Background

In 1990, as a result of an initiative by the British Thoracic Society, the Research Unit of the Royal College of Physicians of London, the King's Fund Centre, and the National Asthma Campaign, guidelines for the management of asthma in adults were published. These were produced by a group of respiratory and general physicians and general practitioners and modified after wide circulation and discussion within the British Thoracic Society.

The guidelines were intended to be reviewed and revised after two years. Such revision has now taken place and the opportunity has been taken to invite the British Paediatric Association and the British Paediatric Respiratory Group to include guidance on the management of asthma in children. The guidelines have also benefited from input from the British Association for Accident and Emergency Medicine, the Royal College of General Practitioners and the General Practitioners in Asthma Group.

To ensure a spread of opinions half of the previous working party was randomly retired and replaced by new members representing a similar geographic and academic or clinical background.

Participants
Asthma in adults:
Professor PJ Barnes,* AH Barnett, RAL Brewis, PS Burge, RA Clark,* D Costain,† GK Crompton,* SR Durham, P Ebden, BDW Harrison,† JPR Hartley,* SR Hilton,*‡ Professor ST Holgate,† WF Holmes, A Hopkins,† DJ Lane, ER Neville,* R Neville,* RL Page, MR Partridge,† MG Pearson,* Professor NB Pride, M Rudolf,* DE Stableforth,* JGB Thurston§
Asthma in children:
W Lenney,† J Price,* Professor JO Warner,* R Clifford,* R Campbell,* T Liscombe, J Williams, G Russell, M Levy,** P McCarthy,* N Barnes,* M Silverman,* S MacKenzie,* C Nourse

*Prepared background paper; †coordinator; ‡representative of Royal College of General Practitioners; §representative of British Association for Accident and Emergency Medicine; **representative of General Practitioners in Asthma Group.

Introduction

SCOPE OF THE GUIDELINES

This statement represents an updating of the papers on managing asthma in adults originally published in the *British Medical Journal* in 1990[1 2] and takes account of the paediatric papers published in the *Archives of Disease in Childhood* in 1989[3] and 1992.[4] The opportunity has also been taken to consider the recently published international consensus report on the diagnosis and management of asthma.[5] Parts of this lengthier and well referenced publication that are relevant to British practice have been incorporated into this revised statement.

The revision incorporates new treatments not considered in 1990 and clearer descriptions of what represents control of asthma, and emphasises guided self management. The stepwise approach to managing asthma has been retained and revised and is presented in a way that emphasises the importance of the stepping down of treatment. A series of charts summarising the main recommendations forms an integral part of this report. These charts are intended to form the basis of reminder cards or posters for use in general practice, hospital wards, and accident and emergency departments.

There are many similarities between childhood and adult asthma. Whenever possible recommendations have been combined or separate paediatric tables have been incorporated in the text. A separate section highlights the main differences characterising asthma in children and especially management in the very young.

Where there is uncertainty this has been indicated and areas requiring further research outlined.

Asthma mortality and morbidity are unacceptably high. Many deaths and much unnecessary morbidity have been associated with overreliance on bronchodilators, with underuse of inhaled and oral corticosteroid treatment and a failure to make objective measurements of severity, and with inadequate supervision.

These recommendations promote greater use of inhaled anti-inflammatory drugs, even in patients with apparently mild asthma; objective monitoring of progress based on the patient's own measurements of peak expiratory flow where possible; and greater participation of the patient or parents in the management of the condition.

DESCRIPTION OF ASTHMA

Asthma is a common and chronic inflammatory condition of the airways whose cause is not completely understood. As a result of inflammation the airways are hyperresponsive and they narrow easily in response to a wide range of stimuli. This may result in coughing, wheezing, chest tightness, and shortness of breath and these symptoms are often worse at night. Narrowing of the airways is usually reversible, but in some patients with chronic asthma the inflammation may lead to irreversible airflow obstruction.

Characteristic pathological features include the presence in the airway of inflammatory cells, plasma exudation, oedema, smooth muscle hypertrophy, mucus plugging, and shedding of epithelium. These changes may be present even in patients with mild asthma when they have few symptoms. The underlying pathology of asthma in preschool children may be different from that in older patients. There is no evidence that these individuals have appreciable bronchial hyperreactivity or that chronic inflammation is the basis for the episodic asthma associated with viral infections.

1

Chronic asthma in adults and children

Aims of management

- To recognise asthma
- To abolish symptoms
- To restore normal or best possible long term airway function
- To reduce the risk of severe attacks
- To enable normal growth to occur in children
- To minimise absence from school or work.

Principles of management

- Patient and family participation
- Avoidance of identified causes where possible
- Use of the lowest effective doses of convenient medications minimising short and long term side effects.

Participation by patients

Management of asthma requires a partnership between the patient and family and the health professional. It should be made clear from the outset that treatment and supervision are likely to be required over a prolonged period. Education means the sharing of information and the acquisition by the patient and family of understanding and skills. But this will result in an appropriate change in behaviour only if patients and family are given adequate opportunity to express any fears or concerns, and time to discuss their expectations of both the condition and its treatment. Patients and parents require both verbal and written advice and many will require guided self management plans (see below), so that the patient can keep well and adjust treatment according to a plan developed with the doctor.

Treatment

As asthma is a chronic inflammatory condition anti-inflammatory treatment should be given to most patients. Treatment should be considered in a stepwise manner as shown in charts 1 (adults) and 2 (children). A short "rescue" course of corticosteroid tablets may be needed at any time and at any step to gain control of the asthma (see box).

MANAGEMENT OF CHRONIC ASTHMA IN ADULTS

A stepwise approach to management is taken (see chart 1 overleaf). Patients should start treatment at the step most appropriate for the initial severity of their condition. Progression to the next higher step is indicated when control cannot be achieved at the current step and there is assurance that medication is being used correctly.

Avoidance

- Beta blockers (tablets and eye drops) are contraindicated in patients with asthma.
- If aspirin and non-steroidal anti-inflammatory drugs are known to induce asthma in an individual they should be avoided.
- Allergens (for example, house dust mites, domestic pets, and pollens) should be considered and avoided where relevant.
- Occupational causes of asthma must be considered.
- Active smoking should be avoided.
- Passive smoking should be avoided.
- It is preferable to adjust treatment to cover exposure to day to day triggers, such as exercise and cold air, because avoidance generally imposes inappropriate restrictions on lifestyle.

RESCUE COURSES OF STEROID TABLETS

"Rescue" courses of steroid tablets may be needed to control exacerbations of asthma at any step. Indications may include the following:

- Symptoms and peak expiratory flow (PEF) get progressively worse day by day
- PEF falls below 60% of patient's best
- Sleep is disturbed by asthma
- Morning symptoms persist until midday
- There is a diminishing response to inhaled bronchodilators
- Emergency use is made of nebulised or injected bronchodilators.

Method

In adults give 30-60 mg of prednisolone immediately. Continue this dose each morning until two days after control is re-established. The drug may then be stopped or the dose tapered. In children a dose of 1-2 mg/kg body weight should be used for one to five days; no tapering of this dose is needed.

Chart 1 Management of chronic asthma in adults

- Avoidance of provoking factors where possible
- Patient's involvement and education
- Selection of best inhaler device
- Treatment stepped up as necessary to achieve good control
- Treatment stepped down if control of asthma good

Note
Patients should start treatment at the step most appropriate to the initial severity. A rescue course of prednisolone may be needed at any time and at any step

Prescribe a peak flow meter and monitor response to treatment

Step 1:

Occasional use of relief bronchodilators

Inhaled short acting β agonists "as required" for symptom relief is acceptable. If they are needed more than once daily move to step 2.
Before altering a treatment step ensure that the patient is having the treatment and has a good inhaler technique. Address any fears.

Step 2:

Regular inhaled anti-inflammatory agents

Inhaled short acting β agonists as required
plus:
beclomethasone or budesonide 100-400 μg twice daily. Alternatively use cromoglycate or nedocromil sodium, but if control is not achieved start inhaled steroids.

Step 3:

High dose inhaled steroids

Inhaled short acting β agonists as required
plus:
beclomethasone or budesonide increased to 800-2000 μg daily via a large volume spacer.
Alternatives
In a few patients who experience problems with high dose inhaled steroids (see notes) inhaled long acting β agonists or sustained release theophylline may be added to step 2 medication. Cromoglycate or nedocromil may also be tried.

Step 4:

High dose inhaled steroids and regular bronchodilators

Inhaled short acting β agonists as required with inhaled beclomethasone or budesonide (800-2000 μg daily via a large volume spacer)
plus:
a sequential therapeutic trial of one or more of:
- inhaled long acting β agonists
- sustained release theophylline
- inhaled ipratropium or oxitropium
- long acting β agonist tablets
- high dose inhaled bronchodilators
- cromoglycate or nedocromil

Step 5:

Addition of regular steroid tablets

Inhaled short acting β agonists as required with inhaled beclomethasone or budesonide (800-2000 μg daily via a large volume spacer) and one or more of the long acting bronchodilators
plus:
regular prednisolone tablets in a single daily dose

Stepping down

Review treatment every three to six months. If control is achieved a stepwise reduction in treatment may be possible.
In patients whose treatment was recently started at step 4 or 5 or included steroid tablets for gaining control of asthma this reduction may take place after a short interval. In other patients with chronic asthma a three to six month period of stability should be shown before slow, stepwise reduction is undertaken (see notes).

