

Chris Hebbes
Clinical lecturer
and Senior
Registrar in
Anaesthesia and
Critical Care
medicine

Hyperoxia — a load of hot air?



Aims

- Definition – what it is
- Problems associated with hyperoxia
- Incidence – how common in our practice
- Evidence

pig-headed

back or shoulders a **piggyback** ride. 2 Of or pertaining to the transporting of loaded truck bodies on railroad flatcars. — *adj.* 1 To carry or be carried on the back or shoulders. 2 To transport or be transported on railroad flatcars. Also **piggy-back**.

pig-headed (pig'hed) *adj.* Stupidly obstinate. — **pig-head edly** *adv.* **pig-head edness** *n.* — *Syn.* headstrong, obstinate, stubborn, unyielding.

pig iron Crude iron obtained by treating ore in a blast furnace.

pigment (pig'ment) *n.* 1 Any of a class of finely powdered, insoluble coloring matters suitable for making paints, enamels, etc. 2 Any substance that imparts color to animal or vegetable tissues. [*L. pigmentum* to paint] — **pigmentary** *adj.*

pigmentation (pig'men-tā'shun) *n.* 1 Coloration by pigment of plant or animal tissue. 2 Result of deposition of pigment by cells.

pigmy (pig'mi) *adj.* & *n.* PYGMY.

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pig nut (pig'nut) *n.* 1 The astragalus bone of several species of hickory. 2 Any of these trees.

pig pen (pig'pen) *n.* 1 A place for keeping or raising pigs. 2 Any dirty, untidy place.

pig skin (pig'skin) *n.* 1 The skin of a pig. 2 Something made of this skin, as a saddle or football.

pig-sticking (pig'stik-ing) *n.* The hunting of wild boars with spears.

pig sty (pig'sti) *n.* *pl.* sties STY.

pig tail (pig'tail) *n.* 1 The tail of a pig. 2 Informal A pair of hair. 3 A twist of tobacco. — **pig-tailed** *adj.*

pike (pik) *n.* A long pole having a metal spearhead, used by foot soldiers in medieval warfare. — *adj.* **piked, piking** To run through or kill with a pike. [*MF pike*]

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Pike heads



Pike staff

pilot

the bill to the nape, as some birds. Also **pilot** (pil'ot) *n.* 1 One who guides the action of a part of a machine, etc. — *adj.* 1 To act as the pilot of, steer. 2 To guide, etc. — *adv.* 1 To act as pilot on, over, or in. [*It. pilota*]

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• $\text{PaO}_2 > 13.3 \text{ kPa}$

• Probable/moderate hyperoxia
101-299 mmHg

• Severe >300 mmHg

• SpO_2 97-100%

pink

lack of something. **pinched** for time. 6 Informal To distress financially; use in the passive. 7 Slang To capture or arrest. 8 Slang To steal. — *adj.* 1 To squeeze, hurt. 10 To be stingy. 11 To become narrow or constricted. — **pinch pennies** To be economical or stingy. — *n.* 1 The act of pinching. 2 Painful pressure of any kind. 3 A case of emergency. 4 So much of a loose substance as can be taken between the finger and thumb. 5 Slang A theft. 6 Slang An arrest or raid. [*OF pincer*] — **pinch/er** *n.*

pinch-beck (pinch'bek) *n.* 1 An alloy of copper and zinc that resembles gold. 2 Anything spurious or pretentious. — *adj.* 1 Made of pinchbeck. 2 Spurious, false. [*Christophorus Pinchbeck, 1670-1732, English inventor*]

pinch-ers (pin'cherz) *n.* *pl.* pinchers

pinch-hit (pinch'hit) *v.* — *hit* *hit* 1 In baseball, to go to bat in place of a regular player, as when a hit is needed. 2 Informal To substitute for another in an emergency. [*pinch* an emergency + *hit*] — **pinch-hitter**

pin-cush-ion (pin'kush-an) *n.* A small cushion into which pins and needles are stuck when not in use.

Pin-dar-ic (pin-dar'ik) *adj.* Of or pertaining to an ode written in the complex style of Pindar, Greek lyric poet.

pin-dling (pind'ling) *adj.* Informal 1 Sickly; puny. 2 To be small. [*Var. of puny*]

pine (pin) *n.* 1 Any of several cone-bearing trees having needle-shaped evergreen leaves growing in clusters. 2 The wood of a pine tree. [*L. pinus*]

pine (pin) *v.* **pined, pining** 1 To grow thin or weak with longing, grief, etc.; languish. 2 To have great desire with. [*OE pinus to torment*] — *Syn.* crave, long, yearn.

pine-app-le (pin'ap-əl) *n.* 1 A tropical plant with spiny leaves and a large cone-shaped fruit. 2 The edible fruit of the plant. 3 Slang A bomb or hand grenade. — *OE pin* a plant

pine-needle (pin'needl) *n.* The needle-shaped leaf of a pine tree.

pine-tar (pin'tar) *n.* A dark, viscous tar obtained from pine.

pine-y (pin'ee) *adj.* *pl.* pine-iest

pin-feath-er (pin'feth-er) *n.* A rudimentary feather just beginning to grow through the skin.

pin-fold (pin'foid) *n.* A pound for stray animals; esp. a mile pound. — *v.* To shut in a pinfold, confine. [*OE pin-fold* to shut + *fold* fold]

ping (ping) *n.* A sharp, metallic, ringing sound. — *v.* To make this sound. [*Imit.*]

Ping-Pong (ping'pong) *n.* TABLE TENNIS a table tennis game.

pin-head (pin'hed) *n.* 1 The head of a pin. 2 Slang A brainless or stupid person; a fool. 3 Something insignificantly small. — **pin-head ed** *adj.*

pin-hole (pin'hul) *n.* A minute puncture made by or as if by a pin.

