Asthma: An Overview

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Received: 19 June 2019; **Accepted:** 10 July 2019

Asthma, a chronic inflammatory condition of the airways, characterized by recurrent episodes of wheezing, breathlessness, chest tightness and coughing, is the term used to describe a heterogeneous group of conditions which result in recurrent reversible bronchial obstruction. A serious global health problem affecting approximately 300 million individuals worldwide, asthma represents 1% of the total global disease burden and results in 250,000 deaths annually. Ireland has the fourth highest prevalence of asthma worldwide, affecting an estimated 450,000 people [1].

Asthma is a significant public health issue in Ireland and poor asthma control has significant health, social and economic costs. It results in more than 5,000 hospital admissions, 20,000 emergency department attendances and 50,000 out-of-hours GP visits every year in Ireland. It is estimated that Irish hospital admissions and ED visits due to asthma cost more than €18 million annually.

Asthma risk is determined by genetic, host and environmental factors. A family history of asthma or atopy is considered a risk factor for the development of asthma and estimates of heritability range from 35-90%. Host factors include obesity and gender. Asthma is observed more frequently in individuals who are obese, especially women, and is twice as likely to occur in young boys as girls. The gender difference lessens with age, and in adulthood asthma is more common in females. Environmental factors include infections, allergens and occupational sensitizers. Tobacco smoke, exercise and stress are contributing factors, and the development of asthma appears to result from exposure to environmental factors in genetically-susceptible individuals. More than 400 occupational sensitizer substances have been associated with occupational asthma which is thought to account for 10-20% of adult asthma in Europe [2].

Diagnosis
Diagnosis of asthma is based on the presence of intermittent symptoms of dyspnoea and wheezing with evidence of variable airflow obstruction on objective measurement that is reversible. Medical history is extremely important in the diagnosis of asthma as symptoms are variable and intermittent, and investigation may be completely normal. A clinical diagnosis of asthma is often prompted by symptoms such as episodic breathlessness, wheezing, cough, and chest tightness. Seasonal variability of symptoms and family history of asthma and atopic disease are also helpful diagnostic guides and increase the probability of a diagnosis of asthma, as does the improvement of symptoms after appropriate treatment. Because asthma symptoms are variable, physical examination of the respiratory system may be normal. Wheezing on auscultation is the most common finding, but may only be detected when the person exhales forcibly, even in the presence of significant airway limitation [3].

Measurements of lung function with spirometry and PEF measurements provide assessment of severity of airflow limitation, reversibility and variability, and provide confirmation of the diagnosis of asthma. Spirometry is recommended as the ideal method to establish a diagnosis of asthma. Reversibility is improvements in FEV1 within minutes after inhalation of rapid-acting bronchodilator (e.g. after 200–400μg salbutamol 2–4 puffs) or sustained improvement over days or weeks after introduction of effective controller treatment such as inhaled gluco-corticosteroids. The degree of reversibility in FEV1 which indicates a diagnosis of asthma is accepted as >12% (or >200ml) from pre-bronchodilator value. Variability is the improvement or deterioration which occurs over time, day to day, month to month or seasonally. Obtaining a history of variability is an essential component of the diagnosis of asthma [3].

PEF measurements can be an important aid in diagnosis and monitoring of asthma but are not interchangeable with FEV1. PEF should be measured first thing in the morning before treatment is taken, when values are at their lowest and last thing

at night when values are usually higher. A 60 L/min (or >20% of pre-bronchodilator PEF) improvement after inhalation of a bronchodilator or a diurnal variation in PEF >20% suggests a diagnosis of asthma [3].

For symptoms consistent with asthma, but with normal spirometry, measurements of an individual's airway responsiveness may help establish a diagnosis of asthma. These tests are usually carried out in a pulmonary function facility.

Measurement of allergic status (IgE, RAST, skin allergy tests) can help to identify risk factors that cause asthma symptoms in individual patients.

The diagnosis of asthma in children under the age of 5 is challenging and has to be based largely on clinical judgment and an assessment of symptoms and physical findings.

