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OUTCOMES RESEARCH Consortium

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Perioperative Mortality

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Dylan Thomas, 1954

Time held me green and dying,

But I sang in my chains like the sea.

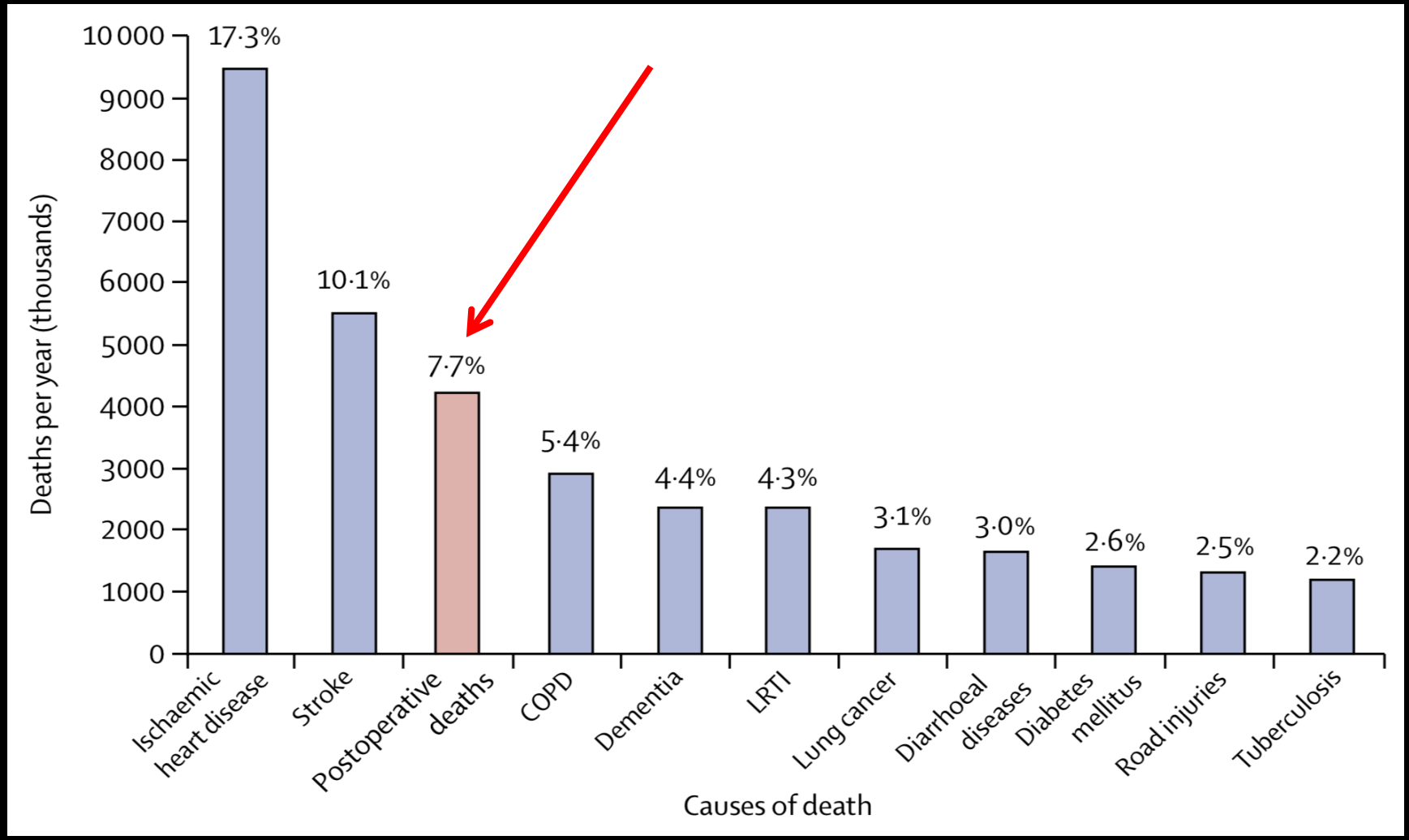
Dylan Thomas, shortly before dying

Do not go gentle into that good night,

Old age should burn and rave at close of day;

