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Emergency oxygen use in adult patients: concise guidance

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ABSTRACT – There is considerable controversy concerning the benefits and risks of oxygen treatment in many situations and healthcare professionals receive conflicting advice about safe oxygen use. The British Thoracic Society (BTS) has published up-to-date, evidence-based guidelines for emergency oxygen use in the UK in order to encourage the safe use of oxygen in emergency situations and improve consistency of clinical practice.[1] The purpose of this concise guideline is to summarise the key recommendations, particularly concerning emergency oxygen use in the hospital setting.

KEY WORDS: hypercapnic respiratory failure, hypoxaemia, oxygen

Background

Oxygen is probably the most common drug to be used in the care of patients who present with medical emergencies; approximately 34% of ambulance journeys involve oxygen use at some stage and national audit data suggest that 18% of hospital inpatients in the UK are being treated with oxygen at any given time.[2,3]

At present, oxygen is administered for three main indications:

1 to correct hypoxaemia, as there is good evidence that severe hypoxaemia is harmful
2 to prevent hypoxaemia in unwell patients
3 to alleviate breathlessness.

Only the first of these indications is evidence based. Recent evidence suggests that the administration of oxygen to prevent hypoxaemia in ill patients may actually place them at increased risk if severe hypoxaemia does actually develop.[1] Additionally, there is no evidence that oxygen relieves breathlessness in non-hypoxaemic patients and there is evidence for lack of effectiveness in non-hypoxaemic breathless patients with chronic obstructive pulmonary disease (COPD) or advanced cancer. However, patients at risk of hypoxaemia should be adequately monitored in an appropriate clinical setting.

Most clinicians who deal with medical emergencies will encounter adverse incidents and occasional deaths due to underuse and overuse of oxygen.[1,4] Audits of oxygen use and oxygen prescription have shown consistently poor performances in many countries.[1] There is considerable controversy concerning the benefits and risks of oxygen treatment in virtually all situations where oxygen is used and, as such, healthcare professionals receive conflicting advice about safe oxygen use. Unfortunately, this is an area of medicine where there are many strongly-held beliefs but very few randomised controlled trials.

Previous UK guidelines on emergency oxygen therapy were published in 2001 by the North West Oxygen Group, based on a systematic literature review.[5] Against this background the Standards of Care Committee of the British Thoracic Society (BTS) established a working party in association with 21 other societies and royal colleges to produce an evidence-based and up-to-date guideline for emergency oxygen use in the UK. Information in this concise guidance document has been extracted from the full BTS guideline.[1] A full description of the methodology may be found in BTS guideline document. The levels of evidence and grades of recommendation are based on those used by the National Institute for Health and Clinical Excellence.[6]

Aims of the guideline

The guideline covers the safe prescription and administration of emergency oxygen to all patients. This concise guidance document provides a summary of the key recommendations detailed in the full BTS guideline.[1] It is intended for use by all healthcare professionals who may be involved in emergency oxygen use, but focuses on use in the general hospital setting (excluding intensive care units and other specialised units). Please refer to the full guideline for specific recommendations on the use of oxygen in the primary care and ambulance settings.

Limitations of the guideline

The recommendations are based on the best available evidence concerning oxygen therapy. However, a guideline can never be a substitute for clinical judgement in individual cases. There may be cases where it is appropriate for clinicians to act outside of the advice contained in this guideline because of the needs of individual patients or practical concerns, such as ward staffing levels or the availability of appropriate monitoring equipment.

The responsibility for the care of individual patients rests with the clinician in charge of the patient's care and the advice offered in this guideline should not be relied upon as the only source of advice in the treatment of individual patients.

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Table 1. Modified Early Warning Score (MEWS).

Score	3	2	1	0	1	2	3
Systolic BP (mmHg)	<70	71–80	81–100	101–199	-	>200	-
Heart rate (beats/min)	-	<40	41–50	51–100	101–110	111–129	>130
Respiratory rate (breaths/min)	-	<9	-	9–14	15–20	21–29	>30
Temperature (°C)	-	<35	-	35.0–38.4	-	>38.5	-
Level of consciousness:	-	-	-	A	V	P	U

A=alert; V=response to voice; P=response to pain; U=unresponsive

Box 1. Arterial and arterialised blood gases.

- For most patients who require arterial blood gas sampling, either **arterial** or **arterialised earlobe** blood gases may be used to obtain an **accurate measure** of **pH** and **pCO_2**.
- For critically ill patients or those with **shock** or **hypotension** (systolic BP <90 mmHg), the initial blood gas measurement should be obtained from an **arterial specimen**.
- Arterial oxygen tension (**pO_2**) is **less accurate** in **earlobe** blood gas samples (underestimates pO_2 by 0.5–1.0 kPa), so oximetry should be monitored carefully if earlobe specimens are used.
- **Local anaesthesia** should be used for all arterial blood gas specimens except in emergencies or if the patient is unconscious or anaesthetised.

