Ossigenoterapia nell'insufficienza respiratoria acuta: non è tutto oro ciò che luccica

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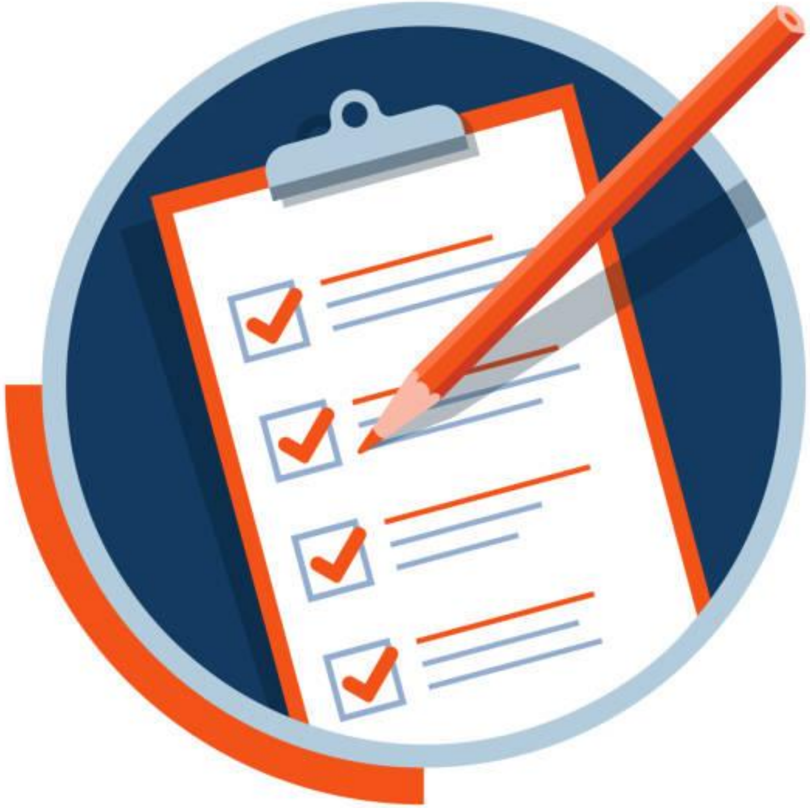
Agenda

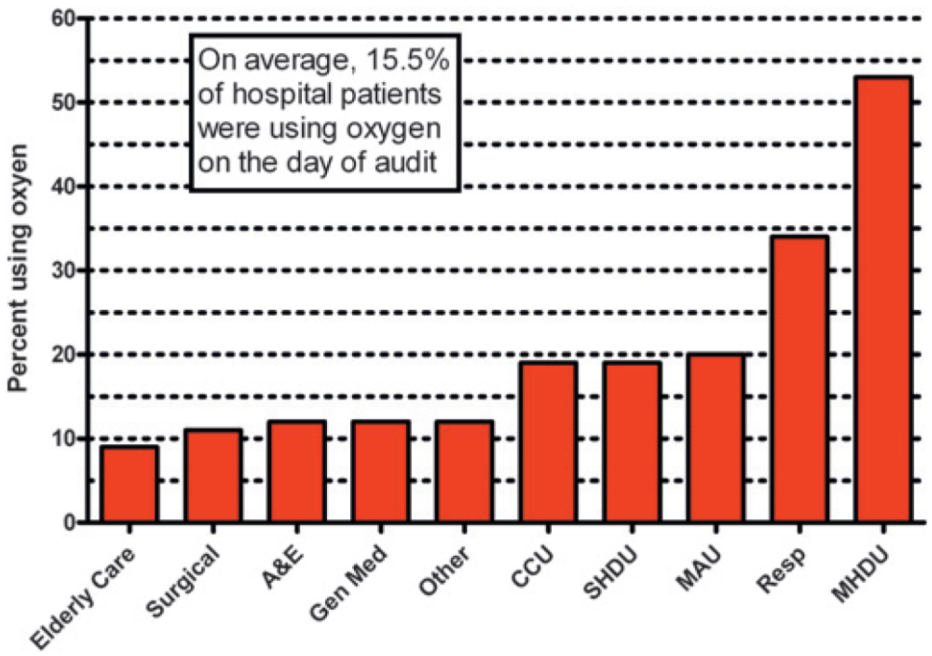
- Standard Oxygen and HFNC
- Hyperoxia and its physiological effects
- Oxygen therapy for patients who are critically ill

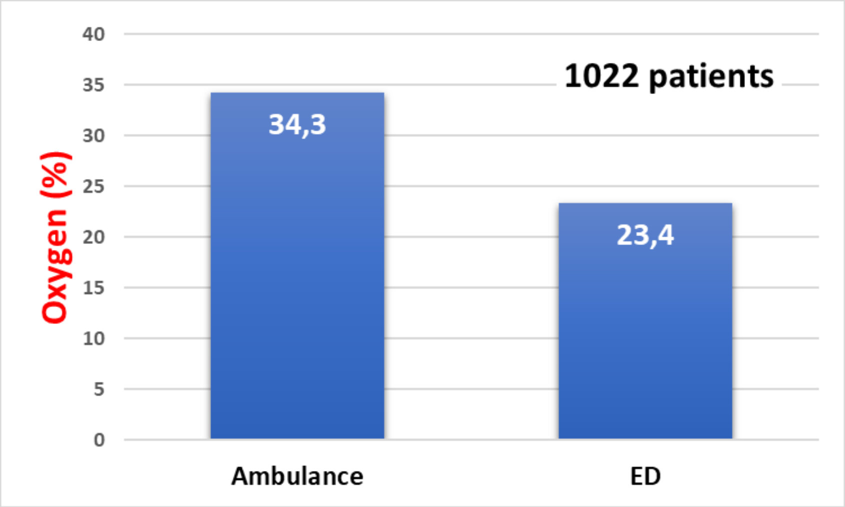


In-hospital

Prehospital & ED

Year	Number of hospitals	Number of patients	Number of wards	On oxygen (%)*
2008	99	14 830	712	17.5
2010	90	22 017	1026	15.5



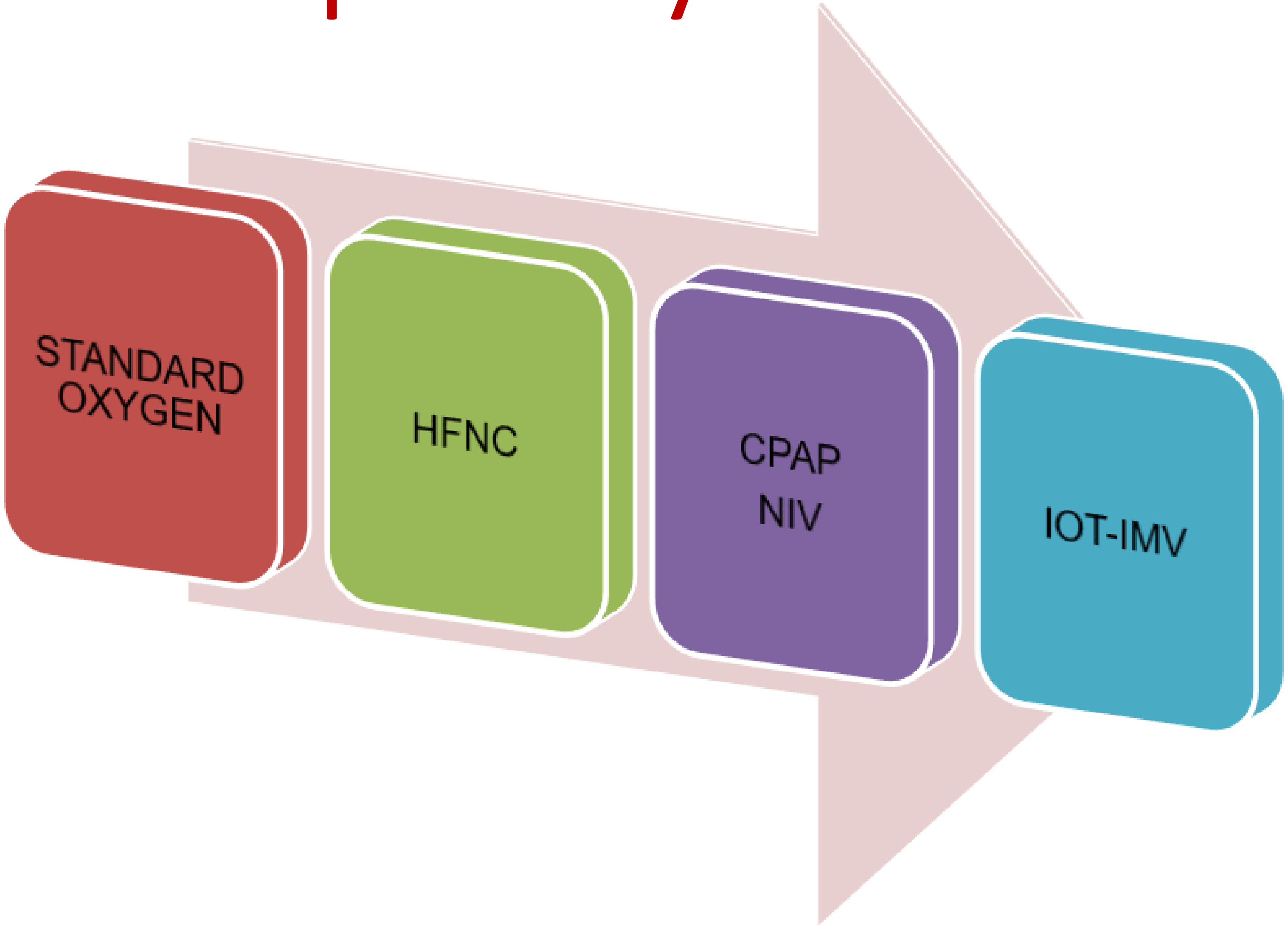


Oxygen use in ambulances is very common, equivalent to 2.2 million episodes annually in the UK.

O'Driscoll BR et al. Thorax 2011;66:734-5

Hale KE et al. Emerg Med J. 2008;25:773-6

Treatment of acute respiratory failure

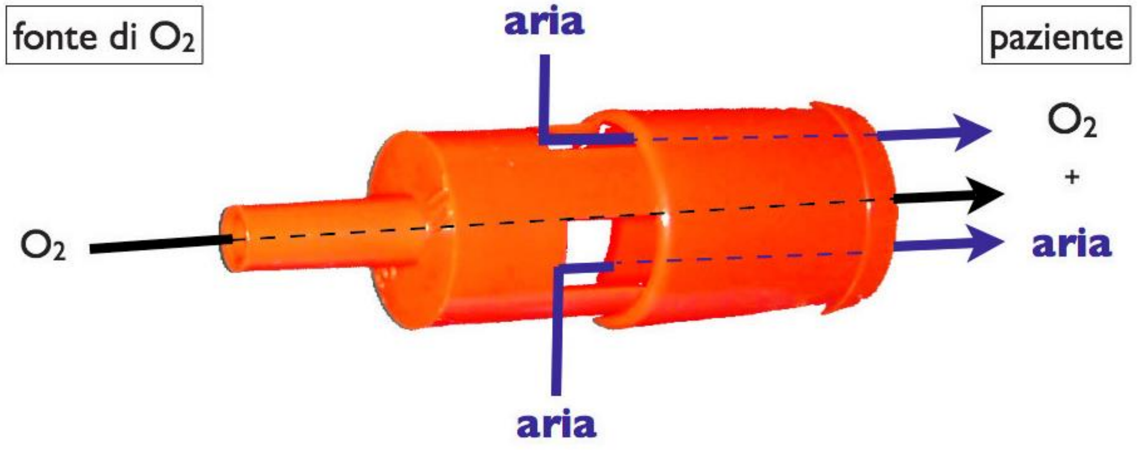


SISTEMI DI EROGAZIONE

- Occhialini
- Maschere di Venturi
- Maschera con Reservoir

EFFETTO VENTURI

Se la ***velocità*** di un fluido aumenta, la ***pressione*** diminuisce (teorema di Bernoulli/ Legge di Poiseuille)



Cosentini et al. L'ABC della ventilazione meccanica non invasiva in urgenza.II edizione Mc Graw Ill

MASCHERA DI VENTURI

Sistema più preciso e costante per la somministrazione di O2 a concentrazioni intermedie

Aumentare il flusso non aumenta la concentrazione di ossigeno !!!

Estimating FiO2

O_2 Flow rate	FiO_2
Nasal cannula	
1	0.24
2	0.28
3	0.32
4	0.36
5	0.4
6	0.44

O_2 Flow rate	FiO_2
Oxygen mask	
5-6	0.4
6-7	0.5
7-8	0.6

O_2 Flow rate	FiO_2
Mask with reservoir	
6	0.6
7	0.7
8	0.8
9	0.80+
10	0.80+

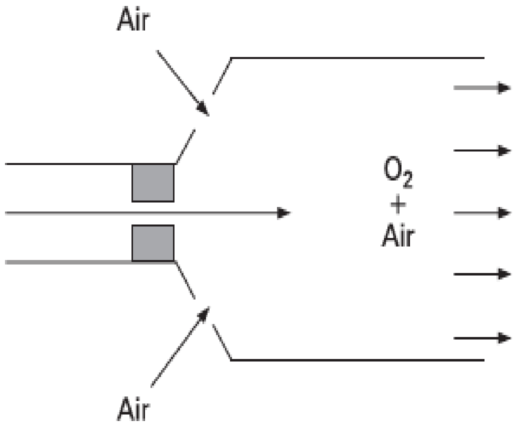
Methods & interfaces for oxygen delivery

FiO_2 is unknown and highly dependent on:

1. **O_2flow**
2. **pt's insp. flow**
3. **breathing pattern**

O'Driscoll BR et al. Thorax 2008;63 (suppl VI):1-68

C

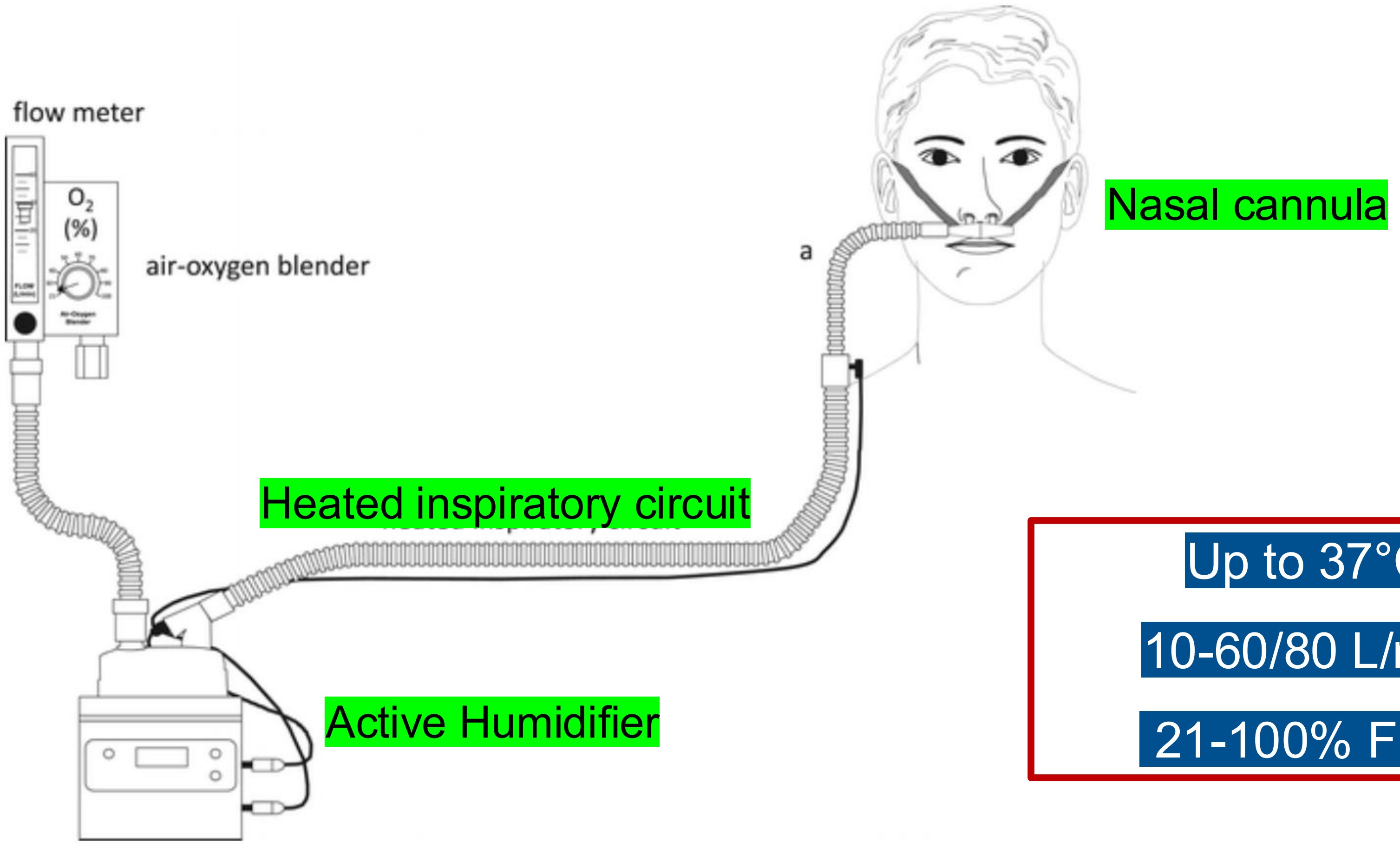


If the patient's ventilatory demand exceeds the flow provided by the device, the patient would breathe part of atmospheric air

NASAL HIGH FLOW THERAPY

Flow generators

- Air-oxygen blender with a flow meter
- A dedicated standalone device
- NHF-capable mechanical ventilator

