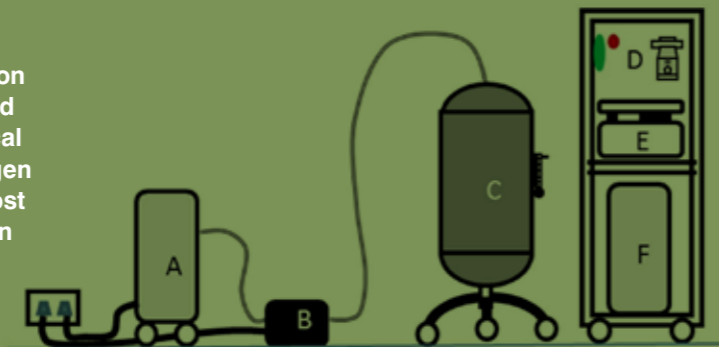


Innovation award-winning oxygen reservoir

A unique system for storing oxygen from an oxygen concentrator has won first prize in this year's AAGBI Award for Innovation in Anaesthesia, Critical Care and Pain. The Diamedica Oxygen Reservoir System provides a low-cost solution to back up oxygen supply in low resource settings and remote locations, where oxygen is often scarce.



A	Oxygen concentrator
B	Diamedica reservoir pump
C	Diamedica reservoir vessel
D	Anaesthetic workstation
E	Anaesthetic ventilator
F	Integral oxygen concentrator

The oxygen reservoir was submitted to the innovation awards as it is the first commercially available device to effectively capture and store oxygen from a concentrator at safe pressures for use in hospitals. Diamedica are delighted that the AAGBI has recognised the reservoir system's importance and its potential to make medical oxygen universally available.

Most hospitals in low resource settings do not have a reliable oxygen supply. Piped oxygen is a rarity and oxygen cylinders are expensive, difficult to transport, and run out. Domiciliary oxygen concentrators are widely used as a low-cost source of oxygen, but they depend on electrical power that is notoriously unreliable in low resource settings. One approach is to provide electrical backup systems to overcome the electrical power failures, but this can be expensive and cumbersome. The novel Diamedica technology enables the storage of oxygen which has been generated by a concentrator when electricity is available. Thus essential oxygen is always available, even during subsequent power cuts.

The system consists of two elements: a compressor and a storage vessel. The compressor pump takes oxygen produced by the concentrator and pressurises it to 5 bar. The compressed oxygen is then stored in an aluminium reservoir vessel. The reservoir vessel is on wheels so it is easily moved around the operating theatre and to the bedside.

Oxygen supply in anaesthesia

This versatile system is designed to store oxygen in vessels at a pressure of 5 bar which is adequate to drive a suitable ventilator (Diamedica Helix Ventilator) or anaesthesia machine (Glostavent Helix). The storage of oxygen at these lower pressures does not require sophisticated and complex technology, at the same time the lower pressures ensure the safety of the system for use in a hospital environment.

The stored oxygen can be used for both draw-over and continuous flow anaesthesia, but it should be recognised that a continuous flow machine is likely to use 6 to 8 times the flow rate required by a draw-over machine, and would therefore require the storage of much greater quantities of oxygen to give reasonable backup times. Work is ongoing to enable this. Oxygen stored in the reservoir vessels can also be used for direct supply to patients during power cuts or when all the oxygen concentrators are already in use with other patients.

The cost effectiveness of this approach can be illustrated by considering that oxygen per litre generated from concentrators may be as little as 1% of the cost of oxygen provided in cylinders. Generating oxygen at the point of use eliminates the problems of transport and, with the possibility of storing that oxygen in multiple vessels, the approach has great potential for cost savings as well as security of supply.

Feedback

This original concept and design of the oxygen reservoir system was first described in *Anaesthesia News* in 2015 [1], since when it has successfully transitioned into wider production and is now in use in 14 countries where supplies of medical oxygen are limited. Feedback has been very positive as the following examples illustrate.



Kenya

A reservoir system supplied with a low pressure/low flow Glostavent Helix anaesthesia machine has made a considerable impact at a low cost day care surgery centre in Nyeri, Kenya. According to surgeon Dr Mathenge Nduhiu, operations do not proceed without the reservoir vessels on standby and they are mainly used in recovery. Without the system the hospital would be making round trips to Nairobi of 400 km every fortnight to refill oxygen cylinders. In the long term this will translate into large savings for the hospital that will help to keep their costs lower.



Liberia

Two oxygen reservoir systems were supplied to hospitals in Liberia by Maternal and Childhealth Advocacy International (MCAI), one of the few charities that worked in the country during the Ebola epidemic. MCAI Medical Director, Professor David Southall, confirmed that the reservoir systems had been invaluable at both Phebe Hospital and C.B. Dunbar Maternity Hospital. An oxygen generating plant has now been installed at Phebe, although the reservoirs continue to be used on a daily basis, as a backup supply in theatre and for patients in intensive care. C.B. Dunbar Hospital has no oxygen generator and cylinders have to be transported from Monrovia, some 200 km away. The oxygen reservoir system at this hospital continues to provide an invaluable resource that ensures a supply of oxygen is always on hand when needed.

Mobile hospitals

The reservoir system is used not just in fixed locations but also in mobile hospital units. The Dutch organisation Hospitainer supplies fully-equipped mobile hospitals to the UN, MSF and other organisations in response to emergencies. They now include the Diamedica oxygen reservoir system in their mobile hospitals. CEO Rolof Mulder selected the reservoir system because its mobility, ruggedness, ease of use and independence of cylinders makes it a reliable and practical solution for the challenging conditions in emergency and disaster situations.

Future developments

A further application of the Diamedica reservoir system has been with SOLOX™, a system developed by Dr David Peel to harness solar power to drive an oxygen concentrator for low resource settings. SOLOX™ won a runner up prize at this year's innovation awards at AAGBI WSM London, where Dr Ylva Konsberg presented recent work on this application. The system has used multiple Diamedica oxygen reservoir vessels in tandem to store oxygen generated by SOLOX™, with the aim of developing a product suitable for use with a standard continuous flow anaesthesia machine. Field trials of this system are now being planned.

There remains a huge unmet need for reliable oxygen supplies in low-resource settings, essential both for anaesthesia and for oxygen therapy. Our aim is to overcome this, even in the most remote locations. Diamedica supply anaesthesia equipment to more than 70 countries worldwide and now offers the oxygen reservoir system as a standard accompaniment to our Glostavent anaesthesia machines.

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Carol Newman
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Reference

1. Neighbour R, Eltringham RJ. An oxygen reservoir for use in difficult environments. *Anaesthesia News* 2015; **334**: 19–20.