All Grade B recommendations

Box 2. Conditions associated with elevated risk of hypercapnic respiratory failure requiring controlled or low-concentration oxygen therapy (target range usually 88–92%).

- **Chronic obstructive pulmonary disease (COPD):**
  - may need lower target SpO_2 if acidotic or known to be very sensitive to oxygen therapy
  - ideally use oxygen alert cards to guide treatment based on previous blood gas results.
- **Exacerbation of cystic fibrosis (CF):**
  - admit to regional CF centre if possible
  - if not, discuss with regional centre and manage according to agreed protocol.
- **Chronic neuromuscular disorders with significantly restrictive lung function:**
  - may require ventilatory support
  - see full guideline for management of acute neuromuscular disorders and subacute conditions eg Guillain–Barré syndrome.
- **Restrictive chest wall disorders**
- **Morbid obesity** (eg BMI > 40kg/m^2)

This guideline gives very little specific advice about the management of many medical conditions that may cause hypoxaemia (apart from the specific issue of managing the patient's hypoxaemia). Readers are referred to other guidelines for advice on the management of specific conditions, eg COPD, pneumonia, heart failure, where slightly different approaches to emergency oxygen therapy may be suggested. The present guideline aims to provide simple all-embracing advice.

Implications and implementation

In order to implement the guideline recommendations, all organisations involved in administering emergency oxygen will need to develop new oxygen policies. The BTS has identified oxygen champions in all acute hospitals to help implement the changes.

The UK Ambulance Service updated their policies to implement the guideline principles in 2009.

The BTS is undertaking annual audits across all acute hospitals and the results of the audits can be taken back to ward level.[3] It is anticipated that this will aid implementation of the guideline.

References

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The full guideline is available on the BTS website (www.brit-thoracic.org.uk/clinical-information/emergency-oxygen.aspx) with a selection of appendices and advice and teaching slides for different user groups.

The guidelines

	Recommendation	Grade
1	**Clinical and laboratory assessment of hypoxaemia and hypercapnia:**	
	□ All acutely ill patients should be assessed by measuring:	C/D
	• pulse, blood pressure and respiratory rate	
	• oxygen saturation (SpO_2), 'the fifth vital sign', using pulse oximetry and record inspired oxygen concentration with result	
	• and assessing circulating blood volume and anaemia.	
	□ Seek **expert assistance** early if the patient is thought to have major, life-threatening illness:	C/D
	• call for resuscitation or intensive care unit outreach team in hospital care.	
	□ Use a recognised **physiological 'track and trigger' system** (eg the Modified Early Warning Score (Table 1)) for initial assessment and monitoring of acutely unwell patients:	C
	• a change in this score requires medical review of patient.	D
	□ Perform **arterial blood gas (ABG)** analysis* and **full blood count (FBC)** early when these measurements may affect patient outcome:	
	• remember pulse oximetry (SpO_2) may be normal in patients with:	
	– normal oxygen tension (pO_2) but **abnormal blood pH** or carbon dioxide tension (**pCO_2**)	
	– low blood oxygen content due to **anaemia**.	
	*Please see Box 1 for further information about ABG samples.	
2	**Emergency use of oxygen in hospital care:**	
	□ **Pulse oximetry** must be available in **all locations** where emergency oxygen is being used.	D
	□ Patients with COPD (and other at-risk conditions) who have had an episode of **hypercapnic respiratory failure** (see Box 2) should be:	C
	• given an **oxygen alert card** and a **24% or 28% Venturi** mask	
	• instructed to show the card to ambulance crew and emergency department staff in the event of an exacerbation.	
	□ In patients with **suspected hypercapnia or respiratory acidosis** due to excessive oxygen therapy:	C
	• **step down oxygen therapy** rather than discontinue completely	
	• use **28% or 35% oxygen** from **Venturi mask** depending on oxygen saturation and subsequent ABG results.	
3	**Equipment used to deliver emergency oxygen therapy:**	
	□ The following **delivery devices** should be available in **hospital** settings where oxygen is administered:	D
	• **high concentration reservoir** (non-rebreathe) mask for **high-concentration** oxygen therapy	
	• **nasal cannulae** or simple face mask for **medium-concentration** therapy	
	• **28% Venturi** mask for patients with definite or likely **COPD or other conditions predisposing to hypercapnic respiratory failure:**	
	– patients may have their own 24% or 28% Venturi mask.	
	• **tracheostomy masks** for patients with tracheostomy.	
	□ **24% Venturi** masks should also be available in hospital settings.	D
	□ **Venturi** mask can be **substituted** with **nasal cannulae** at **low flow** rates (1–2 l/min) once patient has stabilised.	D
	□ Patients with **prior hypercapnic respiratory failure** who do **NOT** have an **oxygen alert card** should receive oxygen therapy using:	D
	• **28% Venturi** mask at 4 l/min in **prehospital** care	
	• either **28%** or **24% Venturi** mask at 2–4 l/min in **hospital** care	
	• with initial **target SpO_2 88–92%** pending urgent ABG results.	
4.	**Achieving desirable oxygen saturation (SpO_2) ranges in acute illness (see chart 1 in BTS full guideline[1]):**	
	□ Aim to achieve **normal**/near-normal **SpO_2** for **all acutely** ill patients **APART** from those at risk of **hypercapnic respiratory failure.**	D
	□ **Recommended target SpO_2** range for acutely ill patients:	
	• **94–98%** for those not at risk of hypercapnic respiratory failure	D
	• **88–92%** for patients with risk factors for hypercapnic respiratory failure (Box 2).	C
	□ Treatment of patients with **recurrent hypercapnic respiratory failure** should be based on **ABG** estimations from previous acute exacerbations:	D
	• as hypercapnic respiratory failure can occur even if $SpO_2 < 88\%$.	
	□ In **myocardial infarction** and **acute coronary syndrome** the target SpO_2 range is the same as that recommended for acutely ill patients above.	D

