Cutting pneumonia deaths with electricity-free oxygen devices

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Not just a source of food: this river could help doctors save lives. Credit: julien_harnies

Pneumonia kills more children worldwide than malaria, AIDS and tuberculosis combined. This is surprising given that treatment for pneumonia is relatively simple. In rich countries survival rates are very high, but in remote areas or poor countries without access to medicine and technology, pneumonia can become deadly.

In severe cases the lungs' ability to extract oxygen from the air around them is drastically reduced. To give them enough time before antibiotics kick in, they need to be supplied with oxygen at around 90% concentration, much higher than the 20% concentration in the air. This oxygen comes from a device called an oxygen concentrator, which just plugs into the wall socket, takes oxygen from the air and concentrates it. But there lies the problem – 1.6 billion people around the world have no access to electricity to run such a device.

Two years ago a team of physics researchers led by Bryn Sobott of the University of Melbourne set out to design a device to address this. The team came up with a device called the first electricity-free oxygen concentrating system, or FREO2.

FREO2 uses water flow, say from a stream, as its source of energy. When syphoned through a pipe, the water rises which causes a drop in pressure to create a vacuum that can be applied to a bellow system. The combination of the two lets the device concentrate oxygen directly from the surrounding air.

This relies on passing air over a material called zeolite that preferentially attracts nitrogen. Some of the nitrogen will be adsorbed (stick onto the solid material) and get left behind, which means the remaining gas is enriched with oxygen. A vacuum is then used to regenerate the adsorbent material, expelling the nitrogen it caught, and the process repeats.

Prototype testing on a farm in rural Victoria, Australia.

The process is known as vacuum pressure swing adsorption. Sobott said: "This is more energy efficient than the normal pressure swing adsorption method used in wall-plug devices, which is not used where electricity is cheap, because creating a vacuum requires an expensive air compressor. In the case of FREO2 we start with a vacuum."

The system is low maintenance and has virtually no running costs. All that is needed is some flowing water within about two miles of the health centre where the oxygen is needed. Crucially, the system does not require that much water, using only a tiny fraction of that needed by the smallest hydroelectric generators.

Sobott's team is aiming to generate about three litres of oxygen per minute. This flow rate of oxygen is comparable to electricity-driven devices currently on the market. And access to a bigger creek means

more oxygen can be generated.

Part of the FREO2 system.

Water quality is not an issue. As the system creates a vacuum, air is always moving from the child towards the water, so the system can be used even in areas where the water quality is poor. One such area is Papua New Guinea, which is the location chosen for the team's field trial.

The team have just successfully received funding from the USAID Saving Lives at Birth challenge, which will enable them to build further prototypes and trial their idea. Sobott says of the team's future goals: "Our long term goal is to supply the equipment to sub-Saharan Africa and South Asia – where pneumonia is most prevalent."

Source: The Conversation