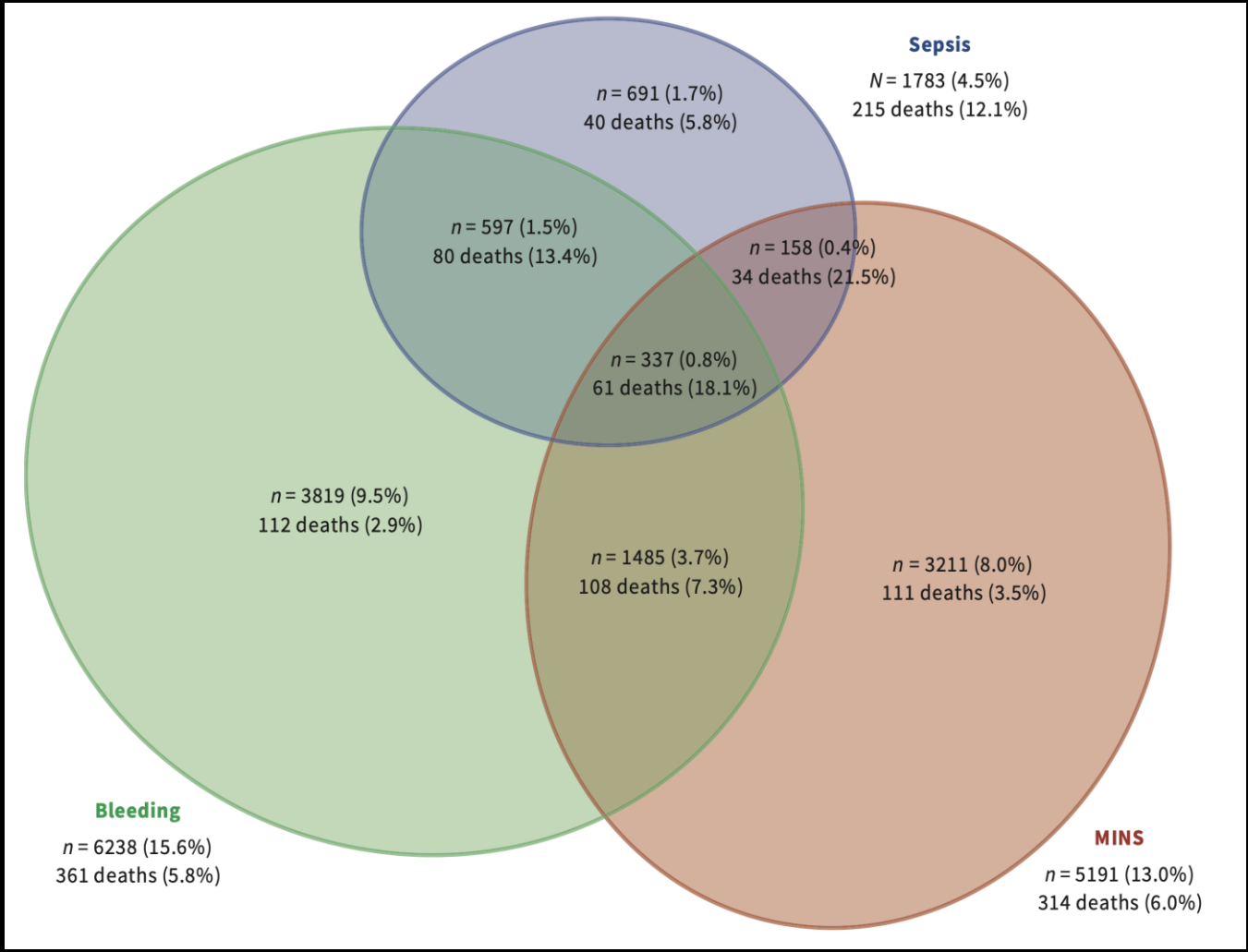
Rage, rage against the dying of the light.

