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The healthcare workers’ clinical skill set requirements for a uniformed international response to the Ebola virus disease outbreak in West Africa: the Canadian perspective

Dennis Marion,1,2 P Charlebois,1,3 R Kao1,4

ABSTRACT

Since December 2013, the Zaire Ebola virus disease (EVD) epidemic has ravaged West Africa. In collaboration with the Public Health Agency of Canada, healthcare workers (HCWs) and support staff from the Royal Canadian Medical Services (RCMS) of the Canadian Armed Forces (CAF) were deployed to Kerry Town, Sierra Leone. A total of 79 RCMS personnel deployed over the course of the 6-month mission in collaboration with the British Armed Forces to support efforts in West Africa. The treatment centre was mandated to treat international and local HCWs exposed to the infection. The goal of the Ebola virus disease treatment unit (EVDTU) was to provide care to affected HCWs and a beacon to attract and engage foreign HCWs to work in one of the international non-governmental organisation Ebola treatment centres in Sierra Leone. We focus on the CAF experience at the Kerry Town Ebola treatment unit (KTTU) in particular on the various clinical skill sets demonstrated in physicians, nurses and medical technicians deployed to the EVDTU. We outline some of the staffing challenges that arose and suggest that the necessary clinical skills needed to effectively manage patients with EVD in an austere environment can be shared across a small and diverse team of healthcare providers.

THE CRISIS

Since December 2013, the Zaire Ebola virus disease (EVD) epidemic has ravaged West Africa.1,4 By November 2014, Canada addressed the need for medical assistance on the ground in West Africa by launching the ‘Join the Fight Against Ebola’5 campaign, which promoted the recruitment of Canadian healthcare workers (HCWs) through the Canadian Red Cross. The Public Health Agency of Canada also donated a range of personal protective equipment (PPE) to the WHO to help with the Ebola outbreak in West Africa. Canada also provided $C20.9 million to 10 humanitarian organisations working to address the increased humanitarian needs of people affected by the Ebola crisis.5 These funds supported treatments, training activities, psychosocial supports and helped to address urgent training needs for medical personnel to be deployed to Ebola-affected countries.

THE PLAN: PREDEPLOYMENT ISSUES

In collaboration with the Public Health Agency of Canada, HCWs and support staff from the Royal Canadian Medical Services (RCMS) of the Canadian Armed Forces (CAF) were deployed to Kerry Town, Sierra Leone (SL). Over a period of 6 months, at any one time there were up to 40 Canadian uniformed personnel on the ground working in collaboration with the British Armed Forces to support efforts in West Africa. A total of 79 RCMS personnel deployed over the course of the mission. The treatment centre was mandated to treat international and local HCWs exposed to the infection. The goal of the EVDTU was to provide care to affected HCWs and a beacon to attract and engage international non-governmental organisation (NGO) HCWs to work in one of the NGO-run Ebola treatment centres in SL.

The initial staffing plan was developed in November 2014 for up to a 20-bed Ebola treatment facility specifically designed to provide supportive care to local and international HCWs involved in the fight against the epidemic who presented with symptoms of potential EVD infection. Once a confirmation of an EVD diagnosis was made, some of the treatments that were available included bedside ultrasound guided fluid management, inotropic support, coagulopathy management through the use of blood products and 1:1 nursing care.

The care was to be directly provided by the international consultants on the ground. This was in contrast to other models where it was led, but not provided, by international consultants.6 The intended level of care was designed to be as close to the standard that might be achievable in a less resource-limited setting and was significantly advanced over the traditional level of care in previous EVD outbreaks, which simply included

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Original article

Key messages

▸ Description and discussion of care provided to patients with Ebola virus disease (EVD) at the Kerry Town Ebola virus disease treatment unit (EVDTU) in Sierra Leone during the recent West African outbreak December 2014–June 2015.
▸ Discussion of clinical skill sets recommended to work at an EVDTU with a similar mandate to Kerry Town treatment unit (KTTU).
▸ Discussion of international military medical collaboration during the recent West African EVD outbreak.
supportive management with oral rehydration solution (ORS) without the use of parenteral access or directed interventions based on laboratory testing. It should be noted that some EVD treatment facilities in this current outbreak continued to rely on ORS as the main modality of treatment.

In preparation for this operation, it was important to have all relevant risk assessments available to the Government of Canada prior to deploying a team of military HCWs to West Africa. In support of their force generation of a team with the necessary skill sets, the UK Joint Operation Command made a request to Canada to provide an infectious disease and a critical care medicine specialist, as well as 16 nurses with a critical care or general nursing background, paired with an equal number of advanced medical technicians and four administrative command staff. After an extensive discussion between the CAF Chief of Medicine and the CAF Director of Health Services Operations, it was determined that Canada could sustainably provide one internal medicine specialist with critical care or infectious disease subspecialty, three general duty medical officers (GDMO) and 16 pairs of nurses with senior medical technicians as requested.

