

Acute severe asthma and status asthmaticus

What is classed as severe asthma?^[1]

Every emergency consultation for asthma should be regarded as for acute severe asthma until proven otherwise. All patients with acute severe asthma that has not responded to immediate treatment or life-threatening asthma must be referred immediately to hospital.

Severe and life-threatening acute asthma in children is discussed in the separate article [Management of Childhood Asthma](#).

Severe asthma is often difficult to treat and results in a severe burden to the person affected and their carers and families, and a disproportionate cost to healthcare systems. Appropriate diagnosis and management of severe asthma is critical, as most asthma deaths have been retrospectively identified as having poorly recognised severe asthma.

People with severe asthma require high-dose inhaled steroid and multiple other controllers or oral corticosteroids to remain in control of their disease, or remain uncontrolled despite this treatment, the burden of severe asthma to patients and to healthcare systems is high.

[Asthma](#) is a common disease and its frequency sometimes detracts from its potential seriousness. In adults with asthma, only 5-10% have severe disease but these individuals carry a substantial proportion of the cost (both in terms of morbidity and economic consideration) and run the highest risk of acute severe exacerbations and death.^[2]

Status asthmaticus is severe asthma that does not respond well to immediate care and is a life-threatening medical emergency. Ensuing respiratory failure results in hypoxia, carbon dioxide retention and acidosis. The exact mechanism underlying the development of an acute severe asthma attack remains elusive but there appear to be two phenotypes:^[3]
^[4]

- Gradual-onset - in about 80%, severe attacks develop over more than 48 hours. These are associated with eosinophilic infiltration and slow response to therapy.
- Sudden-onset - often in association with significant allergen exposure. Patients tend to be older and to present between midnight and 8 am. This type of attack is associated with neutrophilic inflammation and a swifter response to therapy.

How common is severe asthma? (Epidemiology)^[5]

- Asthma accounts for 60,000 hospital admissions and 200,000 bed days a year.
- Regional asthma incidence rates are generally higher in Scotland, Wales, Northern Ireland and (to a slightly lesser extent) north-west England.
- There were around 1,200 deaths from asthma in the UK in 2012.
- Recorded mortality is much higher in the West Midlands and south-east England than the rest of the UK.
- In 2012 incidence rates were 36% higher in the most deprived communities than in the least deprived. Prevalence is around 11% higher.

Risk factors

Risk factors for asthma-related death include:^[6] ^[7]

- A background disease pattern of chronic severe asthma:

Severe asthma

- Previous near-fatal asthma.
 - Previous admission for asthma, especially in the preceding year.
 - Three or more classes of asthma medication.
 - Heavy or increasing use of beta₂ agonists.
 - Frequent emergency contacts for asthma care, especially in the preceding year.
 - 'Brittle' asthma.
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- Inadequately treated disease +/- inadequate medical monitoring.
 - Inappropriate beta-blocker prescription or heavy sedation.
 - Non-steroidal anti-inflammatory sensitivity.
 - Use of a long-acting beta₂ agonist (LABA) such as salmeterol, especially if not using a steroid inhaler.^[8]
 - Personal or passive smoking.
 - Environmental conditions - air pollution (ozone, sulfur dioxide, nitrogen dioxide and particulates) and pollen levels are thought to influence the rate of hospital admissions.
 - Sensitivity to fungi (see 'Severe asthma with fungal sensitisation (SAFS)', below).

- Adverse behavioural/psychosocial factors:
 - Non-compliance, frequent failure to attend appointments, self-discharge, denial of illness.
 - Psychiatric illness (psychosis, depression, deliberate self-harm), alcohol or street drug use.
 - Obesity.
 - Learning difficulties.
 - Employment problems, income problems, social isolation.
 - Childhood abuse.
 - Severe domestic, marital or legal stress factors.
- Seasonal variation (in the UK, the peak of deaths in those aged under 44 years is in July–August and, in older patients, December–January).
- Pregnancy will exacerbate asthma in about a third of affected women. Treat the asthma – medication should be continued/stepped up where necessary; it is a lesser risk to the fetus than uncontrolled asthma or severe exacerbations.

Severe asthma with fungal sensitisation (SAFS) ^[9]

Severe asthma may be caused by sensitisation to fungi. See also the separate [Aspergillosis](#) article for further details regarding allergic bronchopulmonary aspergillosis (ABPA) and SAFS.

- SAFS refers to patients with severe asthma (despite standard treatment) with evidence of fungal sensitisation who do not meet the criteria for ABPA. ^[10] The total IgE is usually lower than for patients with ABPA (total IgE <1000 IU/mL).
- Most affected patients only react to one of two fungi, most often *Aspergillus fumigatus* or *Candida albicans*.
- Patients with SAFS usually have chronic severe asthma symptoms despite maximal treatment, including steroids.
- Treatment of SAFS should initially be similar to that of severe asthma. ^[11]

- Antifungal therapy with itraconazole is beneficial (fluconazole may be beneficial in those sensitised to *Trichophyton* spp.). The duration of antifungal therapy required is not yet fully established.^[12]

Severe asthma symptoms (presentation)

- Shortness of breath may develop over hours or days but is usually progressive rather than sudden.
- A history of poor control is common.
- Often there has been a recent increase in use of reliever inhalers, with decreasing response.
- Possible respiratory tract infection or exposure to an allergen or trigger.