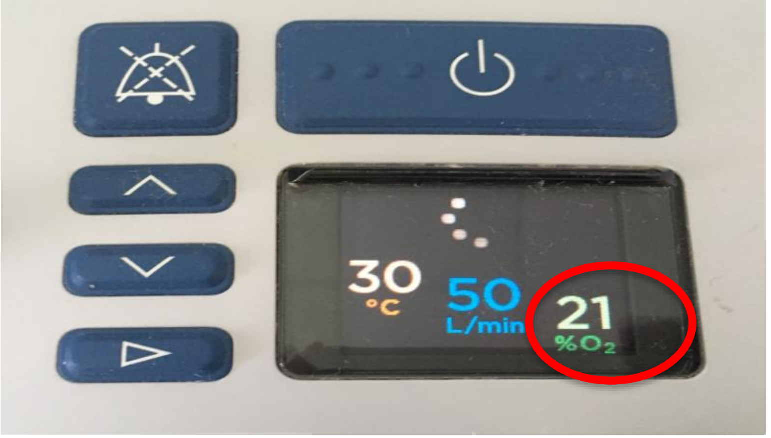


Up to 37°C

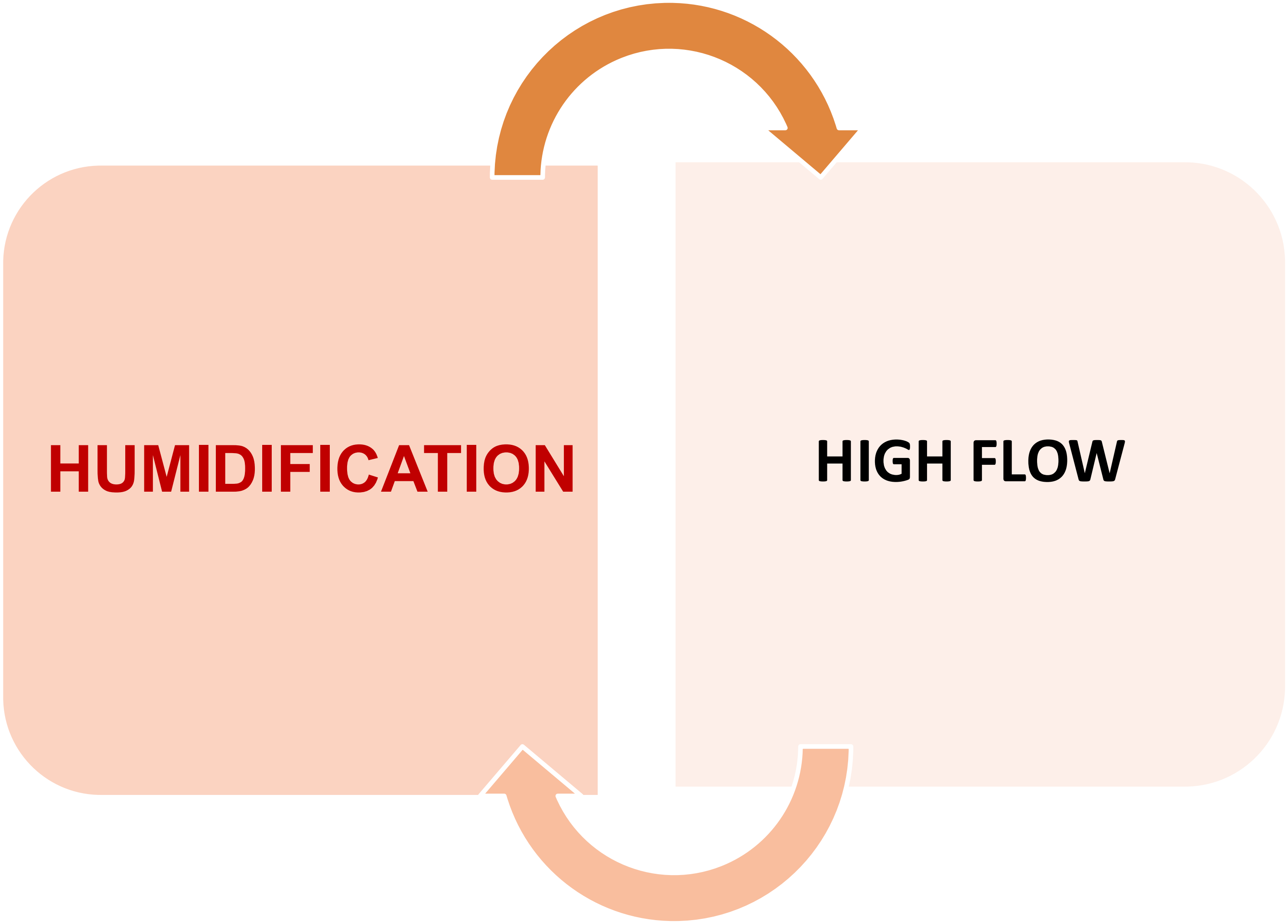
10-60/80 L/min

21-100% FiO2

Nishimura M.Respiratory Care June 2019, 64 (6) 735-742


30
°C
50
L/min
21
%O2

Physiological effects



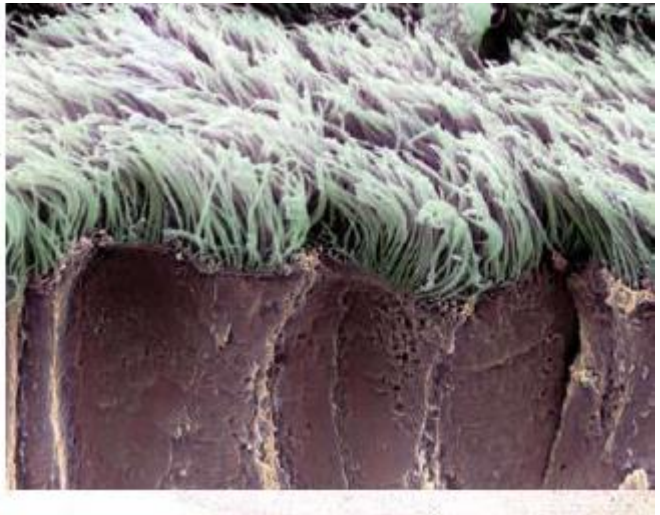
Physiological effects of GAS heating and humification

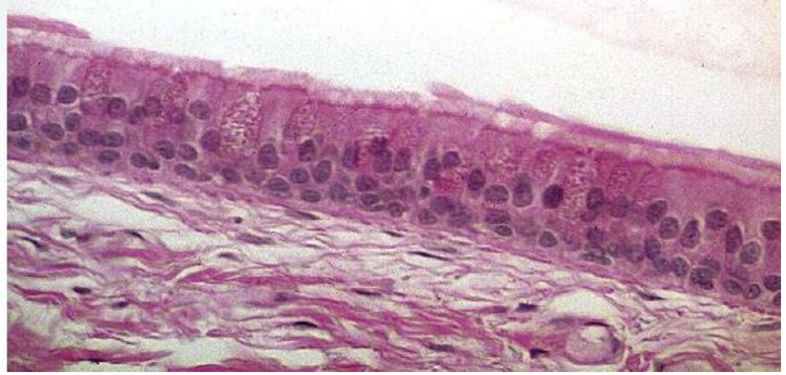
Improvement of lung mucociliary clearance (↑ secretion clearance)

↓ Bronchoconstriction

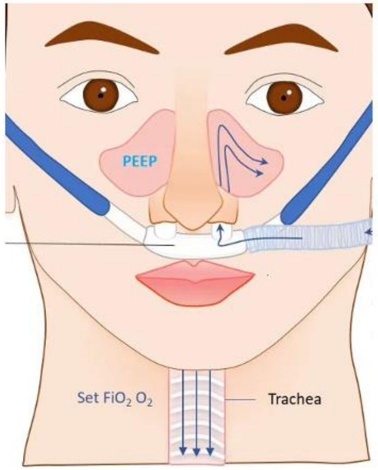
↓Metabolic cost of gas conditioning

Comfort





Physiological effects of HIGH FLOW

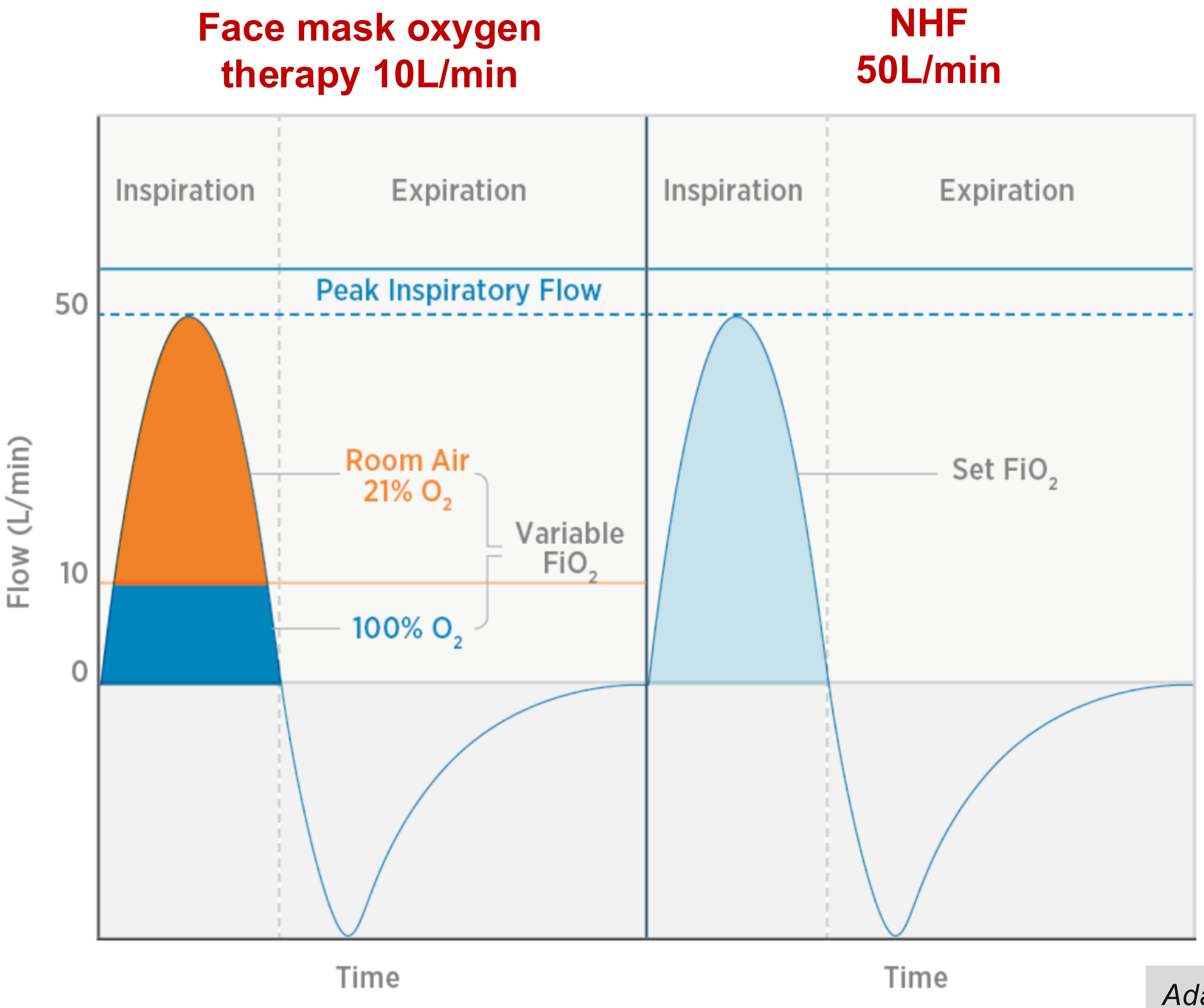


Matching pat's inspiratory flow (stable FiO2)

