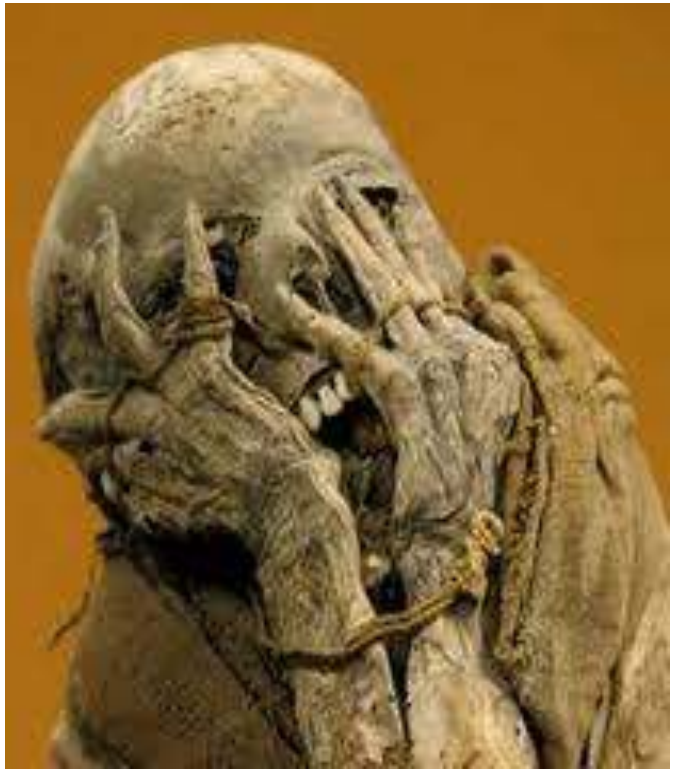
Oxygen

“I’m 67 years old and 3 months ago my doctor diagnosed asthma and started me on an inhaler. “

“It’s not working and in any case I think it has run out.”

“Would I be able to come up and get some oxygen as I’m breathless and that’s what my neighbour has……..she said I could borrow it if you cant see me today!”




AAARGH!

Oxygen - there is a problem

Published audits have shown

- Doctors and nurses have a poor understanding of how oxygen should be used
- Oxygen is often given without any prescription
- If there is a prescription, it is unusual for the patient to receive what is specified on the prescription

Try and answer the following questions

The percentage of Oxygen that comes out of the end of nasal cannulae at a flow of 2L per minute is…

A	24%
B	28%
C	35%
D	40%
E	60%
F	80%
G	100%

One answer only is correct!

The percentage of Oxygen that comes out of the end of nasal cannulae at a flow of 6L per minute is…

A	24%
B	28%
C	35%
D	40%
E	60%
F	80%
G	100%

One answer only is correct!

When starting someone on 24% oxygen the minimum flow required to deliver this FiO2 is……

A	I L/min	
B	1.5 L/min	
C	2.0 L/min	
D	2.5 L/min	
E	3 L/min	

One answer only is correct!

If the flow through a 24% venturi mask is increased from 2L/min to 4L/min the % oxygen delivered…….

A stays at 24%

B decreases to 21%

C increases to 28%

D increases to 35%

E increases to 40%

F increases to 60%

One answer only is correct!

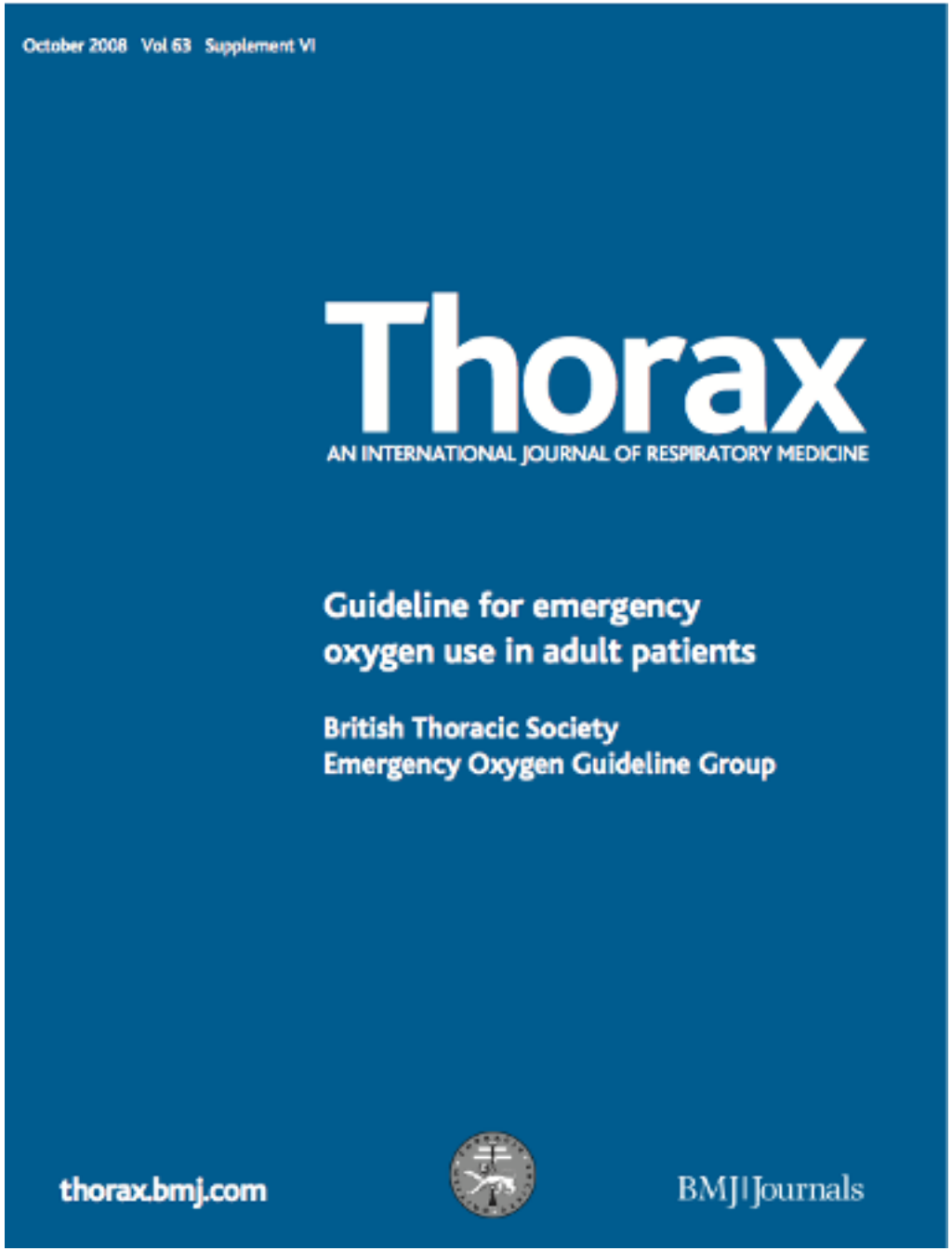
Management in the acute setting

Delivery Devices

Management of Respiratory Failure

Prescribing

2008


October 2008 Vol 63 Supplement VI
Thorax
AN INTERNATIONAL JOURNAL OF RESPIRATORY MEDICINE
Guideline for emergency oxygen use in adult patients
British Thoracic Society
Emergency Oxygen Guideline Group
thorax.bmj.com
BMJ|Journals

Oxygenation

There are 3 things that affect the oxygen delivery to a patient

Supply: from the wall or the Oxygen concentrator(s)

NB: this may be considered as 100% oxygen!
(although it is more like 93% from a concentrator)

The same supply……?

No!- remember that flow from an oxygen concentrator may not equate to that from a cylinder or wall supply

That doesn't matter- you just need to work out what you need to maintain your desired saturations- more on this later!

Oxygenation: factor 2

Delivery to the patient

i.e. the type of delivery device you choose to use

Delivery Devices: deliver oxygen to patients!

Nasal Cannulae

Recommended in the Guideline as suitable for most patients with both type I and II respiratory failure.

2-6L/min gives approx 24-50% FIO_2

FIO_2 depends on oxygen flow and patient's minute volume and inspiratory flow and pattern of breathing.

Comfortable and easily tolerated

No re-breathing

Low cost product

Preferred by patients *(Vs simple mask)*

Simple face mask

(Medium concentration, variable performance)

- Used for patients with type I respiratory failure.
- Delivers variable O_2 concentration between 35% & 60%.
- Low cost product.
- Flow 5-10 L/min

Flow must be at least 5 L/min to avoid CO_2 build up and resistance to breathing

(although packaging may say 2-10L)

Venturi System

- Best for controlled oxygen therapy (you can set the exact %02 you want)
- It is therefore the method of choice for managing type 2 respiratory failure
- Less convenient for eating and drinking
- Requires more supervision (a mask on the forehead doesn't deliver much O2 to the lungs!)
- Flow also important- (see later)
- May require high flow circuit to guarantee desired percentage (again- see later!)

Non-rebreathe system

- Reservoir of oxygen
- One way valve to prevent inspiration and expiration of room air
- Requires flow of 15L per minute
- Usually a temporary measure whilst further assessment occurs

Oxygenation- factor 3

Demands of the patient

Measure the respiratory rate

Record the O2 sats

Measure Blood Gases

How sick is your patient?

??? Measure patient inspiratory flow???

Ever wondered why oxygen masks have holes on the sides??????- find out later

The Inspiratory Flow

What is your current inspiratory flow as you sit reading this?

i.e. when you take a normal breath in, how fast do you do it?

Answer: very slow (25-30 L/min)

Inspiratory Flow

Now imagine you're in the middle of an acute attack of asthma or COPD.

How fast do you think your inspiratory flow might be then?

Answer: much higher than normal!!
(up to 80-90 L/min!)

Inspiratory Flow: so why is this important?

The Venturi system has a minimum flow recommended for delivery of the desired % Oxygen

2 L for 24%

4 L for 28%

8 L for 35%

But remember these are only minimum flows

Venturi Colour	Oxygen (%)	Low Flow setting
	24	2 L/min
	28	4 L/min
	31	6 L/min
	35	8 L/min
	40	8 L/min
	60	12 L/min

So…….

For any given percent of oxygen there is a minimum flow required

But…..