pin-ion (pin'yan) *n.* 1 The wing of a bird. 2 A wing feather. 3 The outer segment of a bird's wing, bearing the flight feathers. — *v.* 1 To cut off one pinion or hind the wings of a bird so as to prevent flight. 2 To bind or hold the arms of. [*L. pinna* feather]

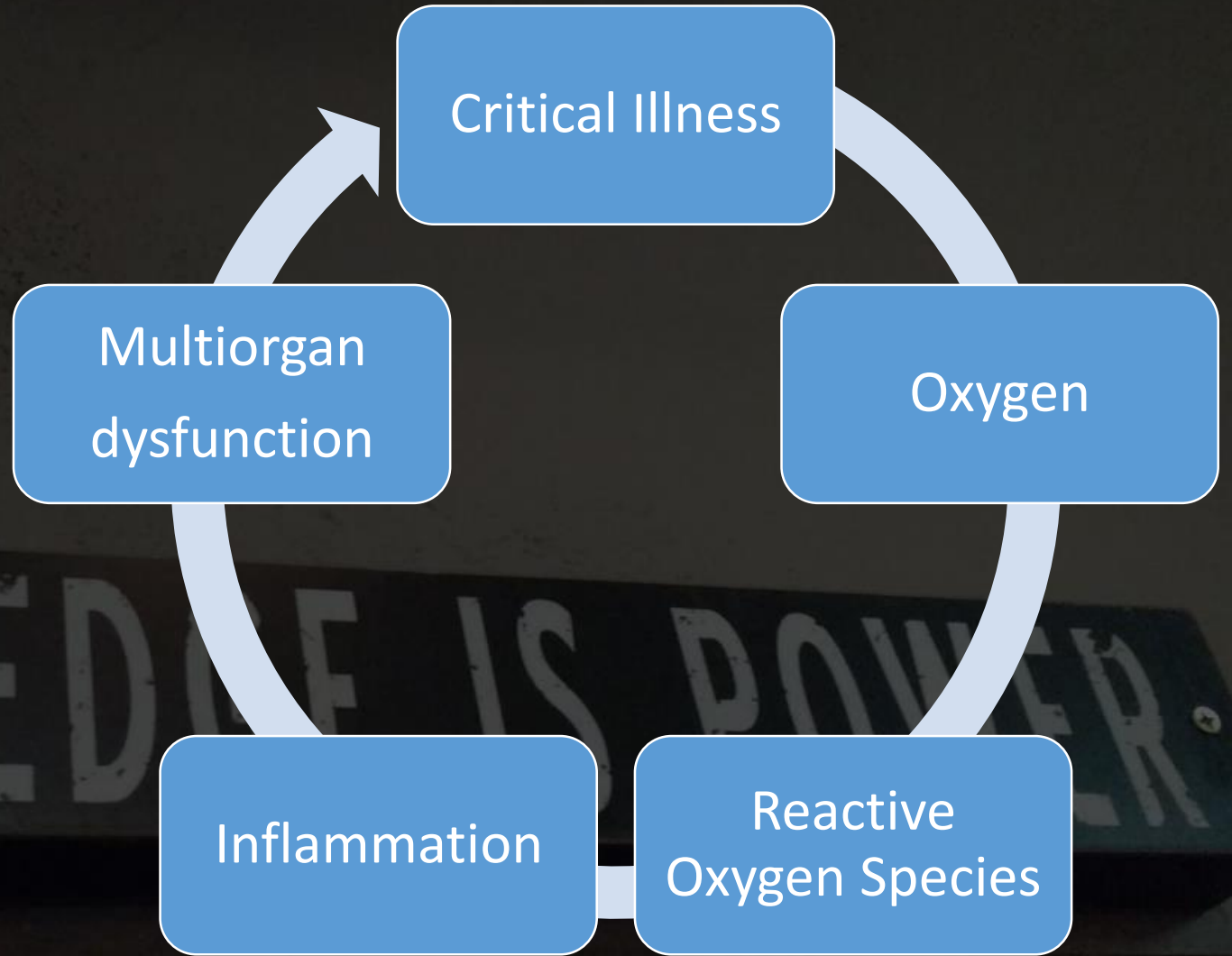
pin-ion (pin'yan) *n.* A small wheel meshing with a larger cogwheel. [*OE pinion* a comb] — *See* RACK.

pink (pink) *n.* 1 A pale hue of red. 2 Any of a genus of garden plants having pink, red, or white flowers with a clove-like scent. 3 The flower cap. A person who holds somewhat radical opinions; a derogatory term. — *in the pink* Informal In the best of health and spirits. — *adj.* 1 Pale red in color; rose. 2 Somewhat radical in opinion. [*?*]