Outcome of steps 1-3: control of asthma

- Minimal (ideally no) chronic symptoms, including nocturnal symptoms
- Minimal (infrequent) exacerbations
- Minimal need for relieving bronchodilators
- No limitations on activities including exercise
- Circadian variation in peak expiratory flow (PEF) <20%
- PEF ≥80% of predicted or best
- Minimal (or no) adverse effects from medicine

Outcome of steps 4 and 5: best results possible

- Least possible symptoms
- Least possible need for relieving bronchodilators
- Least possible limitation of activity
- Least possible variation in PEF
- Best PEF
- Least adverse effects from medicine

Adapted from poster designed by Business Design Group

Notes on treatment of chronic asthma in adults

Step 1
Short acting bronchodilators – for example, salbutamol or terbutaline – should be used "as required" rather than regularly and taken wherever possible by the inhaled route. Concern has been expressed about the regular use of short acting bronchodilators. Our recommendation that these should be used for relieving symptoms and, where necessary, before exercise (rather than regularly) is in keeping with the report of the β Agonist Working Party.[6] Selection of inhaler devices is as important as selection of drugs and should be made in conjunction with the patient.

Step 2
Anti-inflammatory agents should be started if a patient requires inhaled bronchodilators more than once daily, or in the presence of night time symptoms. To gain initial control a higher or more frequent dosage of inhaled steroid may be necessary, but once symptoms and peak flow have improved the dose should be reduced to the minimum that maintains control. Some patients benefit from doubling the dose of inhaled steroid for a short period to cover a respiratory infection. If cromoglycate or nedocromil sodium is begun, and control not achieved after a trial at full dose, the patient should start inhaled steroids before moving to step 3.

Step 3
Before the treatment is altered at any step it is important to ensure that drugs are being used (for example, by monitoring prescriptions), to check inhaler technique, and to review possible precipitating factors. Any fears or concerns that the patient may have about the treatment must be explored and addressed. If control of asthma (as defined above) is not achieved by standard doses of inhaled steroids higher doses may be used. The higher dose of inhaled steroid should be taken through a large volume spacer device (for example, Nebuhaler or Volumatic) to reduce oropharyngeal impaction and the subsequent swallowing of the steroid. Mouth rinsing may further reduce this risk. Inhaled steroids are occasionally associated with local problems such as candidiasis, voice change, and throat irritation. Very high doses may be associated with systemic effects, such as skin thinning and bruising. Suppression of the hypothalamic-pituitary axis is extremely unusual in adults having up to 1500 μg/day of beclomethasone or budesonide. It is very difficult to obtain a clear picture of the likelihood of systemic effects in studies on patients because many have also had steroid tablets. A current area of interest concerns the possible effect of inhaled steroids on bones and some studies in normal subjects and in patients with asthma have suggested a differential effect between steroid aerosol preparations when over 1500 μg/day is used in adults. The reported differences between preparations are small, however, and may not be relevant. Further long term research in patients with asthma is required before a preference can be stated. Further research is also needed to determine the role of inhaled long acting β agonists. At the present time their major role is as a twice daily treatment in step 4 but their use may be an alternative to increasing the dose of inhaled steroid in those having problems with this treatment. In a few patients night time symptoms are disproportionately prominent despite otherwise well documented good control on steps 2 and 3. In these patients sustained release theophylline at night, inhaled long acting β agonists at night, or sustained release oral β agonists at night may be considered.

Step 4
A therapeutic trial may be needed of one or more of: sustained release theophylline,inhaled long acting β agonists, anticholinergic agents, sustained release oral β agonists, and high dose bronchodilators. High doses of inhaled bronchodilators should be considered only if the patient does not respond to standard doses. β Agonists and anticholinergic agents can be given from prediluted phials through a nebuliser (for example, salbutamol 2.5 mg, terbutaline 5 mg, ipratropium 0.5 mg). The use of nebulisers without proper assessment and supervision is potentially dangerous. The guidelines for the safe use of nebulised bronchodilators are summarised in the box on page 6. As an alternative to the use of a nebuliser high doses of bronchodilators may be given by multiple actuations of a metered dose inhaler with a large spacer device. Cromoglycate or nedocromil sodium may be also be tried at this stage.

Step 5
Continue high dose inhaled steroids in addition to regular prednisolone tablets. In exceptional cases doses of inhaled steroids greater than 2000 μg may be used. These patients should normally be referred to a hospital asthma clinic, where additional measures may be considered.

Outcome

Steps 1-3: control of asthma

- Minimal (ideally no) chronic symptoms, including nocturnal symptoms
- Minimal (infrequent) exacerbations
- Minimal need for relieving bronchodilators
- No limitations on activities, including exercise
- Circadian variation in PEF <20%
- PEF ≥80% of predicted or best
- Minimal (or no) adverse effects from medicine

Steps 4-5: best results possible

- Least possible symptoms
- Least possible need for relieving bronchodilators
- Least possible limitation of activity
- Least possible circadian variation in PEF
- Best PEF
- Least adverse effects from medicine

Other measures

- Antihistamines, including ketotifen, have proved disappointing in clinical practice.
- Antibiotics have no place in the management of uncomplicated asthma.
- Immunosuppressive drugs (for example, cyclosporin, methotrexate) remain under investigation but have no clear place in routine treatment.
- There is anecdotal evidence that some patients have benefited from the use of ionisers, acupuncture, homeopathy, and other complementary treatment; but results of controlled clinical trials have so far been disappointing. Conventional treatment must be continued if these treatments are tried.

GUIDELINES FOR GIVING REGULAR NEBULISED BRONCHODILATORS

Initial assessment

Before nebulised bronchodilators are considered:

- The diagnosis should be reviewed and confirmed.
- Other methods of drug administration should be explored.
- Patients should be complying with anti-inflammatory treatment.
- Increased bronchodilatation without unacceptable side effects should be shown.
- An initial home trial for three weeks with monitoring of peak expiratory flow should be undertaken.

Supervision

- Oral and written instruction should be given to the patient on the method and frequency of use, the action to be taken in the event of worsening asthma, and when to attend for follow up.
- Supervision should normally entail attendance at an asthma clinic or home visits by a trained asthma nurse or physiotherapist.
- Supervision should include evaluation of peak expiratory flow, monitoring of prescriptions, and twice yearly servicing of the compressor.

- Hyposensitisation (immunotherapy) is not indicated in the management of asthma.
- Acaricides are effective in controlling numbers of mites but have not been shown to produce clinically relevant benefit.

MANAGEMENT OF CHRONIC ASTHMA IN CHILDREN

Childhood asthma is common and continues to be underdiagnosed and undertreated. Symptoms develop in 50% of children with asthma by the age of 3 and in 80% by the age of 5 years. The symptoms may subside only to reappear in adolescence or adult life. Diagnosis and the continuing management of most children will necessarily be the responsibility of general practitioners. Asthma clinics run by practice nurses trained in respiratory medicine may be beneficial but many nurses have little or no paediatric experience and this problem needs to be addressed. Adolescence is an important period for those with asthma, and for those attending hospital clear handover arrangements should exist in each district to facilitate transfer of responsibility from paediatricians to respiratory physicians.

Clues to the diagnosis of childhood asthma

- A family history of asthma or atopy
- Repeated wheeze
- A cough – especially if recurrent or persistent
- Night time disturbance by wheeze or cough
- Symptoms precipitated by viral infections; exercise or excitement; family emotional disturbances; potential allergens such as those associated with pets, pollens, dust, or feathers; cigarette smoke

Lack of therapeutic response may indicate other diagnoses, such as an inhaled foreign body or chronic obliterative bronchiolitis.

Environmental control

General practitioners are in the best position to observe and modify environmental triggers, one of the most important being parental, especially maternal, smoking.

Tobacco smoke Smoking in pregnancy increases the likelihood of asthma in children. Asthma is more severe and lung function worse in children whose parents smoke. Parents' smoking increases the number of respiratory infections in childhood. Tobacco companies continue to target young people with their advertising policies. Government legislation is needed.

Allergy The principal method of identifying allergy is by clinical history. Skinprick tests and in vitro specific IgE measurements are

rarely helpful in diagnosis and management and results should be interpreted by a physician familiar with such tests. Acaricides reduce numbers of house dust mites but have shown little clinical benefit in studies. Elimination of animal danders is difficult. No pet should be allowed to sleep in a child's bedroom. Families should be discouraged from acquiring furry or feathered pets.

The benefits of immunotherapy remain unproved.

Treatment

Checklist for assessing outcome of asthma treatment:

- Days off school from asthma since last visit
- Amount of daytime and night time cough and wheeze
- Limitation of activity
- Frequency of relief medication
- Appropriateness of inhaler for age and whether inhaler technique is good
- Whether family understands how and when PEF measurement should be used in children of 5 years and over
- Whether children or parents know that medications must be varied according to symptoms or PEF recordings or both
- Whether treatment changes are advised in writing – for example, on a National Asthma Campaign card
- Whether child or family knows when to call for help
- Whether height and weight velocities are documented

Inhaler devices in childhood

The most common reason for failure of inhaled drugs in children is inappropriate selection or incorrect use of an inhaler. The box indicates which devices are suitable according to age and gives some suggested dosages.

