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How covid-19 revealed the scandal of medical oxygen supplies worldwide

Medical oxygen's role has been highlighted during the pandemic. Higher income countries have solved their supply problems but the situation elsewhere remains dire, Jane Feinmann reports

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It became known locally as "the massacre": the day in August 2017 when the medical oxygen supply was shut down over unpaid bills in a hospital in one of the poorest areas in Uttar Pradesh, north India.

As the tanks emptied, relatives of patients described being handed small rubber bags, mouthpiece attached, and told to pump oxygen into their children's mouths to keep them alive for as long as they could. One father later told how he watched his baby daughter suffer as he made her breathe during her last minutes. Another described how he stopped pumping after nearly four hours, surrounded by growing numbers of dead and dying infants. By the following day, 63 children had died.

The event is a reminder that India's fatal shortage of medical oxygen during the current covid-19 outbreak is far from a one off tragedy. Lack of access to oxygen is the key factor in 1.4 million annual deaths from pneumonia in children under 5[1] and a million neonatal deaths in scores of low and middle income countries.[2]

It's taken the covid-19 pandemic for the therapeutic value of supplemental oxygen[3] and its status as a finite resource to be recognised.

For all the talk about global health, priorities are decided in higher income countries, says economic anthropologist Felix Stein. He coauthored a paper, published in *BMJ Global Health* in June 2020, drawing attention to the "shortages of oxygen, shortages of equipment, as well as lack of training to support the correct and optimal use of oxygen therapy" throughout sub-Saharan Africa.[4] In 2018, only one in 10 children with pneumonia in Nigeria received the oxygen they needed, it said.

Anthony Fauci, director of the US National Institute of Allergy and Infectious Diseases told a Clinton Health webinar in March 2021 that he had only recently become "fully aware of the importance and the critical shortage of oxygen."[5] "I've been practising medicine now for 40 years and the thought of a shortage of oxygen never really crossed my mind until all of a sudden it hit me right in the face when we were seeing shortages here in the US," he said.

Jeremy Farrar, director of the Wellcome Trust and a member of the UK government's Scientific Advisory Group for Emergencies, told *The BMJ* in February that, "Oxygen will save more lives in 2021 than vaccines, yet supplies to many countries are precarious."[9]

"Miracle" treatments starved of oxygen

Medical oxygen is on tap in high income countries, delivered as a liquid by tanker, stored in giant containers on hospital grounds, and piped directly to patients' beds. Any patient at risk of hypoxaemia is monitored using pulse oximeters, whether they are undergoing surgery, giving birth, or being treated for trauma, heart failure, asthma, or pneumonia. Those with low oxygen saturation levels receive supplementary oxygen as easily as being handed a glass of water.

This accessibility means its role as an essential medicine has been easy to forget, with interventions such as mechanical ventilation widely seen as more important. In fact, supplemental oxygen is needed in 41% of patients admitted to hospital with covid-19 compared with only 2% who need mechanical ventilation. Further, ventilation—which, like the drug dexamethasone, is one of the few treatments for covid-19 patients—is only effective with a medical oxygen supply

In low and middle countries, medical oxygen is frequently unavailable and when it is the cost can be extortionate. Compressed gas cylinders are largely sold by multinational companies and "tend to be at least five times more expensive by volume than in Europe and North America," according to an April 2020 report by the Bureau of Investigative Journalism, which also reported allegations of profiteering and commercial barriers to competition.[6]

Leith Greenslade, an activist from the coalition Every Breath Counts, a public-private partnership aiming to end pneumonia deaths by 2030, says that some companies have stepped up production, working with governments to ship emergency oxygen to countries that run out. But, she says, there are also reports of hospitals in Africa paying $20 000 (£14 385; €16 673) a month just for oxygen and of individual families paying exorbitant prices to buy oxygen cylinders privately to treat their members. In India, where families are desperately searching for oxygen for critically ill covid-19 patients, black marketing of oxygen cylinders is rife. At the end of April, the Delhi High Court warned that oxygen cylinders are being sold for 100 000 rupees (£975; €1125; $1355) in the capital.[7]

Says Greenslade, "You can imagine how desperate that situation can be for a family, when one of their members has been admitted to hospital and they've had to find the oxygen to help keep them alive and come up with these huge amounts of money."

Reasons for optimism

As of February 2021 the World Health Organization and partners had distributed over 30 000 concentrators, portable suitcase sized machines that convert ambient air into oxygen and can be used in place of cylinders. They have been sent to 121 countries, including 37 whose health systems are classified as "fragile."[8]

At that time, oxygen therapy was added to the Access to Covid-19 Tools Accelerator—a global partnership led by WHO to accelerate development, production, and equitable access to covid-19 tests, treatments, and vaccines. The partnership aims to deliver treatment courses in the year ahead, with the launch of a Covid-19 Oxygen Emergency Taskforce bringing together WHO with organisations such as Unitaid, PATH, and Wellcome. The private sector will play a key role. "Medical oxygen, whether in liquid or gas form, is produced by private companies, not governments," says Greenslade, who is a member of the WHO taskforce.

A total of $1.6bn-3.6bn will be needed, according to an estimate from the health innovation group PATH. This is based on the daily oxygen need of covid-19 cases reported in 20 low and middle income countries where almost half of all hospitals have an inconsistent supply of medical oxygen or lack it entirely.[9]

But questions remain. Some national oxygen plans led by the private sector, such as in Kenya, insist that 99.95% concentrated oxygen be used for patients with covid-19. But WHO defines medical oxygen as anything above 82%[10]; in other words, a lower purity at a lower cost is good enough.

The difference is more about commercial interests than clinical care, and makes little difference to actual treatment, says Hamish Graham, a paediatrician at University College Hospital, Ibadan, Nigeria. "For patient use, we always rely on medical oxygen mixing with air before it reaches the lungs because otherwise it is toxic," he points out.

"If you start with 99% oxygen and mix it with two parts air, you end up with around 47% oxygen reaching the lungs. If you start with 85% you end up with around 42% oxygen. So it makes no difference to us as clinicians," he says, adding that 99% purity oxygen requires cryogenic plans that are big and expensive, and more usually found in mining and big industry.

Beyond covid-19

According to WHO, more than half a million people in low and middle income countries need an extra 1.1 million cylinders of oxygen a day because of the pandemic. But oxygen on its own is not enough, say experts.

The shortage of medical oxygen is more than just access to it, according to Francisca Mutapi, professor of immunology and infection research at the University of Edinburgh, who helped plan Zimbabwe's oxygen provision. "It includes operational aspects such as delayed delivery and limited storage capabilities, as well as maintenance of equipment and infrastructure such as electricity supply," she told *The BMJ*.

In Somalia—which has the highest under-5 and newborn mortality in the world, with more than 60 000 children dying every year—oxygen is largely available from private suppliers charging around $100 a cylinder. WHO is already helping to implement a permanent solution by setting up locally sited oxygen plants with generators funded by the EU and the World Bank. Solar energy could further bring down the cost.

"Oxygen is a smart investment. If we invest now it will help in the future," Shajib Hossain from the WHO office in Somalia said in June 2020.[11] It's a message that India—with an active covid-19 caseload of over 2.8 million and around 3000 deaths daily at the time of writing—is now taking seriously. In October 2020, eight months into the pandemic, the country's Central Medical Services commissioned 162 medical oxygen generation plants costing 2bn rupees. So far only 33 have been installed, the rest "railroaded due to apathy" according to a media investigation by *Scroll*.[12] A further 551 smaller plants for government hospitals have been approved with orders to review planning and implementation on a daily basis[13]—providing a light at the end of a dark tunnel.

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