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Guideline for Emergency Oxygen Use in Adult Patients: Executive Summary

British Thoracic Society

www.brit-thoracic.org.uk

The logo for the Association of Respiratory Nurse Specialists (ARNS), featuring the letters 'ARNS' in a bold, black, serif font with a small red triangle above the 'A'.

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BTS guideline for emergency oxygen use in adult patients

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EXECUTIVE SUMMARY OF THE GUIDELINE

Philosophy of the guideline

- ▶ Oxygen is a treatment for hypoxaemia, not breathlessness. (Oxygen has not been shown to have any effect on the sensation of breathlessness in non-hypoxaemic patients.)
- ▶ The essence of this guideline can be summarised simply as a requirement for oxygen to be prescribed according to a target saturation range and for those who administer oxygen therapy to monitor the patient and keep within the target saturation range.
- ▶ The guideline suggests aiming to achieve normal or near-normal oxygen saturation for all acutely ill patients apart from those at risk of hypercapnic respiratory failure or those receiving terminal palliative care.

Assessing patients

- ▶ For critically ill patients, high concentration oxygen should be administered immediately (table 1 and fig 1) and this should be recorded afterwards in the patient's health record.
- ▶ Oxygen saturation, "the fifth vital sign", should be checked by pulse oximetry in all breathless and acutely ill patients (supplemented by blood gases when necessary) and the inspired oxygen concentration should be recorded on the observation chart with the oximetry result. (The other vital signs are pulse, blood pressure, temperature and respiratory rate).
- ▶ Pulse oximetry must be available in all locations where emergency oxygen is used.
- ▶ All critically ill patients should be assessed and monitored using a recognised physiological track and trigger system.

Oxygen prescription

- ▶ Oxygen should be prescribed to achieve a target saturation of 94–98% for most acutely ill patients or 88–92% for those at risk of hypercapnic respiratory failure (tables 1–3).
- ▶ The target saturation should be written (or ringed) on the drug chart (guidance in fig 1).

Oxygen administration

- ▶ Oxygen should be administered by staff who are trained in oxygen administration.
- ▶ These staff should use appropriate devices and flow rates in order to achieve the target saturation range (fig 2).

Monitoring and maintenance of target saturation

- ▶ Oxygen saturation and delivery system should be recorded on the patient's monitoring chart alongside the oximetry result.
- ▶ Oxygen delivery devices and flow rates should be adjusted to keep the oxygen saturation in the target range.
- ▶ Oxygen should be signed for on the drug chart on each drug round.

Weaning and discontinuation of oxygen therapy

- ▶ Oxygen should be reduced in stable patients with satisfactory oxygen saturation.
- ▶ Oxygen should be crossed off the drug chart once oxygen is discontinued.

Oxygen is one of the most widely used drugs and is used across the whole range of specialities. The Guideline Group recognises that many clinicians will initially wish to read an abbreviated version of this guideline which is available to download from the BTS website (www.brit-thoracic.org.uk).

SUMMARY OF KEY RECOMMENDATIONS FOR EMERGENCY OXYGEN USE

Achieving desirable oxygen saturation ranges in acute illness (sections 6.7 and 6.8)

1. This guideline recommends aiming to achieve a normal or near-normal oxygen saturation for all acutely ill patients apart from those at risk of hypercapnic respiratory failure. [Grade D]
2. The recommended target saturation range for acutely ill patients not at risk of hypercapnic respiratory failure is 94–98%. Some normal subjects, especially people aged >70 years, may have oxygen saturation measurements below 94% and do not require oxygen therapy when clinically stable. [Grade D]
3. Most non-hypoxaemic breathless patients do not benefit from oxygen therapy, but a sudden reduction of more than 3% in a patient's oxygen saturation within the target saturation range should prompt fuller assessment of the patient (and the oximeter signal) because this may be the first evidence of an acute illness. [Grade D]
4. For most patients with known chronic obstructive pulmonary disease (COPD) or other known risk factors for hypercapnic respiratory failure (eg, morbid obesity, chest wall deformities or neuromuscular disorders), a target saturation range of 88–92% is suggested pending the availability of blood gas results. [Grade C]

5. Some patients with COPD and other conditions are vulnerable to repeated episodes of hypercapnic respiratory failure. In these cases it is recommended that treatment should be based on the results of previous blood gas estimations during acute exacerbations because hypercapnic respiratory failure can occur even if the saturation is below 88%. For patients with prior hypercapnic failure (requiring non-invasive ventilation or intermittent positive pressure ventilation) who do not have an alert card, it is recommended that treatment should be commenced using a 28% Venturi mask at 4 l/min in prehospital care or a 24% Venturi mask at 2–4 l/min in hospital settings with an initial target saturation of 88–92% pending urgent blood gas results. These patients should be treated as a high priority by emergency services and the oxygen dose should be reduced if the saturation exceeds 92%. **[Grade D]**
6. Because oxygenation is reduced in the supine position, fully conscious hypoxaemic patients should ideally be allowed to maintain the most upright posture possible (or the most comfortable posture for the patient) unless there are good reasons to immobilise the patient (eg, skeletal or spinal trauma). **[Grade C]**

Clinical and laboratory assessment of hypoxaemia and hypercapnia (section 7.1)