INHALER DEVICES IN CHILDHOOD

	Relief	Prevention
0 - 2 years		
Large volume spacer + face mask (MDI)	Ipratropium up to 200 µg Salbutamol up to 1 mg Terbutaline up to 2.5 mg	Cromoglycate (5 mg) 10 mg tds Beclomethasone 50–200 µg bd Budesonide 50–200 µg bd
Coffee cup (MDI)	Ipratropium up to 200 µg Salbutamol up to 1 mg Terbutaline up to 2.5 mg	
Nebuliser	Ipratropium 0. 25 mg Salbutamol 2.5 mg Terbutaline 5 mg	Cromoglycate 20 mg tds Budesonide 500 µg bd
3 - 4 years		
Large volume spacer (MDI)	Salbutamol up to 2 mg Terbutaline up to 5 mg	Cromoglycate (5 mg) 10 mg tds Beclomethasone 50-200 µg bd Budesonide 50-200 µg bd
Nebuliser	Salbutamol 2.5–5 mg Terbutaline 5–10 mg	Cromoglycate 20 mg tds Budesonide 500 µg bd
5 years and above		
Autohaler Diskhaler or Rotahaler Spinhaler Turbohaler	Salbutamol 100 µg Salbutamol 200–400 µg Terbutaline 500 µg	Beclomethasone 50-200 µg bd Cromoglycate 20 mg tds Budesonide 50-200 µg bd

Notes

- When large volume spacers are used actuate the metered dose inhaler (MDI), breathe in one puff, repeat the actuation, then breathe in the second puff. Continue until the appropriate number of puffs has been inhaled.
- The doses of relief medication for the 0-2 and 3-4 year age groups are maximal doses. Often smaller amounts will suffice.
- Some children under 5 years can inhale powdered drugs, especially with the Turbohaler or Diskhaler.
- Some children receiving powdered drugs for prevention need an MDI plus large volume spacer device for relief treatment.
- Relief treatment outside hospital can be repeated 2-4 hourly but failure to respond or early deterioration requires immediate medical assessment.
- Most children cannot achieve the coordination necessary to use an unmodified MDI; this should not be used unless there is certainty about the child's technique.
- Nebulisers are overused both in hospital and in the community. They are expensive, time consuming, and inefficient. They may often be replaced by large volume spacer devices.
- Every child given inhaled steroids from an MDI should use a large volume spacer to enhance deposition of the medication in the lungs.

Stepwise management of chronic asthma in childhood

A stepped plan has been devised similar to that for adults (see chart 2, p10). Children should start treatment at the step most appropriate to the severity of their condition. Before treatment is stepped up it is vital to ensure that the child is using an inhaler appropriate to his or her age, that the inhaler technique is good, and that parents fully understand the principles of management.

The outcome of successful management should be minimal symptoms during the day and no waking at night. The child should not miss playgroup, nursery, or school; should participate fully in activities and sports; and should require relatively infrequent relief medications.

Inhaled steroids and growth

Inhaled steroids are the mainstay of preventive treatment, combining effectiveness, relative freedom from side effects, and the convenience of twice daily treatment. There is no convincing evidence in children of any important differences between the currently available preparations either in their duration of action or in their side effects. Use the lowest dose that provides acceptable control of symptoms. Asthma itself delays growth and puberty but eventually catch up growth occurs. The inaccuracy of measurements of height and the delay in growth caused by asthma itself make it very difficult to draw conclusions about the effect of medications on growth suppression. Short term reductions in tibial growth rate have been shown when inhaled steroids are used at doses greater than 400 μg/day. These short term reductions cannot be extrapolated to the long term.

Management in very young children (0-2 years)

Particular problems in this age group:

- Recurrent wheeze and cough are associated with viral respiratory infections, often without a family history of asthma or atopy.
- Diagnosis relies almost entirely on symptoms, which may be very variable, rather than on objective lung function tests.
- There is a paucity of suitably designed and tested inhaler devices specific for this age group.
- Very few controlled trials of treatment have been carried out.
- The bronchodilator response is variable in the first year of life but bronchodilators should still be tried.
- The younger the child the more other disorders may mimic asthma, such as gastro-oesophageal reflux, cystic fibrosis, inhaled foreign body, congenital abnormalities, and chronic lung disease of prematurity.

Therapeutic differences in very young children

Nebulised drugs in infancy may result in initial paradoxical bronchoconstriction. Wherever possible treatment should be attempted with a metered dose inhaler with a large volume spacer and face mask. For infants unable to tolerate a face mask an MDI with a polystyrene coffee cup may be effective for administering relief treatment only. Anecdotal evidence suggests that ipratropium bromide may be more effective than salbutamol in the first year of life. There have been no controlled studies. Inhaled budesonide via the Nebuhaler and face mask has been used successfully in children under 18 months of age. Although doubts exist about the efficacy of ketotifen in older children, some benefits have been shown in infancy and it may be of some help in very young children intolerant of other drugs.

GUIDELINES FOR SELF MANAGEMENT OF ASTHMA IN ADULTS AND CHILDREN

1 Patients or parents should be enabled to manage treatment rather than be required to consult the doctor before making changes.

2 Patients, parents, and carers should have a relevant understanding of the nature of asthma and its treatment. This includes:

- Training in the proper use of inhaled drugs and the use of a peak flow meter (where appropriate)
- Knowledge of the difference between bronchodilators ("relievers") and anti-inflammatory treatment ("preventers")
- Instruction to ensure recognition of signs that asthma is worsening and especially awareness of the importance of nocturnal symptoms and changes in peak expiratory flow

3 Patients and family should be given adequate opportunity to express their expectations of treatment and to hear how far those expectations can be met. They should have a balanced view of the possible side effects of the treatments.

4 Education and training are the responsibility of the doctor. The process can be shared with specially trained nurses, pharmacists, or physiotherapists. Advice should be consistent and repeated, and supported by personalised written guidance. The patient and family should be acquainted with the resources of the National Asthma Camaign.

5 Patients who have required, or who are likely to require, a course of systemic corticosteroids should be encouraged to initiate or increase doses of oral or inhaled corticosteroids themselves in specified prearranged circumstances, as outlined in a self management plan.

6 The three elements of a self management plan are:
(*a*) monitoring of symptoms, peak flow, and drug usage, leading to
(*b*) the taking of prearranged action by the patient according to
(*c*) written guidance.

The plan should be carefully discussed with the patient and written down individually. Some cards are available for this purpose (for example, the National Asthma Campaign's adult and paediatric asthma cards). The key actions are:
- Initiation of or increase in inhaled steroid
- Self administration of steroid tablets when the peak flow falls below the level previously agreed for that individual or less than 60% of normal
- The urgent seeking of medical attention when treatment is not working.

The exact levels for action in an individual patient must be revised in the light of experience and records of peak flow monitoring.

7 Patients and parents should regard the plan of management as subject to a process of continuing but orderly review in which they play an active part. Review of a patient's progress at a prearranged visit to the doctor should inquire about:
- Symptoms–especially nocturnal symptoms
- Interference with normal activities (for example, absence from school or work)
- The patient's own record of treatment changes
- Peak flow recordings
- Understanding of management
- Inhalation skills
- Concerns about the condition and its treatment
- The action to be taken by the patient if signs of deterioration develop.

8 Doctors should give high priority to a request for help from a patient with asthma. Other health care workers should be aware that medical help may be required promptly in the event of worsening asthma.

SPECIALIST REFERRAL

Referral to a respiratory physician (adults)

Referral to a specialist is appropriate for:
1 Patients in whom there is doubt about the diagnosis – for example, the elderly and smokers with wheeze, in whom diagnosis may be difficult; those with unexplained persistent cough; and those with systemic symptoms (for instance, fever, rash, weight loss, or proteinuria) that might suggest associated disorders, such as systemic eosinophilia or vasculitis
2 Patients with possible occupational asthma
3 Patients who present a problem in management – for example:
- Those with catastrophic, sudden, severe (brittle) asthma
- Those with continuing symptoms despite high doses of inhaled steroids
- Those being considered for long term treatment with nebulised bronchodilators
- Pregnant women with worsening asthma
- Patients whose asthma is interfering with their lifestyle despite changes in treatment
- Patients who have recently been discharged from hospital.

Referral to a general paediatrician (children)

This will depend on the experience of the general practitioner. In general, it is appropriate when:
- The diagnosis is in doubt
- Asthma is unstable
- Asthma interferes with normal life despite treatment
- Parents or general practitioners need further support
- More than 400 μg/day of inhaled steroids are needed.

Referral to a specialist respiratory paediatrician (children)

This is appropriate:
- After a life threatening episode or admission to the intensive care unit or when asthma is very brittle
- When normal activity is severely restricted
- When special investigations are required
- When long term inhaled steroids are needed at a dose above 800 μg/day
- When oral steroids are required regularly or more frequently than four short courses a year.

The role of community paediatricians (children)

Community paediatricians are skilled in surveillance, disease prevention and health promotion. They should:
- Set up management structures to identify nursery and school children with recurrent respiratory symptoms and with repeated exercise induced or interval symptoms
- Instruct teachers to recognise such symptoms and develop plans for referral and assessment
- Ensure that school nurses obtain instruction from qualified respiratory nurses in inhaler technique (community physicians should ensure that they are appropriately trained as well)
- Promote and disseminate health communications such as those developed by the National Asthma Campaign
- Persuade teachers to allow children to carry and be responsible for their own inhalers
- Refer to asthma risk in discouraging smoking in pregnancy.

Chart 2

Management of chronic asthma in children

- Avoidance of provoking factors where possible
- Working towards a self management plan
- Selection of best inhaler device

Note
Patients should start treatment at the step most appropriate to the initial severity. A rescue course of prednisolone may be needed at any step (maximum daily dose 40 mg).