Several asthma subtypes exist including: Allergic rhinitis, thought to occur in 30-90% of asthmatics; cough-variant asthma where lung function may be normal but bronchial hyper-responsiveness will be found on testing, and aspirin-sensitive asthma (in up to 20% of asthma patients) where exposure to aspirin and NSAIDs results in bronchoconstriction and mucosal inflammation. It is important to recognise and treat these specific subtypes to ensure optimal control of asthma symptoms [1].

The diagnosis of asthma should preferably be confirmed before starting controller treatment as confirming the diagnosis of asthma is more difficult after treatment has been started.

Criteria for making the diagnosis of Asthma [4]
Features used in making the diagnosis of asthma

1. A history of variable respiratory symptoms
Typical symptoms are wheeze, shortness of breath, chest tightness, cough
• People with asthma generally have more than one of these symptoms
• The symptoms occur variably over time and vary in intensity
• The symptoms often occur or are worse at night or on waking
• Symptoms are often triggered by exercise, laughter, allergens or cold air
• Symptoms often occur with or worsen with viral infections
2. Evidence of variable expiratory airflow limitation
• At least once during the diagnostic process, e.g. when FEV1 is low, document that the FEV1/FVC ratio is reduced. The FEV1/FVC ratio is normally more than 0.75–0.80 in adults, and more than 0.90 in children.
• Document that variation in lung function is greater than in healthy people. For example:
○ FEV1 increases by more than 12% and 200mL (in children, >12% of the predicted value) after inhaling a bronchodilator. This is called 'bronchodilator reversibility'.
○ Average daily diurnal PEF variability* is >10% (in children, >13%)
○ FEV1 increases by more than 12% and 200mL from baseline (in children, by >12% of the predicted value) after 4 weeks of anti- inflammatory treatment (outside respiratory infections)
• The greater the variation, or the more times excess variation is seen, the more confident you can be of the diagnosis of asthma.
• Testing may need to be repeated during symptoms, in the early morning, or after withholding bronchodilator medications.
• Bronchodilator reversibility may be absent during severe exacerbations or viral infections. If bronchodilator reversibility is not present when it is first tested, the next step depends on the clinical urgency and availability of other tests.
• For other tests to assist in diagnosis, including bronchial challenge tests

Differentiating between Asthma and COPD is important.

DIFFERENTIATION BETWEEN COPD AND ASTHMA [3]	
Diagnosis	**Suggestive features**
Asthma	Onset early in life (often childhood) • Symptoms vary widely from day to day • Symptoms worsen at night or morning • Allergy, rhinitis and/or eczema present • Family history of asthma
COPD	Onset in mid-life • Symptoms slowly progressive • History of tobacco use or exposure to other types of smoke

Clinical Features of Asthma Vs. COPD [2]

Feature	Asthma	COPD
Age	Any age	>35 years
Cough	Often non-productive	Frequently productive
Breathlessness	Episodic	Persistent + progressive
Atopic Disorders	Common	Possible
Family History	Frequent	No link
Smoking History	Possible	Almost always
Lung Function	Variable	Always abnormal

Because of the heterogeneous nature of asthma there is no gold standard of classification. Classification may be based on aetiology, phenotype such as the clinical symptoms, concomitant atopic manifestations and responses to treatment or the intensity of treatment needed to achieve good control. Asthma cannot be prevented or cured but the clinical manifestations can be effectively controlled with appropriate treatment. When asthma is controlled, there should be no more than occasional recurrence of symptoms and severe exacerbations should be rare.

Treatment and Management
The goals of asthma treatment in adults are to
• maintain control of symptoms
• maintain normal daily activity including exercise
• maintain pulmonary function as close to normal as possible
• prevent asthma exacerbations and asthma-related mortality

The long-term goals of asthma management are symptom control and risk reduction. The aim is to reduce the burden to the patient and to reduce their risk of exacerbation, airway damage, and medication side effects. The patient's own goals regarding their asthma and its treatment should be identified [5].

