



C-START Revision Resources

Airways Disease

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Prepared for revision purposes.



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Table of Contents

Chronic Obstructive Pulmonary Disease (COPD)	3
Definition.....	3
Risk Factors.....	3
Diagnosis – Core Criteria	3
Severity - GOLD ABE Assessment tool.....	4
Key symptoms & assessment tools	4
Diagnostic work up	5
Treatment.....	5
Oxygen therapy	8
Further Treatments	9
Prognostication.....	9
Exacerbations	11
Pre-flight assessment for patients with COPD	14
Lung Volume Reduction Surgery & Endobronchial Valves	15
Aims of the intervention:	15
Patient selection	15
Procedures (LVRS & EBV).....	15
Pulmonary Rehabilitation (PR)	17
Role of PR.....	17
Who is appropriate?	17
Structure & delivery	17
Asthma	18
Definition (GINA)	18
Diagnosis [NICE 2024].....	18
Classification	19
Treatment.....	20
Management	20
Biologic Therapies	21
Other treatments:	22
Acute Asthma	24
Special situations (pregnancy & breastfeeding)	27

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UK-RES-2602137 September 2026



Work related asthma	28
Occupational Asthma	28
Diagnosis	28
Management	29
Prognosis.....	29
Abbreviations	30

Chronic Obstructive Pulmonary Disease (COPD)

Definition

- GOLD 2026 definition: *‘heterogeneous lung condition characterised by chronic respiratory symptoms (dyspnoea, cough, sputum, production and/or exacerbations) due to abnormalities of the airways (bronchitis, bronchiolitis) and/or alveoli (emphysema) that cause persistent, often progressive airflow obstruction’*
- Usually caused by smoking or long-term exposure to noxious particles

Risk Factors

- Tobacco Smoking
 - Indicators of high nicotine dependence: smoking within 3 minutes of waking, smoking at night, ≥ 20 cigarettes per day
- Biomass exposure
- Occupational exposures
- Air pollution
- Abnormal lung development (prematurity, low birthweight etc)
- Genetic factors: SERPINA1 mutations leading to $\alpha 1$ -antitrypsin deficiency
 - Inherited in an autosomal co-dominant pattern

Diagnosis – Core Criteria

- Appropriate clinical context + non-fully reversible airflow obstruction
- Confirm with spirometry
 - Post-bronchodilator $FEV_1/FVC < 0.7$
 - Indicates persistent airflow obstruction
 - FEV_1 % predicted used to assess severity
- Pre-COPD: symptoms/ emphysema on CT scan or physiological abnormalities without airflow obstruction
- Preserved Ratio Impaired spirometry (PRISm): normal ratio but abnormal spirometry (i.e. $FEV_1/ < 80\%$ predicted post bronchodilation but $FEV_1/FVC > 0.7$)
- Those with Pre-COPD/PRISm are at risk of developing airflow obstruction over time- but not all do
- Remember: weak correlation between severity of airflow obstruction and symptoms experienced

FEV1 2026 GOLD Grades and severity of airflow obstruction:

For prescribing information please refer to individual product SmPC.

In patients with FEV ₁ /FVC <0.7	
FEV ₁ ≥80% predicted	Mild (GOLD 1)
50% ≤ FEV ₁ < 80% predicted	Moderate (GOLD 2)
30% ≤ FEV ₁ < 50 % predicted	Severe (GOLD 3)
FEV ₁ < 30% predicted	Very severe (GOLD 4) <i>*If FEV₁ <50% and respiratory failure, would also categorise as very severe</i>

Severity - GOLD ABE Assessment tool

A guide for initial assessment

Group	Exacerbation History	Symptoms
A	0 moderate or severe exacerbations in the previous year	CAAT <10 or mMRC 0–1
B	0 moderate or severe exacerbations in the previous year	CAAT ≥10 or mMRC ≥2
E	≥1 moderate or severe exacerbations in the previous year	Symptoms do not affect classification

Key symptoms & assessment tools

- Dyspnoea (progressive, persistent)
 - Primary symptom
 - Ensure aware of MRC and mMRC scoring; mMRC relates well to other health status measurements and predicts future mortality risk

mMRC	MRC	Description
0	1	Not troubled by breathlessness except on strenuous exercise
1	2	Short of breath when hurrying on the level or walking up a slight hill
2	3	Walks slower than most people on the level, stops after a mile or so, or must stop for a breath when walking at own pace
3	4	Stops for a breath after walking about 100 yards or after a few minutes on level ground
4	5	Too breathless to leave the house or breathless when undressing

- Chronic cough
 - With or without sputum production
- Wheeze, chest tightness (less specific)
- Recurrent lower respiratory tract infections
- Multidimensional questionnaires to assess:
 - COPD Assessment Test (CAT™)/ (Chronic Airways Assessment Test (CAAT™) – used clinically
 - Identifies overall impact of COPD/ chronic airways disease on patients' health
 - 0-40 score from 8 item questionnaire; correlates closely with St George's Respiratory Questionnaire (SGRQ)

For prescribing information please refer to individual product SmPC.

- Includes: Cough, phlegm, chest tightness, breathlessness, activities, confidence, sleep, energy
- Cut off score of 10 is equivalent to SGRQ ≥ 25 threshold for considering regular treatment
 - 0-10 Low health impact
 - 11-20 Medium health impact
 - 21-30 High health impact
 - 31-40 Very high health impact
- Clinical COPD Questionnaire (CCQ[®]) – used clinically
- Chronic Respiratory Questionnaire (CRQ)- predominantly used in research setting
- St George's Respiratory Questionnaire (SGRQ) – predominantly used in research setting

Diagnostic work up

All patients should have:

- Spirometry
- Chest X-ray: hyperinflation, exclude other pathology
- Bloods:
 - FBC (polycythaemia from chronic hypoxia)
 - Eosinophils (may guide inhaled steroid use)
 - Lower BEC / sputum eosinophils associated with greater presence of proteobacteria, notably haemophilus, increased bacterial infection and pneumonia (BEC < 2%)
 - Consider testing for $\alpha 1$ -antitrypsin deficiency if the person is younger than 40 years of age or has a family history.
- BMI assessment

Also consider:

- Sputum culture
- Serial peak flow mx
- ECG/Echo: assess for cor pulmonale
- CT chest: if diagnostic uncertainty or complications

NB: Presence of emphysema on CT is an independent risk factor for cancer

Treatment

Aim of treatment for COPD is to reduce symptoms and the risk of future exacerbations

Fundamentals

- Offer treatment and support to stop smoking
 - Smoking cessation is the only treatment shown to modify natural history of COPD
- Offer pneumococcal, influenza and COVID vaccines; *(NB: CDC recommends: dTaP – pertussis, tetanus and diphtheria if not had in childhood; shingles vaccine; RSV vaccine in those over 60 years with chronic heart or lung disease)*
- Offer PR if indicated (see PR notes)
- Personalised management plan

For prescribing information please refer to individual product SmPC.

Inhalers

As per NICE:

SABA or SAMA – initial empirical treatment to relieve breathlessness and exercise limitation

LABA+LAMA- should be offered to patients who have spirometrically confirmed COPD and do not have features suggestive of steroid responsiveness and remain breathless or having exacerbations despite having been offered smoking cessation, optimisation of non-pharmacological management and relevant vaccinations and are using short acting bronchodilator

For those taking LAMA+LABA consider LABA+LAMA+ICS if have a severe exacerbation (i.e. requires hospitalisation) or they have 2 moderate exacerbations within a year OR they have day-to-day symptoms adversely affecting their QOL (here consider a 3 month trial followed by a clinical review to see if symptoms have improved).