Prescribe a peak flow meter and monitor response to treatment where appropriate.

Step 1

Occasional use of relief bronchodilators

Short acting β agonists "as required" for symptom relief but not more than once daily.
Before altering a treatment step ensure that the patient is having the treatment, the inhaler is appropriate, and inhaler technique is good. Address any concerns or fears.

Step 2

Regular inhaled anti-inflammatory agents

Intermittent inhaled short acting β agonists as required ***plus***:
cromoglycate as powder (20 mg thrice daily) or via metered dose inhaler and large volume spacer (10 mg thrice daily).

Step 3

Inhaled steroids

Inhaled short acting β agonists as required ***plus***:
beclomethasone or budesonide 50–200 μg twice daily
Consider a 5 day course of soluble prednisolone 1–2 mg/kg/day or a temporary increase in inhaled steroids (double dose) for stabilisation.

Step 4

High dose inhaled steroids

Inhaled short acting β agonists as required ***plus***:
beclomethasone or budesonide increased to 400–800 μg daily via a large volume spacer or dry power device.
Consider short prednisolone course.
Consider adding regular twice daily long acting β agonist.

Step 5

a: High dose inhaled steroids and bronchodilators

Inhaled steroids (800 μg daily) and other treatment as in step 4.
Slow release xanthines or nebulised β agonists

b: Addition of regular steroid tablets
As in step 5a with the addition of alternate day low dose (5–10 mg) prednisolone
Consider regular ipratropium or subcutaneous infusion of a β agonist.

Stepping down

Regularly review the need for treatment.
In older children use a peak flow record to assess the speed of withdrawal. Stop regular anti-inflammatory treatment after 6–12 months of few or no symptoms.
If symptoms are seasonal consider stopping anti-inflammatory drugs at the end of the season.

Adapted from poster designed by Business Design Group

Notes on the management of chronic asthma in children

Step 1
Use inhaled drugs wherever possible. Bronchodilator syrups are much less effective than inhaled ß agonists and have more systemic side effects.

Step 2
Cromoglycate is safe and helpful in many children and is still recommended as first line preventive treatment. A therapeutic trial of 4–6 weeks is indicated before the child progresses to step 3. Use an age appropriate delivery system chosen by the patient or family. Give instructions on inhaler technique and supply the child with a peak flow meter where appropriate.

Step 3
Start an inhaled steroid at a dosage appropriate to the child's age and size and the severity of the asthma (50–200 µg twice daily). It may be necessary to start at a higher dose or to give a short course of prednisolone tablets for stabilisation (1–2 mg/kg/day for one to five days – maximum daily dose 40 mg). After one month assess the effect on symptoms and/or peak flow readings and adjust the dose. When a child inhales from a metered dose inhaler he or she should always use a large volume spacer to increase lung deposition. To reduce absorption of steroids deposited in the mouth teach children to rinse out their mouth after inhalation. Cleaning the teeth is equally effective.
If control is not adequate consider doubling the dose of inhaled steroid for one month. Alternatively give a short course of prednisolone tablets, or consider introducing other treatments before increasing the inhaled steroid for prolonged periods.

Step 4
Inhaled long acting β agonists produce bronchodilatation in children for up to 12 hours, inhibit exercise induced bronchoconstriction and protect against methacholine challenge for a similar length of time. More information about their long term clinical effects is awaited. It seems likely that their role should be reserved for supplementing treatment in children already receiving anti-inflammatory drugs.

Step 5
Sustained release xanthines produce effective bronchodilatation but have appreciable side effects in up to one third of paediatric patients (gastrointestinal disorders, sleep disturbance, and psychological changes). They may be helpful, particularly for nocturnal symptoms, but monitoring of serum or salivary concentrations is recommended. Similar clinical improvements have been shown with sustained release preparations of salbutamol and this treatment has fewer side effects.

Stepping down
Review treatment every few months. If symptoms are minimal a reduction in treatment may be possible. A diary score card and peak flow measurements may be helpful in the step down period.

Management in very young children (0-2 years)

Particular problems in this age group:

- Recurrent wheeze and cough are associated with viral respiratory infections, often without a family history of asthma or atopy.
- Diagnosis relies almost entirely on symptoms, which may be very variable, rather than on objective lung function tests.
- There is a paucity of suitably designed and tested inhaler devices specific for this age group.
- Very few controlled trials of treatment have been carried out.
- The bronchodilator response is variable in the first year of life but bronchodilators should still be tried.
- The younger the child the more other disorders may mimic asthma, such as gastro-oesophageal reflux, cystic fibrosis, inhaled foreign body, congenital abnormalities, and chronic lung disease of prematurity.

Therapeutic differences in very young children

Nebulised drugs in infancy may result in initial paradoxical bronchoconstriction. Wherever possible treatment should be attempted with a metered dose inhaler with a large volume spacer and face mask. For infants unable to tolerate a face mask an MDI with a polystyrene coffee cup may be effective for administering relief treatment only. Anecdotal evidence suggests that ipratropium bromide may be more effective than salbutamol in the first year of life. There have been no controlled studies. Inhaled budesonide via the Nebuhaler and face mask has been used successfully in children under 18 months of age. Although doubts exist about the efficacy of ketotifen in older children, some benefits have been shown in infancy and it may be of some help in very young children intolerant of other drugs.

2

Acute severe asthma in adults and children

This section is presented in the form of directions designed to help doctors attending patients with exacerbations of asthma in the home, in the accident and emergency department, and in hospital. The severity of an attack of acute asthma is often underestimated by patients, their relatives and their doctors, largely because of failure to make objective measurements. If not recognised or not treated appropriately such attacks can be fatal.

Aims of management

- To prevent death
- To restore the patient's clinical condition and lung function to their best possible levels as soon as possible
- To maintain optimal function and prevent early relapse

RECOGNITION AND ASSESSMENT IN ADULTS (chart 3, p20)

FEATURES OF SEVERE ASTHMA

- Too wheezy or breathless to complete sentences in one breath
- Respiratory rate ≥25 breaths/min
- Heart rate ≥110 beats/min
- PEF ≤50% of predicted normal or best

LIFE THREATENING FEATURES

- PEF <33% of predicted normal or best
- A silent chest, cyanosis, or feeble respiratory effort
- Bradycardia or hypotension
- Exhaustion, confusion, or coma

Arterial blood gas tensions

Arterial blood gas tensions should always be measured in patients with acute severe asthma who are admitted to hospital. The following are markers of a very severe, life threatening attack:

- A normal (5–6 kPa) or high arterial carbon dioxide tension ($PaCO_2$) in a breathless asthmatic patient
- Severe hypoxia: arterial oxygen tension (Pao_2) <8 kPa irrespective of treatment with oxygen
- A low pH value (or high H^+)

Peak expiratory flow

Measurements of peak expiratory flow are most easily interpreted when expressed as percentages of the predicted normal value (see chart, page 13) or of the best obtainable value for the individual with optimal treatment. If neither of these is known the doctor must take decisions on the basis of the absolute value recorded, remembering that normal values vary with age, sex, and height (older people, women, and shorter people have a lower normal range). Values expressed as percentages of the predicted normal are not useful in patients with chronically impaired lung function. No other investigations are needed for immediate management.

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 a doctor.

Immediate treatment

Begin the following AT ONCE:

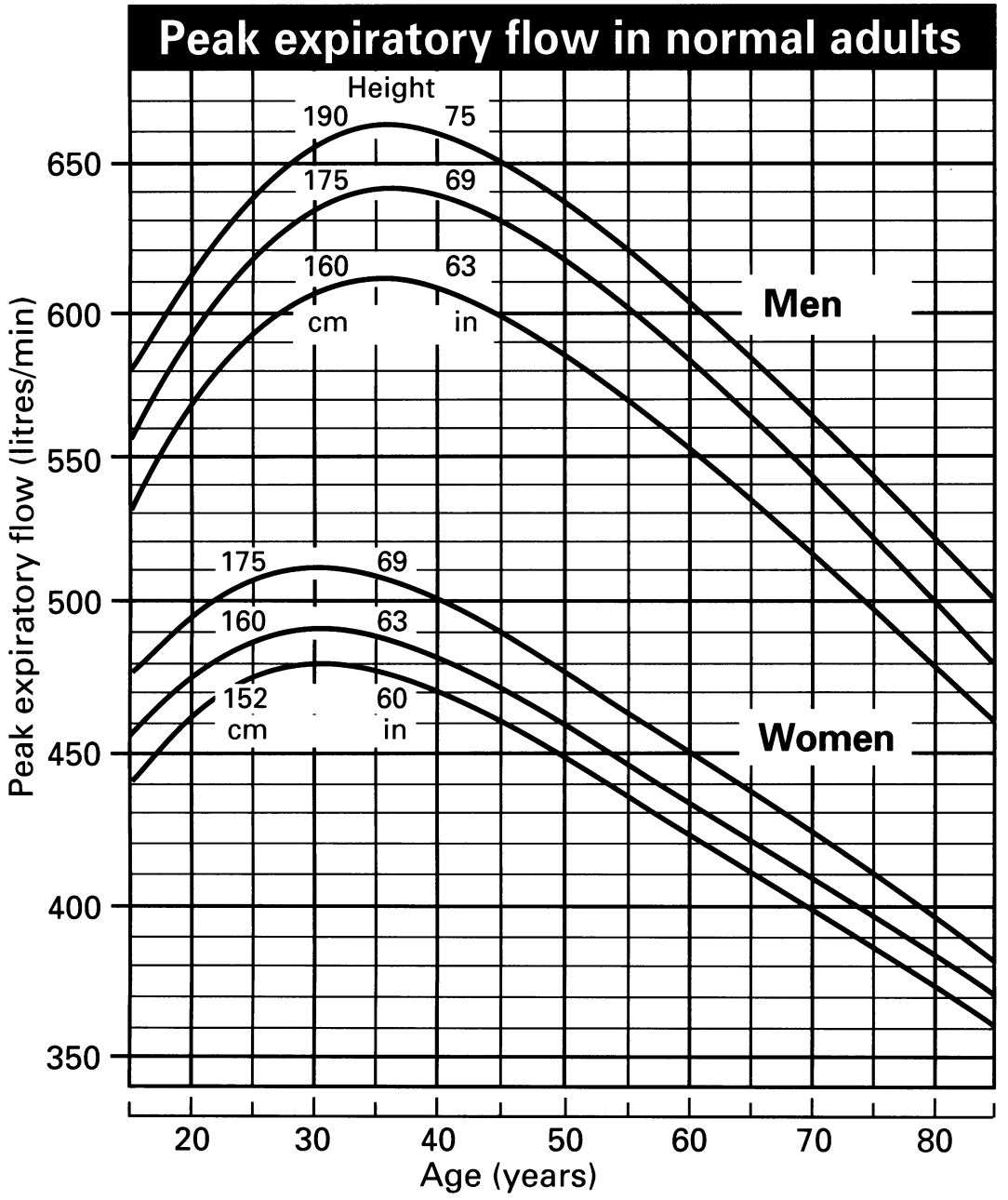
Oxygen Use the highest concentration available and set a high flow rate. Carbon dioxide retention is not aggravated by oxygen therapy in asthma; thus 24% or 28% oxygen is inappropriate.

