Respiratory system

Contents:

For full information on treatment, side effects, cautions and contraindications, see electronic British National Formulary (www.bnf.org) or the relevant summary of product characteristics (www.medicines.org.uk).

For information on preparing intravenous medicines for administration, see Medusa Injectable Medicines Guide for the NHS (see Clinical Guidance home page)

1. Asthma — acute exacerbations

Initial treatment consists of three components:

i) Oxygen
ii) Nebulised bronchodilators
iii) Corticosteroids

NOTE: If an infective cause is implicated in an exacerbation, it is usually viral. Therefore, routine prescribing of antibiotics for asthma exacerbations is not warranted.

i) Oxygen

Oxygen 40% to 60% via a Venturi mask or nasal cannulae. Adjust concentration to achieve a target saturation of 94–98%.
NOTE: Oxygen is a drug and must be prescribed on the electronic prescribing system for all inpatients.

ii) Nebulised bronchodilators

First choice
Salbutamol 5mg, via an oxygen-driven nebuliser, stat and then every 4 to 6 hours; for life-threatening exacerbations, can be given every 15 to 30 minutes

Second choice — for patients who cannot tolerate salbutamol
Terbutaline 10mg, via an oxygen-driven nebuliser, stat and then every 4 to 6 hours; for life-threatening exacerbations, can be given every 15 to 30 minutes

For patients with acute severe asthma or poor initial response to the treatments above — add
Ipratropium bromide 500micrograms, via an oxygen-driven nebuliser, stat and then every 4 to 6 hours

iii) Corticosteroids

First choice
Prednisolone 40mg, orally, stat and then daily (in the morning) for at least 5 days or until recovery

Second choice, if the oral route is not available
Hydrocortisone sodium succinate 100mg, by IV injection, stat and then every 6 hours. Therapy should be reviewed daily and switched to oral prednisolone as soon as the oral route is available.

Following recovery, the dose of prednisolone can be stopped abruptly unless the patient:
- Is usually prescribed a maintenance dose of prednisolone
- Has received treatment for longer than 3 weeks
- Has received doses greater than 40mg daily
- Has received repeated doses in the evenings
- Has taken a short course within 1 year of stopping long-term therapy
- Has received repeated courses (especially if taken for longer than 3 weeks)
- Has other factors pre-disposing to adrenal suppression (eg, Addison's disease)

iv) Other treatments (on recommendation of senior medical staff ONLY)

For severe or life-threatening exacerbations that are resistant to initial treatment
Magnesium sulphate 50% 1.2 to 2g, by IV infusion, in 100mL sodium chloride 0.9% over 20 minutes as a single dose.

For refractory cases

Aminophylline by IV infusion — see below for preparation and dosing advice
Or
Salbutamol by IV infusion — see below for preparation and dosing advice

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Aminophylline: preparation and dose
Loading dose: 250 to 500mg (5mg/kg), by IV infusion, as a loading dose in 100mL sodium chloride 0.9% over at least 20 mins.
NOTE: This loading dose is not required for patients already taking theophylline.

Then, for maintenance treatment: 500micrograms/kg/hour, by continuous IV infusion. Dilute 500mg in 500mL sodium chloride 0.9%. Prescribe with the rate specified in mL/hour (see below). Subsequent bags will need to be prescribed depending on the duration of therapy. Theophylline levels **MUST** be checked 12 to 24 hours after starting the infusion and the dose adjusted accordingly (therapeutic range: 10–20mg/L). For more information, see **Therapeutic Drug Monitoring – theophylline and aminophylline**

Infusion rates (mL/hour) for a 500mg/500mL solution

	Body weight (kg)						
Dose	40	50	60	70	80	90	100
500 micrograms/kg/hour	20	25	30	35	40	45	50

NOTE: There are numerous drug-drug and drug-disease interactions with aminophylline — contact pharmacy for further advice

Salbutamol: preparation and dose
Starting dose: 5micrograms/minute, by continuous IV infusion. Adjust dose according to response; infusion rates of 3 to 20 micrograms/minute are usually adequate but in patients with respiratory failure higher doses may be required. Dilute 5mg in 500mL sodium chloride 0.9% or glucose 5%.

