptoms and their severity in adulthood.^{20 22 27 31 33-42}

2.3.3 EFFECT OF SEX

Male sex is a risk factor for asthma in prepubertal children and female sex is a risk factor for persistence of asthma in the transition from childhood to adulthood. Male children with asthma are more likely to “grow out” of their asthma in the transition to adulthood.^{21 22 24 26 33 35 42-52}

2.3.4 BRONCHIOLITIS IN INFANCY

Viral associated wheeze in infancy is often followed by wheeze in early childhood. This association weakens with advancing age and by 35-40 years ventilatory function and bronchial reactivity are similar to those who had no symptoms as children.^{22 30 32 38 49 53-58}

2.3.5 PARENTAL SMOKING

Maternal smoking is associated with significantly higher prevalence of wheezing illness in early childhood. However, there is no identifiable association between parental smoking and respiratory symptoms in adult life. Reducing the prevalence of smoking in the adult population, and particularly in women of childbearing age, would significantly reduce the prevalence of wheezing in young children.^{20-24 26 27 32 36 59-61}

2.3.6 BIRTH WEIGHT AND PREMATURITY

Wheezing is more common in young children who were born prematurely. In adulthood there are no consistent relationships between asthma and birth weight.^{21 30 59 60 62 63}

2.3.7 AGE AT PRESENTATION

The natural history of wheeze is dependent on the age at first presentation. The earlier the onset of wheeze, the better the prognosis. Available data from child cohorts show a “break point” at two years with the majority of those presenting before this age becoming asymptomatic by mid childhood (6-11 years). It must be remembered that coexistent atopy (see section 2.3.2) is a risk factor for persistence independent of age of presentation.^{20 33 34 38 42 43 47 48 54 64-69}

2.3.8 SEVERITY AND FREQUENCY OF EPISODES

Increased frequency and severity of wheezing episodes in childhood are associated with recurrent wheeze into adulthood.^{20 28 33 34 39 41 43 46 52 68 70 71}

2.3.9 LUNG FUNCTION MEASUREMENTS

There is a relationship between the level of pulmonary function in childhood and in adulthood. Persistent reduction in baseline airway function and increased airway responsiveness is associated with continuation of symptoms into adulthood.^{20 22 40 43 52 53 70-73}

3 Non-pharmacological management

There is increasing interest in factors which, if avoided, might facilitate the management of asthma, reducing the requirement for pharmacotherapy; and which may have the potential to modify fundamental causes of asthma. However, evidence has been difficult to obtain for many approaches and more studies are required.

This section distinguishes:

- primary prophylaxis: interventions made before there is any evidence of disease
- secondary prophylaxis: interventions made after the onset of disease to reduce its impact.

The distinction is made as factors that induce the disease in the first place are not necessarily the same as those that incite a pre-existing problem.

3.1 PRIMARY PROPHYLAXIS

Primary prophylaxis is employed before there is any evidence of disease in an attempt to prevent its onset. A number of potential strategies are discussed below.

3.1.1 ALLERGEN AVOIDANCE

There is a strong correlation between allergic sensitisation to common aeroallergens and the subsequent development of asthma. There is also a strong association between allergen exposure in early life and sensitisation to these allergens, although it has not been possible to demonstrate an association between allergen exposure and the development of asthma.⁷⁴

The majority of allergen avoidance studies focus on dietary manipulation to prevent atopic eczema and have paid little attention to aeroallergen avoidance. Two trials in progress are investigating the consequences of introducing house dust mite reduction in early pregnancy, and are following up the children born to the participating mothers. Although accurate asthma phenotyping is not possible in infancy, outcomes at one year of age indicate a modest but significant reduction in wheezing illnesses.^{75 76}

Allergen avoidance after birth has been studied in a number of controlled (but not double blind trials). There appears to be a transient reduction in the prevalence of atopic eczema in the first two years of life but no evidence of sustained benefit in relation to asthma.^{77 78} A number of epidemiological studies suggest that close contact with a cat or dog in very early infancy reduces subsequent prevalence of allergy and asthma. This may be a consequence of high allergen exposure inducing tolerance.⁷⁹⁻⁸¹

No recommendations on prenatal or postnatal allergen avoidance can be made in relation to primary prevention of asthma.

3.1.2 BREAST-FEEDING

A systematic review and meta-analysis involving 8,183 subjects followed for a mean of four years revealed a significant protective effect of breast-feeding against the development of asthma. The effect was greatest in children with a family history of atopy.⁸² In contrast, a more recent study in 1,246 patients found that breast-feeding was associated with a reduced risk of infant wheeze, but also with an increased risk of asthma at six years.⁸³

1+

A Breast-feeding should be encouraged and its benefits include a protective effect in relation to early life wheezing.

3.1.3 MODIFIED INFANT MILK FORMULAE

Trials of modified milk formulae using partial and extensive hydrolysates of whey or casein or soy formulae compared with conventional formulae have not shown any consistent significant long-term benefits in relation to asthma. Variation in study design, intervention used, co-interventions and outcome definition make meta-analysis problematical.⁸⁴

3.1.4 OTHER DIETARY MODIFICATIONS

Limited epidemiological evidence suggests that fish oil consumption may protect against asthma in childhood.⁸⁵ Trials of lipid supplementation during pregnancy and postnatally to prevent atopic disease are in progress.

3.1.5 MICROBIAL EXPOSURE

The “hygiene hypothesis” suggests that early exposure to microbial products will switch off allergic responses preventing allergic diseases such as asthma.⁸⁶ Epidemiological studies comparing large populations who have or have not had such exposures support the hypothesis.⁸⁷ A double blind placebo trial of the probiotic, Lactobacillus CG, reported a reduced incidence of atopic eczema but no effect on IgE antibody sensitisation. Small sample size and early outcome age limit the interpretation of this study.⁸⁸ In the absence of good quality intervention studies, no recommendation can be made at present.

3.1.6 IMMUNOTHERAPY AND PRIMARY PREVENTION

Three observational studies, in over 8,000 patients, have shown that immunotherapy in individuals with a single allergy reduces the numbers subsequently developing new allergies over a three to four year follow up compared with contemporaneous untreated controls.⁸⁹⁻⁹¹ No double blind placebo controlled trials of immunotherapy as primary prevention have been conducted, and at present immunotherapy cannot be recommended for primary prevention. Preliminary results from an ongoing parallel group study using contemporaneous untreated children as the control group for pollen immunotherapy in children with allergic rhinitis suggest a lower rate of onset of asthma in the treated group.⁹²

3.1.7 AVOIDING POLLUTANTS

No evidence was found to support a link between exposure to environmental tobacco smoke and other air pollutants and the induction of atopic asthma.

An early meta-analysis suggested an association between gas cooking and respiratory illness⁹³ but this has not been borne out in larger studies.^{94 95}

Increased risk of infant wheeze is associated with smoking during pregnancy and maternal postnatal smoking.⁹⁶ Pregnancy smoking affects an infant’s airway function, increasing susceptibility to wheeze.⁹⁷⁻¹⁰¹ There are many other adverse effects on the young child of such exposures.

2⁺⁺

B Parents and parents-to-be who smoke should be advised of the many adverse effects of smoking on their children, including increased wheezing in infancy, and be offered appropriate support to stop smoking.

3.1.8 PHARMACOTHERAPY

For completeness, this section on the primary prevention of asthma should mention pharmacological trials of treatments designed to prevent onset of the disease. Children given ketotifen (206 infants, in two trials) showed significantly less asthma at one and three year follow-up compared with those receiving placebo.^{102 103} In the third study, using cetirizine, 18 months’ treatment had no effect in the intention to treat population but significantly reduced asthma in children with atopic dermatitis sensitised to either grass pollen or house dust mite. Cetirizine had additional benefits for atopic dermatitis alone and reduced the frequency of urticaria.¹⁰⁴

3.2 SECONDARY NON-PHARMACOLOGICAL PROPHYLAXIS

3.2.1 ALLERGEN AVOIDANCE

Allergen avoidance measures may be helpful in reducing the severity of existing disease. Increasing allergen exposure in sensitised individuals is associated with an increase in asthma symptoms, bronchial reactivity and deterioration in lung function.¹⁰⁵⁻¹⁰⁷

Treatment requirements, hospital attendance and respiratory arrest are associated with increased exposure to high concentrations of indoor allergens.¹⁰⁸

Threshold concentrations of allergens that can be regarded as risk factors for acute attacks include:

- 10 mcg/g dust of group 1 mite allergen¹⁰⁹
- 8 mcg/g dust of Fel d 1, the major cat allergen¹⁰⁹
- 10 mcg/g dust of Can f 1, the major dog allergen¹⁰⁹
- 8 mcg/g dust of cockroach allergen.¹¹⁰

Evidence that reducing allergen exposure can reduce morbidity and mortality is tenuous. In uncontrolled studies, children and adults have both shown benefit from exposure to a very low allergen environment. However, the benefits in such circumstances cannot be necessarily attributed to the allergen avoidance.¹¹¹⁻¹¹³

3.2.2 HOUSE DUST MITE CONTROL MEASURES

There have been two Cochrane reviews on house dust mite control measures and the management of asthma.^{114 115} The first concluded that current chemical and physical methods were ineffective and could not be recommended as prophylactic treatment for asthma patients with sensitivity to house dust mites. An amendment concluded that physical reduction methods may reduce asthma symptoms.¹¹⁵

The reviewed studies used various chemical, physical or combinations of methods to reduce mite exposure. The combined meta-analysis showed no difference in improvement in asthma between patients in experimental groups compared with controls. There was heterogeneity between studies with regard to intervention, and in some studies intervention allocation was not adequately concealed.¹¹⁵

Larger and more carefully controlled studies are required to demonstrate any clear benefit from house dust mite avoidance. At present, this does not appear to be a cost-effective method of achieving benefit.

- ✓ In committed families with evidence of house dust mite allergy and who wish to try mite avoidance, the following are recommended:¹¹⁶
 - complete barrier bed-covering systems
 - removal of carpets
 - removal of soft toys from bed
 - high temperature washing of bed linen
 - acaricides to soft furnishings
 - dehumidification.

3.2.3 OTHER ALLERGENS

Animal allergens, particularly cat and dog, are a potent cause of asthma symptoms. Observational studies have not found that removing a pet from a home improves asthma control.¹¹⁷ In a study in adults with cat sensitivity, randomisation to either bedroom air cleaner and covers for bedding or no active intervention with restriction of cats away from the bedroom, resulted in no differences between groups with regard to symptoms, peak flow, lung function or bronchial reactivity.¹¹⁸ Alternatively, there is a suggestion that maintaining a high exposure to cat allergen in the domestic environment might actually induce some degree of tolerance.⁸¹ Many experts still feel that removal of pets from the home of individuals with asthma who also have an allergy to that pet should be recommended.

Cockroach allergy is not a common problem in the UK. There is no conclusive evidence regarding the impact of cockroach allergen reduction on asthma symptoms.¹¹⁹

Although fungal exposure has been strongly associated with hospitalisation and increased mortality in asthma, to date no controlled trials have addressed fungal exposure reduction and asthma.¹²⁰

3.3 ENVIRONMENTAL FACTORS

3.3.1 SMOKING

The association between passive smoking and respiratory health has been extensively reviewed.¹²¹ There is a direct causal relationship between parental smoking and lower respiratory illness in children up to three years of age. Infants whose mothers smoke are four times more likely to develop wheezing illnesses in the first year of life.⁹⁷

The independent contributions of prenatal and postnatal maternal smoking to the development of asthma in children are difficult to distinguish.¹²¹ Maternal pregnancy smoking has been shown to have an adverse influence on lung development.⁹⁷⁻⁹⁹ There is little evidence that maternal pregnancy smoking has an effect on allergic sensitisation.¹²¹

2+

Exposure to tobacco smoke in the home contributes to the severity of childhood asthma. A US Institute of Medicine review identified a causal relationship between environmental tobacco smoke (ETS) exposure and exacerbations of asthma in pre-school children. Average exposure is associated with a 30% increased risk of symptoms.¹²² One small study suggests that by stopping smoking, parents decrease the severity of asthma in their children.¹²³

B Parents who smoke should be advised about the dangers for themselves and their children and offered appropriate support to stop smoking.

Starting smoking as a teenager increases the risk of persisting asthma. Only one study was identified that examined the incidence of asthma related to taking up smoking. This showed a relative risk of 2.1 for the development of asthma over six years in 14 year-old children who have started to smoke.¹²⁴

No studies were identified that directly related to the question of whether smoking affects asthma severity. One controlled cohort study suggested that exposure to passive smoke at home delayed recovery from an acute asthma attack.¹²⁵ Studies of interventions designed to reduce environmental tobacco smoke exposure in the home have been largely ineffective in reducing the degree of exposure and none were designed with primarily clinical (as opposed to smoking) outcomes.¹²⁶ ¹²⁷ In one observational study, giving up smoking in adults was associated with improved severity of asthma scores.¹²⁸

✓ Smoking cessation should be encouraged as it is good for general health and may decrease asthma severity.

3.3.2 AIR POLLUTION

There is evidence that changing from a high particulate sulphur dioxide (coal burning) environment to a low sulphur dioxide/high diesel particulate environment increases the incidence of asthma and atopy.^{129 130} In the UK, asthma is more prevalent in 12-14 year olds in non-metropolitan rather than metropolitan areas.¹³¹ However, many differences between environments might explain the variation in asthma and allergy risk. There is some laboratory evidence that various pollutants can enhance the response of patients with asthma to allergens,^{132 133} but there is no firm epidemiological evidence that this has occurred in the UK or elsewhere.¹³⁴

Time series studies suggest that air pollution may provoke acute asthma attacks or aggravate existing chronic asthma, although the effects are minimal in comparison with factors such as infection. The short-term fluctuations in levels of air pollution currently encountered in the UK may be responsible for small changes in numbers of hospital admissions and A&E attendances for asthma.¹³⁴

No evidence was identified regarding asthma and indoor air pollutants, such as volatile organic compounds, formaldehyde or nitrogen oxides.^{135 136} Further research in this area is required.

3.4 COMPLEMENTARY AND ALTERNATIVE MEDICINE

3.4.1 HERBAL AND TRADITIONAL CHINESE MEDICINE

Currently available evidence does not allow any firm judgement to be made on herbal remedies in general or individual preparations in particular. Seventeen trials were identified, but the combined results are inconclusive. Nine of the 17 trials reported some improvement in lung function, but it is not clear that the results reported would be generalisable to a UK population.¹³⁷

3.4.2 ACUPUNCTURE

A Cochrane review¹³⁸ of 21 trials raised many methodological concerns. Only seven trials (174 patients) achieved randomisation to active (i.e. recognised in traditional Chinese medicine to be of benefit in asthma) or sham acupuncture (i.e. points with no recognised activity) for the treatment of persistent or chronic asthma. Blinding was a common problem, and only achieved for those making the observations. The difficulty in making sham acupuncture convincing and part of the holistic approach of traditional Chinese medicine was emphasised. There was wide inconsistency in methodology. Acute trials show that acupuncture has a beneficial effect, but this is less in magnitude than that achieved by inhaled bronchodilators or cromones. Demonstrating that this effect can be transferred to persistent asthma using regular treatment was achieved in one RCT reported in the Cochrane review.

The Cochrane review found no evidence for a clinically valuable benefit from acupuncture, with no statistically significant improvement in lung function being demonstrated. More rigorous research methodology and attention to outcomes other than lung function are required.

3.4.3 AIR IONISERS

Ionisers are widely advertised and marketed as being of benefit to patients with asthma, however there is no evidence that they are of value in ameliorating the symptoms of asthma or improving lung function. They do reduce mite allergen levels in the room in which they are used, and could be incorporated into a co-ordinated allergen avoidance programme, but this has not been formally tested.

One study has raised concerns that ionisation may produce an increase in nocturnal cough.¹³⁹

✓ The use of ionisers cannot be encouraged, as there is no evidence of benefit and a suggestion of adverse effect.

3.4.4 HOMEOPATHY

A Cochrane Review¹⁴⁰ identified only three methodologically sound RCTs. In the first trial (24 patients), homeopathy improved symptom scores and forced vital capacity (FVC) but had no effect on FEV₁ or bronchial reactivity. The second study demonstrated improvements in both active and placebo groups. The third, poorly reported, trial demonstrated an increase in lung function in patients receiving the active preparation.

There is insufficient information regarding the value of homeopathy in the treatment of asthma. Large, well designed trials using defined remedies and a spectrum of patients are warranted.

3.4.5 HYPNOSIS

Studies of hypnosis in patients with asthma are generally poorly controlled and patient characteristics and outcome measures vary enormously. The conclusions from a critical review¹⁴¹ were that hypnosis may be effective for asthma with the biggest effect in susceptible subjects, but more randomised and appropriately controlled studies are required.

3.4.6 MANUAL THERAPY INCLUDING MASSAGE AND SPINAL MANIPULATION

A Cochrane review identified four relevant RCTs.¹⁴² The two trials of chiropractic suggest that there is no place for this modality of treatment in the management of asthma. No conclusions can be drawn on massage therapy.

3.4.7 PHYSICAL EXERCISE TRAINING

A Cochrane review¹⁴³ has shown no effect of physical training on PEF, FEV₁, FVC or VE_{max}. However oxygen consumption, maximum heart rate, and work capacity all increased significantly. Most studies discussed the potential problems of exercise-induced asthma, but none made any observations on this phenomenon. As physical training improves indices of cardiopulmonary efficiency, it should be seen as part of a general approach to improving lifestyle and rehabilitation in asthma, with appropriate precautions advised about exercise-induced asthma (see section 4.7.2).

3.4.8 BREATHING EXERCISES INCLUDING YOGA AND BUTEYKO

The underlying principle of yoga and Buteyko is to reduce hyperventilation by lowering respiratory frequency. A Cochrane review¹⁴⁴ found no change in routine measures of lung function. Two studies reported a reduction in use of medication, and two a reduced frequency of attacks. At present it is not possible to make an evidence-based recommendation about breathing exercises for asthma.

3.4.9 FAMILY THERAPY

A Cochrane review identified two trials, in 55 children, showing that family therapy may be a useful adjunct to medication in children with asthma.¹⁴⁵ Small study size limits the recommendations.

✓ In difficult childhood asthma, there may be a role for family therapy as an adjunct to pharmacotherapy.

3.5 DIETARY MANIPULATION

3.5.1 MINERALS

Low magnesium intakes have been associated with higher prevalence of asthma. An intervention study of magnesium supplementation has suggested a reduced rate of bronchial hyper-responsiveness and wheeze.¹⁴⁶ Studies of sodium¹⁴⁷ and antioxidant supplements such as selenium and vitamin C¹⁴⁸ have produced little or no evidence of benefit amongst patients with asthma.

3.5.2 FISH OILS AND FATTY ACIDS

In vitro studies suggest that supplementing diet with the omega n-3 fatty acids found predominantly in fish oils might reduce the inflammation associated with asthma.¹⁴⁹ Controlled clinical studies in small numbers have on the whole been negative, with a Cochrane review concluding that there was little evidence to recommend fish oil supplements in asthma.¹⁵⁰

3.5.3 WEIGHT REDUCTION IN OBESE PATIENTS WITH ASTHMA

A small randomised parallel group study has shown improved asthma control following weight reduction in obese patients with asthma.¹⁵¹ | 2+

C Weight reduction is recommended in obese patients with asthma, to improve asthma control.

3.6 GASTRO-OESOPHAGEAL REFLUX IN ASTHMA

A Cochrane review of 12 double blind controlled trials found that treatment of gastro-oesophageal reflux had no benefit on asthma symptoms or lung function, when both conditions were present. Reduction in dry cough was observed, although this was probably not due to asthma.¹⁵² | 1+

B Gastro-oesophageal reflux should be treated if present but this will generally have no impact on asthma control.

3.7 HIGH ALTITUDE AND SPELEOTHERAPY

Speleotherapy involves the use of subterranean environments as a therapeutic measure. A Cochrane review of the available evidence does not permit reliable conclusions to be drawn, although in two out of three studies, a total of 124 asthmatic children showed some short-term benefit.¹⁵³ Randomised controlled trials with longer term follow up are required.

Moving children to high altitude environments with low allergen and pollutant exposure has been reported to be associated with clinical improvements,^{111 113} but there are no published controlled trials and no long-term follow up data available.

3.8 IMMUNOTHERAPY

Trials of allergen-specific immunotherapy (hyposensitisation or desensitisation) by subcutaneous injection of increasing doses of allergens have been systematically reviewed.¹⁵⁴⁻¹⁵⁶ Three reviews have demonstrated consistent beneficial effects of the treatment compared with placebos. Allergens used in the studies included mites, pollen, animal danders, and moulds.

However, there are as yet no properly controlled studies making direct comparisons between conventional asthma pharmacotherapy and allergen immunotherapy. The preparation of materials for immunotherapy, dose frequency and duration of therapy has not been optimised; and the risk benefits compared with pharmacotherapy require careful consideration.

Immunotherapy may reduce asthma symptoms and use of asthma medications, but the size of benefit compared to other therapies is not known. Further comparative studies are needed.

4 Pharmacological management

The aims of pharmacological management of asthma are the control of symptoms, including nocturnal symptoms and exercise-induced asthma, prevention of exacerbations and the achievement of best possible pulmonary function, with minimal side-effects.

It is not appropriate to define a fixed level of lung function or symptom control which must be achieved, as individual patients will have different goals and may also wish to balance these aims against the potential side-effects or inconvenience of taking the medication necessary to achieve “perfect” control.

In general terms, control of asthma is assessed against these standards:

- minimal symptoms during day and night
- minimal need for reliever medication
- no exacerbations
- no limitation of physical activity
- normal lung function (in practical terms FEV₁ and/or PEF > 80% predicted or best)

2004



Lung function measurements cannot be reliably used to guide asthma management in children under 5 years of age.

A stepwise approach aims to abolish symptoms as soon as possible and to optimise peak flow by starting treatment at the level most likely to achieve this.

Patients should start treatment at the step most appropriate to the initial severity of their asthma.

The aim is to achieve early control and to maintain control by stepping up treatment as necessary and stepping down when control is good (see *Figures 4, 5 and 6 for summaries of stepwise management in adults and children*).

Before initiating a new drug therapy practitioners should check compliance with existing therapies (see *section 11*), inhaler technique (see *section 5*) and eliminate trigger factors (see *section 3*).

2004

2007

All doses of inhaled steroids in this section refer to beclomethasone (BDP) given via CFC-MDIs (metered dose inhaler). Although now almost phased out, this is the device used in most of the evidence-base that supports current asthma management. Adjustment to dose will have to be made for other devices and other corticosteroid molecules.

2007

In this and the following section, each recommendation has been graded and the supporting evidence assessed for adults (> 12 years old), children 5-12 years, and children under 5 years.

1

2

3

1 Adults
2 Children aged 5-12 years
3 Children under 5 years



Recommendation does not apply to this age group.

4.1 STEP 1: MILD INTERMITTENT ASTHMA

The following medicines act as short-acting bronchodilators:

- inhaled short-acting β_2 agonists¹⁵⁷
- inhaled ipratropium bromide¹⁵⁸
- β_2 agonist tablets or syrup¹⁵⁷
- theophyllines.¹⁵⁷

> 12 years	5-12 years	< 5 years
1 ⁺⁺	1 ⁺	4
1 ⁺	1 ⁺⁺	
1 ⁺⁺		
1 ⁺⁺		

Short-acting inhaled β_2 agonists work more quickly and/or with fewer side-effects than the alternatives.¹⁵⁷

A B D Prescribe an inhaled short-acting β_2 agonist as short-term reliever therapy for all patients with symptomatic asthma.

4.1.1 FREQUENCY OF DOSING OF INHALED SHORT-ACTING β_2 AGONISTS

2005

Using short acting β_2 agonists as required is at least as good as regular (four times daily) administration.^{159,160} Unless individual patients are shown to benefit from regular use of inhaled short-acting β_2 agonists then as required use is recommended.

Using two or more canisters of β_2 agonists per month or > 10-12 puffs per day is a marker of poorly controlled asthma.¹⁶¹

> 12 years	5-12 years	< 5 years
1 ⁺⁺	1 ⁺⁺	1 ⁺⁺
2 ⁺⁺	4	4

B D D Patients with a high usage of inhaled short-acting β_2 agonists should have their asthma management reviewed.