30-day Postoperative Mortality



Nepogodiev, Lancet 2019

Causes of Perioperative Mortality



Attributable risk

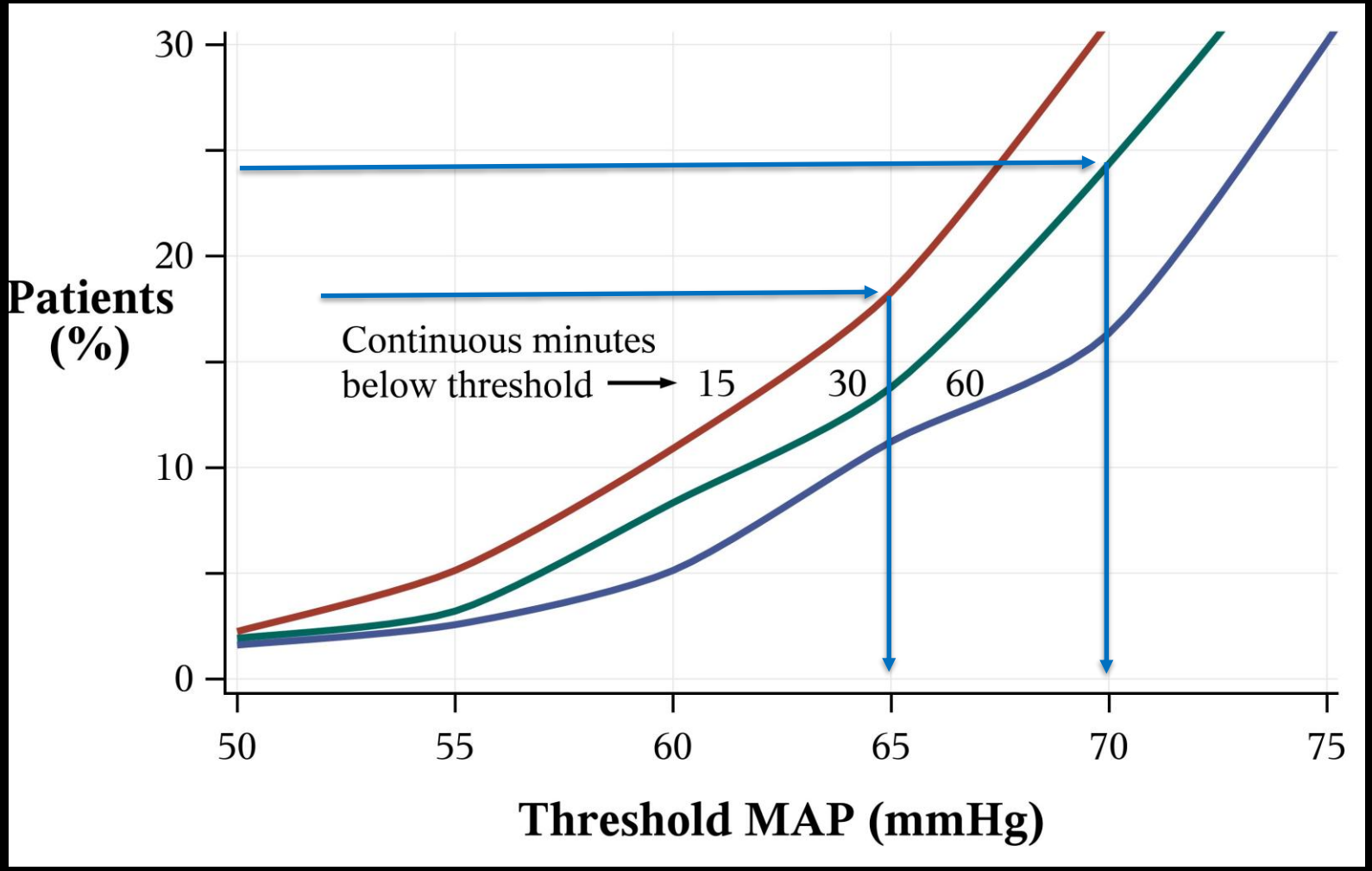
- Bleeding 17%
- Myocardial injury 16%
- Sepsis 12%

Respiratory events

- ≈45,000 US pts/yr need emergency ventilation
  - 40% lethal
- 40% of ward cardiopulmonary arrests are respiratory
  - 80% lethal
- Largely preventable

VISION Investigators CMAJ 2019

Continuous Ward MAP Monitoring (n=312)



Routine vital signs missed half the patients with MAP <65 mmHg for 15 minutes

Turan, Anesthesiology 2019

Respiratory Complications

Respiratory arrests should not kill hospitalized patients

Causes

- Obstruction
- Respiratory muscle weakness, including residual blocks
- Reduced ventilation, often from pain
- Impaired respiratory control