7. Fully trained clinicians should assess all acutely ill patients by measuring pulse, blood pressure, respiratory rate and assessing circulating blood volume and anaemia. Expert assistance from specialists in intensive care or from other disciplines should be sought at an early stage if patients are thought to have major life-threatening illnesses and clinicians should be prepared to call for assistance when necessary, including a call for a 999 ambulance in prehospital care or a call for the resuscitation team or ICU outreach team in hospital care. **[Grade C–D]**
8. Initial clinical assessment and subsequent monitoring of acutely unwell patients should include the use of a recognised physiological “track and trigger” system, such as the Modified Early Warning Scoring System (mEWS), and a change in this score should require medical review even if there is no change in oxygen saturation. **[Grade C]**
9. Oxygen saturation, “the fifth vital sign”, should be checked by trained staff using pulse oximetry in all breathless and acutely ill patients (supplemented by blood gases when necessary) and the inspired oxygen concentration should be recorded on the observation chart with the oximetry result. **[Grade D]**
10. The presence of a normal oxygen saturation (arterial oxygen saturation measured by pulse oximetry (SpO₂)) does not always negate the need for blood gas measurements because pulse oximetry will be normal in a patient with normal oxygen tension but abnormal blood pH or carbon dioxide tension (PCO₂) or with a low blood oxygen content due to anaemia). Blood gas measurements and full blood counts are therefore required as early as possible in all situations where these measurements may affect patient outcomes. **[Grade D]**

Arterial and arteriolised blood gases (sections 7.1.3 and 8.4)

11. For critically ill patients or those with shock or hypotension (systolic blood pressure <90 mm Hg), the initial blood gas measurement should be obtained from an arterial specimen. However, for most patients who require blood gas sampling, either arterial blood gases or arteriolised earlobe blood gases may be used to obtain an accurate measure of

pH and PCO₂. However, the arterial oxygen tension (PaO₂) is less accurate in earlobe blood gas samples (it underestimates the oxygen tension by 0.5–1 kPa), so oximetry should be monitored carefully if earlobe blood gas specimens are used.

[Grade B]

12. Local anaesthesia should be used for all arterial blood gas specimens except in emergencies or if the patient is unconscious or anaesthetised. **[Grade B]**
13. Blood gases should be checked in the following situations:
 - All critically ill patients.
 - Unexpected or inappropriate hypoxaemia (SpO₂ <94%) or any patient requiring oxygen to achieve this target range. (Allowance should be made for transient dips in saturation to 90% or less in normal subjects during sleep). **[Grade D]**
 - Deteriorating oxygen saturation or increasing breathlessness in a patient with previously stable hypoxaemia (eg, severe COPD). **[Grade D]**
 - Any previously stable patient who deteriorates and requires a significantly increased fraction of inspired oxygen (FiO₂) to maintain a constant oxygen saturation. **[Grade D]**
 - Any patient with risk factors for hypercapnic respiratory failure who develops acute breathlessness, deteriorating oxygen saturation or drowsiness or other symptoms of CO₂ retention. **[Grade D]**
 - Breathless patients who are thought to be at risk of metabolic conditions such as diabetic ketoacidosis or metabolic acidosis due to renal failure. **[Grade D]**
 - Acutely breathless or critically ill patients with poor peripheral circulation in whom a reliable oximetry signal cannot be obtained. **[Grade D]**
 - Any other evidence from the patient’s medical condition that would indicate that blood gas results would be useful in the patient’s management (eg, an unexpected change in “track and trigger” systems such as a sudden rise of several units in the mEWS or an unexpected fall in oxygen saturation of 3% or more, even if within the target range). **[Grade D]**

Oxygen use in specific illnesses

- ▶ See tables 1–4 and figs 1 and 2 (and section 8 in main text)
- ▶ Critical illness requiring high levels of supplemental oxygen: see table 1 and section 8
- ▶ Serious illness requiring moderate levels of supplemental oxygen if a patient is hypoxaemic: see table 2 and section 8.
- ▶ COPD and other conditions requiring controlled or low-dose oxygen therapy: see table 3 and section 8.
- ▶ Conditions for which patients should be monitored closely but oxygen therapy is not required unless the patient is hypoxaemic: see table 4 and section 8.

Oxygen therapy in pregnancy (section 8.13.3)

14. Women who suffer from major trauma, sepsis or acute illness during pregnancy should receive the same oxygen therapy as any other seriously ill patients, with a target oxygen saturation of 94–98%. The same target range should be applied to women with hypoxaemia due to acute complications of pregnancy (eg, collapse related to amniotic fluid embolus, eclampsia or antepartum or postpartum haemorrhage). **[Grade D]**

15. Women with underlying hypoxaemic conditions (eg, heart failure) should be given supplemental oxygen during labour to achieve an oxygen saturation of 94–98%. **[Grade D]**
16. All women with evidence of hypoxaemia who are more than 20 weeks pregnant should be managed with left lateral tilt to improve cardiac output. **[Grade B]**
17. The use of oxygen during labour is widespread but there is evidence that this may be harmful to the fetus. The use of oxygen during labour is therefore not currently recommended in situations where the mother is not hypoxaemic (except as part of a controlled trial). **[Grade A]**

Emergency use of oxygen in prehospital and hospital care (sections 8 and 9)