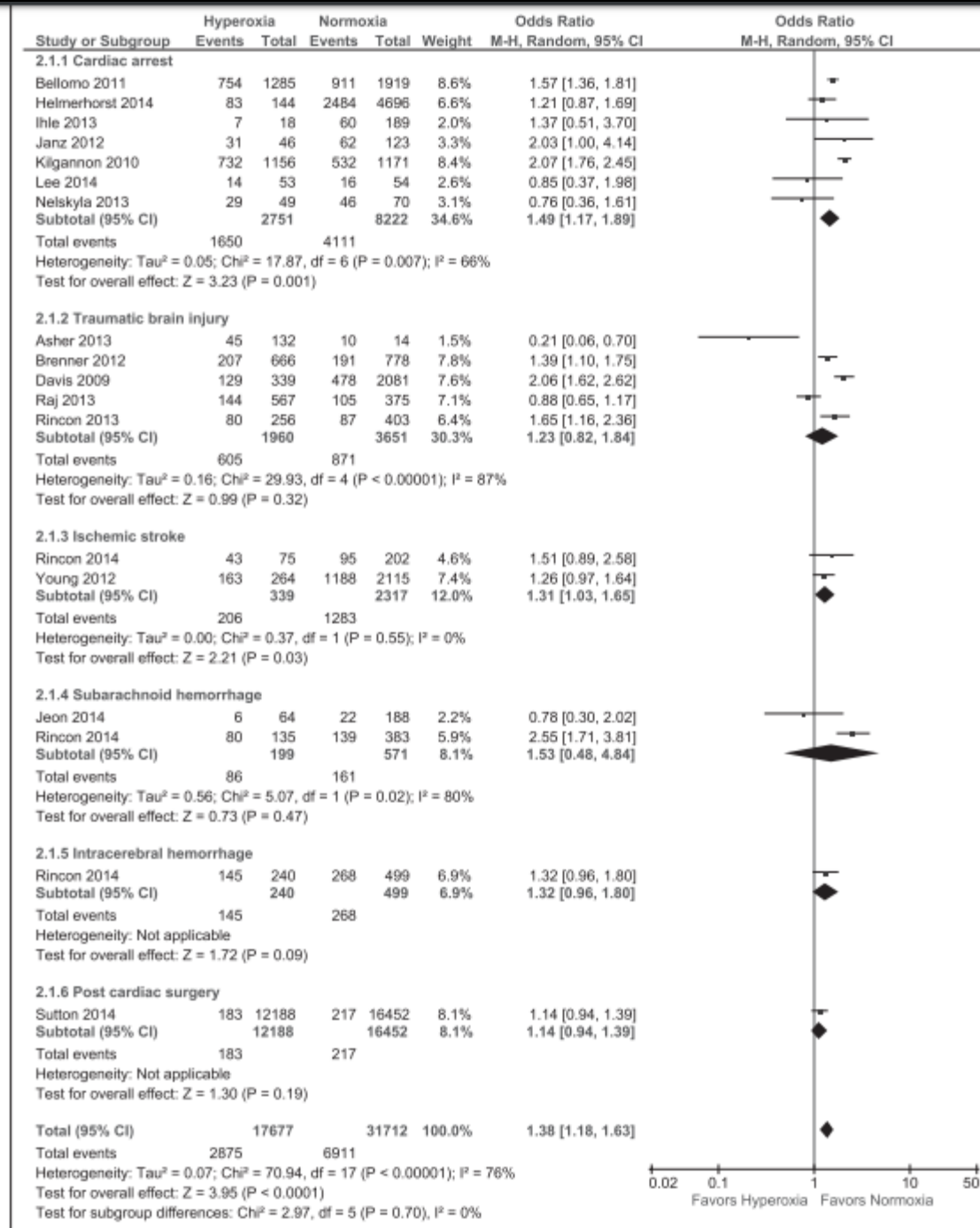


Pineapple

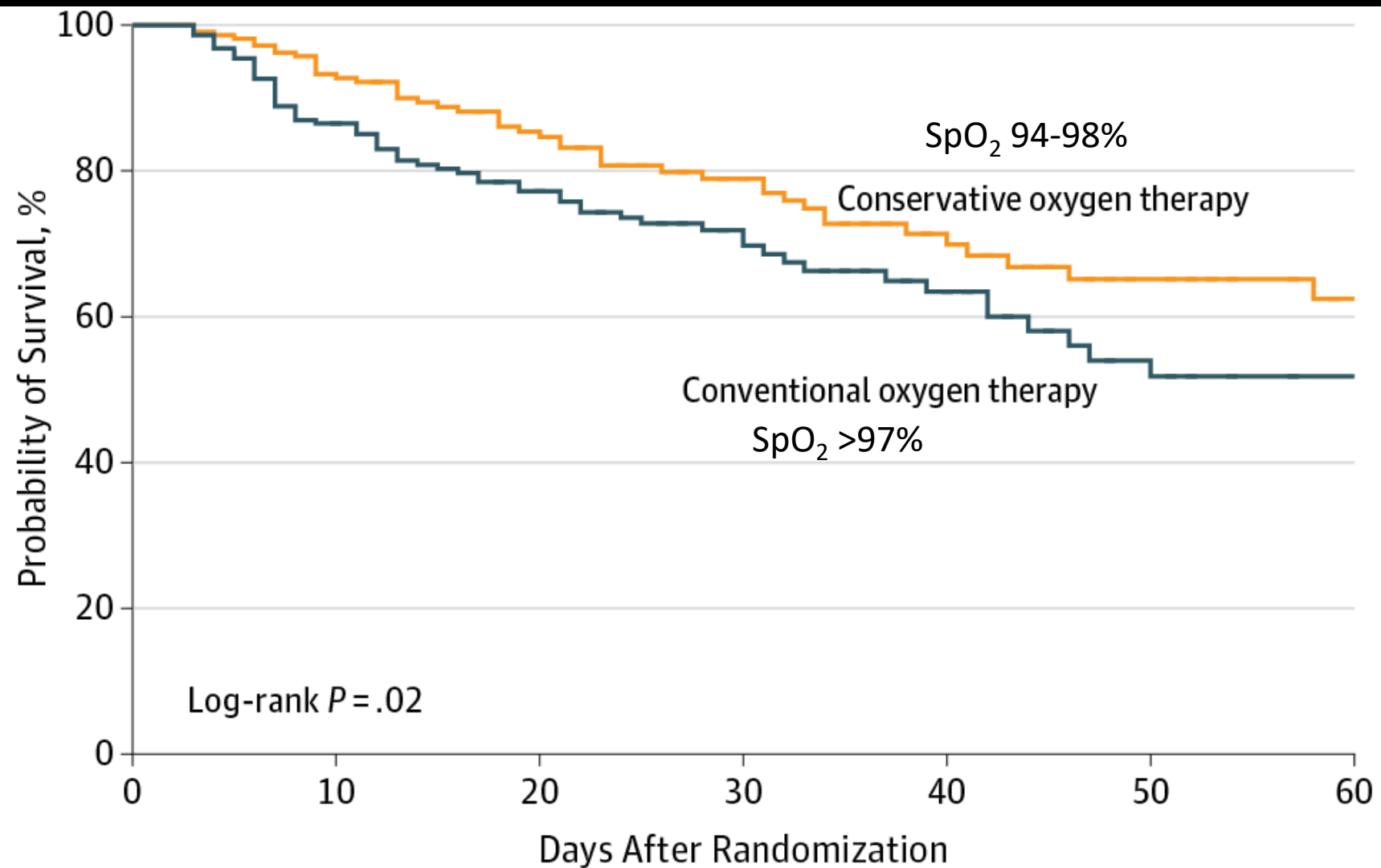
Harms



Ox