Pharmacotherapy involves the use of medication which should be initiated in a stepwise fashion according to the severity of the patient's symptoms. There are two main types of medication used in asthma control: 'Controller' (preventative) medication taken daily, on a chronic basis, to keep asthma symptoms under good clinical control and 'Reliever' medication used on an "as required" basis that produce rapid bronchodilation and provide relief from

symptoms. The main reliever medications available are the short-acting β2 agonists. Patients should have regular structured reviews and their pharmacotherapy regimen stepped up or down in line with the level of symptom control.

Patients must be taught correct inhaler techniques. Up to 80% of patients do not use their inhaler correctly and this contributes to poor symptom control and exacerbations. At every opportunity check the patient's inhaler technique. Check technique up to 2–3 times if necessary, paying attention to incorrect steps [5].

Individual patients need to be educated to identify trigger factors, recognize when their condition is becoming uncontrolled and when they should upscale treatment or seek additional medical input. The Irish National Clinical Programme for Asthma recommends that all patients diagnosed with asthma are enrolled in a structured asthma programme. All patients should be provided with a written asthma plan appropriate for their level of asthma control and health literacy, so that they recognize and react to worsening symptoms.

Smoking cessation is the most important lifestyle change an asthmatic patient can make in improving symptoms and optimising response to treatment. Providing smoking cessation advice at every visit and encouraging smokers to quit is important, as is providing access to counseling and resources. Avoidance of known allergens for those with atopic asthma is helpful, and exercise and weight loss is recommended for those who are overweight or obese. Individuals with asthma should be encouraged to take part in regular physical activity and be provided with advice about management of exercise-induced bronchoconstriction. Patients with adult-onset asthma should be asked about their work history and attempts made to identify and remove occupational sensitizers as soon as possible. All patients should be asked about a history of asthma before NSAIDs including aspirin are prescribed.

Every opportunity should be taken to assess patients with a diagnosis of asthma, particularly when they are symptomatic or after a recent exacerbation, but also when they attend for a prescription refill. A routine review should be scheduled at least once a year.

Patients should preferably be seen 1–3 months after starting treatment and every 3–12 months after that, except in pregnancy when they should be reviewed every 4–6 weeks. After an exacerbation, a review visit within 1 week should be scheduled. The frequency of review depends on the patient's initial level of control, their response to previous treatment, and their ability and willingness to engage in self-management with an action plan [5].

Assessment of a patient with asthma [5]

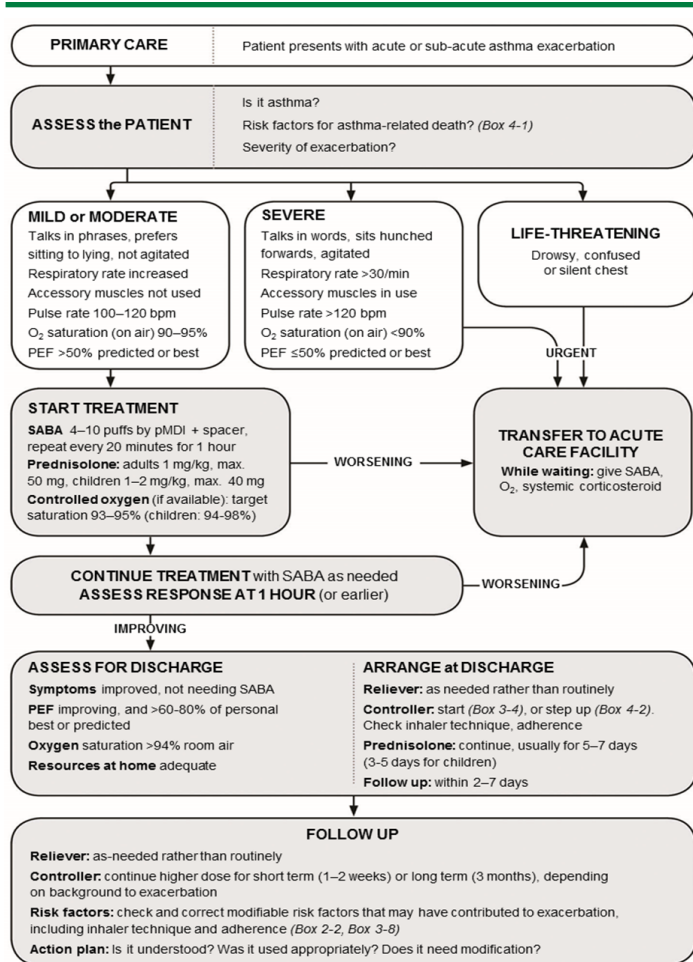| 1. Asthma control – assess both symptom control and risk factors |
| --- |
| Assess symptom control over the last 4 weeks |
| Identify any other risk factors for poor outcomes |
| Measure lung function before starting treatment, 3–6 months later, and then periodically, e.g. at least yearly in most patients |