NB: Think about nebuliser therapy for those with distressing/disabling breathlessness despite maximal therapy

Initial pharmacological management as per GOLD:

- Group A: Bronchodilator
- Group B: LABA+LAMA
- Group E: LABA+LAMA (consider LABA+LAMA+ICS if blood eosinophil ≥ 300 cells/uL)

NB: GOLD no longer encourages the use of LABA+ICS alone in COPD. GOLD states that where an inhaled corticosteroid is indicated, LABA+LAMA+ICS is the preferred option, having demonstrated superiority to LABA+ICS in relevant clinical outcomes.

Biologics

Dupilumab (anti IL4R) now approved by NICE as an add-on maintenance treatment for:

- Uncontrolled COPD - defined as 1 or more severe exacerbations or 2 or more moderate exacerbation in previous 12 months
with
- Raised BEC (≥ 300 cells /uL)
if they are on
- Triple therapy (LABA+LAMA+ICS)
OR
- Double therapy (LABA+LAMA) if inhaled ICS not appropriate

Assess response at 12 months and stop if number of severe exacerbations is higher OR the number of severe exacerbations is the same and the number of moderate exacerbations is higher

Proven in clinical trials to reduce the number of exacerbations and improve lung function compared with placebo plus double/triple therapy

Oral corticosteroids

Do not start oral corticosteroids for maintenance treatment of COPD

For prescribing information please refer to individual product SmPC.

Oral Theophylline (slow release)

- Only after trial of short and long-acting bronchodilator or for people who are unable to use inhaled therapies
- Plasma levels and interactions must be monitored in the elderly
- Difficult pharmacokinetics in elderly- caution
- To assess efficacy: look for improvements in symptoms, activities of daily living, exercise capacity and lung function
- Reduce dose of theophylline for patients who are having exacerbation if prescribed a macrolide (i.e. clarithromycin) or fluoroquinolone (i.e. ciprofloxacin)

Oral mucolytic

- Stable COPD with chronic cough productive of sputum
- Continue to prescribe if symptomatic improvement (reduction in sputum/ cough frequency)

Anti-oxidant/anti-tussive

- Not recommended

Prophylactic antibiotics

- Consider Azithromycin 250mg to 500mg three times per week for a minimum of 6-12 months in patients who:
 - Do not smoke
 - Optimised non-pharmacological and inhaled therapies
 - And continue to have one or more of the following:
 - Frequent (more than 3) exacerbations per year with sputum production
 - Prolonged exacerbation with sputum production
 - Exacerbation resulting in hospitalisation
- Before offering, ensure:
 - Smoking cessation (if appropriate)
 - Optimised inhaler technique
 - Sputum culture and sensitivity (including TB)- to identify any specific cases of persistent infection or recurrent infection (i.e. NTM/Pseudomonas)
 - If NTM identified, macrolide monotherapy should be avoided
 - Training in airway clearance
 - CT Thorax
 - Rule out bronchiectasis
 - ECG – QTc interval
 - Repeat at 1 month
 - Baseline Liver function tests
 - These should be rechecked at 1 month after starting, and then every 6 months
 - Counsel patient re risk of gastrointestinal upset, hearing and balance disturbance, cardiac effects and microbiological resistance
 - If on higher dose and get GI side effects, can trial reduced dose
- Not necessary to stop during an exacerbation (unless concurrent antibiotic with effect on QTc)

For prescribing information please refer to individual product SmPC.

- Assess at 6- and 12-months review re exacerbation rate, CAT™ score or QOLD – if no benefit stop

Oral phosphodiesterase-4 inhibitors

- Reduce inflammation by inhibiting the breakdown of intracellular cyclic AMP
- Roflumilast 500microgram OD, for specialist initiation
- Add on therapy for severe COPD if:
 - Severe (FEV₁ <50% predicted)
- AND
 - 2 or more exacerbations in last year despite triple therapy
- Common side effects: Diarrhoea, weight loss, nausea, abdominal pain and headache
- Which patient to avoid in?
 - Underweight
 - Caution if depressed
- Shown to reduce rates of moderate/severe exacerbations compared with placebo and improve lung function

Oxygen therapy

Long term oxygen therapy (LTOT)

Assess need for oxygen therapy in patients with:

- Severe (FEV₁ 30-49%) or very severe FEV₁ (<30%) airflow obstruction
- Oxygen saturations of 92% or less on room air
- Polycythaemia
- Peripheral oedema
- Cyanosis
- Raised JVP

LTOT assessment – should be 2 ABGs, on 2 occasions at least 3 weeks apart in those who are stable and therapy optimised as far as possible.

- Do not offer to people who continue to smoke (need to have quit for 6 months)
- Do not offer to treat isolated nocturnal hypoxaemia

LTOT Criteria:

PaO₂ <7.3kPa when stable OR PaO₂ 7.3-8kPa with secondary polycythaemia/ peripheral oedema/ pulmonary hypertension

LTOT has been shown to improve survival in patients meeting the above criteria

Prescription:

- LTOT prescription is for at least 15 hours each day

Ambulatory oxygen

- Oxygen delivered via portable system during:
 - Exercise

For prescribing information please refer to individual product SmPC.

- Activities of daily living
- Aimed at reducing exertional desaturation and improving function

Indications for ambulatory oxygen:

- Established LTOT patients
 - To allow continuation of oxygen outside the home
- Consider in COPD if ALL present:
 - Exercise desaturation
 - Objective improvement in exercise capacity with oxygen
 - Motivated to use therapy
- No evidence of clinically meaningful improvement in breathlessness in:
 - Mild hypoxaemia
 - No hypoxaemia

Short burst oxygen therapy

- Do not offer

Further Treatments

Non-Invasive Ventilation

- Chronic hypercapnic respiratory failure and history of hospitalisation for acute hypercapnic respiratory failure- NIV may decrease mortality and prevent re-hospitalisation

Pulmonary Rehabilitation (PR):

- See PR notes

Lung Volume Reduction Surgery (LVRS):

- See LVRS notes

Lung transplant:

Refer for assessment if:

- Severe COPD ($FEV_1 < 50\%$) and breathless with effects on QOL despite optimal treatment
- Do not smoke
- Completed PR
- No contraindications

Palliative approaches

- Often effective in controlling symptoms of advanced COPD

Prognostication

The treatments that can influence mortality:

- LABA+LAMA+ICS (in selected patients with symptomatic COPD and a history of exacerbations)
- Smoking cessation

For prescribing information please refer to individual product SmPC.

- Pulmonary rehabilitation
- LTOT
- NIV
- LVRS/transplantation

Scores:

- NICE does not recommend 1 score/prognosticator: no single measure adequately reflects severity or prognosis- patients require multidimensional assessment
- NICE advise multi-dimensional indices such as BODE, not recommended for prognosis
- COPD severity combination of:
 - physiology + symptoms +exacerbations + systemic impact + frailty

Key factors to consider:

- Lung Function
 - FEV₁ limited prognostic value in isolation
 - TLCO
- Symptoms and functional status
 - Dyspnoea – MRC Score
 - Symptom burden – CAAT™ assessment
 - CAT™: COPD Assessment Tool
 - CAAT™: Chronic Airways Assessment Test
 - Exercise capacity
- Exacerbation burden
 - Frequency and severity of exacerbations
 - Hospital admissions
- Systemic complications
 - Chronic hypoxia and/ or cor pulmonale
 - Low BMI
- Meeting criteria for:
 - Long term oxygen therapy (LTOT)
 - Home non-invasive ventilation (NIV)
- Patient factors
 - Multimorbidity
 - Frailty
 - Smoking status
 - Pack year calculation: (No of cigarettes per day/20) * years

SCORES TO BE AWARE OF

- BODE:
 - BMI, Air flow Obstruction, Dyspnoea, Exercise capacity
 - Score 0-10
 - BODE 0-2 (80%)
 - BODE 3-4 (67%)
 - BODE 5-6 (57%)
 - BODE 7-10 (18%)
 - Predicts 4-year survival in COPD patients

For prescribing information please refer to individual product SmPC.

