

Improving access to oxygen therapy in countries struggling with the COVID pandemic

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A device that helps desperately sick patients breathe and costs just £150 (\$212) to manufacture could revolutionize access to life-saving care in low to middle income countries.

It has been designed to provide therapeutic oxygen support to patients severely ill with COVID 19, pneumonia or other forms of respiratory distress, and was developed by a team of scientists and clinicians from the University of Leeds, Leeds Teaching Hospitals NHS Trust and Bradford Teaching Hospitals NHS Foundation Trust using the principles of "frugal engineering."

Stripped of unnecessary functionality, the [device](#) has been made to function in lower-resourced healthcare settings, where there is a critical shortage of equipment to support patients' breathing.

Known as the Leeds LeVe, it delivers a form of oxygen therapy known as CPAP or continuous positive airway pressure. Recent scientific reports have shown that CPAP can help save the lives of patients moderately or severely ill with COVID 19.

Dr. Tom Lawton, consultant in critical care and anesthesia at Bradford and a member of the research team, said: "CPAP has become one of the mainstays of respiratory treatment of COVID-19 during the pandemic, but can be oxygen-intensive which is an issue in low-income settings or

where [health systems](#) become overwhelmed.

"Low-resource devices like this have already saved many lives in the pandemic and making them available across the world at low cost has the potential to save more, both in COVID-19 and potentially other respiratory diseases too."

The LeVe system has been designed to make efficient use of scarce oxygen supplies.

Low-cost technology

The Leeds system is remarkably simple. It is made up of an oxygen mask, tubing, filter and a small electric fan blower that can generate a flow of air at a raised pressure. Oxygen is added either from a cylinder or oxygen concentrator, a machine the size of a suitcase that takes in air, removes the nitrogen—and pumps out an oxygen supply.

A patient receives the air and oxygen mix at a slightly raised pressure, to keep their airway open and lungs oxygenated. Conventional breathing support systems cost from around £800 to £30,000-plus for the mechanical ventilators found in intensive care units. Those costs and the way oxygen supplies are configured in many clinics and hospitals in poorer health economies have resulted in a dire shortage of life-support equipment.

Dr. Pete Culmer, associate professor in the school of mechanical engineering at the University of Leeds, from the project's engineering team said: "The pandemic is highlighting the devastating shortage of medical equipment that can help people breathe. This project has brought together a team of doctors, scientists and engineers, from the UK and Uganda, to develop a simplified, easy-to-maintain device.

"Our hope is that the device will revolutionize the care that can be offered to people in low to middle income countries who are experiencing respiratory distress."

Patient Trial

The prototype device has passed safety tests following a trial on healthy volunteers. A patient trial involving people with breathing difficulties is planned to start shortly at the Mengo Hospital, a not-for-profit health institution in Kampala, Uganda.

Dr. Edith Namulema, an Epidemiologist leading the clinical trial, said: "Since the outbreak of the COVID 19 epidemic, the demand for oxygen is quite high. Looking at the available infrastructure at Mengo Hospital, for every 20 patients requiring extensive [oxygen](#) needs, only three access it.

"The situation is worse in the lower-level health centers where none of the patients that visit these facilities can access these services."

The trial will evaluate whether the device is as clinically effective as other CPAP breathing aids.

Professor Nikil Kapur, from the School of Mechanical Engineering at the University of Leeds who has led the project, said: "Designing equipment that remains sustainable over the long term is vital. As well as providing for patients now, we want equipment that will continue to support patients in the future. This includes considering the training of healthcare professionals and the long-term maintenance of technology.

"We are working with colleagues from these settings to ensure we are meeting these requirements."

Prof. David Brettle, chief scientific officer at Leeds Hospitals NHS Trust, said: "The LeVe CPAP device is the culmination of a fantastic collaboration between academia and health in direct response to the COVID pandemic. In the UK we often take for granted access to the necessary health technology, but even relatively simple technology is often not available in low-and middle-income countries.

"This new development should help to level the playing field in this respect, not just for COVID but for other respiratory conditions, helping to improve care world-wide and ultimately saving lives."

A preprint scientific paper describing the engineering principles of the device and its evaluation has been published online on the *MedRxiv* website. As a preprint, it has not yet been subject to peer review.

More information: P. Culmer et al, The LeVe CPAP System for oxygen-efficient CPAP respiratory support: Development and pilot evaluation, (2021). [DOI: 10.1101/2021.05.24.21256987](https://doi.org/10.1101/2021.05.24.21256987)

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