# LungfitPH Nitric Oxide Delivery System

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## Device

The Lungfit PH is a system that delivers nitric oxide, generated by ionized room air, to a neonate through the breathing circuit of a ventilator.[1] According to the manufacturer, the Lungfit has two ionizers (main and backup) that generate inhaled nitric oxide (iNO) regardless of dose or flow, can deliver continuous iNO through both the main line and bagging system, and has a "comprehensive monitoring system" with high and low alarms.[1] The system functions by flowing room air through a chamber that ionizes nitrogen and oxygen (with 60 Watts power). The molecules recombine as nitric oxide (NO) with low levels of nitrogen dioxide ($NO_2$), as a byproduct, which is removed from the circuit via a "smart filter".[1] Benefits listed by the manufacturer include the ability to deliver iNO within one minute of powering up, an auto-purge feature, accurate "real-time" measures of gas flow in the circuit, the removal of $NO_2$ via filtration, and the elimination of the need for canisters.[1]

## Actions for Consideration

**Partner:** Identify respiratory therapists, physicians, nurses, and the appropriate clinical and non-clinical value analysis team members to assess implementation of this technology. There may be reimbursement considerations with iNO therapy. Connect with your specialist as needed.

**Connect**: Leverage the supplier to assist with education on use and care of product. Collecting and reviewing data including outcomes and clinician/end user feedback will help inform management of these products. Identify and review evidence related to this specific product.

**Communicate:** Provide education on the product and share utilization with team to develop a common goal. Robust data sharing will not only enhance discussions, but may lead to actionable conversations between peers.

**HealthTrust Resources**: Access the Clinical Knowledge Insights Library to find other relevant documents and toolkits with actionable information. Examples for this product include resources on product conversion, value analysis, and clinical trials.[2] Network on HealthTrust Huddle, our member community that shares ideas and seeks guidance from colleagues.[3]

## Professional Society Statements and Clinical Practice Guidelines

The American Association for Respiratory Care published (2010) *Evidence-Based Clinical Practice Guideline: Inhaled Nitric Oxide for Neonates With Acute Hypoxic Respiratory Failure* found here.[4]

The American Heart Association and the American Thoracic Society published (2015) *Pediatric Pulmonary Hypertension: Guidelines From the American Heart Association and American Thoracic Society* that include recommendations for the use of iNO in the treatment of term and pre-term neonates. Found here.[5]

The American College of Critical Care Medicine published (2017) *Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock* which include recommendations on the use of iNO as a "first treatment" for persistent pulmonary hypertension therapy. Found here.[6]

## FDA Approval

Lungfit has an FDA premarket approval (PMA number P200044) and is intended to[7]:

> "…deliver NO, a vasodilator, generated by the device into the inspiratory limb of the patient breathing circuit of a ventilator in a way that provides a constant concentration of NO, as set

by the user, to the patient throughout the inspired breath."[7]

"…provide continuous integrated monitoring of inspired oxygen ($O_2$), $NO_2$, and NO, and a comprehensive alarm system.[7]

"… include an integrated backup NO delivery system that is a completely independent backup NO generating system; it has its own NO generator and gas flow delivery system. The backup flow is delivered at 1 L/min at 220ppm NO to either a ventilator circuit or to a bagging system, depending upon the user selected setting.[7]

"… improve oxygenation and reduce the need for extracorporeal membrane oxygenation in term and near-term (>34 weeks gestation) neonates with hypoxic respiratory failure associated with clinical or echocardiographic evidence of pulmonary hypertension in conjunction with ventilatory support and other appropriate agents."[7]

## Clinical Evidence

There are limited studies specific to electrically generated NO from air; however, there are numerous studies on the use of NO in the treatment of term or near-term infants. Samples of both are provided below.

- A 2021 review by Gianni et al. compared systems that generate and administer NO. They discussed benefits of canister therapy as being safe, reliable, and able to deliver a wide range of NO concentrations by changing flow from the cylinder. They listed disadvantages of canister therapy as the expense, the need for trained personnel to connect cylinders, and extensive supply chain inventory management and storage. Benefits of electricity generated NO, per this article, are the opportunity to generate NO from air without the need for expensive and bulky gas cylinders and potential for widely available NO in "underrepresented" regions. Limitations included potential safety risk if malfunction of filters for toxic byproducts and potential limitation of use with high minute volume ventilators if the NO production is dependent on steady air flow through chamber.[8]
- A 2017 meta-analysis by Barrington et al. included 17 randomized controlled studies of iNO in term and near-term infants with hypoxemia. The authors concluded that "…iNO has been established as effective therapy for near-term and term infants with hypoxic respiratory failure unresponsive to other therapy, with the possible exclusion of infants with congenital diaphragmatic hernia." Limitations included variability of bias in included studies and variability of other therapies in included studies.[9]
- A 2019 meta- analysis by Wang et al. included nine randomized controlled trials comparing death rates and use of ECMO in infants born at or near term treated with iNO versus control (no gas or placebo). They concluded that the group treated with iNO had a "significantly lower death or use of ECMO than the control group" and a "significantly higher change in PaO after treatment ".[10] Limitations included low sample size for the PaO2 group, two different interventions in the control groups, and variation in dosing of iNO.[10]

## Clinical Advisory Board Insight

Members of the HealthTrust respiratory therapy and perinatal committees provided the following insights into this category:

- Benefits may include tankless system, eliminating gas waste and potential for exposure, efficient operation, less bulk, faster delivery of iNO, more precise delivery, no purging required, continuous availability of iNO, and ease of use.
- Limitations and/or safety considerations may include equipment failure, availability of transport, availability of non-invasive attachments, MRI compatibility, and newness to the market.
- Consider trialing in focused NICU

## Summary

Careful review and understanding of interest, patient needs, cost, and product attributes will help determine direction and potential opportunity. Share data and evidence to engage clinicians and therapists. When considering a change of product ensure physicians are included in the discussion, that evidence and pricing are shared, and appropriate support is provided from the supplier.

## References

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