4.2 STEP 2: INTRODUCTION OF REGULAR PREVENTER THERAPY

For steps 2, 3, and 4, treatments have been judged on their ability to improve symptoms, improve lung function, and prevent exacerbations, with an acceptable safety profile. Improvement of quality of life, while important, is the subject of too few studies to be used to make recommendations at present.

4.2.1 INHALED STEROIDS

2007

Inhaled steroids are the most effective preventer drug for adults and older children for achieving overall treatment goals.¹⁶²⁻¹⁶⁶ There is an increasing body of evidence demonstrating that they are also safe and effective in infants and younger children with asthma.⁶⁶⁸⁻⁶⁷¹

A A A Inhaled steroids are the recommended preventer drug for adults and children for achieving overall treatment goals

2004

The exact threshold for introduction of inhaled steroids has never been firmly established. Two recent studies have shown benefit from regular use of inhaled steroids in patients with mild asthma.^{526,527} Benefit in these studies was seen even with an FEV₁ of 90% predicted.

> 12 years	5-12 years	< 5 years
1 ⁺⁺	1 ⁺⁺	1 ⁺⁺
1 ⁻	1 ⁺	

2004

2005

B C ✓ Inhaled steroids should be considered for patients with any of the following:

- exacerbations of asthma in the last two years
- using inhaled β_2 agonists three times a week or more
- symptomatic three times a week or more, or waking one night a week.

Starting dose of inhaled steroids

In mild to moderate asthma, starting at very high doses of inhaled steroids and stepping down confers no benefit.¹⁶⁷

> 12 years	5-12 years	< 5 years
1 ⁺	1 ⁺	

- ✓ Start patients at a dose of inhaled steroids appropriate to the severity of disease.
- ✓ In adults, a reasonable starting dose will usually be 400 mcg per day and in children 200 mcg per day. In children under 5 years, higher doses may be required if there are problems in obtaining consistent drug delivery.
- ✓ Titrate the dose of inhaled steroid to the lowest dose at which effective control of asthma is maintained.

Frequency of dosing of inhaled steroids

2007

Most current inhaled steroids are slightly more effective when taken twice rather than once daily, but may be used once daily in some patients with milder disease.^{157,165,672}

> 12 years	5-12 years	< 5 years
1+	1+	

There is little evidence of benefit for dosage frequency more than twice daily.¹⁶⁵

2007

A D D

Give inhaled steroids initially twice daily, except ciclesonide which is given once daily.

A D D

Once a day inhaled steroids at the same total daily dose can be considered if good control is established.

4.2.2 SAFETY OF INHALED STEROIDS

The safety of inhaled steroids is of crucial importance and a balance between benefits and risks for each individual needs to be assessed. Account should be taken of other topical steroid therapy when assessing systemic risk. It has been suggested that steroid warning cards should be issued to patients on high dose inhaled steroids, but the benefits and possible disadvantages of such a policy remain to be defined.

Adults

There is little evidence that doses below 800 mcg per day cause any short-term detrimental effects apart from the local side-effects of dysphonia and oral candidiasis. However, the possibility of long-term effects on bone has been raised. One recent systematic review reported no effect on bone density at doses up to 1000 mcg per day.⁵²⁸ The significance of small biochemical changes in adrenocortical function is unknown.

2004

2004

✓

Titrate the dose of inhaled steroid to the lowest dose at which effective control of asthma is maintained.

Children

Administration of inhaled steroids at or above 400 mcg a day of BDP or equivalent may be associated with systemic side-effects.¹⁶⁸ These may include growth failure and adrenal suppression. Isolated growth failure is not a reliable indicator of adrenal suppression and monitoring growth cannot be used as a screening test of adrenal function.^{571,672} Clinical adrenal insufficiency has been identified in a small number of children who have become acutely unwell at the time of intercurrent illness. Most of these children had been treated with high doses of inhaled corticosteroids. The smallest dose of inhaled steroids compatible with maintaining disease control should be used. At higher doses, add-on agents, for example, long-acting β_2 agonists, should be actively considered.

2005

2007

✓

Monitor children's height on a regular basis.

2007 → The low dose ACTH test is considered to provide a physiological stimulation of adrenal responsiveness but it is not known how useful such a sensitive test is at predicting clinically relevant adrenal insufficiency.^{667,673}

The dose or duration of inhaled steroid treatment required to place a child at risk of clinical adrenal insufficiency is unknown but is likely to be at least ≥ 1000 mcg per day of BDP or equivalent. In addition, it is unknown how frequently tests of adrenal function would need to be repeated if a child remained on high dose inhaled corticosteroid.

2007 →

- Specific written advice about steroid replacement in the event of a severe intercurrent illness should be part of the management plan for children treated with ≥ 800 mcg per day of BDP or equivalent.
- ✓ ■ Any child on this dose should be under the care of a specialist paediatrician for the duration of the treatment.
- Consider the use of a steroid warning card.

2005 →

- ✓ ■ Consider the possibility of adrenal insufficiency in any child maintained on inhaled steroids presenting with **shock** or a decreased level of consciousness; **serum biochemistry and blood glucose levels** should be checked urgently.
- Consider whether intramuscular (IM) hydrocortisone is required.

2004 → ✓ **Titrate the dose of inhaled steroid to the lowest dose at which effective control of asthma is maintained.**

4.2.3 COMPARISON OF INHALED STEROIDS

Many studies comparing different inhaled steroids are of inadequate design and have been omitted from further assessment. In view of the clear differences between normal volunteers and asthma patients in the absorption of inhaled steroids, data from normal volunteers have not been taken into account. Only studies in which more than one dose of at least one of the inhaled steroids or both safety and efficacy had been studied together in the same trial were evaluated. Non-blinded studies also had to be considered because of the problems of obtaining competitors' delivery devices. All comparisons used BDP-CFC (chlorofluorocarbons) as the reference.

BDP and budesonide are approximately equivalent in clinical practice, although there may be variations with different delivery devices. There is limited evidence from two open studies of less than ideal design that budesonide via the turbohaler is more clinically effective.¹⁶⁹ However, at present a 1:1 ratio should be assumed when changing between BDP and budesonide.

Fluticasone provides equal clinical activity to BDP and budesonide at half the dosage. The evidence that it causes fewer side-effects at doses with equal clinical effect is limited.

2004 → **Mometasone is a new inhaled steroid and the relatively limited number of studies suggests it is equivalent to twice the dose of BDP-CFC.⁵²¹ The relative safety of mometasone is not fully established.**

2005 → **Ciclesonide is a new inhaled steroid. Evidence from clinical trials suggests that it has less systemic activity and local oropharyngeal side effects than conventional inhaled steroids. The clinical benefit of this is not clear as the exact efficacy to safety ratio compared to other inhaled steroids has not been fully established.**

2007 →

4.2.4 SMOKING

2007 Current and previous cigarette smoking reduces the effect of inhaled steroids which may be overcome with increased doses.⁶⁷⁴

B Clinicians should be aware that higher doses of inhaled steroids may be needed in patients who are smokers/ex-smokers.

✓ Patients should be advised that smoking reduces the effectiveness of therapy.

4.2.5 OTHER PREVENTER THERAPIES

2004 Inhaled steroids are the first choice preventer drug. Long-acting inhaled β_2 agonists should not be used without inhaled corticosteroids.⁵²⁹ Alternative, less effective preventer therapies in

2005 patients taking short-acting β_2 agonists alone are:

- Chromones

2004 - Sodium cromoglicate is of some benefit in adults^{170,675} and is effective in children aged 5-12⁵⁷²

2005 - Nedocromil sodium is also of benefit in adults and children > 5^{170,519}

2007 - There is no clear evidence of benefit with sodium cromoglicate in children aged < 5⁵⁷³

- Leukotriene receptor antagonists have some beneficial clinical effect^{165 172 666}
- Theophyllines have some beneficial effect^{157,164}
- Antihistamines and ketotifen are ineffective.¹⁷⁵

	> 12 years	5-12 years	< 5 years
2004	1+		
2005	1++	1+	
2007			
	1++	1++	1++
	1+	1+	1+
	1++	1++	1++

2004 ✓ Long-acting inhaled β_2 agonists should only be started in patients who are already on inhaled corticosteroids.

2007 The Medicines and Healthcare products Regulatory Agency (MHRA) has completed a full review of the balance of risks and benefits associated with long-acting beta₂ agonists in the management of asthma and chronic obstructive pulmonary disease (see www.mhra.gov.uk/home/idcplg?IdcService=SS_GET_PAGE&ssDocName=CON2030319&ssSourceNodeId=1016&ssTargetNodeId=221)

4.3 STEP 3: ADD-ON THERAPY

2007 In a proportion of patients asthma may not be adequately controlled at step 2. Before initiating a new drug therapy practitioners should recheck compliance, inhaler technique and eliminate trigger factors. The duration of a trial of add-on therapy will depend on the desired outcome. For instance, preventing nocturnal awakening may require a relatively short trial of treatment (days or weeks), whereas preventing exacerbations of asthma or decreasing steroid tablet use may require a longer trial of therapy (weeks or months). If there is no response to treatment the drug should be discontinued.

4.3.1	CRITERIA FOR INTRODUCTION OF ADD-ON THERAPY	> 12 years	5-12 years	< 5 years
	No exact dose of inhaled steroid can be deemed the correct dose at which to add another therapy. The addition of other treatment options to inhaled steroids has been investigated at doses from 200-1000 mcg in adults and up to 400 mcg in children. ¹⁷⁶⁻¹⁷⁹ Many patients will benefit more from add-on therapy than from increasing inhaled steroids above doses as low as 200 mcg/day. Furthermore, at doses of inhaled steroid above 800 mcg/day side-effects become more frequent. An absolute threshold for introduction of add-on therapy in all patients cannot be defined.	1 ⁺⁺	1 ⁺	

A **B** **Carry out a trial of other treatments before increasing the inhaled steroid dose above 800 mcg/day in adults and 400 mcg/day in children.**

4.3.2	ADD-ON THERAPY	> 12 years	5-12 years	< 5 years
	Options for add-on therapy are summarised in Figure 3.			
	In adult patients taking inhaled steroids at doses of 200-800 mcg/day and in children taking inhaled steroids at a dose of 400 mcg/day the following interventions are of value:			
	<ul style="list-style-type: none"> First choice would be the addition of an inhaled long-acting β_2 agonist (LABA), which improves lung function and symptoms, and decreases exacerbations.^{176,180,181} 	1 ⁺⁺	1 ⁺⁺	

A **B** **The first choice as add-on therapy to inhaled steroids in adults and children (5-12 years) is an inhaled long-acting β_2 agonist.**

	If, as may happen, there is no response to inhaled long-acting β_2 agonist, stop the LABA and increase the dose of inhaled steroid to 800 mcg/day (adults) or 400 mcg/day (children) if not already on this dose. If there is a response to LABA, but control remains poor, continue with the LABA and increase the dose of inhaled steroid to 800 mcg/day (adults) or 400 mcg/day (children 5-12 years). ¹⁸²	> 12 years	5-12 years	< 5 years
		4	4	

D **D** **If asthma control remains sub-optimal after the addition of an inhaled long-acting β_2 agonist then the dose of inhaled steroids should be increased to 800 mcg/day in adults or 400 mcg/day in children (5-12 years).**

2007 →	<ul style="list-style-type: none"> Leukotriene receptor antagonists may provide improvement in lung function, a decrease in exacerbations, and an improvement in symptoms.^{171,183,184} Theophyllines may improve lung function and symptoms, but side-effects occur more commonly.¹⁷⁷ Slow release β_2 agonist tablets may also improve lung function and symptoms, but side-effects occur more commonly.¹⁷⁶ 	> 12 years	5-12 years	< 5 years
		1 ⁺⁺	1 ⁺⁺	1 ⁺
		1 ⁺⁺	1 ⁻	
		1 ⁺⁺		

If control is still inadequate after a trial of LABA and after increasing the dose of inhaled steroid, consider a sequential trial of add-on therapy, i.e. leukotriene receptor antagonists, theophyllines, slow release β_2 agonist tablets (this in adults only).

2004 →	Addition of short-acting anticholinergics is generally of no value. ^{178,574} Addition of nedocromil is of marginal benefit. ^{179,675}	> 12 years	5-12 years	< 5 years
2005 →		1 ⁺		

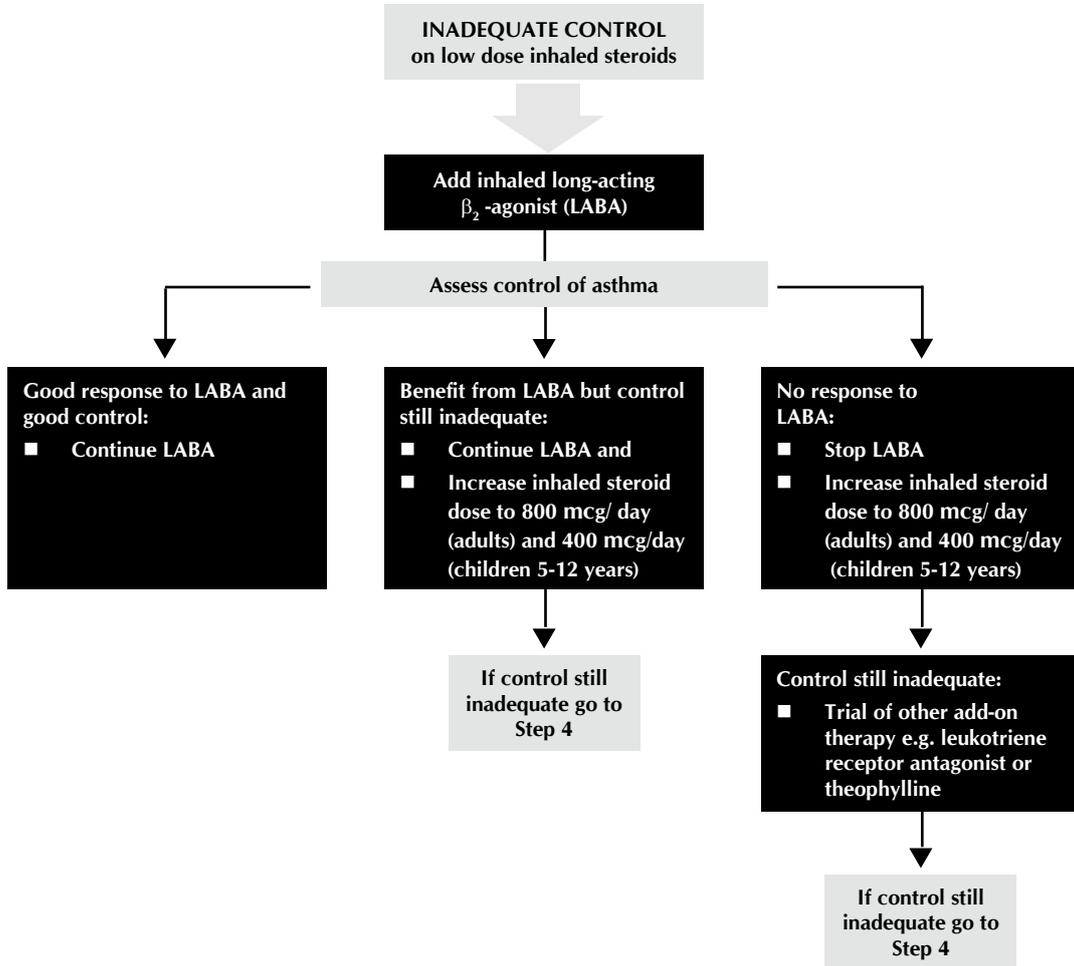
2007 →	In patients on inhaled steroids whose asthma is stable, no intervention has been consistently shown to decrease inhaled steroid requirement in a clinically significant manner compared to placebo.			
---------------	---	--	--	--

4.3.3 COMBINATION INHALERS

There is no difference in efficacy in giving inhaled steroid and long-acting β_2 agonist in combination or in separate inhalers.¹⁸²

>12 years	5-12 years	<5 years
1++	1++	

Figure 3: Summary of Step 3: Add-on therapy



4.4 STEP 4: POOR CONTROL ON MODERATE DOSE OF INHALED STEROID + ADD-ON THERAPY: ADDITION OF FOURTH DRUG

In a small proportion of patients asthma is not adequately controlled on a combination of short-acting β_2 agonist as required, inhaled steroid (800 mcg daily), and an additional drug, usually a long-acting β_2 agonist. There are very few clinical trials in this specific patient group to guide management. The following recommendations are based on extrapolation from trials of add-on therapy to inhaled steroids and on previous guidelines.

D	D	<p>If control remains inadequate on 800 mcg daily (adults) and 400 mcg daily (children) of an inhaled steroid plus a long-acting β_2 agonist, consider the following interventions:</p> <ul style="list-style-type: none"> ▪ increasing inhaled steroids to 2000 mcg/day (adults) or 800 mcg/day (children 5-12 years) ▪ leukotriene receptor antagonists ▪ theophyllines ▪ slow release β_2 agonist tablets, though caution needs to be used in patients on long-acting β_2 agonists.
---	---	--

There are no controlled trials indicating which of these is the best option.

- ✓ If a trial of an add-on treatment is ineffective, stop the drug (or in the case of increased dose of inhaled steroid, reduce to the original dose).
- ✓ Before proceeding to step 5, consider referring patients with inadequately controlled asthma, especially children, to specialist care.

4.5 STEP 5: CONTINUOUS OR FREQUENT USE OF ORAL STEROIDS

4.5.1 PREVENTION AND TREATMENT OF STEROID TABLET-INDUCED SIDE-EFFECTS

2007 Patients on long-term steroid tablets (e.g. longer than three months) or requiring frequent courses of steroid tablets (e.g. three to four per year) will be at risk of systemic side-effects.⁶⁷⁶

- Blood pressure should be monitored.
- Diabetes mellitus and hyperlipidaemia may occur.
- **2007** Reduction in bone mineral density commonly occurs and should be monitored. When this occurs, those adults also receiving prednisolone for over three months should be prescribed a long-acting bisphosphonate (see new British Osteoporosis Society guidelines, www.nos.org.uk).¹⁸⁵
- **2004** Growth should be monitored in children.
- **2007** Cataracts may be screened for in children through community optometric services.

4.5.2 STEROID TABLET-SPARING MEDICATION

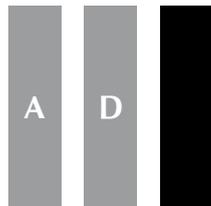
The aim of treatment is to control the asthma using the lowest possible dose or, if possible, to stop long-term steroid tablets completely.

Inhaled steroids are the most effective drug for decreasing requirement for long-term steroid tablets.^{162,163}

> 12 years	5-12 years	< 5 years
1 ⁺⁺	4	

2005

There is limited evidence for the ability of long-acting β_2 agonists, theophyllines, or leukotriene receptor antagonists to decrease requirement for steroid tablets, but they may improve symptoms and pulmonary function.¹⁹²



- In adults, the recommended method of eliminating or reducing the dose of steroid tablets is inhaled steroids, at doses of up to 2000 mcg/day if required.
- In children aged 5-12, consider very carefully before going above a dose of 1000 mcg/day.



There is a role for a trial of treatment with long-acting β_2 agonists, leukotriene receptor antagonists, and theophyllines for about six weeks. They should be stopped if no improvement in steroid dose, symptoms or lung function is detected.

Immunosuppressants (methotrexate, ciclosporin and oral gold) decrease long-term steroid tablet requirements, but all have significant side-effects. There is no evidence of persisting beneficial effect after stopping them; and there is marked variability in response.¹⁸⁶

> 12 years	5-12 years	< 5 years
1 ⁺	3	

2007



Immunosuppressants (methotrexate, ciclosporin and oral gold) may be given as a three month trial, once other drug treatments have proved unsuccessful. Their risks and benefits should be discussed with the patient and their treatment effects carefully monitored. Treatment should be in a centre with experience of using these medicines.

Colchicine and intravenous immunoglobulin have not been shown to have any beneficial effect in adults.¹⁸⁶

> 12 years	5-12 years	< 5 years
1 ⁺		
4		

2007

Continuous subcutaneous terbutaline infusion has been reported to be beneficial in severe asthma but efficacy and safety have not been assessed in RCTs.^{187,677}

4.5.3 STEROID FORMULATIONS

Prednisolone is the most widely used steroid tablet for maintenance therapy in chronic asthma. There is no evidence that other formulations offer any advantage.

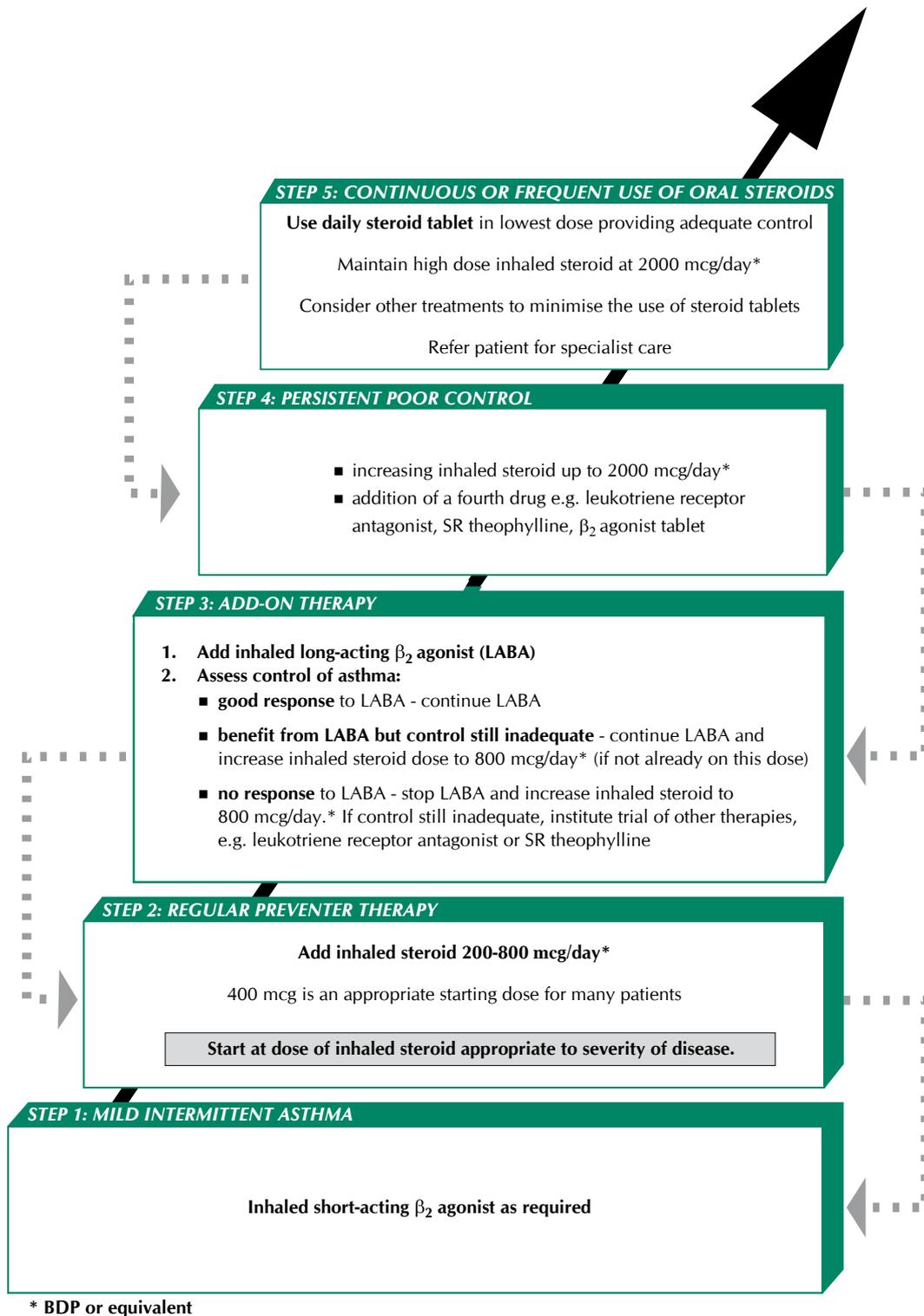
4.5.4 FREQUENCY OF DOSING OF STEROID TABLETS

Although popular in paediatric practice, there are no studies to show whether alternate day steroids produce fewer side-effects than daily steroids.