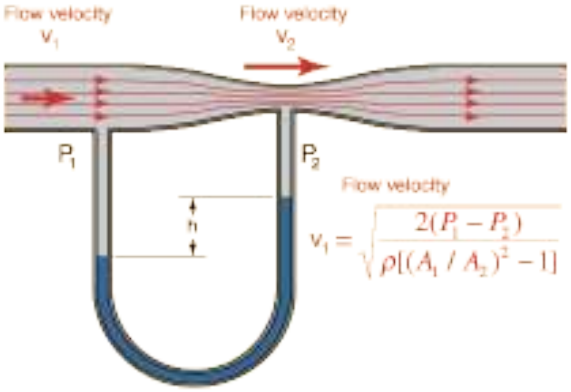
This minimum flow is worked out on “normal” people rather than those having an exacerbation of COPD!

This SOMETIMES matters….

Because sometimes they are breathing in at “fast” inspiratory flows

Delivering Oxygen from supply……..

There is some fancy mathematics you can use to calculate the speed at which the oxygen passes through the venturi system and is breathed in by a patient



The Bernouille Effect!
Just as well you don't need to learn this eh!!!

The size of the hole through which the oxygen from the supply passes is wider as the percentage you want to give increases

All this means that you can work out how fast a particular percentage of oxygen is being delivered to a patient

Venturi Colour	Oxygen (%)	Low Flow setting
	24	2 L/min
	28	4 L/min
	31	6 L/min
	35	8 L/min
	40	8 L/min
	60	12 L/min

So for each of these percentages of oxygen at these flows we can work out the speed at which the oxygen arrives at the patient's mouth

Venturi Colour	Oxygen (%)	Low Flow setting	Total gas delivered at low flow
	24	2 L/min	52 L/min
	28	4 L/min	45
	31	6 L/min	47
	35	8 L/min	45
	40	8 L/min	33
	60	12 L/min	24

The term used is
"Total Gas Delivered"

As the percentage increases the speed the gas arrives at the mouth decreases….

…because the hole for the particular venturi mask gets bigger as you increase amount of oxygen you want to give

Why bother about all this……?

Well remember your patient with an exacerbation of COPD?

They may have an inspiratory flow
(i.e. be breathing in) at a rate of 80L/min

If you put them on 24% venturi at 2L/min….

Venturi Colour	Oxygen (%)	Low Flow setting	Total gas delivered at low flow
	24	2 L/min	52 L/min

They will receive their oxygen at
a rate of 52L/min

What will happen……?

Venturi Colour	Oxygen (%)	Low Flow setting	Total gas delivered at low flow
	24	2 L/min	52 L/min

The flow to the patient is 52L/min

The patient is breathing in at a flow of 80L/min

They will suck in air (21% oxygen!) through the holes in the side of the mask!

This will “dilute” the 24%!!

How do I prevent this?

Remember that you can increase the flow from the oxygen supply

Venturi Colour	Oxygen (%)	Low Flow setting	Total gas delivered at low flow	High Flow setting	Total gas delivered at high flow
	24	2 L/min	52 L/min	4 L/min	102 L/min

If you increase the flow from 2L-4L/min then you increase the speed to the patient to 102L/min

What will happen……?

Venturi Colour	Oxygen (%)	High Flow setting	Total gas delivered at high flow
	24	4 L/min	102 L/min

The flow to the patient is 102L/min

The patient is breathing in at a flow of 80L/min

This overcomes the speed at which the patient is sucking air in and so no air comes through the mask holes to dilute the 24% oxygen

Your patient gets 24% Oxygen!!!

The same principle applies no matter what percentage oxygen you are giving

Venturi Colour	Oxygen (%)	Low Flow setting	Total gas delivered at low flow	High Flow setting	Total gas delivered at high flow
	24	2 L/min	52 L/min	4 L/min	102 L/min
	28	4 L/min	45	6 L/min	68 L/min
	31	6 L/min	47	8 L/min	63 L/min
	35	8 L/min	45	10 L/min	56 L/min
	40	8 L/min	33	12 L/min	50 L/min
	60	12 L/min	24	20 L/min	40 L/min

Venturi Colour	Oxygen (%)	Low Flow setting	Total gas delivered at low flow	High Flow setting	Total gas delivered at high flow
	24	2 L/min	52 L/min	4 L/min	102 L/min
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	31	6 L/min	47	8 L/min	63 L/min
	35	8 L/min	45	10 L/min	56 L/min
	40	8 L/min	33	12 L/min	50 L/min
	60	12 L/min	24	20 L/min	40 L/min

If you increase the flow at a particular percentage you can speed up delivery of oxygen to the patient without affecting the percentage delivered

But I can’t measure inspiratory flow!!!

True: but you can measure respiratory rate!

And you can ask a patient:
“Do you think you are getting this oxygen?”

Are you still struggling with this?????

Checkout next slide

Assessing whether flow is important…..

1. Go and see your patient on 24% oxygen and measure their respiratory rate.

2. If it is >25 per minute and ask them,
"Do you feel as though you are getting that oxygen?"

3. If they say, "I don't know" or "I'm not sure" or "No I don't think so….

4. Increase the flow to 4L/min and wait for 1 minute

5. If flow is a real issue you will notice that their respiratory rate slows quickly

6. And they will tell you they can "feel" the oxygen

So remember: when assessing oxygen

What is your supply?

What device is best for your patient?

What are their “demands”?
(i.e. is their inspiratory flow fast?)

Always measure respiratory rate

Consider **flow** as well as FiO2

Aim for pO2 of 8kPa or 60mmHg

What is normal and what is dangerous?

Normal Range for Oxygen saturation

Normal range for healthy young adults is approximately 96-98% *(Crapo AJRCCM, 1999;160:1525)*

SLIGHT FALL WITH ADVANCING AGE

A study of 871 subjects showed that age > 60 was associated with minor SpO2 reduction of 0.4% *Witting MD et al Am J Emerg Med 2008: 26: 131-136*

An audit in Salford and Southend showed mean SpO2 of 96.7% with SD 1.9 in 320 stable hospital patients aged >70

O'Driscoll R et al Thorax 2008; 63(suppl Vii): A126

What is the minimum arterial oxygen level recommended in acute illness

	Target oxygen Saturation
Critical care consensus guidelines	*Minimum 90%*
Surviving sepsis campaign	Aim at *88-95%*

But these patients have intensive levels of nursing & monitoring

This guideline recommends a minimum of 94% for most patients – combines what is near normal and what is safe

Exposure to high concentrations of oxygen may be harmful

- Absorption Atelectasis even at FIO_2 30-50%
- Intrapulmonary shunting
- Post-operative hypoxaemia (on return to room air)
- Risk to COPD patients
- Coronary vasoconstriction
- Increased Systemic Vascular Resistance
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- Hyperoxaemia was associated with INCREASED mortality in survivors of cardiac arrest
- Oxygen therapy INCREASED mortality in non-hypoxic patients with mild-moderate stroke

This guideline recommends an upper limit of 98% for most patients. Combination of what is normal and safe

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Kilgannon JH et al. JAMA 2010; 302: 2165-71

Some patients are at risk of CO2 retention and acidosis if given high dose oxygen

- **Chronic hypoxic lung disease**
  - ***COPD***
  - *Severe Chronic Asthma*
  - *Bronchiectasis / CF*
- **Chest wall disease**
  - *Kyphoscoliosis*
  - *Thoracoplasty*
- **Neuromuscular disease**
- **Obesity hypoventilation**

What is a safe upper limit of oxygen target range in acute COPD ?

- 47% of 982 patients with exacerbation of COPD were hypercapnic on arrival in hospital
- 20% had Respiratory Acidosis (pH < 7.35)
- 5% had pH < 7.25 (and were likely to need ICU care)
- Most hypercapnic patients with pO_2 > 10 kPa were acidotic (equivalent to oxygen saturation of above ~ 92%) i.e. They had been given too much oxygen

RECOMMENDED UPPER LIMITS

Keep PaO2 below 10 kPa and keep $SpO_2 \leq 92\%$ in acute COPD

Plant et al Thorax 2000; 55:550

Recommended target saturations

The target ranges are a consensus agreement by the guidelines group and the endorsing colleges and societies

Rationale for the target saturations is combination of what is normal and what is safe

Most patients **94 - 98%**

Risk of hypercapnic respiratory failure **88 – 92%***

****Or patient specific saturation on Alert Card***

OXYGEN ALERT CARD

Name: _____

I am at risk of type II respiratory failure with a raised CO_2 level.

Please use my % Venturi mask to achieve an

oxygen saturation of _____ % to _____ % during exacerbations

Use compressed air to drive nebulisers (with nasal oxygen a 2 l/min).
If compressed air not available, limit oxygen-driven nebulisers to 6 minutes.


Where Is It?

What device and flow rate should you use in each situation?

Standard Oxygen Therapy 1960s-2008

Acute Patients

Stable Patients

Oxygen therapy 2008 onwards

Critical illness

Most patients

Selected COPD patients

Many patients need high-dose oxygen to normalize saturation

- Severe Pneumonia
- Severe LVF
- Major Trauma
- Sepsis and Shock
- Major atelectasis
- Pulmonary Embolism
- Lung Fibrosis
- Etc etc etc

Then you will prescribe oxygen correctly!!!

Remember that oxygen is a drug and therefore needs to be written up!!!

PRN vs REGULAR

MASK vs NASAL SPECS

FLOW L/MIN

Royal College of Physicians

IN-PATIENT MEDICATION ADMINISTRATION RECORD

Developed in collaboration with the All Wales Chief Pharmacists Committee

GIG NHS

DRUG ALLERGIES & SENSITIVITIES

PLEASE CIRCLE AS APPROPRIATE: **NONE KNOWN** **YES**

SIGNED ..... DATE .....

NAME .....

Drug / Allergen:	Description of Reaction:

This section must usually be completed prior to administration of any medicine. Refer to local policies for further guidance.

HOSPITAL No: .....

SURNAME: .....

FIRST NAME: .....

ADDRESS: .....

.....

ADDRESSOGRAPH

DATE OF BIRTH: .....

Height (m)			Weight (kg)			Surface Area (m²)
Date	Height	Sign	Date	Weight	Sign	
			Date	Weight	Sign	

DATE OF ADMISSION .....