18. Pulse oximetry must be available in all locations where emergency oxygen is being used (see also the limitations of using pulse oximetry, section 7.1.2). **[Grade D]**
19. Emergency oxygen should be available in primary care medical centres, preferably using oxygen cylinders with integral high-flow regulators. Alternatively, oxygen cylinders fitted with high-flow regulators (delivering over 6 l/min) must be used. **[Grade D]**
20. All documents which record oximetry measurements should state whether the patient is breathing air or a specified dose of supplemental oxygen. **[Grade C]**
21. The oxygen saturation should be monitored continuously until the patient is stable or arrives at hospital for a full assessment. The oxygen concentration should be adjusted upwards or downwards to maintain the target saturation range. **[Grade D]**
22. In most emergency situations, oxygen is given to patients immediately without a formal prescription or drug order. The lack of a prescription should never preclude oxygen being given when needed in an emergency situation. However, a subsequent written record must be made of what oxygen therapy has been given to every patient (in a similar manner to the recording of all other emergency treatment). **[Grade D]**
23. Patients with COPD (and other at-risk conditions) who have had an episode of hypercapnic respiratory failure should be issued with an oxygen alert card and with a 24% or 28% Venturi mask. They should be instructed to show the card to the ambulance crew and emergency department staff in the event of an exacerbation. **[Grade C]**
24. The content of the alert card should be specified by the physician in charge of the patient's care, based on previous blood gas results. **[Grade D]**
25. The primary care team and ambulance service should also be informed by the responsible clinician that the patient has had an episode of hypercapnic respiratory failure and carries an oxygen alert card. The home address and ideal oxygen dose or target saturation ranges of these patients can be flagged in the ambulance control systems and disseminated to ambulance crews when required. **[Grade D]**
26. Out-of-hours services providing emergency primary care services should be informed by a responsible clinician that the patient has had an episode of hypercapnic respiratory failure and carries an oxygen alert card. Use of oxygen in these patients will be guided by the instructions on the alert card. **[Grade D]**
27. During ambulance journeys oxygen-driven nebulisers should be used for patients with asthma and may be used for patients with COPD in the absence of an air-driven compressor system. If oxygen is used for patients with known COPD, its use should be limited to 6 min. This will deliver most of the nebulised drug dose but limit the risk of hypercapnic respiratory failure (section 10.8.2). **[Grade D]**
28. If a patient is suspected to have hypercapnia or respiratory acidosis due to excessive oxygen therapy, the oxygen therapy should not be discontinued but should be stepped down to 28% or 24% oxygen from a Venturi mask depending on oxygen saturation and subsequent blood gas results. **[Grade C]**

Equipment used to deliver emergency oxygen therapy (see section 10)

29. (a) It is recommended that the following delivery devices should be available in prehospital settings where oxygen is administered: **[Grade D]**
 - high concentration reservoir mask (non-rebreathe mask) for high-dose oxygen therapy;
 - nasal cannulae (preferably) or a simple face mask for medium-dose oxygen therapy;
 - 28% Venturi mask for patients with definite or likely COPD (patients who have an oxygen alert card may have their own 24% or 28% Venturi mask);
 - tracheostomy masks for patients with tracheostomy or previous laryngectomy.(b) Most hospital patients can be managed with the same delivery device as in 29a, but 24% Venturi masks should also be available. **[Grade D]**
30. For many patients Venturi masks can be substituted with nasal cannulae at low flow rates (1–2 l/min) to achieve the same target range once patients have stabilised. **[Grade D]**
31. The flow rate from simple face masks should be adjusted between 5 and 10 l/min to achieve the desired target saturation. Flow rates below 5 l/min may cause carbon dioxide rebreathing and increased resistance to inspiration. **[Grade C]**
32. Patients with COPD with a respiratory rate of >30 breaths/min should have the flow rate set to 50% above the minimum flow rate specified for the Venturi mask and/or packaging (increasing the oxygen flow rate into a Venturi mask increases the total gas flow from the mask but does not increase the concentration of oxygen which is delivered). **[Grade C]**
33. Trusts should take measures to eliminate the risk of oxygen tubing being connected to the incorrect wall oxygen outlet or to outlets that deliver compressed air or other gases instead of oxygen. Air flow meters should be removed from the wall sockets or covered with a designated air outlet cover when not in use. Special care should be taken if twin oxygen outlets are in use. **[Grade D]**
34. Humidification is not required for the delivery of low-flow oxygen or for the short-term use of high-flow oxygen. It is not therefore required in prehospital care. Pending the results of clinical trials, it is reasonable to use humidified oxygen for patients who require high-flow oxygen systems for more than 24 h or who report upper airway discomfort due to dryness. **[Grade B]**
35. In the emergency situation humidified oxygen use can be confined to patients with tracheostomy or an artificial airway, although these patients can be managed without humidification for short periods of time (eg, ambulance journeys). **[Grade D]**

36. Humidification may also be of benefit to patients with viscous secretions causing difficulty with expectoration. This benefit can be achieved using nebulised normal saline. **[Grade C]**
37. Bubble bottles should not be used because there is no evidence of clinically significant benefit but there is a risk of infection. **[Grade C]**
38. When oxygen is required by patients with prior tracheostomy or laryngectomy, a tracheostomy mask (varying the flow as necessary) should achieve the desired oxygen saturation (tables 1–4). An alternative delivery device, usually a two-piece device fitted directly to the tracheostomy tube, may be necessary if the patient deteriorates. **[Grade D]**

Oxygen therapy during nebulised treatments (see section 10)