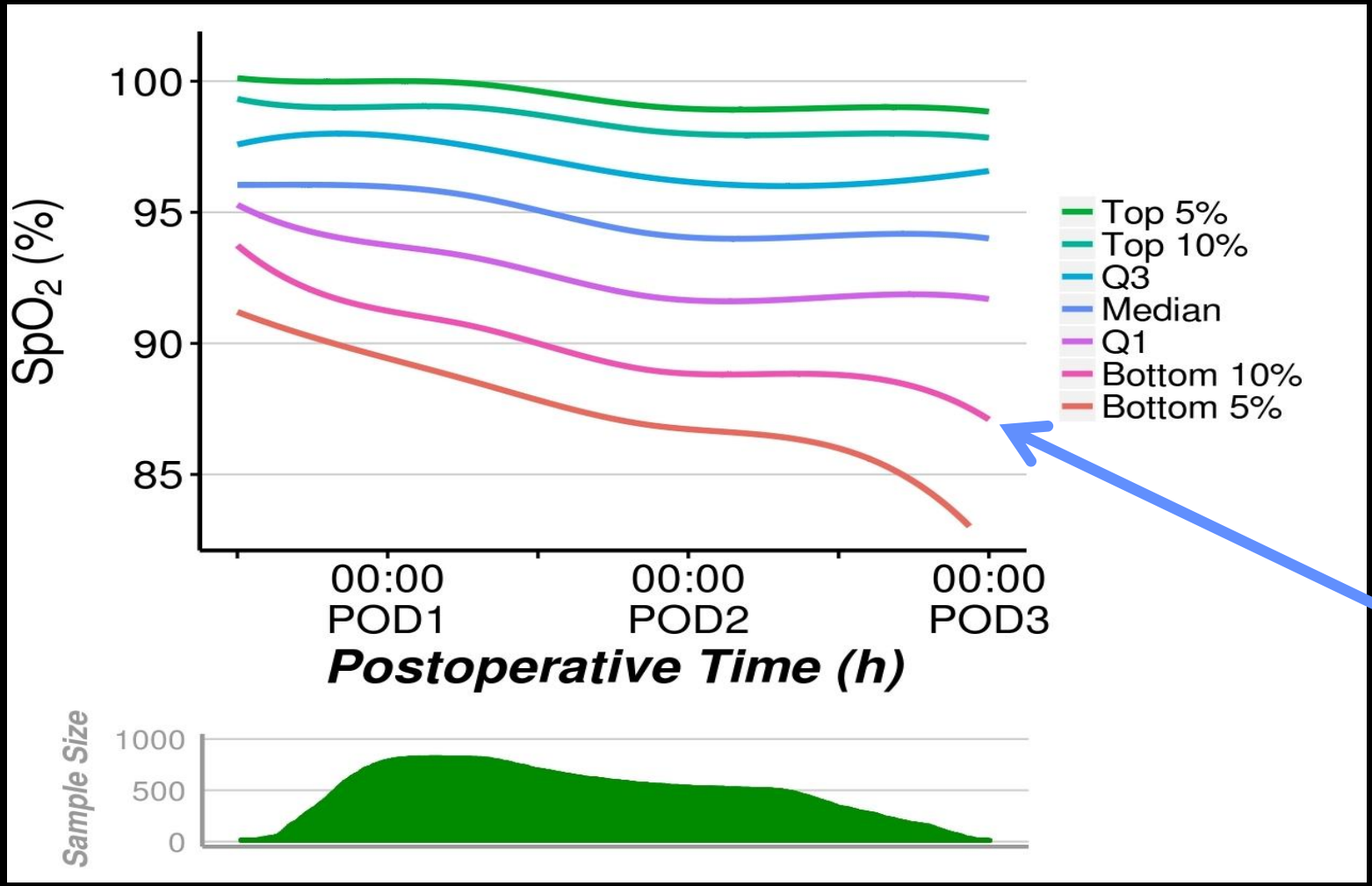
And…

Opioids & Sedatives

	Cardiac Arrest (n=96,554)	No Cardiac Arrest (n=12,180,137)	OR	95%CI
Opioids & Sedatives	41%	22%	3.47	(3.40, 3.54)
Opioids only	28%	31%	1.81	(1.77, 1.85)
Sedatives only	14%	14%	1.82	(1.78, 1.87)
Neither opioids nor sedatives	17%	33%	Ref	

Overdyk, PLoS One, 2018

Blinded Saturation Over Time



Nurses missed 90% of patients who had 1 continuous hour of saturation <90%

More than 10% of ward saturations were <90%

Sun, A&A 2015

Opioid-induced Respiratory Depression

Closed-claims analysis

- 77% of episodes = death or severe brain injury
- 88% within 24 hours of anesthesia