HOSPITAL .....

WARD .....

CONSULTANT .....

MULTIPLE MEDICATION CHARTS

CHART ..... OF .....

MEDICATION ON SUPPLEMENTARY CHARTS SHOULD ALSO BE RECORDED ON THIS DRUG CHART.

DETAILS OF SUPPLEMENTARY CHARTS
TICK APPROPRIATE BOX

- ANTICOAGULANT ☐
- SUPPLEMENTARY INFUSION CHART ☐
- INSULIN ☐
- PATIENT CONTROLLED ANALGESIA/EPIDURAL ☐
- SYRINGE DRIVER ☐
- OTHER (PLEASE SPECIFY)

Venous Thromboembolism Risk Assessment

	(Y/N)	Signature	Date
Does the patient need thromboprophylaxis? (Refer to local policy)			

If **YES**, please prescribe appropriate thromboprophylaxis on the prescription chart

If thromboprophylaxis contraindicated, please state reason: .....

(N.B. Reassess risk of bleeding and venous thromboembolism within 24 hours and if clinical situation changes)

PRESCRIPTIONS FOR ONCE ONLY and PRE-ANAESTHETIC MEDICATION

DATE	MEDICINE (APPROVED NAME)	DOSE	ROUTE	TIME TO BE GIVEN	PRESCRIBERS SIGNATURE	PHARMACY	DATE	TIME GIVEN	GIVEN BY	CHECKED BY
					(Bleep No)					
					(Bleep No)					
					(Bleep No)					
					(Bleep No)					
					(Bleep No)					
					(Bleep No)					
					(Bleep No)					
					(Bleep No)					
					(Bleep No)					

MEDICINES MANAGEMENT

MEDICATION HISTORY OBTAINED FROM:

PATIENT ☐ GP ☐ NH/RH ☐ CARER ☐

PODS ☐ MDS ☐ OTHER .....

COMPLIANCE ISSUES .....

INITIALS ..... DATE .....

COMMENTS / NOTES

MEDICINES RECONCILED

INITIALS ..... DATE .....

GP	COMMUNITY PHARMACY DETAILS	DISCHARGE PRESCRIPTION WRITTEN
		INITIALS ..... DATE .....

IN-PATIENT MEDICATION ADMINISTRATION RECORD

AWMR03.12

PATIENT'S NAME ..... **HEALTH RECORD NUMBER** .....

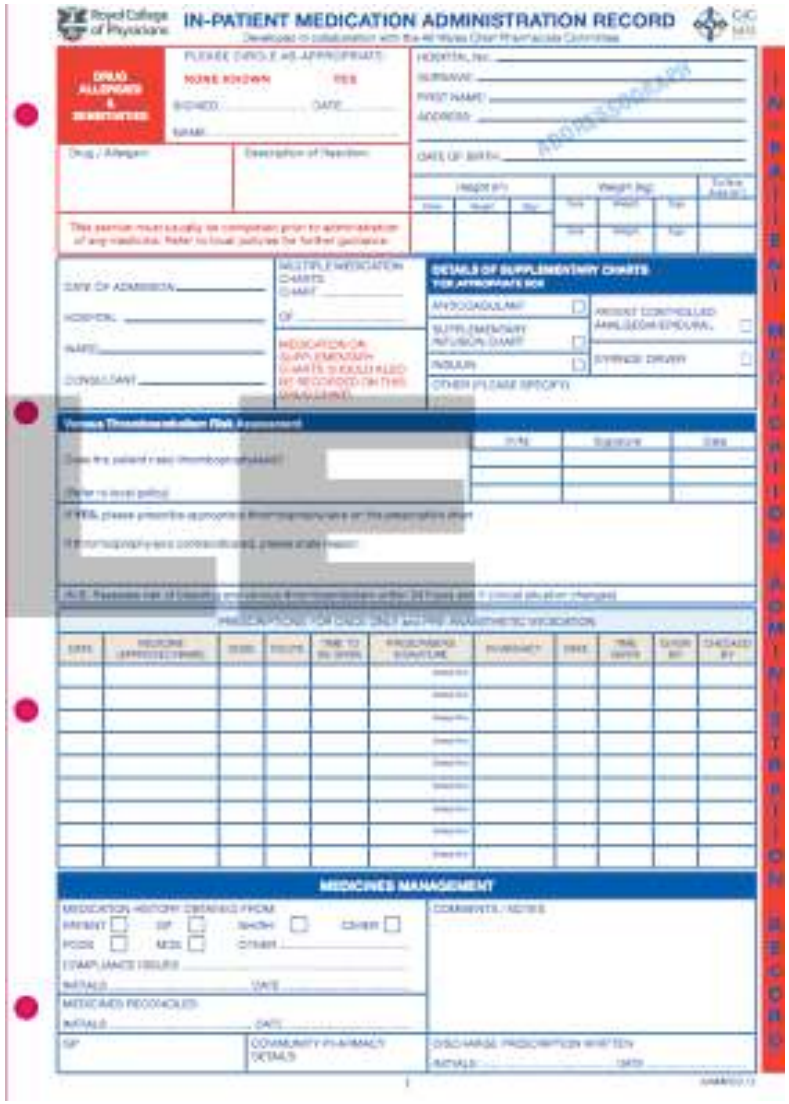
MORNING (around 0800); MIDDAY (between 1200 & 1400); EVENING (around 1800); BEDTIME (around 2200)

ENTER DOSE AGAINST TIME REQUIRED. USE ONE ROUTE ONLY FOR EACH ENTRY	REGULAR MEDICINES	MONTH	YEAR
	DATE		

MEDICINE (Approved Name) **OXYGEN**	SPECIAL INSTRUCTIONS Sign in box to indicate that specified target saturations have been checked and achieved. Adjust flow rate and/or delivery device as necessary. Refer to Local Policy for further details.	PRESCRIBER'S SIGNATURE bleep No.	DATE	PHARMACY

Circle Saturation target															
88-92%	MORNING														
94-98%	MIDDAY														
Other	EVENING														
	BEDTIME														

Device? **Flow?** **Changes?**



Royal College of Physicians

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PLEASE CIRCLE AS APPROPRIATE

NONE KNOWN YES

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NAME .....

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Height (ft) | Weight (kg) | Surface Area (m²)

Date | Height | Sin | Date | Weight | Age | Date | Weight | Age

DATE OF ADMISSION: .....

HOSPITAL: .....

WARD: .....

CONSULTANT: .....

MULTIPLE MEDICATION CHARTS

CHART ..... OF .....

MEDICATION ON SUPPLEMENTARY CHARTS IS NOT TO BE RECORDED ON THIS MAIN CHART

DETAILS OF SUPPLEMENTARY CHARTS

TICK APPROPRIATE BOX

ANTICOAGULANT ☐

PATIENT CONTROLLED ANALGESIA/EPIDURAL ☐

SUPPLEMENTARY INFUSION CHART ☐

INSULIN ☐

SYRINGE DRIVER ☐

OTHER (PLEASE SPECIFY)

Venous Thromboembolism Risk Assessment

Initials | Signature | Date

Does this patient need thromboprophylaxis?

Refer to local policy

If YES, please prescribe appropriate thromboprophylaxis on the prescription sheet

If thromboprophylaxis contraindicated, please state reason

At 6 - 8 weeks risk of bleeding and venous thromboembolism will be 24 hours and 1 clinical situation changes

PRESCRIPTIONS FOR ONCE ONLY AND PRE-ANESTHETIC MEDICATION

DATE	MEDICINE (APPROVED NAME)	DOSE	ROUTE	TIME TO BE GIVEN	PRESCRIBER SIGNATURE	WARFARIN?	INR	TRIAL DATE	GIVEN BY	CHECKED BY

MEDICINES MANAGEMENT

MEDICATION HISTORY OBTAINED FROM:

PATIENT ☐ GP ☐ SHOW ☐ OTHER ☐

FCOD ☐ MDS ☐ OTHER .....

COMPLIANCE ISSUES .....

INITIALS ..... DATE .....

COMMENTS / NOTES

MEDICINES RECONCILED:

INITIALS ..... DATE .....

GP

COMMUNITY PHARMACY DETAILS

DISCHARGE PRESCRIPTION WRITTEN

INITIALS ..... DATE .....

INPATIENT MEDICATION RECORD

Now……

Did you get those questions right?

Try and answer the following questions

The percentage of Oxygen that comes out of the end of nasal cannulae at a flow of 2L per minute is…

A	24%	
B	28%	
C	35%	
D	40%	
E	60%	
F	80%	
G	100%	✓

One answer only is correct!

Remember- this is the oxygen supply!

The percentage of Oxygen that comes out of the end of nasal cannulae at a flow of 6L per minute is…

A	24%	☐
B	28%	☐
C	35%	☐
D	40%	☐
E	60%	☐
F	80%	☐
G	100%	☑

One answer only is correct!

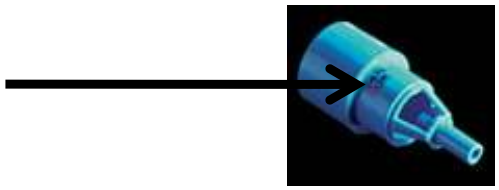
It doesn't matter what the flow is the percentage will stay the same from 100% supply!

When starting someone on 24% oxygen the minimum flow required to deliver this FiO2 is……

A	I L/min	
B	1.5 L/min	
C	2.0 L/min	✓
D	2.5 L/min	
E	3 L/min	

One answer only is correct!

It’s written on the mask



If the flow through a 24% venturi mask is increased from 2L/min to 4L/min the % oxygen delivered…….

One answer only is correct!

A stays at 24% ✓

B decreases to 21%

C increases to 28%

D increases to 35%

E increases to 40%

F increases to 60%

It is the flow to the patient that is increased NOT the percent oxygen

Venturi Colour	Oxygen (%)	Low Flow setting	Total gas delivered at low flow	High Flow setting	Total gas delivered at high flow
	24	2 L/min	52 L/min	4 L/min	102 L/min


OUT OF
ORDER!

Basis of the BTS guideline
Prescribing by target oxygen saturation

Keep it normal/near-normal for all patients except pre-defined groups who are at risk from hypercapnic respiratory failure

What is normal and what is dangerous?

