

Optimal Partial Oxygen Pressure in Patients Receiving Mechanical Ventilation



Mechanical ventilation is an intervention used worldwide in intensive care, with most patients also receiving supplemental oxygen. Determining the optimal arterial oxygen target (PaO_2) is essential, as both hypoxaemia and hyperoxaemia carry risks.

A recent review examines these risks and provides evidence-based guidance on appropriate oxygen targets for mechanically ventilated critically ill patients.

Mild to moderate reductions in PaO_2 are common in respiratory illness, but aggressively correcting hypoxaemia can cause harm from high FiO_2 or elevated PEEP. This has led to the concept of permissive hypoxaemia, where lower-than-normal oxygen levels are accepted to avoid complications, similar to permissive hypercapnia, though with more immediate risks. Hypoxaemia triggers compensatory increases in cardiac output, raising oxygen demand, and can affect physiology by increasing respiratory workload, accelerating catabolism, impairing neurological function, and suppressing immunity. Hypoxaemia does not always equal hypoxia, as tissues may still receive adequate oxygen, as seen in high-altitude studies.

While SpO_2 of 100% may seem reassuring, it often reflects dangerously high PaO_2 . Hyperoxaemia is linked to microcirculatory dysfunction, lung toxicity, reduced coronary blood flow, and myocardial metabolic disruption, largely due to excess reactive oxygen species causing oxidative stress, inflammation, and tissue injury. Experimental and clinical studies show worse neurological outcomes, higher mortality after cardiac arrest, and increased death in septic shock patients exposed to hyperoxia. Unlike hypoxaemia, hyperoxia has no natural physiological role, making excessive oxygen harmful, though moderate supplementation may be appropriate in select cases.

Both hypoxaemia and hyperoxaemia are harmful, and evidence suggests that extreme PaO_2 levels worsen outcomes across conditions such as cardiac arrest, sepsis, brain injury, and critical illness. This has led to trials comparing conservative oxygen therapy with conventional liberal strategies. Some studies, like the Oxygen-ICU trial, showed lower mortality with conservative targets, while many others found no significant differences. Results appear mixed, with possible disease-specific effects: lower oxygen targets may benefit brain injury, while higher targets may help in sepsis. Large ongoing trials, including the 40,000-patient mega-ROX study, aim to clarify optimal oxygen ranges for different critical care populations.

Current evidence supports maintaining PaO_2 near physiological levels and avoiding extremes, with SpO_2 around 95% for most ICU patients. Small deviations in oxygen levels are unlikely to affect outcomes significantly. Future advances, including tissue oxygenation monitoring and AI-based analyses, may help identify patient-specific targets, moving toward personalised oxygen therapy in critical care.

Source: [Journal of Translational Critical Care Medicine](#)

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