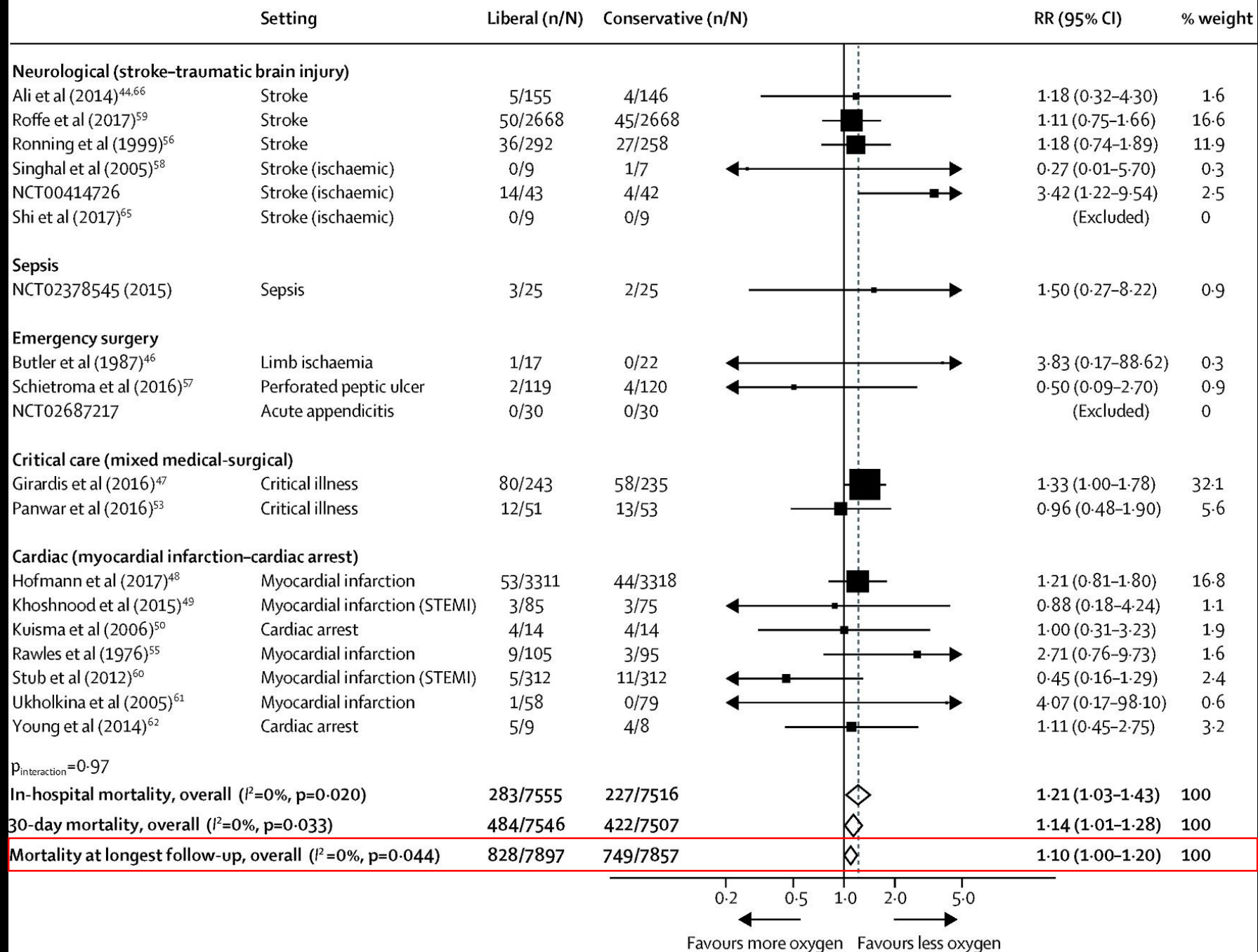
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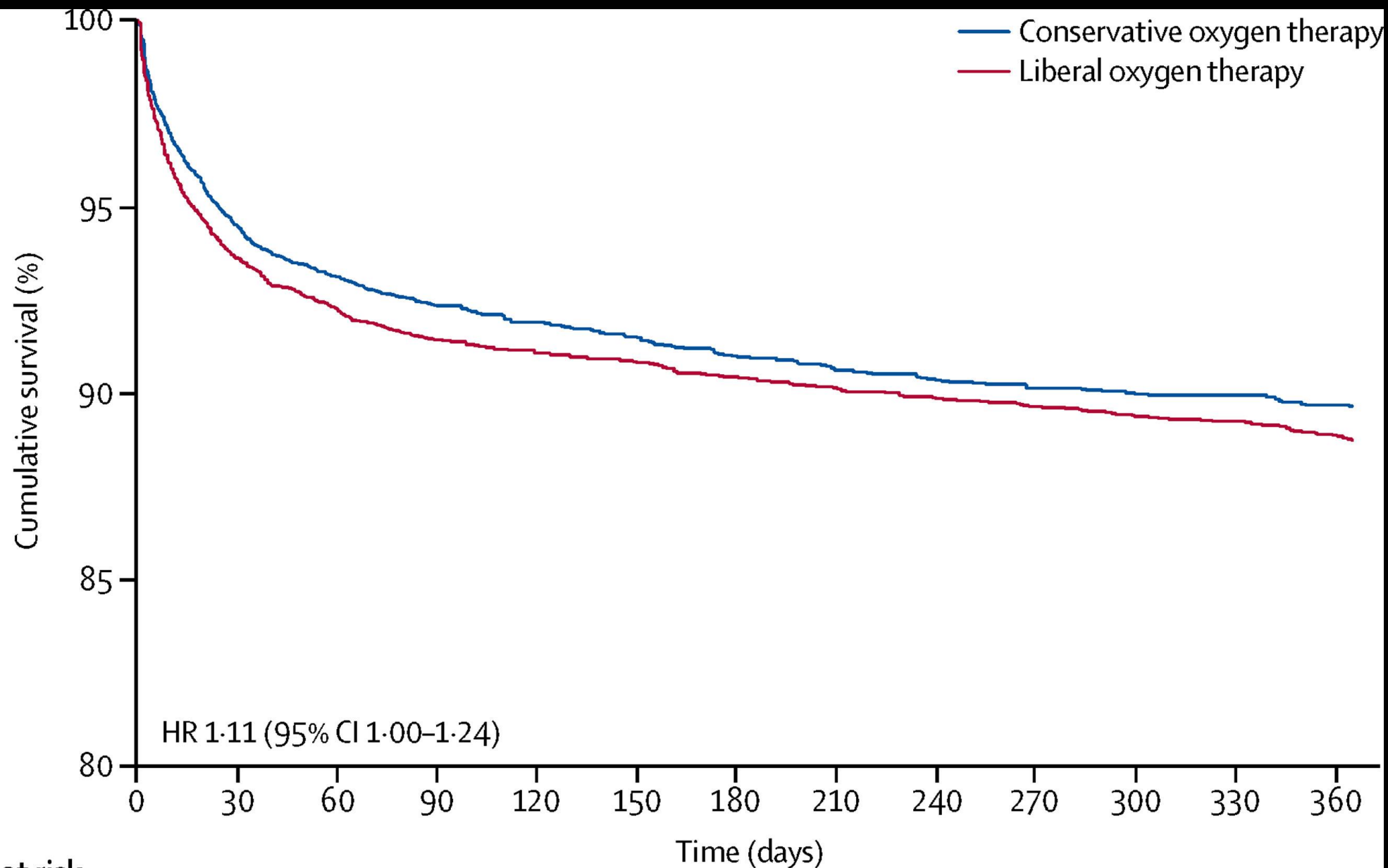