Normal Range for Oxygen saturation

Normal range for healthy young adults is approximately 96-98% *(Crapo AJRCCM, 1999;160:1525)*

SLIGHT FALL WITH ADVANCING AGE

A study of 871 subjects showed that age > 60 was associated with minor SpO2 reduction of 0.4% *Witting MD et al Am J Emerg Med 2008: 26: 131-136*

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O'Driscoll R et al Thorax 2008; 63(suppl Vii): A126

Why is oxygen used?

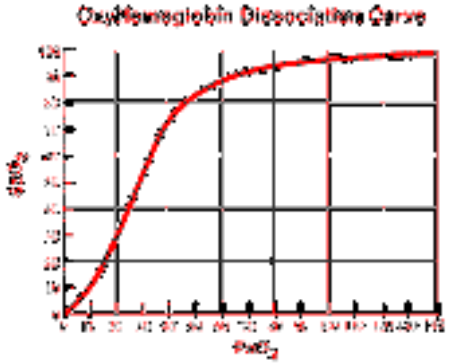
Aims of emergency oxygen therapy

- To correct or prevent potentially harmful hypoxaemia
- *To alleviate breathlessness (only if hypoxaemic)*

Oxygen has no effect on breathlessness if the oxygen saturation is normal

Fallacies regarding Oxygen Therapy

"Routine administration of supplemental oxygen is useful, harmless and clinically indicated''



- Little increase in oxygen-carrying capacity
- Renders pulse oximetry worthless as a measure of ventilation
- May prevent early diagnosis & specific treatment of hypoventilation

This guideline only recommends supplemental oxygen when SpO2 is below the target range

or in critical illness or CO Poisoning

John B Downs MD Respiratory care 2003;48:611-20

Oxygen therapy is only one element of resuscitation of a critically ill patient

The oxygen carrying power of blood may be increased by

- **Safeguarding the airway**
- **Enhancing circulating volume**
- **Correcting severe anaemia**
- **Enhancing cardiac output**
- **Avoiding/Reversing Respiratory Depressants**
- **Increasing Fraction of Inspired Oxygen (FIO_2)**

- Establish the reason for Hypoxia and **treat the underlying cause** (e.g Bronchospasm, LVF etc)

- Patient may need, **CPAP** or **NIV** or **Invasive ventilation**

Defining safe lower and upper limits of oxygen saturation

What is the minimum arterial oxygen level recommended in acute illness

	Target oxygen Saturation
Critical care consensus guidelines	*Minimum 90%*
Surviving sepsis campaign	Aim at *88-95%*

But these patients have intensive levels of nursing & monitoring

This guideline recommends a minimum of 94% for most patients – combines what is near normal and what is safe

Exposure to high concentrations of oxygen may be harmful

- Absorption Atelectasis even at FIO_2 30-50%
- Intrapulmonary shunting
- Post-operative hypoxaemia (on return to room air)
- Risk to COPD patients
- Coronary vasoconstriction
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- **Chest wall disease**
  - *Kyphoscoliosis*
  - *Thoracoplasty*
- **Neuromuscular disease**
- **Obesity hypoventilation**

What is a safe upper limit of oxygen target range in acute COPD ?

- 47% of 982 patients with exacerbation of COPD were hypercapnic on arrival in hospital
- 20% had Respiratory Acidosis (pH < 7.35)
- 5% had pH < 7.25 (and were likely to need ICU care)
- Most hypercapnic patients with pO_2 > 10 kPa were acidotic (equivalent to oxygen saturation of above ~ 92%) i.e. They had been given too much oxygen

RECOMMENDED UPPER LIMITS

Keep PaO2 below 10 kPa and keep $SpO_2 \leq 92\%$ in acute COPD

Plant et al Thorax 2000; 55:550

Recommended target saturations

The target ranges are a consensus agreement by the guidelines group and the endorsing colleges and societies

Rationale for the target saturations is combination of what is normal and what is safe

Most patients **94 - 98%**

Risk of hypercapnic respiratory failure **88 – 92%***

****Or patient specific saturation on Alert Card***

Safeguarding patients at risk of type 2 respiratory failure

- Lower target saturation range for these patients (88-92%)
- Education of patients and health care workers
- Use of controlled oxygen via Venturi masks
- Use of oxygen alert cards
- Issue of personal Venturi masks to high-risk patients

OXYGEN ALERT CARD

Name: _____

I am at risk of type II respiratory failure with a raised CO_2 level.

Please use my % Venturi mask to achieve an

oxygen saturation of _____ % to _____ % during exacerbations

Use compressed air to drive nebulisers (with nasal oxygen a 2 l/min).
If compressed air not available, limit oxygen-driven nebulisers to 6 minutes.

Oxygen Alert Cards and Venturi masks can avoid hypercapnic respiratory failure associated with high flow oxygen masks

- Oxygen alert card (and a Venturi mask) given to patients admitted with hypercapnic acidosis with a PO_2 > 10kPa.
- Patients instructed to show these to ambulance and A&E staff.

After introduction of alert cards

- Use of Venturi mask: 63% in Ambulance
  94% in A&E

Gooptu B, Ward L, Davison A et al. Oxygen alert cards and controlled oxygen masks: Emerg Med J 2006; 23:636-8

Oxygen use in palliative care

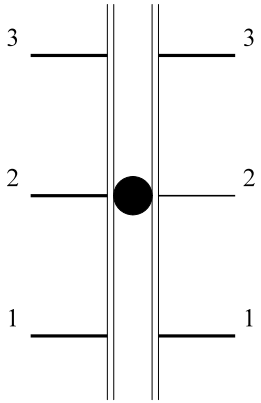
- Most breathlessness in cancer patients is caused by specific issues such as airflow obstruction, infections or pleural effusions and the main issue is to treat the cause

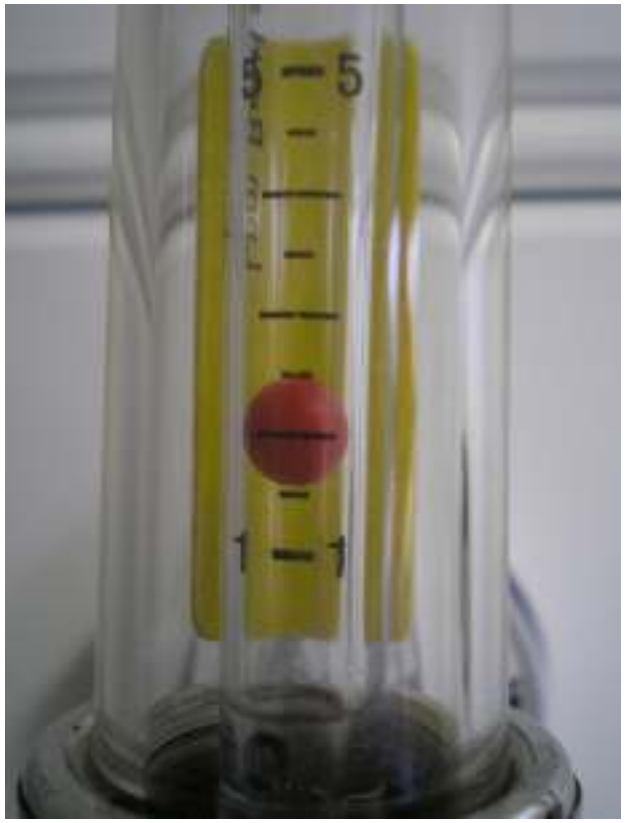
- Oxygen has been shown to relieve dyspnoea in hypoxic cancer patients

- Morphine and Midazolam may also relieve breathlessness

Oxygen Flow Meter

The centre of the ball indicates the correct flow rate.





This diagram illustrates the correct setting of the flow meter to deliver a flow of 2 litres per minute

What device and flow rate should you use in each situation?

Standard Oxygen Therapy 1960s-2008

Acute Patients

Stable Patients

Oxygen therapy 2008 onwards

Critical illness

Most patients

Selected COPD patients

Many patients need high-dose oxygen to normalize saturation

- Severe Pneumonia
- Severe LVF
- Major Trauma
- Sepsis and Shock
- Major atelectasis
- Pulmonary Embolism
- Lung Fibrosis
- Etc etc etc