High doses of inhaled β agonists Give β agonist for inhalation (salbutamol 5 mg or terbutaline 10 mg). This may be nebulised with oxygen (in hospital and during transport by ambulance), nebulised with an air compressor (in general practice), or – if neither method is available – given by multiple actuations of a metered dose inhaler into a large spacer device (two puffs 10–20 times)

High doses of systemic steroids Give prednisolone 30–60 mg or intravenous hydrocortisone 200 mg, or both, immediately.

If life threatening features are present:

- Add ipratropium (0.5 mg) to the nebulised β agonist.
- Give intravenous aminophylline (250 mg over 20 minutes) or salbutamol or terbutaline (250 μg over 10 minutes). Do not give bolus aminophylline to patients already taking oral theophyllines.



From: Gregg I, Nunn AJ. *BMJ* 1989; **298:** 1068-70

CRITERIA FOR IMMEDIATE REFERRAL TO HOSPITAL

- Any life threatening features
- Any features of a severe attack that persist after initial treatment
- Peak expiratory flow 15-30 minutes after nebulisation <33% of predicted or best value

A lower threshold for admission is appropriate in patients:

- Seen in the afternoon or evening rather than earlier in the day
- With recent onset of nocturnal symptoms or worsening of symptoms
- Who have had previous severe attacks, especially if the onset was rapid
- In whom there is concern over their assessment of severity of symptoms
- In whom there is concern over the social circumstances or relatives' ability to respond appropriately

The box gives the criteria for immediate referral to hospital. Their use will lead to the admission of more patients. Patients not admitted continue to need close supervision over the next few days.

Subsequent management

Continuation of treatment

1 Ensure that a nurse or doctor stays with the patient for at least 15 minutes and certainly until clear improvement is seen.

2 Continue oxygen therapy.

3 Continue high doses of steroids: prednisolone tablets 30–60 mg daily (or intravenous hydrocortisone 200 mg every six hours in patients who are seriously ill or vomiting).

4 If the patient's condition is improving continue to give nebulised β agonist every four hours.

5 If the patient's condition has not improved after 15–30 minutes give nebulised β agonists more frequently (up to every 15 minutes) and add ipratropium bromide 0.5 mg to the nebuliser solution. Repeat the ipratropium six hourly until the patient is improving.

6 If progress is still unsatisfactory consider giving aminophylline or a parenteral β agonist:

(*a*) *Aminophylline infusion* (0.5–0.9 mg/kg/h). If the weight of the patient is unknown doses can be estimated from the patient's size (small patients 750 mg/24 h, large patients 1500 mg/24 h). No loading dose is required unless the patient's condition is deteriorating. Lower doses may be needed in patients with liver disease or heart failure and in those taking cimetidine and most quinolone and macrolide antibiotics. Higher doses are appropriate in smokers.

(*b*) *Salbutamol* (5 μg/min, range 3–2 μg/min) or terbutaline infusion (1.5–5.0 μg/min). The rate of infusion should be adjusted according to the responses of the peak expiratory flow and heart rate.

Note

Nebulised ipratropium bromide and aminophylline or β agonist infusions are not needed in every patient. They are indicated in patients with initially very severe attacks and in those whose initial response to the other treatment is unsatisfactory.

Further investigations in hospital

- Arrange for chest radiography to exclude or show pneumothorax, consolidation, or pulmonary oedema.
- Arrange for measurement of plasma electrolyte and urea concentrations, a blood count, and in older patients electrocardiography.

Monitoring of treatment

1 Measure and record peak expiratory flow 15–30 minutes after starting treatment, and thereafter according to the response. Measure and record PEF before and after the nebulised or inhaled β agonist (at least four times daily) throughout the hospital stay.

2 Record oxygen saturation by oximetry. Maintain arterial oxygen saturation (Sa_{O_2}) above 92%.

3 Repeat measurement of blood gas tensions within two hours of starting treatment if

a) the initial Pa_{O_2} is below 8 kPa unless the Sa_{O_2} is above 92%

b) the initial Pa_{CO_2} is normal or raised; or

c) the patient's condition deteriorates. Measure them again if the patient's condition has not improved by 4–6hours.

4 Measure and record the heart rate.

5 Measure the serum theophylline concentration if aminophylline is continued for more than 24 hours (aim at a concentration of 55–110 μmol/l).

6 Measure serum potassium and blood glucose concentrations.

Unhelpful treatment

- Any sedation is contraindicated.
- Give antibiotics only if bacterial infection is present.
- Percussive physiotherapy is unnecessary.

Indications for intensive care

Patients with features of life threatening asthma require intensive monitoring by experienced staff. If no beds are available in a properly staffed medical ward this may be available only in an intensive care unit. Patients with the following features require intensive care:

- Deteriorating peak flow, worsening or persisting hypoxia (PaO_2 <8 kPa) despite 60% inspired oxygen or hypercapnia ($PaCO_2$ > 6 kPa)
- Onset of exhaustion, feeble respiration, confusion, or drowsiness
- Coma or respiratory arrest

Indications for intermittent positive pressure ventilation

Not all patients admitted to the intensive care unit need ventilation, but those with worsening hypoxia or hypercapnia, 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.

Management during recovery in hospital and after discharge

Duration of hospital stay
Patients should not normally be discharged until their symptoms have cleared and lung function has stabilised or returned to its normal or best level. This stage might be recognised by a peak expiratory flow above 75% of the predicted value or of their best level, a diurnal variability of below 25% (diurnal variability is equal to the highest peak expiratory flow minus the lowest peak expiratory flow divided by the highest peak expiratory flow and multiplied by 100 in each 24 hours), and no nocturnal symptoms. If these criteria are not met the patient should be seen while in hospital by a respiratory physician.

With the agreement and support of their general practitioner and respiratory physician some patients who are responding well and can be relied on to comply with treament may be discharged earlier provided that on discharge they are prescribed prednisolone tablets (30 mg daily or more) to be taken until for several consecutive days their peak flow has been above 75% of the best value and diurnal variation below 25%.

Changes in treatment before discharge
Treatment with inhaled steroids must be started at least 48 hours before discharge. Nebulisers should be replaced by standard inhaler devices 24–48 hours before discharge unless the patient requires a nebuliser at home. The inhaler technique should be checked and performance recorded. If necessary alternative inhaler devices should be used. In patients requiring oral xanthines blood theophylline concentrations should be monitored.

Drugs at discharge from hospital
All patients should be discharged taking:

- Prednisolone tablets (30 mg daily or more) for one to three weeks (or longer in some patients with chronic asthma) according to a written action plan.
- Inhaled steroids at a higher dosage than before admission
- Inhaled or nebulised β agonists for use "as necessary"
- Oral theophylline, long acting β agonists, or inhaled ipratropium if required

All patients should continue taking inhaled steroids and inhaled β agonists until the first hospital visit. Prednisolone may be stopped before this but must never be stopped, or the dose tailed, if the asthma is worsening.

Investigation of the circumstances of admission
In all cases ask:

- Was there an avoidable precipitating cause? An allergy history should be taken.
- Was this a catastrophic sudden attack or was there a period of recognisable deterioration before the "acute" attack?
- Did the patient (or relatives) react appropriately to worsening asthma?
- Was the patient complying with regular treatment, and if not why not?
- Was medical management appropriate?

Peak flow meter and self management plan
All patients should have a peak expiratory flow meter prescribed on discharge and be taught how to use it and how to act on the results. The admission to hospital provides an opportunity to educate patients about their asthma and train them to respond to changes in symptoms and peak expiratory flow. They should know at what values of peak expiratory flow to increase their treatment, call their doctor, or readmit themselves to hospital. All patients should have a written self management plan (see above).