- DECAF
 - Dyspnoea, Eosinopenia, Consolidation, Acidaemia, AF
 - Predicts in-hospital mortality in acute COPD exacerbation
 - Score 0-1: 0-1.5%
 - Score 2: 5.4%
 - Score 3-6: 15.3-50%

Exacerbations

Definition:

- Exacerbation defined as an event characterised by dyspnoea and /or cough and sputum that worsen over 14 days
- Commonly reported symptoms: worsening SOB, cough, increased sputum production, change in sputum colour – often necessitate change in medication

Severity classifications:

- Currently based on healthcare utilisation with severe exacerbation classed as one requiring hospital treatment
 - *NB: 40% of patients will be readmitted or die within 90 days of a severe COPD exacerbation*
- ROME proposal proposed delineating mild/moderate / severe based on symptom score, physiological parameters and blood results- has not translated to use in clinical practice

Causes:

- Usually caused by viruses (especially rhinovirus), but bacterial and environmental factors play role
- Strongest predictor for future exacerbations is previous exacerbations

COPD exacerbation: who needs hospital admission?

Admit if any of the following are present:

Severe clinical features

- Severe breathlessness
- Poor or deteriorating general condition
- Confined to bed / low activity
- Cyanosis
- Worsening peripheral oedema
- Impaired consciousness
- Acute confusion

High-risk respiratory findings

- $\text{SaO}_2 < 90\%$
- Arterial pH < 7.35 (acidosis)
- $\text{PaO}_2 < 7 \text{ kPa}$
- New changes on CXR

Background risk factors

For prescribing information please refer to individual product SmPC.

- Already on long-term oxygen therapy
- Significant comorbidities (esp. cardiac disease, insulin-dependent diabetes)
- Rapid onset of symptoms

Social factors

- Unable to cope at home
- Living alone / poor support

Suitable for home management if:

- Mild breathlessness
- Stable general condition
- Good activity level
- No cyanosis
- Normal consciousness
- Good social support
- Normal gases ($\text{pH} \geq 7.35$, $\text{PaO}_2 \geq 7 \text{ kPa}$, $\text{SaO}_2 \geq 90\%$)

NB: Hospital at home/assisted discharge can be used as alternative way of caring for people with exacerbations who would otherwise need to stay in hospital

Investigations:

CXR	ABG	ECG
FBC and U&E + Theophylline level if taken	Sputum M, C + S Respiratory viral screen	Blood culture if pyrexial

Treatment:

- Currently treated with bronchodilators, corticosteroids +/- antibiotics
 - Corticosteroids (5-day course) can improve lung function and short-term recovery time and hospitalisation duration
 - In research space evidence that BEC tailored treatment is non inferior, yet to translate to clinical practice/NICE guidance
 - Antibiotics when indicated shorten recovery, reduce risk of relapse, treatment failure and hospitalisation
 - Theophylline – only use as an adjunct if there is inadequate response to nebulised bronchodilators, monitor levels
- Indications for NIV:
 - Hypercapnic ventilatory failure $\text{PaCO}_2 \geq 6.5$ and $\text{pH} \leq 7.35$; persisting after 1-hour appropriate medical management
 - Should be delivered in dedicated setting, with clear escalation plan

Assessing suitability for intubation and ventilation, considerations:

- BMI
- Requirement for oxygen when stable
- Co-morbidities
- Previous admissions

For prescribing information please refer to individual product SmPC.

- In addition to age and FEV₁ , NB: NICE guidelines state neither age nor FEV₁ should be used in isolation when assessing suitability

Monitoring recovery:

- Do not routinely perform PEF or FEV₁ to monitor recovery from an exacerbation

Discharge planning:

- NICE states spirometry should be measured in all before discharge
- If episode of respiratory failure, need to have satisfactory blood gas results prior to discharge

References and suggested reading:

1. NICE 2019 Chronic obstructive pulmonary disease in over 16s: diagnosis and management [NG115]
 2. NICE 2017 Roflumilast for treating chronic obstructive pulmonary disease [TA461]
 3. Smith D, Du Rand I, Addy CL, Collyns T, Hart SP, Mitchelmore PJ, Rahman NM, Saggu R. British Thoracic Society guideline for the use of long-term macrolides in adults with respiratory disease. Thorax. 2020 May;75(5):370-404. doi: 10.1136/thoraxjnl-2019-213929. Epub 2020 Apr 17. PMID: 32303621.
 4. NICE 2026 Dupilumab for maintenance treatment of uncontrolled chronic obstructive pulmonary disease with raised blood eosinophils [TA1142]
-

For prescribing information please refer to individual product SmPC.