Infusion rates (mL/hour) for a 10 micrograms/mL solution:

Dose (micrograms/minute)	Infusion rate (mL/hour)
3	18
5	30
7.5	45
10	60
15	90
20	120
30	180

Discharge from hospital
Prior to discharge, patients should have:
- Been interviewed to try to elicit the reason for the exacerbation
- Been taking their discharge medication for at least 24 hours
- Had their inhaler technique checked and recorded within their hospital notes
- Have a Peak Expiratory Flow (PEF) that is >75% of their best or predicted flow rate and have < 25% diurnal variability in their PEF
- Been prescribed a short course of oral corticosteroids and long-term treatment with inhaled corticosteroids and bronchodilators
- Been issued with their own peak flow meter and, whenever possible, a written action plan (a copy of this should be sent to their GP)

Follow up appointments should be arranged with:

- **The patient's GP or asthma nurse within 2 working days**
- **A respiratory clinic within 4 weeks**

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2. Asthma — chronic

For details of treatment and which medicine to choose, see the clinical guideline **Asthma – chronic management (adults)**

Severe cases (ONLY when response is poor to other treatments)
NOTE: To be initiated by respiratory consultants ONLY.
Methotrexate 7.5mg, orally, once weekly; increase dose up to a maximum of 15mg weekly. See shared care guideline for **Methotrexate for asthma and sarcoidosis (adults)**
NOTE: Unlicensed indication.
And
Folic acid 5mg, orally, once weekly taken 3 days after the methotrexate dose.

Or
Omalizumab dose as per clinical guideline

For information on when to prescribe nebulisers for patients to use at home, see section 15 of this chapter **(Domiciliary nebulised bronchodilators)**.

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3. Chronic obstructive pulmonary disease — acute exacerbations

Smoking cessation
Smoking cessation is the most significant intervention that can be made at any stage of chronic obstructive pulmonary disease (COPD).
See more information on smoking cessation (including nicotine replacement therapy) in the "Nicotine replacement therapy" section of **Medicines Formulary — Central Nervous System.**

Initial treatment consists of:
i) Oxygen
ii) Nebulised bronchodilators
iii) Corticosteroids
iv) Oral antibiotics
v) Other treatments

i) Oxygen

Oxygen 24–28%, via a Venturi mask or nasal cannulae. Adjust concentration to achieve a target saturation of 88–92%.
NOTE: Oxygen is a drug and must be prescribed on the electronic prescribing system for all inpatients.

ii) Nebulised bronchodilators

First choice
Salbutamol 5mg, via an air-driven nebuliser, stat and then every 4 to 6 hours
And
Ipratropium bromide 500micrograms, via an air-driven nebuliser, stat and then every 4 to 6 hours (do not use tiotropium concurrently)

Second choice — change salbutamol for
Terbutaline 10mg, via an air-driven nebuliser, stat and then every 4 to 6 hours;

iii) Corticosteroids

Prednisolone 30mg, orally, stat and then daily (in the morning) for 7 to 14 days.
Or, if the oral route is unavailable
Hydrocortisone sodium succinate 100mg, by intravenous injection, stat and then every 6 hours. Therapy should be reviewed daily and switched to oral prednisolone as soon as the oral route is available.

Following recovery, the dose of prednisolone can be stopped abruptly unless the patient:
- Is usually prescribed a maintenance dose of prednisolone
- Has received treatment for longer than 3 weeks
- Has received doses greater than 40mg daily

- Has received repeated doses in the evenings
- Has taken a short course within 1 year of stopping long-term therapy
- Has received repeated courses (especially if taken for longer than 3 weeks)
- Has other factors pre-disposing to adrenal suppression (eg, Addison's disease)

iv) Oral antibiotics (if exacerbation is infective)

Antibiotics should be prescribed if there are 2 out of the following 3 criteria present:
- Increased breathlessness
- Increased sputum production
- Increased sputum purulence

For advice on antibiotic choice, see **Antibiotic Formulary.**

v) Other treatments (on recommendation of senior medical staff ONLY)

For refractory cases
Aminophylline by IV infusion — see below for preparation and dosing advice

Preparation and dose
Loading dose: 250 to 500mg (5mg/kg), by IV infusion, as a loading dose in 100mL sodium chloride 0.9% over at least 20 mins.
NOTE: This loading dose is not required for patients already taking theophylline.