Contact with a general practitioner
Good communication with the patient's practitioner is essential. Discharge letters are best delivered by hand. They should include the peak expiratory flow on admission and at discharge (recorded on the patient's meter) and details of treatment to be continued at home. Sometimes contact by telephone is important.

Follow up arrangements
All patients require follow up. They should see their general practitioner within a week of discharge. Hospital follow up should be by a respiratory physician, and the initial outpatient appointment should be within a month. Further management to enable the patient to lead a normal life and to prevent further severe attacks should follow that outlined for patients with chronic persistent asthma.

RECOGNITION AND ASSESSMENT IN CHILDREN (chart 4, p21)

FEATURES OF SEVERE ASTHMA

- Too breathless to talk
- Too breathless to feed
- Respiratory rate ≥50 breaths/min
- Heart rate ≥140 beats/min
- PEF ≤50% of best

LIFE THREATENING FEATURES

- PEF <33% of best
- Cyanosis,silent chest, or feeble respiratory effort
- Fatigue or exhaustion
- Agitation or reduced level of consciousness

Blood gas estimations are rarely needed and are not helpful in deciding initial management in children, but are indicated if a child is not responding or is deteriorating despite treatment.

Immediate treatment

- High flow oxygen via a face mask
- Salbutamol (5 mg) or terbutaline (10 mg) via an oxygen driven nebuliser (half doses in the very young)
- Prednisolone tablets 1–2 mg/kg body weight orally (maximum 40 mg)

In many children admitted to hospital the above treatment produces substantial improvement. Subsequent management in these cases may require only nebulised β agonists one to four hourly as necessary. In those with more severe asthma the following may be required:

- Nebulised salbutamol (0.15 mg/kg) up to half hourly
- Intravenous aminophylline (5 mg/kg over 20 minutes) followed by a maintenance infusion of 1 mg/kg/hour; omit the loading dose if the child is already taking oral theophyllines
- Intravenous hydrocortisone (100 mg six hourly)

Monitor by means of pulse oximetry and give supplemental oxygen to maintain saturation above 92%. Assess the need for intravenous fluids but do not overhydrate. Adding ipratropium 0.25 mg to the nebulised β agonists may be helpful. Chest radiographs are rarely helpful in acute asthma in children.

Indications for hospital admission

Hospital admission is indicated under the following circumstances:

- Failure to respond to or early deterioration after inhaled bronchodilators
- Inability of the child to take, or the parents to give, appropriate treatment
- Request for admission from the general practitioner
- Severe breathlessness and increasing tiredness
- Peak expiratory flow ≤50% of the expected value 10 minutes after treatment

SPECIAL POINTS ABOUT MANAGMENT OF ACUTE ASTHMA IN GENERAL PRACTICE (chart 5, p22)

Regard each case needing emergency consultation as acute severe asthma until it is shown to be otherwise and see the patient (adult or child) without delay.

Adults

Uncontrolled asthma, without the features of an acute severe or life threatening episode, requires increased treatment, including prednisolone 30–60 mg daily, if the PEF, after a nebulised β agonist, is >50–75% of the predicted or best. If the patient is treated at home the improvement requires objective confirmation before the doctor leaves. Patients should continue to monitor their peak flow and also require a self management plan and review in the surgery within 48 hours. Further management is as for chronic persistent asthma.

Children

Assessment is also required before, during and after treatment. Short acting β agonists administered with a metered dose inhaler (MDI) and a large volume spacer device may be as effective as nebulised β agonists. Give one puff every few seconds until improvement occurs (maximum 20 puffs). Use a face mask in very young children.

Terbutaline (2.5 mg) may be administered subcutaneously in severe episodes.

Oxygen is of benefit.

A child requiring high dose inhaled bronchodilators should also receive soluble prednisolone 1–2 mg/kg (maximum dose 40 mg) as a single dose repeated for up to five days as required. If no better after five days the child needs immediate referral to hospital.

Aminophylline should no longer be used in children at home.

MANAGEMENT OF PATIENTS PRESENTING TO AN ACCIDENT AND EMERGENCY DEPARTMENT (chart 6, p23)

Adults

Patients with asthma who present to an accident and emergency department may have asthma of any severity from very mild to extremely severe. They should be assessed soon after arrival. If the department is very busy and supervision of the patient cannot be guaranteed the medical registrar or senior house officer should be called at an early stage. These guidelines should be followed:

- If features of an acute severe attack are present recognise, assess, and manage the patient as outlined above and call the medical registrar or senior house officer to admit the patient.
- If the patient is unconscious or confused call the anaesthetist immediately and arrange admission to the intensive care unit; ensure uninterrupted administration of high flow oxygen; and do not attempt intubation until the most expert available doctor (ideally an anaesthetist) is present.
- If no features of an acute severe attack are present measure the peak expiratory flow and proceed as shown in chart 6.
- If the peak flow is 50% or less of the predicted value or of the patient's best result treat the patient as for a severe attack.
- In all other patients give inhaled or nebulised β agonist (see above for doses), and 30 minutes later measure the peak expiratory flow again.
- Before discharge determine why the patient attended the accident and emergency department. Such patients usually need extra care in their follow up. Ideally, contact the patient's general practitioner by telephone as soon as possible during surgery hours.

Children

- Take a careful history and examine the child. Most children over 5 years can use a peak flow meter.
- Note the peak flow reading as a percentage of the child's expected level in relation to height.
- Give inhaled bronchodilator by MDI and large volume spacer device if the child is not too distressed, or nebulised salbutamol or terbutaline (2.5 mg up to the age of 2, 5mg over the age of 2 years).
- Reassess 10 minutes later.

Admission criteria

The same as above.

Return to home

- If the child is fit for discharge give 1–2 mg/kg of soluble prednisolone for one to five days (maximum 40 mg/day). If vomiting occurs within one hour repeat that day's dose of prednisolone. Allow parents to decide the need to continue prednisolone after the first dose.
- Ensure that each child has a suitable delivery system (for example, a large volume spacer device and MDI) to give inhaled bronchodilator treatment at home.
- Give parents a written information sheet.
- Give parents a letter for the general practitioner and arrange who should follow up the child.

MANAGEMENT OF CATASTROPHIC SUDDEN, SEVERE (BRITTLE) ASTHMA

There is an unusual but important group of patients with asthma who are at great risk of sudden death. Their asthma may become severe within minutes or a few hours, despite little instability of the asthma in the preceding days. They are best handled by a management plan that is mutually agreed on by the patient, the general practitioner, and the consultant.

These patients should be constantly reviewed by a respiratory physician and carry a Medic-Alert bracelet or equivalent. They must also carry a β agonist and prednisolone at all times and have duplicate supplies of drugs for emergencies to be kept in their handbag, car glove compartment, office, etc. Provision of a resuscitation box and oxygen cylinder to be kept in the patient's home should be considered.

As soon as an attack starts the patient's mangement plan might be:

1 Call for help.

2 Inhale a β agonist at a high dose (nebulised salbutamol 5 mg or terbutaline 10 mg or two puffs from a metered dose inhaler repeated 10–20 times). If this management has failed on previous occasions, a syringe preloaded with adrenaline (Min-I-Jet, 0.5 mg) for subcutaneous injection may be helpful. The patient or relative, or both, must be shown how to use the syringe under supervision (using isotonic saline for practice). The shelf life is limited to six months. No similar β agonist is commercially available.

3 Swallow prednisolone 30–60 mg.

4 Go to the nearest hospital as previously agreed with the general practitioner. If such a patient is seen during an attack his or her history may suggest direct admission to the intensive care unit.

Areas of uncertainty

CHRONIC SEVERE ASTHMA

The views expressed in the guidelines reflect majority opinion but more research is needed.

Regular use of bronchodilators

Although there was a consensus among the working party about the need to start regular anti-inflammatory treatment if a patient needs a relieving bronchodilator more than once a day, it remains unclear whether "regular" bronchodilators should be prescribed or encouraged within steps 2 and 3. The positioning of salmeterol must also be somewhat arbitrary while the results of further trials are awaited.

Inhaled steroids

Inhaled steroids may have systemic effects in certain circumstances. It is often difficult to separate such effects from those of concomitant steroid tablets. Further long term research is needed to determine the significance of some of the published work and to compare the effects of different products.

Increasing inhaled steroids at the onset of deterioration

It has become common practice to advise patients to increase (double) their inhaled steroids at the first sign of a cold or deterioration of their asthma. Although this may be effective there is no corroboratory evidence from trials to date.

Guided self management plans

The levels at which certain interventions should be initiated have not been validated in a controlled trial at the time of writing.

Outcomes

Outcomes that may suggest control of asthma have been proposed. Further work on this subject is needed, however, to determine which measures are valid in which circumstances.

ACUTE SEVERE ASTHMA

Again the views expressed reflect majority opinion, but they are not based on results of published studies.

Use of pulsus paradoxus

Most doctors do not record pulsus paradoxus in their assessment of severe asthma and the majority view is that this measurement is not useful. Only 5% of patients with severe asthma appear to have abnormal paradox as the only criterion of severity as defined in the original guidelines. This issue could be evaluated in a prospective study.

Use of peak flow thresholds

The threshold of 33% predicted or best as an absolute criterion for admission is derived from five studies comparing PEF, FEV_1, $PaCO_2$ and clinical grading. It is widely accepted. The higher threshold for admission of 50% predicted or best, though recommended in a wide range of guidelines, is not based on published objective data, but it does reflect practice set out in the current hospital asthma audit of the British Thoracic Society, the Royal College of Physicians, and the National Asthma Campaign (BTS-RCP-NAC).