Pre-flight assessment for patients with COPD

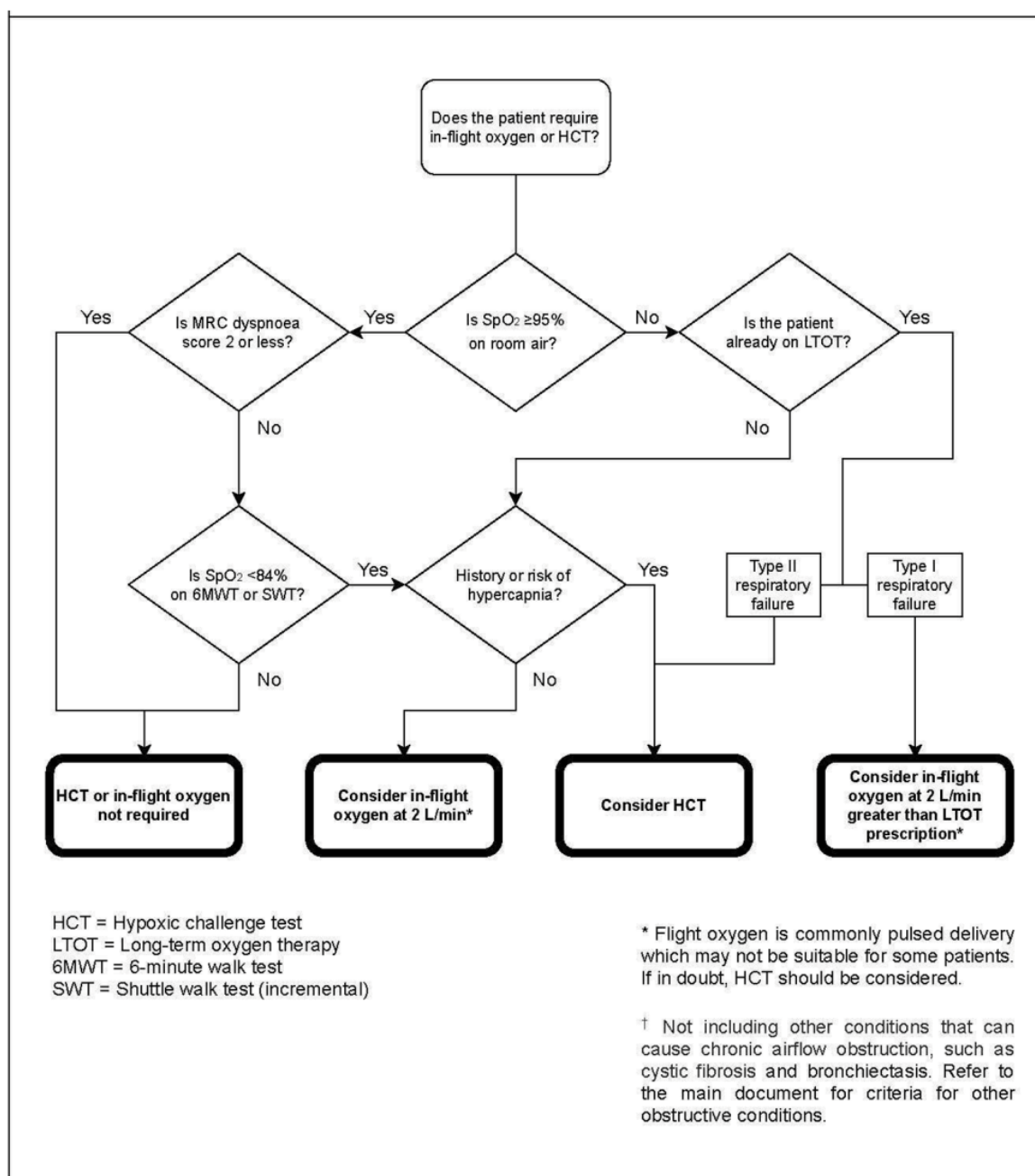


Figure adapted from Coker et al. 2022

References and suggested reading:

1. Coker RK, Armstrong A, Church AC, Holmes S, Naylor J, Pike K, Saunders P, Spurling KJ, Vaughn P. BTS Clinical Statement on air travel for passengers with respiratory disease. Thorax. 2022 Apr;77(4):329-350. doi: 10.1136/thoraxjnl-2021-218110. Epub 2022 Feb 28. PMID: 35228307; PMCID: PMC8938676.

For prescribing information please refer to individual product SmPC.

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Lung Volume Reduction Surgery & Endobronchial Valves

Aims of the intervention:

- In the appropriate patients, these interventions can:
 - Reduce gas trapping – improving lung function & reduced breathlessness
 - Improve exercise capacity
 - Enhance QOL
 - Prolong survival by delaying progression to respiratory failure and reducing hospital admissions

Patient selection

What is required for LVR MDT discussion and consideration of treatment as per NICE?

1. Evidence of symptomatic hyperinflation due to emphysema with impaired QOL. MRC ≥ 3
2. Non-smoker for at least 4 months
3. Completing of PR within last 12 months, or ongoing participation in post-PR exercise programme
4. 6MWT > 140m or ISWT >80m
5. FEV1 <50 % predicted
6. DL_{CO} or K_{CO} >20 % predicted
7. RV:TLC >55%
8. RV >150%
9. PaCO₂ <7
10. BMI >18

Who is not suitable for referral to LVR MDT as per NICE?

Those with:

- Severe co-morbidities
- Severe progressive disease
- Severe pulmonary HTN

Procedures (LVRS & EBV)

What is involved in MDT assessment?

- Quantitative lung perfusion scans and HRCT
- Determines distribution of emphysema in either UL or LL as target areas
- Exercise ability: 6MWT or ISWT
- Calculation of predicted procedural risk: BODE and Glenfield risk scoring
- QOL of life assessment: CATTM/ SGRQ
- Those suitable from the above, proceed to bronchoscopy assessment to evaluate the presence of collateral ventilation between lobes (which would exclude EBV)

Main reasons LVR declined?

- Lack of suitable target areas
- Excess risk, measured by:
 - Absolute FEV1

For prescribing information please refer to individual product SmPC.

- Predicted DL_{co}
 - BMI
- Significant respiratory co-morbidity (fibrosis)

What are the eligibility criteria for LVRS or EBV as per NICE?

- Upper or lower lobe heterogeneous emphysema without collateral ventilation
- RV>180% and/or RV:TLC >60 , TL_{co}> 20, BMI >18

Lung volume reduction surgery (LVRS)

Lung volume reduction surgery best in those with:

- Upper lobe emphysema
- Reduced exercise capacity

Most common complication post LVRS?

- Persistent air leak

What are the eligibility criteria for LVRS as per NICE?

- Upper lobe heterogeneous emphysema
- RV:TLC >60, TL_{co} or K_{co} >20, BMI>18
- Collateral ventilation and low exercise capacity
- Predominantly apical disease with collateral ventilation and low exercise capacity
- Lower lobe heterogeneous emphysema with collateral ventilation

Endobronchial valves (EBV)

Endobronchial valves (EBV) best in those with:

- Heterogeneous emphysema
- No collateral ventilation
- Lobar occlusion is complete (intact fissures on CT)

Which 2 devices are available for EBV?

- Duckbill
- Umbrella

What are the eligibility criteria for EBV as per NICE?

- Upper/lower heterogeneous emphysema
- No collateral ventilation
- RV >180%, TL_{co}>20, BMI >18
- Previous thoracic surgery

References and suggested reading:

1. NHS England 2022; Clinical Commissioning Policy: Lung volume reduction by surgery or endobronchial valve for severe emphysema in adults
2. NICE 2017; Endobronchial valve insertion to reduce lung volume in emphysema [HTG457]
3. NICE 2005; Lung volume reduction surgery for advanced emphysema [HTG69]

For prescribing information please refer to individual product SmPC.

Pulmonary Rehabilitation (PR)

Role of PR

- PR should be offered to COPD patients with a view to improving exercise capacity by a clinically meaningful amount, as well as improving dyspnoea
- Fundamental treatment- not an optional one

Who is appropriate?

- Smoking
 - Patients should be referred regardless of their smoking status, opportunity for smoking cessation advice
- Chronic respiratory failure
 - Can still refer
- Cardiovascular disease
 - If co existent abdominal aortic aneurysm (AAA) <5.5 cm can still refer (provided BP well controlled)
 - If AAA >5.5 cm and not fit for surgery, then can refer to PR incorporating mild-moderate intensity aerobic exercise but not resistance
 - If severe peripheral vascular disease – should not be referred
 - Unstable cardiovascular disease- should not be referred
- Locomotor
 - Severe locomotor difficulties that stop activity i.e. severe arthritis, should not be referred
- MRC
 - PR for MRC 3-5 and functionally limited by breathlessness > refer for PR
 - If MRC 2 but functionally limited by breathlessness can be referred
 - MRC 5 and housebound should not routinely be referred for supervised PR in home
- Bronchodilator therapy
 - Patient should be taking prior to referral
- Cognition
 - If significant cognitive compromise, should not be referred
- Post exacerbation PR
 - Patients with AECOPD should be offered PR at hospital discharge to commence within 1 month of discharge

Structure & delivery

How is it set up?

- Twice weekly sessions for 6-12 weeks; attendance at minimum of 12 sessions recommended
- Can be cohort or rolling programme

Can you repeat PR?

- Yes, if done >1 year previously but can consider earlier if accelerated decline

References and suggested reading:

For prescribing information please refer to individual product SmPC.