2. Treatment issues
Record the patient's treatment, and ask about side-effects
Watch the patient using their inhaler, to check their technique
Have an open empathic discussion about adherence
Check that the patient has a written asthma action plan
Ask the patient about their attitudes and goals for their asthma

3. Are there any comorbidities?
These include rhinitis, chronic rhinosinusitis, gastroesophageal reflux (GERD), obesity, obstructive sleep apnea, depression and anxiety.
Comorbidities should be identified as they may contribute to respiratory symptoms and poor quality of life. Their treatment may complicate asthma management.

Assessment of symptom control and future risk [5]

A. Level of asthma symptom control			
In the past 4 weeks, has the patient had:	Well controlled	Partly controlled	Uncontrolled
Daytime symptoms more than twice/week? Yes☐ No☐			
Any night waking due to asthma? Yes☐ No☐	None of these	1–2 of these	3–4 of these
Reliever needed* more than twice/week? Yes☐ No☐			
Any activity limitation due to asthma? Yes☐ No☐			

B. Risk factors for poor asthma outcomes

Assess risk factors at diagnosis and periodically, at least every 1-2 years, particularly for patients experiencing exacerbations.

Measure FEV1 at start of treatment, after 3–6 months of controller treatment to record personal best lung function, then periodically for ongoing risk assessment.

Having uncontrolled asthma symptoms is an important risk factor for exacerbations

Additional potentially modifiable risk factors for exacerbations, even in patients with few asthma symptoms, include:
- ICS not prescribed; poor ICS adherence; incorrect inhaler technique
- High SABA use (with increased mortality if >1x200-dose canister/month)
- Low FEV1, especially if <60% predicted
- Higher bronchodilator reversibility
- Major psychological or socioeconomic problems
- Exposures: smoking; allergen exposure if sensitized
- Comorbidities: obesity; chronic rhino-sinusitis; confirmed food allergy
- Sputum or blood eosinophilia; elevated FENO in allergic adults taking ICS
- Pregnancy

Having any of these risk factors increases the patient's risk of exacerbations even if they have few asthma symptoms

Other major independent risk factors for flare-ups (exacerbations) include:
- Ever being intubated or in intensive care for asthma
- Having 1 or more severe exacerbations in the last 12 months.

Risk factors for developing fixed airflow limitation include preterm birth, low birth weight and greater infant weight gain; lack of ICS treatment; exposure to tobacco smoke, noxious chemicals or occupational exposures; low FEV1; chronic mucus hypersecretion; and sputum or blood eosinophilia

Risk factors for medication side-effects include:
- *Systemic*: frequent OCS; long-term, high dose and/or potent ICS; also taking P450 inhibitors
- *Local*: high-dose or potent ICS; poor inhaler technique

Management of Asthma Exacerbations in Primary Care [5]

The management of worsening asthma and exacerbations should be considered as a continuum, from self-management by the patient with a written asthma action plan, through to management of more severe symptoms in primary care, ED and hospital. Exacerbations often represent failures in chronic asthma care, and they provide opportunities to review the patient's asthma management. All patients must be followed up regularly until symptoms and lung function return to normal [6].

PRIMARY CARE — Patient presents with acute or sub-acute asthma exacerbation

ASSESS the PATIENT
Is it asthma?
Risk factors for asthma-related death? *(Box 4-1)*
Severity of exacerbation?