97% deemed preventable

- 42% within 2 hours of last nursing check

Potential causes

- Multiple prescribers
- Potentiating non-opioid sedatives

Lee *et al*, Anesthesiology 2015

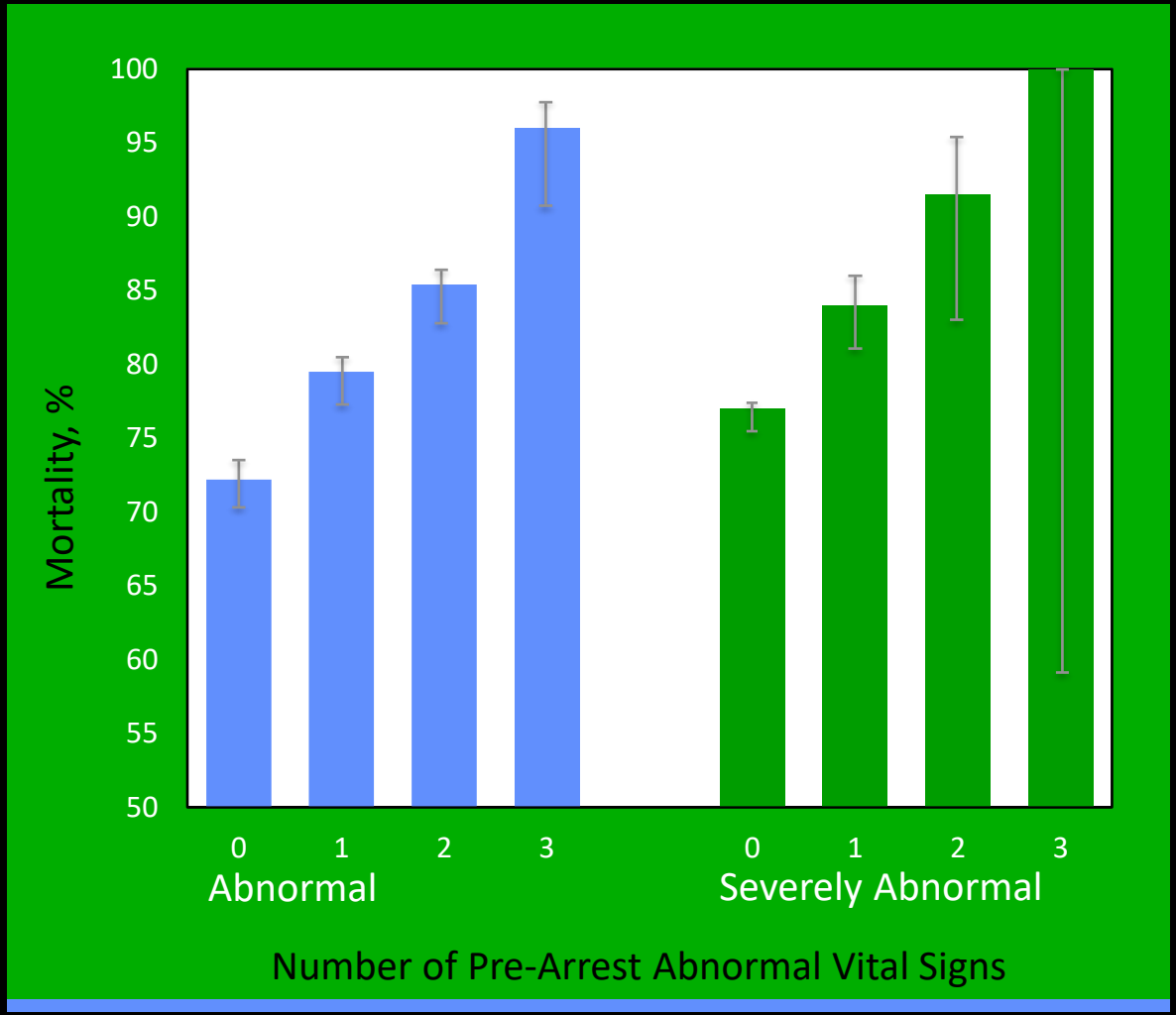
Vital Sign Monitoring

We monitor vital signs about the way we did a half-century ago

We're still stuck on "failure to rescue" rather than *preventing complications*

Continuous ward vital sign monitoring may help

Arrests Proceeded by Abnormalities



Most in-hospital cardiorespiratory arrests preceded by hours of vital sign abnormalities

Anderson, Resuscitation 2016

Dartmouth 10-year Outcomes Study

Continuous Masimo surveillance monitoring of general ward patients (n=111,488)

No OIRD deaths among continuously monitored patients

One OIRD-related death among patient for whom continuous monitoring was available but not used

Continuous SpO2 monitoring reduced death rate from baseline of 19.73 per 100,000 patients (p=0.03)