4.5.5 B-BLOCKERS

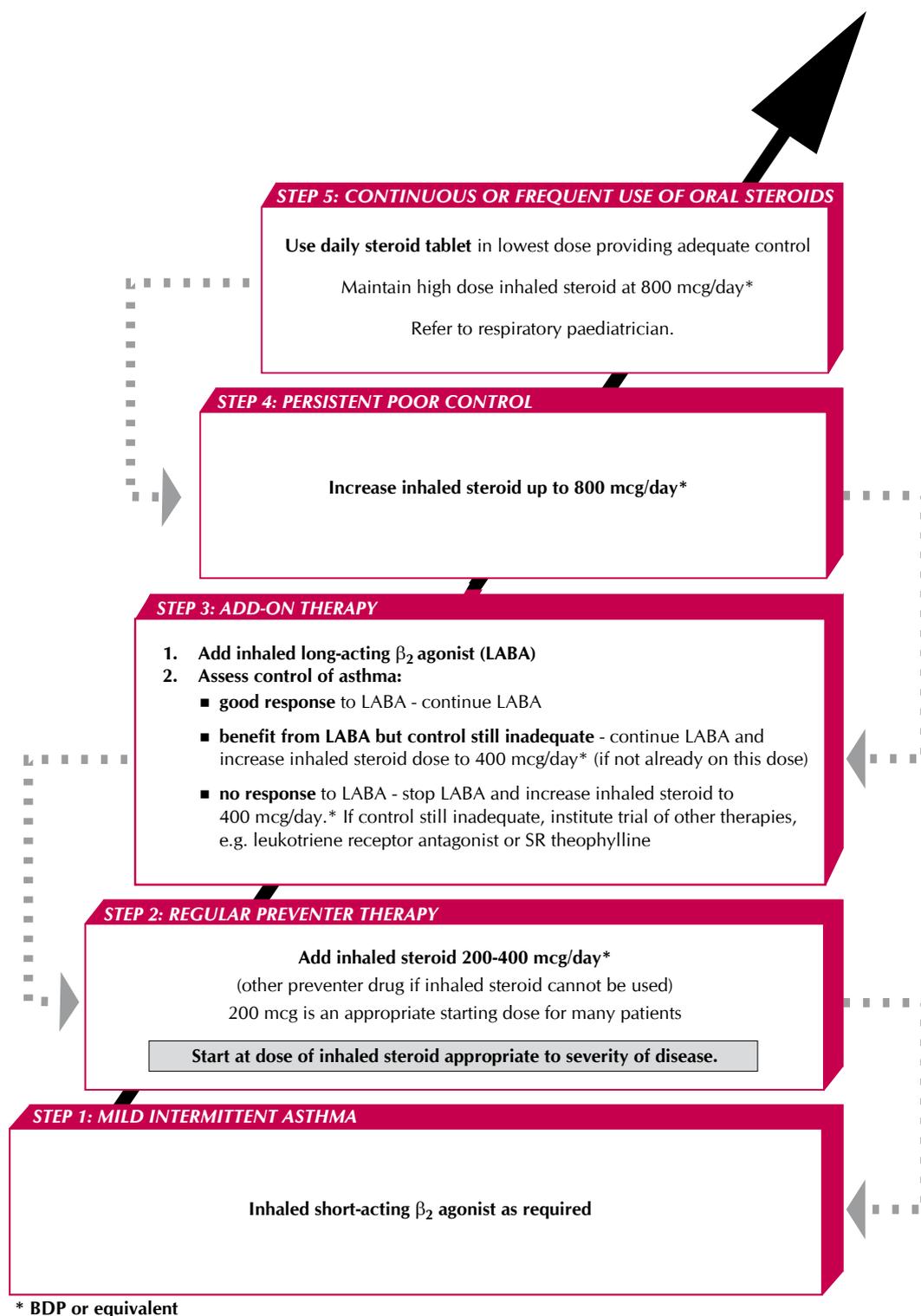
β -blockers, including eye drops, are contraindicated in patients with asthma

Figure 4: Summary of stepwise management in adults



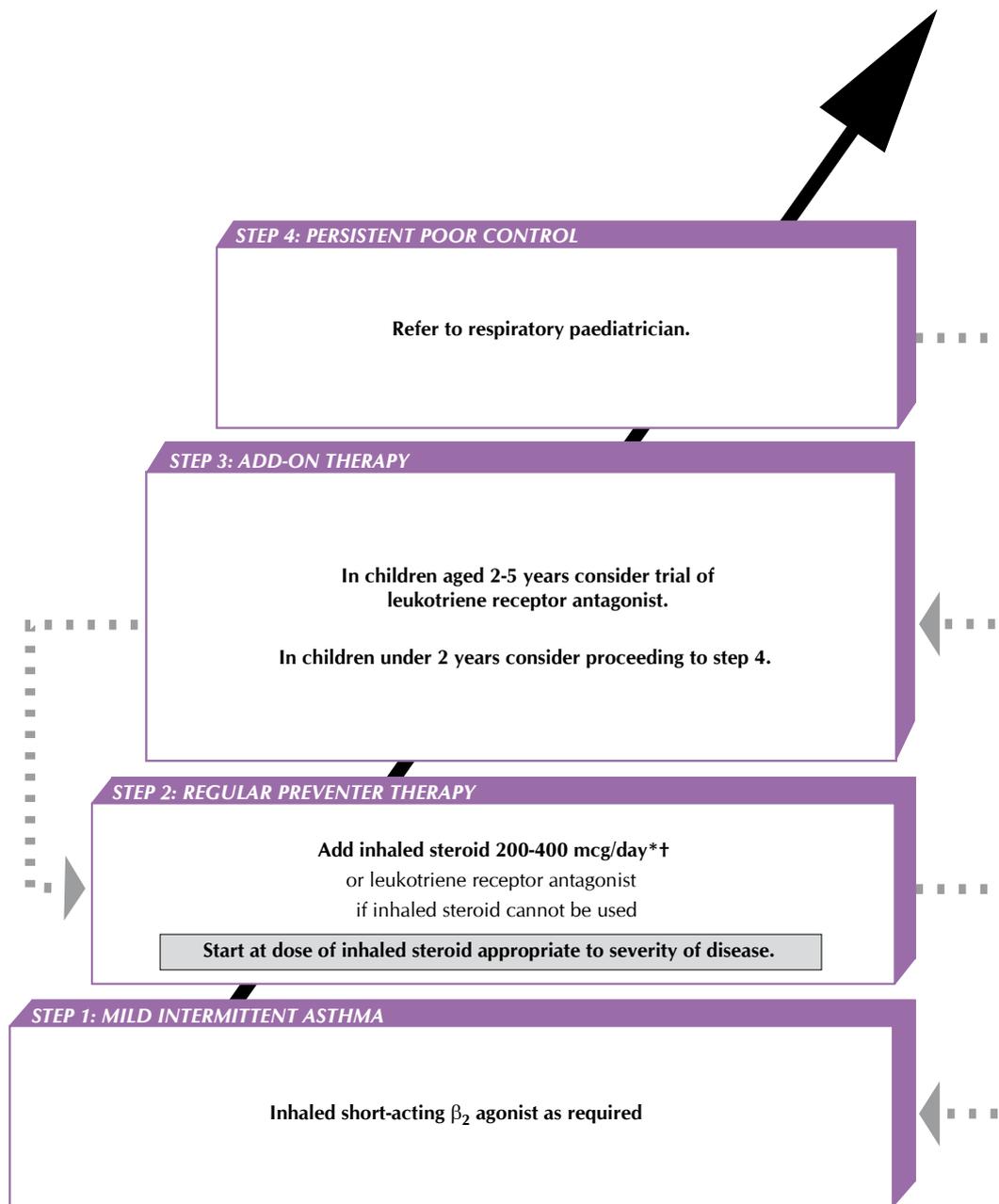
Patients should start treatment at the step most appropriate to the initial severity of their asthma.

Figure 5: Summary of stepwise management in children aged 5 - 12 years



Patients should start treatment at the step most appropriate to the initial severity of their asthma.

Figure 6: Summary of stepwise management in children less than 5 years



* BDP or equivalent

† Higher nominal doses may be required if drug delivery is difficult

Patients should start treatment at the step most appropriate to the initial severity of their asthma.

4.6 STEPPING DOWN

2004

Stepping down therapy once asthma is controlled is recommended, but often not implemented leaving some patients over-treated. There are few studies that have investigated the most appropriate way to step down treatment. A study in adults on at least 900mcg per day of inhaled steroids has shown that for patients who are stable it is reasonable to attempt to halve the dose of inhaled steroids every three months.⁵³⁰

✓

Regular review of patients as treatment is stepped down is important. When deciding which drug to step down first and at what rate, the severity of asthma, the side-effects of the treatment, the beneficial effect achieved, and the patient's preference should all be taken into account.

✓

Patients should be maintained at the lowest possible dose of inhaled steroid. Reduction in inhaled steroid dose should be slow as patients deteriorate at different rates. Reductions should be considered every three months, decreasing the dose by approximately 25-50% each time.

4.7 SPECIFIC MANAGEMENT PROBLEMS

4.7.1 ONSET OF EXACERBATION OF ASTHMA

2004

Although recommended for both adults and children in previous guidelines and as part of asthma action plans, doubling the dose at the time of an exacerbation is of unproven value.¹⁸⁸

2005

In adult patients on a low dose (200 mcg) of inhaled steroids, a five-fold increase in dose at the time of exacerbation leads to a decrease in the severity of exacerbations.^{188,575} This study should not be extrapolated to patients already taking higher doses of inhaled steroids and further evidence in this area is required.

2007

In adults doubling the dose of inhaled steroids at the time of exacerbation has not been shown to be effective. Studies in which the dose of a combination inhaler budesonide/formoterol is adjusted according to symptoms have shown good levels of asthma control.⁶⁷⁸ It is not clear if this is superior to the use of more conventional stable dose of inhaled steroids and long acting β_2 agonists. This study should not be extrapolated to patients already taking high doses of inhaled steroids.

4.7.2 EXERCISE-INDUCED ASTHMA

✓

For most patients, exercise-induced asthma is an expression of poorly controlled asthma and regular treatment including inhaled steroids should be reviewed.

The following medicines give protection against exercise-induced asthma: inhaled steroids^{162,163,189}

- short-acting β_2 agonists¹⁵⁷
- long-acting β_2 agonists¹⁹⁰
- theophyllines^{191,192}
- leukotriene receptor antagonists¹⁹³
- chromones¹⁹⁴
- β_2 agonist tablets.¹⁹⁵

The following medicines do not give protection against exercise-induced asthma at normal doses:

- anticholinergics¹⁹⁶
- ketotifen¹⁹⁷
- antihistamine.¹⁹⁸

	> 12 years	5-12 years	< 5 years
	1++	1++	
	1++	1++	
	1++	1++	
	1-	2+	
	1++	2+	
	1++	2+	
	1++	1+	
	1+	1+	
	1+	1+	
	1++	1++	

Long-acting β_2 agonists and leukotriene antagonists provide more prolonged protection than short-acting β_2 agonists, but a degree of tolerance develops with LABA particularly with respect to duration of action. No tolerance has been demonstrated with leukotriene receptor antagonists. ^{190,193}	> 12 years 1 ⁺⁺	5-12 years	< 5 years
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If exercise is a specific problem in patients taking inhaled steroids who are otherwise well controlled, consider the following therapies:

A	C	■	▪ leukotriene receptor antagonists
A	A	■	▪ long-acting β_2 agonists
C	C	■	▪ chromones
A	A	■	▪ oral β_2 agonists
C	C	■	▪ theophyllines.
A	A	✓	Immediately prior to exercise, inhaled short-acting β_2 agonists are the drug of choice.

4.7.3	RHINITIS	> 12 years 1 ⁺	5-12 years	< 5 years
	Patients with asthma often have rhinitis. The most effective therapy is intranasal steroids. ¹⁹⁹ Treatment of allergic rhinitis has not been shown to improve asthma control.			

4.7.4	ALLERGIC BRONCHOPULMONARY ASPERGILLOSIS	> 12 years 1 ⁺	5-12 years	< 5 years
2005	In adult patients with allergic bronchopulmonary aspergillosis (ABPA), itraconazole may decrease steroid tablet dose and improve asthma control. ^{518,576}			

C	■	■	In adult patients with ABPA, a four month trial of itraconazole should be considered.
✓	Careful monitoring for side-effects, particularly hepatic is recommended.		

4.7.5 ASPIRIN-INTOLERANT ASTHMA

There are theoretical reasons to suggest that leukotriene receptor antagonists might be of particular value in the treatment of aspirin intolerant asthma. However, there is little evidence to justify managing patients with aspirin intolerant asthma in a different manner to patients tolerant of aspirin, apart from the rigorous avoidance of non-steroidal anti-inflammatory medications.²⁰⁰

4.8 ANTI IGE MONOCLONAL ANTIBODY

2007

Omalizumab is a humanised monoclonal antibody which binds to circulating IgE markedly reducing levels of free serum IgE.^{679,680} In adults and children over 12, it is licensed in the UK with the following indication; patients on high dose inhaled steroids and long acting β_2 agonists who have impaired lung function are symptomatic with frequent exacerbations, and have allergy as an important cause of their asthma. Omalizumab is given as a subcutaneous injection every 2 to 4 weeks depending on dose. The total IgE must be less than 700iu/litre for it to be effective.

In the single study in the licensed group, there was a 19% reduction in exacerbations of asthma requiring oral steroids which was non-significant. When corrected for imbalance in the exacerbation history at baseline, there was a 26% reduction in severe exacerbations (0.91 on placebo vs 0.68 on omalizumab over a 28 week period) $p=0.042$. This was associated with a 2.8% increase in FEV1, a non-significant 0.5 puffs/day decrease in β_2 agonist use and 13% more patients having a significant improvement in health related quality of life. At IgE levels below 76iu/l the beneficial effect is reduced.

Apart from local reactions there appear to be no major safety issues. There are no active comparative studies and it is therefore not possible to place omalizumab in the stepwise treatment of asthma.

Anaphylaxis, presenting as bronchospasm, hypotension, syncope, urticaria, and/or angioedema of the throat or tongue has been reported to occur after administration of omalizumab. Anaphylaxis has occurred as early as after the first dose, but also has occurred beyond one year after beginning regular treatment.

Due to the risk of anaphylaxis, omalizumab should only be administered to patients in a healthcare setting under direct medical supervision. For further information see www.fda.gov/cder/drug/InfoSheets/HCP/omalizumabHCP.pdf

5 Inhaler devices

Although studies of inhaler devices are more suitable for an evidence-based approach than many other aspects of asthma management, a number of methodological issues complicate evidence review in this area. In young (0-5 years) children, little or no evidence is available on which to base recommendations.

5.1 TECHNIQUE AND TRAINING

Studies of technique and the effects of training have used arbitrary non-standardised scores making comparison difficult. Although technique will have some bearing, it does not necessarily relate to clinical effectiveness.

The proportion of patients making no mistakes with an inhaler in one well-conducted study was 23-43% for pMDI, 53-59% for dry powder inhaler (DPI) and 55-57% for pMDI + spacer. When technique was assessed as number of steps correct out of the total number of steps, pMDI + spacer was slightly better than DPI.²⁰²

Teaching technique improved the correct usage score from a mean of 60% to 79%. Figures for no mistakes post teaching were 63% for pMDI, 65% for DPI, and 75% for breath-actuated MDI (the latter figure based on one study of 2,467 patients).²⁰²

> 12 years	5-12 years	< 5 years
1 ⁺⁺		

2005



Prescribe inhalers only after patients have received training in the use of the device and have demonstrated satisfactory technique.

5.2 β_2 AGONIST DELIVERY

5.2.1 ACUTE ASTHMA

pMDI + spacer is at least as good as a nebuliser at treating mild and moderate exacerbations of asthma in children and adults.^{203-205, 577}

> 12 years	2-12 years	< 2 years
1 ⁺⁺	1 ⁺⁺	

2005



Children and adults with mild and moderate exacerbations of asthma should be treated by pMDI + spacer with doses titrated according to clinical response.

There are no data to make recommendations in severe (life-threatening) asthma.

5.2.2 STABLE ASTHMA

For children aged 0-5, there is no evidence comparing nebuliser and other inhalers and the data are insufficiently extensive or robust to draw conclusions for pMDI vs. DPI.

In children aged 5-12 there is no significant difference between pMDI and DPI. In adults there is no significant difference between pMDI + spacer and DPI. The lower pulse rate with pMDI v Turbohaler is the only difference with regard to side-effects. Patients have been shown to prefer Turbohaler to pMDI.^{202 206 578}

> 12 years	5-12 years	< 5 years
1 ⁺⁺	1 ⁺⁺	

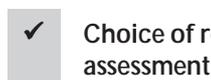


In children aged 5-12, pMDI + spacer is as effective as any other hand held inhaler.



In adults, pMDI ± spacer is as effective as any other hand held inhaler, but patients may prefer some types of DPI.

There are no data to make recommendations in children under five.



Choice of reliever inhaler for stable asthma should be based on patient preference and assessment of correct use. Many patients will not be prepared to carry a spacer.

5.3 INHALED STEROIDS FOR STABLE ASTHMA

There are no comparative data on inhaled steroids for stable asthma in children under 5 years. A single study included 4-5 year olds, but the data were not extractable.

2005

For the delivery of inhaled steroids in stable asthma in children aged 5-12 years, pMDI is as effective as Clickhaler,^{207,208} and Pulvinal is as effective as Diskhaler.⁵⁷⁹ No significant clinical difference was found between pMDI and Turbohaler at half the dose for the same drug (budesonide).^{202,209} This comparison cannot necessarily be made against other inhaled steroid/device combinations.

> 12 years	5-12 years	< 5 years
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2005

In adults, there is no clinical difference in effectiveness of pMDI ± spacer v DPI. Breath-actuated MDI is as effective as pMDI. [More recent DPIs are as effective as older DPIs.](#)⁵⁸⁰ Nebulisers have not been shown to be superior to pMDI + spacer for delivery of inhaled steroids in chronic asthma. A specialised specific nebuliser may provide improved lung function and reduced rescue therapy use, but at high prescribed doses. Higher doses (> 2 mg) are generally only licensed for use from a nebuliser.^{202,209}

1++	1++
-----	-----



In children aged 5-12 years, pMDI + spacer is as effective as any DPI.



In adults, a pMDI ± spacer is as effective as any DPI.

No recommendation can be given for nebulised therapy in children aged 5-12 years and there is no evidence relating to children aged < 5 years.

5.4 CFC PROPELLANT pMDI vs HFA PROPELLANT pMDI

2005

HFA pMDI salbutamol is as effective as CFC pMDI salbutamol at standard therapeutic doses.^{207,210,581-585}

> 12 years 1++	5-12 years	< 5 years
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It is important to differentiate Qvar from other HFA beclomethasone products. Many studies now show Qvar equivalence at half the dose of CFC BDP pMDI, whereas non-Qvar HFA BDP pMDI studies show equivalence at 1:1 dosing.^{208,586-592}

HFA fluticasone is as effective as CFC fluticasone across the standard clinical dose range.⁵⁹³⁻⁵⁹⁷

> 12 years 1++	5-12 years	< 5 years
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Salbutamol HFA can be substituted for salbutamol CFC at 1:1 dosing.



HFA BDP pMDI (Qvar) may be substituted for CFC BDP pMDI at 1:2 dosing. This ratio does not apply to reformulated HFA BDP pMDIs.



Fluticasone HFA can be substituted for fluticasone CFC at 1:1 dosing.

5.5 PRESCRIBING DEVICES

There is no evidence to dictate an order in which devices should be tested for those patients who cannot use pMDI. In the absence of evidence, the most important points to consider are patient preference and local cost.

✓

- The choice of device may be determined by the choice of drug.
- If the patient is unable to use a device satisfactorily an alternative should be found.
- The patient should have their ability to use an inhaler device assessed by a competent health care professional (*see section 5.1*).
- The medication needs to be titrated against clinical response to ensure optimum efficacy.
- Reassess inhaler technique as part of structured clinical review (*see section 9.1.1*).

- ✓ In children aged 0-5 years, pMDI and spacer are the preferred method of delivery of β_2 agonists or inhaled steroids. A face mask is required until the child can breathe reproducibly using the spacer mouthpiece. Where this is ineffective a nebuliser may be required.

5.6 USE AND CARE OF SPACERS

- ✓
 - The spacer should be compatible with the pMDI being used.
 - The drug should be administered by repeated single actuations of the metered dose inhaler into the spacer, each followed by inhalation.
 - There should be minimal delay between pMDI actuation and inhalation.
 - Tidal breathing is as effective as single breaths.
 - Spacers should be cleaned monthly rather than weekly as per manufacturer's recommendations or performance is adversely affected. They should be washed in detergent and allowed to dry in air. The mouthpiece should be wiped clean of detergent before use.
 - Drug delivery may vary significantly due to static charge. Metal and other antistatic spacers [are not affected in this way](#)
 - Plastic spacers should be replaced at least every 12 months but some may need changing at six months.

2005

6 Management of acute asthma

6.1 LESSONS FROM STUDIES OF ASTHMA DEATHS AND NEAR FATAL ASTHMA

Confidential enquires into over 200 asthma deaths in the UK have concluded there are factors associated with the disease, the medical management and the patient's behaviour or psychosocial status which contributed to the death. Most deaths occurred before admission to hospital.²¹³⁻²¹⁷

6.1.1 DISEASE FACTORS

Most patients who died of asthma had chronically severe asthma. In a minority the fatal attack occurred suddenly in a patient with only mild or moderately severe background disease.²¹³⁻²¹⁸

2++

6.1.2 MEDICAL MANAGEMENT

Many of the deaths occurred in patients who had received inadequate treatment with inhaled steroid or steroid tablets and/or inadequate objective monitoring of their asthma. Follow up was inadequate in some and others should have been referred earlier for specialist advice. There was widespread under-use of written management plans. Heavy or increasing use of β_2 agonist therapy was associated with asthma death.^{213-217 219 220}

2++

Deaths have continued to be reported following inappropriate prescription of β -blocker therapy or heavy sedation (*see section 4.5.5*). A small proportion of patients with asthma were sensitive to non-steroidal anti-inflammatory agents; all asthma patients should be asked about past reactions to these agents.

6.1.3 ADVERSE PSYCHOSOCIAL AND BEHAVIOURAL FACTORS

Behavioural and adverse psychosocial factors were recorded in the majority of patients who died of asthma.²¹³⁻²¹⁷ The most important are shown in Table 3.

Table 3: Patients at risk of developing near fatal or fatal asthma

A COMBINATION OF SEVERE ASTHMA RECOGNISED BY ONE OR MORE OF:

- previous near fatal asthma, e.g. previous ventilation or respiratory acidosis
- previous admission for asthma especially if in the last year
- requiring three or more classes of asthma medication
- heavy use of β_2 agonist
- repeated attendances at A&E for asthma care especially if in the last year
- brittle asthma.

AND ADVERSE BEHAVIOURAL OR PSYCHOSOCIAL FEATURES RECOGNISED BY ONE OR MORE OF:

- non-compliance with treatment or monitoring
- failure to attend appointments
- self-discharge from hospital
- psychosis, depression, other psychiatric illness or deliberate self-harm
- current or recent major tranquilliser use
- denial
- alcohol or drug abuse
- obesity
- learning difficulties
- employment problems
- income problems
- social isolation
- childhood abuse
- severe domestic, marital or legal stress.

Case control studies support most of these observations.^{221 222} Compared with control patients admitted to hospital with asthma, those who died were significantly more likely to have learning difficulties; psychosis or prescribed antipsychotic drugs; financial or employment problems; repeatedly failed to attend appointments or discharged themselves from hospital; drug or alcohol abuse; obesity; or a previous near fatal attack.

2⁺⁺

Compared with control patients with asthma in the community, patients who died had more severe disease; more likelihood of a hospital admission or visit to A&E for their asthma in the previous year; more likelihood of a previous near fatal attack; poor medical management; failure to measure pulmonary function; and non-compliance.

B Health care professionals must be aware that patients with severe asthma and one or more adverse psychosocial factors are at risk of death.

Studies comparing near fatal asthma with deaths from asthma have concluded that patients with near fatal asthma have identical adverse factors to those described in Table 3, and that these contribute to the near fatal asthma attack.²²³⁻²²⁵ Compared with patients who die, those with near fatal asthma are significantly younger, are significantly more likely to have had a previous near fatal asthma attack, are less likely to have concurrent medical conditions, are less likely to experience delay in receiving medical care, and more likely to have ready access to acute medical care.

2⁺

Not all patients with near fatal asthma require intermittent positive pressure ventilation.

