Inpatient Notes: Rethinking Oxygen Therapy for Hospitalized Patients

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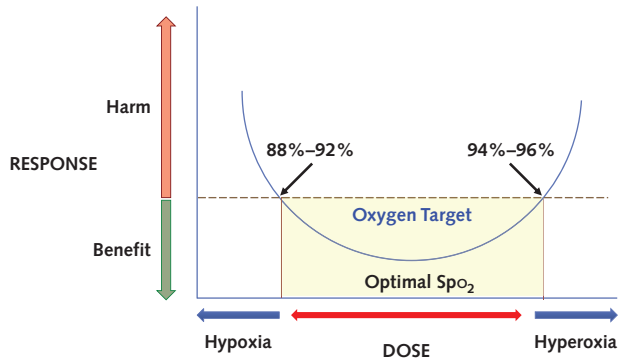
Oxygen therapy has been a critical life-saving measure since its first use for pneumonia in the 19th century. With its widespread use in contemporary medicine came the notion that supplemental oxygen is harmless, and that it may even be beneficial in nonhypoxemic patients. Over time, this conviction has become ingrained in clinical practice and the medical training of health care providers. Indeed, the classic mantra taught for any acutely ill patient is, "ABC IV O_2 Monitor."

Among acutely ill patients, supplemental oxygen is one of the most commonly prescribed therapies; at least 25% of patients in emergency departments and 15% of admitted patients are exposed (1). These statistics likely reflect the rationale behind oxygen use in acutely ill patients: Oxygen can be life-saving, so more is better. However, new evidence challenges this notion.

In fact, inhalation of supraphysiologic concentrations of oxygen can be harmful. In contrast to hypoxia, humans have no evolutionary adaptation to hyperoxia. Consequently, there are several proposed harmful mechanisms of oxygen toxicity, including vasoconstrictive effects on the coronary, cerebral, and systemic vasculature, as well as generation of oxygen free radicals in various organs (1). Hyperoxia causes atelectasis (by alveolar nitrogen washout), direct lung damage, and inflammation (for example, tracheobronchitis) and also decreases cardiac output. Altogether, treatment with an excessive FIO_2 may lead to paradoxical tissue hypoxia (for example, shock or myocardial infarction) due to poor perfusion. In clinical practice, liberal oxygen therapy may also delay recognition of clinical deterioration in patients because of falsely reassuring oxygen saturation (SpO_2) values.

The IOTA (Improving Oxygen Therapy in Acute illness) systematic review and meta-analysis addresses optimal use of oxygen therapy in clinical practice. In total, 25 randomized controlled trials (RCTs) that included more than 16 000 patients compared liberal and conservative oxygen strategies in acutely ill adults with sepsis, critical illness, stroke, trauma, myocardial infarction, cardiac arrest, or emergency surgery (2). Liberal oxygen use increased in-hospital mortality by approximately 20% (relative risk, 1.21 [95% CI, 1.03 to 1.43]), translating to a number needed to harm of 71. The findings were consistent across populations (sepsis, critical care, cardiac, neurologic), interventions (nasal cannula, facemasks, invasive ventilation), and outcomes (in-hospital, 30-day, and individual patient–level survival analyses to about 1 year). These data are also consistent with an RCT that compared use of high-dose oxygen therapy versus lower doses (with titration to an SpO_2 level of 88% to 92%) for suspected chronic obstructive pulmonary disease exacerbation (3). Given the ubiquitous use of oxygen in hospital settings, these findings have significant implications.

Figure. A paradigm shift in use of supplemental oxygen therapy for acutely ill patients in the hospital.



Improving outcomes in acutely ill patients requires avoiding both hyperoxia (discontinuing oxygen therapy at an SpO_2 level of 94% to 96%) and hypoxia (considering initiation of oxygen therapy at an SpO_2 level of 88% to 92%). Ongoing trials aim to identify the optimal lower threshold of SpO_2 at which to start oxygen therapy. SpO_2 = oxygen saturation.

The results from IOTA informed a clinical practice guideline on oxygen therapy for acutely ill medical patients (4). The panel issued a strong recommendation for an upper limit of 96% for SpO_2 values. For patients with acute stroke or myocardial infarction, the panel issued a strong recommendation to avoid supplemental oxygen if SpO_2 levels are greater than 92% on room air and a weak recommendation to avoid oxygen therapy for SpO_2 levels of 90% to 92% (4). These new recommendations challenge the way oxygen therapy is often used in practice.

Oxygen therapy is also commonly provided as a comfort measure, even when the patient is not hypoxemic. However, supplemental analyses of IOTA showed that oxygen treatment did not significantly improve angina or reduce the need for rescue nitroglycerin in patients with myocardial infarction (4). In addition, other RCTs have failed to demonstrate any benefit of oxygen therapy versus breathing room air for patients with refractory dyspnea (5). Therefore, clinicians should avoid administering oxygen solely for comfort.

There are clinical scenarios where supplemental oxygen is indicated regardless of hypoxemia, such as in the treatment of pneumothorax, decompression sickness, carbon monoxide poisoning, and sickle cell crisis. Nevertheless, IOTA's findings should prompt all health care professionals—from frontline providers to hospital administrators and policymakers—to rethink the optimal use of oxygen therapy.

Hospitalists are well positioned to challenge the status quo on the use of supplemental oxygen. They can promote the understanding that there is an optimal SpO_2 target range (**Figure**) and that hyperoxia—similar

to hypoxia—can be life-threatening. This should be reflected in clinical practice by actively titrating the inhaled oxygen concentration to the lowest effective level, especially when the SpO_2 level is 96% or higher.

At the systems level, this is an opportunity for hospitals to implement safe prescribing measures for oxygen, similar to other prescribed medications. One such example would be for all admission order sets to include statements about safe use of oxygen, such as, "Do not initiate oxygen therapy if the SpO_2 is greater than 92%; use the minimum FIO_2 to maintain an SpO_2 of 90% to 96%; reduce the FIO_2 when the SpO_2 is greater than 96%."

It is time for a paradigm shift in oxygen therapy. It will take multidisciplinary efforts from physicians, nurses, allied health professionals, and policymakers to ensure that we appropriately administer this life-saving but potentially toxic therapy.

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