No. at risk

Conservative oxygen therapy	216	201	188	181	173	170	169
Conventional oxygen therapy	218	189	172	163	158	152	152

A





Number at risk

Conservative	6900	6484	6372	6130	3542	3527	3507	3372	3361	3352	3345	3344	3334
Liberal	6943	6450	6345	6119	3564	3554	3539	3402	3390	3381	3370	3365	3351

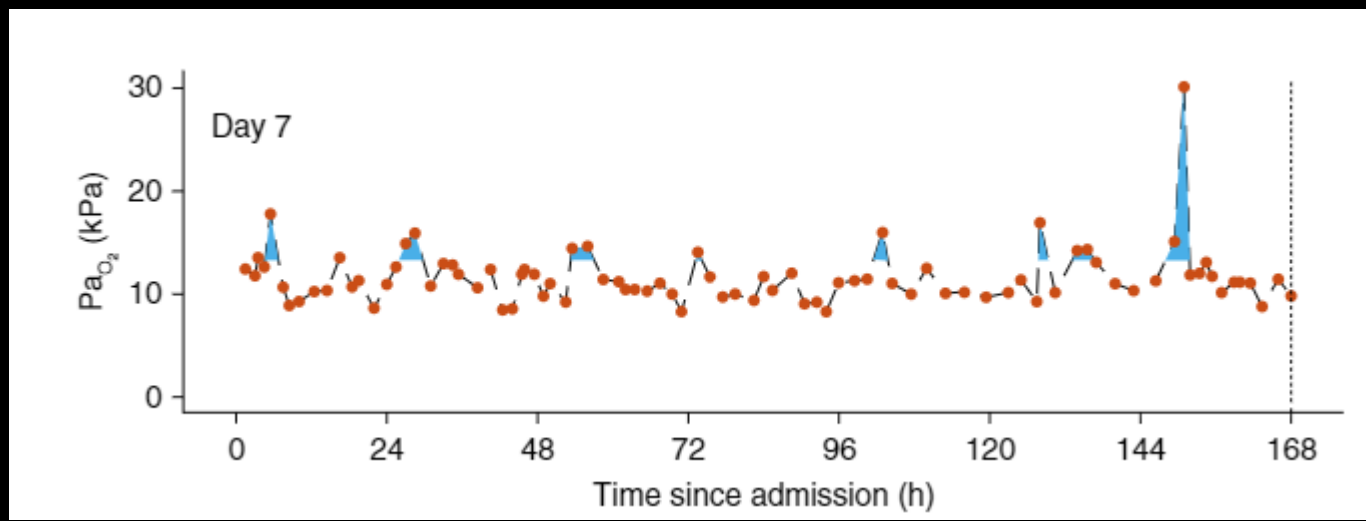


Table 2. Odds Ratios (95% Compatibility Intervals) for Hyperoxemia Dose (in Kilopascals) and Any Hyperoxemia Exposure (as Indicator Variable)

Model	Variable	Odds Ratio (95% CI)	Chi Square	DoF	P Value
0–1 d	Hyperoxemia dose	1.01 (0.93–1.10)	0.071	1	0.790
	Any hyperoxemia exposure	1.15 (0.95–1.38)	2.110	1	0.146
0–3 d	Hyperoxemia dose	0.94 (0.85–1.03)	1.777	1	0.183
	Any hyperoxemia exposure	1.35 (1.04–1.74)	5.157	1	0.023
0–5 d	Hyperoxemia dose	0.93 (0.83–1.04)	1.441	1	0.230
	Any hyperoxemia exposure	1.5 (1.07–2.13)	5.372	1	0.020
0–7 d	Hyperoxemia dose	0.92 (0.81–1.05)	1.416	1	0.234
	Any hyperoxemia exposure	1.74 (1.11–2.72)	5.815	1	0.016

Definition of abbreviations: CI = compatibility interval; DoF = degrees of freedom.
All other predictor variables are described in the online supplement.