Washout of the upper airway deadspace

The positive pressure in the airways

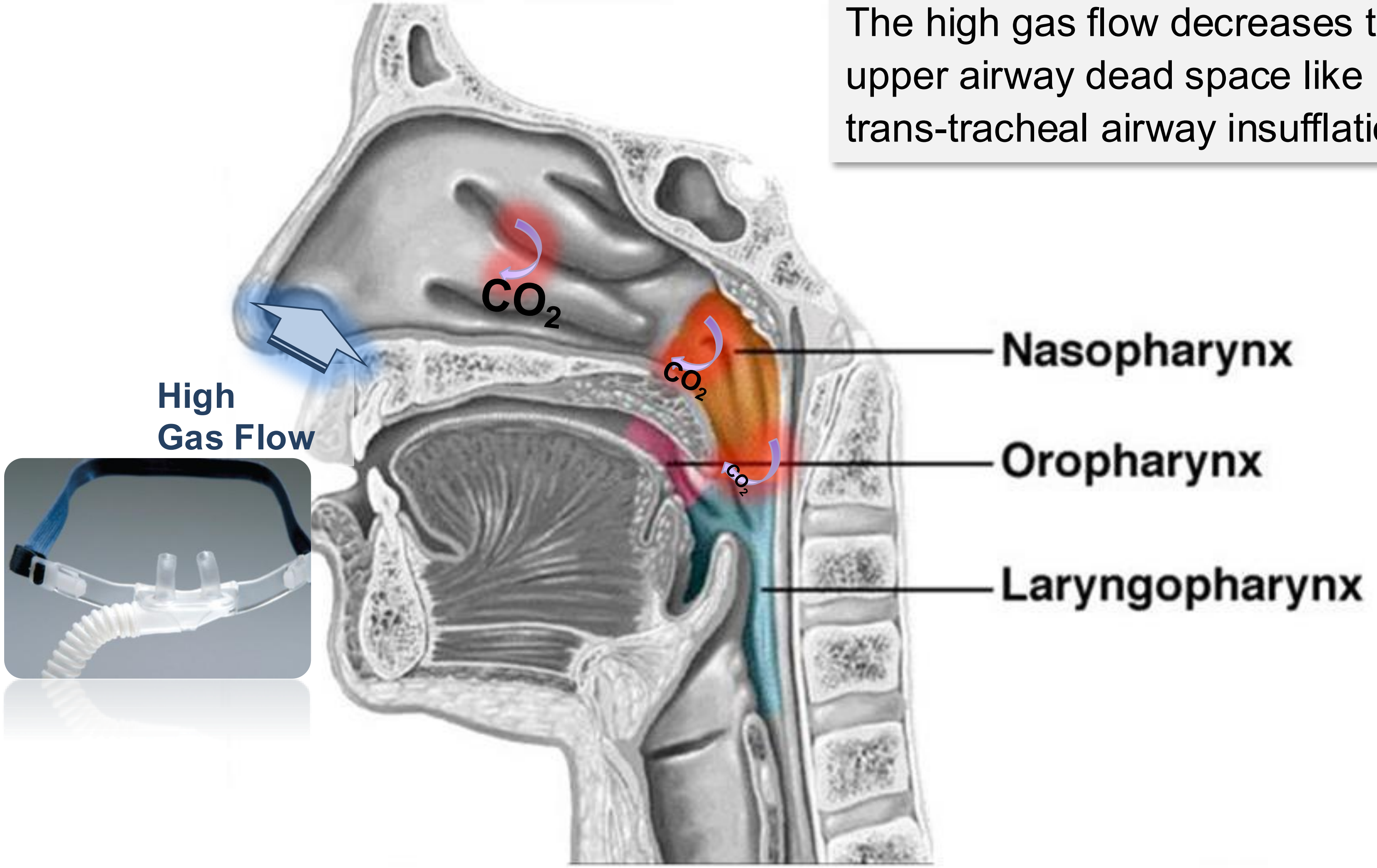
More accurate and stable FiO_2 delivery



Adapted from Masclans et al .2012

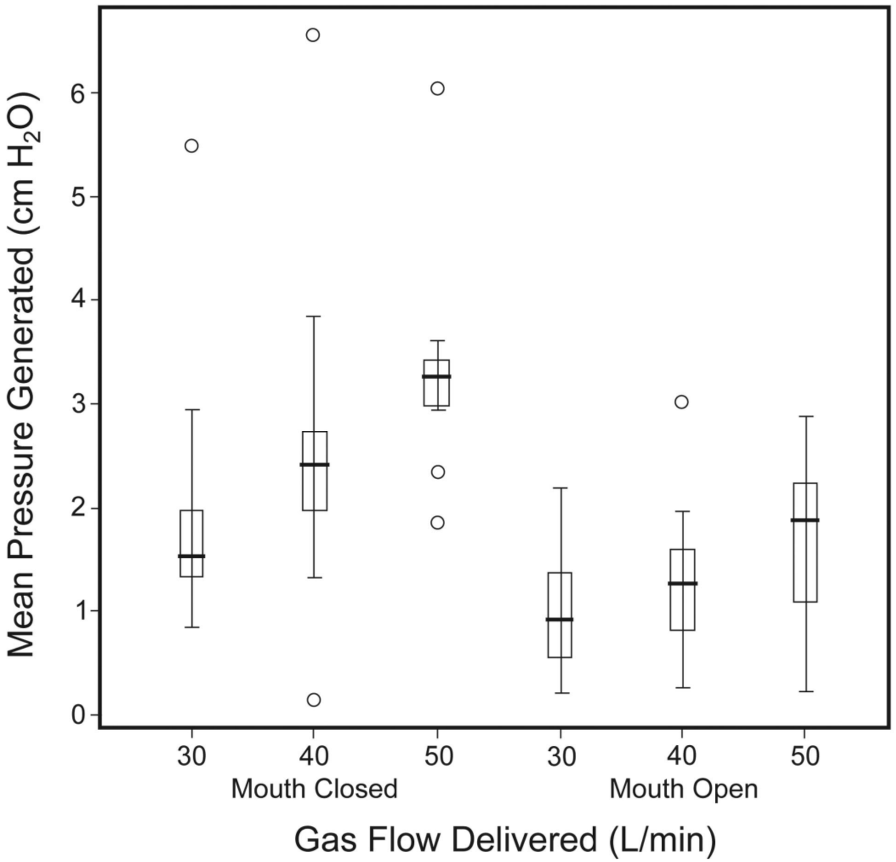
Washout of nasopharyngeal dead space

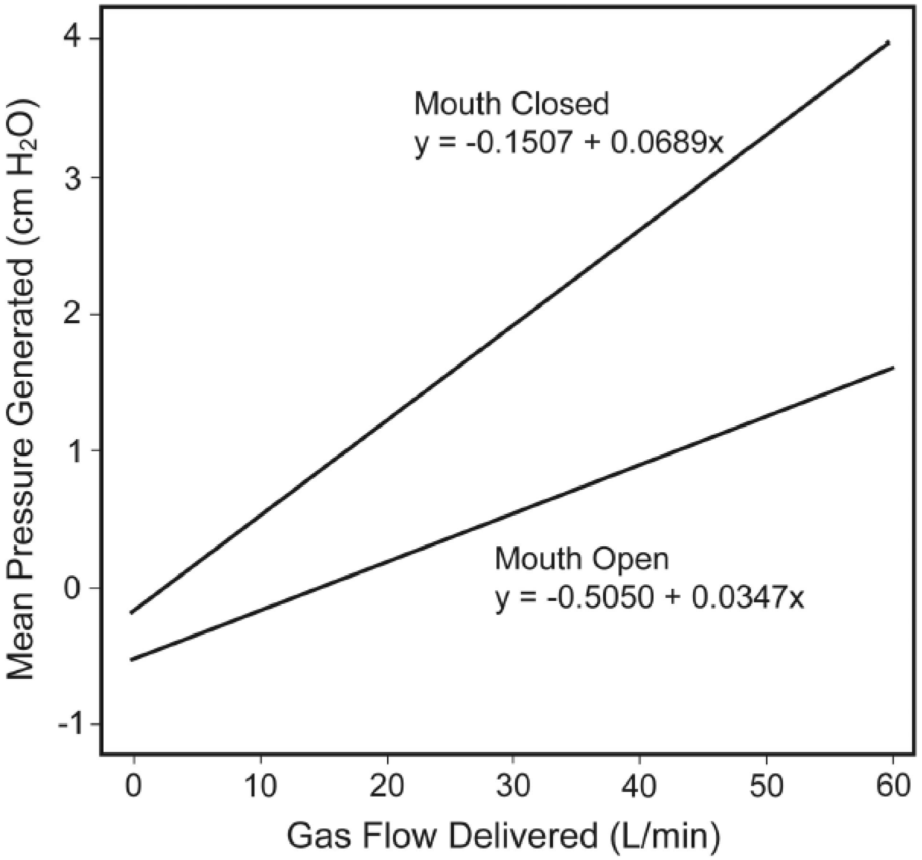
The high gas flow decreases the upper airway dead space like trans-tracheal airway insufflation



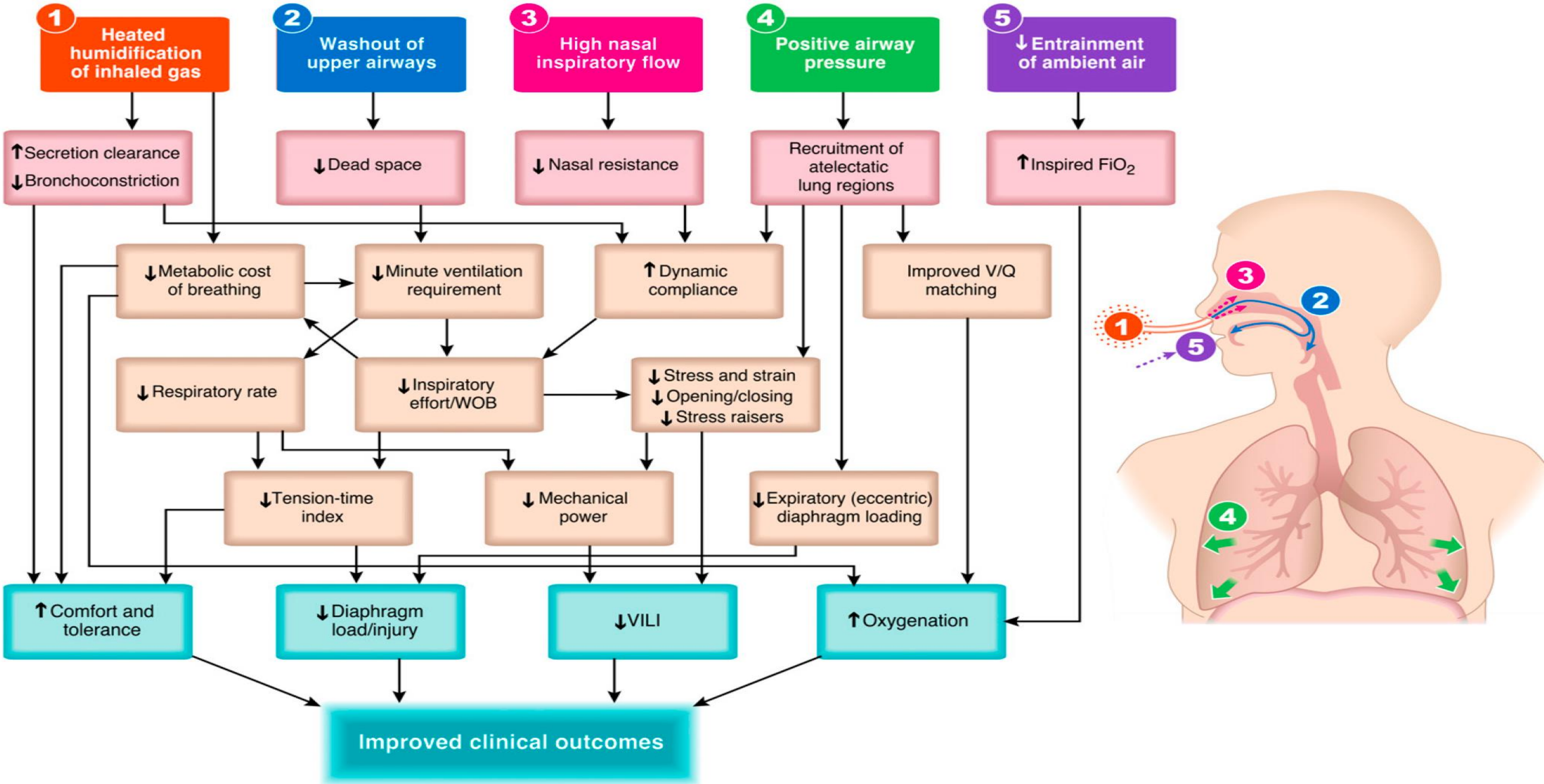
J Appl Physiol 118: 1525–1532, 2015.

HFNC can provide a distending pressure





Parke RL et al, Resp Care 2011



Goligher EC et al. Am J Respir Crit Care Med.2017;195(9):1128-1131

EUROPEAN RESPIRATORY JOURNAL
ERS OFFICIAL DOCUMENTS
S. OCZKOWSKI ET AL.

Eur Respir J 2022; 59: 2101574

ERS clinical practice guidelines: high-flow nasal cannula in acute respiratory failure

Simon Oczkowski[1,2,26], Begüm Ergan[3,26], Lieuwe Bos[4,5], Michelle Chatwin[6], Miguel Ferrer[7], Cesare Gregoretti[8,9], Leo Heunks[10], Jean-Pierre Frat[11,12], Federico Longhini[13], Stefano Nava[14,15], Paolo Navalesi[16,17], Aylin Ozsancak Uğurlu[18], Lara Pisani[14,15], Teresa Renda[19], Arnaud W. Thille[11,12], João Carlos Winck[20], Wolfram Windisch[21], Thomy Tonia[22], Jeanette Boyd[23], Giovanni Sotgiu[24] and Raffaele Scala[25]

CONFERENCE REPORTS AND EXPERT PANEL

The role for high flow nasal cannula as a respiratory support strategy in adults: a clinical practice guideline

Intensive Care Med (2020) 46:2226–2237

Bram Rochwerg[1,2], Sharon Einav[3,4], Dipayan Chaudhuri[1], Jordi Mancebo[5], Tommaso Mauri[6,7], Yigal Helviz[3], Ewan C. Goligher[8,9], Samir Jaber[10], Jean-Damien Ricard[11,12], Nuttapol Rittayamai[13], Oriol Roca[14,15], Massimo Antonelli[16,17], Salvatore Maurizio Maggiore[18], Alexandre Demoule[19,20], Carol L. Hodgson[21,22], Alain Mercat[23], M. Elizabeth Wilcox[8,9], David Granton[1], Dominic Wang[1], Elie Azoulay[24], Lamia Ouanes-Besbes[25,26], Gilda Cinnella[27], Michela Rauseo[27], Carlos Carvalho[28], Armand Dessap-Mekontso[29,30], John Fraser[31,32], Jean-Pierre Frat[33], Charles Gomersall[34], Giacomo Grasselli[6,7], Gonzalo Hernandez[35], Sameer Jog[36], Antonio Pesenti[37], Elisabeth D. Riviello[38], Arthur S. Slutsky[9,39,40], Renee D. Stapleton[41], Daniel Talmor[42], Arnaud W. Thille[43], Laurent Brochard[9,40] and Karen E. A. Burns[2,9,40*]

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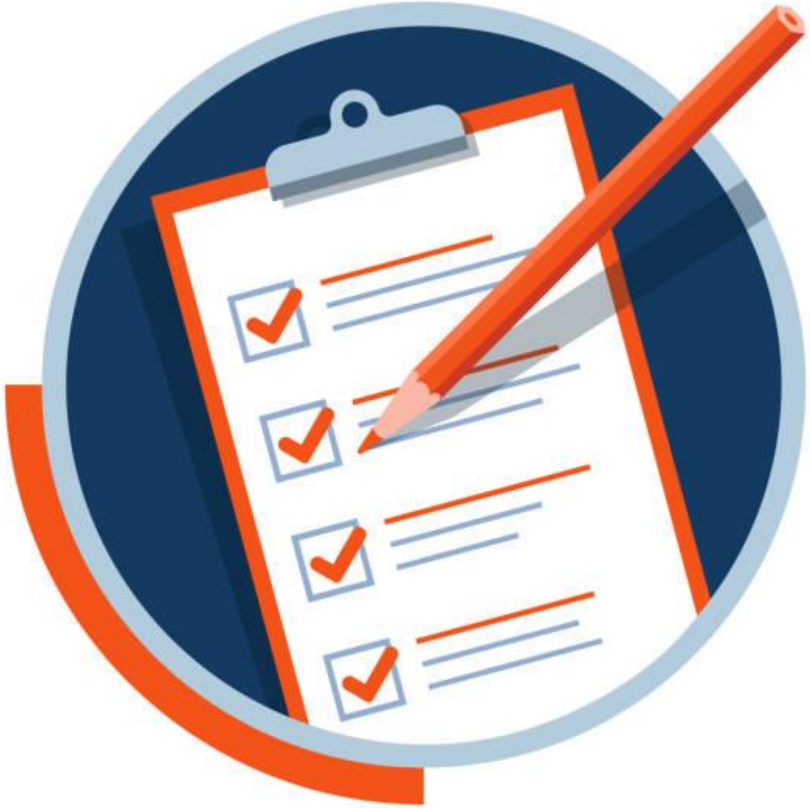

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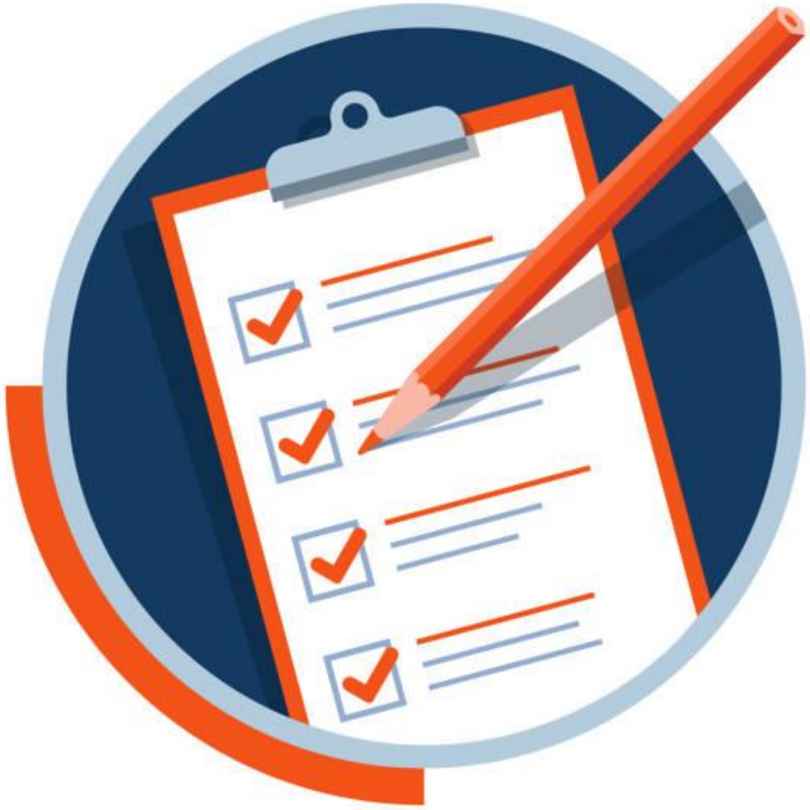


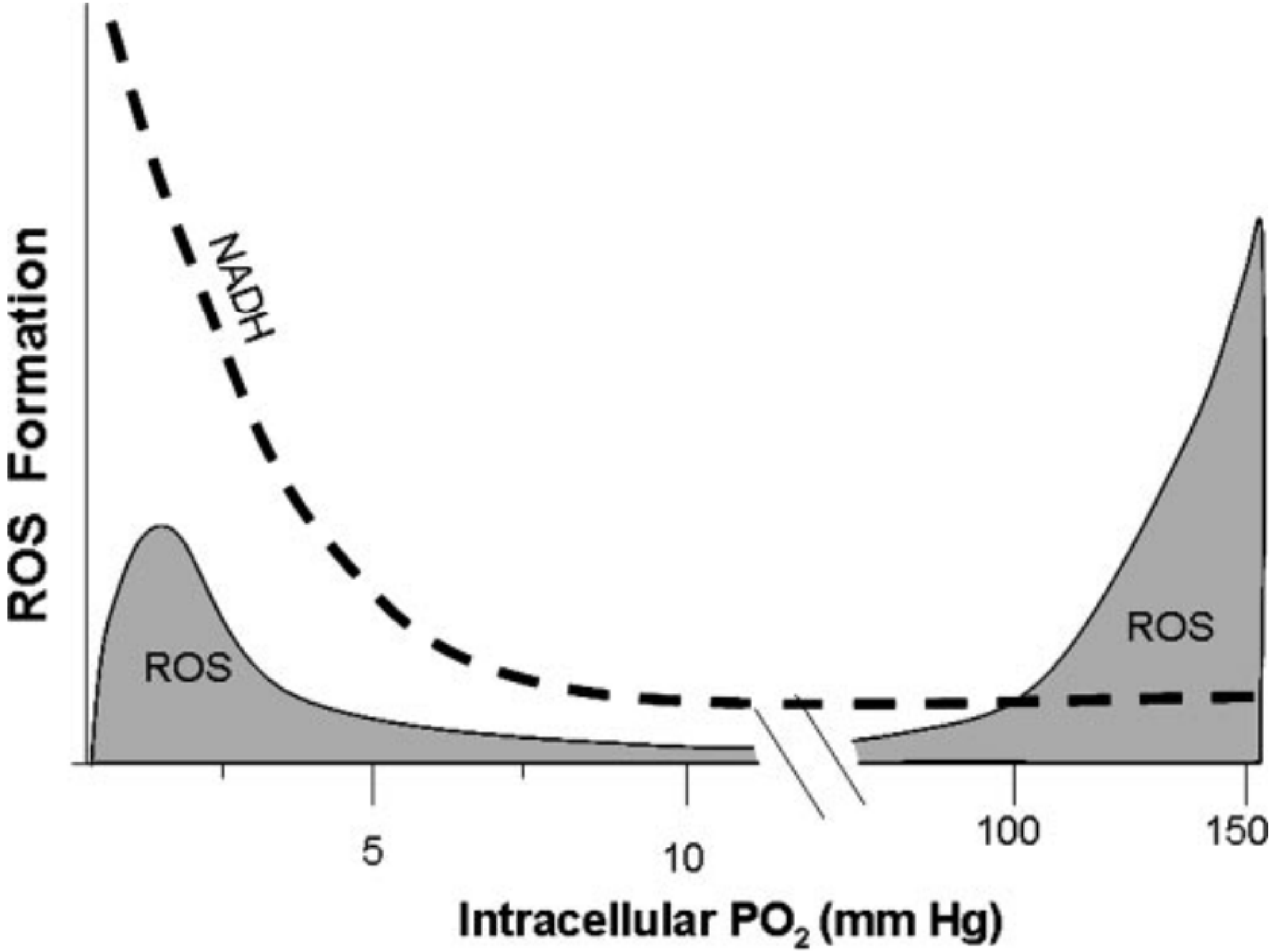
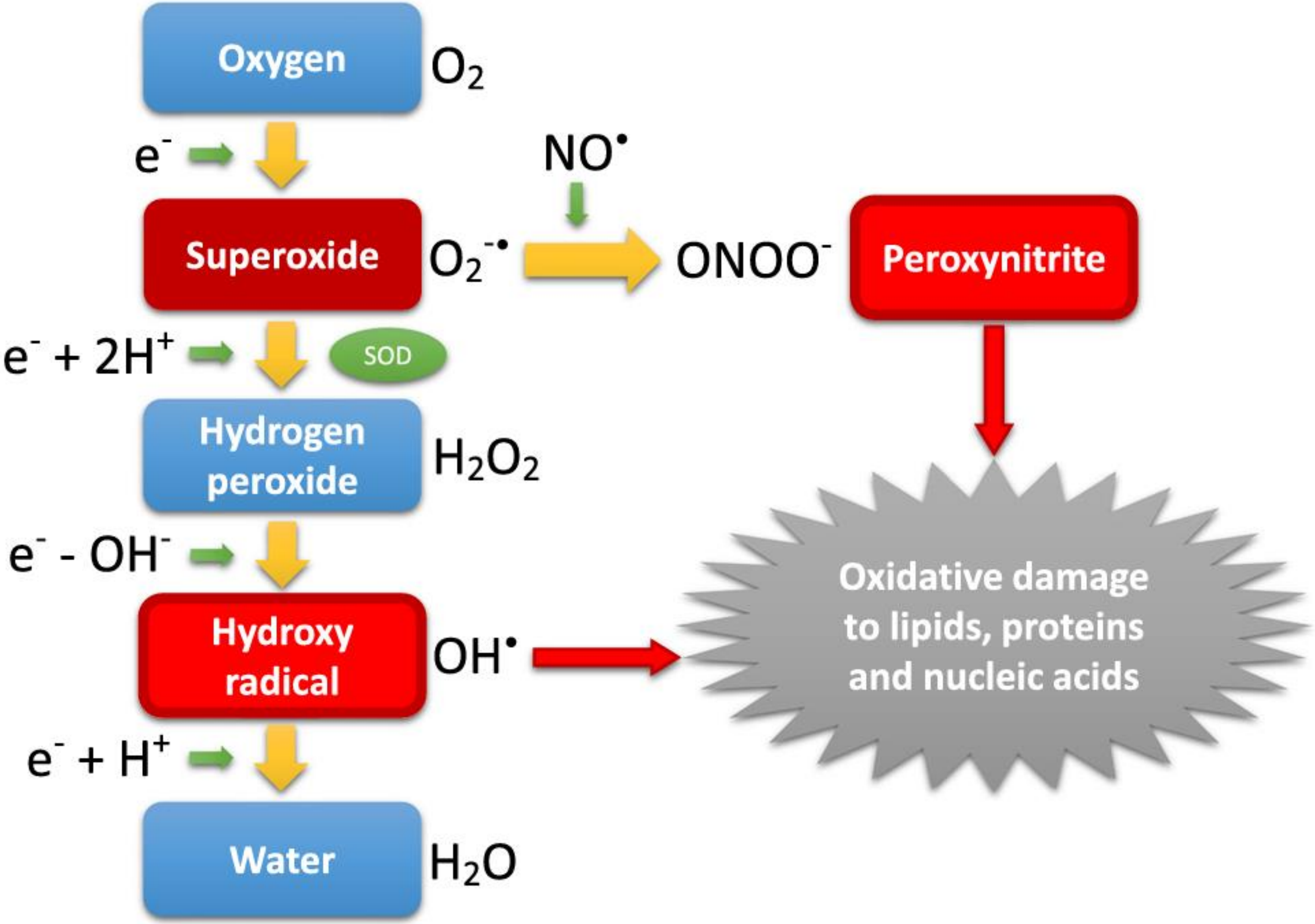