39. For patients with asthma, nebulisers should be driven by piped oxygen or from an oxygen cylinder fitted with a high-flow regulator capable of delivering a flow rate of >6 l/min. The patient should be changed back to his/her usual mask when nebuliser therapy is complete. If the cylinder does not produce this flow rate, an air-driven nebuliser (with electrical compressor) should be used with supplemental oxygen by nasal cannulae at 2–6 l/min to maintain an appropriate oxygen saturation level. **[Grade D]**
40. When nebulised bronchodilators are given to patients with hypercapnic acidosis, they should be driven by compressed air and, if necessary, supplementary oxygen should be given concurrently by nasal cannulae at 2–4 l/min to maintain an

oxygen saturation of 88–92%. The same precautions should be applied to patients who are at risk of hypercapnic respiratory failure prior to the availability of blood gas results. Once the nebulised treatment is completed for patients at risk of hypercapnia, controlled oxygen therapy with a fixed concentration (Venturi) device should be reinstituted. **[Grade D]**

- During ambulance journeys, oxygen-driven nebulisers should be used for patients with asthma and may be used for patients with COPD in the absence of an air-driven compressor system. If oxygen is used for patients with known COPD, its use should be limited to 6 min. This will deliver most of the nebulised drug dose but limit the risk of hypercapnic respiratory failure (see recommendation 27).

Prescription, administration, monitoring and discontinuation of oxygen therapy (see sections 11 and 12)

Oxygen should always be prescribed or ordered on a designated document. In emergencies, oxygen should be given first and documented later. See recommendations 41–76 in section 11 of the main guideline for prescription, administration and monitoring of oxygen therapy and recommendations 77–84 in section 12 for guidance on meaning and discontinuation of oxygen therapy.

All primary care trusts, ambulance trusts and hospital trusts should take specific measures to institute safe and effective administration and documentation of oxygen as described in recommendations 41–84 in sections 11 and 12 of this guideline.

Table 1 Critical illnesses requiring high levels of supplemental oxygen (see section 8.10)

► The initial oxygen therapy is a reservoir mask at 15 l/min.		
► Once stable, reduce the oxygen dose and aim for target saturation range of 94–98%		
► If oximetry is unavailable, continue to use a reservoir mask until definitive treatment is available.		
► Patients with COPD and other risk factors for hypercapnia who develop critical illness should have the same initial target saturations as other critically ill patients pending the results of blood gas measurements, after which these patients may need controlled oxygen therapy or supported ventilation if there is severe hypoxaemia and/or hypercapnia with respiratory acidosis.		
	Additional comments	Grade of recommendation
Cardiac arrest or resuscitation	Use bag-valve mask during active resuscitation Aim for maximum possible oxygen saturation until the patient is stable	Grade D
Shock, sepsis, major trauma, near-drowning, anaphylaxis, major pulmonary haemorrhage	Also give specific treatment for the underlying condition	Grade D
Major head injury	Early intubation and ventilation if comatose	Grade D
Carbon monoxide poisoning	Give as much oxygen as possible using a bag-valve mask or reservoir mask. Check carboxyhaemoglobin levels A normal or high oximetry reading should be disregarded because saturation monitors cannot differentiate between carboxyhaemoglobin and oxyhaemoglobin owing to their similar absorbances. The blood gas Pao ₂ will also be normal in these cases (despite the presence of tissue hypoxia)	Grade C

COPD, chronic obstructive pulmonary disease; Pao₂, arterial oxygen tension.

Table 2 Serious illnesses requiring moderate levels of supplemental oxygen if the patient is hypoxaemic (section 8.11)

- ▶ The initial oxygen therapy is nasal cannulae at 2–6 l/min (preferably) or simple face mask at 5–10 l/min unless stated otherwise.
- ▶ For patients not at risk of hypercapnic respiratory failure who have saturation <85%, treatment should be commenced with a reservoir mask at 10–15 l/min.
- ▶ The recommended initial oxygen saturation target range is 94–98%.
- ▶ If oximetry is not available, give oxygen as above until oximetry or blood gas results are available.
- ▶ Change to reservoir mask if the desired saturation range cannot be maintained with nasal cannulae or simple face mask (and ensure that the patient is assessed by senior medical staff).
- ▶ If these patients have co-existing COPD or other risk factors for hypercapnic respiratory failure, aim at a saturation of 88–92% pending blood gas results but adjust to 94–98% if the P_{aCO_2} is normal (unless there is a history of previous hypercapnic respiratory failure requiring NIV or IPPV) and recheck blood gases after 30–60 min.

	Additional comments	Grade of recommendation
Acute hypoxaemia (cause not yet diagnosed)	Reservoir mask at 10–15 l/min if initial SpO_2 <85%, otherwise nasal cannulae or simple face mask Patients requiring reservoir mask therapy need urgent clinical assessment by senior staff	Grade D
Acute asthma		Grade C
Pneumonia		Grade C
Lung cancer		Grade C
Postoperative breathlessness	Management depends on underlying cause	Grade D
Acute heart failure	Consider CPAP or NIV in cases of pulmonary oedema	Grade D
Pulmonary embolism	Most patients with minor pulmonary embolism are not hypoxaemic and do not require oxygen therapy	Grade D
Pleural effusions	Most patients with pleural effusions are not hypoxaemic. If hypoxaemic, treat by draining the effusion as well as giving oxygen therapy	Grade D
Pneumothorax	Needs aspiration or drainage if the patient is hypoxaemic. Most patients with pneumothorax are not hypoxaemic and do not require oxygen therapy Use a reservoir mask at 10–15 l/min if admitted for observation. Aim at 100% saturation (oxygen accelerates clearance of pneumothorax if drainage is not required)	Grades C and D
Deterioration of lung fibrosis or other interstitial lung disease	Reservoir mask at 10–15 l/min if initial SpO_2 <85%, otherwise nasal cannulae or simple face mask	Grade D
Severe anaemia	The main issue is to correct the anaemia Most anaemic patients do not require oxygen therapy	Grades B and D
Sickle cell crisis	Requires oxygen only if hypoxaemic (below the above target ranges or below what is known to be normal for the individual patient) Low oxygen tension will aggravate sickling	Grade B