For those with near fatal asthma, adults as well as children, it is always wise to involve a close relative when discussing future management.

Patients with brittle asthma should also be identified (*see section 6.2.3, table 4*).

✓ Keep patients who have had near fatal asthma or brittle asthma under specialist supervision indefinitely.

6.1.4 SEASONAL FACTORS

In the UK there is a peak of asthma deaths in younger people (aged up to 44 years) in July and August and in December and January in older people.^{224 226}

2⁺⁺

6.1.5 PREDICTION AND PREVENTION OF A SEVERE ASTHMA ATTACK

Most (88-92%) attacks of asthma severe enough to require hospital admission develop relatively slowly over a period of six hours or more. In one study, over 80% of attacks developed over more than 48 hours.²²⁷⁻²³² There should therefore be time for effective action and the potential to reduce the number of attacks requiring hospitalisation. There are many similarities between patients who die from asthma, patients with near fatal asthma and asthmatic controls who are admitted to hospital.

2⁺⁺

✓ A respiratory specialist should follow up patients admitted with severe asthma for at least one year after the admission.

6.2 ACUTE ASTHMA IN ADULTS

Annexes 1-3 contain algorithms summarising the recommended treatment for patients presenting with acute or uncontrolled asthma in primary care (*annex 1*), A&E (*annex 2*), and hospital (*annex 3*).

6.2.1 RECOGNITION OF ACUTE ASTHMA

Definitions of increasing levels of severity of acute asthma exacerbations are provided in Table 4.^{4 7 11 233-235} Predicted PEF values²³⁶ should be used only if the recent best PEF (within two years) is unknown.

2⁺
4

6.2.2 SELF-TREATMENT BY PATIENTS DEVELOPING ACUTE OR UNCONTROLLED ASTHMA

Many patients with asthma and all patients with severe asthma should have an agreed written action plan and their own peak flow meter, with regular checks of inhaler technique and compliance. They should know when and how to increase their medication and when to seek medical assistance. Asthma action plans have been shown to decrease hospitalisation for²³⁷ and deaths from²³⁸ asthma (see section 9.1.4)

6.2.3 INITIAL ASSESSMENT

All possible initial contact personnel, e.g. practice receptionists, ambulance call takers, NHS Direct (England & Wales), NHS 24 (Scotland), should be aware that asthma patients complaining of respiratory symptoms may be at risk and should have immediate access to a doctor or trained asthma nurse. The assessments required to determine whether the patient is suffering from an acute attack of asthma, the severity of the attack and the nature of treatment required are detailed in Tables 4 and 5. It may also be helpful to use a systematic recording process. Proformas have proved useful in the A&E setting.²³⁹

Table 4: Levels of severity of acute asthma exacerbations

Near fatal asthma	Raised PaCO ₂ and/or requiring mechanical ventilation with raised inflation pressures ²²³⁻²²⁵
Life threatening asthma	Any one of the following in a patient with severe asthma: <ul style="list-style-type: none"> - PEF < 33% best or predicted - SpO₂ < 92% - PaO₂ < 8 kPa - normal PaCO₂ (4.6 – 6.0 kPa) - silent chest - cyanosis - feeble respiratory effort - bradycardia - dysrhythmia - hypotension - exhaustion - confusion - coma
Acute severe asthma	Any one of: <ul style="list-style-type: none"> - PEF 33-50% best or predicted - respiratory rate ≥25/min - heart rate ≥110/min - inability to complete sentences in one breath
Moderate asthma exacerbation	<ul style="list-style-type: none"> - Increasing symptoms - PEF > 50-75% best or predicted - no features of acute severe asthma
Brittle asthma	<ul style="list-style-type: none"> - Type 1: wide PEF variability (> 40% diurnal variation for > 50% of the time over a period > 150 days) despite intense therapy - Type 2: sudden severe attacks on a background of apparently well controlled asthma

6.2.4 PREVENTION OF ACUTE DETERIORATION

A register of patients at risk may help primary care health professionals to identify patients who are more likely to die from their asthma. A system should be in place to ensure that these patients are contacted if they fail to attend for follow up.

6.2.5 CRITERIA FOR REFERRAL

D Refer to hospital any patients with features of acute severe or life threatening asthma.

Other factors, such as failure to respond to treatment, social circumstances or concomitant disease, may warrant hospital referral.

Table 5: Initial assessment: the role of symptoms, signs and measurements

Clinical features	<p>Clinical features, symptoms and respiratory and cardiovascular signs are helpful in recognising some patients with severe asthma, e.g. severe breathlessness (including too breathless to complete sentences in one breath), tachypnea, tachycardia, silent chest, cyanosis or collapse.^{4 7 11 233-235}</p> <p><i>None of these singly or together is specific and their absence does not exclude a severe attack.</i></p>	2+
PEF or FEV₁	<p>Measurements of airway calibre improve recognition of the degree of severity, the appropriateness or intensity of therapy, and decisions about management in hospital or at home.^{240 241}</p> <p>PEF or FEV₁ are both useful and valid measures of airway calibre. PEF is more convenient and cheaper.</p> <p>PEF expressed as a percentage of the patient's previous best value is most useful clinically. PEF as a percentage of predicted gives a rough guide in the absence of a known previous best value. Different peak flow meters give different readings. Where possible the same or similar type of peak flow meter should be used. The Nunn & Gregg nomogram is recommended for use with peak flow meter.⁵³²</p>	2+
Pulse oximetry	<p>Measurement of oxygen saturation (SpO₂) with a pulse oximeter is necessary in acute severe asthma to determine the adequacy of oxygen therapy and the need for arterial blood gas (ABG) measurement. The aim of oxygen therapy is to maintain SpO₂ ≥ 92%.</p>	2+
Blood gases (ABG)	<p>Patients with SpO₂ < 92% or other features of life threatening asthma require ABG measurement.^{4 7 11 233 235 243}</p>	2+
Chest x-ray	<p>Chest x-ray is not routinely recommended in patients in the absence of:</p> <ul style="list-style-type: none"> - suspected pneumomediastinum or pneumothorax - suspected consolidation - life threatening asthma - failure to respond to treatment satisfactorily - requirement for ventilation. 	4
Systolic paradox	<p>Systolic paradox (<i>pulsus paradoxus</i>) has been abandoned as an indicator of the severity of an attack for pragmatic reasons.^{4 7 11 233-235 244}</p>	2+

6.2.6 CRITERIA FOR ADMISSION

- B** Admit patients with any feature of a life threatening or near fatal attack.^{213-217 224 225}
- B** Admit patients with any feature of a severe attack persisting after initial treatment.^{213-217 224 225}
- C** Patients whose peak flow is greater than 75% best or predicted one hour after initial treatment may be discharged from A&E, unless they meet any of the following criteria, when admission may be appropriate:
- still have significant symptoms
 - concerns about compliance
 - living alone / socially isolated
 - psychological problems
 - physical disability or learning difficulties
 - previous near fatal or brittle asthma
 - exacerbation despite adequate dose steroid tablets pre-presentation
 - presentation at night
 - pregnancy.

Criteria for admission in adults are summarised in annexes 1 and 2.

6.3 TREATMENT OF ACUTE ASTHMA IN ADULTS

6.3.1 OXYGEN

Patients with acute severe asthma are hypoxaemic.²⁴⁵⁻²⁴⁸ This should be corrected urgently using high concentrations of inspired oxygen (usually 40-60%) and a high flow mask such as a Hudson mask. Unlike patients with COPD there is little danger of precipitating hypercapnea with high flow oxygen. Hypercapnea indicates the development of near fatal asthma and the need for emergency specialist/anaesthetic intervention. Oxygen saturations of at least 92% must be achieved. 2+

- C** Give high flow oxygen to all patients with acute severe asthma.

In view of the theoretical risk of oxygen desaturation while using air driven compressors to nebulise β_2 agonist bronchodilators, oxygen-driven nebulisers are the preferred method of delivery in hospitals, ambulances and primary care.^{4 203 249} (NB: In order to generate the flow rate of 6 l/min required to drive most nebulisers, a high flow regulator must be fitted to the oxygen cylinder). The absence of supplemental oxygen should not prevent nebulised therapy from being administered where appropriate.²⁵⁰ 1++
4

- A**
- In hospital, ambulance and primary care, nebulised β_2 agonist bronchodilators should be driven by oxygen.
 - Outside hospital, high dose β_2 agonist bronchodilators may be delivered via large volume spacers or nebulisers.
- C** Whilst supplemental oxygen is recommended, its absence should not prevent nebulised therapy being given if indicated.

6.3.2 β_2 AGONIST BRONCHODILATORS

In most cases of acute asthma, inhaled β_2 agonists given in high doses act quickly to relieve bronchospasm with few side-effects.²⁵¹⁻²⁵³ There is no evidence for any difference in efficacy between salbutamol and terbutaline, although rarely patients may express a preference. 1+

2004 In acute asthma without life threatening features, β_2 agonists can be administered by repeated activations of a pMDI via an appropriate large volume spacer (or via spacer (4 to 6 puffs each inhaled separately; this does can be repeated at 10-20 minute intervals) or by wet nebulisation driven by oxygen, if available.²⁰³ Inhaled β_2 agonists are at least as efficacious and preferable to intravenous β_2 agonists (meta-analysis has excluded subcutaneous trials) in adult acute asthma in the majority of cases.²⁵⁴ 1++

A Use high dose inhaled β_2 agonists as first line agents in acute asthma and administer as early as possible. Intravenous β_2 agonists should be reserved for those patients in whom inhaled therapy cannot be used reliably.

✓ In acute asthma with life threatening features the nebulised route (oxygen-driven) is recommended

Parenteral β_2 agonists, in addition to inhaled β_2 agonists, may have a role in ventilated patients or those patients *in extremis* in whom nebulised therapy may fail; however there is limited evidence to support this.

2004 Continuous nebulisation of β_2 agonists is at least as efficacious as bolus nebulisation in relieving acute asthma. It is more effective in airflow obstruction that is severe or unresponsive to initial treatment.^{255-257,531} However, most cases of acute asthma will respond adequately to bolus nebulisation of β_2 agonists. 1+

2004 **A** In severe asthma (PEF or FEV₁ < 50% best or predicted) and asthma that is poorly responsive to an initial bolus dose of β_2 agonist, consider continuous nebulisation, using an appropriate nebuliser system.

2004 Continuous nebulisation cannot be achieved with all nebuliser systems, and is not equivalent to continuously repeating conventional nebuliser doses. 4

Repeated doses of β_2 agonists should be given at 15-30 minute intervals or continuous nebulisation of salbutamol at 5-10 mg/hour (requires appropriate nebuliser) used if there is an inadequate response to initial treatment. Higher bolus doses, e.g. 10 mg of salbutamol, are unlikely to be more effective.

6.3.3 STEROID THERAPY

Steroid tablets reduce mortality, relapses, subsequent hospital admission and requirement for β_2 agonist therapy. The earlier they are given in the acute attack the better the outcome.^{258,259} 1++

A Give steroid tablets in adequate doses in all cases of acute asthma.

Steroid tablets are as effective as injected steroids, provided tablets can be swallowed and retained.²⁵⁸ Doses of prednisolone of 40-50 mg daily or parenteral hydrocortisone 400 mg daily (100 mg six-hourly) are as effective as higher doses.²⁶⁰ For convenience, steroid tablets may be given as 2 x 25 mg tablets daily rather than 8-12 x 5 mg tablets. 1++

✓ Continue prednisolone 40-50 mg daily for at least five days or until recovery.

Following recovery from the acute exacerbation steroid tablets can be stopped abruptly and doses do not need tapering provided the patient receives inhaled steroids^{261,262} (apart from patients on maintenance steroid treatment or rare instances where steroids are required for three or more weeks). 1+

There is no evidence to suggest that inhaled steroids should be substituted for steroid tablets in treating patients with acute severe, or life threatening asthma. Further randomised controlled trials to determine the role of inhaled steroids in these patients are required.

Inhaled steroids do not provide benefit in addition to the initial treatment,²⁶³ but should be continued (or started as soon as possible) to form the start of the chronic asthma management plan. 1++

6.3.4 IPRATROPIUM BROMIDE

Combining nebulised ipratropium bromide with a nebulised β_2 agonist has been shown to produce significantly greater bronchodilation than a β_2 agonist alone, leading to a faster recovery and shorter duration of admission. Anticholinergic treatment is not necessary and may not be beneficial in milder exacerbations of asthma or after stabilisation.²⁶⁴⁻²⁶⁶

1⁺⁺

A Nebulised ipratropium bromide (0.5 mg 4-6 hourly) should be added to β_2 agonist treatment for patients with acute severe or life threatening asthma or those with a poor initial response to β_2 agonist therapy.

6.3.5 INTRAVENOUS MAGNESIUM SULPHATE

2004

A single dose of IV magnesium sulphate has been shown to be safe and effective in acute severe asthma **who have not had a good initial response to treatment.**²⁶⁷

1⁺⁺

The safety and efficacy of repeated doses have not been assessed in patients with asthma. Repeated doses could give rise to hypermagnesaemia with muscle weakness and respiratory failure.

A Consider giving a single dose of IV magnesium sulphate for patients with:

- acute severe asthma who have not had a good initial response to inhaled bronchodilator therapy
- life threatening or near fatal asthma.

✓ IV magnesium sulphate (1.2-2 g IV infusion over 20 minutes) should only be used following consultation with senior medical staff.

More studies are needed to determine the optimal frequency and dose of IV magnesium sulphate therapy.

6.3.6 INTRAVENOUS AMINOPHYLLINE

In acute asthma, the use of IV aminophylline is not likely to result in any additional bronchodilation compared to standard care with inhaled bronchodilators and steroid tablets. Side-effects such as palpitations, arrhythmias and vomiting are increased if IV aminophylline is used.²⁶⁸

1⁺⁺

✓ Use IV aminophylline only after consultation with senior medical staff.

Some individual patients with near fatal asthma or life threatening asthma with a poor response to initial therapy may gain additional benefit from IV aminophylline (5 mg/kg loading dose over 20 minutes unless on maintenance oral therapy, then infusion of 0.5-0.7 mg/kg/hr). Such patients are probably rare and could not be identified in a meta-analysis of trials involving 739 subjects.²⁶⁸ If IV aminophylline is given to patients on oral aminophylline or theophylline, blood levels should be checked on admission. Levels should be checked daily for all patients on aminophylline infusions.

6.3.7 LEUKOTRIENE RECEPTOR ANTAGONISTS

There is no published study of the use of leukotriene receptor antagonists in the management of acute asthma

6.3.8 ANTIBIOTICS

When an infection precipitates an exacerbation of asthma it is likely to be viral in type. The role of bacterial infection has been overestimated.²⁶⁹

1⁺⁺

B Routine prescription of antibiotics is not indicated for acute asthma.

6.3.9 HELIOX

The use of heliox (helium/oxygen mixture in a ratio of 80:20 or 70:30) in acute adult asthma cannot be recommended on the basis of present evidence.²⁷⁰⁻²⁷¹

1⁺

6.3.10 INTRAVENOUS FLUIDS

There are no controlled trials or even observational or cohort studies of differing fluid regimes in acute asthma. Some patients with acute asthma require rehydration and correction of electrolyte imbalance. Hypokalaemia can be caused or exacerbated by β_2 agonist and/or steroid treatment and must be corrected.

6.3.11 REFERRAL TO INTENSIVE CARE

Indications for admission to intensive care facilities or a high dependency unit include patients requiring ventilatory support and those with severe acute or life threatening asthma who are failing to respond to therapy, as evidenced by:

- deteriorating PEF
- persisting or worsening hypoxia
- hypercapnea
- arterial blood gas analysis showing fall in pH or rising H^+ concentration
- exhaustion, feeble respiration
- drowsiness, confusion
- coma or respiratory arrest.⁴⁷

2⁺

Not all patients admitted to the Intensive Care Unit (ICU) need ventilation, but those with worsening hypoxia or hypercapnea, drowsiness or unconsciousness and those who have had a respiratory arrest require intermittent positive pressure ventilation. Intubation in such patients is very difficult and should ideally be performed by an anaesthetist or ICU consultant.⁴⁷ Intensive care management is outwith the remit of these guidelines.

C All patients transferred to intensive care units should be accompanied by a doctor suitably equipped and skilled to intubate if necessary.

6.3.12 NON-INVASIVE VENTILATION

Non-invasive ventilation (NIV) is now well established in the management of ventilatory failure caused by extrapulmonary restrictive conditions and exacerbations of COPD. Hypercapneic respiratory failure developing during the evolution of an acute asthmatic episode is regarded as an indication for urgent admission to the ICU. It is unlikely that NIV would ever replace intubation in these very unstable patients but it has been suggested that this treatment can be used safely and effectively.²⁷² Future studies might usefully examine its role in the gradually tiring patient, but at present this treatment cannot be recommended outside randomised controlled trials.

4

6.4 FURTHER INVESTIGATION AND MONITORING

- ✓ ■ Measure and record PEF 15-30 minutes after starting treatment, and thereafter according to the response. Measure and record PEF before and after nebulised or inhaled β_2 agonist bronchodilator (at least four times daily) throughout the hospital stay and until controlled after discharge.
- Record oxygen saturation by oximetry and maintain arterial $SaO_2 > 92\%$
- Repeat measurements of blood gas tensions within two hours of starting treatment if:
 - the initial PaO_2 is < 8 kPa unless SaO_2 is $> 92\%$; *or*
 - the initial $PaCO_2$ is normal or raised; *or*
 - the patient's condition deteriorates.
- ✓ ■ Measure them again if the patient's condition has not improved by 4-6 hours.
- Measure and record the heart rate.
- Measure serum potassium and blood glucose concentrations.
- Measure the serum theophylline concentration if aminophylline is continued for more than 24 hours (aim at a concentration of 55-110 $\mu\text{mol/l}$).

6.5 ASTHMA MANAGEMENT PROTOCOLS AND PROFORMAS

The use of structured proformas has been shown to facilitate improvements in the process of care in A&E departments and hospital wards and to improve patient outcomes. The use of this type of documentation can assist data collection aimed at determining quality of care and outcomes.^{239 273-275}

2++

6.6 HOSPITAL DISCHARGE AND FOLLOW UP (see annex 3)

6.6.1 TIMING OF DISCHARGE

There is no single physiological parameter that defines absolutely the timing of discharge from an admission with acute asthma. Patients should have clinical signs compatible with home management, be on reducing amounts of β_2 agonist (preferably no more than four hourly) and be on medical therapy they can continue safely at home.

Although diurnal variability of PEF is not always present during an exacerbation, evidence suggests that patients discharged with PEF < 75% best or predicted and with diurnal variability > 25% are at greater risk of early relapse and readmission.^{276 277}

2+

6.6.2 PATIENT EDUCATION

Following discharge from hospital or A&E departments, a proportion of patients re-attend A&E departments, with more than 15% re-attending within two weeks. Some repeat attenders need emergency care, but many delay seeking help, and are under-treated and/or under-monitored.²⁷⁸

2+

Prior to discharge, trained staff should give asthma education. This should include education on inhaler technique and PEF record keeping, with a written PEF and symptom-based action plan being provided allowing the patient to adjust their therapy within recommendations. These measures have been shown to reduce morbidity after the exacerbation and reduce relapse rates.²⁷⁹

1++

There is some experience of a discrete population of patients who inappropriately use A&E departments rather than the primary care services for their asthma care.²⁸⁰

For the above groups there is a role for a trained asthma liaison nurse based in, or associated with, the A&E department.

6.6.3 FOLLOW UP

A careful history should elicit the reasons for the exacerbation and explore possible actions the patient should take to prevent future emergency presentations.

Medication should be altered depending upon the assessment and the patient provided with an asthma action plan aimed at preventing relapse, optimising treatment and preventing delay in seeking assistance in the future.

Follow up should be arranged prior to discharge with the patient's general practitioner or asthma nurse within two working days; and with a hospital specialist asthma nurse or respiratory physician at about one month after admission.

Recommendations for follow up after acute exacerbations of asthma are covered in more detail in section 9.2.



It is essential that the patient's primary care practice is informed within 24 hours of discharge from A&E or hospital following an asthma exacerbation treated in hospital. Ideally this communication should be directly with a named individual responsible for asthma care within the practice, by means of fax or e-mail.

6.7 ACUTE ASTHMA IN CHILDREN AGED OVER 2 YEARS

6.7.1 INITIAL ASSESSMENT

Table 6 details criteria for assessment of severity of acute asthma attacks in children. See also annexes 4-6.

Table 6: Clinical features for assessment of severity

<i>Acute severe</i>	<i>Life threatening</i>
Can't complete sentences in one breath or too breathless to talk or feed	<ul style="list-style-type: none"> ■ Silent chest ■ Cyanosis ■ Poor respiratory effort
Pulse > 120 in children aged > 5 years > 130 in children aged 2-5 years	<ul style="list-style-type: none"> ■ Hypotension ■ Exhaustion
Respiration > 30 breaths/min aged > 5 years > 50 breaths/min aged 2-5 years	<ul style="list-style-type: none"> ■ Confusion ■ Coma

Before children can receive appropriate treatment for acute asthma in any setting, it is essential to assess accurately the severity of their symptoms. The following clinical signs should be recorded:

- Pulse rate
(*increasing tachycardia generally denotes worsening asthma; a fall in heart rate in life threatening asthma is a pre-terminal event*).
- Respiratory rate and degree of breathlessness
(*i.e. too breathless to complete sentences in one breath or to feed*).
- Use of accessory muscles of respiration
(*best noted by palpation of neck muscles*).
- Amount of wheezing
(*which might become biphasic or less apparent with increasing airways obstruction*).
- Degree of agitation and conscious level
(*always give calm reassurance*).

Clinical signs correlate poorly with the severity of airways obstruction.²⁸¹⁻²⁸⁴ Some children with acute severe asthma do not appear distressed.

2⁺⁺

Objective measurements of PEF and SpO₂ are essential. Suitable equipment should be available for use by all health professionals assessing acute asthma in both primary and secondary care settings.

Low oxygen saturations after initial bronchodilator treatment selects a more severe group of patients.^{281 284}

2⁺⁺

B Consider intensive inpatient treatment for children with SpO₂ < 92% on air after initial bronchodilator treatment.

- ✓ Decisions about admission should be made by trained physicians after repeated assessment of the response to further bronchodilator treatment.

A measurement of < 50% predicted PEF or FEV₁ with poor improvement after initial bronchodilator treatment is predictive of a more prolonged asthma attack.

- ✓ Attempt to measure PEF or FEV₁ in all children aged > 5 years, taking the best of three measurements, ideally expressed as percentage of personal best for PEF (as detailed in a written action plan) or alternatively as percentage of predicted for PEF or FEV₁.

Chest x-rays and ABG measurements rarely provide additional useful information and are not routinely indicated.^{285 286}

6.8 TREATMENT OF ACUTE ASTHMA IN CHILDREN AGED OVER 2 YEARS

Emergency units attending to children with acute asthma should have a registered sick children's nurse available on duty at all times and staff familiar with the specific needs of children. The use of proformas can increase the accuracy of severity assessment.

An assessment-driven algorithm has been shown to reduce treatment costs and hospital stay.²⁸⁷ | 2+

D The use of structured care protocols detailing bronchodilator usage, clinical assessment, and specific criteria for safe discharge is recommended.

6.8.1 OXYGEN

✓ Children with life threatening asthma or SpO₂ < 92% should receive high flow oxygen via a tight fitting face mask or nasal cannula at sufficient flow rates to achieve normal saturations.

6.8.2 β₂AGONIST BRONCHODILATORS

A Inhaled β₂ agonists are the first line treatment for acute asthma.²⁸⁸⁻²⁹¹

pMDI + spacer is an effective alternative to nebulisers for bronchodilator inhalation to treat mild to moderate asthma.^{203 292} Children receiving β₂ agonists via pMDI + spacer are less likely to have tachycardia and hypoxia than when the same drug is given via a nebuliser.²⁰³ | 1+

A pMDI + spacer are the preferred option in mild to moderate asthma.

Information about implementing evidence-based guidelines using such devices has been published.²⁹³ Children aged < 3 years are likely to require a face mask connected to the mouthpiece of a spacer for successful drug delivery. Inhalers should be actuated into the spacer in individual puffs and inhaled immediately by tidal breathing.

Frequent doses of β₂ agonists are safe for the treatment of acute asthma,²⁸⁸⁻²⁹⁰ although children with mild symptoms benefit from lower doses.²⁹¹ | 1+

B Individualise drug dosing according to severity and adjust according to the patient's response.