Fig. 1. Depiction of the proposed bimodal distribution of reactive oxygen species (ROS) formation as a function of Po_2 in which conditions of both hypoxia and hyperoxia support elevations in ROS formation.

Clanton TL .J Appl Physiol 102:2379-2388, 2007



Nakane etal. Journal of Intensive Care 2020; 8:95

In contrast to **hypoxia**, humans have not evolved any specific adaptation to counter **hyperoxia**

HIGH ALTITUDE MEDICINE & BIOLOGY
Volume 11, Number 2, 2010

DOI: 10.1089/ham.2009.1089

American Medical Research Expedition to Everest

John B. West

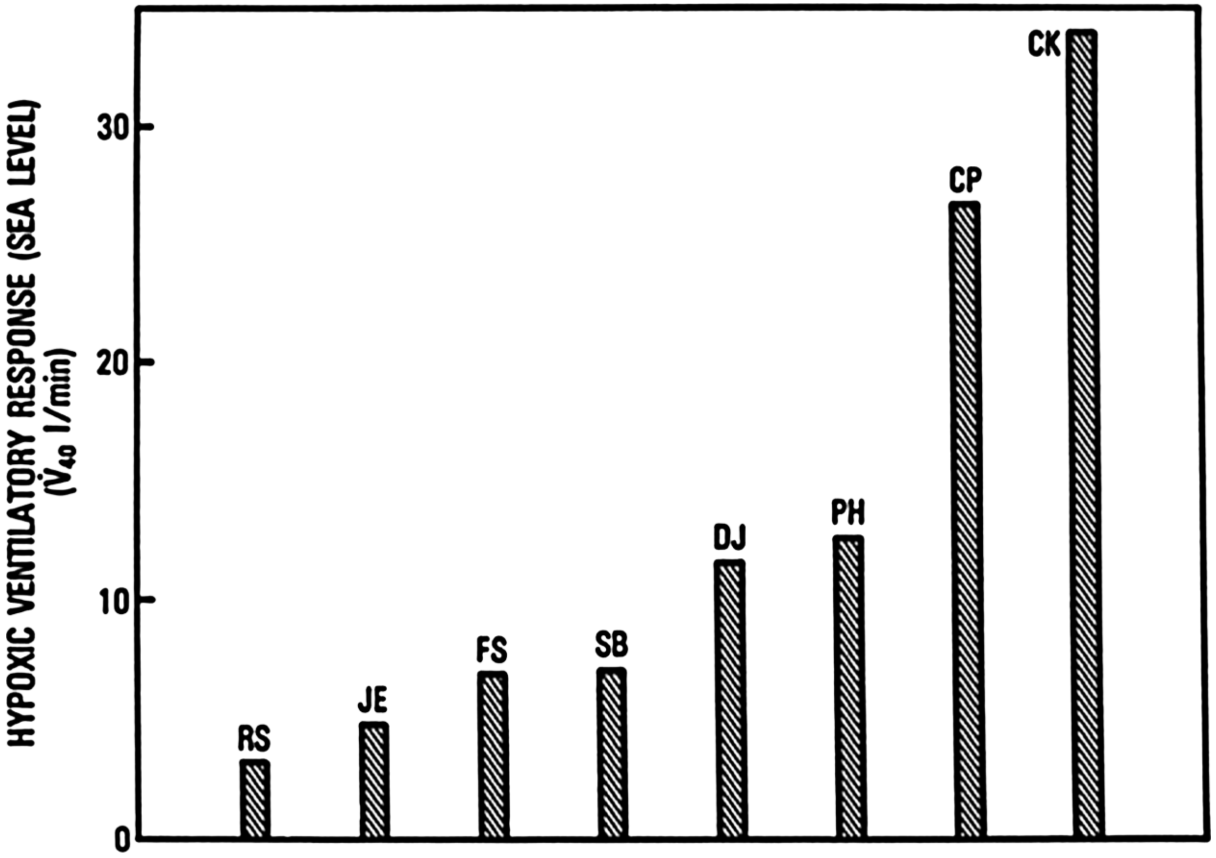
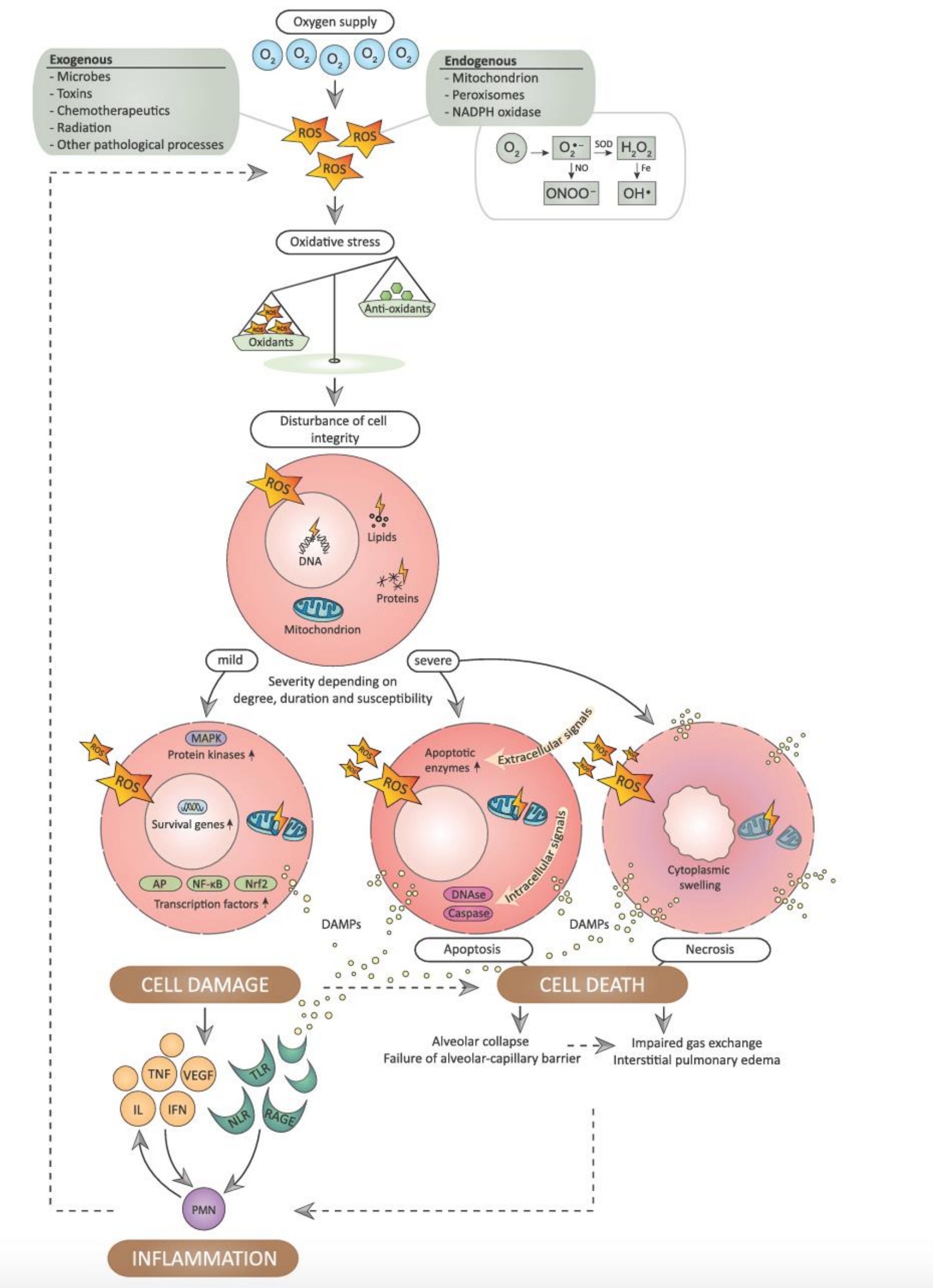


Table 1. Alveolar Gas and Estimated Arterial Blood Values on the Summit of Mt. Everest

Altitude (m)	Barometric pressure (mmHg)	Inspired Po_2 (mmHg)	Alveolar Po_2 (mmHg)	Arterial Po_2 (mmHg)	Arterial Pco_2 (mmHg)	Arterial pH	Arterial Sao_2
8848 (summit)	253	43	35	28	7.5	>7.7	70
Sea level	760	149	100	95	40	7.4	97

West et al., 1983b.

High Alt Med Biol. 2010.



FIO2 > 0.21

Hyperoxaemia (i.e. arterial PaO2 > 100 mmHg)

Hyperoxia (increased tissue O2 concentration)

ROS formation

INTERNAL MEDICINE JOURNAL

Pre-hospital oxygen therapy in acute exacerbations of chronic obstructive pulmonary disease

M. Wijesinghe,[1] K. Perrin,[1,2] B. Healy,[1] K. Hart,[1] J. Clay,[2] M. Weatherall[2,3] and R. Beasley[1,2]

[1]Medical Research Institute of New Zealand, [2]Capital and Coast District Health Board and [3]Department of Medicine, University of Otago Wellington, Wellington, New Zealand

Results: Of 250 patients 77 (31%) died, required assisted ventilation or were in respiratory failure. Increased oxygen flow was associated with increasing risk of death, assisted ventilation or respiratory failure with an odds ratio (OR) of 1.2 (95% CI 1.0–1.4) per 1 L/min oxygen flow. Increasing PaO_2 was associated with a greater risk of a poor outcome with an OR of 1.1 (95% CI 1.0–1.3) per 10 mmHg higher PaO_2. Home oxygen (OR 2.8, 95% CI 1.5–5.1), previous respiratory failure (OR 2.6, 95% CI 1.5–4.6), previous ventilation (OR 3.2, 95% CI 1.7–5.9) and home nebulizer use (OR 2.4, 95% CI 1.4–4.3) were associated with an increased risk of a poor outcome.

Conclusion: In AECOPD high flow oxygen in the ambulance is associated with poor clinical outcomes. A number of easily identified markers of chronic disease severity indicate an increased risk of a poor clinical outcome.

Intern Med J 2011 Aug;41(8):618-22.

CRITICAL CARE

VIEWPOINT

Oxygen-induced hypercapnia in COPD: myths and facts

Wilson F Abdo* and Leo MA Heunks

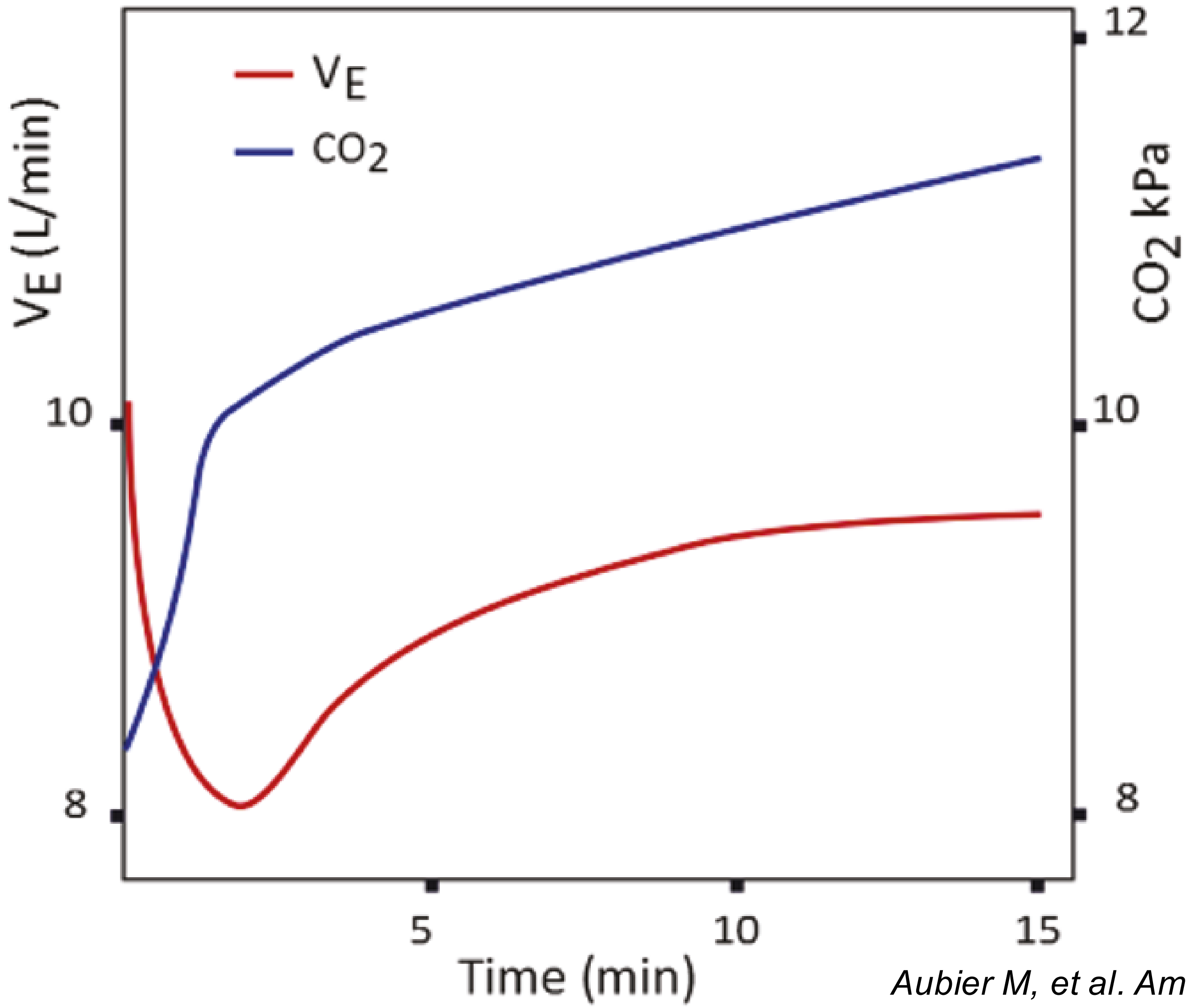
Critical Care 2012, 16:323

Table 11 Physiological effects of acute hypoxaemia and hyperoxaemia

	Hypoxaemia		Hyperoxaemia	
	Effects	**Risks**	**Effects**	**Risks**
Respiratory system	Increased ventilation Pulmonary vasoconstriction	Pulmonary hypertension	Decreased ventilation (minimal)	Worsened ventilation/perfusion matching Absorption atelectasis
Cardiovascular system	Coronary vasodilation Decreased systemic vascular resistance (transient) Increased cardiac output Tachycardia	Myocardial Ischaemia/infarction Ischaemia/infarction of other critically perfused organs Hypotension Arrhythmias		Myocardial ischaemia (in context of decreased haematocrit) Reduced cardiac output Reduced coronary blood flow Increased blood pressure Increased peripheral resistance
Metabolic system	Increased 2,3-DPG Increased CO_2 carriage (Haldane effect)	Lactic acidosis	Decreased 2,3-DPG Decreased CO_2 carriage (Haldane effect)	Increased reactive oxygen species
Neurological system	Increased cerebral blood flow due to vasodilation	Confusion Delirium Coma	Decreased cerebral blood flow	
Renal system	Renin–angiotensin axis activation Increased erythropoietin production	Acute tubular necrosis		Reduced renal blood flow

2,3-DFG, 2,3-diphosphoglycerate.