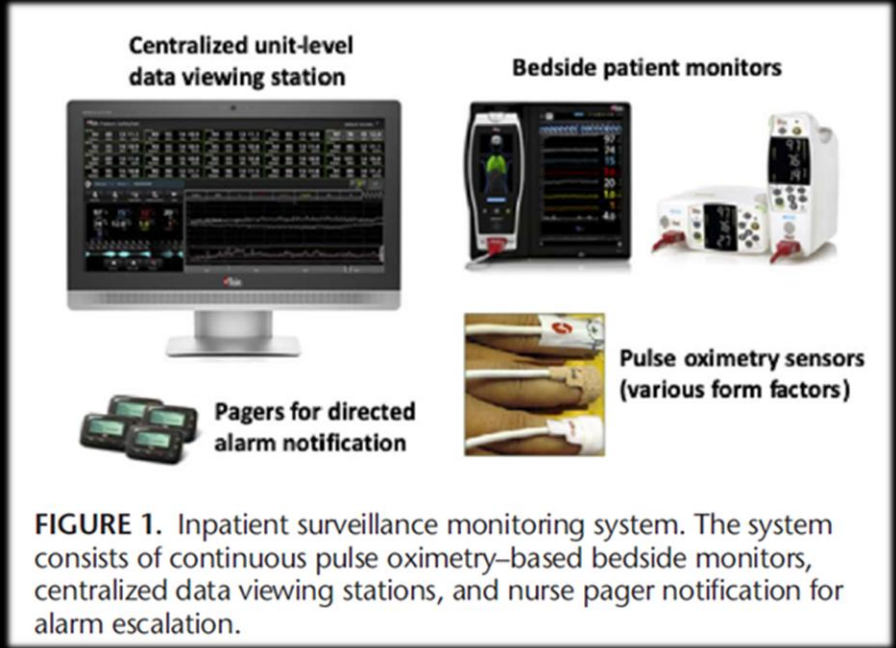


FIGURE 1. Inpatient surveillance monitoring system. The system consists of continuous pulse oximetry–based bedside monitors, centralized data viewing stations, and nurse pager notification for alarm escalation.

McGrath, J Patient Safety 2021

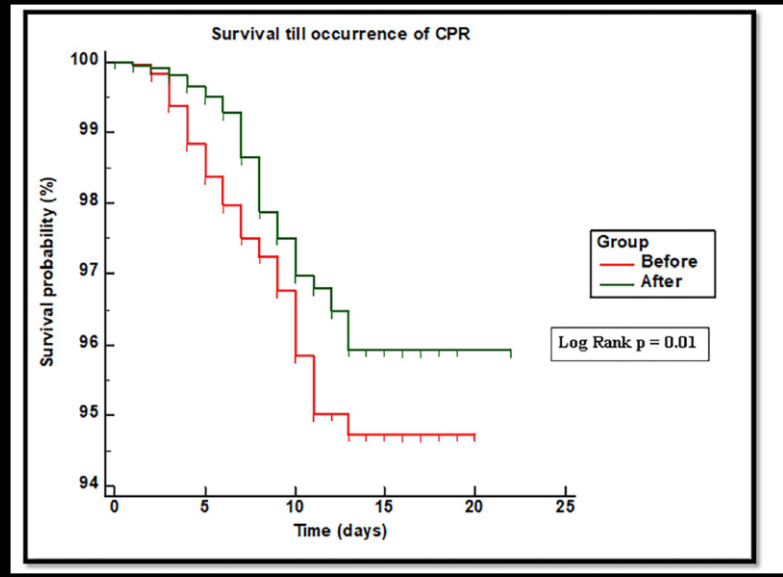
Continuous Ward Monitoring Helps

'Before and After" 8-month comparative outcomes study

Continuous SpO_2 monitoring using Masimo SET with Patient SafetyNet

King Saud Medical City - 1,200 bed hospital

	Before Patient SafetyNet™	After Patient SafetyNet™	P value
CPR Event Rate	3.3%	1.95%	0.01
CPR Success	38.5%	59.5%	0.04
Length of Stay	8.7 ± 3.4 days	8.3 ± 3 days	0.001
Mortality	**5.45%**	**4%**	**0.04**