Role of nebulised ipratropium bromide

Most but not all short term (up to four hour) studies show measurably faster recovery in patients with severe asthma treated with combined nebulised β agonist and ipratropium than in those treated with β agonist alone. Our view is that as most patient recover rapidly and satisfactorily with oxygen, steroids, and nebulised β agonist treatment the addition of nebulised ipratropium is indicated only in patients whose asthma is very severe when they are first seen or who deterior-ate or fail to improve rapidly when treated with the standard regimen. It may also be beneficial in infancy.

We could find no studies looking at the optimum duration for combined nebulised β agonist and ipratropium. Pragmatically we suggest that ipratropium should be withdrawn when patients are clearly responding.

Role of intravenous aminophylline

Most clinicians are unwilling to dispense with intravenous aminophylline. Most patients receiving maximal doses of nebulised β agonists derive no additional benefit from intravenous aminophylline. Some patients, however, obtain more rapid and effective bronchodilatation with the combination of the two. We have therefore recommended intravenous aminophylline for patients whose condition is very severe when they are first seen or who deteriorate or fail to improve rapidly when treated with oxygen, steroids, and β agonists alone.

Peak flow criteria for appropriateness of discharge from hospital or for stepping down treatment

The peak flow variability criterion was modified from that given in one published study because the variability of 20% suggested by it was regarded as too strict. There is widespread agreement that when PEF is above 75% of predicted (or best) and the diurnal variation is below 25% patients no longer need to be having maximal steroid and bronchodilator treatment. The BTS-RCP-NAC audit has confirmed that PEF variability of 25% or more is associated with early readmission.

The safety of discharging patients before these points are reached depends on several other factors, including the patients' social state, personality, and understanding of asthma and the level of support and care in the community. Studies of outcome that include the severity of asthma at discharge, the value of locally produced management protocols, and economic factors associated with care in hospital or at home are required.

Oximetry

All medical teams admitting patients with asthma need oximeters for managing these patients. Their use in reducing the need for arterial blood gas measurements needs to be determined.

Chart 3

Acute severe asthma in adults

Recognition and assessment in hospital

Features of acute severe asthma

- Can't complete sentences in one breath
- Respirations ≥25 breaths/min
- Pulse ≥110 beats/min
- Peak expiratory flow (PEF) ≤ 50% of predicted or best

Life threatening features

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

If a patient has **any** of the above features, then measure **arterial blood gases.**

Markers of a very severe, life threatening attack:

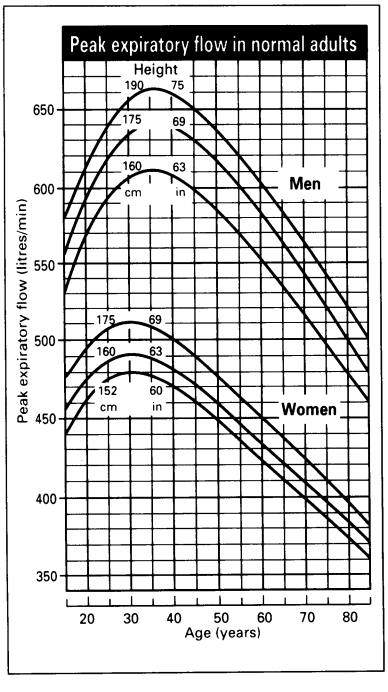
- Normal (5–6 kPa, 36–45 mm Hg) or high $Paco_2$
- Severe hypoxia: Pao_2 <8 kPa (60 mm Hg) irrespective of treatment with oxygen
- A low pH (or high H^+)

No other investigations are needed for immediate management.

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.

1 Immediate treatment

- Oxygen —40-60% (CO_2 retention is not aggravated by oxygen therapy in asthma)
- Salbutamol 5 mg or terbutaline 10 mg via an oxygen driven nebuliser
- Prednisolone tablets 30-60 mg or intravenous hydrocortisone 200 mg, or both, if very ill
- No sedatives of any kind
- Chest radiograph to exclude pneumothorax



From: Gregg I, Nunn AJ. *BMJ* 1989; **298**: 1068-70

IF LIFE THREATENING FEATURES ARE PRESENT:

- Add ipratropium 0.5 mg to the nebulised β agonist
- Give intravenous aminophylline 250 mg over 20 minutes or salbutamol or terbutaline 250 μg over 10 minutes. Do not give bolus aminophylline to patients already taking oral theophyllines

2 Subsequent management

IF PATIENT IS IMPROVING CONTINUE:

- 40-60% oxygen
- Prednisolone 30-60 mg daily or intravenous hydrocortisone 200 mg every 6 hours
- Nebulised β agonist 4 hourly

IF PATIENT IS NOT IMPROVING AFTER 15-30 MINUTES:

- Continue oxygen and steroids
- Give nebulised β agonist more frequently, up to every 15-30 minutes
- Add ipratropium 0.5 mg to nebuliser and repeat 6 hourly until patient is improving

IF PATIENT IS STILL NOT IMPROVING GIVE:

- Aminophylline infusion (small patient 750 mg/24 hours, large patient 1500 mg/24 hours); monitor blood concentrations if it is continued for over 24 hours
- Salbutamol or terbutaline infusion as an alternative to aminophylline

3 Monitoring treatment

- Repeat measurement of PEF 15-30 minutes after starting treatment
- Oximetry: maintain Sao_2 >92%
- Repeat blood gas measurements within 2 hours of starting treatment if
  - initial Pao_2 <8 kPa (60 mm Hg) unless subsequent Sao_2 >92%
  - $Paco_2$ was normal or raised
  - patient deteriorates
- Chart PEF before and after giving nebulised or inhaled β agonists and at least 4 times daily throughout hospital stay

4 Transfer patient to the intensive care unit accompanied by a doctor prepared to intubate if there is:

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

5 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 predicted or best 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 self management plan
- GP follow up arranged within 1 week
- Follow up appointment in respiratory clinic within 4 weeks

Adapted from poster designed by Business Design Group

Chart 4

Acute severe asthma in children

Recognition of acute severe asthma

- Too breathless to talk
- Too breathless to feed
- Respirations ≥50 breaths/min
- Pulse ≥140 beats/min
- PEF ≤50% predicted or best

Life threatening features

- PEF < 33% predicted or best
- Cyanosis, a silent chest, or poor respiratory effort
- Fatigue or exhaustion
- Agitation or reduced level of consciousness

No other investigations are needed for immediate management

Blood gas estimations are rarely helpful in deciding initial management in children.

Caution:
Children with severe attacks may not appear distressed; assessment in the very young may be difficult. The presence of any of these features should alert the doctor.

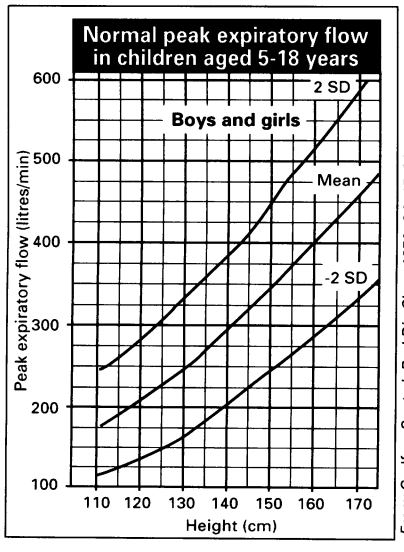
Management of a severe asthma attack

1 Immediate treatment

- High flow oxygen via face mask
- Salbutamol 5 mg or terbutaline 10 mg via an oxygen driven nebuliser (half doses in very young children)
- Prednisolone 1-2 mg/kg body weight orally (maximum 40 mg)

IF LIFE THREATENING FEATURES ARE PRESENT:

- Give intravenous aminophylline 5 mg/kg over 20 minutes followed by maintenance infusion, 1 mg/kg/h; omit the loading dose if child already receiving oral theophyllines



From: Godfrey S, et al. Br J Dis Chest 1970; 64: 15–24

- Give intravenous hydrocortisone 100 mg 6 hourly
- Add ipratropium 0.25 mg to nebulised β agonist (0.125 mg in very young children)
- Pulse oximetry is helpful in assessing response to treatment. An $Sao_2 \leq 92\%$ may indicate the need for chest radiography.

2 Subsequent management

IF PATIENT IS IMPROVING CONTINUE:

- High flow oxygen
- Prednisolone 1-2 mg/kg daily (maximum 40 mg/day)
- Nebulised β agonist 4 hourly

IF PATIENT IS NOT IMPROVING AFTER 15-30 MINUTES:

- Continue oxygen and steroids
- Give nebulised β agonist more frequently, up to every 30 minutes
- Add ipratropium to nebuliser and repeat 6 hourly until improvement starts

IF PATIENT IS STILL NOT IMPROVING GIVE:

- Aminophylline infusion (1 mg/kg/h); monitor blood concentrations if continued for over 24 hours

3 Monitoring treatment

- Repeat PEF measurement 15-30 minutes after starting treatment (if appropriate)
- Oximetry: maintain Sao_2 >92%
- Chart PEF if appropriate before and after the child inhales β agonists and at least 4 times daily throughout hospital stay

4 Transfer to the intensive care unit accompanied by a doctor prepared to intubate if there is:

- Deteriorating PEF or worsening or persistent hypoxia or hypercapnia
- Exhaustion, feeble respirations confusion, or drowsiness
- Coma or respiratory arrest

5 When discharged from hospital patients should have:

- Been on discharge medication for 24 hours and have had inhaler technique checked and recorded
- If recorded, PEF >75% of predicted or best and PEF diurnal variability <25%
- Treatment with soluble steroid tablets and inhaled steroids in addition to bronchodilators
- Own PEF meter and if appropriate self management plan or written instructions for parents
- GP follow up arranged within 1 week
- Follow up appointment in clinic within 4 weeks

Adapted from poster designed by Business Design Group

Chart 5

Acute severe asthma in adults in general practice

Many deaths from asthma are preventable: delay can be fatal

Factors include:

- Doctors failing to assess severity by objective measurement
- Patients or relatives failing to appreciate severity
- Underuse of corticosteroids

Regard each emergency consultation as for acute severe asthma until it is shown otherwise.

