

# Anaesthesia where there is no pressure: a novel set-up for delivering anaesthesia in a remote setting



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## Introduction

Many anaesthetic machines donated to rural African hospitals remain unused due to a lack of a 4 bar oxygen supply. Staff working at Kalene Hospital, a remote rural hospital in North-West Zambia, have developed a novel solution to overcome this problem. An air compressor is utilised to deliver medical quality air at 4 bar pressure to the oxygen supply pipeline of a conventional anaesthetic machine. We describe this technique and evaluate its suitability for wider use in the resource-poor setting.



Kalene Hospital

## Methods



Figure 1 Clean-air compressor

An oil-free air compressor (Clean air Figure 1) provides compressed air at 7 bar. The air is initially filtered (Hi-line air filter) and then the pressure is reduced to 4 bar. The compressed air is then connected to the oxygen pipeline supply at the rear of the anaesthetic machine (Datex modulus). Oxygen from an oxygen concentrator (DeVilbiss) is then connected to the inspiratory limb of a circle circuit (Figure 2).

## Results

Since the system has been operational over 500 general anaesthetics have been delivered for a range of procedures. Inspired oxygen concentrations of up to 65% have been achieved. The gas flow through the anaesthetic machine is actually air and oxygen is added to the circuit later so some variations in anaesthetic technique are required. When the air flow on the anaesthetic machine is increased the FiO<sub>2</sub> decreases: when the FiO<sub>2</sub> is increased the vapour concentration is decreased.

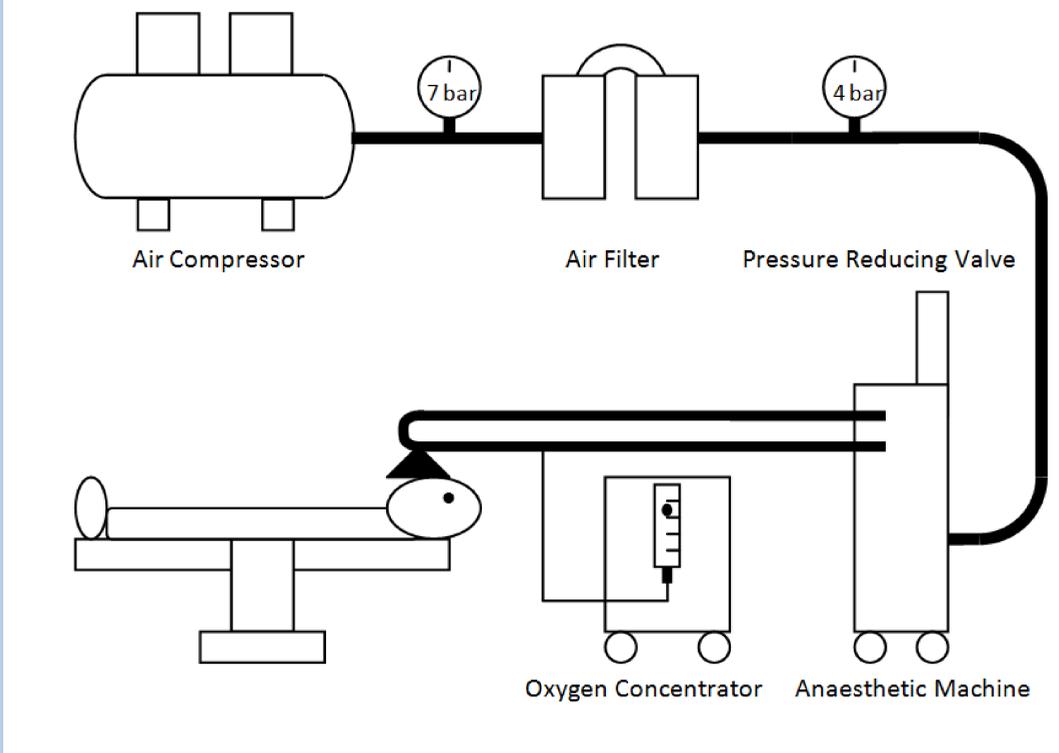


Figure 2 Schematic diagram of the anaesthetic set-up

## Acknowledgements

Mr Peter Gill and Dr Ray Allen have been instrumental in the development of the Kalene anaesthetic set-up and the Zengamina Power Station.

## Electricity

Electricity supply is often intermittent in the rural African setting. This system does require a reliable electricity source and Kalene Hospital is fortunate to receive a 24-hour power supply from nearby Zengamina Hydro (Figure 3). This hydroelectric facility harnesses the nearby Zambezi River and was developed to provide power to the hospital and surrounding area. The hospital has back-up generators in place should the power supply be interrupted.



Figure 3 Zengamina Hydro

## Discussion

This novel set-up addresses the major obstacle in utilising donated anaesthetic machines in a rural African setting: the lack of a pressurised gas supply. The essential requirements for this set-up are gas monitoring, a reliable electricity supply and an engineer who is able to service the compressor. However, many resource poor settings do not have a reliable power supply and this is a major limiting factor in the more widespread introduction of this anaesthetic delivery technique. A further concern is the potential confusion created by setting up the oxygen rotameter to deliver air rather than oxygen: staff using this set-up must be given adequate orientation and training to use the equipment safely. Despite the nuances of the system it is easy to use and feels similar to using a conventional set-up. This set-up also allows 7 bar orthopaedic tools to be driven which expands the range of surgery that can be delivered.

## Conclusion

Despite limitations this anaesthetic set-up represents an excellent solution to the lack of a pressurised gas supply and has potential to be utilised in other low-resource settings.