Two to four puffs repeated every 20-30 minutes according to clinical response might be sufficient for mild attacks although up to 10 puffs might be needed for more severe asthma.

✓ Children with acute asthma in primary care who have not improved after receiving up to 10 puffs of β₂ agonist should be referred to hospital. Further doses of bronchodilator should be given as necessary whilst awaiting transfer.

✓ Treat children transported to hospital by ambulance with oxygen and nebulised β₂ agonists during the journey.

✓ Transfer children with severe or life threatening asthma urgently to hospital to receive frequent doses of nebulised β₂ agonists (2.5-5 mg salbutamol or 5-10 mg terbutaline).

Doses can be repeated every 20-30 minutes. Continuous nebulised β₂ agonists are of no greater benefit than the use of frequent intermittent doses in the same total hourly dosage.^{294 295}

6.8.3 IV SALBUTAMOL

The role of intravenous β₂ agonists in addition to nebulised treatment remains unclear.²⁵⁴ One study has shown that an IV bolus of salbutamol given in addition to near maximal doses of nebulised salbutamol results in clinically significant benefits.²⁵⁴ | 1+

B The early addition of a bolus dose of intravenous salbutamol (15 mcg/kg) can be an effective adjunct to treatment in severe cases.

Continuous intravenous infusion should be considered when there is uncertainty about reliable inhalation or for severe refractory asthma. Doses above 1-2 mcg/kg/min (200 mcg/ml solution) should be given in a Paediatric Intensive Care Unit (PICU) setting (up to 5 mcg/kg/min) with regular monitoring of electrolytes.

6.8.4 STEROID THERAPY

Steroid tablets

The early use of steroids for acute asthma can reduce the need for hospital admission and prevent a relapse in symptoms after initial presentation.^{258 259} Benefits can be apparent within three to four hours.

2+

1+

A Give prednisolone early in the treatment of acute asthma attacks.

A soluble preparation dissolved in a spoonful of water is preferable in those unable to swallow tablets. Use a dose of 20 mg for children 2-5 years old and 30-40 mg for children > 5 years.

Oral and intravenous steroids are of similar efficacy.^{260 296 297} Intravenous hydrocortisone (4 mg/kg repeated four hourly) should be reserved for severely affected children who are unable to retain oral medication.

1+

Larger doses do not appear to offer a therapeutic advantage for the majority of children.²⁹⁸ There is no need to taper the dose of steroid tablets at the end of treatment.

2+

- ✓
 - Use a dose of 20 mg prednisolone for children aged 2-5 years and a dose of 30-40 mg for children > 5 years. Those already receiving maintenance steroid tablets should receive 2 mg/kg prednisolone up to a maximum dose of 60 mg.
 - Repeat the dose of prednisolone in children who vomit and consider intravenous steroids in those who are unable to retain orally ingested medication.
 - Treatment for up to three days is usually sufficient, but the length of course should be tailored to the number of days necessary to bring about recovery.

Inhaled steroids

There is insufficient evidence to support the use of inhaled steroids as alternative or additional treatment to steroid tablets for acute asthma.^{263 299-301}

- ✓ Do not initiate inhaled steroids in preference to steroid tablets to treat acute childhood asthma.

Children with chronic asthma not receiving regular preventive treatment will benefit from initiating inhaled steroids as part of their long term management. There is no evidence that increasing the dose of inhaled steroids is effective in treating acute symptoms, but it is good practice for children already receiving inhaled steroids to continue with their usual maintenance doses.

6.8.5 IPRATROPIUM BROMIDE

There is good evidence for the safety and efficacy of frequent doses of ipratropium bromide used in addition to β_2 agonists for the first two hours of a severe asthma attack. Benefits are more apparent in the most severe patients.³⁰²

1+

A If symptoms are refractory to initial β_2 agonist treatment, add ipratropium bromide (250 mcg/dose mixed with the nebulised β_2 agonist solution).

Frequent doses up to every 20-30 minutes (250 mcg/dose mixed with the β_2 agonist solution in the same nebuliser) should be used early. The dose frequency should be reduced as clinical improvement occurs.

- ✓ Repeated doses of ipratropium bromide should be given early to treat children poorly responsive to β_2 agonists.

Children with continuing severe asthma despite frequent nebulised β_2 agonists and ipratropium bromide and those with life threatening features need urgent review by a specialist with a view to transfer to a High Dependency Unit or PICU.

6.8.6 IV AMINOPHYLLINE

There is no evidence that aminophylline is of benefit for mild to moderate asthma and side-effects are common and troublesome.^{268 303} However, one well conducted study has shown evidence for benefit in severe acute asthma unresponsive to multiple doses of β_2 agonists and steroids.³⁰⁴ | 1+
2+

A Aminophylline is not recommended in children with mild to moderate acute asthma.

C Consider aminophylline in a High Dependency Unit or PICU setting for children with severe or life threatening bronchospasm unresponsive to maximal doses of bronchodilators and steroid tablets.

A 5 mg/kg loading dose should be given over 20 minutes with ECG monitoring (omit in those receiving maintenance oral theophyllines) followed by a continuous infusion at 1 mg/kg/hour. Estimate serum theophylline levels in patients already receiving oral treatment and in those receiving prolonged treatment.

6.8.7 OTHER THERAPIES

There is no evidence to support the use of heliox or leukotriene receptor antagonists for the treatment of acute asthma in childhood.

There is insufficient evidence to support or refute the role of antibiotics in acute asthma,³⁰⁵ but the majority of acute asthma attacks are triggered by viral infection.

✓ Do not give antibiotics routinely in the management of acute childhood asthma.

6.8.8 INTRAVENOUS FLUIDS

Children with prolonged severe asthma not tolerating oral fluids will require intravenous hydration. Two thirds of the child's maintenance requirement should be given because of the possibility of inappropriate antidiuretic hormone secretion. Serum electrolytes should be measured and hypokalaemia corrected if detected.

✓ ECG monitoring is mandatory for all intravenous treatments.

6.8.9 IV MAGNESIUM SULPHATE

Intravenous magnesium sulphate is a safe treatment for acute asthma although its place in management is not yet established.^{267 306} Doses of up to 40 mg/kg/day (maximum 2 g) by slow infusion have been used. Studies of efficacy for severe childhood asthma unresponsive to more conventional therapies have been inconsistent in providing evidence of benefit. | 1+

6.8.10 FURTHER INVESTIGATION AND MONITORING

Children can be discharged when stable on 3-4 hourly inhaled bronchodilators that can be continued at home.³⁰⁷ PEF and/or FEV₁ should be > 75% of best or predicted and SpO₂ > 94%.

Adult studies show that "optimal care" comprising self-monitoring, regular review and a written asthma action plan can improve outcomes.²³⁷ Acute asthma attacks should be considered a failure of preventive therapy and thought should be given about how to help families avoid further severe episodes. Discharge plans should address the following:

- check inhaler technique
- consider the need for regular inhaled steroids
- provide a written asthma action plan for subsequent asthma with clear instructions about the use of bronchodilators, seeking urgent medical attention in the event of worsening symptoms and, if appropriate, starting a course of oral steroids
- arrange follow up by a GP within one week
- arrange follow up in a paediatric asthma clinic within one to two months.

6.9 ASSESSMENT OF ACUTE ASTHMA IN CHILDREN AGED LESS THAN 2 YEARS (see annex 7)

The assessment of acute asthma in early childhood can be difficult. Intermittent wheezing attacks are usually due to viral infection and the response to asthma medication is inconsistent. Prematurity and low birth weight are risk factors for recurrent wheezing. The differential diagnosis of symptoms includes aspiration pneumonitis, pneumonia, bronchiolitis, tracheomalacia, and complications of underlying conditions such as congenital anomalies and cystic fibrosis. These guidelines are intended for those who are thought to have asthma causing acute wheeze. They should not be used as a guide for treating acute bronchiolitis. (See forthcoming SIGN guideline on bronchiolitis in children).

6.10 TREATMENT OF ACUTE ASTHMA IN CHILDREN AGED LESS THAN 2 YEARS

6.10.1 β_2 AGONIST BRONCHODILATORS

A trial of bronchodilator therapy should be considered when symptoms are of concern. If inhalers have been successfully administered but there is no response, review the diagnosis and consider the use of other treatment options.

Oral β_2 agonists have not been shown to affect symptom score or length of hospital stay for acute asthma in infancy when compared to placebo.³⁰⁸ | 1+

B Oral β_2 agonists are not recommended for acute asthma in infants.

Inhaled β_2 agonists are the treatment of choice for the initial treatment of acute asthma. Close fitting face masks are essential for optimal drug delivery. The dose received is increased if the child is breathing appropriately and not taking large gasps because of distress and screaming.

There is good evidence that pMDI + spacer is as effective as, if not better than, nebulisers for treating mild to moderate asthma in children aged < 2 years.^{205 309 310} | 1+

A For mild to moderate acute asthma, a pMDI + spacer is the optimal drug delivery device.

Whilst β_2 agonists offer marginal benefits to children aged < 2 years with acute wheeze, there is little evidence for an impact on the need for hospital admission or length of hospital stay.³¹¹⁻³¹³ | 1+

6.10.2 STEROID THERAPY

Steroid tablets in conjunction with β_2 agonists have been shown to reduce hospital admission rates when used in the emergency department.³¹⁴ Steroid tablets have also been shown to reduce the length of hospital stay.^{308 311 314} | 1+

B Consider steroid tablets in infants early in the management of moderate to severe episodes of acute asthma in the hospital setting.

One study has shown similar benefits when comparing oral and nebulised steroids for acute asthma.³¹¹

✓ Steroid tablet therapy (10 mg of soluble prednisolone for up to three days) is the preferred steroid preparation for use in this age group.

6.10.3 IPRATROPIUM BROMIDE

The addition of ipratropium bromide to β_2 agonists for acute severe asthma may lead to some improvement in clinical symptoms and reduce the need for more intensive treatment. It does not reduce the length of hospital stay either in combination with β_2 agonists or in comparison with placebo.³¹⁵ | 1+

B Consider inhaled ipratropium bromide in combination with an inhaled β_2 agonist for more severe symptoms.

6.10.4 FURTHER INVESTIGATION AND MONITORING

Many children with recurrent episodes of viral-induced wheezing in infancy do not go on to have chronic atopic asthma. The majority do not require treatment with regular inhaled steroids. Parents should be advised about the relationship between cigarette smoke exposure and wheezy illnesses (*see sections 3.1 & 3.3*). Referral to suitable agencies should be offered to those who wish to give up smoking.

Parents of wheezy infants should receive appropriate discharge plans along similar lines to those given for older children (*see section 6.8.10*).

7 Asthma in pregnancy

7.1 NATURAL HISTORY

Several physiological changes occur during pregnancy that could worsen or improve asthma, but it is not clear which, if any, are important in determining the course of asthma during pregnancy. Pregnancy can affect the course of asthma and asthma can affect pregnancy outcomes.

The natural history of asthma during pregnancy is extremely variable. In a prospective cohort study of 366 pregnancies in 330 asthmatic women, asthma worsened during pregnancy in 35%.³¹⁶ US studies suggest that 11-18% of pregnant women with asthma will have at least one emergency department visit for acute asthma and of these 62% will require hospitalisation.^{317 318} There is also some evidence that the course of asthma is similar in successive pregnancies.³¹⁶ Severe asthma is more likely to worsen during pregnancy than mild asthma,³¹⁶ but some patients with very severe asthma may experience improvement, whilst symptoms may deteriorate in some patients with mild asthma.

2-
2+

D Offer pre-pregnancy counselling to women with asthma regarding the importance and safety of continuing their asthma medications during pregnancy to ensure good asthma control.

The conclusions of a meta-analysis of 14 studies is in agreement with the commonly quoted generalisation that during pregnancy about one third of asthma patients experience an improvement in their asthma, one third experience a worsening of symptoms, and one third remain the same.³¹⁹

2++

In a large cohort study, the most severe symptoms were experienced by patients between the 24th and 36th week of pregnancy. Thereafter symptoms decreased significantly in the last four weeks and 90% had no asthma symptoms during labour or delivery. Of those who did, only two patients required anything more than inhaled bronchodilators.³¹⁶ A further study has confirmed the observation that the last month of pregnancy is the one in which patients are least likely to have an asthma exacerbation.³²⁰

2-
2+

A cohort study comparing 198 pregnant women with asthma to 198 women without asthma reported that non-atopic patients with asthma tend to have more severe asthma. Pre-eclampsia was also more common in this group. However with adequate surveillance and treatment, pregnancy and delivery complications can be avoided.³²¹ A systematic review has shown that baseline asthma severity does determine what happens to the course of asthma in pregnancy and asthma may affect the risk of adverse outcomes.³²²

2+
2++

C Monitor pregnant women with asthma closely so that any change in course can be matched with an appropriate change in treatment.

Uncontrolled asthma is associated with many maternal and fetal complications, including hyperemesis, hypertension, pre-eclampsia, vaginal haemorrhage, complicated labour, intrauterine growth restriction, preterm birth, increased perinatal mortality, and neonatal hypoxia.³²³⁻³²⁶ A large Swedish population-based study using record linkage data demonstrated increased risks for preterm birth, low birth weight, perinatal mortality and pre-eclampsia in women with asthma. The risks for prematurity and low birth weight were higher in women with more severe asthma necessitating admission.³²⁷

2+

In contrast, if asthma is well controlled throughout pregnancy there is little or no increased risk of adverse maternal or fetal complications.^{317 318} Pregnancy should therefore be an indication to optimise therapy and maximise lung function in order to reduce the risk of acute exacerbation.

✓ Advise women who smoke about the dangers for themselves and their babies and give appropriate support to stop smoking.

7.2 MANAGEMENT OF ACUTE ASTHMA IN PREGNANCY

The management of acute asthma in pregnancy may be affected by concerns about harmful effects of medication on the fetus. In a prospective controlled study of 51 pregnant women and 500 non-pregnant women presenting with acute asthma to an emergency department in Boston, USA, pregnant patients with asthma were less likely to receive appropriate treatment with steroids and, as a result, were more likely to experience ongoing exacerbation at two weeks.³²⁸ Available studies give little cause for concern regarding treatment side effects (see section 7.3) and the maternal and fetal risks of uncontrolled asthma are much greater than the risks from using conventional asthma medications for management of acute asthma. In the last two confidential enquiries into maternal deaths in the UK (covering 1994-1999) there were eight deaths from asthma.^{329 330}

Oxygen should be delivered to maintain saturation above 95% in order to prevent maternal and fetal hypoxia. Drug therapy should be given as for a non-pregnant patient with acute asthma, including repeated doses of inhaled β_2 agonists and early administration of steroid tablets.^{316 318 320 323 324} In severe cases, intravenous aminophylline or intravenous β_2 agonists can be used as indicated. Continuous fetal monitoring should be performed when asthma is uncontrolled or severe, or when fetal assessment on admission is not reassuring.

- C** Give drug therapy for acute asthma as for the non-pregnant patient.
- D** Deliver oxygen immediately to maintain saturation above 95%.
- D** Acute severe asthma in pregnancy is an emergency and should be treated vigorously in hospital.
- ✓ Continuous fetal monitoring is recommended for severe acute asthma.
- ✓ For women with poorly controlled asthma during pregnancy there should be close liaison between the respiratory physician and obstetrician.

7.3 DRUG THERAPY IN PREGNANCY

In general, the medicines used to treat asthma are safe in pregnancy.³³¹ The risk of harm to the fetus from severe or chronically under-treated asthma outweighs any small risk from the medications used to control asthma.

7.3.1 β_2 AGONISTS

No significant association has been demonstrated between major congenital malformations or adverse perinatal outcome and exposure to β_2 agonists.^{331 332} A prospective study of 259 pregnant patients with asthma who were using bronchodilators compared with 101 pregnant patients with asthma who were not, and 295 control subjects, found no differences in perinatal mortality, congenital abnormalities, prematurity, mean birth weight, apgar scores or labour/delivery complications.³³³ Evidence from prescription event monitoring suggests that salmeterol is also safe in pregnancy.³³⁴

- C** Use β_2 agonists as normal during pregnancy.

7.3.2 INHALED STEROIDS

No significant association has been demonstrated between major congenital malformations or adverse perinatal outcome and exposure to inhaled steroids.^{331 335-338} Inhaled anti-inflammatory treatment has been shown to decrease the risk of an acute attack of asthma in pregnancy³²⁰ and the risk of readmission following asthma exacerbation.³¹⁸

- C** Use inhaled steroids as normal during pregnancy.

7.3.3 THEOPHYLLINES

No significant association has been demonstrated between major congenital malformations or adverse perinatal outcome and exposure to methylxanthines.^{331 339}

For women requiring therapeutic levels of theophylline to maintain asthma control, measurement of theophylline levels is recommended. Since protein binding decreases in pregnancy, resulting in increased free drug levels, a lower therapeutic range is probably appropriate.³⁴⁰

2+
4

C Use oral and intravenous theophyllines as normal during pregnancy.

D Check blood levels of theophylline in acute severe asthma and in those critically dependent on therapeutic theophylline levels.

7.3.4 STEROID TABLETS

The balance of evidence suggests that steroid tablets are not teratogenic.^{323 331 341} Data from many studies have failed to demonstrate an association between first trimester exposure to steroid tablets and oral clefts.³⁴¹ Although one meta-analysis found an increased risk,³⁴² a prospective study by the same group found no difference in the rate of major birth defects in prednisolone-exposed and control babies.³⁴² One case control study that may have influenced the findings of the meta-analysis found a significant association between exposure to steroids in the first trimester and an increased risk of cleft lip,³⁴³ although this increase is not significant if only paired controls are considered.

2+
2

Even if the association is real, the benefit to the mother and the fetus of steroids for treating a life-threatening disease justify their use in pregnancy.³²³ Pregnant women with acute asthma exacerbation are less likely to be treated with steroid tablets than non-pregnant women.³²⁸ This failure to administer steroid tablets when indicated increases the risk of ongoing exacerbation and therefore the risks to the mother and her fetus.

2+

Some studies have found an association between steroid tablet use and pregnancy-induced hypertension or pre-eclampsia and preterm labour,³²¹ but severe asthma may be a confounding variable.

C Use steroid tablets as normal when indicated during pregnancy for severe asthma. Steroid tablets should never be withheld because of pregnancy.

7.3.5 LEUKOTRIENE RECEPTOR ANTAGONISTS

Data regarding the safety of leukotriene antagonists in pregnancy are extremely limited. Animal studies and post-marketing surveillance for zafirlukast and montelukast are reassuring. There are animal data of concern for zileuton.³⁴⁴

4

D Do not commence leukotriene antagonists during pregnancy. They may be continued in women who have demonstrated significant improvement in asthma control with these agents prior to pregnancy not achievable with other medications.

7.3.6 CHROMONES



No significant association has been demonstrated between major congenital malformations or adverse perinatal outcome and exposure to chromones.^{330 331}

C Use chromones as normal during pregnancy.

7.4 MANAGEMENT DURING LABOUR

Acute attacks of asthma are very rare in labour due to endogenous steroid production. In women receiving steroid tablets there is a theoretical risk of maternal hypothalamic-pituitary-adrenal axis suppression. Women with asthma may safely use all forms of pain relief in labour.

In some studies there is an association between asthma and an increased caesarean section rate,^{321 345 346} but this may be due to planned caesarean sections³²⁰ or inductions of labour rather than due to any direct effect of asthma on intrapartum indications. 2+

Data suggest that the risk of postpartum exacerbation of asthma is increased in women having caesarean sections.³⁴⁵ This may relate to the severity of their asthma rather than to the caesarean section, or to factors such as postoperative pain with diaphragmatic splinting, hypoventilation and atelectasis. Prostaglandin E2 may safely be used for labour inductions.³⁴⁰ Prostaglandin F2 α (carboprost/hemobate®) used to treat postpartum haemorrhage due to uterine atony may cause bronchospasm.³⁴⁰ Although ergometrine may cause bronchospasm particularly in association with general anaesthesia,³⁴⁰ this is not a problem encountered when syntometrine (syntocinon/ergometrine) is used for postpartum haemorrhage prophylaxis. 2-
3

Although suppression of the fetal hypothalamic-pituitary-adrenal axis is a theoretical possibility with maternal systemic steroid therapy, there is no evidence from clinical practice or the literature to support this.³⁴⁷

- Advise women that acute asthma is rare in labour.
- Advise women to continue their usual asthma medications in labour.
- In the absence of acute severe asthma, reserve caesarean section for the usual obstetric indications.
- C** **If anaesthesia is required, regional blockade is preferable to general anaesthesia in women with asthma.**
- Women receiving steroid tablets at a dose exceeding prednisolone 7.5 mg per day for more than two weeks prior to delivery should receive parenteral hydrocortisone 100 mg 6-8 hourly during labour.
- D** **Use prostaglandin F2 α with extreme caution in women with asthma because of the risk of inducing bronchoconstriction.**

7.5 DRUG THERAPY IN BREASTFEEDING MOTHERS

The medicines used to treat asthma, including steroid tablets, have been shown in early studies to be safe to use in nursing mothers.³⁵⁰ There is less experience with newer agents. Less than 1% of the maternal dose of theophylline is excreted into breast milk.³⁵⁰ 2+

Prednisolone is secreted in breast milk, but milk concentrations of prednisolone are only 5-25% of those in serum.³⁵¹ The proportion of an oral or intravenous dose of prednisolone recovered in breast milk is less than 0.1%.³⁵¹⁻³⁵³ For maternal doses of at least 20 mg once or twice daily the nursing infant is exposed to minimal amounts of steroid with no clinically significant risk.³⁵¹⁻³⁵³ 2+
3

- C** **Encourage women with asthma to breast feed.**
- C** **Use asthma medications as normal during lactation, in line with manufacturer's recommendations.**

8 Occupational asthma

8.1 INCIDENCE

2005 → The true frequency of occupational asthma is not known, but under reporting is likely. Published reports, which come from surveillance schemes, compensation registries or epidemiological studies, estimate that occupational asthma may account for about 9-15% of adult onset asthma.³⁵⁴ 2⁺⁺
^{600 601} It is now the commonest industrial lung disease in the developed world with over 400 reported causes.³⁵⁵⁻³⁵⁷

2005 → The diagnosis should be suspected in all adults with symptoms of airflow limitation, and positively searched for in those with high-risk occupations or exposures. Patients with pre-existing asthma aggravated non-specifically by dust and fumes at work (work-aggravated asthma) should be distinguished from those with pre-existing asthma who become additionally sensitised to an occupational agent.

2005 → **B** In patients with adult onset, or reappearance of childhood asthma, clinicians should be suspicious that there may be an occupational cause.

8.2 AT RISK POPULATIONS

2005 → Several hundred agents have been reported to cause occupational asthma and new causes are reported regularly in the medical literature.

The most frequently reported causative agents include isocyanates, flour and grain dust, colophony and fluxes, latex, animals, aldehydes and wood dust.⁶⁰²⁻⁶¹¹

The workers most commonly reported to occupational asthma surveillance schemes include paint sprayers, bakers and pastry makers, nurses, chemical workers, animal handlers, welders, food processing workers and timber workers.^{602 603 605 607-613} 2⁺⁺

Workers reported to be at increased risk of developing asthma include bakers, food processors, forestry workers, chemical workers, plastics and rubber workers, metal workers, welders, textile workers, electrical and electronic production workers, storage workers, farm workers, waiters, cleaners, painters, dental workers and laboratory technicians.⁶¹⁴⁻⁶¹⁷ 2⁺

8.3 DIAGNOSIS

2005 → Occupational asthma should be considered in all workers with symptoms of airflow limitation. The best screening question to ask is whether symptoms improve on days away from work. This is more sensitive than asking whether symptoms are worse at work, as many symptoms deteriorate in the hours after work or during sleep.

✓ Adults with airflow obstruction should be asked:

- *Are you better on days away from work?*
- *Are you better on holiday?*

Those with positive answers should be investigated for occupational asthma.

These questions are not specific for occupational asthma and also identify those with asthma due to agents at home (who may improve on holidays), and those who do much less physical exertion away from work.³⁵⁸

2005 → Occupational asthma can be present when tests of lung function are normal, limiting their use as a screening tool. Asthmatic symptoms improving away from work can produce false negative diagnoses, so further validation is needed.

