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EDITORIALS

Safe treatment of health-care workers with Ebola

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The first time a patient with Ebola virus disease vomited in front of me I wasn't worried. I was in the red zone of an Ebola treatment centre in Sierra Leone, by the patient's bedside with a vomit bowl in my hand. It was the second projectile vomit that hit me, covering me from eye level on my visor down the whole of my right side and onto my wellington boots. A wave of resignation washed over me. I would have to leave the patient and spend the next 15 min decontaminating rather than finishing my review of the other sick patients. There was also the risk that I would contract Ebola. I had thought that I would be frightened the first time I went into the red zone to treat infected patients. But in December 2014, after spending 2 months training other military and civilian doctors and nurses to treat patients with the highly infectious filovirus, I was confident that my protective suit, double gloves, visor, and face mask would be enough to keep me safe, although the exact level of risk was difficult to quantify. On first going into the red zone where the risk of infection is considered to be highest, the main thing I felt was frustration that it was too hot to spend much time with the patients.

I worked in the British military-run Ebola Treatment Centre at Kerry Town, with British and Canadian military doctors and nurses. We were in Sierra Leone to staff a specialist treatment unit providing limited critical care to health-care workers who were suspected or confirmed as having been infected with Ebola. For months, West African health-care workers had been getting infected with Ebola at a disproportionate rate, with up to 200 dying.[1] In response, the UK Department for International Development funded an intervention programme, with the British Army building multiple Ebola treatment centres to be run by the Save the Children charity using volunteer staff from UK and European health services. The military medical services played a specialized and crucial part. Our job was to look after health-care workers from Africa and international responders if they developed symptoms of Ebola or other serious infections.[2] The US and French military ran similar units in Liberia and Guinea.

Patients infected with Ebola can be difficult to care for. Affected patients suffer from severe, copious diarrhoea and vomiting, with infectious virus particles in all body fluids. A significant minority of patients suffer gastrointestinal haemorrhage. Most patients are coagulopathic, oozing from venepuncture or vascular access sites. Early in the disease, patients have very high levels of virus in their blood, sweat, and urine. Patients often develop delirium, probably because of encephalitis, and are restless, pulling at lines and tubes or even attempting to wander off. There is a major risk of cross-infection, which means that patients suspected of having Ebola must be kept apart to reduce the risk of those whose symptoms are a result of malaria or gastroenteritis becoming infected in the process of being screened.[3 4]

Contact with the patient risks transmission of the disease, meaning that every interaction, no matter how trivial, requires a laborious process of donning personal protective equipment followed by an even more involved decontamination drill. Needle stick injuries are an ever-present and very real risk, owing to the limited tactile feedback and reduced visibility provided by even the best protective equipment. Even without any recognized breach of personal protective equipment or needle stick injury, some clinicians contracted Ebola.[5]

In addition to the fear and stigma associated with Ebola in the West African population, the standard of care provided in West Africa has been very variable, affected by the low number of staff available in the early stages of the outbreak, but also by the imperative to protect staff from infection, sometimes at the risk of not providing effective treatment to patients. Some treatment centres gave i.v. fluids to only a very small proportion of patients because of a policy of reducing the risk from needle sticks by not cannulating patients, instead relying only on oral

rehydration solution, although this may have changed as more staff became available.[6] This strategy is problematic in patients who are profoundly dehydrated, hypokalaemic, and often unable to take any oral fluids for many days because of severe nausea and vomiting.[7] There were suggestions that it should be possible to provide much better treatment,[8] and most of the European, National Health Service (NHS), and military clinicians I helped to train felt that not to carry out basic laboratory tests and provide i.v. fluid and electrolyte replacement was unacceptable. Certainly, this would be almost inconceivable in any developed country for any other medical condition.

The heat and humidity in West Africa make wearing protective equipment uncomfortably hot and physiologically stressful, with staff feeling physically stressed and typically losing up to a litre of sweat during each trip into the red zone.[9] On top of this, the risk of becoming infected with Ebola was clearly a very real one, with multiple doctors and nurses infected in 2014 in hospitals in North America and Europe whilst treating patients who were known to be harbouring the virus.[10] There was significant concern in the health-care community that bringing infected UK health-care workers back to the UK to be treated would jeopardize the safety of staff in the NHS and risk disrupting the running of already full critical care units. Would intensive care treatment offer any benefit to patients with Ebola infection? At the time of a UK national policy meeting in late 2014, many felt that interventions such as mechanical ventilation and renal replacement therapy would pose a risk to staff without making any difference to the patient's eventual death. There were a few dissenting opinions, including those expressed by staff at the Royal Free Hospital. Not long after the UK meeting, a report was published of successful ventilation and dialysis of a patient in the USA, suggesting that the policy of not offering advanced treatment in the UK was unnecessarily nihilistic.[11]

On this background, one of the biggest worries for doctors, nurses, and other workers travelling to assist in West Africa was whether we would be repatriated to the UK if we contracted the disease we were treating. It was clear that although in our tented facility in the jungle south of Freetown we were able to provide a higher level of care than that available elsewhere in Sierra Leone, we did not have the equipment for respiratory or renal support.[12] One of the factors in whether health-care workers volunteer is probably how they think they will be treated if they develop an infection that has a 70% patient fatality rate in Africa but a 95% survival rate in Europe or the USA. One could argue on ethical grounds that volunteers who were encouraged to travel to West Africa by the NHS to assist in the epidemic should be supported to the full extent possible by the UK, including evacuation for care in a specialist unit. By the end of the outbreak, two UK civilian nurses and one military nurse had contracted Ebola infection in the course of their work. Other staff had significant needle stick injuries or close contact with infected colleagues and were evacuated on a precautionary basis to the Infectious Diseases Department at the Royal Free Hospital in London.