COPD, chronic obstructive pulmonary disease; CPAP, continuous positive airway pressure; IPPV, intermittent positive pressure ventilation; NIV, non-invasive ventilation; P_{aCO_2} , arterial carbon dioxide tension; SpO_2 , arterial oxygen saturation measured by pulse oximetry.

Table 3 COPD and other conditions requiring controlled or low-dose oxygen therapy (section 8.12)

- ▶ Prior to availability of blood gases, use a 28% Venturi mask at 4 l/min and aim for an oxygen saturation of 88–92% for patients with risk factors for hypercapnia but no prior history of respiratory acidosis. **[Grade D]**
- ▶ Adjust target range to 94–98% if the $Paco_2$ is normal (unless there is a history of previous NIV or IPPV) and recheck blood gases after 30–60 min **[Grade D]**
- ▶ Aim at a prespecified saturation range (from alert card) in patients with a history of previous respiratory acidosis. These patients may have their own Venturi mask. In the absence of an oxygen alert card but with a history of previous respiratory failure (use of NIV or IPPV), treatment should be commenced using a 28% oxygen mask at 4 l/min in prehospital care or a 24% Venturi mask at 2–4 l/min in hospital settings with an initial target saturation of 88–92% pending urgent blood gas results. **[Grade D]**
- ▶ If the saturation remains below 88% in prehospital care despite a 28% Venturi mask, change to nasal cannulae at 2–6 l/min or a simple mask at 5 l/min with target saturation of 88–92%. All at-risk patients with alert cards, previous NIV or IPPV or with saturation <88% in the ambulance should be treated as a high priority. Alert the A&E department that the patient requires immediate senior assessment on arrival at the hospital. **[Grade D]**
- ▶ If the diagnosis is unknown, patients aged >50 years who are long-term smokers with a history of chronic breathlessness on minor exertion such as walking on level ground and no other known cause of breathlessness should be treated as if having COPD for the purposes of this guideline. Patients with COPD may also use terms such as chronic bronchitis and emphysema to describe their condition but may sometimes mistakenly use “asthma”. FEV_1 should be measured on arrival in hospital if possible and should be measured at least once before discharge from hospital in all cases of suspected COPD. **[Grade D]**
- ▶ Patients with a significant likelihood of severe COPD or other illness that may cause hypercapnic respiratory failure should be triaged as very urgent and blood gases should be measured on arrival in hospital. **[Grade D]**
- ▶ Blood gases should be rechecked after 30–60 min (or if there is clinical deterioration) even if the initial $Paco_2$ measurement was normal. **[Grade D]**
- ▶ If the $Paco_2$ is raised but pH is ≥ 7.35 ($[H^+] \leq 45$ nmol/l), the patient has probably got long-standing hypercapnia; maintain target range of 88–92% for these patients. Blood gases should be repeated at 30–60 min to check for rising $Paco_2$ or falling pH. **[Grade D]**
- ▶ If the patient is hypercapnic ($Paco_2 > 6$ kPa or 45 mm Hg) and acidotic (pH <7.35 or $[H^+] > 45$ nmol/l) consider non-invasive ventilation, especially if acidosis has persisted for more than 30 min despite appropriate therapy. **[Grade A]**