1. Man W, Chaplin E, Daynes E, Drummond A, Evans RA, Greening NJ, Nolan C, Pavitt MJ, Roberts NJ, Vogiatzis I, Singh SJ. British Thoracic Society Clinical Statement on pulmonary rehabilitation. *Thorax*. 2023 Oct;78(Suppl 4):s2-s15. doi: 10.1136/thorax-2023-220439. PMID: 37770084.
 2. Bolton CE, Bevan-Smith EF, Blakey JD, Crowe P, Elkin SL, Garrod R, Greening NJ, Heslop K, Hull JH, Man WD, Morgan MD, Proud D, Roberts CM, Sewell L, Singh SJ, Walker PP, Walmsley S; British Thoracic Society Pulmonary Rehabilitation Guideline Development Group; British Thoracic Society Standards of Care Committee. British Thoracic Society guideline on pulmonary rehabilitation in adults. *Thorax*. 2013 Sep;68 Suppl 2:ii1-30. doi: 10.1136/thoraxjnl-2013-203808. PMID: 23880483.
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Asthma

Definition (GINA)

'Asthma is a heterogeneous disease, usually characterised by chronic airway inflammation. It is defined by the history of respiratory symptoms, such as wheeze, shortness of breath, chest tightness and cough, that vary over time and in intensity, together with variable expiratory airflow. Airflow limitation may become persistent'

Diagnosis [NICE 2024]

Clinical suspicion:

Symptoms (variable):

- Wheeze
- Shortness of breath
- Cough
- Chest tightness
- Noisy breathing

Supportive features:

- Triggered by allergens, exercise, cold air, infections
- Personal/family history of atopy (asthma, allergic rhinitis)

Confirm with objective evidence

- Blood eosinophils or FeNO
 - Diagnose if either:
 - Blood eosinophils (BEC): above laboratory reference range
 - OR
 - FeNO: ≥ 50 ppb
 - Increases FeNO levels: Allergic rhinitis, rhinovirus infection, being male, being tall, intake of dietary nitrates
 - Decreases FeNO levels: Smoking, being a child, inhaled or oral corticosteroids
- Bronchodilator Reversibility (BDR) (*if above not diagnostic*)
 - Diagnose if either:

For prescribing information please refer to individual product SmPC.

- FEV₁ increases $\geq 12\%$ AND ≥ 200 mL from baseline

OR

- FEV₁ increases $\geq 10\%$ of predicted normal
- Peak Expiratory Flow variability (*if BDR delayed/not possible*)
 - Measure twice daily for 2 weeks
 - Positive if amplitude percentage mean 20% or more
- Bronchial challenge test (if still uncertain)
 - Diagnosis if bronchial hyper-responsiveness
 - Measuring change in FEV₁ a set time after inhalation of methacholine or histamine, usually recorded as the provocation concentration (PC₂₀) or dose (PD₂₀) required to cause a 20% fall in FEV₁
 - A PC₂₀ of $< 8\text{mg/ml}$ is considered positive
 - False negative rate of methacholine test is $< 10\%$

Classification

- Severe Asthma
 - More than 2 asthma attacks a year OR persistent symptoms with SABA use more than twice a week despite specialist level therapy
- Difficult Asthma
 - Diagnosis of asthma exists and asthma like symptoms and asthma attacks persist despite prescription of high dose asthma therapy. High rates of alternative or co-existent diagnoses and psychological co-morbidity. Factors contributing: poor adherence, psychological, dysfunctional breathing, allergy

Monitoring

Assess at every review:

- Symptoms (daytime, nocturnal, activity limitation)
- Time off work
- Reliever inhaler use (check prescription record)
- Number of oral corticosteroid courses
- Hospital admissions or emergency department attendances due to asthma

Questionnaires

- Asthma Control Questionnaire (ACQ)
 - Reviews last 1 week of symptoms
- Asthma Control Test (ACT)
 - Reviews last 4 weeks of symptoms

PEFR

- Do not use routinely to monitor control
- Use as part of personalised asthma action plan or specific indication

FeNO monitoring

- Consider at routine review

For prescribing information please refer to individual product SmPC.

- Consider before and after treatment changes

If control suboptimal:

- Step up treatment as per pharmacological guidance

Treatment

Uncontrolled Asthma: Before Stepping Up Treatment

Check for reversible causes first:

- Incorrect diagnosis or comorbidities
- Poor adherence
- Poor inhaler technique
- Smoking (active/passive) or vaping
- Occupational exposures (consider occupational asthma)
- Psychosocial factors (i.e. anxiety, depression, social issues)
- Seasonal triggers
- Environmental exposures (i.e. air pollution, mould)

Check FeNO if available

- Raised FeNO suggest:
 - Poor adherence to ICS
 - Or
 - Need to increase ICS dose

NB: SABA-only treatment is no longer recommended in asthma

After treatment change

- Review response in 8-12 weeks
- Assess symptom control and exacerbation risk

Management:

What is the aim of asthma management?

- Complete control of symptoms
 - no daytime sx, no nighttime sx, no need for rescue medication, no asthma attacks, no limitation of activity, normal lung function, minimal side effects for medications

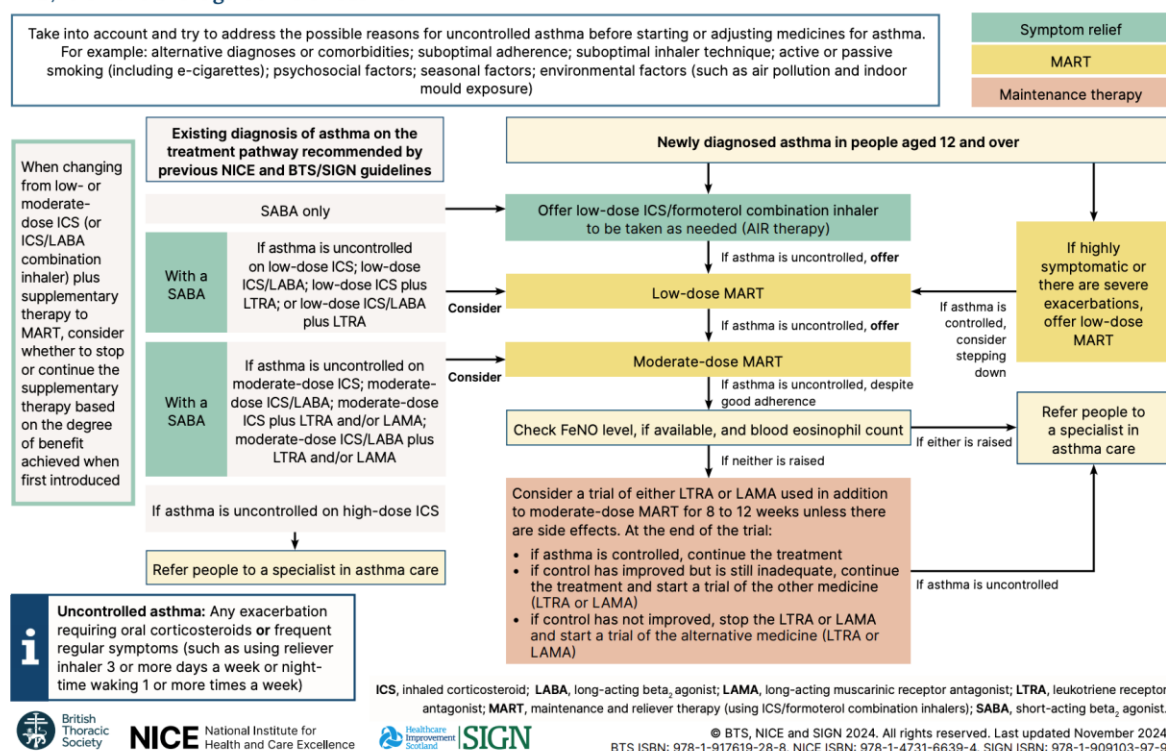
Treatment algorithm:

For prescribing information please refer to individual product SmPC.