The guidelines (*continued*)

Recommendation	Grade
☐ Some **normal subjects** (particularly >70 yrs or if obese) may have **SpO_2 <94%** and do NOT require oxygen therapy when **clinically stable**.	D
☐ **Non-hypoxaemic** breathless patients do NOT benefit from oxygen therapy (except in carbon monoxide poisoning and some other rare instances):	
• but **reduction >3% in SpO_2** within target range may be first evidence of acute illness and should prompt further assessment.	D
5 Oxygen therapy during nebulised treatments:	
For patients with asthma	
☐ **Nebulisers** should be **driven** by:	D
• **piped oxygen** OR	
• an **oxygen cylinder** capable of delivering **flow** rate of **>6 l/min**.	
☐ Use an **air-driven** nebuliser if cylinder unable to produce flow >6 l/min:	
• with **supplemental oxygen** by nasal cannulae at 2–6 l/min to maintain appropriate SpO_2 level.	
• Change patient back to their usual mask or continue to use nasal cannulae when nebulised therapy complete.	
For patients with hypercapnic acidosis	
☐ **Nebulisers** should be driven by **compressed air in hospitals**.	D
☐ **Supplementary oxygen** can be given concurrently by nasal cannulae at 2–4 l/min to maintain **SpO_2 88–92%**.	
☐ Reinstitute controlled oxygen therapy via Venturi mask once nebulised treatment complete.	
☐ If compressed air is not available, limit nebulisation to six minutes for patients at risk of hypercapnia.	
6. Oxygen therapy in pregnancy:	
☐ Women who suffer major trauma, sepsis or acute illness during pregnancy should receive **same oxygen therapy** as any other **acutely ill patient:**	D
• with target oxygen saturation (SpO_2) range **94–98%**.	
☐ The same target SpO_2 range (94–98%) should be applied to women with:	D
• hypoxaemia due to acute complications of pregnancy (eg amniotic fluid embolus, eclampsia, major haemorrhage)	
• underlying hypoxaemic conditions (eg heart failure).	
☐ All women with evidence of hypoxaemia who are **>20 weeks** pregnant should be managed with **left lateral tilt** to improve cardiac output.	B
☐ The use of **oxygen during labour** is **NOT** currently **recommended** in situations where the mother is **NOT hypoxaemic:**	A
• there is evidence that this may be harmful to the fetus.	
7 Prescription, administration, monitoring and discontinuation of oxygen therapy:	
☐ Oxygen therapy should **always be prescribed** on a designated document eg drug chart or electronic prescription.	D
☐ Oxygen **prescriptions** should include:	
• starting **dose** (oxygen delivery in l/min or %)	
• initial **mode of delivery** (ie type of delivery device)	
• **target** oxygen **saturation** (SpO_2) range	
• doctor or prescriber's **signature**.	
☐ Health professionals who administer oxygen should be **trained** to **adjust oxygen concentration** as necessary to maintain SpO_2 in target range (see chart 2 in BTS full guideline for advice concerning oxygen dose adjustment).	
☐ Nurses should be advised about the frequency of SpO_2 monitoring required on a case-by-case basis.	
☐ **Nurses** should **review** the patient's **oxygen therapy** at every drug round and sign the drug chart to indicate whether:	
• the patient is receiving oxygen therapy	
• the patient is within the target SpO_2 range	
• weaning or discontinuation should be instituted.	
☐ In **emergencies, oxygen should be given first** and documented later.	
☐ Detailed instructions for monitoring and discontinuation of oxygen are provided in the main guideline.[1]	