A Conservative Oxygen Therapy

Too High

Unless the FiO_2 is 0.21, this level should be treated as an emergency
Reduce the FiO_2 by 0.10 at intervals of no greater than 5 min until the SpO_2 is less than 97%

Just Right

Use the lowest FiO_2 possible to achieve an acceptable SpO_2
If the FiO_2 is >0.21 , it should be decreased by at least 0.05 at intervals of 30 min or less until the FiO_2 is 0.21 or the SpO_2 falls below the target range

Too Low

The lower limit of SpO_2 should be determined by the treating clinician
Use a target SpO_2 of $\geq 91\%$ if no lower limit is prescribed (i.e., set the lower SpO_2 alarm at 90%)
If the SpO_2 falls below target range during a decrease, immediately return to the previous FiO_2 that achieved the target SpO_2

SpO_2 97% or more

Target range

SpO_2 below target range

B Usual Oxygen Therapy

Upper Limit of SpO_2

There is no protocol-defined upper limit of SpO_2
Do not use upper-limit SpO_2 alarms

Target Range

Any SpO_2 greater than the lower limit is acceptable
The use of an FiO_2 of <0.3 is discouraged

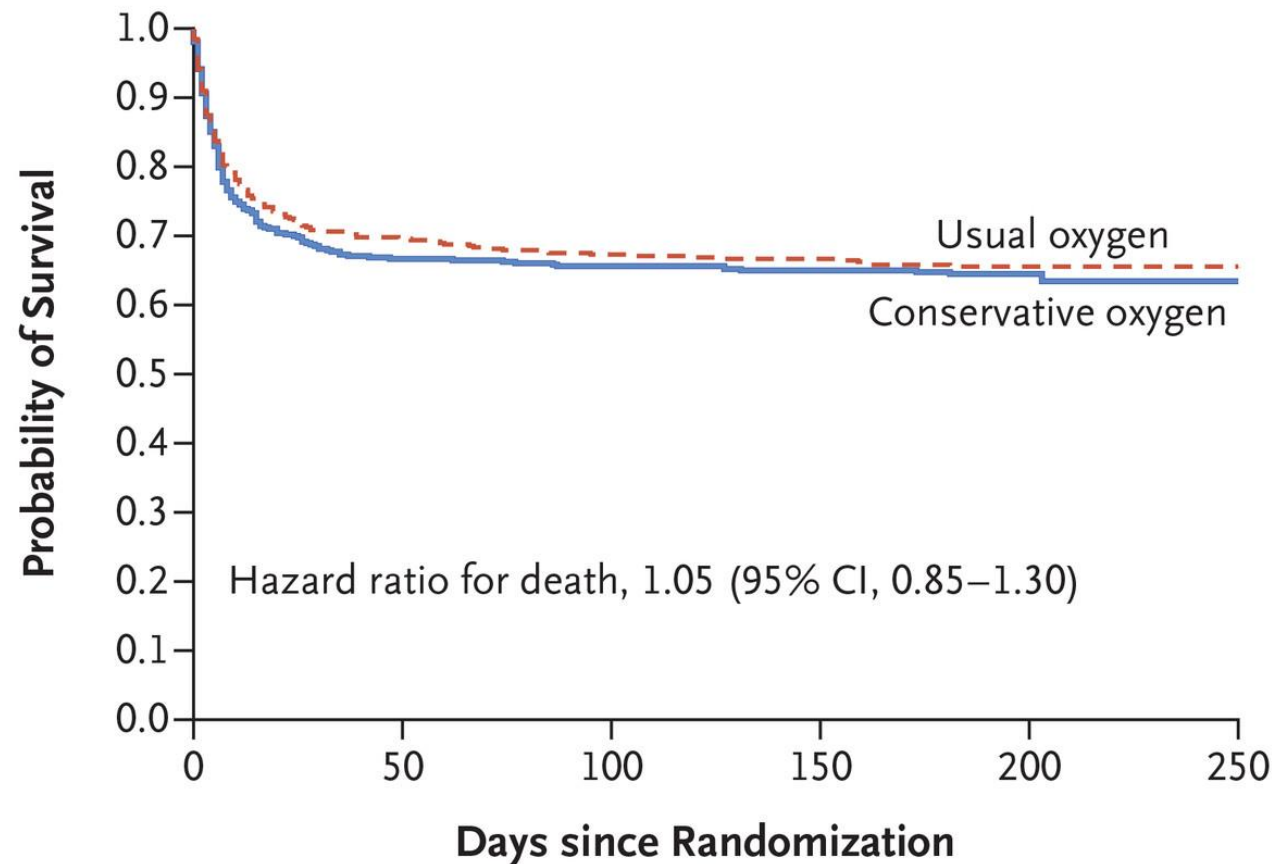
Lower Limit of SpO_2

The lower limit of SpO_2 should be determined by the treating clinician
Use a target SpO_2 of $\geq 91\%$ if no lower limit is prescribed (i.e., set the lower SpO_2 alarm at 90%)

Upper limit of SpO_2

Target range

Lower limit of SpO_2



No. at Risk

Usual oxygen	481	334	319	314	69	13
Conservative oxygen	484	319	313	310	73	11

Table 3 Relationship between median intraoperative inspiratory oxygen fraction and major postoperative complications in patients undergoing general anaesthesia. Data are reported as the median (range) or as adjusted odds ratio [95% confidence interval] with Group 1 as the reference group. *P-value of the partial correlation coefficient. FI_{O_2} , median intraoperative inspiratory oxygen fraction; ICU, intensive care unit; PCC, partial correlation coefficient