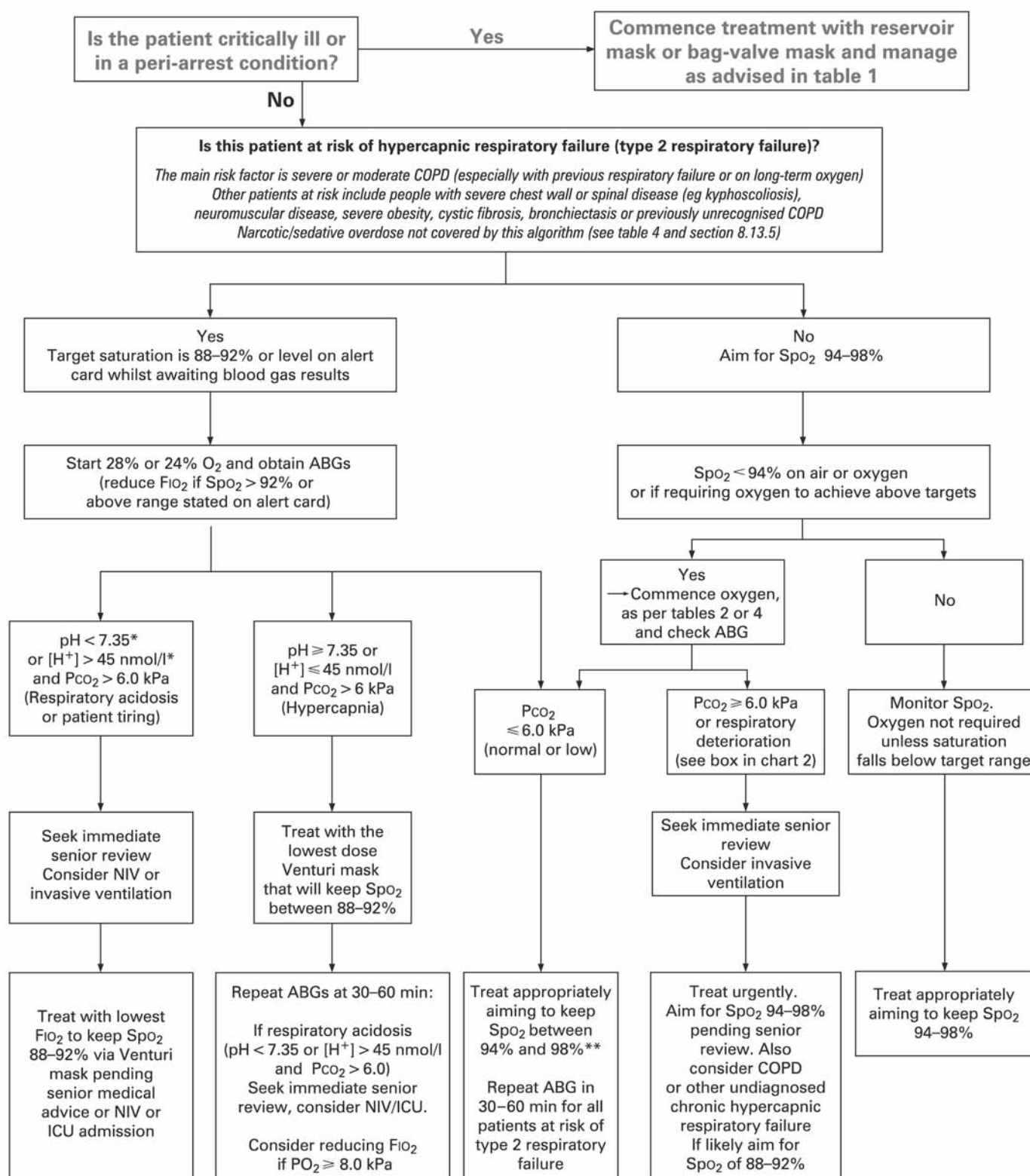
	Additional comments	Grade of recommendation
COPD	May need lower range if acidotic or if known to be very sensitive to oxygen therapy. Ideally use alert cards to guide treatment based on previous blood gas results. Increase flow by 50% if respiratory rate is >30 (see recommendation 32)	Grade C
Exacerbation of CF	Admit to regional CF centre if possible; if not, discuss with regional centre or manage according to protocol agreed with regional CF centre Ideally use alert cards to guide therapy. Increase flow by 50% if respiratory rate is >30 (see recommendation 32)	Grade D
Chronic neuromuscular disorders	May require ventilatory support. Risk of hypercapnic respiratory failure	Grade D
Chest wall disorders	For acute neuromuscular disorders and subacute conditions such as Guillain-Barré syndrome (see table 4)	Grade D
Morbid obesity		Grade D

CF, cystic fibrosis; COPD, chronic obstructive pulmonary disease; CPAP, continuous positive airway pressure; IPPV, intermittent positive pressure ventilation; NIV, non-invasive ventilation; $Paco_2$, arterial carbon dioxide tension; SpO_2 , arterial oxygen saturation measured by pulse oximetry.

Table 4 Conditions for which patients should be monitored closely but oxygen therapy is not required unless the patient is hypoxaemic (section 8.13)

► If hypoxaemic, the initial oxygen therapy is nasal cannulae at 2–6 l/min or simple face mask at 5–10 l/min unless saturation is <85% (use reservoir mask) or if at risk from hypercapnia (see below). ► The recommended initial target saturation range, unless stated otherwise, is 94–98% ► If oximetry is not available, give oxygen as above until oximetry or blood gas results are available ► If patients have COPD or other risk factors for hypercapnic respiratory failure, aim at a saturation of 88–92% pending blood gas results but adjust to 94–98% if the $Paco_2$ is normal (unless there is a history of respiratory failure requiring NIV or IPPV) and recheck blood gases after 30–60 min		
	Additional comments	Grade of recommendation
Myocardial infarction and acute coronary syndromes	Most patients with acute coronary artery syndromes are not hypoxaemic and the benefits/harms of oxygen therapy are unknown in such cases	Grade D
Stroke	Most stroke patients are not hypoxaemic. Oxygen therapy may be harmful for non-hypoxaemic patients with mild to moderate strokes.	Grade B
Pregnancy and obstetric emergencies	Oxygen therapy may be harmful to the fetus if the mother is not hypoxaemic (see recommendations 14–17)	Grades A–D
Hyperventilation or dysfunctional breathing	Exclude organic illness. Patients with pure hyperventilation due to anxiety or panic attacks are unlikely to require oxygen therapy Rebreathing from a paper bag may cause hypoxaemia and is not recommended	Grade C
Most poisonings and drug overdoses (see table 1 for carbon monoxide poisoning)	Hypoxaemia is more likely with respiratory depressant drugs, give antidote if available (eg, naloxone for opiate poisoning) Check blood gases to exclude hypercapnia if a respiratory depressant drug has been taken. Avoid high blood oxygen levels in cases of acid aspiration as there is theoretical evidence that oxygen may be harmful in this condition Monitor all potentially serious cases of poisoning in a level 2 or level 3 environment (high dependency unit or ICU)	Grade D
Poisoning with paraquat or bleomycin	Patients with paraquat poisoning or bleomycin lung injury may be harmed by supplemental oxygen Avoid oxygen unless the patient is hypoxaemic Target saturation is 88–92%	Grade C
Metabolic and renal disorders	Most do not need oxygen (tachypnoea may be due to acidosis in these patients)	Grade D
Acute and subacute neurological and muscular conditions producing muscle weakness	These patients may require ventilatory support and they need careful monitoring which includes spirometry. If the patient's oxygen level falls below the target saturation, they need urgent blood gas measurements and are likely to need ventilatory support	Grade C

