Development of a reliable, robust, and scalable oxygen concentrator for low-resource settings

Accelerating access to oxygen therapy for infants and children

HEALTH NEED

Hypoxemia, or low blood oxygen saturation, has a high risk of mortality and is a major fatal complication of a number of serious conditions contributing to the global burden of maternal, infant, and child mortality.[1] Hypoxemia is a predictor of severe disease and is a major risk factor for death in pneumonia, the leading infectious cause of death in children under 5 years of age worldwide. In 2013, pneumonia killed 935,000 children, accounting for more childhood deaths than HIV/AIDS and malaria combined.[2] Although oxygen is included in the World Health Organization (WHO) list of essential medicines, it is still not widely available in developing-countries—a great danger to seriously ill patients. Having a reliable oxygen supply and device for measuring oxygen saturation is necessary to treat patients with hypoxemia and to improve their probability of survival.

Photo credit: David Jacobs

INNOVATIVE SOLUTIONS

Oxygen concentrators are a suitable, cost-effective, and favorable option for providing an uninterruptible supply of oxygen for the treatment of hypoxemia in developing-country settings. They have numerous advantages, including sustainability and low-cost, compared to oxygen cylinders and piped oxygen supply systems. Oxygen concentrators are self-contained, electrically powered medical devices that produce oxygen by the absorption of nitrogen from ambient air. They are designed for continuous operation and can produce oxygen 24 hours per day, seven days per week, for up to five years or more with minimal preventive maintenance. However, the reliable operation of currently available oxygen concentrators is limited in low-resource settings that are characterized by intermittent and poor-quality power, a lack of access to replacement parts, and an absence of trained maintenance personnel. Our approach is to support the development of appropriate and reliable oxygen concentrators and encourage the use of associated pulse oximetry devices to increase oxygen delivery and utilization in low-resource settings. With funding from the Bill & Melinda Gates Foundation, PATH aims to determine the set of necessary technical inputs to accelerate the development and utilization of reliable, robust, and scalable oxygen concentrator systems that are appropriate for use in low-resource settings.

Setup of a pulse oximeter, oxygen concentrator, and connections to the patient. Image credit: PATH.

PROJECT OBJECTIVES

PATH recognizes the need for appropriate, safe, and reliable pulse oximetry and oxygen concentrator systems for

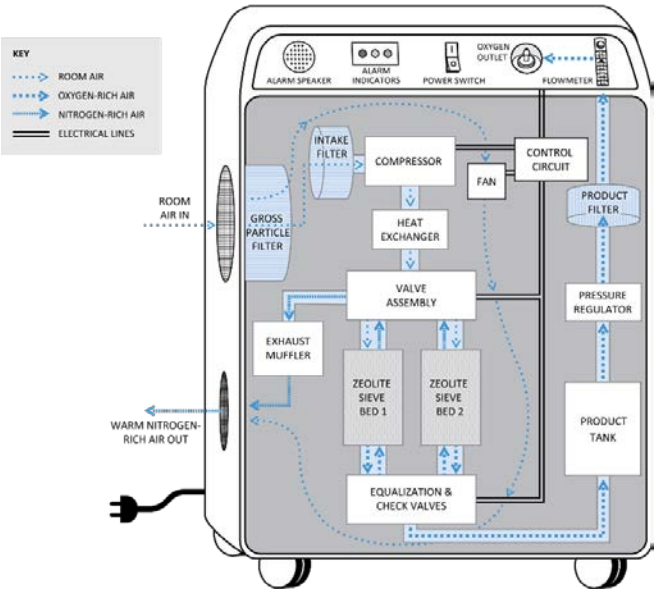
the treatment of hypoxemia in low-resource settings, as well as recent technological advances in the industry that could be leveraged to develop suitable products. PATH is therefore mobilizing relevant knowledge leaders, technical advisors, clinicians, engineers, researchers, innovators, and manufacturers in an effort to increase the availability, management, and quality of oxygen delivery in low-resource settings, and ultimately, to improve health outcomes.

CURRENT STATUS AND RESULTS

In collaboration with WHO and with critical input from a consortium of expert advisors, PATH is facilitating the development and publication of WHO medical device technical specifications to define the key performance requirements for oxygen concentrators that are designed to handle the challenging hot, humid, and dusty operating environments frequently encountered in low-resource settings. This document is intended to provide guidance to technical health workers regarding the selection, procurement, and maintenance of high-quality oxygen concentrators that are appropriate for health facilities in low-resource settings with relatively reliable access to power and regular maintenance.

Additionally, to define the key specifications for the development of oxygen concentrator systems that are suitable for health facilities characterized by unreliable power and a lack of access to maintenance infrastructure, PATH conducted an engineering analysis to assess improvement strategies, alternative sources of power, and means by which to make the devices more robust while minimizing the maintenance requirements. Based on our findings and collective input from a broad range of stakeholders around the world, PATH has developed a target product profile, which includes design recommendations that have the greatest potential to address the root causes of underutilization and failure in low-resource settings.

With the goal of creating a sustainable, market-based solution, PATH is also undertaking several initial market research activities. These include conducting key stakeholder interviews and in-country facility visits to understand relevant policy and procurement practices, current oxygen availability and utilization, the market for oxygen concentrators in developing countries, the value of such devices to programmatic and procurement decision-makers, and potential solutions to mitigate barriers to uptake. The results of this work will inform future programmatic interventions and market-shaping activities, as well as portray the business opportunity for manufacturers and distributors.



Process flow and components of an oxygen concentrator. Image credit: PATH

PATH is currently seeking input from developers interested in manufacturing appropriate pulse oximetry and oxygen concentrator systems that are designed to overcome the challenges of operating in developing countries.

PROJECT INQUIRES

For more information on this project, contact:

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REFERENCES

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2. World Health Organization (WHO) and The United Nations Children's Fund (UNICEF). *Ending Preventable Child Deaths from Pneumonia and Diarrhoea by 2025. The Integrated Global Action Plan for Pneumonia and Diarrhoea*. Geneva and New York: WHO and UNICEF; 2013.

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PATH is the leader in global health innovation. An international nonprofit organization, we save lives and improve health, especially among women and children. We accelerate innovation across five platforms—vaccines, drugs, diagnostics, devices, and system and service innovations—that harness our entrepreneurial insight, scientific and public health expertise, and passion for health equity. By mobilizing partners around the world, we take innovation to scale, working alongside countries primarily in Africa and Asia to tackle their greatest health needs. Together, we deliver measurable results that disrupt the cycle of poor health. Learn more at www.path.org.

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