Signs of severe asthma

- The patient will usually appear pink. Cyanosis is a serious sign.
- Their respiratory rate is raised.
- Tachycardia is usual and may be increased by use of beta₂ agonists.
- Accessory muscles of respiration are employed (best assessed by palpation of the neck muscles) and the chest appears hyper-inflated.
- In normal breathing, the ratio of the duration of inspiration to expiration is about 1:2 but, as asthma becomes more severe, the expiratory phase becomes relatively more prolonged.

- Wheeze is usually expiratory but may also be inspiratory in more severe asthma.

Pitfalls

- A very tight chest may not wheeze at all due to poor air entry. Beware the silent chest.
 - Patients with severe or life-threatening asthma may not appear distressed.
 - The presence of *any* relevant abnormality should alert the doctor.
 - Where signs/symptoms cross categories of severity, always assign the most severe category.
- Pulsus paradoxus is no longer recommended as a reliable indicator of the severity of an asthma attack.

Differential diagnosis

Status asthmaticus must be distinguished from other causes of acute breathlessness, including:

- Wheezing in children, which can be caused by a variety of infective conditions – eg, respiratory syncytial virus – causing [bronchiolitis](#).
- [Foreign body inhalation](#) and other causes of stridor (eg, [epiglottitis](#), [croup](#), tracheitis, vascular ring, tracheomalacia, etc).
- [Allergic reaction, anaphylaxis](#).
- [Primary pulmonary hypertension](#).
- [Pneumothorax](#) with or without asthma.
- [Inhalation injury](#).
- Acute exacerbations of [chronic obstructive pulmonary disease \(COPD\)](#).
- [Bronchiectasis](#).
- [Lung cancer](#).

- Cardiac failure ('cardiac asthma').

Assessment^[6]

The following summary applies to adults. See the separate [Management of Childhood Asthma](#) article.

Many deaths from severe asthma are preventable. Delay can be fatal.

Factors leading to poor outcome include:

- Clinical staff failing to assess severity by objective measurement.
- Patients or relatives failing to appreciate severity.
- Under-use of corticosteroids.

Regard each emergency asthma consultation as for acute severe asthma until shown otherwise. Assess and record:

- Peak expiratory flow rate (PEFR).
- Symptoms and response to self-treatment.
- Heart and respiratory rates.
- Oxygen saturation (by pulse oximetry).

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

Assessment of severity^[6]

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

- Moderate asthma exacerbation:
 - PEFr >50–75% best or predicted.
 - Oxygen saturations (SpO₂) ≥92%.
 - Speech normal.
 - Respiration <25 breaths per minute.
 - Pulse <110 beats per minute.
- Acute severe asthma – any one of:
 - PEFr 33–50% best or predicted.
 - Oxygen saturations (SpO₂) ≥92%.
 - Can't complete sentences.
 - Respiratory rate ≥25 breaths per minute.
 - Pulse ≥110 beats per minute.
- Life-threatening asthma – any one of the following in a patient with severe asthma:
 - PEFr <33 best or predicted.
 - Oxygen saturations (SpO₂) <92%.
 - Silent chest, cyanosis or poor respiratory effort.
 - Arrhythmia or hypotension.
 - Exhaustion, altered consciousness.

Asthma treatment and management

Moderate asthma

Treat at home or in the surgery and assess response to treatment.

- If PEFr >50–75% predicted/best:
 - Beta₂ bronchodilator. Depending on the equipment available, use either:
 - Beta₂ bronchodilator via spacer (give four puffs initially and give a further two puffs every two minutes according to response up to maximum of 10 puffs); **or**
 - Nebuliser (preferably oxygen-driven) with salbutamol 5 mg.
 - Give prednisolone 40–50 mg.
 - Continue or increase usual treatment.
- If good response to first treatment (symptoms improved, respiration and pulse settling and PEFr >50%), continue or increase usual treatment and continue prednisolone.
- Admit to hospital if there are any of the following:
 - Life-threatening features.
 - Features of acute severe asthma present after initial treatment.
 - Previous near-fatal asthma.
- Lower threshold for admission if afternoon or evening attack, recent nocturnal symptoms or hospital admission, previous severe attacks, patient unable to assess own condition, or concern over social circumstances.

Severe or life-threatening acute asthma ^[13]

Adults with features of severe or life-threatening acute asthma should start treatment as soon as possible and be referred to hospital immediately following initial assessment.

- Supplementary oxygen should be given to all hypoxaemic patients with severe acute asthma to maintain an SpO₂ level between 94–98%. Do not delay if pulse oximetry is unavailable.
- First-line treatment for acute asthma is a high-dose inhaled short-acting beta₂ agonist (such as salbutamol) given as soon as possible.