BTS Recommendations

Critical Illness Requiring High Levels of Oxygen Supplementation

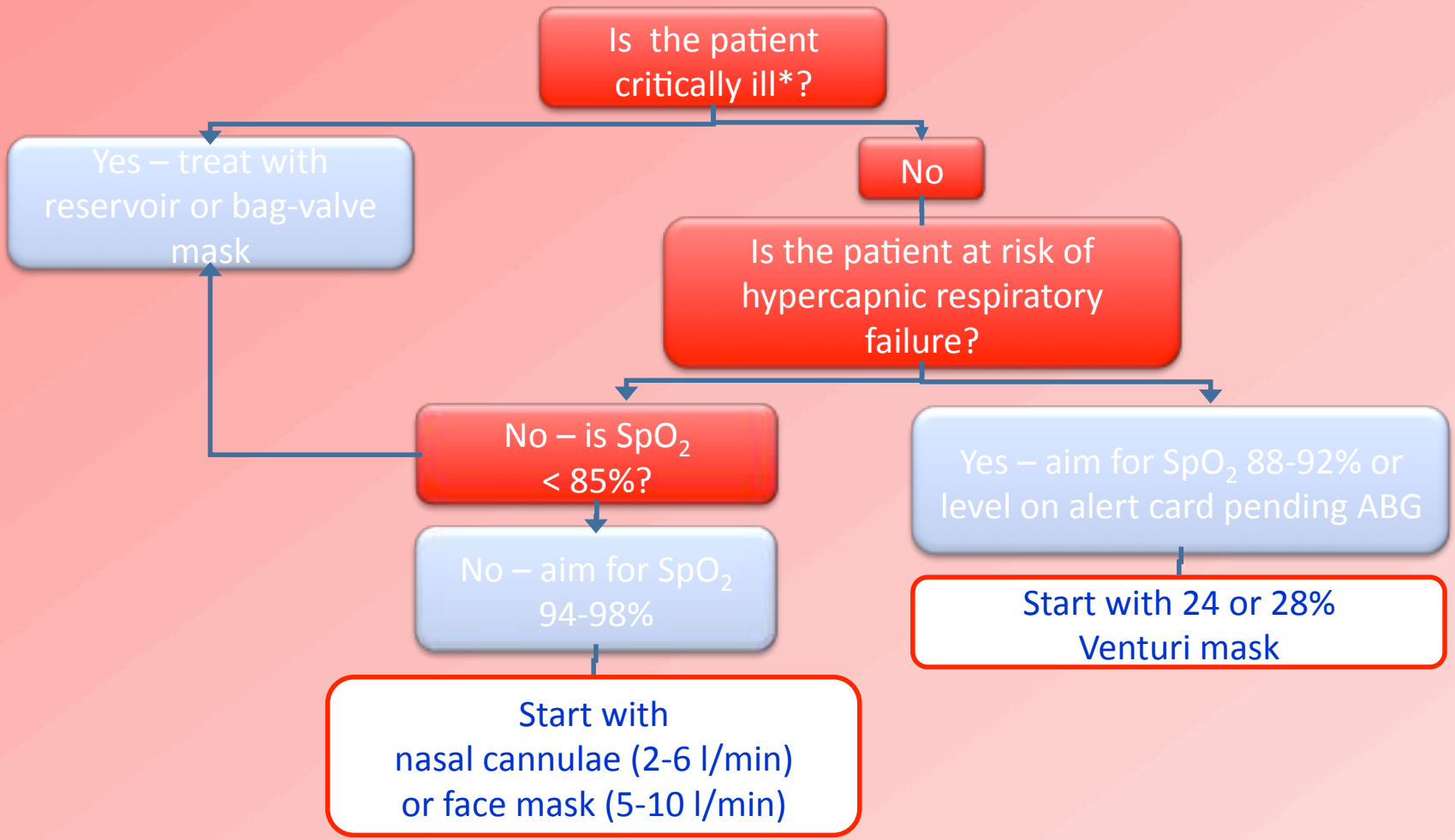
Serious Illness Requiring Moderate Levels of Oxygen if the Patient is Hypoxaemic

COPD and Other Conditions Requiring Controlled or low-dose Oxygen Therapy

Conditions for which patients should be monitored closely but oxygen therapy is not required unless the patient is hypoxaemic

Prescribe to target

Prior to Blood Gas Analysis



*Critical illness is defined as cardiopulmonary arrest, shock, major trauma & head injury, near-drowning, anaphylaxis, major pulmonary haemorrhage and carbon monoxide poisoning.

Titrating Oxygen up and down.

This table below shows APPROXIMATE conversion values.

Venturi 24% (blue) 2-4l/min	OR	Nasal specs 1L
Venturi 28% (white) 4-6 l/min	OR	Nasal specs 2L
Venturi 35% (yellow) 8-10l/min	OR	Nasal spec 4L
Venturi 40% (red)10-12l/min	OR	Simple face mask 5-6L/min
Venturi 60% (green) 15l/min	OR	Simple face mask 7-10L/min

Reservoir mask at 15L oxygen flow

seek medical advice

I f reservoir mask required

seek senior medical Input immediately

So……..

If her diagnosis is COPD?

Target saturations? 88-92%

Device?

Type 1 Respiratory Failure is…..

A Low pO2/Low pCO2

B Normal pO2/Low pC02

C Low pH/Low pO2

D Low pO2/normal pCO2

E Low pO2 /High pCO2

F Low pH/High pCO2

One answer only is correct!

Type 2 Respiratory Failure is…..

One answer only is correct!

A Low pO2/Low pCO2

B Normal pO2/Low pC02

C Low pH/Low pO2

D Low pO2/normal pCO2

E Low pO2 /High pCO2

F normal pH/High pCO2

The most important measurement on a blood gas to determine whether a patient needs NIV is…….

One answer only is correct!

A	pO2	
B	pC02	
C	pH	
D	HCO3	
E	O2 sats	
F	Base Excess	

Which of the following are most likely to be present in type 2 respiratory failure

One answer only is correct!

A metabolic acidosis

B respiratory alkalosis

C hypokalaemic acidosis

D respiratory alkalosis

E respiratory acidosis

F hypochloraemic alkalosis

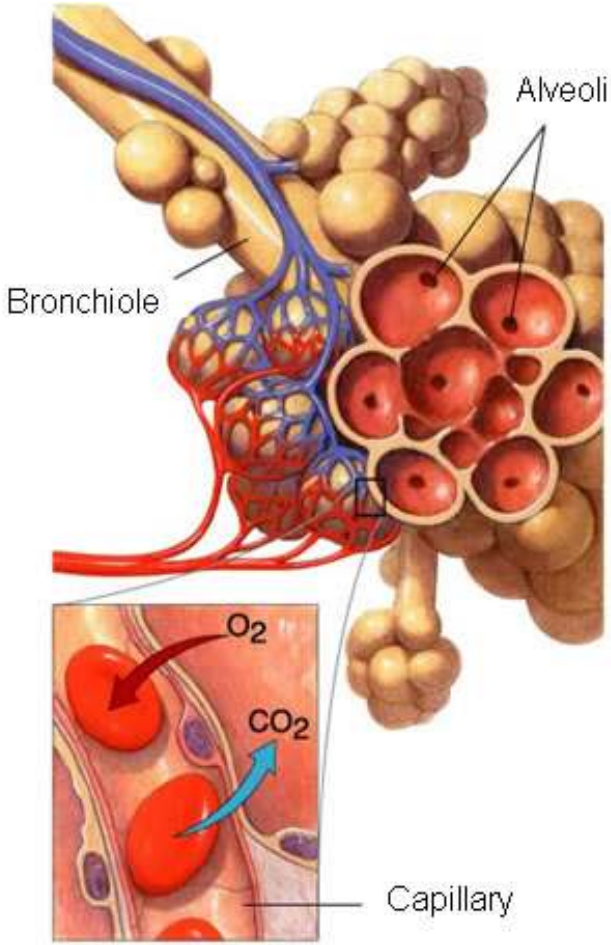
Respiratory Failure

A failure of gas exchange

Type 1

Hypoxia

Normal CO2



Type 2

Hypoxia

Raised CO2

Respiratory Failure: Why?

Alveolar Hypoventilation

Usually Type 2
Respiratory Failure

*NB in COPD there is
also loss of lung elasticity

Lungs e.g. COPD*, bronchospasm

Thoracic cage e.g. ankylosing spondylitis

Muscles e.g. myopathy

Neuromuscular junction e.g. myesthenia gravis

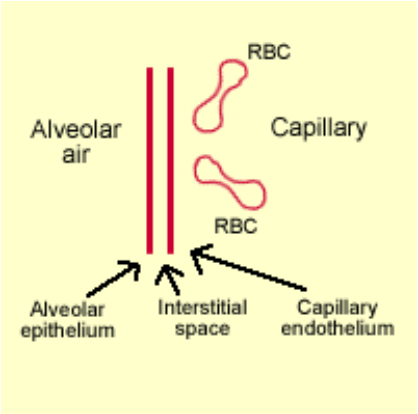
Nerves e.g. Motor Neurone Disease

Spinal Cord e.g. trauma

Brain Stem e.g. CVA, drugs

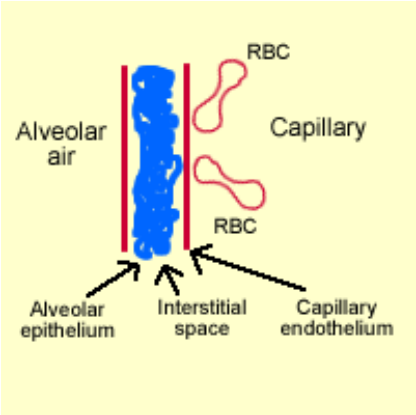
Respiratory Failure: Why?

Diffusion Deficit

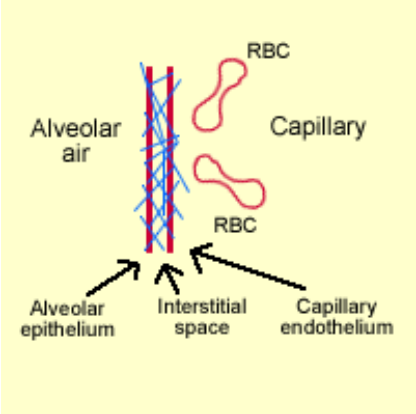


A pathological process
Affecting exchange at alveoli

Pulmonary oedema
(usually type 1)



Pulmonary Fibrosis
(starts off as type 1)



Respiratory Failure: Why?

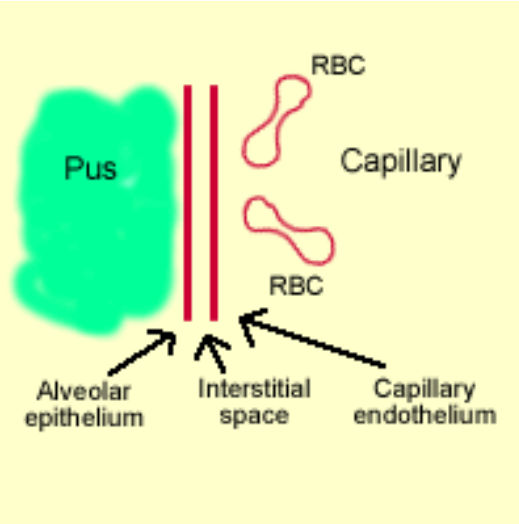
Shunt

when venous blood mixes with arterial blood either by bypassing the lungs completely (extra-pulmonary shunt) or by passing through the lungs without adequate oxygenation (intra-pulmonary shunt).

Extra-pulmonary usually involves congenital heart disease so you won't see it in adults

Intra-pulmonary - blood is transported through the lungs without taking part in gas exchange. The commonest causes are alveoli being filled (with pus, oedema, blood or tumour) and atelectasis

Usually type 1

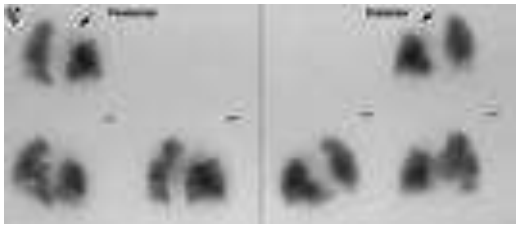


Respiratory Failure: Why?

