Editor's Commentary

We begin the year 2013 with the proceedings of the 50th RESPIRATORY CARE Journal Conference. It is fitting that the topic of oxygen was selected for the 50th conference, as there is probably no other subject as fundamental and important for the readers of RESPIRATORY CARE. We are grateful to John Heffner and Richard Branson for co-chairing this conference.

The history of oxygen is described by Heffner. Within a relatively short period, early investigators not only discovered oxygen but also recognized its importance to life and its role in respiration. The use of oxygen to treat chronic lung disease, however, took several centuries. It took bold clinicians to pursue oxygen as a therapeutic option for patients with chronic lung disease due to 20th century concerns about oxygen toxicity. Application of ambulatory oxygen devices allowed investigations of the long-term effects of continuous oxygen that established its safety and efficacy.

Owens addresses the issue of supplemental oxygen during sleep. The physiologic changes that occur in ventilation with sleep contribute to nocturnal oxygen desaturation in patients with lung disease. Nocturnal supplemental oxygen is often used as therapy, although convincing data exist only for those who are hypoxemic both during sleep and awake. If used, oxygen should be dosed as needed, and patients should be monitored for hypercapnia. Obstructive sleep apnea may overlap with lung disease and may have important consequences. Patients with overlap syndromes are candidates for noninvasive ventilation during sleep.

Ambulatory home oxygen is addressed by Criner. Oxygen has been prescribed to millions of patients with COPD in the home setting. It is also commonly prescribed for chronic hypoxemic respiratory failure not due to COPD, or in patients with hypoxemia at hospital discharge. Despite the importance of long-term oxygen therapy (LTOT), there are many gaps in our current knowledge regarding the mechanisms of action of LTOT, indications for prescription, and its effects on important patient outcomes.

As discussed by McCoy, home oxygen therapy equipment options have increased over the past several decades. The majority of published studies of the value of LTOT have been based on continuous-flow delivery of oxygen. New standards are required to address the need to have consistent titration of LTOT to meet the patient's home needs at all activity levels. Consistent labeling of metering devices on home oxygen equipment needs to be developed by medical societies, to be implemented by standards organizations that direct industrial manufacturers.

Branson and Johannigman address the topic of pre-hospital oxygen therapy. Oxygen use in prehospital care is aimed at treating or preventing hypoxemia. However, hyperoxia can adversely impact outcome. The unique environment of prehospital care poses logistical and educational challenges related to oxygen delivery. Oxygen therapy in prehospital care should be provided to patients with hypoxemia and titrated to achieve normoxemia.

As discussed by Kallet and Matthay, prolonged breathing of very high F_{IO_2} causes severe hyperoxic acute lung injury (HALI). The severity of HALI is related to P_{aO_2} and exposure duration. Clinically, the risk of HALI may occur when F_{IO_2} exceeds 0.7, and may become problematic when F_{IO_2} exceeds 0.8 for an extended period of time. Patients with very severe ARDS requiring hyperoxic therapy are at substantial risk for developing HALI, therefore justifying the use of adjunctive therapies to reduce F_{IO_2}.

The nasal cannula is a commonly used interface to provide supplemental oxygen. As addressed by Jeff Ward, the nasal cannula has also been successfully used in adults, children, and neonates. In the early 21st century, high-flow nasal cannula (HFNC) oxygen therapy with heated humidification was introduced at flows for adults in the 15 - 40 L/min range, with F_{IO_2} titrated using air/O_2 blending. Clinical observations report greater patient acceptance and comfort versus oxygen masks. HFNC therapy is also used in perinatal care in settings similar to the application of nasal CPAP.

As presented by MacIntyre, strategies to support oxygenation can cause substantial harm through lung stretch injury, oxygen toxicity, transfusion risks, and cardiac over-stimulation. We can learn much about hypoxic compensatory mechanisms from the fetus and from high altitude residents. In order to reduce iatrogenic harm, it may be important for clinicians to become comfortable with permissive hypoxemia. We also need to identify better ways of monitoring tissue oxygenation in critical tissues.

In the premature infant, the goal of F_{IO_2} control is to maintain adequate oxygenation and to minimize hypoxemia and hyperoxemia. In the adult the primary goal is to avoid hypoxemia. There are growing concerns related to unnecessarily high F_{IO_2} levels that increase the exposure to hyperoxemia and excessive oxygen use in settings where resources are limited. As described by Claure and Bancalari, systems for automated closed loop control of F_{IO_2} have been developed for use in neonates and adults.

Brain tissue oxygenation monitoring has been shown to provide prognostic information, as indicated by poor prognosis associated with low brain tissue oxygen values. Various physiologic manipulations, including increasing the P_{aO_2}, have been associated with an increase in brain tissue oxygenation. As described by Martini et al, however, whether or not brain-oxygenation-guided therapy results in improvement in outcomes is debatable. Data from high quality randomized trials are necessary to determine if brain-oxygenation-guided therapy is beneficial.

Blakeman and Branson address the subject of oxygen supplies in disaster management. Planning for oxygen needs following a disaster still presents a substantial challenge, but alternate care facilities have proven to be valuable in relieving pressure from the mass influx of patients into hospitals, especially for those on home oxygen who only require an electrical source to power their oxygen concentrators.

Kevin Ward and colleagues describe chemical oxygen generation. While promising, the routine use of chemically produced oxygen continues to pose significant engineering and physiologic challenges.

Pierson provides a personal perspective of oxygen in respiratory care, based on his 40 years of clinical experience. P_{aO_2} has become the gold standard for clinically assessing oxygenation in the body. Pulse oximetry is commonly used as an adjunct to P_{aO_2}. Despite the desirability of measuring tissue oxygenation directly, no such measure has emerged that is both reliable and clinically relevant. It is now commonly accepted that LTOT improves survival in appropriately selected patients with COPD. The goals of normalizing arterial oxygenation with high tidal volumes and lung-distending pressures in patients with ARDS have required modification as appreciation for ventilator-related lung injury has emerged. High concentrations of inspired oxygen may play a role in such injury, but aggressive measures to reduce F_{IO_2} in order to avoid oxygen toxicity have been tempered in the era of lung-protective ventilation.