Serial measurement of peak respiratory flow is the most readily available initial investigation, and the sensitivity and specificity of serial peak flow measurement in the diagnosis of occupational asthma are high.^{360 618-623} 3

2005 Although skin prick tests or blood tests for specific IgE are available, there are few standardised allergens commercially available which limits their use. A positive test denotes sensitisation, which can occur with or without disease. The diagnosis of occupational asthma can usually be made without specific bronchial provocation testing, considered to be the gold standard diagnostic test. The availability of centres with expertise and facilities for specific provocation testing is very limited in the UK and the test itself is time-consuming.

As a general observation, the history is more useful in excluding occupational asthma than in confirming it. A significant proportion of workers with symptoms that improve on days away from work or on holiday have been shown by objective tests not to have occupational asthma.³⁵⁹

2005 Expert histories have poor specificity compared with specific challenge testing. Free histories taken by experts have high sensitivity but their specificity is lower.⁶²⁴⁻⁶³⁰

2005 **D** In suspected work-related asthma, the diagnosis of asthma should be confirmed using standard objective criteria.

3

2+

8.3.1 SENSITIVITY AND SPECIFICITY OF SERIAL PEAK FLOW MEASUREMENTS

2005 Direct and blinded comparisons of serial peak flow measurement with either specific bronchial provocation testing, or an expert diagnosis based on a combination of other types of evidence, reported consistently high sensitivities and specificities, averaging 80% and 90% respectively.^{618-623, 631-632}

3

Just one computed method of analysis has been reported, with a sensitivity of 75% and a specificity of 94%.⁶³³⁻⁶³⁴

Computed analysis of peak flow records has good diagnostic performance, but statistical analysis of serial peak flow measurements appears to be of limited diagnostic value compared to expert interpretation.⁶²¹⁻⁶³¹⁻⁶³²

Serial measurements of peak expiratory flow

Measurements should be made every two hours from waking to sleeping for four weeks, keeping treatment constant and documenting times at work.

Minimum standards for diagnostic sensitivity > 70% and specificity > 85% are:

- At least three days in each consecutive work period.
- At least three series of consecutive days at work with three periods away from work (usually about three weeks).
- At least four evenly spaced readings per day.⁶²³

The analysis is best done with the aid of a criterion-based expert system. Suitable record forms and support are available from <http://www.occupationalasthma.com>

2005 **D** Objective diagnosis of occupational asthma should be made using serial peak flow measurements, with at least four readings per day.

8.3.2 NON-SPECIFIC REACTIVITY

2005 Studies of non-specific reactivity are confounded by different methods used, different cut-offs for normality and the interval between last occupational exposure and the performance of the test (increasing time may allow recovery of initial hyper-reactors). Such studies show that non-specific bronchial hyper-reactivity may be normal in 5-40% of specific challenge positive workers. Testing with higher concentrations of methacholine or histamine, at which some people without asthma would react, reduces the number of non-reacting people with occupational asthma, but still leaves some non-reactors. One study showed no additional benefit of non-specific bronchial reactivity measurement over and above a history and specific IgE to inhaled antigens. A normal test of non-specific reactivity is not sufficiently specific to exclude occupational asthma in clinical practice.⁶¹⁹⁻⁶²⁵⁻⁶²⁷⁻⁶²⁹⁻⁶³⁰⁻⁶³²⁻⁶³⁵⁻⁶⁴⁶

2++

2005

Changes in non-specific reactivity at and away from work alone have been found to have only moderate sensitivity and specificity for diagnosis. Three studies were identified where at and away from work exposure measurements were attempted. One did not investigate workers further when the at work reactivity was normal, limiting its interpretation. Using a 3.2 fold change in reactivity, one study found a sensitivity of 48% and a specificity of 64%. Reducing the required change to twofold increased the sensitivity to 67%, reducing specificity to 54%. A smaller study with 14 workers with occupational asthma showed a sensitivity of 62% and specificity of 78%.

620 632 645

2-

8.3.3 SPECIFIC BRONCHIAL PROVOCATION TESTING

2005

Specific provocation challenges are usually used as the gold standard for occupational asthma diagnosis making assessments of their diagnostic validity difficult. In addition, there are no standardised methods for many occupational agents. There is also evidence that the threshold exposure increases with time since last exposure, making the tests less sensitive after prolonged absence from work. There are reports of people having non-specific reactions to specific challenges at concentrations likely to be found in the workplace, or of negative reactions to specific challenges in workers with otherwise good evidence of occupational asthma when challenge concentrations are confined to levels below occupational exposure standards.

637 641 644 647 648

4

2005

D A negative specific bronchial challenge in a worker with otherwise good evidence of occupational asthma is not sufficient to exclude the diagnosis.

8.4 MANAGEMENT OF OCCUPATIONAL ASTHMA

The aim of management is to identify the cause, remove the worker from exposure, and for the worker to have worthwhile employment.

2005

Complete avoidance of exposure may or may not improve symptoms and bronchial hyper-responsiveness. Both the duration of continued exposure following the onset of symptoms and the severity of asthma at diagnosis may be important determinants of outcome. Early diagnosis and early avoidance of further exposure, either by relocation of the worker or substitution of the hazard offer the best chance of complete recovery. Workers who remain in the same job and continue to be exposed to the same causative agent after diagnosis are unlikely to improve and symptoms may worsen. The likelihood of improvement or resolution of symptoms or of preventing deterioration is greater in workers who have no further exposure to the causative agent.

619 649-657

2⁺⁺

Several studies have shown that the prognosis for workers with occupational asthma is worse for those who remain exposed for more than one year after symptoms develop, compared with those removed earlier.

363-365

2005

D Relocation away from exposure should occur as soon as diagnosis is confirmed, and ideally within 12 months of the first work-related symptoms of asthma.

2005

There is consistent evidence from clinical and workforce case series that about one third of workers with occupational asthma are unemployed after diagnosis. It is unclear whether this risk is higher than that for other adults with asthma. The risk of unemployment may fall with increasing time after diagnosis. There is consistent evidence that loss of employment following a diagnosis of occupational asthma is associated with loss of income. Adults with occupational asthma may find employment more difficult than adults with non-occupational asthma. Approximately one third of workers with occupational asthma have been shown to be unemployed up to six years after diagnosis.

624 658-665

2-

9 Organisation and delivery of care

9.1 ROUTINE PRIMARY CARE

9.1.1 ACCESS TO ROUTINE PRIMARY CARE

2004

Primary care services delivered by clinicians trained in asthma management improve diagnosis, prescribing, education, monitoring, and continuity of care.⁵³³

2004

B All people with asthma should have access to primary care delivered by clinicians with appropriate training in asthma management.

9.1.2 STRUCTURED REVIEW

2004

Proactive routine clinical review of people with asthma is associated with favourable clinical outcome including reduced school or work absence, a reduced exacerbation rate and improved symptom control.³⁶⁷⁻³⁶⁹ It is difficult to be prescriptive about the frequency of review as this will vary with the severity of the disease. Outcome is similar whether a practice nurse (PN), or a general practitioner (GP) conducts the review. Clinicians trained in asthma management achieve better outcomes for their patients.^{371 372 375} Reviews carried out by telephone may be as effective as those using face-to-face consultations.⁵³⁴

2+
3
4
1+

2004

B In primary care, people with asthma should be reviewed regularly by a nurse or doctor with appropriate training in asthma management.

Proactive structured review, as opposed to opportunistic or unscheduled review, is associated with reduced exacerbation rate and days lost from normal activity.³⁷³⁻³⁷⁵ Asthma rehabilitation courses may reduce anxiety and depression, and improve exercise capacity and quality of life scores.³⁷⁶⁻³⁷⁸ General practices need to maintain a list of their patients known to have asthma in order to offer each patient regular, structured clinical review. This process requires administrative support. However, not all patients wish regular review, or are willing to attend a pre-arranged appointment.

1+
2+
3

Outcome would appear to be improved if the practice is involved in an audit activity linking patient management to recommended guidelines.^{379 380} Feedback would appear to be most effective when guideline recommendations are linked to individual patients.⁵³⁵ Collection of data on the structure and process of care and small group education sessions for GPs do not, by themselves, lead to improved clinical outcome. Asthma clinics in primary care may be a convenient way of delivering care, but do not in themselves improve outcome:⁵³⁶ it is what happens during the clinic that matters.³⁸¹⁻³⁸⁴

C General practices should maintain a list of people with asthma.

C Clinical review should be structured and utilise a standard recording system.

B Feedback of information to clinicians should link individual patients with recommendations from guidelines.

Structured clinical review systems include the Royal College of Physicians 'Three Questions' (see section 12.1.4),³⁸⁵ the Tayside Asthma Stamp,³⁸⁶ and the modified Jones Morbidity Index.³⁸⁷

9.1.3 SHARED CARE

Shared care schemes have been shown to be effective in some health care environments. There are no UK studies directly comparing primary and secondary care management, but international work suggests there may be little difference: what is done would appear to be more important than who by or where.³⁸⁸

1+
2+

- 2004** Integrated care schemes such as Grampian Asthma Study in Integrated Care (GRASSIC) suggest that place of care is not directly linked to clinical outcome.³⁸⁹⁻³⁹² Shared care had a similar outcome to outpatient care. Hospital and primary care staff worked together on a shared agenda to ensure that patients were regularly reviewed using a structured clinical format and standard outcome parameters. This resulted in reduced exacerbation and admission rates and improved symptom control. **Outreach support for primary care by asthma specialist nurses has not been shown to improve outcomes.**³⁹⁴ | 1+
2+
- 2004** **Community pharmacists trained in asthma care and teaching self-management skills may improve asthma control,**^{537 538} although evidence is inconsistent.⁵³⁹ | 1

9.1.4 PATIENT SUBGROUPS

Ethnic subgroups have adverse clinical outcomes, including higher hospital admission and exacerbation rates.^{376 396 397} In some countries ethnic minority groups experience a higher death rate due to asthma than their contemporaries.^{398 399} Minority groups describe poorer access to primary care and acute medical care,⁵⁴⁰ and compared with majority groups, minority groups have a higher use of emergency facilities for routine care.⁵³³ Educating primary care clinicians improves diagnosis, prescribing, education, and continuity of care for minority group children.⁵³³ There is an established link between socio-economic status and adverse asthma outcome.⁴⁰⁰⁻⁴⁰⁴ | 2+
3
4
1+

Adolescents and the elderly are particularly vulnerable to the adverse effects of asthma. Adolescents and young adults make more frequent use of emergency asthma health care services and less use of structured clinical review services than other age groups.^{405 406} Asthma in the elderly is a neglected area of research, despite high mortality and morbidity.^{224 407 408} | 3

D **Health professionals who provide asthma care should have heightened awareness of the complex needs of ethnic minorities, socially disadvantaged groups, and those with communication difficulties.**

9.2 ACUTE EXACERBATIONS

People with asthma who experience deterioration in symptom control leading to an acute exacerbation can access a wide variety of sources of help. Few studies have looked at the relative merits of one type of service compared to another. Exceptions include a UK study showing a better outcome for patients managed in a specialist respiratory ward compared to a general medical ward, and a US study showing more favourable outcome in patients managed by specialist allergists compared to generalists.^{429 430} | 2+
3

2004 **C** **Manage hospital inpatients in specialist rather than general units, where available.**

2004 **✓** **All services involved in the care of acute asthma should be staffed by appropriately trained personnel and have access to all the equipment needed to manage acute asthma.**

2004 **Models of care addressing access such as NHS Direct/NHS 24 produce similar outcomes to routine general practice, but have high referral rates and are unlikely to promote the continuity of care required for longer term management.**⁵⁴¹ | 3

A structured clinical assessment and a standardised recording system are associated with favourable outcome in acute exacerbations.⁴³¹ Audit of the management of patients with acute asthma attacks is associated with improved concordance with recommended guidelines and in turn improved clinical outcome and reduced exacerbation rate.⁴³²⁻⁴³⁴ | 2+
2
3

There is no evidence that the publication of guidelines per se improve care: clinicians need to link best practice to the management of individual patients. This effect is apparent in hospital and general practice care.²⁷⁷

2004 **B** **Clinicians in primary and secondary care should treat asthma according to recommended guidelines.**

The use of acute asthma management protocols and clinical pathways may be beneficial and cost effective. Sub-optimal control of asthma leading to exacerbation is more expensive to manage than well-controlled asthma.⁴³⁵ Early discharge schemes from hospital and emergency departments may be cost effective.^{275 436} | 2+
3

The safety of telephone help lines has not been established. 'Direct dial' emergency admission schemes may be of benefit to a small group of patients with severe or 'brittle' asthma but there is insufficient evidence to justify their widespread introduction.⁴³⁷ Admission criteria are discussed elsewhere (see section 6.2.6). | 4

Criteria for and timing of discharge from hospital and emergency departments have been studied. The key events in recovery appear to be improved symptoms and peak flow rather than a complete return to normality. Discharge when improvement is apparent may be as safe as discharge when full stability is achieved. Asthma specialist nurse education of adults and school-age (but not pre-school) children at or shortly after hospital attendance improves symptom control, self-management and re-attendance rates.^{438-440 442 542 543} | 1+
2++
2+
2-

Review within 30 days after hospital attendance with acute asthma is associated with reduced risk of further acute episodes.⁵⁴⁴ Various types of follow up after an acute exacerbation have been evaluated including GP care, hospital out-patient, and telephone follow up.^{440 441} There would appear to be little difference in outcome depending on place or personnel involved in follow up.⁴³⁶ (see section 6.6). | 3
1+

B Discharge from hospital or the emergency department should be a planned, supervised event.

2004 →

B All people attending hospital with acute exacerbations of asthma should be reviewed by a clinician with expertise in asthma management, preferably within 30 days.

10 Patient education and self-management

10.1 PERSONALISED ASTHMA ACTION PLANS

2004 → Written personalised action plans as part of self-management education have been shown to improve health outcomes for people with asthma.^{237 413 419 438 442-449 542 545-546 548-549} **The evidence is particularly good for those in secondary care with moderate to severe disease, and those who have had recent exacerbations where successful interventions have reduced hospitalisations and A&E attendances in people with severe asthma.**^{426 450 542} A consistent finding in many studies has been improvement in patient outcomes such as self-efficacy, knowledge and confidence.^{443 457 458 465 468 469 545 548-557}

1+

2004 → **A Patients with asthma should be offered self-management education that should focus on individual needs, and be reinforced by a written action plan.**

2004 → **A Prior to discharge, in-patients should receive individualised asthma action plans, given by clinicians with appropriate training in asthma management.**

The term 'action plan' is proposed as a replacement to the existing 'self-management plan'. It reflects patient terminology preferences (unpublished data from the Asthma UK), may be perceived as less daunting and is appropriate when working with parents and carers as well as adult patients. There is wide variation in the construction of education/self-management programmes⁴⁶⁰ and it has not been feasible to isolate each component of such a programme and subject it to rigorous analysis.^{558 559} While the self-management education package is effective, no individual component is consistently shown to be effective in isolation.

1+

Successful programmes vary considerably, but encompass:

- structured education, reinforced with written personal action plans, though the duration, intensity and format for delivery may vary.^{460 560}
- specific advice about recognizing loss of asthma control, though this may be assessed by symptoms or peak flows or both.^{413 415 419 438 442 443 445 446 452 558 561 562}
- action to take if asthma deteriorates, including seeking emergency help, commencing oral steroids (which may include provision of an emergency course of steroid tablets), and recommencing or temporarily increasing inhaled steroids⁴⁴², as appropriate to clinical severity. Many plans have used a 'zoned' approach.

A range of different patient populations are included in the trials. It cannot be assumed that a successful intervention in one setting will be feasible or appropriate in another. The greatest benefits are shown in those with the most severe disease.^{426 450 542} The limited number of primary care studies show less consistent results, perhaps because clinical benefit is harder to demonstrate in mild patients.^{446 546 549} Innovative approaches to self-management education in teenagers (web-based, peer delivered within schools) appear to have more success than more traditional programmes.^{546 548 563} A different approach may be needed for pre-school children, many of whom have viral induced wheeze.⁵⁶⁴ There are no studies which specifically address the provision of self-management education for the elderly.

1+

Successful interventions have been delivered by trained asthma health care professionals, usually doctors and nurses in the UK, and have been supported by educational discussion.^{413 438 442 443 447} Many published studies report long, intensive programmes.^{453 454 565} However, there is evidence that short programmes are as effective,^{438 455} and that usual care can be raised to a standard that incorporates many of the core elements of the extensive successful programmes⁴⁵⁶ (see Checklist 1). Self-management programmes will only achieve better health outcomes if the prescribed asthma treatment is appropriate and within guideline recommendations.^{457 458} **There is some evidence that patients who are provided with an asthma action plan receive more effective treatment.**^{446 547 549}

1+

2004 → **B Introduce asthma action plans as part of a structured educational discussion.**

10.2 PATIENT EDUCATION AND SELF-MANAGEMENT TOOLS

A number of educational tools are available to support health professionals, many of which are free, well researched and non-promotional. Amongst these are the *'Be in Control'* materials produced by Asthma UK, accessible from the website (www.asthma.org.uk/about) or by contacting the organisation. Annex 8 reproduces the Asthma UK action plan. Additional support and information for patients and carers is also available from the Asthma UK website (www.asthma.org.uk) and their nurse run helpline: 0845 701 0203.

10.3 PATIENT EDUCATION AND SELF-MANAGEMENT IN PRACTICE

The programmes evaluated used a wide range of approaches, making it difficult to give definitive advice.^{418 453-455 459-472} Checklists 1 and 2 are drawn from components of successful programmes, and may be useful when developing educational and organisational aspects of asthma care.

Every asthma consultation is an opportunity to review, reinforce and extend both knowledge and skills. This is true whether the patient is seen in primary care, the accident and emergency department, the ward, or the outpatient clinic. It is important to recognise that education is a process and not a single event.

- ✓
 - A hospital admission represents a window of opportunity to review self-management skills. No patient should leave hospital without a written asthma action plan.
 - An acute consultation offers the opportunity to determine what action the patient has already taken to deal with the exacerbation. Their self-management strategy may be reinforced or refined and the need for consolidation at a routine follow up considered.
 - A consultation for an upper respiratory tract infection or other known trigger is an opportunity to rehearse with the patient their self-management in the event of their asthma deteriorating.
 - Brief simple education linked to patient goals is most likely to be acceptable to patients.

Checklist 1. Setting up a structured asthma programme

- Investigate the availability of resources. This should include written asthma action plans and information leaflets, etc. Non-promotional material is available from Asthma UK (www.asthma.org.uk).
- Seek consensus opinion to ensure all members of the team are giving consistent advice.
- Discuss practical aspects of implementation. Points to consider will include which patients to target, whether education is to be integrated into usual care and delivered in one-to-one consultations or groups.
- Tailor the education and advice to the individual needs of the patient, respecting differing ambitions, wishes for autonomy and age.

Checklist 2. Suggested content for an educational programme/discussion

This checklist is intended as an example, which health professionals should adapt to meet the needs of individual patients and/or carers. The purpose of education is to empower patients and/or carers to undertake self-management more appropriately and effectively. Information given should be tailored to individual patient's social, emotional and disease status, and age. Different approaches are needed for different ages.

- Nature of the disease
- Nature of the treatment
- I identify areas where patient most wants treatment to have effect
- How to use the treatment
- Development of self-monitoring/self-assessment skills
- Negotiation of the asthma action plan in light of identified patient goals
- Recognition and management of acute exacerbations
- Appropriate allergen or trigger avoidance.

11 Concordance and compliance

The term “compliance” embodies a traditional model of prescriptive care. The newer term “concordance” is intended to convey a respect for the aims of both the health professional and the patient, and signifies a negotiated agreement between the two. Non-concordance describes an inability of both parties to come to an understanding, not merely a failure of the patient to follow the health professional’s instructions.⁴⁷³ Both terms are used throughout this section.

11.1 ASSESSING COMPLIANCE

Most studies of use of medication employ a compliance approach, which measures how often patients use a medication or carry out other behaviour defined as desirable, such as avoiding triggers. Many compliance studies do not assess whether the patient believes that their behaviour is appropriate, or whether the patient has in fact been given acceptable instructions on to how to use their medication. Thus, compliance studies generally compare patient behaviour to this “ideal model”, of which the patient may not be aware. It may be for this reason that there has been little evidence linking patients’ social or psychological characteristics to “compliance”, and little evidence that lower morbidity is linked to higher compliance.⁴⁷⁴

Generally, patients are more likely to under-use than over-use treatment^{475 476} and under-use should be considered when there is a failure to control asthma symptoms. Regular use of prophylactic asthma medication is difficult to assess. Electronic monitoring is the most accurate method, but is impractical for everyday use. It is most likely to be employed in clinical drug trials.⁴⁷⁷ Prescription counting gives the next best estimate, and is useful. Computer repeat-prescribing systems, widely available in general practice, provide a good indication of compliance with prescribed asthma regimens. Patient self-reporting and health care professional assessment both overestimate regular use of prophylactic medication.^{475 477 478}

✓ Prescription counting is a useful index of compliance.

11.2 REGULAR USE OF PROPHYLACTIC MEDICATION

The factors influencing regular use of prophylactic medication are complex. It is not always simply associated with individual psychosocial factors such as depression.⁴⁷⁹ Further research is required in this area.

11.2.1 REGULAR SELF-MONITORING PRACTICES

Regular monitoring with peak flow meters even in clinical drug trials is poor, with daily use recorded as low as 6%.^{480 481} There is little evidence of value as a long-term monitoring tool,^{390 562,566,567} but this does not negate the use of home charting at critical times. These include, for example, at diagnosis and initial assessment, when assessing response to changes in treatment, when monitoring response during exacerbations and changes in treatment, or as part of an asthma action plan.

11.2.2 INTERVENTIONS TO IMPROVE REGULAR USE OF PROPHYLACTIC MEDICATION

There is no clear evidence on how regular use of prophylactic medication may be improved. The two main approaches investigated have been the simplification of medication regimes by using combination inhalers, and patient education. Combination inhalers have not been shown to improve compliance in the medium to long term.^{478 482 483} Patient education programmes have not consistently improved regular use and health outcomes, and many have limited generalisability.^{477 456-458 484 485}

There is a suggestion in the literature that interventions designed to meet the needs of the intended target population, and improve communication between individuals and health professionals achieve better programme adherence.^{453 459 486} Simple written instruction increases patient concordance.⁴⁸⁷ Presenting important information first in a repetitive fashion can improve patient recall.⁴⁸⁸ Further evidence is required if recommendations are to be made around improving compliance. See checklist 3 for guidance on practical application.

- ✓ Provide simple, verbal and written instructions and information on drug treatment for patients and carers.

Checklist 3. Practical tips for improving concordance

- Open-ended questions like *"If we could make one thing better for your asthma what would it be?"* may help to elicit a more patient-centred agenda.
- Make it clear you are listening and responding to the patient's concerns and goals.
- Reinforce practical information and negotiated treatment plans with written instruction.
- Consider reminder strategies.
- Recall patients who miss appointments.

12 Outcomes and audit

Evidence suggests that guidelines alone do not affect clinical practice. Feedback based on audit is useful, both as part of an implementation strategy and for longer term positive influence on practice.⁴⁸⁹ The recommendations listed below are intended to assist in auditing the recommendations contained in the guideline. The gradings relate to the benefit demonstrated for the intervention being audited. Audit datasets (including definitions) are listed in annex 9.

12.1 PRIMARY CARE AND HOSPITAL CLINICS

12.1.1 STRUCTURING CARE

Structured care has been shown to produce benefits for patients with asthma.^{374 380 490} The evidence on the important aspects of structured care is not good, although the recording of morbidity, PEF levels, inhaler technique and current treatment and the promotion of self-management skills are common themes. 1+
2+

Nurse-run interventions targeting particular groups of patients³⁷¹ often show benefits, suggesting that this is one possible model for the delivery of structured care. 2++

Involvement in clinical audit has also been shown to be beneficial.³⁸⁰ 2+

One RCT has shown the value of a particular form of continued medical education course (CME) which included information on asthma management as well as training in self-regulation theory. This may increase participants' ability to develop patients' self-management skills.⁴⁸⁶ Patients who judged their physicians to involve them actively in decision-making had better outcomes.⁴⁹¹ 1+
2++

C Use a structured record for asthma patients, including a system for recording inhaler technique, morbidity, PEF levels, current treatment and asthma action plans.

B Practices should offer nurse run structured care for targeted patients with asthma.

C Health professionals should be involved in clinical audit.