↓ **Mortality**
↓ **CPR events**
↑ **CPR success**
↓ **Length of stay**

Balshi, PLOS ONE 2022

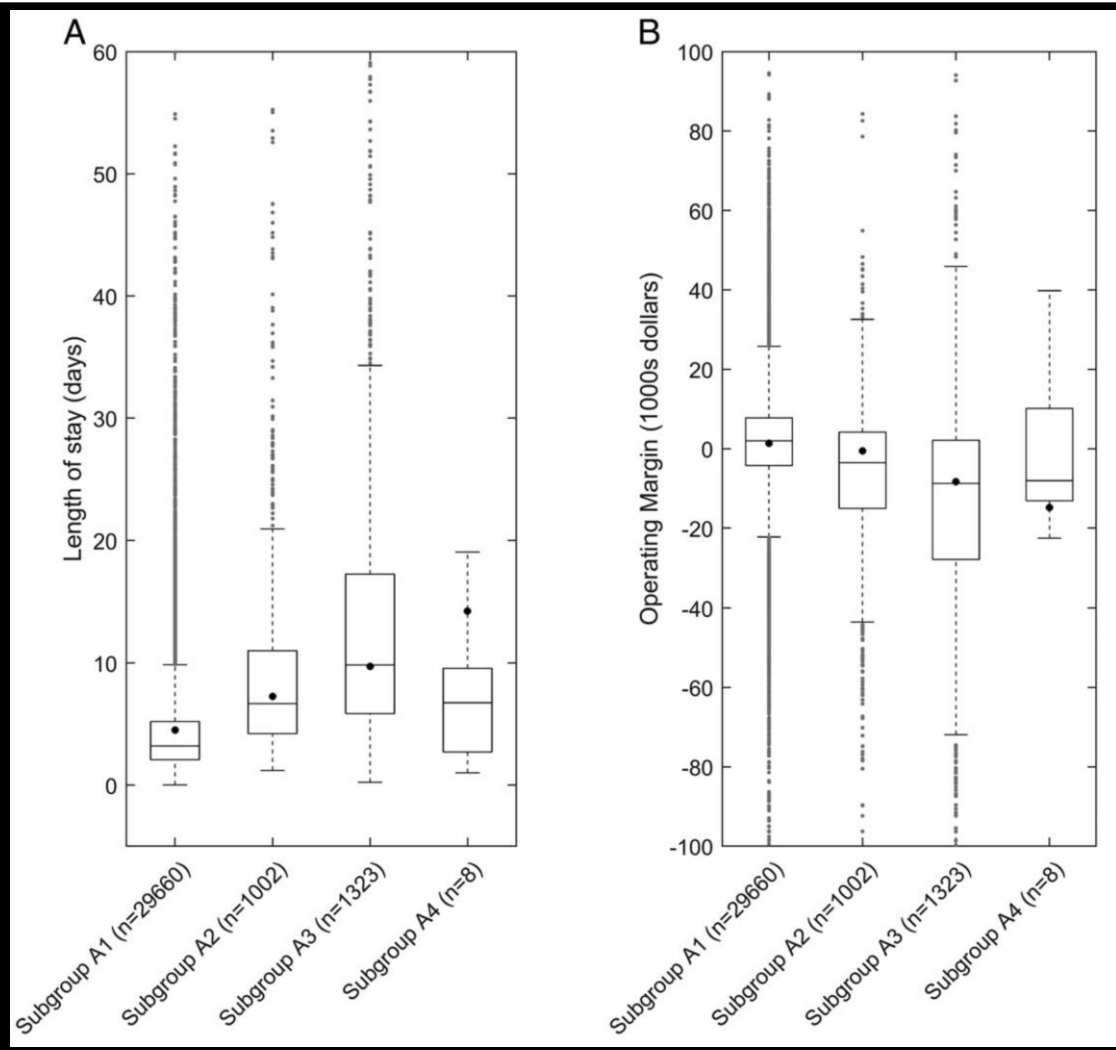
Impact to Cost of Care

Dartmouth clinical outcome study using Masimo SET with Patient SafetyNet

Cost-of-care analysis of 31,993 ward patients admitted July 2016 – Dec 2019

Operating margin savings of $5,500 per patient rescue prevented and $10,700 per patient for rescue/care transfer prevented

Significant operating margin savings



Blike, J Patient Safety 2025

CONSTANT Trial: Methods

500 Patients recovering from major noncardiac surgery

Intermittent postop nursing vital signs per routine

Continuous vital sign monitoring for 48 hours

- Radius PPG and Patient SafetyNet

Randomization

- Blinded continuous vital sign monitoring
- Unblinded continuous vital sign monitoring with nurse alerts

Investigator-initiated, Masimo-funded

CONSTANT Trial: Primary Hypothesis

Unblinded continuous ward monitoring reduces a composite of areas exceeding the thresholds of desaturation (<85%), bradypnea (<5 breaths/min), tachypnea (>25 breaths/min), tachycardia (heart rate >130 beats/min), bradycardia (heart rate <35 beats/min), mean arterial pressure (MAP) <65 mmHg, and MAP >145 mmHg during the initial 48 postoperative hours after major non-cardiac surgery.

CONSTANT Trial: Secondary Hypothesis

Unblinded continuous ward monitoring increases a composite of clinical *interventions* for desaturation, hypoventilation, tachypnea, tachycardia, bradycardia, and hypotension within 48 hours after major non-cardiac surgery.

Summary: Postop Mortality is Preventable

Postoperative deaths are world's 3rd leading cause of death

Major causes are cardiovascular and respiratory events

- Preceded by vital sign abnormalities
- Most are missed with conventional 4-hour vital sign monitoring

Continuous ward monitoring is likely to:

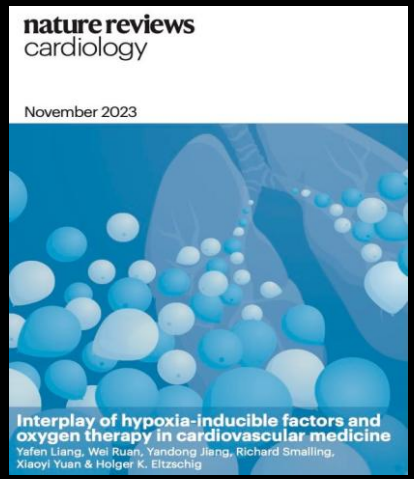
- Identify vital sign abnormalities in real time
- Provoke salutatory clinical responses
- Reduce the incidence and severity of critical events