The next assessment was the predeployment training and evaluation for all those who were to deploy to the EVDTU. All personnel were required to enhance their skills by attending individual and collective training in the use of Ebola PPE at the Army Medical Services Training Centre (AMSTC) in Strensall, Yorkshire, UK. The AMSTC provided mission-specific training using a high-fidelity trainer that had been employed for medical deployments to a range of operational theatres. Prior to the current mission, the centre was configured as the British military hospital in Camp Bastion, Afghanistan. The AMSTC was re-equipped to accurately simulate the EVDTU in Kerry Town. Prior to deployment, HCWs completed a 10-day training package that culminated in a 3-day individual and collective training and validation exercise to assess newly acquired skills. The PPE used by the military in the EVDTU was selected following expert advice and consensus agreement with civilian agencies in the UK, which included Public Health England and the National Ambulance Resilience Unit. The donning and doffing drills developed with the PPE were practiced repeatedly until the individual learners were familiar with the equipment and comfortable wearing it for a prolonged period. This process also allowed an individual to test their physical and psychological tolerance while working in a PPE environment. Finally, skills were assessed during 5 days of acclimatisation in theatre, so that the HCWs could hone in their clinical skills in the actual environment prior to taking over clinical care in the EVDTU. Figure 1 shows the AMSTC in Strensall, UK.

Diagnostic and treatment protocols were developed as guidelines to assist providers in managing a clinical presentation that few would have had experience with. This was based on reviews of available guidelines and papers on the care of EVD in a facility where advanced modalities were available.7–9

From a clinical staffing perspective, there were no obstacles that would prevent the interoperability of CAF and UK personnel working within a UK-led EVDTU in SL. Staff at all levels of the UK Ministry of Defense indicated that the preferred stage for CAF personnel to integrate into the UK teams would be at the start of the training phase at the AMSTC. This allowed familiarisation with all aspects of the mission, including items such as charting, documentation and review of standard operating procedures.

Although the organisation of medical care in Canada and the UK is quite similar, there are small differences that may have caused confusion and inefficiencies if not recognised early. These differences were mainly clerical in nature that medications and intravenous fluid were ordered and administered. The UK system was noted to be more detail oriented on the part of the physicians’ orders, whereas the Canadian method uses a simpler order system with specific details of administration being the responsibility of the nursing staff. It was also noted that there are a number of medical tasks that are often carried out by physicians in the UK rather than nursing staff such as the insertion of peripheral intravenous catheters. Although Canadian physicians are trained in this skill, it is not one that is used on a day-to-day basis outside certain specialties.

**THE EXPERIENCE: DEPLOYMENT ISSUES**

The clinical status of patients on arrival to the EVDTU varied widely. Many of the patients with EVD were already in an advanced stage of disease with organ dysfunction. This resulted in a significant challenge for the HCWs in caring for these patients. The HCWs needed to wear PPE in an adverse environment for extended periods while in the treatment unit, with the added burden of the realisation that many of these patients in the advanced stages of EVD would have a poor outcome. The
staff at the EVDTU had to arrive with a well-developed knowledge base and an established set of procedural skills. The challenging work environment (cumbersome PPE and heat) and the risks involved in dealing with a biosafety level IV pathogen meant that this was not an environment in which skills could be learned or polished. Care providers, at all levels, needed to be current and proficient in all realms. In terms of knowledge sets, the Kerry Town EVDTU required its providers to be adept at the management of medically complex patients. Due to the nature of the disease, many of the patients were critically ill, exhibiting haemodynamic instability, respiratory compromise and severe haematological and biochemical abnormalities.

Working within the facility also required a good understanding of the management of other tropical infectious diseases endemic to this area of sub-Saharan West Africa. Figure 2 shows HCWs donning with checks by colleagues prior to entering the Red Zone.

Medical staff had to possess a number of procedural skills, including the placement of peripheral intravenous lines and central venous catheters (CVCs). The use of CVCs was felt to be beneficial, as it minimised the need for repeated venipunctures and replacement of peripheral catheters that was balanced against the risks of initial placement. Although invasive haemodynamic monitoring equipment was available, it was determined that the risks of increased exposure to contaminated body fluids would make arterial lines and measurement of central venous pressure too risky. Bedside ultrasonography was used for the placement of CVCs and for the assessment of volume status. Since there were no radiological services, ultrasound was also used to assess the lungs, heart and abdomen in a limited fashion. Figure 3 shows an HCW inserting a peripheral intravenous cannula wearing PPE in the Red Zone.

Although laboratory facilities were available, point of care devices (ISTAT, malaria RDTs and urine pregnancy tests) for blood glucose, haematological and biochemical testing were widely used within the facility to guide patient care. Although orientation to these devices was provided during the predeployment training, healthcare providers benefited from a prior working knowledge of these devices and previous experiences allowed for ease of troubleshooting in the event of device malfunction.

The physician cadre was made up of consultants and senior registrars from the disciplines of internal medicine and anaesthesiology. The subspecialties of the consultants varied considerably between the different rotation groups, and participation was often based on a consultant having a complementary skill set that would enhance the capability of the care team in the EVDTU. Canada also provided GDMO to the physician group. These are physicians who have completed a 2-year family medicine training programme and typically provide primary outpatient and limited inpatient care.