UK-RES-2602137 September 2026

Only certain ICS/LABA inhalers are licensed for MART and/or as-needed AIR therapy, please refer to individual product SPCs for licensed indications.

Algorithm C: Pharmacological management of asthma in people aged 12 years and over BTS, NICE and SIGN guideline on asthma



Adapted from BTS/SIGN/NICE joint guidelines 2024

Biologic Therapies

Monoclonal antibodies:

Class	Drug	Dosing	Criteria	Continuation criteria
Anti-IL5	Mepolizumab	Every 4/52	BEC ≥ 300 cells/ul and 4 OCS OR BEC ≥ 300 cells/ul and continuous OCS >5 mg OR BEC ≥ 400 cells/ul and 3 OCS	Adequate response at 12 months: fewer severe exacerbations needing systemic corticosteroids and/or reduced maintenance OCS use with maintained or improved asthma control.
Anti-IL5	Reslizumab	Every 4/52 IV infusion	BEC ≥ 400 cells/ul OR ≥ 3 severe exacerbations needing OCS in last 12 months	Adequate response at 12 months: fewer severe exacerbations needing systemic corticosteroids and/or reduced maintenance OCS use with maintained or improved asthma control.

For prescribing information please refer to individual product SmPC.

Anti IL5R α	Benralizumab	Every 4/52 for first 3, then every 8 weeks	BEC $\geq$ 300 cells/ul and 4 OCS OR BEC $\geq$ 300 cells/ul and continuous OCS >5mg OR BEC $\geq$ 400 cells/ul and 3 OCS	Adequate response at 12 months: fewer severe exacerbations needing systemic corticosteroids and/or reduced maintenance OCS use with maintained or improved asthma control.
Anti IL4 R α	Dupilumab	Every 2/52	BEC $\geq$ 150 cells/ul, FeNO $\geq$ 25ppb and $\geq$ 4 exacerbations in the last 12 months Not eligible for anti-IL5/anti-IL5R α	50% reduction in rate of severe asthma exacerbations after 12 months
Anti TSLP	Tezepelumab	Every 4/52	$\geq$ 3 exacerbations in the previous year OR continuous OCS	A reduction in the rate of severe asthma exacerbations or maintenance OCS dose of 50% after 12 months
Anti-IgE	Omalizumab	Every 2/52 -4/52	<i>Sensitisation to perennial aeroallergen (house dust mite, mould)</i> AND <i>IgE 30-700</i> AND <i>$\geq$4 OCS in previous 12 months or continuous OCS</i>	Assessment after 16 weeks and continuation only in patients whose asthma has markedly improved

Adapted from NICE guidance (2,3,4,5,6,7)

Other treatments:

Bronchial thermoplasty:

- Aim to reduce bronchial smooth muscle mass thus reducing the capacity for bronchoconstriction
- Who is eligible?
 - High dose ICS
 - Non-smoker for > 1 year
 - FEV1 >60%
 - No life-threatening exacerbations
 - <3 hospitalisations
 - Willing to accept risk of asthma exacerbation post procedure
 - NB: increased rate of adverse events in the short term with more admissions to hospital in first 12 weeks following treatment, but by 12 months, no difference
 - C/I: <18 years, evidence of ILD, pacemaker

For prescribing information please refer to individual product SmPC.

Decreasing maintenance therapy:

- At annual review, discuss risks and benefits of stepping down treatment if asthma well controlled
- Involve patient, family or carer in decision-making
- When stepping down:
 - Reduce or stop treatments in logical order based on clinical benefit, side effects and patient preference
 - Wait 8–12 weeks between each step-down
 - In well-controlled patients on low-dose ICS + SABA or low-dose MART, step down to as-needed low-dose ICS/formoterol (AIR therapy)

Why are personalised asthma action plans useful?

- Reduce emergency use of healthcare resources
- Improves markers of asthma control

Other considerations:

Difficult asthma

- Factors contributing:
 - Poor adherence
 - Psychological factors
 - Dysfunctional breathing
 - Allergy
 - Monitoring airway response

Co-morbid Rhinitis:

- Patients with asthma often have rhinitis
- Most effective therapy: intranasal steroids

ABPA:

- Hypersensitivity to aspergillus reflected by high aspergillus specific IgE or positive aspergillus skin test
- Manifests as poorly controlled asthma but also in addition: fever, haemoptysis, malaise and expectoration of mucus plugs
- Can lead to development of bronchiectasis if left untreated
- Treatment for ABPA :
 - Corticosteroids and taper accordingly, itraconazole is second line

Aspirin intolerant asthma:

- Little evidence to suggest alternative treatment to normal asthma bar rigorous avoidance of NSAIDs
- Theoretical reasons to suggest LTRA may be of value

GORD:

- Treatment leads to reduction in cough but likely not due to better controlled asthma

For prescribing information please refer to individual product SmPC.

Beta Blockers:

- Beta blockers, including eye drops, contraindicated in patients with asthma

Monitoring:

- Agree how control will be monitored (symptoms, exacerbations, self-monitoring)
- Arrange follow-up review with healthcare professional
- Update personalised asthma action plan

Risk factors for poor asthma outcomes

- Treatment non-adherence
- Overuse of SABA (>2 inhalers per year)
- ≥ 2 courses of oral corticosteroids per year
- ≥ 2 or more visits to ED/hospital admission for asthma

Acute Asthma

Asthma Attacks

Classification:

Classification	Criteria
Moderate acute asthma	Increasing symptoms PEF >50-75% best or predicted No features of acute severe asthma
Acute severe asthma	Any one of: PEF 33-50% best or predicted RR ≥ 25 /min HR ≥ 110 /min Inability to complete sentences in one breath
Life threatening asthma	Any one of the following in a patient with severe asthma: Altered consciousness level Exhaustion Arrhythmia Hypotension Cyanosis Silent chest poor respiratory effort PEF <33% best or predicted SpO ₂ <92% PaO ₂ <8kPa 'normal' PaCO ₂ (4.6-6 kPa)
Near fatal asthma	Raised PaCO ₂ and/or requiring mechanical ventilation with raised inflation pressures

Who requires hospital admission?

- Patients with features of near fatal, life threatening or acute severe asthma that does not resolve after initial treatment should be admitted
- Admission may also be appropriate when PEF has improved to > 75% best or predicted after initial treatment but concerns re:

For prescribing information please refer to individual product SmPC.

- Continuing to have significant symptoms
- Concerns about adherence
- Living alone/socially isolated
- Psych issues
- Previous near fatal asthma
- Asthma attack despite adequate corticosteroids
- Presentation at night
- Pregnancy

Who are the patients at risk of developing near fatal or fatal asthma

- Previous near fatal asthma
- Previous admission for asthma (particularly in last year)
- Requiring 3 or more classes of asthma medication
- Heavy SABA use
- Repeated attendances at ED for asthma care – particularly in last year

AND adverse behavioural/psychosocial features recognised by one or more of:

- Non-adherence with treatment or monitoring
- Failure to attend appts
- Fewer GP contacts
- Frequent home visits
- Self-discharge from hospital
- Psychosis, depression, other psych illness and deliberate self-harm
- Current or recent major tranquilizer use
- Denial
- Alcohol or drug abuse
- Obesity
- LD
- Employment problems / income problems
- Social isolation
- Childhood abuse
- Severe domestic marital or legal stress

What is the seasonal variation seen with asthma related deaths?