A Self-regulation based CME courses on asthma management are recommended for doctors.

12.1.2 TARGETING CARE

There is an increased likelihood of asthma in children consulting frequently with respiratory symptoms, identifying this group as an at risk group, requiring special review.^{492 493} Children with persistent symptoms of asthma should be on regular treatment; inhaled steroids improve symptoms and lung function.^{494, 495, 598} 2+
1++

2005

Evidence for the efficacy of self-management plans is strongest in those with persistent symptoms^{237 419} or experiencing exacerbations – emergency nebulisations, frequent steroid courses,⁴¹⁹ A&E visits, or hospitalisations, but patients with milder asthma will also benefit.^{450 496 497 549} Mailing a partly completed (or a blank) self management plan, with an invitation for asthma review, can double the chances of a patient attending.⁵⁹⁹ 1++

2005

- Identify groups of patients at risk:**
- C** ■ children with frequent consultations with respiratory infection
 - A** ■ children over 5 years with persistent symptoms of asthma
 - C** ■ patients with asthma and psychiatric disease or learning disability
 - B** ■ patients using large quantities of β_2 agonists
- B** **Monitor the provision of asthma action plans, particularly to patients:**
- with moderate or severe asthma, based on step 3 or above
 - with regular symptoms
 - having frequent steroid courses or exacerbations
 - having emergency nebulisation or A&E attendances/hospitalisations
 - seeing different doctors.

Specialist input has a role in the management of patients with persistent symptoms, although the evidence for this comes from a before and after analysis in ambulatory care in secondary care, supported by extrapolation from studies in hospital inpatients.⁴⁹⁸⁻⁵⁰¹ No evidence was found on which to base a recommendation regarding the value of specialist primary care physicians, neither is there a robust definition of this group.

2+

- C** **Specialist review in adults with continuing symptoms is recommended to confirm or refute a diagnosis of asthma and to identify and manage the causes of persistent symptoms.**

12.1.3 OUTCOME MEASURES FOR PRIMARY CARE AND HOSPITAL CLINICS

Patients with stable asthma have fewer symptoms, better lung function and are less likely to experience an exacerbation. Having normal lung function is a good proxy for a number of different outcomes relating to patients' quality of life.⁵⁰²⁻⁵⁰⁴ Even short quality of life measurement instruments can be too cumbersome to be realistically recommended for routine practice.

2++

2+

Questionnaire assessment of current control is marginally more useful than diary recording of symptoms, which is also not practical in routine practice.⁵⁰⁵ The RCP three questions on current morbidity represent a consensus UK view on a short symptom questionnaire (*see Figure 7*).³⁸⁵ It is based on questionnaire responses which correlate with treatment level and are responsive to change,^{503 506} and widespread use should minimise the number of observed differences that may have been attributable to the use of different tools.

4

Actual lung function expressed as a percentage of best is a robust measure which allows data from patients with variable degrees of irreversible airflow obstruction to be combined and compared.⁵⁰⁷

There is a strong body of evidence to show efficacy of inhaled steroids in terms of symptom control, and epidemiology studies show a protective effect.⁵⁰⁸

1++

- Monitor the proportion of patients with active disease or taking asthma treatment:**
- C** ■ having no or few current symptoms
 - A** ■ able to use their prescribed inhalers effectively
 - A** ■ using inhaled steroids
 - C** ■ with normal lung function (PEF or FEV₁ > 80% predicted)
 - C** ■ with actual/best PEF or FEV₁ > 85%
 - A** ■ with an asthma action plan (*patients who should have an action plan include those on step 3 or above, plus any not on this level of treatment who have had an emergency nebulisation, a course of oral steroids or A&E attendance or hospital admission with asthma within the past 12 months*).
- B** **Recommended tools for monitoring morbidity: RCP three questions or tools which incorporate these (such as The Tayside stamp,³⁸⁰ Jones index³⁸⁷ and Q score⁵⁰⁴).**

Figure 7: Monitoring morbidity: the RCP three questions

RCP 3 QUESTIONS

IN THE LAST WEEK / MONTH		
	YES	NO
"Have you had difficulty sleeping because of your asthma symptoms (including cough)?"	<input type="checkbox"/>	<input type="checkbox"/>
"Have you had your usual asthma symptoms during the day (cough, wheeze, chest tightness or breathlessness)?"	<input type="checkbox"/>	<input type="checkbox"/>
"Has your asthma interfered with your usual activities (eg,housework, work, school etc)?"	<input type="checkbox"/>	<input type="checkbox"/>
Date ____ / ____ / ____		

- Applies to all patients with asthma aged 16 and over.
- Only use after diagnosis has been established.

12.2 OUTCOMES FOR MANAGEMENT OF ACUTE ASTHMA IN PRIMARY CARE

Confidential enquiries into asthma deaths continue to show that patients often had no recent objective measurements of airflow obstruction made.²¹⁴⁻²¹⁶ Audit of acute attacks has also documented the under-recording of objective measurements, although records usually allow severity to be classified in terms of ability to speak.^{432 433 509}

2++
2+

Early treatment with steroids is associated with better outcome (including fewer hospital admissions).^{258 259} Patients having acute asthma attacks can be regarded as a target group for more intensive input, in particular for learning self-management skills. Follow up after acute treatment was proposed from one of the confidential inquiries²¹⁵ as a practical way of ensuring that the patient was responding to treatment and would also allow self-management to be reviewed.

1++
2++

Monitor the proportion of patients attending for an unscheduled appointment or seen urgently, including those receiving emergency nebulisation who:

- | | |
|---|---|
| C | ■ have PEF measured |
| A | ■ are given steroid tablets |
| C | ■ are seen for review after an unscheduled visit, in order to confirm improvement (objectively, with PEF) and target them for teaching of self-management skills. |

12.3 A&E CARE FOR PATIENTS WITH ASTHMA

Structured care has been shown to improve management in A&E departments (*see section 6.5*).

- | | |
|---|--|
| C | Structure asthma care to prompt the recording of key aspects of assessment and treatment (include historical data on previous attendances, corticosteroid, home nebuliser use, administration of steroid tablets, pulse, PEF, oxygen saturations, arterial blood gases) |
|---|--|

The need to attend A&E with poorly controlled asthma signals a failure of long term care, except in a small minority of patients with brittle and catastrophic asthma. Referral for specialist review after emergency room attendance in the USA has been shown to significantly improve outcomes.⁵¹⁰ A nurse run intervention targeted at adult patients attending A&E with acute asthma significantly improved self-management behaviour, with associated improvements in use of resources.⁴⁴⁰

1+

A Monitor access to an asthma specialist nurse for teaching of self-management skills (adults).

B Monitor the rate of referral for specialist medical review.

Although steroid tablets are effective in preventing hospital admissions when used early (within one hour of attending A&E)²⁵⁸ and in reducing the risk of relapse in the ensuing 21 days²⁵⁹ there is evidence to suggest that they are not always used.⁵¹¹ Review of the proportion of patients receiving such treatment will alert departments when this proportion is low. | 1++

A Monitor the proportion of patients with acute asthma who are treated with steroid tablets within one hour of attendance, and the overall percentage.

12.4 HOSPITAL INPATIENTS WITH ACUTE ASTHMA

Cohort studies indicate that the process of care adheres more closely to guideline recommendations when respiratory specialists contribute to inpatient care.^{431 499 501 512} One study has related improvements in process to better outcomes for the patient.⁵⁰⁰ | 2+
2++

C Monitor the proportion of patients seen by a respiratory specialist.

Nurse-run interventions also improve outcomes for high risk patients, both adults⁴⁴⁷ and children.^{438 442} | 1++

A Monitor the proportion of patients seen by an asthma specialist nurse.

Following discharge, subsequent outpatient education/self-management training produces significant benefits.^{379 450} The problem of non-attendance highlights a need for inpatients to be targeted whilst still in hospital to increase the chance of modifying behaviour following discharge. | 1+
2005 ➔ Parents of preschool children did not benefit from self management advice at the time of a hospital admission with acute wheeze.⁵⁴³

B Monitor the availability of outpatient programmes teaching self-management skills for those who have had a recent hospital admission.

The use of stamps and proformas has a positive impact on the collection of important information process of care in inpatients with acute asthma.^{273 513} Clinical pathways similarly prompt health care workers about important aspects of care at different stages. An asthma-specific study showed significant improvements in quality of care, length of stay and costs.⁵¹⁴ This reflects the broader evidence base that such devices, by reminding clinicians about the important aspects of care as they deliver that care, are beneficial.⁴⁸⁹ | 2+

C Monitor the use of prompts – stamps, proformas, clinical pathways – to promote good quality of care and improve the collection of relevant process of care data.

Process of care has been shown to relate to outcome.⁵⁰⁰ The British Thoracic Society has developed an eight item audit dataset⁵¹⁵ which can identify differences in process between units with high and lower readmission rates,⁵¹⁶ strengthening the case for using these process measures as proxies for outcome. A similar tool is also available for paediatric practice. | 2+

2004 ➔ **C** Measure adherence to guideline recommendations using the BTS (adults) or BPRS (children) audit tools (available at www.brit-thoracic.org.uk)

12.5 OUTCOMES OF CARE FOR HOSPITAL MANAGEMENT OF ACUTE ASTHMA

Readmission rates reflect the process of care^{500 516} and as readmission rates are influenced by the interventions experienced by the patient, they can be seen as an “outcome of health care” measure.⁴³⁸ | 2++
^{442 447 517} Monitoring of readmission rates can only be recommended where these are likely to occur to the same institution. | 2+

B Monitor readmission rates (within two months), where readmissions can be linked between different institutions or are only likely to occur to the same institution.

13 Dissemination and implementation of the guideline

A number of initiatives are underway to support the implementation of the guideline. These include:

- dissemination activities including mailings and the use of lay and medical media
- profession and locality specific summaries
- educational materials including “off-the-shelf” presentation packages, case histories suitable for discussion, and scenarios for problem-based learning (available on CD-ROM and the SIGN and BTS websites)
- summary wall charts for different health care settings
- electronic links between the guideline and electronic support systems, e.g. GPASS and VAMP in primary care to enhance intraconsultation prompting
- patient information materials.

Further details of these initiatives will be available on the SIGN (www.sign.ac.uk) and BTS (www.brit-thoracic.org.uk) websites.

13.1 SUMMARY OF WEBSITES QUOTED IN THE GUIDELINE

British Thoracic Society	www.brit-thoracic.org.uk
Asthma UK	www.asthma.org.uk
Be in Control materials	www.asthma.org.uk/about
National Osteoporosis Society	www.nos.org.uk
Occupational asthma record forms	www.occupationalasthma.com
Scottish Intercollegiate Guidelines Network	www.sign.ac.uk

14 Guideline development group

The development of the original 2003 asthma guideline and the 2004 update involved the work of nine different multidisciplinary Evidence Review Groups, a Steering group and an Executive group. The membership of these groups has evolved since 2003. The two chairmen (Dr Bernard Higgins and Dr Graham Douglas) remain the same. Further details of membership can be obtained from the SIGN Executive (sign@sign.ac.uk). The 2004 revisions were co-ordinated by Joanne Topalian, Duncan Service and Safia Qureshi at SIGN.

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Declarations of interest were made by all members of the guideline development group. Further details are available from the SIGN Executive.

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14.4 CONSULTATION AND PEER REVIEW**14.4.1 NATIONAL OPEN MEETING**

A national open meeting is the main consultative phase in SIGN guideline development methodology, at which the guideline development group present their draft recommendations for the first time. The national open meeting for this guideline was held on 3 October 2001 and was attended by 346 representatives of all the key specialties relevant to the guideline. The draft guideline was also available on the SIGN and BTS web sites for a limited period at this stage to allow those unable to attend the meeting to contribute to the development of the guideline.

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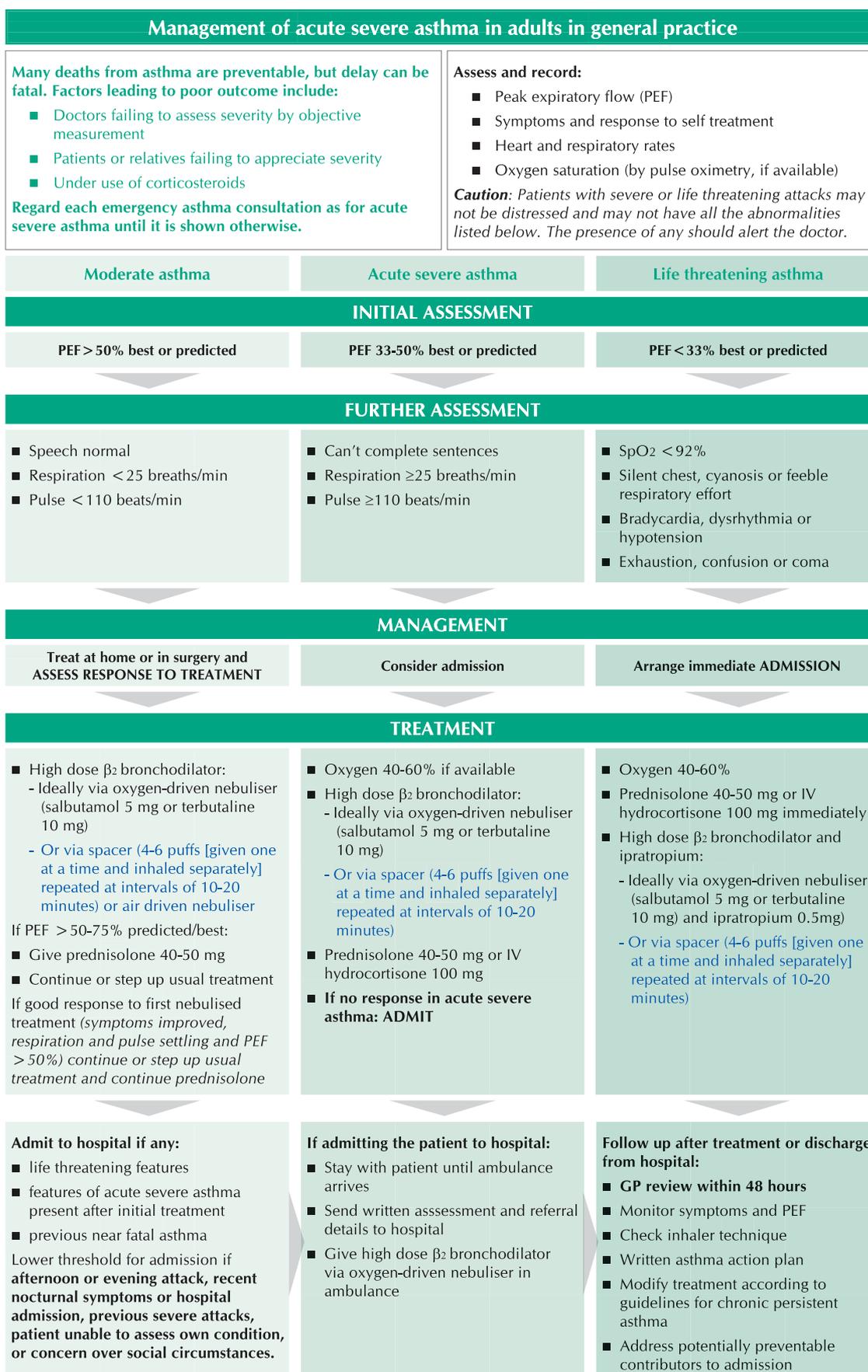
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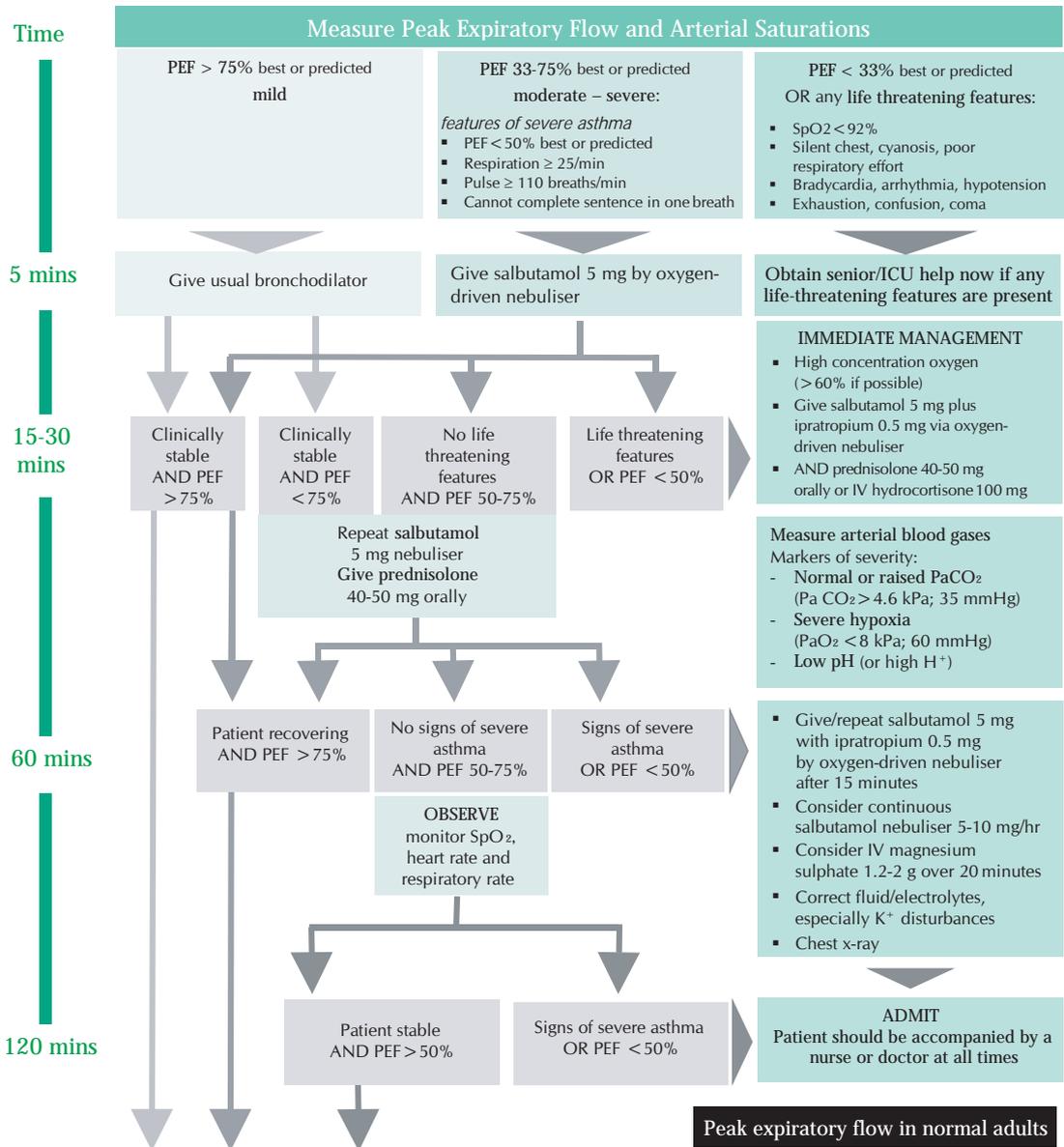
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Annex 1



Annex 2

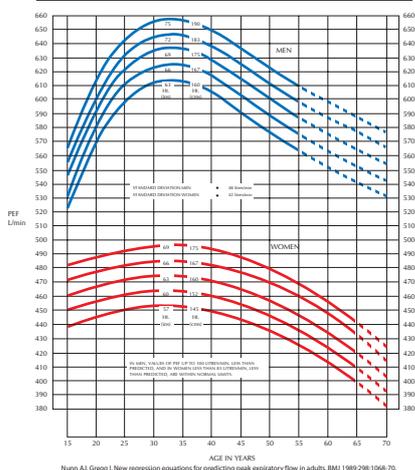
Management of acute severe asthma in adults in A&E



POTENTIAL DISCHARGE

- In all patients who received nebulised β_2 agonists prior to presentation, consider an extended observation period prior to discharge
- If PEF < 50% on presentation, prescribe prednisolone 40-50 mg/day for 5 days
- In all patients ensure treatment supply of inhaled steroid and β_2 agonist and check inhaler technique
- Arrange GP follow up for 2 days post presentation
- Fax discharge letter to GP
- Refer to asthma liaison nurse/chest clinic

Peak expiratory flow in normal adults



Annex 3

Management of acute severe asthma in adults in hospital

Features of acute severe asthma

- Peak expiratory flow (PEF) 33-50% of best (*use % predicted if recent best unknown*)
- Can't complete sentences in one breath
- Respirations ≥ 25 breaths/min
- Pulse ≥ 110 beats/min

Life threatening features

- PEF $< 33\%$ of best or predicted
- SpO₂ $< 92\%$
- Silent chest, cyanosis, or feeble respiratory effort
- Bradycardia, dysrhythmia, or hypotension
- Exhaustion, confusion, or coma

If a patient has any life threatening feature, measure arterial blood gases. No other investigations are needed for immediate management.

Blood gas markers of a life threatening attack:

- Normal (4.6-6 kPa, 35-45 mmHg) PaCO₂
- Severe hypoxia: PaO₂ < 8 kPa (60mmHg) irrespective of treatment with oxygen
- A low pH (or high H⁺)

Caution: Patients with severe or life threatening attacks may not be distressed and may not have all these abnormalities. The presence of any should alert the doctor.

