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It’s all part of the service: an engineering contribution to anaesthesia in difficult circumstances

The Britain Nepal Otology Service

The Mushin Museum: drawing parallels between the past and present
Robert Neighbour, a mechanical engineer with no experience of anaesthesia, was approached by Diamedica late yesterday to inspect the older Glostavent anaesthesia machine that had been in use since the early 1990s at Phebe Hospital, Liberia. The ventilator had been reported several months previously. Upon examination, it had been decided that the only course of action was to return the ventilator to the UK where it was rebuilt and subsequently returned to Phebe Hospital together with operating instructions. However, after it had been re-installed, the staff were unsure that it was functioning correctly as the bellows was making an unusual noise.

Robert, however, seemed to appreciate the potential for his skills to become more widely appreciated in the context of the need to solve problems when local anaesthetic equipment was not working properly. In a normal setting, he would have been more impressed by the waste of resources, but this was just the tip of the iceberg.

The Glostavent was found to be fully functional, but the staff were uncertain if it was functioning correctly as the bellows were making an unusual noise. It had been decided that the only course of action was to return the ventilator to the UK where it was rebuilt and subsequently returned to Phebe Hospital together with operating instructions. However, after it had been re-installed, the staff were unsure that it was functioning correctly as the bellows was making an unusual noise.

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During another overseas tour, he became aware of the difficulty of providing continuous positive airway pressure (CPAP) to infants and young children in remote locations. Although this life-saving treatment has been shown to be very effective, it frequently cannot be given because of the high cost and logistical problems of delivering oxygen in the necessary quantities. He tackled this problem by adapting a standard oxygen concentrator to supply sufficiently high flows of both oxygen and air and at a fraction of the cost of the expensive and time-consuming cylinders. This has proved very successful and is already being used in over 15 countries. The new CPAP apparatus was a runner up at the AAGBI innovations awards in 2014.

Robert’s next project was to modify the Diamedica vaporiser accordingly and this is currently undergoing clinical trials in Malaysia and Zambia.

Robert’s work has included designing a portable capnograph which did not require any connection to the ventilator. Instead, the capnograph made use of a standard oxygen concentrator to deliver oxygen to the patient and to measure the expired carbon dioxide using infrared absorption techniques to determine the concentration. This has proved to be very successful in the field and has been used in the most challenging locations worldwide.

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Robert is frequently asked to look at a wide range of equipment in hospitals, hospices, and other medical centres. He has regularly returned to Phebe Hospital in Liberia to inspect the older Glostavent anaesthesia machine that had been in use since the early 1990s. The ventilator had been reported several months previously. Upon examination, it had been decided that the only course of action was to return the ventilator to the UK where it was rebuilt and subsequently returned to Phebe Hospital together with operating instructions. However, after it had been re-installed, the staff were unsure that it was functioning correctly as the bellows was making an unusual noise.

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The new Glostavent was set up in Theatre 1 ready to be used on a female patient weighing just 17kg with a suspected ruptured appendix; her condition was very poor. The Glostavent was set in paediatric mode and the vaporiser filled with isoflurane. Intavenous induction was carried out with propofol which was followed by atracurium. Intubation was rapidly achieved but the tube initially entered one lung and had to be withdrawn until breath sounds were heard over both lungs. The vaporiser was set at 2%, the ventilator was set to deliver a tidal volume of 200ml at a rate of 25 bpm and surgery commenced.

The appendix was found to be normal but the patient had a perforated bowel, with the opinion expressed that it was due to typhoid. At this point the patient was observed to be fighting the ventilator, and more relaxant was given but without effect. A nerve stimulator was found but this needed repair before it could be used. Once it was functional again it showed that the relaxant was ineffective. It transpired that the relaxant had not been stored in a refrigerator and had lost its potency. An alternative relaxant was found which proved to be effective.

Power was interrupted a number of times during the course of the surgery but the UPS on the Glostavent dealt with that successfully each time, together with voltage variations of between 170-180. Eventually surgery was completed but, before the patient had even been extubated, my attention was drawn to a further emergency where help was needed.

A baby with bronchiolitis required treatment with CPAP (Figure 2) The new Diamedica baby CPAP apparatus was set up quickly in the recovery area. However this was not without problems as the voltage had again dropped to 170 and the voltage stabiliser supplied with the CPAP apparatus was required in order to maintain function. The baby’s saturation was initially 82% but with normal function returned.

A nebuliser was also found and used although, due to the size of the patient, it increased rapidly to 95%.

The baby’s saturation was initially 82% but with help was needed. At the same time the Mothers of Africa team had done considerable work but was now in need of attention as it required an external oxygen supply. On investigation, the concentrator was found which proved to be effective.

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I met Dr Keith Thomson at 8.00am. There were 10 people in his party, who had travelled to Liberia to carry out several days of anaesthesia and midwifery training. During the course of the day, information was received from Phebe hospital that the baby with bronchiolitis was doing well. At 2.00pm we had to leave Phebe hospital for the return journey to Monrovia, arriving at the hotel at dusk.

I had an early phone call from Phebe hospital asking if I could identify the working 220 volt sockets in the recovery area, which I did. This is a major problem for them and it is important that they obtain a suitable voltage tester for the range of sockets and voltages in the hospital.

I then travelled with Dr Thomson’s party to Redemption Hospital in Monrovia. Since 2007, the hospital has been using a Glostavent anaesthetic machine which apparently had recently developed an intermittent fault. The concentrator would run normally for a period of time and then stop for no apparent reason. However, it was still in constant use. The fault appeared to result from a loose power connection; this was fixed, and in addition a new vaporiser cap was fitted, together with a replacement patient valve as the existing one was held together with tape. The machine was run for 1 hour to confirm it was now functioning normally. There was also a problem with a Lifefox oximeter, but this was found to be the charging station, and when charged directly the problem was solved.

After lunch we moved to JFK Hospital, which was better equipped than Redemption Hospital but did not appear to be as busy. This hospital had also used a Glostavent since 2007 (Figure 3) which had done considerable work but was now in need of attention as it required an external oxygen supply. On investigation, the concentrator was found to have a power board fault and when the board was replaced it worked within normal parameters. It also appeared that someone had closed down its internal regulator, effectively stopping the flow of oxygen. The regulator was reset and normal function returned.