- Peak of asthma deaths in July/August in people up to 44 years
- Peak of asthma deaths in Dec/January in older people

Management of acute asthma

- SABA and SAMA via nebuliser
 - Combining nebulised ipratropium bromide with nebulised SABA produces significantly greater bronchodilatation than Beta agonist alone, leading to faster recovery and reduced duration
- Steroids
 - Steroids - reduce mortality, reduce relapse, reduce subsequent hospital admissions, reduce requirement of beta agonist therapy. Should be given for a minimum of 5 days

For prescribing information please refer to individual product SmPC.

- MgSO₄
 - A single dose of MgSO₄ IV is safe and may improve lung function and reduce intubation rates with acute severe asthma – may also reduce admission
 - Can give to those with acute severe
- Aminophylline
 - In acute asthma IV aminophylline not likely to result in additional bronchodilatation c/w standard care with inhaled bronchodilators and steroids
 - Side effects include vomiting and arrhythmias
 - Levels need to be checked
- LTRA
 - No benefit in acute asthma
- Abx:
 - Infection precipitating an asthma attack, arrhythmias, usually viral, routine antibiotics not recommended
- IVF:
 - Some require rehydration and correct electrolyte imbalance
- Critical Care:
 - Should be utilised for those requiring ventilatory support, deterioration PEFR, persistent or worsening hypoxia, hypercapnia, ABG showing low pH, exhaustion, drowsiness, altered consciousness, respiratory arrest
 - Ketamine- potential bronchodilator
 - ECMO- can be considered if needed. Survival to discharge 83.5% but complication rates high
- CXR
 - Not routinely recommended in absence of: suspected pneumothorax/suspected consolidation/life threatening risk/failure to respond to treatment/requiring ventilation
- Can use predicted PEFR if best PEFR for last 2 years not known
- Heavy or increasing use of SABA associated with asthma death
- Prescription of 12 or more SABA inhalers a year should prompt review
- Previous NRAP report highlighted increased risk of death within one month of discharge from hospital – hence need for follow up on discharge

What factors increase a patient's risk for future asthma attacks?

Highest

- Previous asthma attacks increase risk of future

Moderate

- Poor control (assess with ACT/ACQ)
- Inappropriate or excess SABA use

Slight

- Old age
- Female
- Reduced lung function
- Obesity

For prescribing information please refer to individual product SmPC.

Discharge:

- Evidence suggest that PEFR <75% best or PEFR diurnal variability >25% more likely to have early relapse and readmission
 - Criteria for discharge: PEFR $\geq$ 75% 24 hours off nebulisers
- Should have asthma education prior to discharge

Special situations (pregnancy & breastfeeding)

Asthma in pregnancy

- Asthma review in early pregnancy and post-partum – important to maintain good control
- Very variable: 1/3 experience improvement, 1/3 worsen, 1/3 remain the same
 - Severe asthma more likely to worsen in pregnancy than mild asthma
- Consider use of the following medications: SABA, ICS/LABA, oral theophylline (please refer to individual product SPCs for licensed indications)
- Oral corticosteroids should be given as normal
- Remember pregnancy leads to progesterone driven increase in minute ventilation which may lead to relative hypocapnia and respiratory alkalosis and increase PaO₂ but O₂ saturations are unaltered
- Maintenance therapy:
 - Consider use of the following medications: SABA, ICS/LABA, oral theophylline (please refer to individual product SPCs for licensed indications)
 - Do not stop leukotriene receptor antagonists if required for control
 - Do not stop long-acting muscarinic receptor antagonists if required for control
- Treat exacerbations as usual:
 - Offer oral corticosteroids if indicated
 - Advise that benefits outweigh risks
 - Low threshold for ICU referral – NB: In late pregnancy reduced FRC may result in earlier desaturation

Breastfeeding

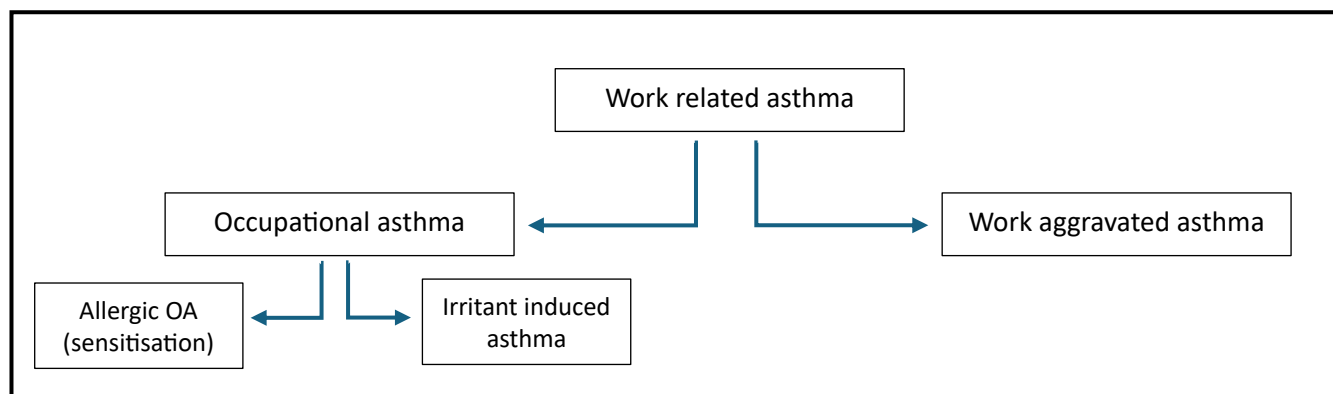
- Use all medication as normal

References and suggested reading:

1. Asthma: diagnosis, monitoring and chronic asthma management (BTS, NICE, SIGN). London: National Institute for Health and Care Excellence (NICE); 2024 Nov 27. PMID: 39937939.
2. Omalizumab for treating severe persistent allergic asthma. NICE 2013 [TA278]
3. Mepolizumab for treating severe refractory eosinophilic asthma. NICE 2021 [TA671]
4. Reslizumab for treating severe eosinophilic asthma NICE 2017 [TA479]
5. Benralizumab for treating severe eosinophilic asthma. NICE 2019 [TA565]
6. Tezepelumab for treating severe asthma. NICE 2023 [TA880]
7. Dupilumab for treating severe asthma with type 2 inflammation. NICE 2021 [TA751]

For prescribing information please refer to individual product SmPC.

Work related asthma



Adapted from Barber CM et al. 2022

- Need to delineate difference between occupational asthma (OA) and work aggravated asthma
 - OA:
 - patient is sensitised to an agent in the workplace – i.e. if they did not do that job, they would not have asthma
 - Work aggravated asthma:
 - either patient has pre-existing asthma OR develops co-incidental asthma and reports symptoms made worse by non-specific factors in the workplace (i.e. temp/humidity, non-specific dusts/fumes)

	Occupational Asthma	Work Aggravated
Latency (min)	Yes (6-24 months)	No
Latency max	Yes	No
Work relationship	No clear difference	No clear difference
Ophthalmic/Nasal symptoms	Yes (High molecular weight)	No clear relationship
Continued exposure	Worsens prognosis	No effect
Treatment	Useless	Effective
Respiratory protective equipment	Often useless	Effective
IIDB	Yes	No

Occupational Asthma

Occupational exposures account for 1 in 6 asthma cases in adults of working age

Most common cause?

- Flour dust
- Isocyanates

Diagnosis

- Often diagnosed late, delay of 4 years on average
- Note: easier to make diagnosis *prior* to work-based adaptations etc
- Key Qs:

For prescribing information please refer to individual product SmPC.