COPD, chronic obstructive pulmonary disease; ICU, intensive care unit; IPPV, intermittent positive pressure ventilation; NIV, non-invasive ventilation; $Paco_2$, arterial carbon dioxide tension; SpO_2 , arterial oxygen saturation measured by pulse oximetry.



Any increase in FiO_2 must be followed by repeat ABGs in 1 h (or sooner if conscious level deteriorates)

*If pH is < 7.35 ($[\text{H}^+] > 45 \text{ nmol/l}$) with normal or low Paco_2 , investigate and treat for metabolic acidosis and keep SpO_2 94–98%

**Patients previously requiring NIV or IPPV should have a target range of 88–92%, even if the initial Paco_2 is normal.

Figure 1 Chart 1: Oxygen prescription for acutely hypoxaemic patients in hospital. ABG, arterial blood gas; COPD, chronic obstructive pulmonary disease; FiO_2 , fraction of inspired oxygen; ICU, intensive care unit; NIV, non-invasive ventilation; Pco_2 , carbon dioxide tension; SpO_2 , arterial oxygen saturation measured by pulse oximetry.

See patient's drug chart and chart 1 and tables 1–4 for starting dose and target saturation

Choose the most suitable delivery system and flow rate

Titrate oxygen up or down to maintain the target oxygen saturation.

The table below shows available options for stepping dosage up or down. The chart does not imply any equivalence of dose between Venturi masks and nasal cannulae.

Allow at least 5 minutes at each dose before adjusting further upwards or downwards (except with major and sudden fall in saturation). Once your patient has adequate and stable saturation on minimal oxygen dose, consider discontinuation of oxygen therapy.