In the accompanying paper, Martin and colleagues[13] clearly describe how they are able to provide highly effective, safe treatment to critically ill patients with Ebola virus disease repatriated from overseas to their specialist unit. The Royal Free Hospital High Level Isolation Unit has a long pedigree of using Trexler isolators and recent practical experience with viral haemorrhagic fevers.[14] The Trexler system contains the infectious patient within a negative pressure compartment in a specially adapted ward. The system allows delivery from another hospital or from overseas of the infected patient in a mobile isolator, which docks with the ward Trexler. Air locks allow delivery of medications and fluids without staff needing to wear elaborate personal protective equipment. Clinical waste can be removed by the same system. Access to the patient is through the Trexler's plastic membrane via integral faceplates and sleeves. Staff training is critical to the successful use of the Trexler system, and complex interventions, such as intubation or central venous access, are regularly practised in simulation scenarios before being carried out for real. Other well-run, professional infectious disease units in Europe and the USA have also shown that it is possible to provide critical care interventions for patients with Ebola, including mechanical ventilation and renal replacement therapy. Thanks to these specialized units taking an interventionist approach, most patients treated in the developed world have survived.

The current Ebola epidemic is now in its final stages. There may yet be a few more instances secondary to reactivation of the virus in survivors, but the response systems in West Africa are much better now than previously. A great many health professionals from Africa and other parts of the world now have experience of treating Ebola patients, and there is promise of an effective vaccine,[15] so it seems less likely that we will see another outbreak on the same scale. The article by Martin and colleagues[13] gives us confidence that the UK can safely manage Ebola patients and provide critical care interventions without disruption to NHS services.

There are still some unanswered questions. The nature of the Ebola epidemic made it unlikely that there would be a very large number of simultaneous infections in deployed staff, but this could have happened, and indeed, at one point multiple clinical staff from an American charity were exposed to an infected colleague at work, with 10 staff at risk of contracting the disease, all of whom were rapidly evacuated to the USA.[16] Ebola is predominantly spread by contact of blood or body fluids with mucosal surfaces or broken skin, whereas other highly infectious pathogens, such as severe acute respiratory syndrome (SARS), are spread by aerosols or, possibly, true airborne spread.[17]

What would the UK response be if there were more patients infected with Ebola than could be accommodated by the four specialist isolation beds available in the UK? What would the response be if there were hundreds of patients with a novel highly lethal and highly transmissible respiratory virus similar to Middle East respiratory syndrome or SARS? How would this affect the provision of critical care to the rest of the NHS?

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Malpositioning of supraglottic airway devices: preventive and corrective strategies

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Airway management is one of the cornerstones for modern anaesthesia and is vital for all patients undergoing general anaesthesia. Supraglottic airway devices (SADs) are increasingly used for managing airways. The World Health Organization estimates that worldwide, ~250 million patients undergo general anaesthesia for major surgery on an annual basis.[1] If we translate the figures of the 4th National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society (NAP4) in the UK, where almost 60% of the patients receive SADs during anaesthesia, we can assume that annually, ~150 million such devices are used worldwide.[2 3]

Manufacturers continue to invest in research in designing these devices to prevent aspiration, resulting in first-generation (ventilation channel only) and second-generation (separation of ventilatory and gastric access channels) SADs, with several other modifications and characteristics designed to improve their functionality and safety.[4–6]

Anaesthetists consider the SAD to be a device that is easy to insert and that can be used for ever-increasing indications during various types of general surgery, obstetrics, and gynaecology. They also advocate its use in other areas, including the following: during cardiopulmonary resuscitation, in the department of emergency medicine, in the intensive care unit, in the prehospital setting, and as an important step in the difficult airway algorithm.[7–9]

Manufacturers hardly put efforts into verification of the correct placement or positioning of the device *in situ* after insertion. Contrary to the insertion of a tracheal tube, which is guided to the trachea under (in)direct vision of a (video)laryngoscope, the insertion of a SAD is virtually a 'blind' technique, whereby one relies on the practitioner's skills to insert the device correctly into the hypopharynx. Routine verifications include auscultation of the lungs and gastric area, capnogram, oxygen saturation, airway pressure, oropharyngeal leak pressure, and the gold standard to evaluate its position using a fibreoptic scope, which is typically inserted through the tube of the airway device. However, the use of a fibreoptic scope only helps in diagnosis of malpositioning but does not allow the ability to change an incorrectly positioned SAD.

Supraglottic airway devices are generally forgiving devices because even suboptimally positioned SADs still can provide adequate ventilation for the patients during short procedures. However, malpositioning of the device can result in severe leaks and