Assess and record:

- Symptoms and response to self treatment
- Heart and respiratory rates
- Peak expiratory flow (PEF)

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.

Uncontrolled asthma

ASSESSMENT

- Speech normal
- Pulse <110 beats/min
- Respiration <25 breaths/min
- PEF >50% predicted or best

MANAGEMENT

Treat at home but response to treatment MUST be assessed before you leave

TREATMENT

Nebulised salbutamol 5 mg or terbutaline 10 mg

MONITOR RESPONSE 15-30 MIN AFTER NEBULISER

If PEF >50–75% predicted/best
- Give prednisolone 30-60 mg
- Step up usual treatment

or
if PEF >75% predicted/best
- Step up usual treatment

FOLLOW UP

- Monitor symptoms and PEF on PEF chart
- Self management plan
- Surgery review ≤48 hours
- Modify treatment at review according to guidelines for chronic persistent asthma

CRITERIA FOR HOSPITAL ADMISSION

- Any life threatening features
- Any features of acute severe asthma present after initial treatment, especially PEF <33%

LOWER THE THRESHOLD FOR ADMISSION IF:

Attack is in afternoon or evening, recent nocturnal symptoms etc, recent hospital admission, previous severe attacks, patient unable to assess own condition, concern over social circumstances

Acute severe asthma

ASSESSMENT

- Can't complete sentences
- Pulse ≥110 beats/min
- Respiration ≥25 breaths/min
- PEF ≤50% of predicted or best

MANAGEMENT

Seriously consider admission if more than one feature above present

TREATMENT

- Oxygen 40–60% if available
- Nebulised salbutamol 5 mg or terbutaline 10 mg
- Prednisolone 30–60 mg or intra venous hydrocortisone 200 mg

MONITOR RESPONSE 15–30 MIN AFTER NEBULISER

If any signs of acute severe asthma persist
- Arrange admission
- Repeat nebulised β agonist plus ipratropium 0.5 mg
  or give subcutaneous terbutaline
  or give intravenous aminophylline (slowly) while awaiting ambulance

or
if good response to first nebulised treatment (symptoms improved, respiration and pulse settling, and PEF >50%):
- Step up usual treatment and continue prednisolone

FOLLOW UP

- Monitoring of symptoms and PEF
- Self management plan
- Surgery review ≤24 hours

Modify treatment at review according to guidelines for chronic persistent asthma

Life threatening asthma

ASSESSEMENT

- Silent chest
- Cyanosis
- Bradycardia or exhaustion
- PEF < 33% of predicted or best

MANAGEMENT

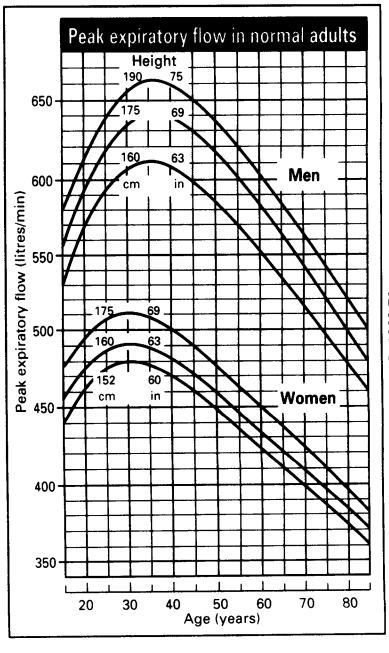
Arrange immediate ADMISSION

TREATMENT

- Prednisolone 30–60 mg or intravenous hydrocortisone 200 mg immediately
- Oxygen driven nebuliser in ambulance
- Nebulised β agonist and ipratropium or subcutaneous terbutaline or intravenous aminophylline (250 mg slowly)

Stay with patient until ambulance arrives

NB If there is no nebuliser give 2 puffs of β agonist via a large volume spacer and repeat 10–20 times



From: Gregg I, Nunn AJ. *BMJ* 1989; **298**: 1068-70

Adapted from poster designed by Business Design Group

Chart 6 Asthma in accident and emergency departments

ASTHMA CAN KILL

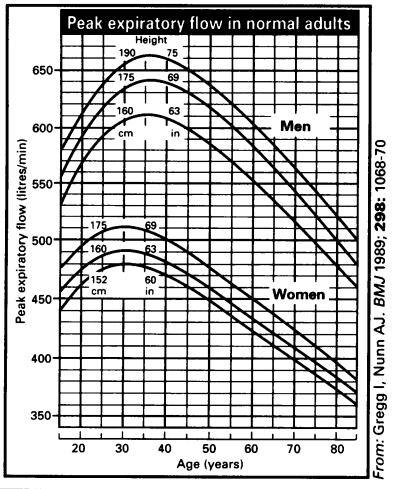
Immediately measure peak expiratory flow

>75% predicted mild

>50–75% moderate

33–50% severe

<33% life threatening



From: Gregg I, Nunn AJ. *BMJ* 1989; **298**: 1068-70

POSSIBLE DISCHARGE

ADMIT

USUAL INHALED BRONCHODILATOR

NURSE TO GIVE NEBULISED SALBUTAMOL 5 mg OR TERBUTALINE 10 mg WITH OXYGEN AS DRIVING GAS

Any severe or life threatening features

Features of severe asthma
- Cannot complete sentence in one breath
- Respirations ≥25/min
- Pulse ≥110 beats/min

Life threatening features
- Silent chest, cyanosis, feeble respiratory effort
- Bradycardia or hypotension
- Exhaustion, confusion, or coma

Caution
Patient 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

Keep under observation 60 min. If patient stable and PEF >75%

Wait 30 minutes

If PEF >50–75% repeat nebulised β agonist. Give prednisolone tablets 40 mg. Wait 30 minutes

If stable or improving and PEF >75%

If worse or PEF ≤50%

If PEF >50–75% wait 60 min

If patient stable or improving and PEF >60%

If patient worse or PEF ≤60%

ARTERIAL BLOOD GAS MARKERS OF SEVERITY
- Normal (5–6 kPa, 36-45 mm Hg) or high $Paco_2$
- Severe hypoxia (Pao_2 <8 kPa, 60 mm Hg) irrespective of oxygen treatment
- Low pH (or high H^+)

No other investigations are needed for immediate management

DISCHARGE

Mild
- Ensure patient has usual treatment supply and inhaler technique is correct, advise full compliance, instruct relatives if appropriate
- Give note for GP, advise early consultation, recommend PEF charting, advise registration with GP
- Tell patient to return immediately if asthma worsens and be admitted

Moderate
- As for mild, plus:
- Prednisolone tablets 30-40 mg, regular inhaled corticosteroid, and β agonist as neccessary.
- Consider referral to chest clinic

MANAGEMENT

Immediate:
- Oxygen 40–60% in all cases
- Salbutamol 5 mg or terbutaline 10 mg via oxygen driven nebuliser
- Prednisolone tablets 30–60 mg or intravenous hydrocortisone 200 mg, or both

If life threatening features present:
- Add ipratropium 0.5 mg to nebulised β agonist
- Give intravenous aminophylline 250 mg over 20 minutes or salbutamol or terbutaline 250 μg over 10 minutes. Caution when giving bolus aminophylline if patient is already taking theophyllines
- Chest radiography to exclude pneumothorax

ADMIT

DISCHARGED PATIENTS NEED EXTRA CARE AS MORTALITY IS HIGH IN THIS GROUP

PATIENTS SHOULD BE ACCOMPANIED BY A NURSE OR DOCTOR AT ALL TIMES

This chart is appropriate for patients from puberty onwards

References

1 Guidelines for the management of asthma in adults. 1–Chronic persistent asthma. Statement by the British Thoracic Society, Research Unit of the Royal College of Physicians of London, King's Fund Centre, National Asthma Campaign. *BMJ* 1990;**301**;651-3.

2 Guidelines for the management of asthma in adults. 2–Acute severe asthma. Statement by the British Thoracic Society, Research Unit of the Royal College of Physicians of London, King's Fund Centre, National Asthma Campaign. *BMJ* 1990;**301**;797-800.

3 Warner JO, Götz M, Landau LI, *et al.* Management of asthma: a consensus statement. *Arch Dis Child* 1989;64:1065-79.

4 International Paediatric Asthma Consensus Group. Asthma, a follow-up statement. *Arch Dis Child* 1992; **67**;240-8.

5 International consensus report on the diagnosis and management of asthma. *Clin Exp Allergy* 1992; **22** (suppl): 1-72.

6 Committee on the Safety of Medicines. *Report of the Beta Agonist Working Party*. London: Medicines Control Agency, 1992.