

Increasing access to oxygen therapy

Accelerating the development of a low-cost, robust, and scalable oxygen concentrator to increase access to oxygen therapy in low-resource settings

THE NEED FOR OXYGEN

Hypoxemia has a high risk of mortality in children under five years of age with pneumonia and requires treatment with lifesaving oxygen. However, oxygen is not always available or accessible, and many health facilities in low-resource settings (LRS) are faced with insufficient supply. Across 22 low- and middle-income countries, 55% of health facilities have unreliable or no access to oxygen and 41% have intermittent or no electricity available.¹

Oxygen concentrators are medical devices that supply oxygen at the point of care. Compared to oxygen cylinders, concentrators are more cost effective, easy to use, and reliable.



Oxygen cylinders (left) and an oxygen concentrator used to treat patients in a health facility in Bihar, India (right). Photo credit: PATH.

THE PROBLEM

Despite the unique benefits of oxygen concentrators, many fail or are underutilized in hospitals in LRS. This is largely due to power outages, voltage spikes, lack of spare parts, and preventative maintenance issues that are frequent in low-level facilities. To address this, from 2014 to 2016 PATH set out to understand the technical requirements for a more appropriate, robust, and scalable oxygen concentrator.

OUR SOLUTION

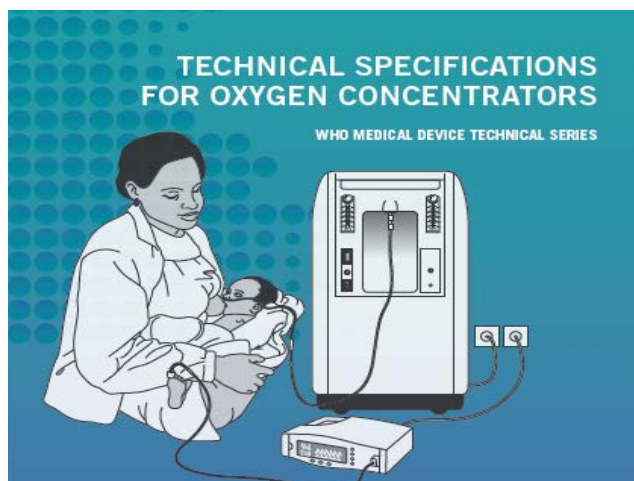
Increased knowledge on product specifications for procurement of oxygen concentrators: PATH convened an Expert Advisory Group on oxygen concentrators² to understand device failure modes and achieve consensus on how to improve their availability in LRS. They recognized that existing concentrators are suitable for many facilities, but further innovation is needed to increase coverage in more remote facilities with gaps in electricity and maintenance services. PATH initiated and facilitated the development and global dissemination of the World Health Organization's *Technical Specifications for Oxygen Concentrators*³ and target product profile⁴ to promote the availability, accessibility, appropriateness, and affordability of oxygen concentrators.

Increased awareness of oxygen as a public health issue and coordination of global suppliers and purchasers: PATH convened a consultation with manufacturers,⁵ distributors, and global/national organizations to understand and identify potential solutions to address market entry barriers in LRS. Manufacturers are interested in expanding into LRS markets; however, greater information and reduced risk is needed for new players.

Explored and incubated ideas for product innovation: Oxygen supply technologies can be improved in a number of ways, from optimizing device components, to consolidating high-efficiency methods into a singular platform, to innovating pediatric-compatible accessories. PATH conducted extensive engineering, regulatory landscapes, and value cost modeling to assess various design concepts. Among the published findings are a technology landscape of oxygen concentrators⁶ and manuscripts on oxygen conservation via reservoir cannulas⁷ and titration.⁸

Provided analysis and recommendations to address gaps in policy, market, and technology: PATH is increasing the availability of essential oxygen technologies in a dynamic effort across our diverse areas of expertise—as a research and product development organization, as an implementer and advocate, and as a trusted advisor to country

governments and multilateral institutions. We pursued opportunities to raise awareness and understanding of the key procurement decision criteria among stakeholders in Uttar Pradesh and Bihar, two highest-burden child pneumonia states in India. And we continue to work on global-level normative policy change, shaping markets in target countries to better integrate oxygen technologies, and increasing understanding of the access issue and solutions among decision-makers, health care providers, suppliers, and advocates.



World Health Organization technical specifications for oxygen concentrators. Also available in French and Spanish.

REMAINING GAPS AND RECOMMENDATIONS

- **Lack of availability of pulse oximeters in facilities:** Appropriate technical and product selection guidance is needed for manufacturers and procurement agencies.
- **Lack of coordinated use of pulse oximetry and oxygen:** Global and national treatment guidelines are available, but targeted efforts are needed to improve training and utilization of pulse oximeters among health care providers.
- **Lack of systems and resources to ensure appropriate use and biomedical equipment maintenance:** Trained technicians, device warranties, and service components are essential to ensuring long-term operation of medical equipment.
- **Existing oxygen technologies are inadequate for facilities with harsh environmental and power conditions:** Frequent voltage fluctuations can cause mass equipment failure, leading to downtime and gaps in treatment.

OPPORTUNITIES FOR FUTURE WORK

To date, the design and performance inputs from our project have helped catalyze partnerships for innovation and global action. We are now seeking to identify funding to support continuation of this important work to expand access to high-quality, reliable oxygen technologies in LRS.

A source of funding and new collaboration opportunities will enable us to conduct the following activities:

- Facilitate the establishment of technical specifications for oxygen devices such as pulse oximeters.
- Advance the development of improved and easy-to-maintain oxygen concentrators and pulse oximetry, with product attributes that are acceptable to users and suitable for use in LRS.
- Provide technical assistance to ensure robustness against poor electricity quality and hot and humid environments.
- Demonstrate usability, feasibility, and acceptability through field testing and stakeholder feedback.
- Identify technical processes and training components necessary to achieve successful adoption and use.
- Partner with industry on technology scale-up through pilot batch production and introduction.

PROJECT INQUIRIES

For more information on this project, please contact:

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