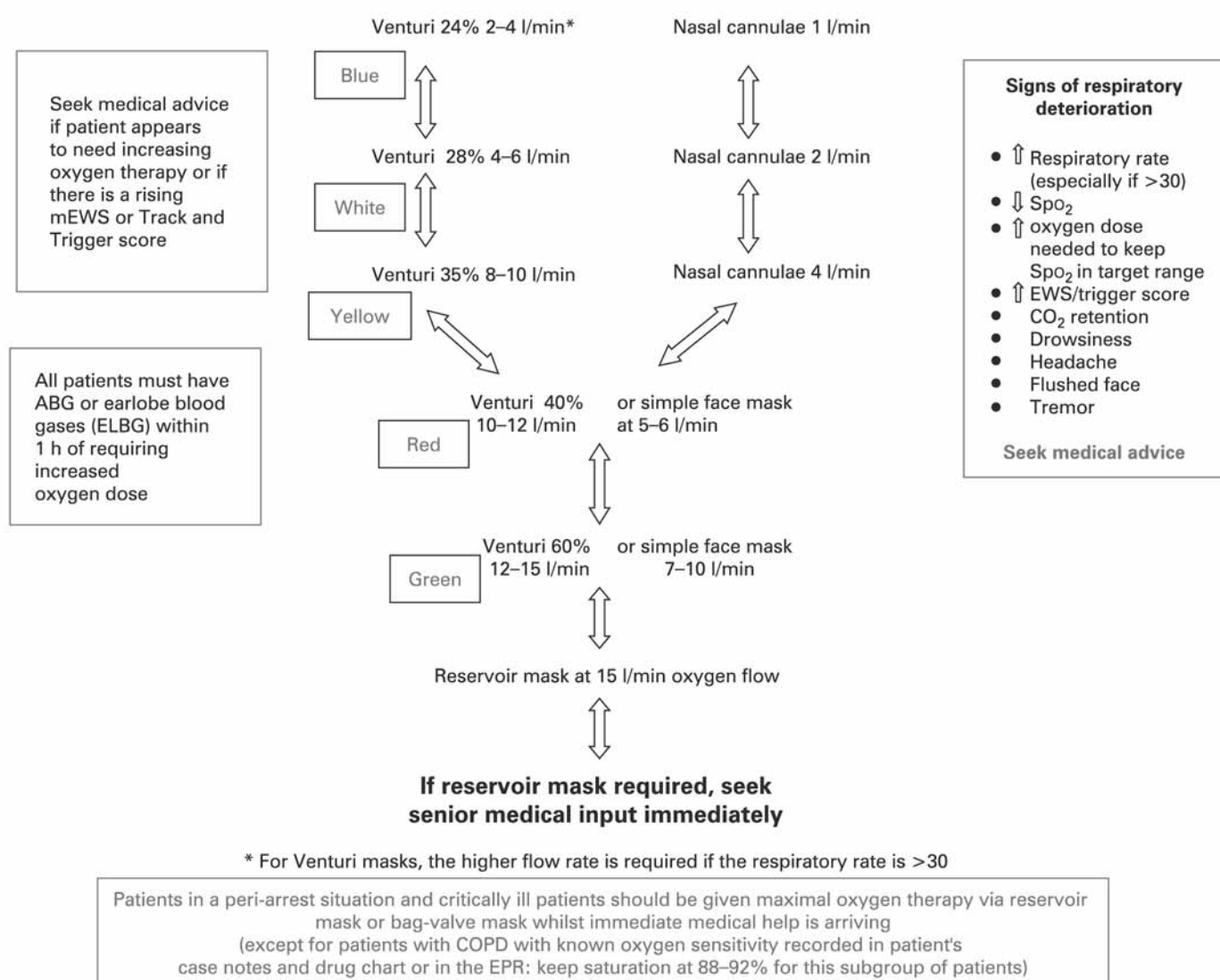


Figure 2 Chart 2: Flow chart for oxygen administration on general wards in hospitals. ABG, arterial blood gas; EPR, electronic patient record; EWS, Early Warning Score; SpO₂, arterial oxygen saturation measured by pulse oximetry.

SECTION 16: MEMBERSHIP OF WORKING PARTY AND AUTHORSHIP

16.1 Membership of Working Party

Physicians in general/respiratory medicine: R O'Driscoll, Salford (Co-Chair), British Thoracic Society; A Davison, Southend (Co-Chair), British Thoracic Society; M Elliott, Leeds, Royal College of Physicians; *Respiratory physicians:* L Howard, London, British Thoracic Society; J Wedzicha, London, British Thoracic Society and Editor of *Thorax*; *Emergency medicine:* K Mackway-Jones, Manchester, British Association for Emergency Medicine; *Emergency physician (EAU):* P Jenkins, Norwich, Society for Acute Medicine (SAMUK); *Intensive care:* R Kishen, Salford, Intensive Care Society; *General practitioner:* M Levy, London, Royal College of General Practitioners and GP in Airways Group (GPIAG); *Nurse:* S Perrott, Cambridge, Royal College of Nursing; *Physiotherapist:* L Mansfield, Newcastle upon Tyne, Chartered Society of Physiotherapy; *ARTP representative:* A Evans, North Staffs, Association for Respiratory Technology and Physiology; *Patient/lay representative:* S Panizzo, London, Nominated by Royal College of Physicians; *Ambulance service representatives:* F Moore, London, Joint Royal Collages Ambulance Liaison Committee; D Whitmore, London, British Paramedic Association Senior Clinical Advisor to the Medical Director, LAS; *Cardiologist:* S Gibbs, London, British Cardiovascular Society; *Anaesthetist:* B Martin, London, Royal College of Anaesthetists; *Obstetrician:* K Hinshaw, Sunderland, Royal College of Obstetricians and Gynaecologists.

16.2 Authorship of sections of the guideline

The outline of the guideline was developed and refined by the entire group at various meetings and email discussions as described in section 2 and each section was edited by all group members, but the work of preparing the main draft for each section was divided as follows:

16.2.1 Main text of guideline

1. Introduction: R O'Driscoll, A Davison
2. Methodology: R O'Driscoll, A Davison
3. Normal values and definitions: R O'Driscoll, A Davison, M Elliott, L Howard
4. General blood gas physiology: L Howard, R O'Driscoll, A Davison

5. Advanced blood gas physiology: L Howard, R Kishen, M Elliott
6. Hypoxia, hyperoxia, etc: L Howard, R O'Driscoll, A Davison, R Kishen
7. Clinical/laboratory assessment: R O'Driscoll, M Elliott
8. Hospital settings: R O'Driscoll
9. Prehospital settings: A Davison, D Whitmore, F Moore, M Levy
10. Practical aspects: A Evans, L Mansfield, S Perrott, L Howard
11. Prescription of oxygen: A Davison, S Perrott, R O'Driscoll
12. Weaning and discontinuation: A Davison, R O'Driscoll
13. Outcomes and audit: R O'Driscoll, A Davison
14. Dissemination/implementation: A Davison, R O'Driscoll
15. Areas requiring further research: R O'Driscoll, A Davison

16.2.2 Web appendices (available on BTS website: www.brit-thoracic.org.uk)

1. Summary of recommendations: whole group
2. Summary of Guideline for hospital use: A Davison/ R O'Driscoll
3. Example of local oxygen policy: N Linaker, L Ward, R Smith, R O'Driscoll, A Davison
4. Summary for prehospital settings: A Davison, R O'Driscoll, D Whitmore, M Levy
5. Patient information sheet: L Ward, A Davison, R O'Driscoll, S Panizzo (with feedback from patients)
6. Summary of prescription, etc: A Davison, R O'Driscoll
7. Example of audit tool: L Ward, R O'Driscoll, A Davison,
8. Lecture for doctors: A Davison, R O'Driscoll
9. Teaching aids for nurses: L Ward, A Davison, R O'Driscoll
10. Key points for hospital managers and oxygen champions: R O'Driscoll, A Davison
11. Key points for PCT managers: A Davison, R O'Driscoll
12. Key points for ambulance service managers: D Whitmore, A Davison, R O'Driscoll
13. List of NHS Trusts with oxygen champions: A Davison
14. Details of search methodology: R O'Driscoll

The full Guideline plus the appendices listed above can be found at:
www.brit-thoracic.org.uk/emergencyoxygen

Enquiries to: bts@brit-thoracic.org.uk