Parameter	Group 1 (n=15 150)	Group 2 (n=14 586)	Group 3 (n=18 213)	Group 4 (n=14 282)	Group 5 (n=11 691)	PCC [95% CI]/ P-value*
Median FI_{O_2}	0.31 (0.16–0.34)	0.41 (0.35–0.46)	0.52 (0.47–0.55)	0.58 (0.56–0.63)	0.79 (0.64–1.00)	
Major respiratory complications	Reference	1.14 [0.99–1.31]	1.29 [1.13–1.48]	1.38 [1.19–1.60]	1.99 [1.72–2.31]	0.05 [0.04–0.05]/ P<0.001
Pulmonary oedema	Reference	1.13 [0.96–1.34]	1.18 [1.00–1.39]	1.37 [1.15–1.64]	1.94 [1.62–2.32]	0.04 [0.03–0.05]/ P<0.001
Pneumonia	Reference	1.32 [1.02–1.73]	1.36 [1.05–1.77]	1.26 [0.95–1.67]	1.72 [1.30–2.28]	0.02 [0.01–0.03]/ P<0.001
Respiratory failure	Reference	1.07 [0.84–1.37]	1.39 [1.10–1.76]	1.53 [1.10–1.96]	2.03 [1.58–2.62]	0.03 [0.02–0.03]/ P<0.001
Re-intubation	Reference	1.10 [0.69–1.75]	1.40 [0.90–2.19]	1.73 [1.08–2.78]	2.41 [1.49–3.90]	0.01 [0.00–0.02]/ P=0.002
Wound dehiscence	Reference	1.21 [0.87–1.68]	0.91 [0.64–1.30]	0.93 [0.62–1.38]	1.12 [0.74–1.71]	–0.002 [–0.01 to 0.01]/ P=0.57
ICU admission	Reference	1.22 [1.06–1.41]	1.29 [1.12–1.49]	1.58 [1.35–1.85]	1.64 [1.38–1.95]	–0.003 [–0.01 to 0.00]/ P=0.48
Mortality within 7 days	Reference	0.68 [0.24–1.97]	0.61 [0.21–1.74]	0.63 [0.21–1.86]	2.09 [0.81–5.43]	0.008 [0.00–0.02]/ P=0.03
Mortality within 30 days	Reference	1.31 [0.86–2.00]	1.42 [0.95–2.13]	1.38 [0.90–2.10]	1.97 [1.30–2.99]	0.018 [0.01–0.03]/ P<0.001
Stroke	Reference	0.76 [0.55–1.04]	0.84 [0.60–1.16]	0.83 [0.56–1.22]	0.90 [0.59–1.37]	–0.015 [–0.02 to –0.01]/ P<0.001
Myocardial infarction	Reference	1.01 [0.68–1.77]	0.94 [0.57–1.57]	1.22 [0.71–2.08]	1.24 [0.69–2.20]	0.002 [–0.01 to 0.01]/ P=0.55
Positive troponin test	Reference	1.17 [0.77–1.77]	1.02 [0.67–1.55]	1.14 [0.73–1.78]	1.44 [0.92–2.26]	0.007 [0.00–0.01]/ P=0.05

High intraoperative inspiratory oxygen fraction and risk of major respiratory complications