Effect of minute ventilation during 15 minutes of high oxygen administration

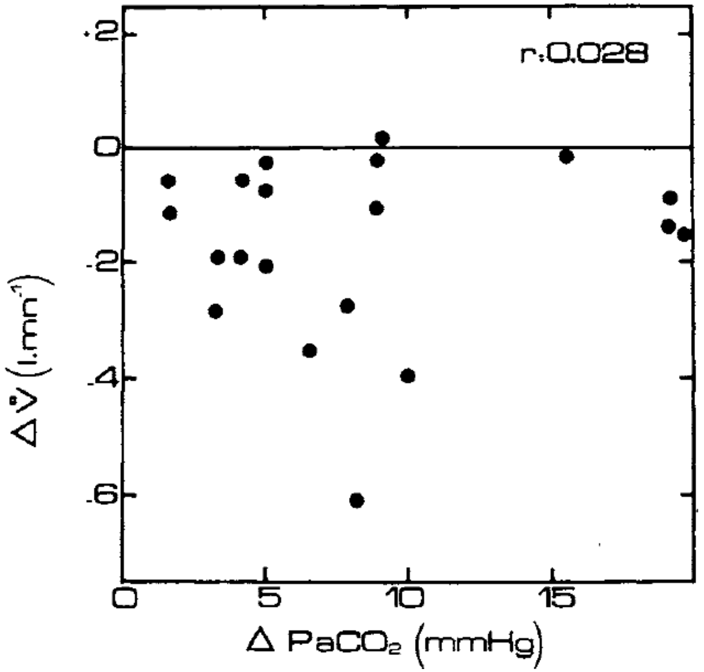


Aubier M, et al. Am Rev Respir Dis. 1980;122(5):747-54

20 COPD patients with with acute respiratory failure
FEV1(%, pred) 25.3 ± 2.8

Effect of O2

	Pa_{O_2} (mm Hg)	PaCO2	V_E	VT	Fr	T_I (s)	T_E (s)	T_I/T_{TOT}	V_T/T_I (ml/s)	P0.1
Acute air	37.2 ± 1.8	59 ± 2.4	11.8 ± 0.8	395 ± 31	31 ± 3	0.73 ± 0.07	1.4 ± 0.14	0.342 ± 0.009	569 ± 31	8.1 ± 0.8
	*	*	*	NS	†	*	†	NS	†	*
Acute O_2	108.6 ± 12	69.1 ± 4	10.1 ± 0.6	405 ± 31	27 ± 0.3	0.79 ± 0.07	1.64 ± 0.10	0.328 ± 0.009	530 ± 28	4.9 ± 0.08

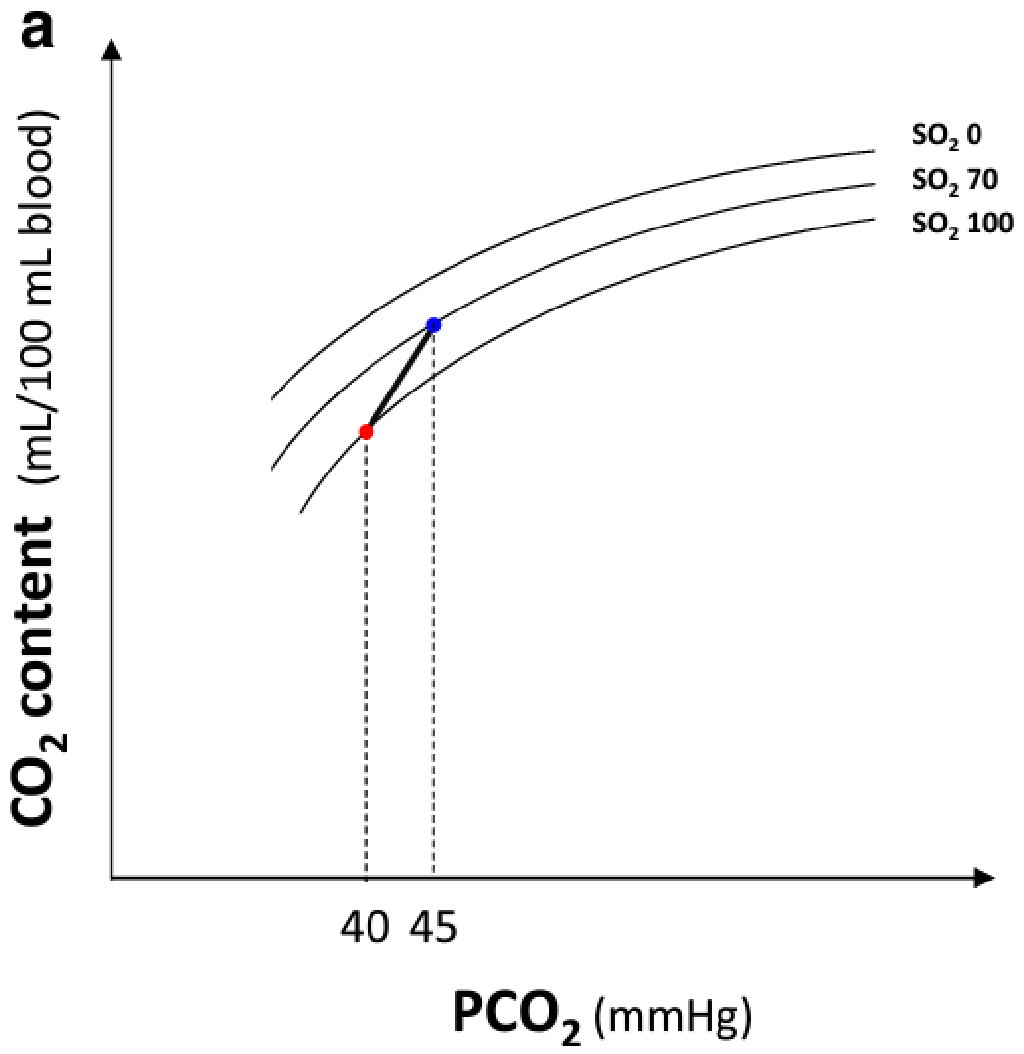


40%

The reduction in respiratory drive is not a major contributor to oxygen induced hypercapnia in AECOPD patients

Aubier M, et al. Am Rev Respir Dis 1980;122:191-199

The Haldane effect



Il legame dell'O2 con Hb favorisce l'eliminazione della CO2, la curva di dissociazione della CO2 è spostata verso il basso

Intensive Care Med. 2017 ;43(1):91-93

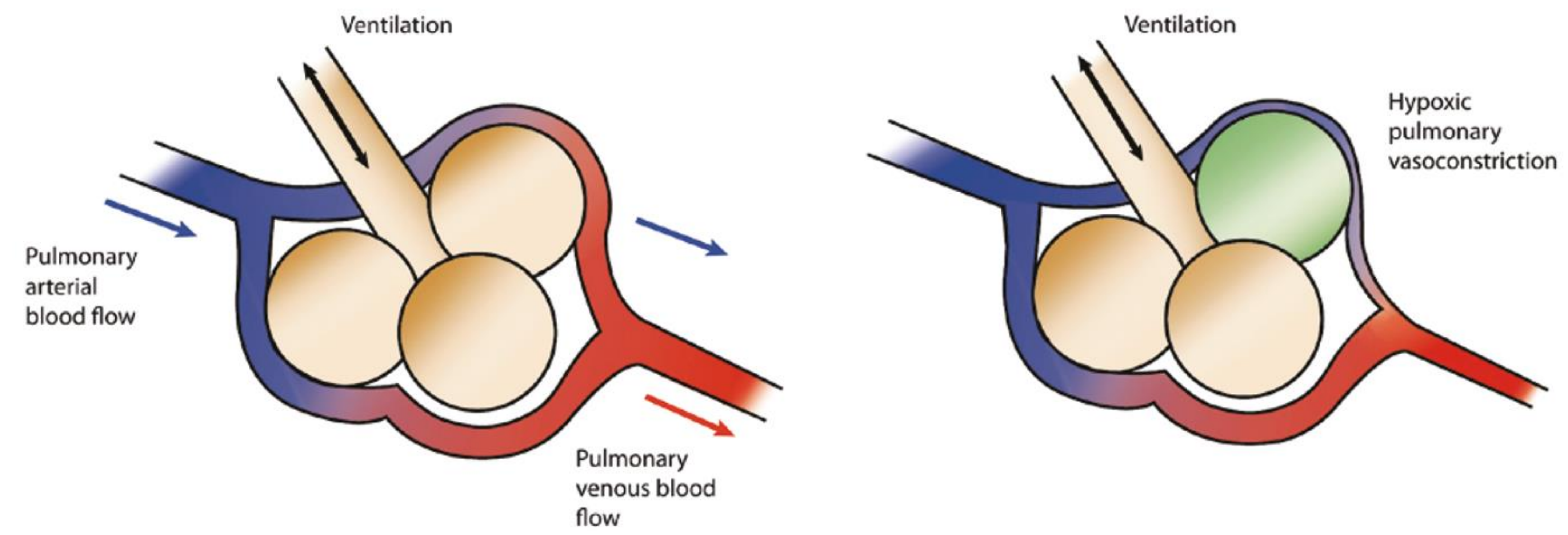
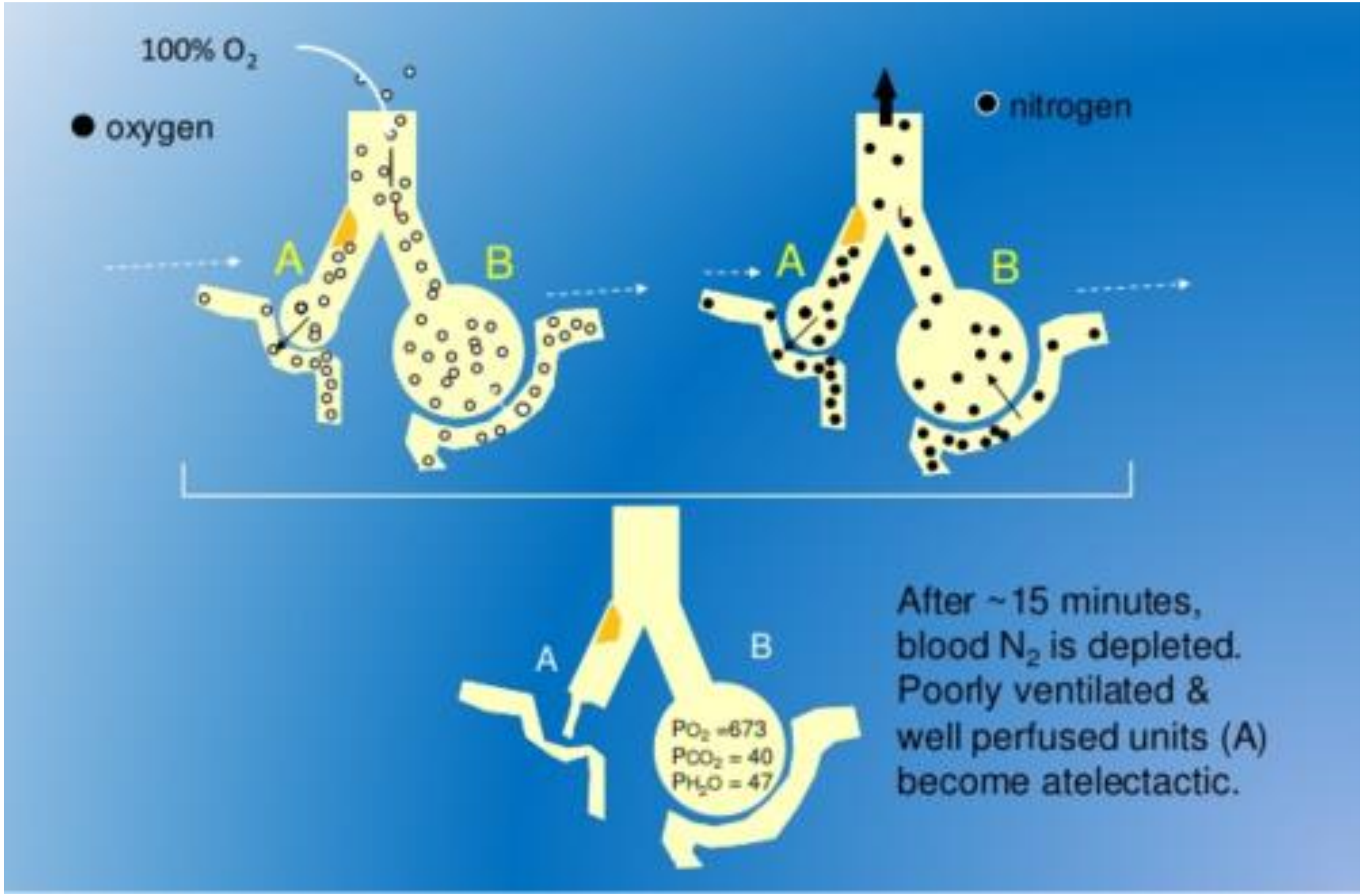
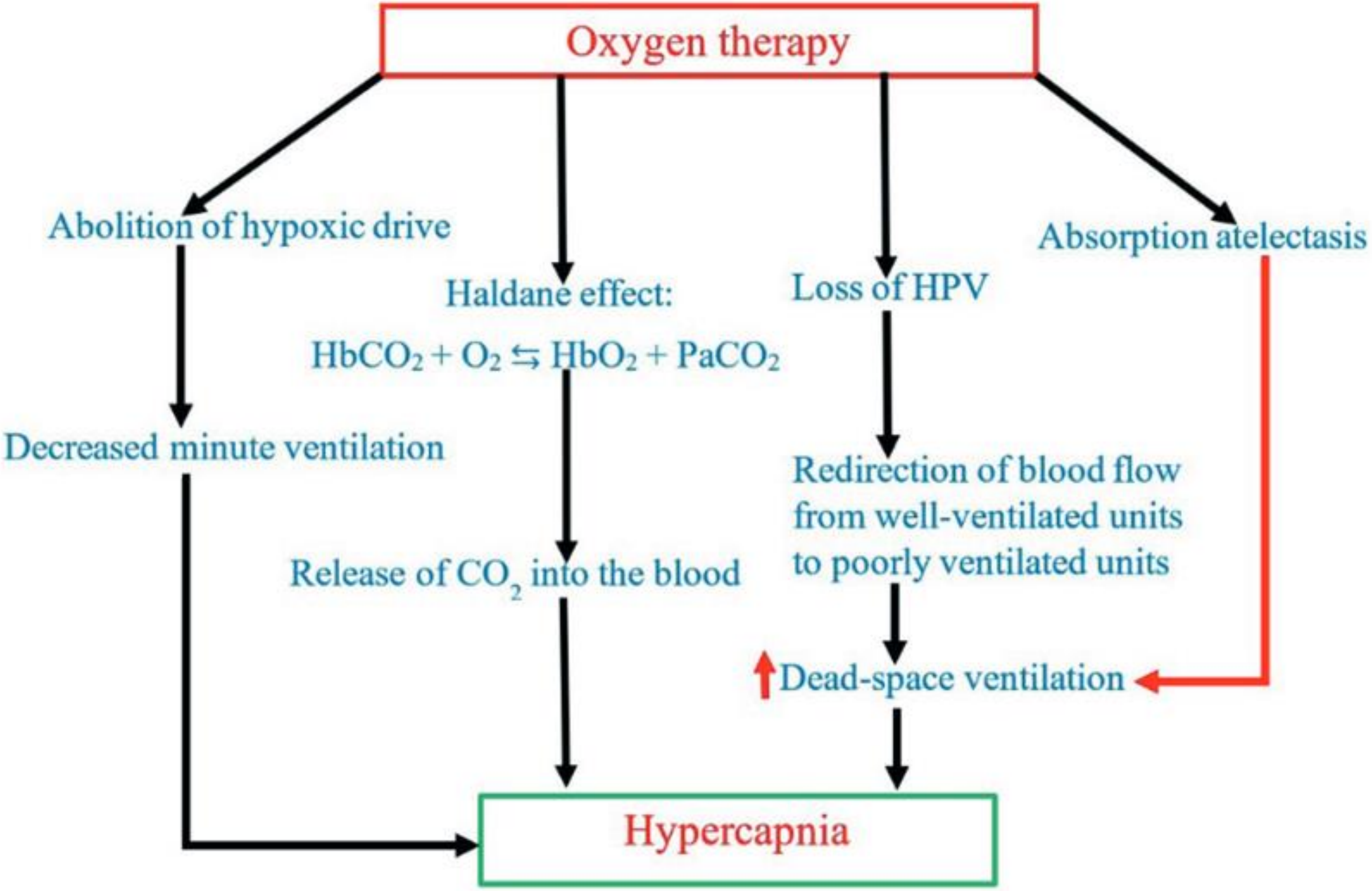


Figure 2. Hypoxic pulmonary vasoconstriction. The left frame shows normal alveolar ventilation and perfusion. In the right frame, reduced ventilation (thus O_2 tension) in the alveolus (green) leads to a reduced perfusion because of the hypoxic pulmonary vasoconstriction mechanism. Reprinted with permission from BMJ Publishing Group Ltd and Royal College of Paediatrics and Child Health [13].