Ventilation-Perfusion Mismatch

V/Q mismatch is the presence of a degree of shunt and a degree of dead space in the same lung.

It is a component of most causes of respiratory failure and is the commonest cause of hypoxaemia.



A patient with this condition is likely to have areas in the lungs that are better perfused than ventilated and areas that are better ventilated than perfused.

This occurs in normal lungs to some extent. The difference in V/Q mismatch is that the extent to which this occurs is significantly increased.

Types 1 and 2 can be associated with V/Q mismatch

Usually responds to Oxygen

Conditions causing Respiratory Failure

Common	Exacerbation of COPD	**less common**	Valvular heart disease
	LVF		Interstitial Lung Disease (e.g. acute interstitial pneumonitis, drug induced pneumonitis, pulmonary fibrosis)
	Community Acquired Pneumonia/Hospital Acquired Pneumonia		Extrinsic allergic alveolitis
	Acute asthma		Pulmonary haemorrhage
	Drug overdose		Organising Pneumonia
	ARDS/ALI		Fat emboli
	Reduced GCS		
	Atelectasis		
	Abdominal splinting		
	Pulmonary embolus		
	Pneumothorax		

74 yr old man with COPD

ABG on AIR

pH	7.37	**Normal:** but will need watching
pO2	5.6	**Low:** try and find out what it usually is
pCO2	6.7	**High:** but pH is OK so DON'T PANIC
HCO3	42	**High:** so he has been hypoxic for AGES
BE	-2	**Normal:** but less than -2 means he's sick so watch!

In addition to usual COPD treatment, this man needs CONTROLLED oxygen therapy

74 yr old man with COPD

Start 24% oxygen via venturi mask:

2L per minute to start with, but consider increasing flow (NOT the percentage) if respiratory rate >25

Recheck ABG in 1-2 hours

If you don't know usual pO2 aim for 8kPa

Aim for O2 sats 88-92%

74 yr old man with COPD

Repeat gases an hour later

ABG on AIR		ABG 24% O2	
pH	7.37	pH	7.36
pO2	5.6	pO2	6.6
pCO2	6.7	pCO2	8.7
HCO3	42	HCO3	32
BE	-2	BE	-3

Normal: but will need watching

Still Low: you're aiming for 8

High: but pH is OK so DON'T PANIC

High: so he has been hypoxic for AGES

Low: less than -2 means he's sick so watch!

In addition to usual COPD treatment, this man needs MORE OXYGEN

74 yr old man with COPD

28% via venturi:

Check the flow!!!

Recheck ABG in 1-2 hours

If you don't know usual pO2 aim for 8kPa

Aim for O2 sats 88-92%

74 yr old man with COPD

Repeat gases an hour later

ABG on AIR		ABG 24%O2		ABG 28% O2		
pH	7.37	pH	7.36	pH	7.33	**Low: this triggers NIV**
pO2	5.6	pO2	6.6	pO2	7.1	**Still Low: you need 8kPa**
pCO2	6.7	pCO2	8.7	pCO2	8.5	**High: but irrelevant really**
HCO3	42	HCO3	32	HCO3	28	**Normal: but low for him!**
BE	-2	BE	-3	BE	-4	**Low: equals sick!**

In addition to usual COPD treatment, this man needs **NIV and Oxygen**

NIV

Non-Invasive Ventilation

Treatment of choice for Type 2 respiratory failure in patients with acute exacerbations of COPD

Also used in patients with neuromuscular disease affecting respiratory system

Can be used by patients in their own homes (“Home NIV!”)

In patients with acute COPD……

Use if: pH <7.35 and pO2 <8kPa after controlled oxygen therapy and other COPD treatments (Nebs/Pred etc)

Check:

No risk of vomiting
No recent (6 weeks)facial surgery
No recent (6 weeks)GI bleed
No recent (6 weeks) pneumothorax

Correct size of mask- face mask only
Machine connected to power source
Mask fits tightly around face

A confused or agitated patient may not tolerate NIV that well

Machine Settings and Terms

IPAP = Inspiratory Positive Airway Pressure

Helps the patient breathe in more "efficiently"

Start usually at 10cmH_20

Usually need to increase to 18-25cmH_20 depending on response

Machine Settings and Terms

EPAP= Expiratory Positive Airway Pressure

Protects the small airways from closing when your patient breathes out (like PEEP on a ventilator in ICU)

Usually only need to set at 4cmH_20 and never adjust (unless the patient has a BMI >35)

Back to our patient……

74 yr old man with COPD

Repeat gases an hour later

ABG on AIR		ABG 24%O2		ABG 28% O2		
pH	7.37	pH	7.36	pH	7.33	**Low: this triggers NIV**
pO2	5.6	pO2	6.6	pO2	7.1	**Still Low: you need 8kPa**
pCO2	6.7	pCO2	8.7	pCO2	8.5	**High: but irrelevant really**
HCO3	42	HCO3	32	HCO3	28	**Normal: but low for him!**
BE	-2	BE	-3	BE	-4	**Low: equals sick!**

In addition to usual COPD treatment, this man needs **NIV and Oxygen**

74 year old man with COPD

Start NIV (10 IPAP /4 EPAP) and increase IPAP as quickly as tolerated
- oxygen at flow of 4L/Min

Recheck ABG after 60 minutes

Pre NIV		**60 mins post NIV**	
pH	**7.33**	**pH**	**7.35**
pO2	**8.23**	**pO2**	**8.6**
pCO2	**8.50**	**pCO2**	**6.92**
HCO3	**28**	**HCO3**	**34**
BE	**-4**	**BE**	**-2**

What next……?

74 year old man with COPD

Pre NIV		60 mins post NIV		
pH	7.33	pH	7.35	Better
pO2	8.23	pO2	8.6	Better
pCO2	8.50	pCO2	6.92	Better
HCO3	28	HCO3	34	Better
BE	-4	BE	-2	Better

DON'T STOP THE NIV just because you are winning

Continue at these settings and aim for sats of 88-92%

It is fine to give people a 10-15min break every couple of hours

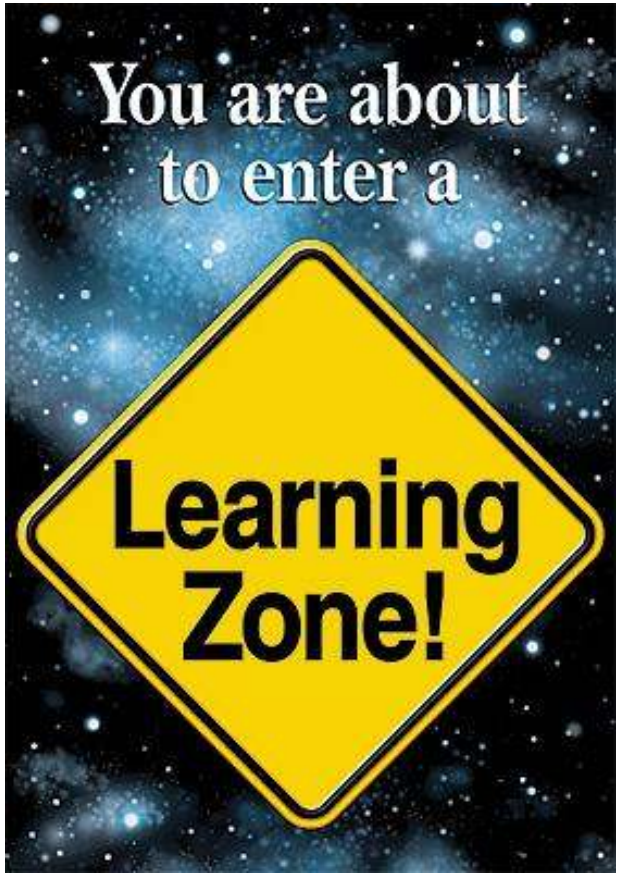
So when should I stop the NIV?

Once you've started someone on NIV you should aim for at least 24 hours of treatment.

Stop if: Patient looks better (clinical acumen!)
Patient can talk to you in complete sentences
O2 sats 88-92% on controlled oxygen therapy
Respiratory Rate <25 breaths per minute

If you repeat ABG: pH >7.35
pO2 >8.0
(Don't worry about the pCO2 if pH is normal!)

So how well did you do……?



Type 1 Respiratory Failure is…..

A Low pO2/Low pCO2

B Normal pO2/Low pC02

C Low pH/Low pO2

D Low pO2/normal pCO2

E Low pO2 /High pCO2

F Low pH/High pCO2

One answer only is correct!

Type 1 Respiratory Failure is…..

One answer only is correct!

A Low pO2/Low pCO2

B Normal pO2/Low pC02

C Low pH/Low pO2

D Low pO2/normal pCO2 ✓

E Low pO2 /High pCO2

F Low pH/High pCO2

Type 2 Respiratory Failure is…..

One answer only is correct!

A Low pO2/Low pCO2

B Normal pO2/Low pC02

C Low pH/Low pO2

D Low pO2/normal pCO2

E Low pO2 /High pCO2

F normal pH/High pCO2

Type 2 Respiratory Failure is…..

One answer only is correct!

A	Low pO2/Low pCO2	
B	Normal pO2/Low pC02	
C	Low pH/Low pO2	
D	Low pO2/normal pCO2	
E	Low pO2 /High pCO2	✓
F	normal pH/High pCO2	

The most important measurement on a blood gas to determine whether a patient needs NIV is…….

One answer only is correct!

A	pO2	
B	pC02	
C	pH	
D	HCO3	
E	O2 sats	
F	Base Excess	

The most important measurement on a blood gas to determine whether a patient needs NIV is…….

One answer only is correct!

A	pO2	
B	pC02	
C	pH	✓
D	HCO3	
E	O2 sats	
F	Base Excess	

Don’t get hung up on pCO2

Acidosis and Hypoxia kill you!

Which of the following are most likely to be present in type 2 respiratory failure

One answer only is correct!