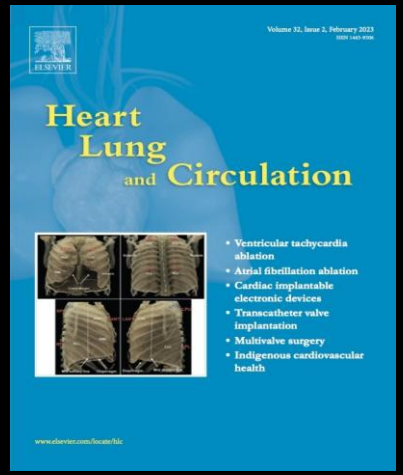
Triple win for patients, hospitals and payors

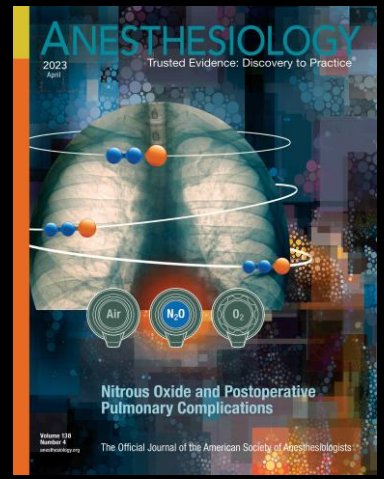
We can make a difference!

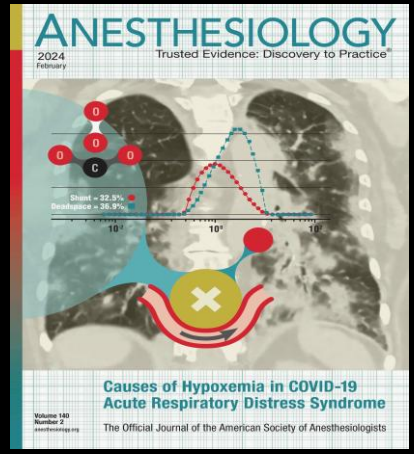

Carpe diem

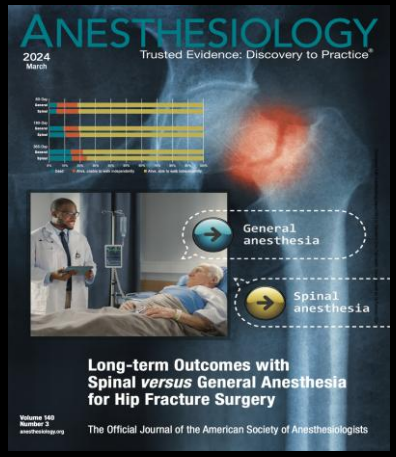
And that's all folks…

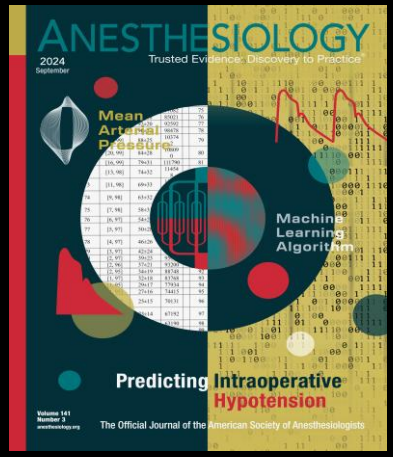


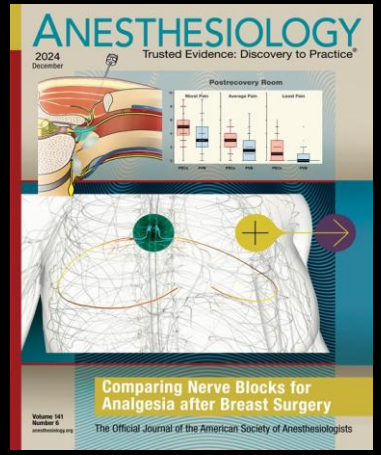


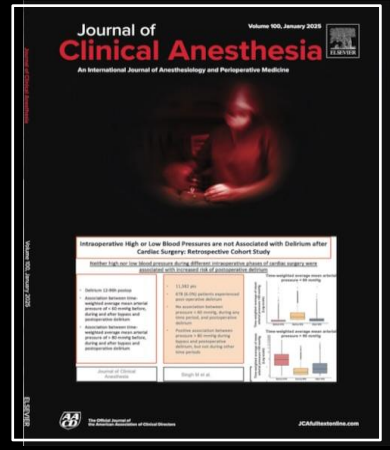












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