- For patients with acute severe or life-threatening symptoms, administration via an oxygen-driven nebuliser is recommended, if available. If the response to an initial dose of nebulised short-acting beta₂ agonist is poor, consider continuous nebulisation with an appropriate nebuliser. Intravenous beta₂ agonists are reserved for those patients in whom inhaled therapy cannot be used reliably.
- In all cases of acute asthma, patients should be prescribed an adequate dose of oral prednisolone. Continue usual inhaled corticosteroid use during oral corticosteroid treatment. Parenteral hydrocortisone or intramuscular methylprednisolone are alternatives in patients who are unable to take oral prednisolone.
- Nebulised ipratropium bromide may be combined with a nebulised beta₂ agonist in patients with severe or life-threatening acute asthma, or in those with a poor initial response to beta₂ agonist therapy to provide greater bronchodilation.
- There is some evidence that magnesium sulfate has bronchodilator effects. A single intravenous dose of magnesium sulfate may be considered in patients with severe acute asthma (peak flow <50% best or predicted) who have not had a good initial response to inhaled bronchodilator therapy (unlicensed use).
- In an acute asthma attack, intravenous aminophylline is not likely to produce any additional bronchodilation compared to standard therapy with inhaled bronchodilators and corticosteroids. However, in some patients with near-fatal or life-threatening acute asthma with a poor response to initial therapy, intravenous aminophylline may provide some benefit. Magnesium sulfate by intravenous infusion or aminophylline should only be used after consultation with senior medical staff.

Follow-up^[13]

- Episodes of acute asthma may be a failure of preventative therapy; review is required to prevent further episodes.
- A careful history should be taken to establish the reason for the asthma attack. Inhaler technique should be checked and regular treatment should be reviewed.

- Patients should be given a written asthma action plan aimed at preventing relapse, optimising treatment, and preventing delay in seeking assistance in future attacks.
- It is essential that the patient's GP practice is informed within 24 hours of discharge from the emergency department or hospital following an asthma attack, and the patient be reviewed by their GP within two working days.
- Patients who have had a near-fatal asthma attack should be kept under specialist supervision indefinitely.
- A respiratory specialist should follow up all patients admitted with a severe asthma attack for at least one year after the admission.

Further hospital-based asthma management^[6]

Following initial assessments and initial treatment of severe asthma with oxygen, salbutamol and prednisolone or hydrocortisone, further management will depend on the severity of asthma and response to treatment. Further treatments of severe asthma may include intravenous magnesium and correction of fluid/electrolyte disturbances. The patient may need to be treated in the Intensive Care Unit (ICU).

Not all patients admitted to the ICU 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 be performed by an anaesthetist or ICU consultant.

Evidence on the efficacy of bronchial thermoplasty for severe asthma shows some improvement in symptoms and quality of life, and reduced exacerbations and admission to hospital. Bronchial thermoplasty for severe asthma aims to reduce the smooth muscle mass lining the airways, decreasing their ability to constrict. Using sedation or general anaesthesia, short pulses of radiofrequency energy are applied circumferentially to sequential portions of the airway wall via a catheter. Treatment is usually delivered in three sessions. After the first session, treated airways are evaluated by bronchoscopy before proceeding with further treatment.^[14]

Asthma complications

Complications of status asthmaticus include:

- [Aspiration pneumonia](#).
- Pneumomediastinum.
- [Pneumothorax](#).
- [Rhabdomyolysis](#).
- [Respiratory failure and arrest](#).
- [Cardiac arrest](#).
- Hypoxic-ischaemic brain injury.

The risk of death is increased where there is delay in getting treatment, particularly time to starting steroids, comorbidities such as congestive heart failure or COPD and in smokers. Mortality is highest in the very young and the very old.

Asthma prevention^[6]

- All patients with asthma – but especially those with poorly controlled disease – should have access to education about their condition and to regular review, and should have an [asthma action plan](#).
- In addition to an asthma register, an 'at-risk' asthma register may help. If 'at-risk' patients fail to attend for appointments this should be actively followed up.
- Those who are difficult to control need referral to specialist services.
- Be especially vigilant about those with psychosocial adverse factors too.
- Beta₂-agonist therapy used in isolation is only appropriate for those with the mildest variant of asthma.
- Receptionists, ambulance control workers and those who are first point of contact by patients must appreciate that a patient with asthma having difficulty breathing needs to be seen as an emergency.

- Hospital admission should be an opportunity to review the patient's care plan.
- Anyone who has required admission should be followed up by a respiratory physician for at least a year.
- Patients who have had near-fatal asthma or brittle asthma should remain under specialist care indefinitely.

Further reading

- [Global Initiative for Asthma \(GINA\)](#)
- [Why asthma still kills](#); Royal College of Physicians, August 2015
- [Maselli DJ, Peters JI](#); Medication Regimens for Managing Acute Asthma. *Respir Care*. 2018 Jun;63(6):783–796. doi: 10.4187/respcare.05953.

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