A metabolic acidosis

B respiratory alkalosis

C hypokalaemic acidosis

D respiratory alkalosis

E respiratory acidosis

F hypochloraemic alkalosis

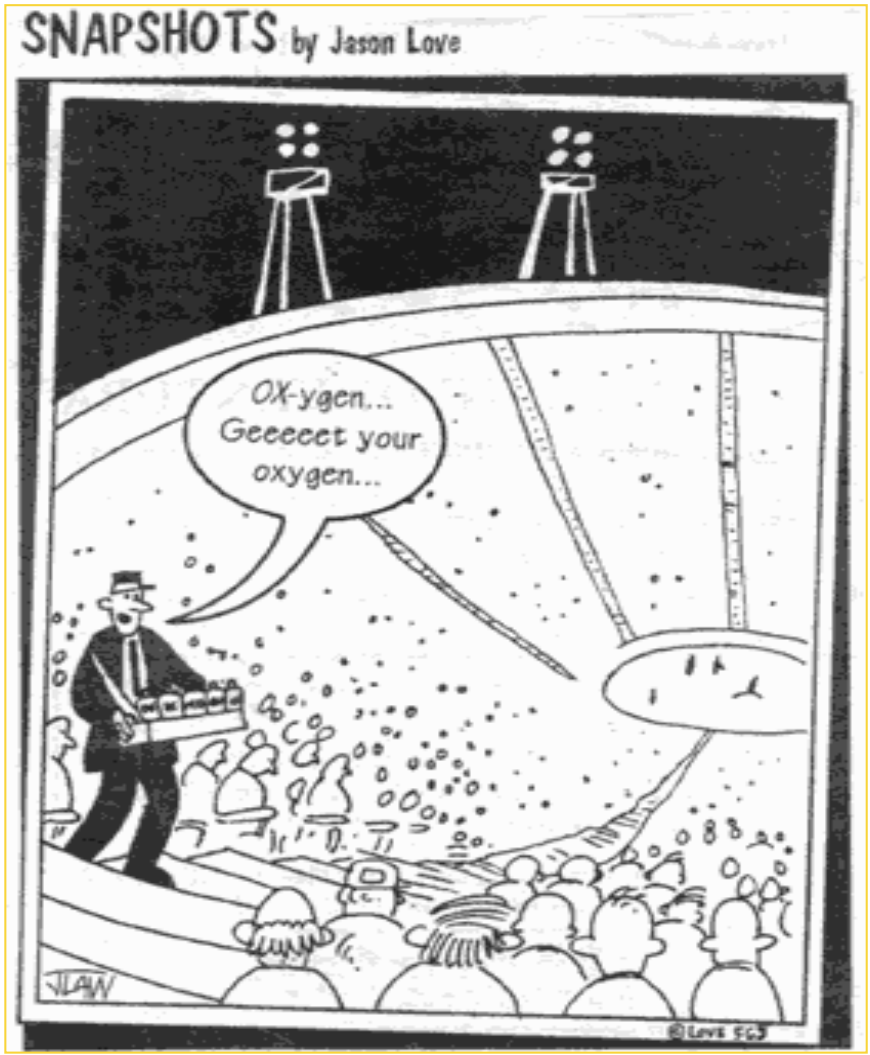
Which of the following are most likely to be present in type 2 respiratory failure

One answer only is correct!

A	metabolic acidosis	
B	respiratory alkalosis	
C	hypokalaemic acidosis	
D	respiratory alkalosis	
E	respiratory acidosis	✓
F	hypochloraemic alkalosis	

So remember if your blood gases show a low HCO3 then you should think about metabolic not respiratory disease and NIV won't work!

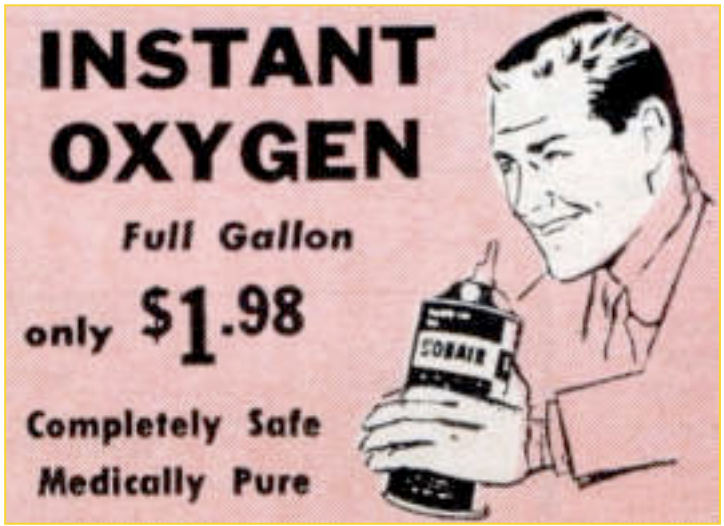
And what about when your patient wants to take it home with them……



Oxygen

Why do people need oxygen?

When should people be referred for oxygen assessment?



How do you give oxygen?

Special circumstances

Steps in the Development of Cor Pulmonale

Abnormal blood gases

Responsive respiratory centre

Increased respiration

Normalisation of blood gases

Dyspnoea

Unresponsive respiratory centre

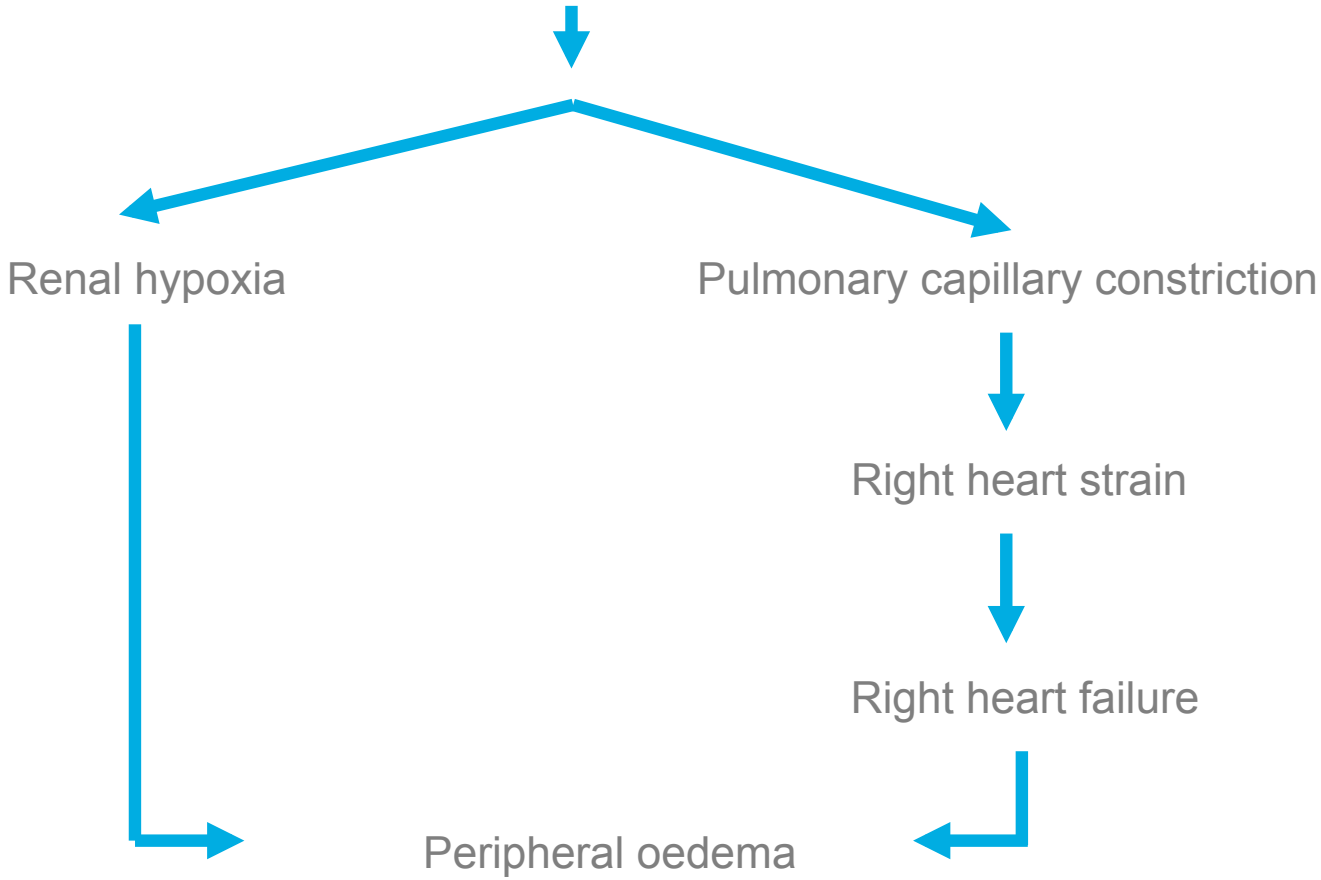
Chronic hypoxia

Pulmonary hypertension

Cor pulmonale

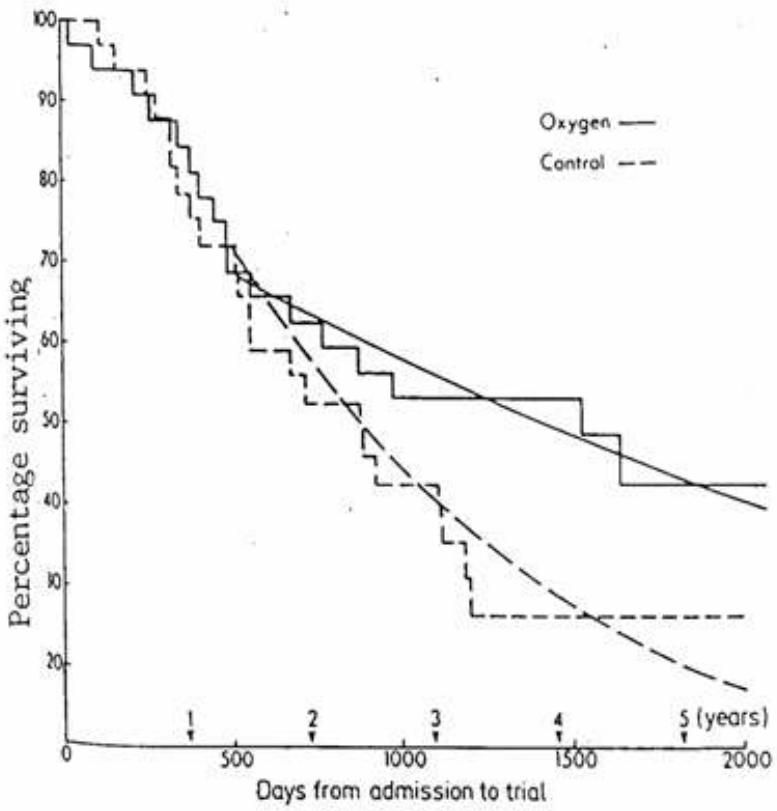
Disease progression

Abnormal blood gases (Respiratory failure)