Then, for maintenance treatment: 500micrograms/kg/hour, by continuous IV infusion. Dilute 500mg in 500mL sodium chloride 0.9%. Prescribe with the rate specified in mL/hour (see below). Subsequent bags will need to be prescribed depending on the duration of therapy. Theophylline levels **MUST** be checked 12 to 24 hours after starting the infusion and the dose adjusted accordingly (therapeutic range: 10–20mg/L). For more information, see **Therapeutic Drug Monitoring – theophylline and aminophylline**

Infusion rates (mL/hour) for a 500mg/500mL solution

	Body weight (kg)						
Dose	40	50	60	70	80	90	100
500 micrograms/kg/hour	20	25	30	35	40	45	50

NOTE: There are numerous drug-drug and drug-disease interactions with aminophylline — contact pharmacy for further advice

For patients requiring non-invasive ventilation but for whom it is contraindicated or not available
Doxapram Use the 1g/500mL (in glucose 5%) ready made infusion and give IV as follows:
- From 0–15mins: 4mg/min (120mL/hour)
- From 15–30mins: 3mg/min (90mL/hour)
- From 30–60mins: 2mg/min (60mL/hour)
- From 60mins (until condition improves or stabilises): 1.5mg/min (45mL/hour)

Guidance on when to admit patients to ITU, when to use non-invasive ventilation and when to consider support for early discharge is under development.

Discharge Planning

- Patients should be re-established on their optimal maintenance bronchodilator therapy before discharge
- Patients that have had an episode of respiratory failure should have satisfactory oximetry or arterial blood gas results before discharge
- Patients (or carers) should be given appropriate information to enable them to fully understand the correct use of medicines (including oxygen) before discharge

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4. Chronic obstructive pulmonary disease — stable/chronic

Smoking cessation is the most significant intervention that can be made at any stage of COPD. For more information on smoking cessation (including nicotine replacement therapy), see the "Nicotine replacement therapy" section of the **Medicines Formulary — Central Nervous System**

Management of this condition is categorised as:

i) Mild-to-moderate disease (FEV1 more than 50% of predicted value)
ii) Severe disease (FEV1 less than 50% of predicted value)

For details on the treatment of COPD and which medicine to choose, see the clinical guideline-**Wirral COPD Prescribing Guidelines** and the **Wirral COPD Supplementary Information**.

For more information on diagnosing and managing COPD, see **NICE clinical guideline 101: Chronic obstructive pulmonary disease (update)** and the **Global Strategy for the Diagnosis, Management and Prevention of COPD, Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2016.**

For information on when to prescribe nebulisers for patients to use at home, see section 15 of this chapter **(Domiciliary nebulised bronchodilators).**

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5. Long-term oxygen therapy

Long-term oxygen therapy (LTOT) is indicated for the following conditions with chronic hypoxaemia:

- COPD
- Severe chronic asthma
- Interstitial lung disease
- Cystic fibrosis
- Bronchiectasis
- Pulmonary vascular disease

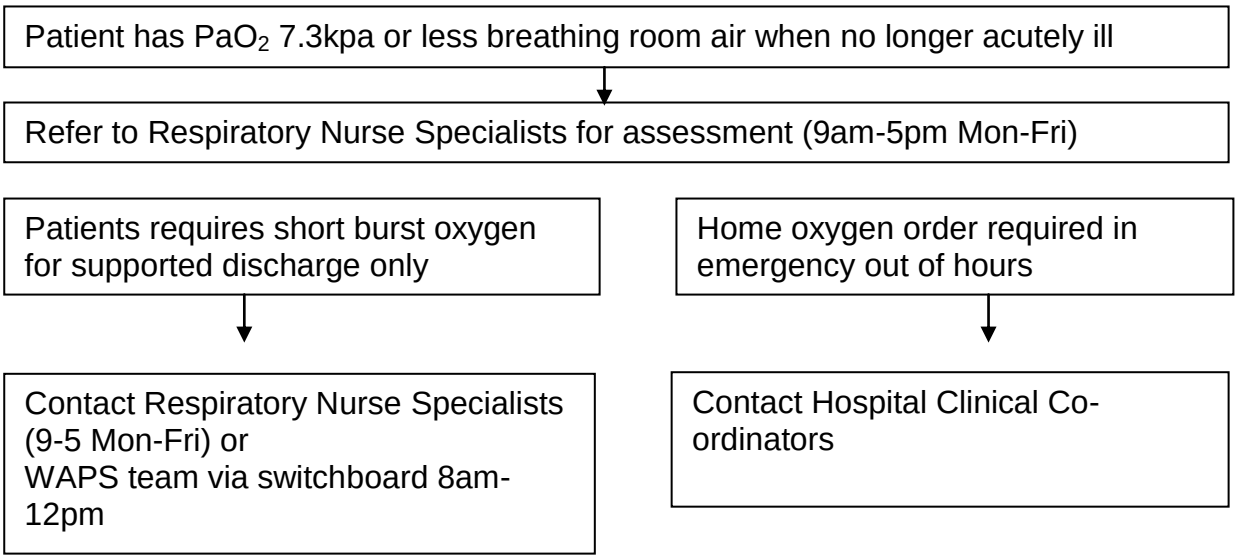
- Primary pulmonary hypertension
- Pulmonary malignancy
- Chronic heart failure

LTOT should be prescribed after appropriate assessment when the patient's $Pa0_2$ is consistently at or below 7.3kpa when breathing air during a **period of clinical stability**. Clinical stability is defined as the absence of exacerbation of chronic lung disease for the previous five weeks.
The level of $PaC0_2$ does not influence the need for LTOT prescription.