OXYGEN REGULATOR MARK VIII A *

REF. NO. G6D/124

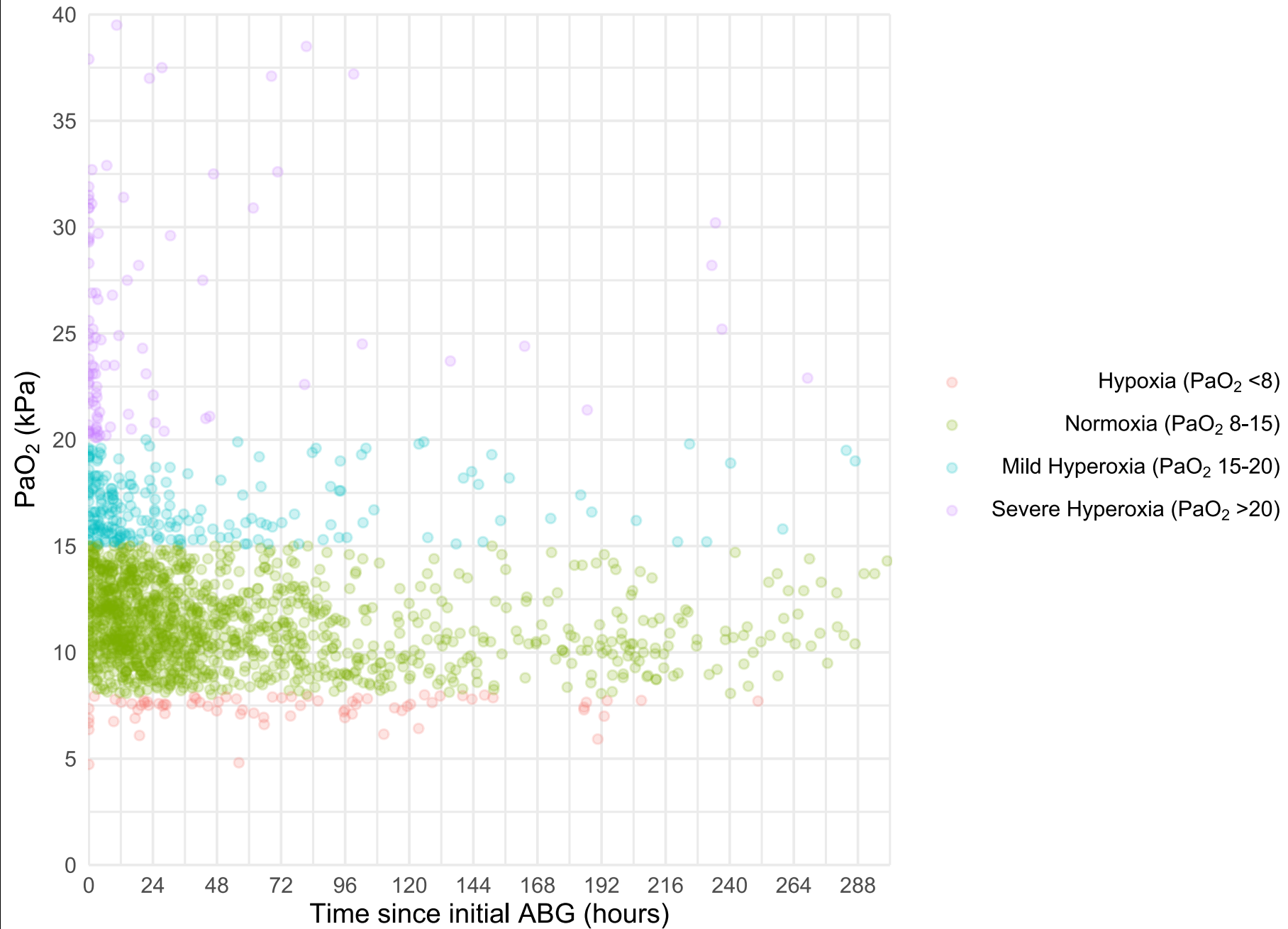
DELIVERY

OXYGEN

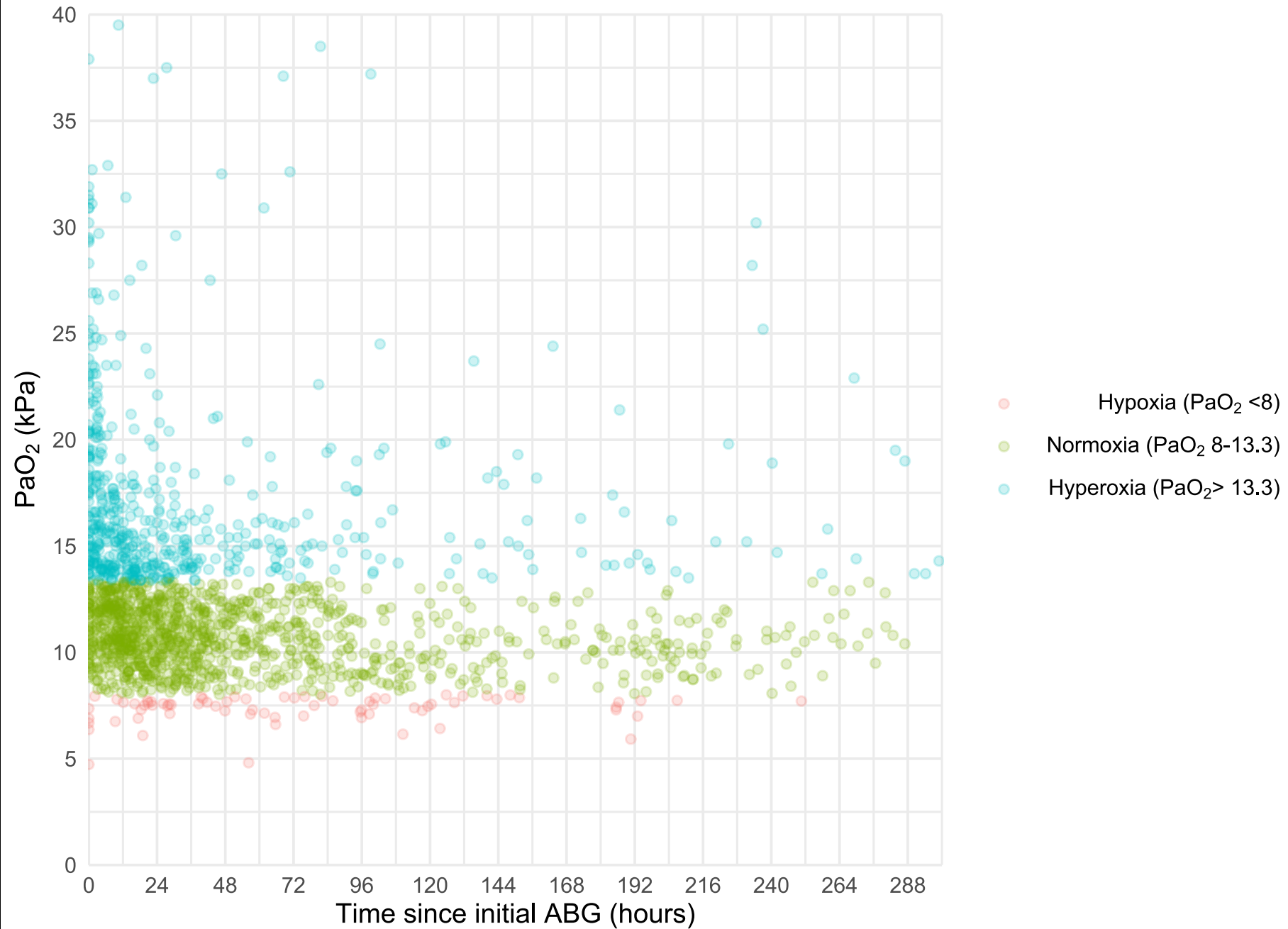
ALT THOUSANDS OF FEET. SUPPLY AVAILABLE



Measured PaO₂ after initial ITU admission



Measured PaO₂ after initial ITU admission



Take home messages..

- Perioperative and ICU Hyperoxia associated with harm
- Set a target – and review it
- SpO₂ monitoring is adequate – not all need to be subjected to ABGs
 - Arguably Oxygen not needed unless SpO₂ < 90%
 - “Routine” targets 94-98%
 - “CO₂ retainer” target 88-92%





What we need is a
Randomised Controlled....

No!....