Abdo and Heunks Critical Care 2012, 16:323

Absorption atelectasis



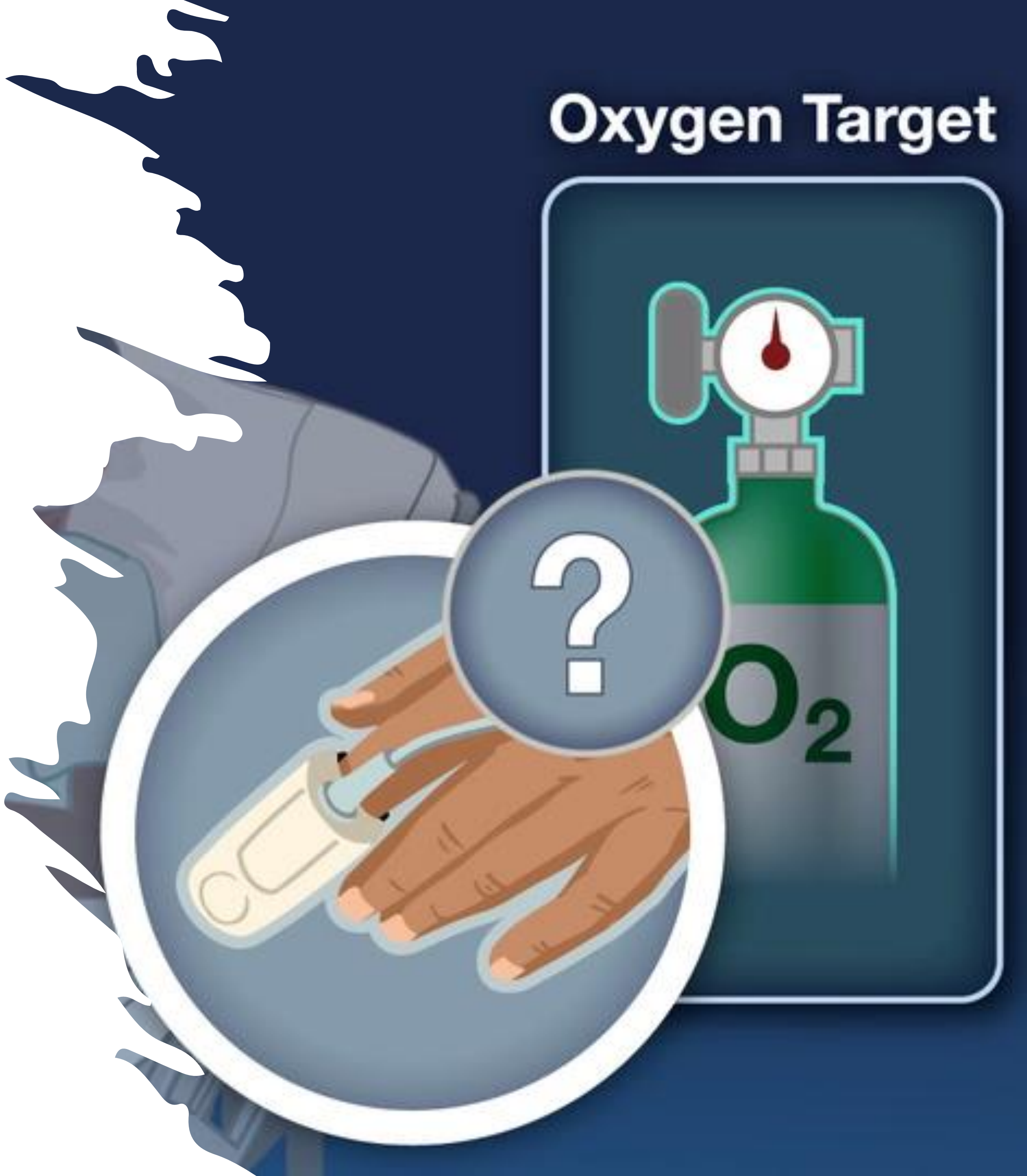


Oxygen therapy
Abolition of hypoxic drive
Haldane effect:
$HbCO_2 + O_2 \leftrightarrows HbO_2 + PaCO_2$
Loss of HPV
Absorption atelectasis
Decreased minute ventilation
Redirection of blood flow from well-ventilated units to poorly ventilated units
Release of CO_2 into the blood
Dead-space ventilation
Hypercapnia

AECOPD

target range 88–92%

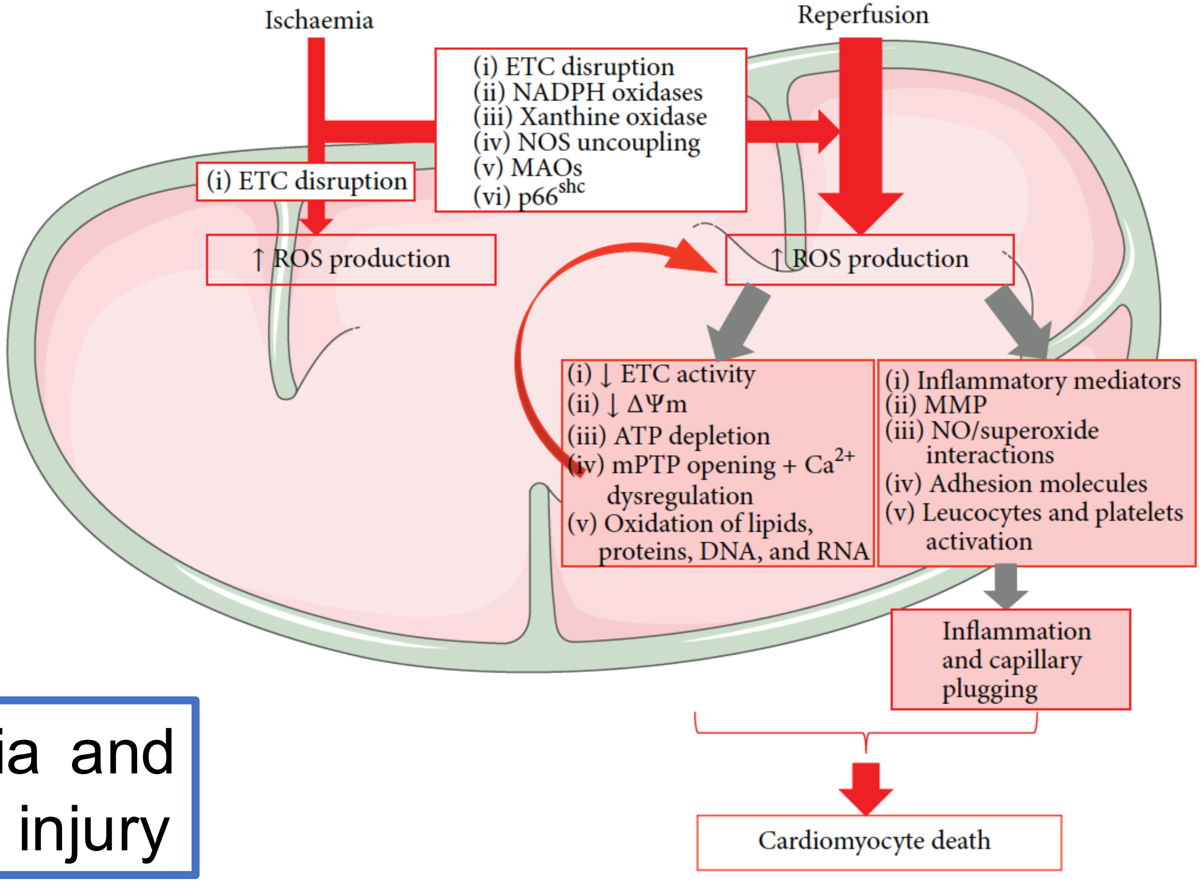
O'Driscoll BRet al. Thorax 2017;72:i1–i90.



Effects on the Heart

Hyperoxia can:

- ⇧ vascular resistance in the coronary artery
- ⇩ the coronary blood flow
- ⇧ myocardial oxygen consumption



Paradoxical increase in myocardial ischemia and aggravated myocardial ischemia reperfusion injury

Oxidative Med Cell Longev. 2016;2016:8254942.

2023 ESC Guidelines for the management of acute coronary syndromes

Developed by the task force on the management of acute coronary syndromes of the European Society of Cardiology (ESC)

Recommendation Table 3 — Recommendations for the initial management of patients with acute coronary syndrome

Recommendations	Class[a]	Level[b]
Hypoxia		
Oxygen is recommended in patients with hypoxaemia (SaO_2 <90%).	I	C
Routine oxygen is not recommended in patients without hypoxaemia (SaO_2 >90%).[148,172]	III	A
Symptoms		
Intravenous opioids should be considered to relieve pain.	IIa	C
A mild tranquilizer should be considered in very anxious patients.	IIa	C
Intravenous beta-blockers		
Intravenous beta-blockers (preferably metoprolol) should be considered at the time of presentation in patients undergoing PPCI with no signs of acute heart failure, an SBP >120 mmHg, and no other contraindications.[163–167,169]	IIa	A

European Heart Journal (2023) **44**, 3720–3826

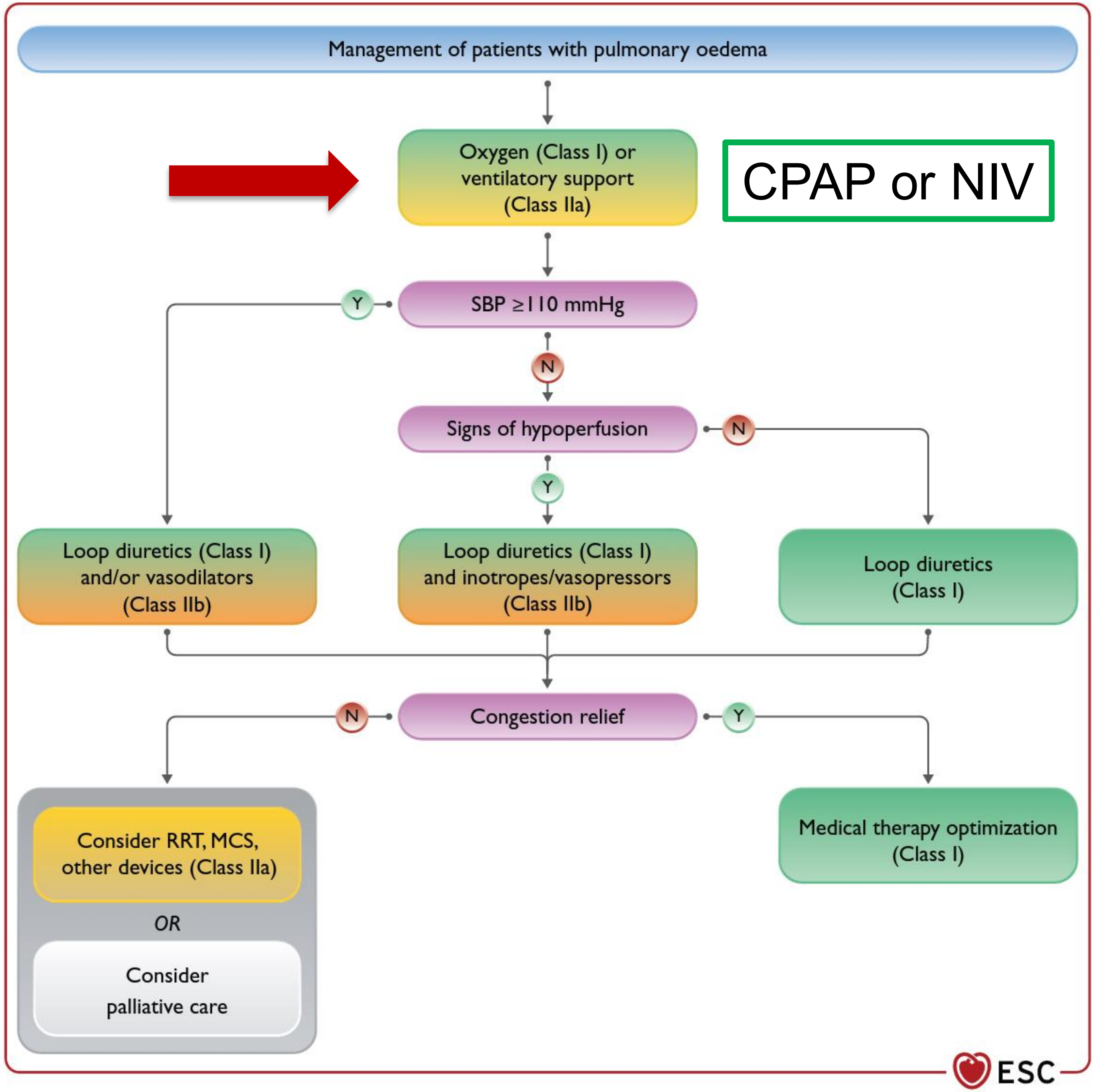
ESC GUIDELINES

ESC European Society of Cardiology

European Heart Journal (2021) **42**, 3599–3726
doi:10.1093/eurheartj/ehab368

2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure

In AHF patients oxygen should not be used routinely in non-hypoxaemic patients, as it causes vasoconstriction and a reduction in cardiac output



Effects on the Brain

Hyperoxia

- Cerebral vasoconstriction
- Reduced CBF and metabolic dysfunction
- neuronal damage and neurological impairment

EAN Guidelines/CME Article | Free Access

European Academy of Neurology and European Stroke Organization consensus statement and practical guidance for pre-hospital management of stroke

Routine use of O_2 is not recommended
In patients with $SpaO_2$ <95% the administration of O_2 titrated to maintain normoxia is recommended.

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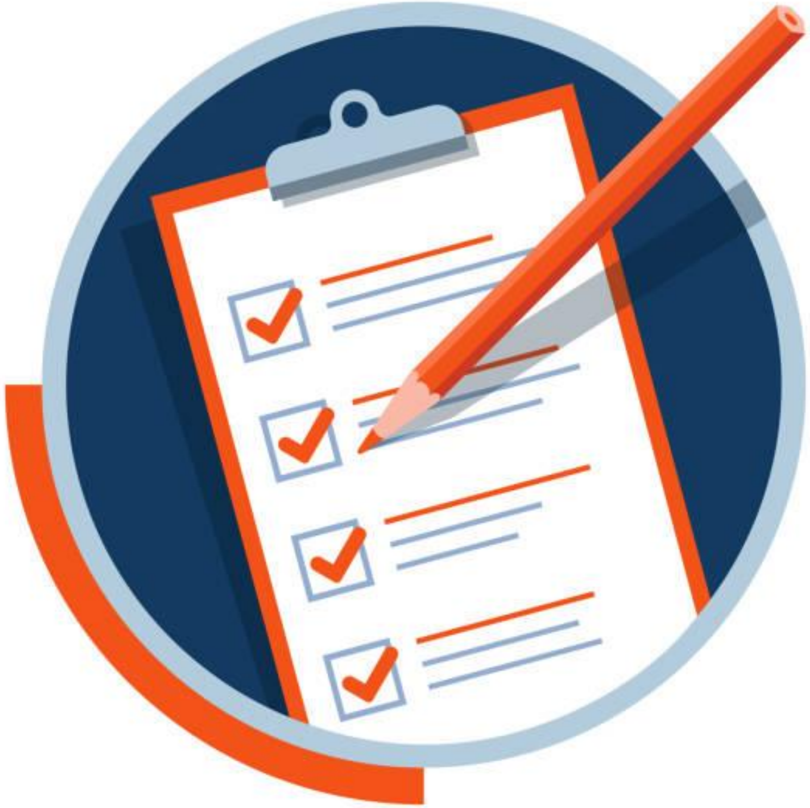

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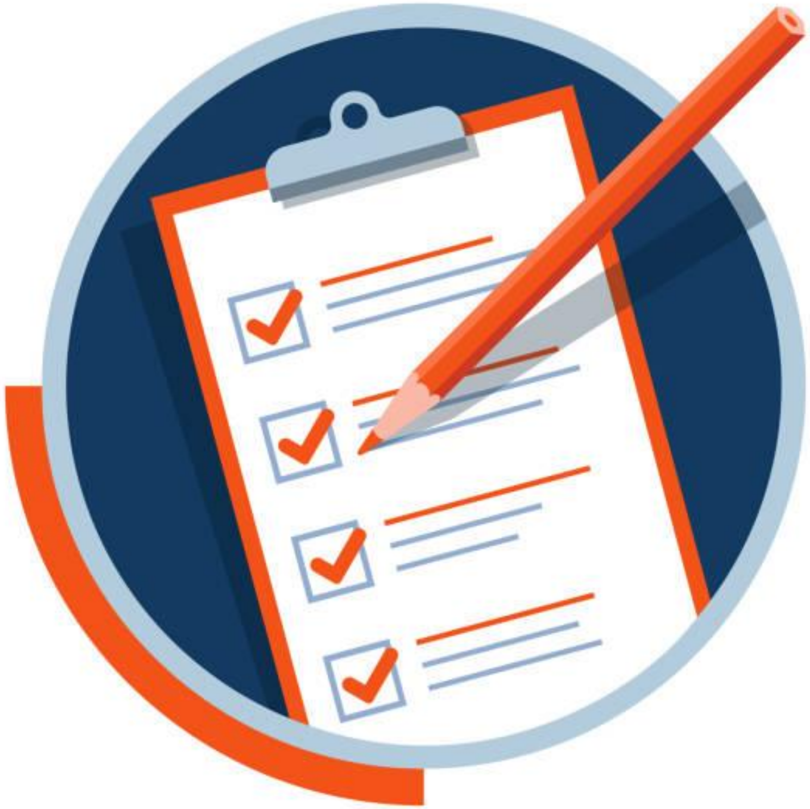


ICU Patients

Oxygen in the critically ill: friend or foe?