LTOT can also be prescribed for patients who have a clinically stable $Pa0_2$ between 7.3-8.0kpa, together with one of the following:

- Secondary polycythaemia
- Clinical or echocardiographic evidence of pulmonary hypertension

NOTE: LTOT should not be prescribed for patients with PaO_2 greater than 8.0kpa.
All patients requiring LTOT should be referred to the Specialist Respiratory Nurses for formal assessment:



Reference: BTS (2006) Clinical Component for the Home Oxygen Service in England and Wales.

6. Smoking cessation (use of nicotine replacement therapy)

For information on smoking cessation products, see the "Smoking cessation" section (section 17) of the **Medicines Formulary — Central Nervous System.**

7. Bronchiectasis

Further information on bronchiectasis is under development.

See shared care guideline: **Colistin – nebulised use in bronchiectasis (adults)**

8. Allergy (symptomatic relief)

Antihistamines are useful in the treatment of nasal allergies, hay fever, urticarial rashes, drug allergies and insect bites. The sedating activity of the older antihistamines (e.g. chlorphenamine) can be used to manage the pruritus associated with some allergies. Non-sedating antihistamines (e.g. cetirizine) cause less sedation and psychomotor impairment, though have not been shown to offer improved efficacy. Cetirizine should only be used where chlorphenamine is not appropriate.

For a sedating antihistamine
Chlorphenamine 4mg, orally, every 4 to 6 hours. Maximum 24mg in 24 hours.

For a non-sedating antihistamine
Cetirizine 10mg, orally, daily or 5mg twice daily.

Primary care
Use non-sedating antihistamines as first choice

9. Allergic emergencies

Anaphylactic shock requires prompt treatment of laryngeal oedema, bronchospasm and hypotension.

All patients should recline in a comfortable position (lying flat may be helpful for hypotension but unhelpful for dyspnoea).

Consider as necessary
Oxygen should be administered at high flow rates (10 to 15L per minute).

For patients with clinical signs of shock, airway swelling or dyspnoea
Adrenaline (epinephrine) 500micrograms by IM injection (give 0.5mL of 1 in 1,000 injection). The dose can be repeated after 5 minutes if there is no clinical improvement or if the patient deteriorates. In some cases several doses may be required, particularly if the improvement is transient.
And
Chlorphenamine 10mg, by IV or IM injection, after adrenaline has been administered. Then continue orally (4mg every 4 to 6 hours) for 48 hours to prevent relapse.

NOTE: IV administration of adrenaline (epinephrine) is hazardous. It should only be used in patients with profound shock that is immediately life threatening and for special

circumstances (e.g. during anaesthesia). When giving adrenaline (epinephrine) by the intravenous route, the more dilute 1:10,000 solution is used.

To prevent further deterioration
An intravenous corticosteroid (**hydrocortisone**) may help prevent further deterioration in severely affected patients and in asthmatics (who are at increased risk of severe or fatal anaphylaxis) if they have been treated with corticosteroids previously. It is of little value as first-line therapy due to its delayed onset of action.

NOTE: If an allergic reaction is believed to have been caused by a medicine, document the allergy in the patient's medical record and on the electronic prescribing system.

Primary care
For patients who administer their own treatment
Adrenaline (epinephrine) 300 - 500 micrograms, by IM injection, as needed from pre-filled syringe (ie **Epipen®, Jext® or Emerade®**).

Patients should be trained to use the particular auto-injector that they have been prescribed. Injection technique varies between injectors (MHRA 2014).

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10. Acute cough

Acute viral cough usually does not require any prescribed treatment. There is little evidence that any of the over-the-counter cough preparations have a specific pharmacological effect.
Demulcent cough preparations (such as simple linctus) contain syrup or glycerol and may, in some patients, relieve a dry irritating cough. Menthol crystals may be used as an inhalation although cough suppression is acute and short lived.

Simple linctus 5mL, orally, three to four times daily.

The opiate antitussives (codeine and pholcodine) are **no longer recommended** as they have a significant adverse effect profile.