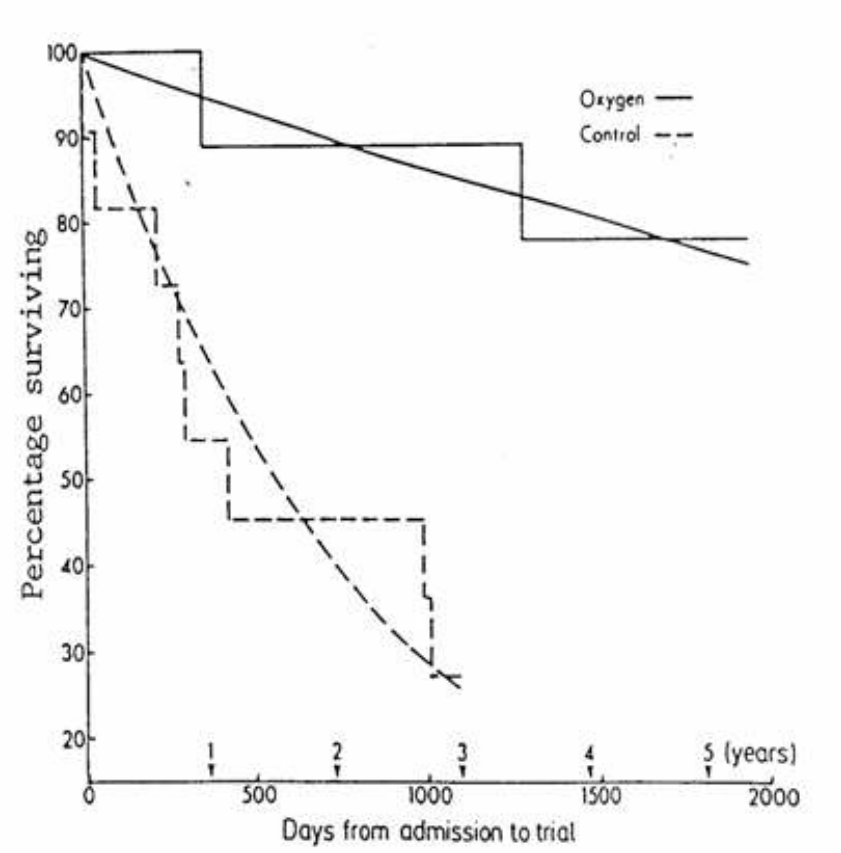


MRC Long-Term Oxygen Therapy (LTOT) Trial

Mortality in male patients



Mortality in female patients

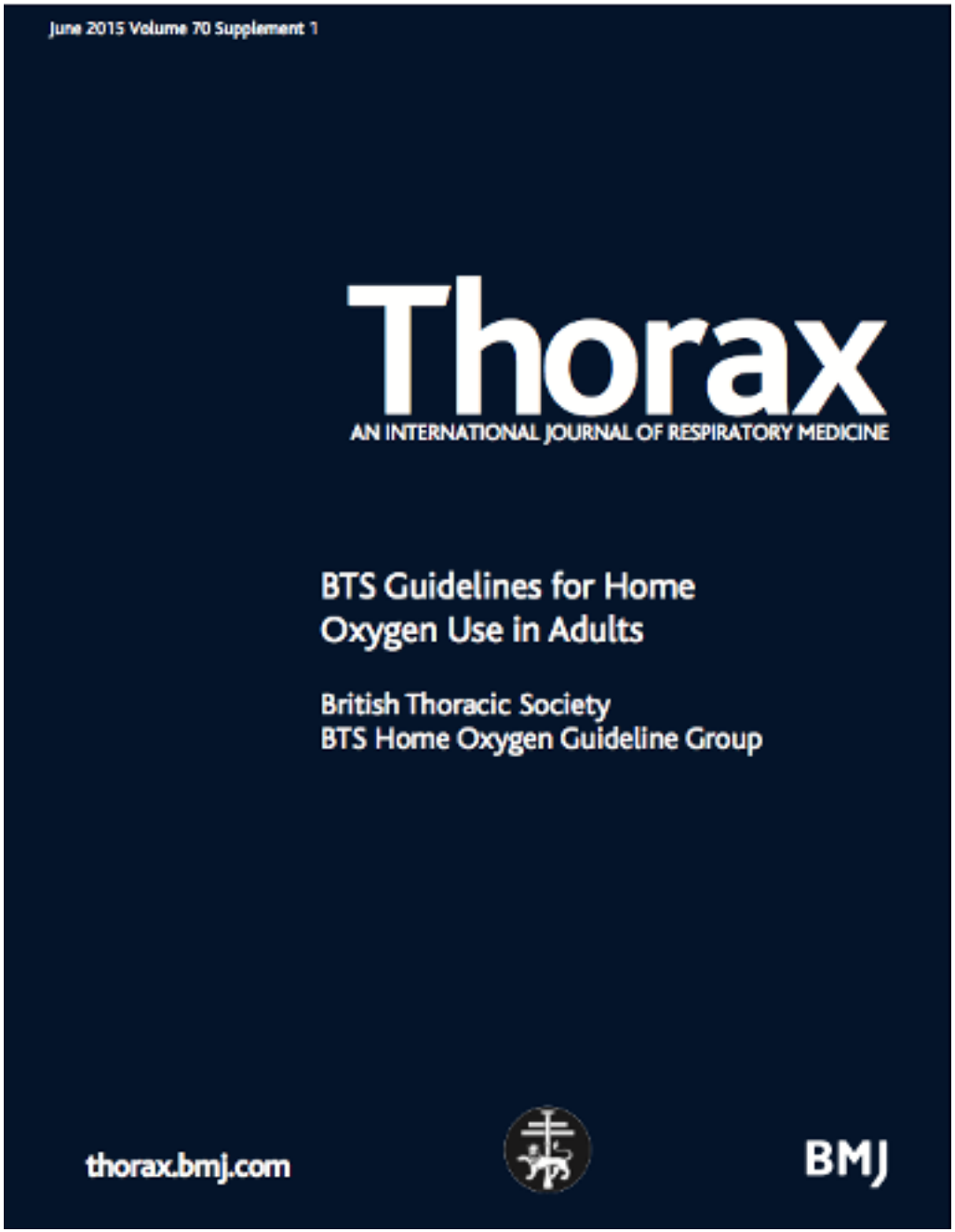


NOTT and MRC trials

Assessment for LTOT

- Confident clinical diagnosis

  $SaO_2 \leq 92\%$
- Optimum medical management (treatable causes of hypoxia eliminated)
- Clinical stability – 5 weeks post exacerbation
- Referral to specialist assessment service


June 2015 Volume 70 Supplement 1
Thorax
AN INTERNATIONAL JOURNAL OF RESPIRATORY MEDICINE
BTS Guidelines for Home Oxygen Use in Adults
British Thoracic Society
BTS Home Oxygen Guideline Group
thorax.bmj.com
BMJ


Oxygen treatment
British Lung Foundation


i-STAT
SCAN
ABC
1
2
3
4
5
6
7
8
9
0
ENT
MENU
ARTERIAL BLOOD SAMPLING SYSTEM
PULSAT ORC
Smiths

The assessment process.....

- 2 blood gases 3 weeks apart
- $PaO_2 < 7.3kPa$ OR $< 8kPa$ if peripheral oedema, nocturnal hypoxaemia, pulmonary hypertension
- Proceed to full oxygen assessment : 30 mins on oxygen then blood gas
- Aim to get $PaO_2 > 8kPa$ without acidosis

LTOT – Follow-Up

After assessment:

– Home visit at 1 month – education, O_2 sats and appropriate use (safety)

Thereafter:

– Home visit 6 monthly – sats and education

– Blood Gas yearly

Ambulatory

- Fall in SaO_2 of 4% to a value of <90%
- On LTOT and mobile
- Exercise test and response to supplemental O_2
- Ideally after pulmonary rehabilitation
- Review after 2 months to assess real usage: diary card, interview, O_2 usage
- This can now only be prescribed by the Specialist Service

Grading

Grade 1 – LTOT with low activity

Grade 2 – Mobile LTOT

Grade 3 – Patients with exercise desaturation but not on LTOT


THE
SEQUOIA
CHAD
THERAPEUTICS


MEDICAL LIQUID
OXYGEN

Short Burst

Lack of evidence to support use

- Palliative……only if hypoxic!
- whilst awaiting LTOT assessment?? NO
- GP for emergency use? NO

NO COPD PATIENT SHOULD BE ON SHORT BURST O_2 FOR ANY LENGTH OF TIME WITHOUT FORMAL ASSESSMENT

Difficult questions?….

- What do I do nurse when……
  - I want a weekend away, a holiday, or have been admitted from home to a hospice or care home for a period of respite care
  - the patient has a second (holiday) home, where he stays on a regular basis or where a patient stays with family or friends each weekend
  - a patient is able to attend school or work

It’s Easy!

- Patient contacts the oxygen company themselves!
- Don’t need to cancel if specified dates are given
- Patient’s responsibility to check with holiday destination
- Need at least two weeks notice (more at peak times)

And Further Afield?

- Oxygen supplier will give advice
- Will be a charge usually
- May need a flight assessment
- In flight oxygen costs can vary
- http://www.blf.org.uk/


DANGER
OXYGEN, NO SMOKING
NO OPEN FLAMES
No Mobile Phones

BBC NEWS

Monday, 12 August, 2002, 13:55 GMT 14:55 UK

Explosion at old people's home

"It was a horrific scene on arrival."

"The council has confirmed to us that no gas was used on the premises, but we know that the victim suffered from **breathing problems** and had some breathing equipment, including an oxygen cylinder in the flat."