Elisa Damiani[a], Abele Donati[a], and Massimo Girardis[b]

Curr Opin Anesthesiol 2018, 31:129–135

JAMA | Preliminary Communication | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Conservative vs Conventional Oxygen Therapy on Mortality Among Patients in an Intensive Care Unit
The Oxygen-ICU Randomized Clinical Trial

Massimo Girardis, MD; Stefano Busani, MD; Elisa Damiani, MD; Abele Donati, MD; Laura Rinaldi, MD; Andrea Marudi, MD; Andrea Morelli, MD; Massimo Antonelli, MD; Mervyn Singer, MD, FRCA

RESULTS A total of 434 patients (median age, 64 years; 188 [43.3%] women) received conventional (n = 218) or conservative (n = 216) oxygen therapy and were included in the modified intent-to-treat analysis. Daily time-weighted PaO_2 averages during the ICU stay were significantly higher ($P < .001$) in the conventional group (median PaO_2, 102 mm Hg [IQR, 88-116]) vs the conservative group (median PaO_2, 87 mm Hg [IQR, 79-97]). Mortality was lower in the conservative oxygen therapy group. The conservative group had fewer episodes of shock, liver failure, and bacteremia.

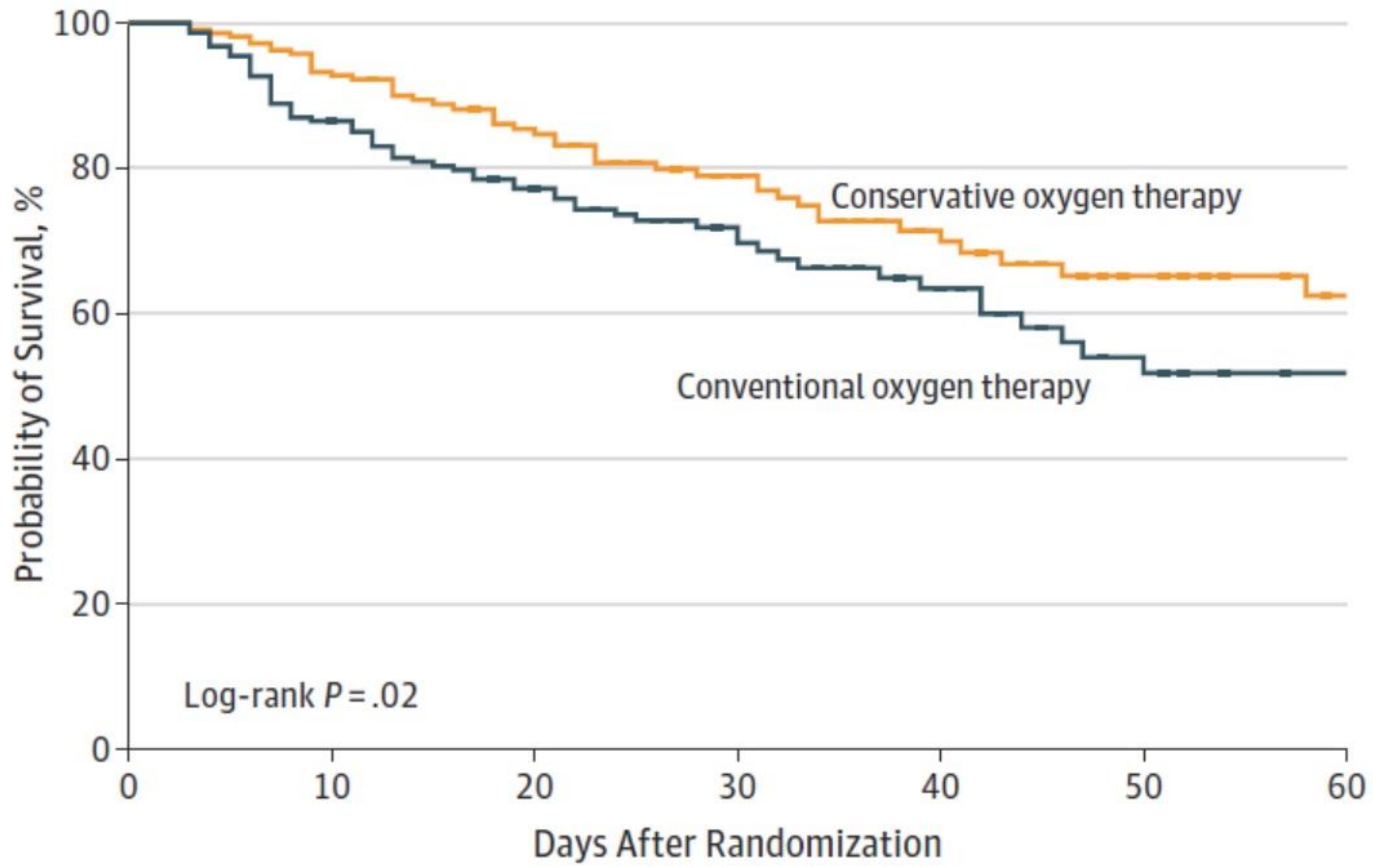
	Oxygen Therapy, No. (%)			
	Conservative (n = 216)	Conventional (n = 218)	Absolute Risk Reduction (95% CI)	P Value
Primary outcome				
ICU mortality	25 (11.6)	44 (20.2)	0.086 (0.017-0.150)	.01
Secondary outcomes				
Shock	8 (3.7)	23 (10.6)	0.068 (0.020-0.120)	.006
Liver failure	4 (1.9)	14 (6.4)	0.046 (0.008-0.088)	.02
Bacteremia	11 (5.1)	22 (10.1)	0.050 (0.000-0.090)	.049

Conventional:
PaO2 up to 150 and 97%<SpO2>100%

Conservative:
PaO2 between 70 and100 or 94%<SpO2 >98%

JAMA. 2016 ;316(15):1583-1589.

Figure 2. Probability of Survival From Study Inclusion (Day 0) Through Day 60 for Patients in the Conservative and Conventional Oxygen Strategy Groups



8,6%

No. at risk							
Conservative oxygen therapy	216	201	188	181	173	170	169
Conventional oxygen therapy	218	189	172	163	158	152	152

JAMA. 2016 ;316(15):1583-1589.

Higher versus lower fractions of inspired oxygen or targets of arterial oxygenation for adults admitted to the intensive care unit (Review)

Cochrane Library

Cochrane Database of Systematic Reviews

Klitgaard TL, Schjørring OL, Nielsen FM, Meyhoff CS, Perner A, Wetterslev J, Rasmussen BS, Barbateskovic M

19 RCTs (10,385 participants)

Authors' conclusions

In adult ICU patients, it is still not possible to draw clear conclusions about the effects of higher versus lower oxygenation strategies on all-cause mortality, SAEs, quality of life, lung injuries, myocardial infarction, stroke, and sepsis at maximum follow-up. This is due to low or very low-certainty evidence.

Cochrane Database Syst Rev. 2023 Sep 13;9(9):CD012631.

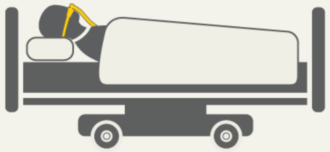
JAMA

COVID-19

QUESTION Does targeting a Pa_{O_2} of 60 mm Hg vs 90 mm Hg affect the number of days alive without life support in patients in the intensive care unit (ICU) with COVID-19 and severe hypoxemia?

CONCLUSION A Pa_{O_2} target of 60 mm Hg vs 90 mm Hg resulted in more days alive without life support in ICU patients with COVID-19 and severe hypoxemia.

POPULATION



495 Men **231** Women

Adults in the ICU with COVID-19, receiving at least 10 L/min of oxygen or mechanical ventilation

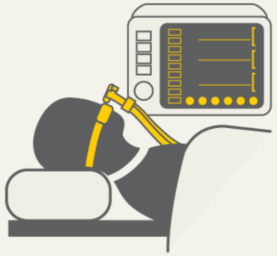
Median age: **66** years

LOCATIONS

11
ICUs in Europe

INTERVENTION

726 Patients randomized
697 Patients analyzed



351
Lower oxygenation target
Supplemental oxygen targeting a Pa_{O_2} of 60 mm Hg

346
Higher oxygenation target
Supplemental oxygen targeting a Pa_{O_2} of 90 mm Hg

PRIMARY OUTCOME

Number of days alive without life support (mechanical ventilation, circulatory support, or kidney replacement therapy) at 90 days

FINDINGS

Median days alive without life support

Lower oxygenation target
80 (IQR, 9-89)

Higher oxygenation target
72 (IQR, 2-88)

The findings were statistically significant:

Between-group difference,
***P* = .009** by van Elteren test

Supplemental bootstrapped adjusted mean difference,
5.8 days (95% CI, 0.2 to 11.5)

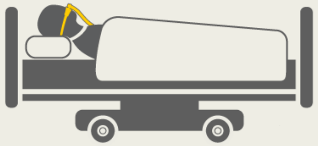
Nielsen FM, Klitgaard TL, Siegemund M, et al; HOT-COVID Trial Group. Lower vs higher oxygenation target and days alive without life support in COVID-19: the HOT-COVID randomized clinical trial. *JAMA*. Published online March 19, 2024. doi:10.1001/jama.2024.2934

JAMA

QUESTION Does reducing oxygen to a peripheral oxygen saturation (Spo_2) target of 90% reduce 90-day all-cause mortality in adult patients receiving supplemental oxygen in the intensive care unit?

CONCLUSION The findings do not support an approach of reducing oxygen exposure by targeting an Spo_2 of 90% in mechanically ventilated adults receiving oxygen while in an intensive care unit (ICU).

POPULATION



16 500 Patients

Adult patients (≥18 years) receiving mechanical ventilation and supplemental oxygen

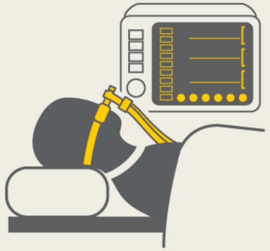
Mean age: **60** years

LOCATIONS

97
ICUs in the UK

INTERVENTION

16 500 Patients randomized
16 394 Patients analyzed



8258
Conservative oxygen therapy
Reduced peripheral Spo_2 target to 90% (range, 88%-92%)

8242
Usual oxygen therapy
Oxygen therapy determined by treating clinician

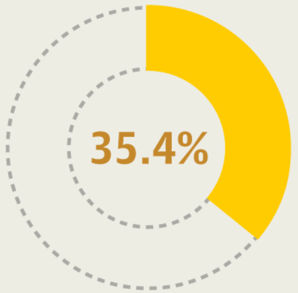
PRIMARY OUTCOME

All-cause mortality at 90 days

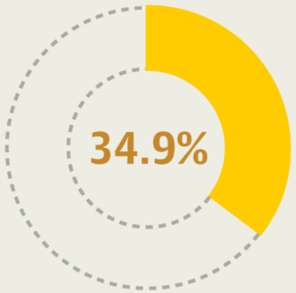
FINDINGS

All-cause mortality at 90 days

Conservative oxygen therapy
2908 patients



Usual oxygen therapy
2858 patients



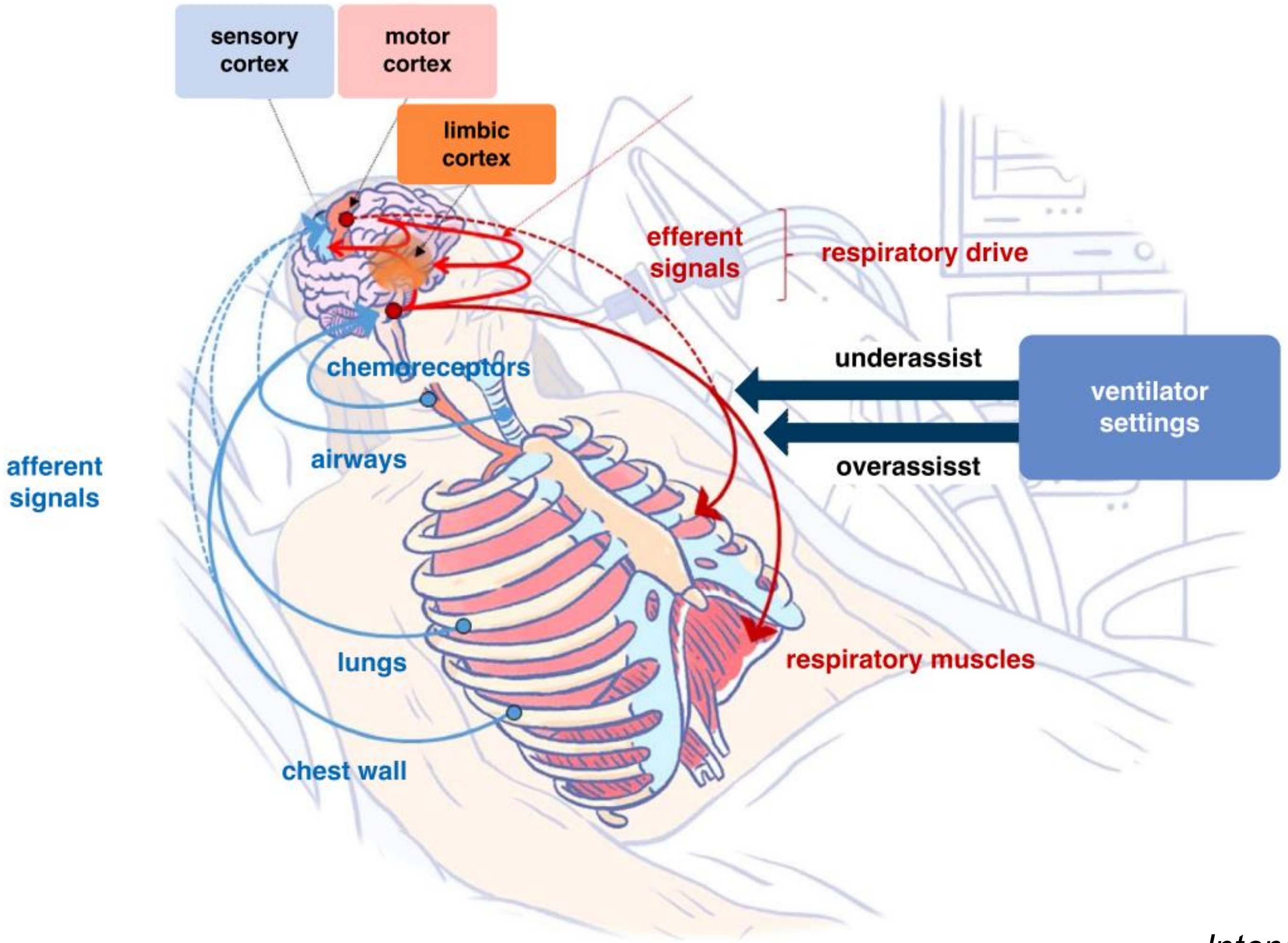
After adjustment for prespecified baseline variables, the risk difference was

0.7 percentage points

(95% CI, −0.7 to 2.0; *P* = .28)

Martin DS, Gould DW, Shahid T, et al; the UK-ROX Investigators. Conservative oxygen therapy in mechanically ventilated critically ill adult patients: the UK-ROX randomized clinical trial. *JAMA*. Published online June 12, 2025. doi:10.1001/jama.2025.9663

Dyspnoea in acutely ill mechanically ventilated adult patients: an ERS/ESICM statement



Intensive Care Med (2024) 50:159–180

ASCO Guideline

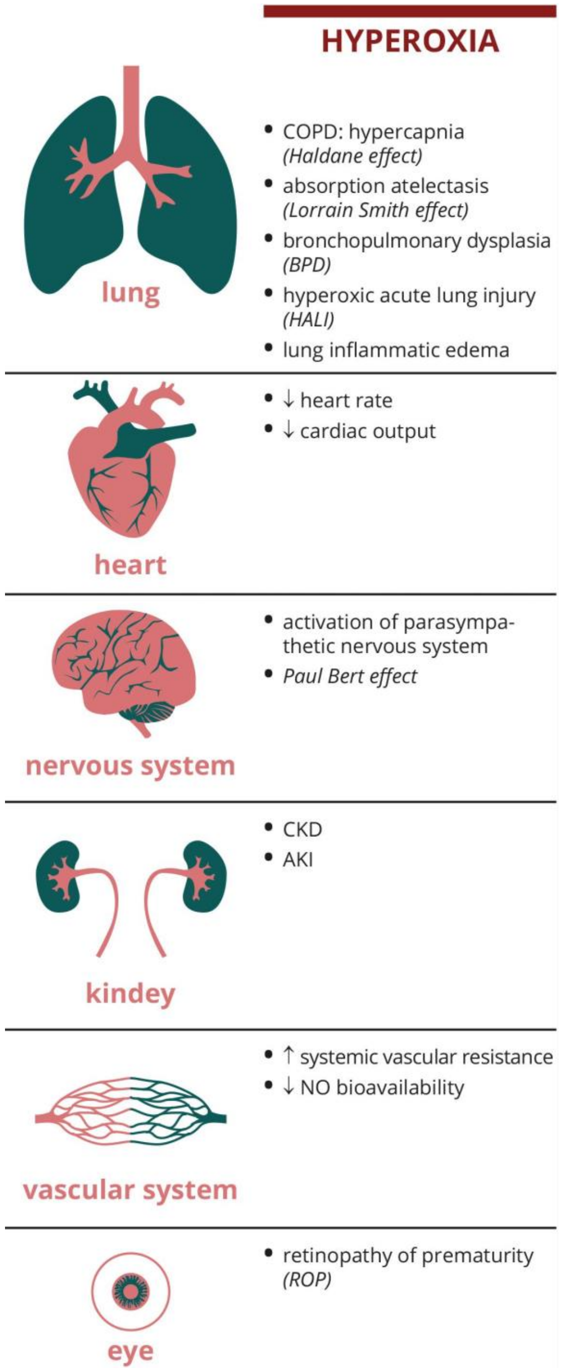
Clinical Question 4: What Nonpharmacologic Interventions Provide Palliation of Dyspnea?