Primary Care
Over the counter combination preparations containing dextromethorphan or sedative antihistamines may be of use. These are not prescribable on the NHS but can be purchased over the counter.
Alternatively, patients can be simply advised to use a "home remedy" such as lemon and glycerin.

Reference: The British Thoracic Society. The BTS recommendations for cough management in adults. August 2006 www.brit-thoracic.org.uk

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11. Nasal congestion

An oral decongestant is recommended to treat nasal congestion as it is less likely to cause rebound nasal congestion when the treatment is withdrawn (as is the case for topical nasal decongestants).

Pseudoephedrine 60mg orally every four to six hours (maximum 60mg four times daily)

NOTE: Oral decongestants should be avoided in patients who:

- **Have hypertension**
- **Have ischaemic heart disease**
- **Are prescribed monoamine oxidase inhibitors (eg, phenelzine, isocarboxazide, tranylcypromine)**

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12. Pulmonary fibrosis

Prednisolone 0.5mg/kg, orally, daily (in the morning); tapering over 3 months to 0.125mg/kg/day
And
Azathioprine 2-3mg/kg, orally, daily; titrate to a maximum of 150mg/day
And
N-acetylcysteine 600mg, orally, three times daily (unlicensed)

See the following shared care guidelines for further information:
Azathioprine – orally for pulmonary fibrosis (adults)
Acetylcysteine – orally for idiopathic pulmonary fibrosis (adults)

NOTE: Osteoporosis prophylaxis should be prescribed for patients maintained long-term on oral corticosteroids.
The routine prescribing of inhaled therapy has no role in managing pulmonary fibrosis.

Reference: The British Thoracic Society (BTS) Interstitial Lung Disease Guideline 2008.
http://www.brit-thoracic.org.uk/clinical-information/interstitial-lung-disease-(dpld)/interstitial-lung-disease-(dpld)-guideline.aspx

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13. Blocked chest drain (use of fibrinolytic drugs)

If a chest drain becomes blocked and pus is unable to drain, then flushing with 20 to 50mL sodium chloride 0.9% may ensure its patency. If this fails, intrapleural fibrinolytic administration may be considered for some patients to improve pleural drainage.

However, **intrapleural fibrinolytics should ONLY be used on the recommendation of a Respiratory Consultant.**

The choice of treatment depends on whether or not the patient has received streptokinase before.

For patients who **HAVE NOT** received streptokinase before
Streptokinase 250,000 units (in 50ml sodium chloride) twice a day for three days.
NOTE: Give all patients a streptokinase exposure card and ensure they are aware that they should not receive streptokinase again, irrespective of its route of administration.

For patients who **HAVE** received streptokinase before
Patients should receive **alteplase** or **tenecteplase** as an alternative (contact a Respiratory Consultant for advice on contraindications, preparation or administration).

Post-fibrinolytic review — ALL patients
Patients with pleural infection who require a fibrinolytic should be reviewed 5 to 7 days after initial insertion of the chest drain regarding its removal. If the patient is better (ie, fluid drained, fever and sepsis improved) then the chest drain can be removed.
If the patient is not better, consider reviewing the diagnosis or consulting with a cardiothoracic surgeon.

Reference and for further information: British Thoracic Society Guidelines for the Management of pleural infection. Thorax 2003;58 (Suppl II):ii18-28.

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14. Malignant pleural effusions

It is important that advice is sought from a Respiratory Consultant within the Trust before treating any patient with a malignant pleural effusion. All subsequent prescribing of sclerosing agents must be carried out only on the advice of a Respiratory Consultant.

Sclerosing agents ***(Respiratory Consultant initiation only)***

Talc (sterile) slurry 4g, given intrapleurally, in 40mL sodium chloride 0.9% as a single dose (unlicensed)
Or
Doxycycline 500mg, given intrapleurally, as a single dose (unlicensed)

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15. Domiciliary nebulised bronchodilators

Before considering giving domiciliary nebulised bronchodilators:
- Review and confirm the diagnosis; only consider home nebulisers for severe asthmatics or COPD patients
- Maximise inhaled therapy, a sequential trial of the following should be tried:
  - Short-acting beta$_2$ agonist

  - Long-acting $beta_2$ agonist
  - Corticosteroids
  - Oral modified release theophylline preparation
- Explore other methods of drug administration (eg, using 1 puff of metered dose inhaler via a spacer device, repeated 10-20 times)
- Review inhaler technique and compliance with therapy
- Demonstrate increased bronchodilation with acceptable side effects
- Contact Respiratory Nurses