MILD or MODERATE
Talks in phrases, prefers sitting to lying, not agitated
Respiratory rate increased
Accessory muscles not used
Pulse rate 100–120 bpm
O_2 saturation (on air) 90–95%
PEF >50% predicted or best

SEVERE
Talks in words, sits hunched forwards, agitated
Respiratory rate >30/min
Accessory muscles in use
Pulse rate >120 bpm
O_2 saturation (on air) <90%
PEF ≤50% predicted or best

LIFE-THREATENING
Drowsy, confused or silent chest

URGENT

START TREATMENT
SABA 4–10 puffs by pMDI + spacer, repeat every 20 minutes for 1 hour
Prednisolone: adults 1 mg/kg, max. 50 mg, children 1–2 mg/kg, max. 40 mg
Controlled oxygen (if available): target saturation 93–95% (children: 94-98%)

WORSENING →

TRANSFER TO ACUTE CARE FACILITY
While waiting: give SABA, O_2, systemic corticosteroid

CONTINUE TREATMENT with SABA as needed
ASSESS RESPONSE AT 1 HOUR (or earlier)

WORSENING

IMPROVING

ASSESS FOR DISCHARGE
Symptoms improved, not needing SABA
PEF improving, and >60-80% of personal best or predicted
Oxygen saturation >94% room air
Resources at home adequate

ARRANGE at DISCHARGE
Reliever: as needed rather than routinely
Controller: start *(Box 3-4)*, or step up *(Box 4-2)*. Check inhaler technique, adherence
Prednisolone: continue, usually for 5–7 days (3-5 days for children)
Follow up: within 2–7 days

FOLLOW UP
Reliever: as-needed rather than routinely
Controller: continue higher dose for short term (1–2 weeks) or long term (3 months), depending on background to exacerbation
Risk factors: check and correct modifiable risk factors that may have contributed to exacerbation, including inhaler technique and adherence *(Box 2-2, Box 3-8)*
Action plan: Is it understood? Was it used appropriately? Does it need modification?

Identifying patients at risk of asthma-related death [5]

Patients at risk of asthma related death should be identified and flagged for more frequent review. This includes patients with:

- A history of near-fatal asthma requiring intubation and ventilation
- Hospitalization or emergency care for asthma in last 12 months
- Not currently using ICS, or poor adherence with ICS
- Currently using or recently stopped using OCS (this indicates the severity of recent events)
- Over-use of SABAs, especially more than 1 canister/month
- Lack of a written asthma action plan
- History of psychiatric disease or psychosocial problems
- Confirmed food allergy in a patient with asthma

The Asthma Society of Ireland (ASI) empowers people with asthma to take control of their condition by providing them and their families with information, education, services and support. In February 2015 they launched a five-year strategy: 'Vision 2020', which aims for an Ireland where everyone with asthma lives life to the full symptom free. The Asthma Society actively engages with healthcare professionals, government departments and third-party organisations to keep asthma high on the agenda. They also support research and innovative projects which investigate the causes and treatment of asthma.

The Global Initiative for Asthma (GINA) strives to increase awareness of asthma among health professionals, health authorities, and the general public. Goals include improving diagnoses, management and prevention of asthma by stimulating research, and providing evidence-based educational resources for worldwide use. The 2018 update of the Global Strategy for Asthma Management and Prevention incorporates new scientific information about asthma based on a review of recent scientific literature by an international panel of experts on the GINA Science Committee. It is available at https://ginasthma.org/ginareports/.

Landmark Changes in the 2019 GINA Asthma Strategy Report (Updated April 2019)

The Global Initiative for Asthma (GINA) has released a 2019 update. [7].

The key changes in GINA (Updated Report April 2019) are that GINA no longer recommends starting treatment of asthma with short-acting beta2-agonist reliever inhalers on their own. Instead, GINA recommends that all adults and adolescents with asthma should receive either symptom-driven (for mild asthma) or daily inhaled anti-inflammatory controller treatment, to reduce their risk of serious exacerbations and to control symptoms.

The updated recommendations for severe asthma include additions to the treatment algorithm for severe asthma, including the availability of an additional biologic treatment (dupilumab, an antibody against interleukin-4 receptor alpha), and advice about extension of a treatment trial of biologic therapy to 6-12 months if the initial response is unclear.

References

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