Recommendation 4.1. Airflow interventions such as directing a fan at the cheek (trigeminal nerve distribution) should be offered (type: evidence-based; evidence quality: intermediate; strength of recommendation: moderate).

Recommendation 4.2. Standard supplemental oxygen should be available for patients with hypoxemia who are experiencing dyspnea (ie, $SpO_2 \leq 90\%$ on room air) (type: evidence-based; evidence quality: intermediate; strength of recommendation: moderate).

Recommendation 4.3. Supplemental oxygen is not recommended when $SpO_2 > 90\%$ (type: evidence-based; evidence quality: intermediate; strength of recommendation: moderate).

J Clin Oncol 39:1389-1411.



FIO2 > 0.21

Hyperoxaemia (i.e. arterial PaO2 > 100 mmHg)

Hyperoxia (increased tissue O2 concentration)

ROS formation

Discomfort!!!


CE
0476
MAX
MIN
Flow-meter
Via del Lino, 6
24040 Levate - Bergamo
MADE IN ITALY


MR 810
Fisher&Paykel
HEALTHCARE

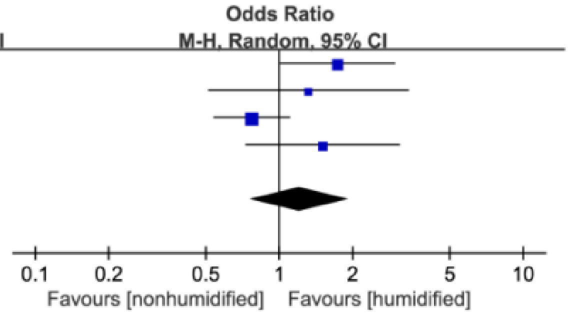

Clear-Therm 3 Filter/HME
Min. Vt 200ml

Is Humidified Better than Non -humidified Low Flow Oxygen Therapy?

A Systematic Review and Meta -Analysis

Study or Subgroup	Nonhumidified oxygen Events	Total	Humidified oxygen Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Andres 1997	52	126	32	111	27.8%	1.73 [1.01, 2.98]
Chen 2012	10	235	8	245	15.7%	1.32 [0.51, 3.40]
Tian 2012	221	316	211	281	35.2%	0.77 [0.54, 1.11]
Yang T 2015	52	70	46	70	21.3%	1.51 [0.73, 3.12]
Total (95% CI)		**747**		**707**	**100.0%**	**1.21 [0.76, 1.93]**
Total events	335		297			

Heterogeneity: $Tau^2 = 0.13$; $Chi^2 = 7.21$, df = 3 (P = 0.07); $I^2 = 58\%$
Test for overall effect: Z = 0.81 (P = 0.42)

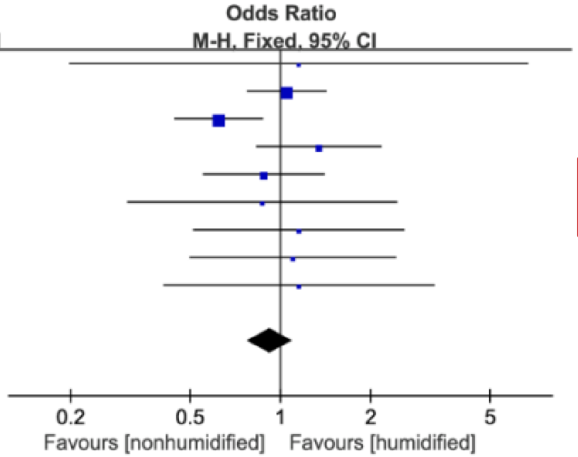


A The forest plot for the incidence of dry nose

Dry nose

Study or Subgroup	Nonhumidified oxygen Events	Total	Humidified oxygen Events	Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Cai 2013	4	51	2	29	0.9%	1.15 [0.20, 6.69]
Chen 2015	138	328	144	352	29.7%	1.05 [0.77, 1.42]
Han 2011	71	400	103	400	31.3%	0.62 [0.44, 0.87]
Li 2010	47	418	30	348	10.7%	1.34 [0.83, 2.17]
Li 2015	120	173	121	168	13.9%	0.88 [0.55, 1.40]
Liu 2015	7	174	8	174	2.8%	0.87 [0.31, 2.45]
Yuan 2013	14	256	11	230	4.0%	1.15 [0.51, 2.59]
Yue 2015	14	224	12	210	4.3%	1.10 [0.50, 2.44]
Zeng 2009	12	30	11	30	2.4%	1.15 [0.41, 3.26]
Total (95% CI)		**2054**		**1941**	**100.0%**	**0.93 [0.78, 1.10]**
Total events	427		442			

Heterogeneity: $Chi^2 = 8.90$, df = 8 (P = 0.35); $I^2 = 10\%$
Test for overall effect: Z = 0.85 (P = 0.39)



B The forest plot for the incidence of dry nose and throat

Dry nose and throat

J Adv Nurs 73:2522-2533, 2017

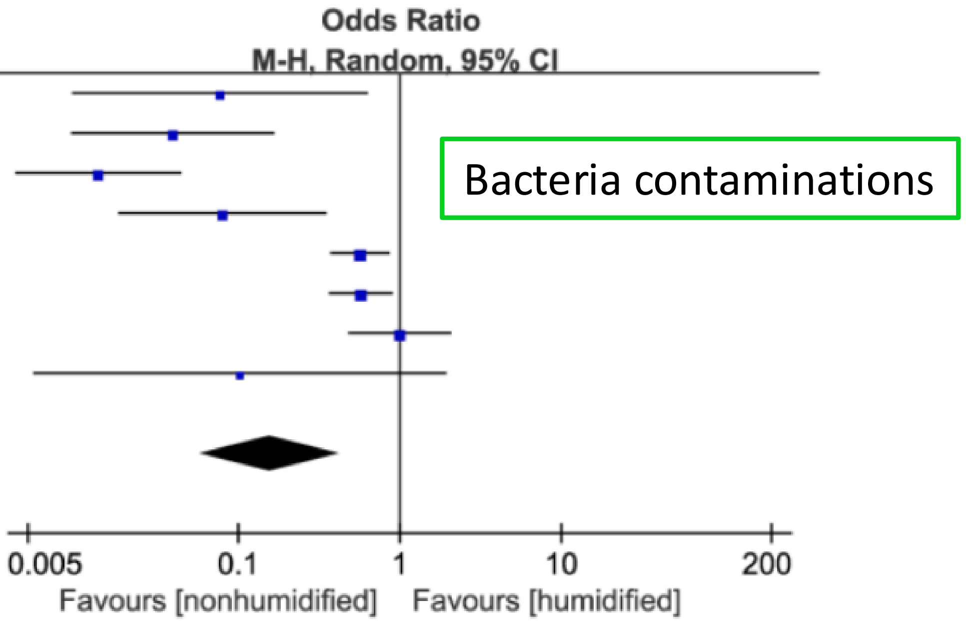
Is Humidified Better than Non -humidified Low Flow Oxygen Therapy?

A Systematic Review and Meta -Analysis

Study or Subgroup	Nonhumidified oxygen Events	Nonhumidified oxygen Total	Humidified oxygen Events	Humidified oxygen Total	Weight	Odds Ratio M-H, Random, 95% CI
Huang J 2014	1	40	10	40	9.4%	0.08 [0.01, 0.63]
Li 2011	2	130	37	130	12.1%	0.04 [0.01, 0.17]
Li 2015	3	173	95	168	13.3%	0.01 [0.00, 0.04]
Lou 2016	2	101	20	99	12.0%	0.08 [0.02, 0.35]
Ning 2014	53	201	77	199	15.8%	0.57 [0.37, 0.87]
Yang B 2015	41	184	67	201	15.8%	0.57 [0.36, 0.90]
Yang T 2015	20	70	20	70	15.0%	1.00 [0.48, 2.08]
Zhou 2015	0	50	4	50	6.7%	0.10 [0.01, 1.95]
Total (95% CI)		**949**		**957**	**100.0%**	**0.16 [0.06, 0.43]**
Total events	122		330			

Heterogeneity: Tau² = 1.58; Chi² = 68.44, df = 7 (P < 0.00001); I² = 90%

Test for overall effect: Z = 3.62 (P = 0.0003)

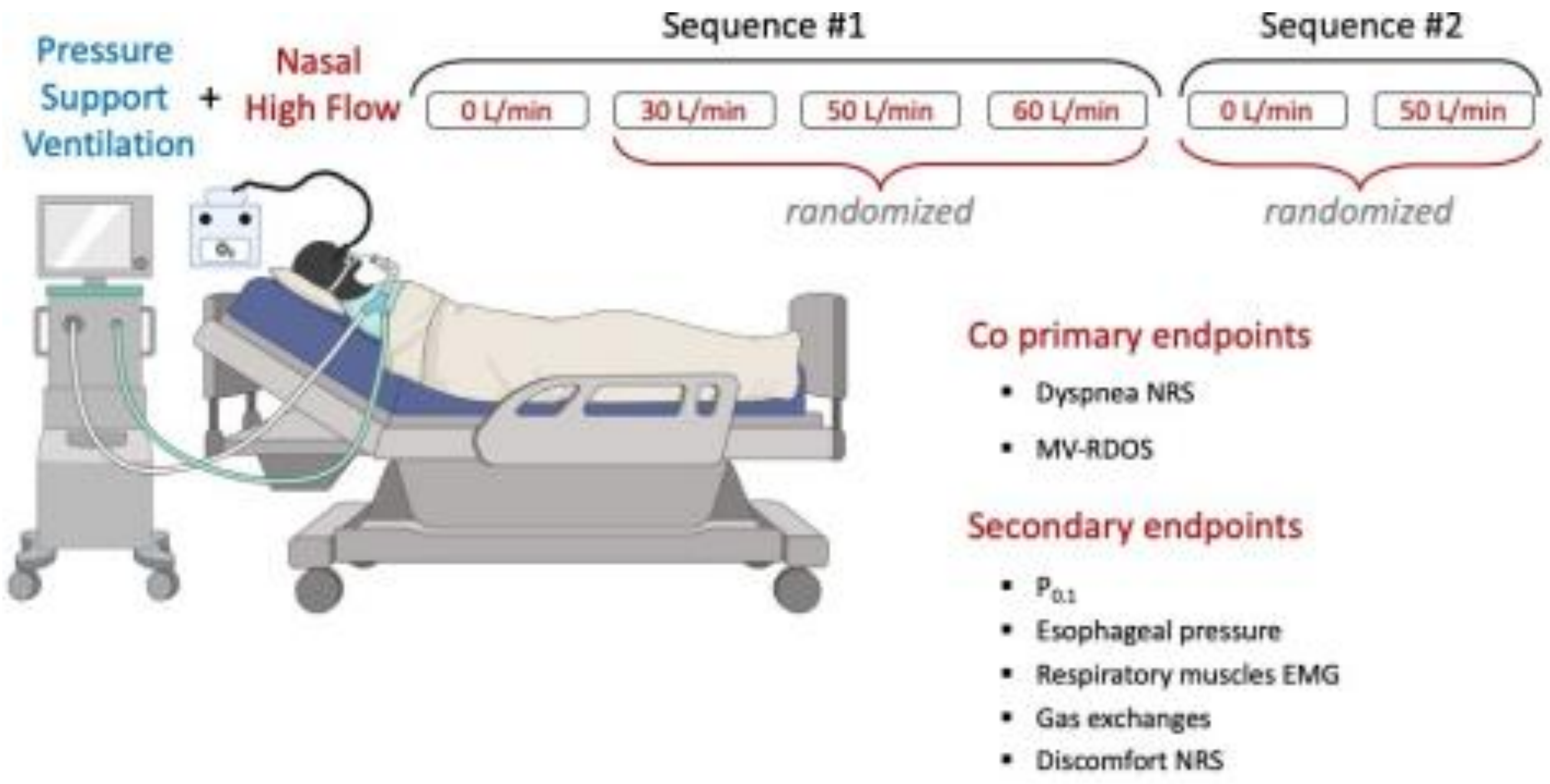


A The forest plot for bacteria contaminations of humidifier bottles

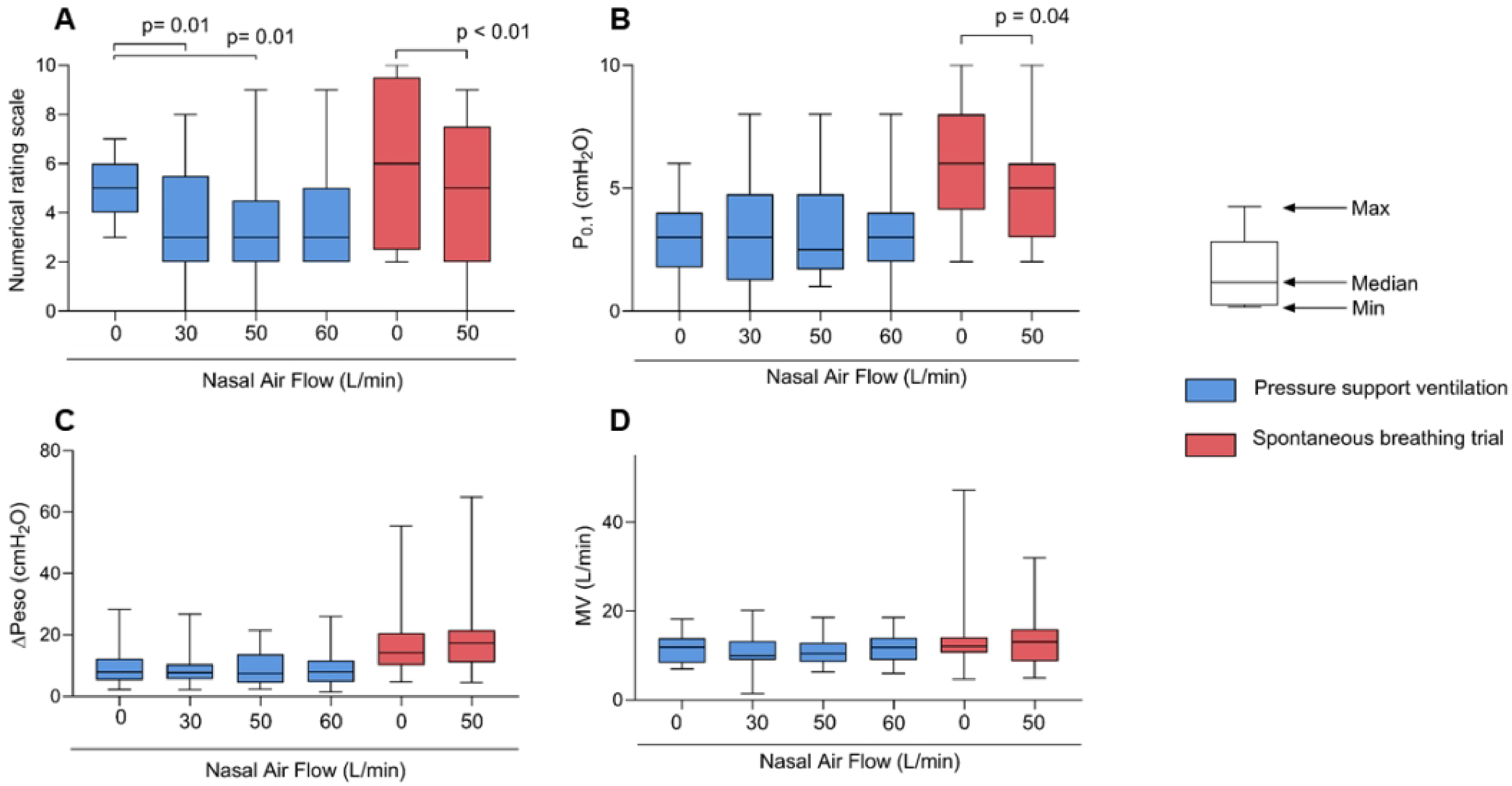
J Adv Nurs 73:2522-2533, 2017

Nasal High Flow to Modulate Dyspnea in Orally Intubated Patients

Valentine Le Stang [1, 2], Mélodie Graverot [1, 2], Antoine Kimmoun [3, 4], Marie-Cécile Niérat [1],
Maxens Decavèle [1, 2], Thomas Similowski [1, 5], Alexandre Demoule [1, 2], Martin Dres [1, 2]



Am J Respir Crit Care Med 2025 Apr;211(4):577-586.



Am J Respir Crit Care Med 2025 Apr;211(4):577-586.

Conclusions

- Oxygen is one of the most ubiquitously used medical interventions in medicine
- Although oxygen supplementation is beneficial to support life in the clinic, excessive oxygen therapy has also been linked to multiple organ injuries (lung, heart, brain, etc)
- To date, no consensus has been reached regarding the clinical impact of hyperoxia and hyperoxemia, specifically in ICU patients. It is plausible that oxygen therapy has a differing effect according to patients' characteristics
- Don't forget palliation of dyspnea and comfort!!