Near fatal asthma

- Raised PaCO₂
- Requiring IPPV with raised inflation pressures

IMMEDIATE TREATMENT

- Oxygen 40-60% (CO₂ retention is not usually aggravated by oxygen therapy in asthma)
- Salbutamol 5 mg or terbutaline 10 mg via an oxygen-driven nebuliser
- Ipratropium bromide 0.5 mg via an oxygen-driven nebuliser
- Prednisolone tablets 40-50 mg or IV hydrocortisone 100 mg or both if very ill
- No sedatives of any kind
- Chest radiograph only if pneumothorax or consolidation are suspected or patient requires IPPV

IF LIFE THREATENING FEATURES ARE PRESENT:

- Discuss with senior clinician and ICU team
- Add IV magnesium sulphate 1.2-2 g infusion over 20 minutes (*unless already given*)
- Give nebulised β_2 agonist more frequently e.g. salbutamol 5 mg up to every 15-30 minutes or 10 mg continuously hourly

SUBSEQUENT MANAGEMENT

IF PATIENT IS IMPROVING continue:

- 40-60% oxygen
- Prednisolone 40-50mg daily or IV hydrocortisone 100 mg 6 hourly
- Nebulised β_2 agonist and ipratropium 4-6 hourly

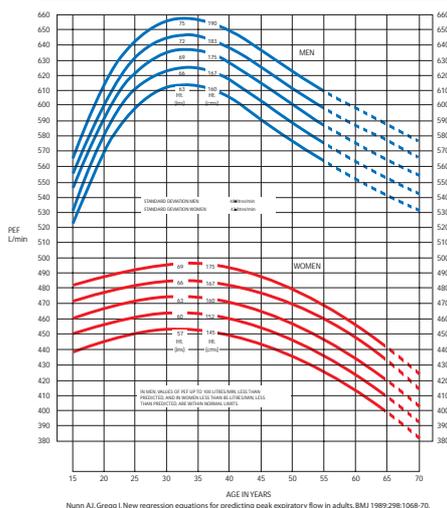
IF PATIENT NOT IMPROVING AFTER 15-30 MINUTES:

- Continue oxygen and steroids
- Give nebulised β_2 agonist more frequently e.g. salbutamol 5 mg up to every 15-30 minutes or 10 mg continuously hourly
- Continue ipratropium 0.5 mg 4-6 hourly until patient is improving

IF PATIENT IS STILL NOT IMPROVING:

- Discuss patient with senior clinician and ICU team
- IV magnesium sulphate 1.2-2 g over 20 minutes (*unless already given*)
- Senior clinician may consider use of IV β_2 agonist or IV aminophylline or progression to IPPV

Peak expiratory flow in normal adults



MONITORING

- Repeat measurement of PEF 15-30 minutes after starting treatment
- Oximetry: maintain SpO₂ $> 92\%$
- Repeat blood gas measurements within 2 hours of starting treatment if:
 - initial PaO₂ < 8 kPa (60 mmHg) unless subsequent SpO₂ $> 92\%$
 - PaCO₂ normal or raised
 - patient deteriorates
- Chart PEF before and after giving β_2 agonists and at least 4 times daily throughout hospital stay

Transfer to ICU accompanied by a doctor prepared to intubate if:

- Deteriorating PEF, worsening or persisting hypoxia, or hypercapnea
- Exhaustion, feeble respirations, confusion or drowsiness
- Coma or respiratory arrest

DISCHARGE

When discharged from hospital, patients should have:

- Been on discharge medication for 24 hours and *have had inhaler technique checked and recorded*
- PEF $> 75\%$ of best or predicted and PEF diurnal variability $< 25\%$ *unless discharge is agreed with respiratory physician*
- Treatment with oral and inhaled steroids in addition to bronchodilators
- Own PEF meter and written asthma action plan
- GP follow up arranged *within 2 working days*
- Follow up appointment in respiratory clinic *within 4 weeks*

Patients with severe asthma (*indicated by need for admission*) and adverse behavioural or psychosocial features are at risk of further severe or fatal attacks

- Determine reason(s) for exacerbation and admission
- Send details of admission, discharge and potential best PEF to GP

Annex 4

Management of acute asthma in children in general practice	
Age 2-5 years	Age > 5 years
ASSESS ASTHMA SEVERITY	
<p>Moderate exacerbation</p> <ul style="list-style-type: none"> SpO₂ ≥92% Able to talk Heart rate ≤130/min Respiratory rate ≤50/min 	<p>Moderate exacerbation</p> <ul style="list-style-type: none"> SpO₂ ≥92% PEF ≥50% best or predicted Able to talk Heart rate ≤120/min Respiratory rate ≤30/min
<p>β₂ agonist 2-4 puffs via spacer ± facemask</p> <p>Consider soluble prednisolone 20 mg</p>	<p>β₂ agonist 2-4 puffs via spacer</p> <p>Consider soluble prednisolone 30-40 mg</p>
<p>Increase β₂ agonist dose by 2 puffs every 2 minutes up to 10 puffs according to response</p>	<p>Increase β₂ agonist dose by 2 puffs every 2 minutes up to 10 puffs according to response</p>
<p>IF POOR RESPONSE ARRANGE ADMISSION</p>	<p>IF POOR RESPONSE REPEAT β₂ AGONIST AND ARRANGE ADMISSION</p>
<p>GOOD RESPONSE</p> <ul style="list-style-type: none"> Continue β₂ agonist via spacer or nebuliser, as needed but not exceeding 4-hourly If symptoms are not controlled repeat β₂ agonist and refer to hospital Continue prednisolone for up to 3 days Arrange follow-up clinic visit 	<p>GOOD RESPONSE</p> <ul style="list-style-type: none"> Continue β₂ agonist via spacer or nebuliser, as needed but not exceeding 4-hourly If symptoms are not controlled repeat β₂ agonist and refer to hospital Continue prednisolone for up to 3 days Arrange follow-up clinic visit
<p>POOR RESPONSE</p> <ul style="list-style-type: none"> Stay with patient until ambulance arrives Send written assessment and referral details Repeat β₂ agonist via oxygen-driven nebuliser in ambulance 	<p>POOR RESPONSE</p> <ul style="list-style-type: none"> Stay with patient until ambulance arrives Send written assessment and referral details Repeat β₂ agonist via oxygen-driven nebuliser in ambulance
<p>REPEAT β₂ AGONIST VIA OXYGEN-DRIVEN NEBULISER WHILST ARRANGING IMMEDIATE HOSPITAL ADMISSION</p>	<p>REPEAT β₂ AGONIST VIA OXYGEN-DRIVEN NEBULISER WHILST ARRANGING IMMEDIATE HOSPITAL ADMISSION</p>
<p>Life threatening asthma</p> <ul style="list-style-type: none"> SpO₂ <92% Silent chest Poor respiratory effort Agitation Altered consciousness Cyanosis 	<p>Life threatening asthma</p> <ul style="list-style-type: none"> SpO₂ <92% PEF <33% best or predicted Silent chest Poor respiratory effort Agitation Altered consciousness Cyanosis
<p>Oxygen via face mask</p> <p>Nebulise:</p> <ul style="list-style-type: none"> salbutamol 2.5 mg or terbutaline 5 mg + ipratropium 0.25 mg Soluble prednisolone 20 mg or IV hydrocortisone 50 mg 	<p>Oxygen via face mask</p> <p>Nebulise:</p> <ul style="list-style-type: none"> salbutamol 5 mg or terbutaline 10 mg + ipratropium 0.25 mg Soluble prednisolone 30-40 mg or IV hydrocortisone 100 mg
<p>Assess response to treatment 15 mins after β₂ agonist</p>	<p>Assess response to treatment 15 mins after β₂ agonist</p>
<p>IF POOR RESPONSE REPEAT β₂ AGONIST AND ARRANGE ADMISSION</p>	<p>IF POOR RESPONSE REPEAT β₂ AGONIST AND ARRANGE ADMISSION</p>
<p>GOOD RESPONSE</p> <ul style="list-style-type: none"> Continue β₂ agonist via spacer or nebuliser, as needed but not exceeding 4-hourly If symptoms are not controlled repeat β₂ agonist and refer to hospital Continue prednisolone for up to 3 days Arrange follow-up clinic visit 	<p>GOOD RESPONSE</p> <ul style="list-style-type: none"> Continue β₂ agonist via spacer or nebuliser, as needed but not exceeding 4-hourly If symptoms are not controlled repeat β₂ agonist and refer to hospital Continue prednisolone for up to 3 days Arrange follow-up clinic visit
<p>POOR RESPONSE</p> <ul style="list-style-type: none"> Stay with patient until ambulance arrives Send written assessment and referral details Repeat β₂ agonist via oxygen-driven nebuliser in ambulance 	<p>POOR RESPONSE</p> <ul style="list-style-type: none"> Stay with patient until ambulance arrives Send written assessment and referral details Repeat β₂ agonist via oxygen-driven nebuliser in ambulance
<p>REPEAT β₂ AGONIST VIA OXYGEN-DRIVEN NEBULISER WHILST ARRANGING IMMEDIATE HOSPITAL ADMISSION</p>	<p>REPEAT β₂ AGONIST VIA OXYGEN-DRIVEN NEBULISER WHILST ARRANGING IMMEDIATE HOSPITAL ADMISSION</p>
<p>LOWER THRESHOLD FOR ADMISSION IF:</p> <ul style="list-style-type: none"> Attack in late afternoon or at night Recent hospital admission or previous severe attack Concern over social circumstances or ability to cope at home 	<p>LOWER THRESHOLD FOR ADMISSION IF:</p> <ul style="list-style-type: none"> Attack in late afternoon or at night Recent hospital admission or previous severe attack Concern over social circumstances or ability to cope at home
<p>NB: If a patient has signs and symptoms across categories, always treat according to their most severe features</p>	<p>NB: If a patient has signs and symptoms across categories, always treat according to their most severe features</p>

Annex 5

Management of acute asthma in children in A&E

Age 2-5 years

ASSESS ASTHMA SEVERITY

Moderate exacerbation

- SpO₂ ≥92%
- No clinical features of severe asthma

NB: If a patient has signs and symptoms across categories, always treat according to their most severe features

- β₂ agonist 2-10 puffs via spacer ± facemask
- Reassess after 15 minutes

RESPONDING

- Continue inhaled β₂ agonist 1-4 hourly
- Give soluble oral prednisolone 20 mg

DISCHARGE PLAN

- Continue β₂ agonist 4 hourly prn
- Consider prednisolone 20 mg daily for up to 3 days
- Advise to contact GP if not controlled on above treatment
- Provide a written asthma action plan
- Review regular treatment
- Check inhaler technique
- Arrange GP follow up

Severe exacerbation

- SpO₂ <92%
- Too breathless to talk or eat
- Heart rate > 130/min
- Respiratory rate >50/min
- Use of accessory neck muscles

- Give nebulised β₂ agonist: salbutamol 2.5 mg or terbutaline 5 mg with oxygen as driving gas
- Continue O₂ via face mask/nasal prongs
- Give soluble prednisolone 20 mg or IV hydrocortisone 50 mg

NOT RESPONDING

- Repeat inhaled β₂ agonist
- Give soluble oral prednisolone 20 mg

ARRANGE ADMISSION

(lower threshold if concern over social circumstances)

IF LIFE THREATENING FEATURES PRESENT

Discuss with senior clinician, PICU team or paediatrician

Consider:

- Chest x-ray and blood gases
- Repeat nebulised β₂ agonist
- Plus: ipratropium bromide 0.25 mg
- Bolus IV salbutamol 15 mcg/kg of 200 mcg/ml solution over 10 minutes

- Arrange immediate transfer to PICU/HDU if poor response to treatment
- Admit all cases if features of severe exacerbation persist after initial treatment

Age > 5 years

ASSESS ASTHMA SEVERITY

Moderate exacerbation

- SpO₂ ≥92%
- PEF ≥50% best or predicted
- No clinical features of severe asthma

NB: If a patient has signs and symptoms across categories, always treat according to their most severe features

- β₂ agonist 2-10 puffs via spacer
- Reassess after 15 minutes

RESPONDING

- Continue inhaled β₂ agonist 1-4 hourly
- Add 30-40 mg soluble oral prednisolone

DISCHARGE PLAN

- Continue β₂ agonist 4 hourly prn
- Consider prednisolone 30-40 mg daily for up to 3 days
- Advise to contact GP if not controlled on above treatment
- Provide a written asthma action plan
- Review regular treatment
- Check inhaler technique
- Arrange GP follow up

Severe exacerbation

- SpO₂ <92%
- PEF <50% best or predicted
- Heart rate > 120/min
- Respiratory rate >30/min
- Use of accessory neck muscles

- Give nebulised β₂ agonist: salbutamol 2.5 mg or terbutaline 5 mg with oxygen as driving gas
- Continue O₂ via face mask/nasal prongs
- Give soluble prednisolone 30-40 mg or IV hydrocortisone 100 mg

NOT RESPONDING

- Repeat inhaled β₂ agonist
- Add 30-40 mg soluble oral prednisolone

ARRANGE ADMISSION

(lower threshold if concern over social circumstances)

IF LIFE THREATENING FEATURES PRESENT

Discuss with senior clinician, PICU team or paediatrician

Consider:

- Chest x-ray and blood gases
- Bolus IV salbutamol 15 mcg/kg of 200 mcg/ml solution over 10 minutes
- Repeat nebulised β₂ agonist
- Plus: ipratropium bromide 0.25 mg nebulised

- Arrange immediate transfer to PICU/HDU if poor response to treatment
- Admit all cases if features of severe exacerbation persist after initial treatment

Annex 6

Management of acute asthma in children in hospital

Age 2-5 years

ASSESS ASTHMA SEVERITY

Moderate exacerbation

- SpO₂ ≥92%
- No clinical features of severe asthma

NB: If a patient has signs and symptoms across categories, always treat according to their most severe features

- β₂ agonist 2-4 puffs via spacer ± facemask
- Increase β₂ agonist dose by 2 puffs every 2 minutes up to 10 puffs according to response
- Consider soluble oral prednisolone 20 mg

Reassess within 1 hour

Severe exacerbation

- SpO₂ <92%
- Too breathless to talk or eat
- Heart rate > 130/min
- Respiratory rate >50/min
- Use of accessory neck muscles

Oxygen via face mask/nasal prongs to achieve normal saturations

- β₂ agonist 10 puffs via spacer ± facemask or nebulised salbutamol 2.5 mg or terbutaline 5 mg
- Soluble prednisolone 20 mg or IV hydrocortisone 4 mg/kg
- Repeat β₂ agonist up to every 20-30 minutes according to response
- If poor response add 0.25 mg nebulised ipratropium bromide

Discuss with senior clinician, PICU team or paediatrician

- Repeat bronchodilators every 20-30 minutes

Life threatening asthma

- SpO₂ <92%
- Silent chest
- Poor respiratory effort
- Agitation
- Altered consciousness
- Cyanosis

Oxygen via face mask/nasal prongs to achieve normal saturations

- Nebulised β₂ agonist: salbutamol 2.5 mg or terbutaline 5 mg plus ipratropium bromide 0.25 mg nebulised
- IV hydrocortisone 4 mg/kg

Discuss with senior clinician, PICU team or paediatrician

- Repeat bronchodilators every 20-30 minutes

Age > 5 years

ASSESS ASTHMA SEVERITY

Moderate exacerbation

- SpO₂ ≥92%
- PEF ≥50% best or predicted
- No clinical features of severe asthma

NB: If a patient has signs and symptoms across categories, always treat according to their most severe features

- β₂ agonist 2-4 puffs via spacer
- Increase β₂ agonist dose by 2 puffs every 2 minutes up to 10 puffs according to response
- Oral prednisolone 30-40 mg

Reassess within 1 hour

Severe exacerbation

- SpO₂ <92%
- PEF <50% best or predicted
- Heart rate > 120/min
- Respiratory rate >30/min
- Use of accessory neck muscles

Oxygen via face mask/nasal prongs to achieve normal saturations

- β₂ agonist 10 puffs via spacer or nebulised salbutamol 2.5-5 mg or terbutaline 5-10 mg
- Oral prednisolone 30-40 mg or IV hydrocortisone 4 mg/kg if vomiting

- If poor response nebulised ipratropium bromide 0.25 mg
- Repeat β₂ agonist and ipratropium up to every 20-30 minutes according to response

Discuss with senior clinician, PICU team or paediatrician

- Repeat bronchodilators every 20-30 minutes

Life threatening asthma

- SpO₂ <92%
- PEF <33% best or predicted
- Silent chest
- Poor respiratory effort
- Altered consciousness
- Cyanosis

Oxygen via face mask/nasal prongs to achieve normal saturations

- Nebulised β₂ agonist: salbutamol 5 mg or terbutaline 10 mg plus ipratropium bromide 0.25 mg nebulised
- IV hydrocortisone 4 mg/kg

Discuss with senior clinician, PICU team or paediatrician

- Repeat bronchodilators every 20-30 minutes

ASSESS RESPONSE TO TREATMENT

Record respiratory rate, heart rate, oxygen saturation and PEF/FEV every 1-4 hours

RESPONDING

- Continue bronchodilators 1-4 hours prn
 - Discharge when stable on 4 hourly treatment
 - Continue oral prednisolone 30-40 mg for up to 3 days
- At discharge
- Ensure stable on 4 hourly inhaled treatment
 - Review the need for regular treatment and the use of inhaled steroids
 - Review inhaler technique
 - Provide a written asthma action plan for treating future attacks
 - Arrange follow up according to local policy

NOT RESPONDING

- Continue 20-30 minute nebulisers and arrange HDU/PICU transfer
- Chest x-ray and blood gases
- Bolus IV salbutamol 1.5 mcg/kg if not already given
- Continuous IV salbutamol infusion 1-5 mcg/kg/min (200 mcg/ml solution) over 20 minutes followed by continuous infusion 1mg/kg/hour (omit in those receiving oral theophyllines)
- Bolus IV infusion of magnesium sulphate 40 mg/kg (max 2 g) over 20 minutes

ASSESS RESPONSE TO TREATMENT

Record respiratory rate, heart rate and oxygen saturation every 1-4 hours

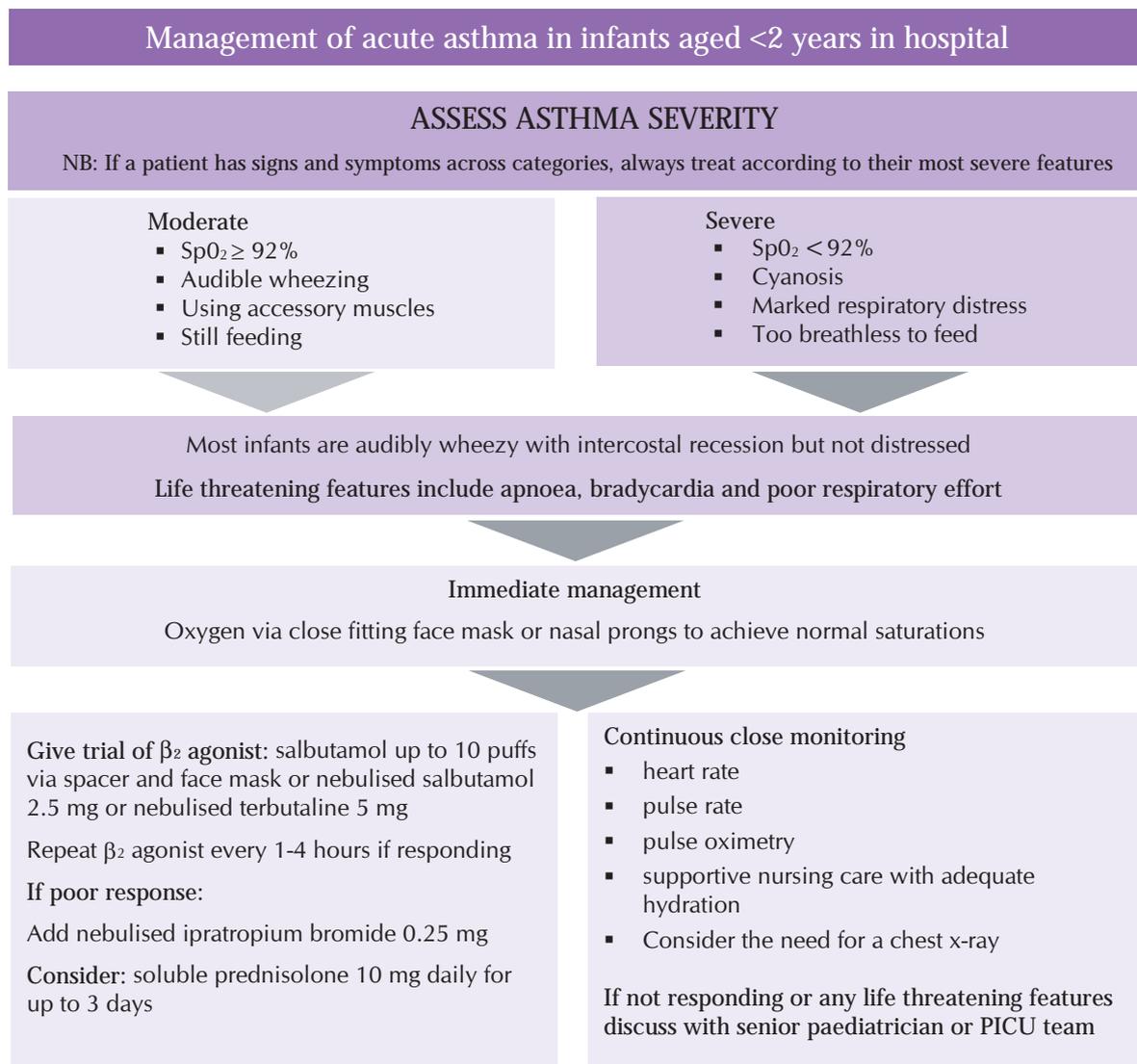
RESPONDING

- Continue bronchodilators 1-4 hours prn
 - Discharge when stable on 4 hourly treatment
 - Continue oral prednisolone for up to 3 days
- At discharge
- Ensure stable on 4 hourly inhaled treatment
 - Review the need for regular treatment and the use of inhaled steroids
 - Review inhaler technique
 - Provide a written asthma action plan for treating future attacks
 - Arrange follow up according to local policy

NOT RESPONDING

- Arrange HDU/PICU transfer
- Consider:
- Chest x-ray and blood gases
 - IV salbutamol 15 mcg/kg bolus over 10 minutes followed by continuous infusion 1-5 mcg/kg/min (dilute to 200 mcg/ml)
 - IV aminophylline 5 mg/kg loading dose over 20 minutes (omit in those receiving oral theophyllines) followed by continuous infusion 1 mg/kg/hour

Annex 7



Annex 9

AUDIT AND OUTCOMES

Audit points for asthma care in primary care and hospital respiratory clinics

Organisational level

- Is there a practice nurse with recognised asthma training/diploma?
- How much time has he/she for seeing patients with asthma?
- Do you have a system for identifying:
 - 1 Children having frequent consultations with respiratory infection so that the possibility of asthma can be considered
 - 2 Patients with asthma and psychiatric disease or learning disability for surveillance of asthma control
 - 3 Those requesting β_2 agonists inhalers frequently so that the need for other treatment (usually inhaled steroids) can be reviewed
- How do you identify the following groups of patients in order to optimise their treatment and teach self-management skills?
 - 1 Patients on step 3 or above
 - 2 Those having steroid courses for acute asthma/emergency nebulisation/unscheduled appointments for asthma
 - 3 Patients seen in A&E or hospitalised
 - 4 Patients seeing different doctors
- Do you have a structured record for patients with asthma, that includes symptom questions?
- What is the nature of asthma related CME undertaken by partners in past five years?
- Has an audit of asthma care been completed in the past year?
- Is there any evidence of changes in practice in response to findings?

Audit dataset for asthma care in primary care and hospitals

Audit point	Output from audit
RCP 3 questions – stratify responses as 0-3/3	Distribution of patient scores
Comment on inhaler technique, for all devices in use (within past year)	% patients judged to have satisfactory inhaler technique
PEF when stable (within one year)	Mean (SD) PEF as % predicted or best
FEV ₁ when stable (within three years)	Mean (SD) FEV ₁ as % predicted or best
PEF or FEV ₁ expressed as percentage of above	Mean (SD) PEF or FEV ₁ expressed as percentage of above
Treatment step	Distribution of patients across treatment steps
Number of courses of steroid tablets within past year	% patients having courses of oral steroids in one year
Number of emergency nebulisations within past year*	% patients having emergency nebulisations in one year
Number of A&E attendances or hospitalisations with asthma within past year	% patients seen in A&E or admitted to hospital in one year
Documented asthma action plan	% of patients with action plans
Seen in secondary care respiratory clinic within past year (Y/N)	% patients attending hospital asthma/respiratory clinics

*Denominator = all patients on or above step 3 plus any others who have had an emergency nebulisation, a course of steroid tablets, an A&E attendance or hospital admission with asthma in the past 12 months

Annex 9 (continued)

Audit dataset for acute asthma managed in primary care	
Audit point	Output from audit
Record the following items in patients receiving emergency nebulisation or unscheduled/urgent appointment: <ul style="list-style-type: none"> ● PEF measurement ● Whether or not oral steroids are prescribed ● Whether or not reviewed within two weeks ● Convalescent PEF ● Documented review of action plan 	Proportion of patients for whom these actions were taken

Audit points for A&E asthma management

Organisational level

Structured records for patients with asthma should include information on:

- previous A&E attendances/hospital admissions with asthma/whether currently attending respiratory clinic
- home nebuliser use
- number of courses of systemic corticosteroid within 12 months/currently on long term oral steroids (more than three months)
- admission pulse, PEF, oxygen saturations/gases, if appropriate
- referral to respiratory clinic and/or respiratory nurse specialist
- Is there a policy for referrals, agreed with respiratory physicians and nurse specialists?

Audit dataset for outcomes for A&E asthma management	
Audit point	Output from audit
Triage time and category	Overall % of patients in appropriate triage category* and treated with steroid tablets and % treated within one hour of attendance
Time of administration of systemic corticosteroids taken with time of triage, to allow calculation of the time interval)	
Referral to respiratory clinic	% of cases not already attending, who are referred to respiratory clinic
Referral to respiratory nurse specialist for self management training	% of all cases referred to respiratory nurse specialist for self-management training

* Different departments may use different triage systems; these reports should refer to patients judged to be unwell with acute asthma and should exclude those attending because they have run out of inhaled treatment and who are not judged to have any sign of poorly controlled asthma

Annex 9 (continued)

Audit points for hospital inpatients with asthma

Organisational level

- Are acute asthma patients triaged to the care of respiratory physician, either on admission or within 24 hours?
- If not, is there a hospital wide protocol for the care of asthma patients, agreed with respiratory physicians?
- Is there a respiratory nurse specialist?
- Do they have time to see inpatients before they are discharged?
- Are stamps, proformas or integrated care pathways used to collect relevant details of admission and discharge plans (including dataset items)?
- Is there an outpatient programme for teaching self-management skills to those who have had a recent hospital admission?

Audit dataset for hospital inpatients with asthma

Audit point	Output from audit
See BTS/BPRS audit datasets (www.brit-thoracic.org.uk) Hospital activity analysis data on readmission within two months % of patients with acute asthma managed by respiratory specialists	<ul style="list-style-type: none"> ● A comparison of key items of process of care with national data ● % of patients readmitted within two months ● % of patients managed by respiratory physicians

Annex 10