- *Are your symptoms the same, better or worse on days away from work?*
 - *Are symptoms the same, better or worse when on holiday (time away from work, longer than usual breaks, at weekends or between shifts)?*
- Symptomatic patients in high-risk jobs or those reporting improvement on days away from work should be referred for specialist assessment

Objective tests:

- Skin prick tests and specific IgE
 - If present confirms sensitisation but not presence of OA
 - Better for HMW particles with clear immunological mechanism
- PEFR:
 - 4 evenly spaced readings a day (prebronchodilator and best of 3) so 2 within working hours for at least 3 weeks, ideally also sustained period away from work within the period
- Non-specific bronchial hyperresponsiveness testing
 - Reduced sensitivity for OA
 - Can be useful in symptomatic workers with recent exposures, tested within a few hours of leaving work, where the absence of non-specific bronchial hyperresponsiveness makes OA unlikely
- Specific inhalation challenges
 - Though important not widely available
- Spirometry – all should have

Management

- Best opportunity for improved asthma: early and complete cessation of exposure to the cause – where consent given directly liaising with occupational health (OH) provider
- Standard asthma therapy
- Written information confirming diagnosis – implication in jobs and Industrial Injuries Disablement Benefit (IIDB)
- Report to SWORD- Surveillance of work related and occupational respiratory diseases

Prognosis

- 1 in 6 patients with OA meet criteria for severe asthma
- Prognosis largely depends on severity at diagnosis and whether continual exposure after; those with continual exposure at risk of accelerated lung function decline which may result in fixed airway obstruction
- Approx. 25-30% with OA that cease exposure will achieve full recovery
- Approx. 30-35% will report reduction in symptoms with treatment
- Increased risk of unemployment with OA- 1 in 3 out of work 3-5 years after diagnosis
- Approx. 50% patients with OA have anxiety and/or depression

References and suggested reading:

1. Barber CM, Cullinan P, Feary J, Fishwick D, Hoyle J, Mainman H, Walters GI. British Thoracic Society Clinical Statement on occupational asthma. Thorax. 2022 May;77(5):433-442. doi: 10.1136/thoraxjnl-2021-218597. Epub 2022 Mar 21. PMID: 35314486.

For prescribing information please refer to individual product SmPC.

2. Asthma: diagnosis, monitoring and chronic asthma management (BTS, NICE, SIGN).
London: National Institute for Health and Care Excellence (NICE); 2024 Nov 27. PMID: 39937939.

Abbreviations

Abbreviation	Full Term	Explanation
AAA	Abdominal Aortic Aneurysm	Localised dilation of the abdominal aorta
ABG	Arterial Blood Gas	Blood test assessing oxygenation, ventilation, and acid-base status
ACQ	Asthma Control Questionnaire	Tool assessing asthma control over 1 week
ACT	Asthma Control Test	Questionnaire assessing asthma control over 4 weeks
AF	Atrial Fibrillation	Irregular heart rhythm
BDR	Bronchodilator Reversibility	Test assessing improvement in airflow after bronchodilator
BEC	Blood Eosinophil Count	Marker of eosinophilic inflammation
BMI	Body Mass Index	Measure of body fat based on height and weight
BODE	BMI, Obstruction, Dyspnoea, Exercise	COPD prognostic scoring system
CAT/CAAT	COPD Assessment Test/ Chronic Airways Assessment Test	Questionnaire assessing COPD/ Chronic Airways Disease Impact
CCQ	Clinical COPD Questionnaire	Tool measuring COPD symptoms and functional state
COPD	Chronic Obstructive Pulmonary Disease	Progressive inflammatory lung disease causing airflow limitation
CRQ	Chronic Respiratory Questionnaire	Research tool assessing respiratory quality of life
CXR	Chest X-ray	Imaging of thoracic structures
DECAF	Dyspnoea, Eosinopenia, Consolidation, Acidaemia, Atrial Fibrillation	Score predicting mortality in COPD exacerbations
DLCO	Diffusing Capacity of the Lung for Carbon Monoxide	Measures gas transfer in lungs
ECG	Electrocardiogram	Measures electrical activity of the heart
ECMO	Extracorporeal Membrane Oxygenation	Advanced life support for severe respiratory failure
EBV	Endobronchial Valve	Device used in lung volume reduction
ED	Emergency Department	Hospital emergency care setting
FeNO	Fractional Exhaled Nitric Oxide	Marker of airway inflammation
FEV ₁	Forced Expiratory Volume in 1 Second	Volume exhaled in first second of forced breath
FVC	Forced Vital Capacity	Total volume exhaled forcefully
GOLD	Global Initiative for Chronic Obstructive Lung Disease	International COPD guideline body
HR	Heart Rate	Beats per minute

For prescribing information please refer to individual product SmPC.

HRCT	High-Resolution Computed Tomography	Detailed CT imaging of lungs
ICS	Inhaled Corticosteroid	Anti-inflammatory inhaled medication
IgE	Immunoglobulin E	Antibody associated with allergic responses
IL	Interleukin	Immune system signaling molecule
ISWT	Incremental Shuttle Walk Test	Exercise capacity test
LABA	Long-Acting Beta Agonist	Long-acting bronchodilator
LAMA	Long-Acting Muscarinic Antagonist	Long-acting bronchodilator
LD	Learning Disability	Cognitive impairment affecting learning
LTOT	Long-Term Oxygen Therapy	Oxygen therapy for chronic hypoxia
LTRA	Leukotriene Receptor Antagonist	Anti-inflammatory asthma medication
LVRS	Lung Volume Reduction Surgery	Surgical removal of diseased lung tissue
mMRC	Modified Medical Research Council Dyspnoea Scale	Breathlessness scoring system
MRC	Medical Research Council	Breathlessness scale
NIV	Non-Invasive Ventilation	Ventilatory support without intubation
NSAID	Non-Steroidal Anti-Inflammatory Drug	Medication class (e.g., ibuprofen)
OA	Occupational Asthma	Asthma caused by workplace exposure
OCS	Oral Corticosteroids	Systemic steroid medication
PaCO ₂	Partial Pressure of Carbon Dioxide	Measure of CO ₂ in blood
PaO ₂	Partial Pressure of Oxygen	Measure of oxygen in blood
PC ₂₀	Provocation Concentration	Concentration causing 20% fall in FEV ₁
PD ₂₀	Provocation Dose	Dose causing 20% fall in FEV ₁
PEFR	Peak Expiratory Flow Rate	Maximum speed of expiration
PR	Pulmonary Rehabilitation	Exercise and education programme
PRISm	Preserved Ratio Impaired Spirometry	Abnormal spirometry with normal ratio
QOL	Quality of Life	Measure of patient wellbeing
QTc	Corrected QT Interval	ECG measure of cardiac repolarisation
RV	Residual Volume	Air remaining after full exhalation
SABA	Short-Acting Beta Agonist	Quick-relief bronchodilator
SAMA	Short-Acting Muscarinic Antagonist	Short-acting bronchodilator
SaO ₂	Oxygen Saturation	Percentage of oxygenated haemoglobin
SGRQ	St George's Respiratory Questionnaire	Respiratory quality of life tool
SOB	Shortness of Breath	Symptom of breathlessness
SWORD	Surveillance of Work-related and Occupational Respiratory Disease	UK reporting system
TLCO	Transfer Factor of Lung for Carbon Monoxide	Gas transfer measurement
µL	Microlitre	Unit of volume
U&E	Urea and Electrolytes	Blood test assessing kidney function

For prescribing information please refer to individual product SmPC.