Clinician shifts were organised with two physicians available for duty at the EVDTU in each shift during the early stage of the mission. An attempt was made to ensure that the clinical skill sets of each clinician on duty complemented each other. However, when specialised skill or knowledge was needed, the relevant clinician could be contacted by cell phone or called back to the unit. The addition of senior GDMO, with robust generalist skills, was seen to be advantageous to provide support to the team and provided additional care within a larger specialist medical officer team. Since the medical management of patients with EVD is supportive in nature, the optimal management in an austere environment often consists of relatively routine medical interventions such as volume resuscitation, electrolyte replacement, analgesia and empiric antibiotics that can largely be handled by an astute generalist whose skills are current in acute care medicine.

The nursing staff from Canada and the UK were from a mix of disciplines, including critical care, emergency and general ward nurses. As with the physicians, selection of personnel was not just based on discipline, but on the individual clinical skill levels and currency. The final group of patient care providers

Figure 2  Healthcare workers donning with checks by colleagues prior to entering the Red Zone.

Figure 3  Healthcare worker inserting a peripheral intravenous cannula wearing personal protective equipment in the Red Zone.
were medical technicians from both the Canadian and UK militaries. Canada no longer has defined military inpatient wards, and Canadian medical technicians do not care for inpatients on a day-to-day basis, although they continue to receive training in bedside care. The UK military employs healthcare assistants who have extensive bedside care experience.

The remainder of staff were not directly involved in patient care, and included laboratory and biomedical equipment technicians, preventative medicine staff, mortuary affairs personnel, infection prevention and control nurses, PPE monitors, healthcare administrators and command staff. Although not directly involved in patient care on a regular basis, they often had roles that could require their entry into the facility such as for management of the deceased, equipment and structure maintenance, supervision and assessment of working conditions and planning purposes. Figure 4 shows a team of HCWs working in the Red Zone.

**THE REFLECTION: LESSONS LEARNED**

Our experience should be interpreted in the context of a group of international medical providers, trained to similar standards, working at a deployed field hospital that was designed to provide a high level of medical care in a resource-limited area to an adult patient population. Although the facility was resource limited by developed nation standards, it had access to more resources and medical capabilities than most other facilities with a similar mandate. The clinical skill set advocated in this article, although appropriate to accomplish the mission of the KTTU, may not include skills that would be appropriate in a similar facility with a different mandate.

The factors that affected the selection of RCMS medical personnel to deploy were many. These factors included the skill sets that were thought necessary or desirable and the availability of those skill sets. Given the uncertainty regarding the duration of the mission, consideration of what was sustainable was also important. The RCMS has a relatively small cadre of specialist medical officers, but a larger cadre of GDMO from which to draw physician personnel. This led to the deployment of only one internist with a subspecialty in either of critical care or infectious diseases rather than both. The addition of GDMOs, half of which were senior generalist clinicians within the RCMS, was a Canadian initiative based on Canada having a smaller pool of military physicians to draw from.

Given the non-specific initial presentation of EVD and the broad differential diagnosis for suspect EVD patients, physicians had to be adept at investigating the undifferentiated febrile patient. Coupled with the need to manage alternate infectious diagnoses, it was beneficial to include one or more infectious disease specialists on each rotation. Fortunately, most military internists in both Canada and the UK participate in some type of tropical medicine training. This training is an absolute requirement for all Canadian military internists, who attend the Gorgas Diploma Course in Clinical Tropical Medicine offered through the University of Alabama (Birmingham) and taught at the University of Cayetano Heredia in Lima, Peru.

During the early rotations, the mission focused heavily on clinicians with critical care and infectious diseases backgrounds. This resulted in a rapidly shrinking pool of military physicians with these skill sets and it became a sustainability issue when the mission was to continue for a prolonged period of time. Thus, subsequent deployments included fewer physicians trained exclusively in critical care and infectious diseases. In later deployments, the UK provided more internists from other subspecialties such as general internal medicine, gastroenterology, nephrology and cardiology. The UK expanded their pool of critical care physicians by employing anaesthetists who also provided critical care in their usual clinical practice. These clinicians would only use a portion of their skill set, as endotracheal intubation, ventilator support or need for the administration of anaesthetics was not in the normal spectrum of care in this facility. This seemed to work well, as inserting central lines and patient resuscitation are key skills in the management of the critically ill patient with EVD and can readily be provided by an anaesthetist. Canada had the capability to deploy critical care-trained anaesthesiologists but did not tap this pool of clinicians as they were being employed on other operational tasks.

As the EVD outbreak evolved, the mission goals changed accordingly. With the outbreak increasingly under control due to the robust public health intervention in SL, the Kerry Town EVDTU capacity, along with other facilities, began to exceed the actual need of the country. EVDTUs staffing and beds were reduced accordingly including the number of physicians deployed at one time. Required skills could no longer be easily duplicated in multiple physicians and later rotations sometimes included only two experienced CVC inserters or a single infectious diseases-trained physician. This loss of redundancy exposed the unit to greater risk of losing a capability in the event of accident or illness or a resurgence of the EVD epidemic.

The optimal management of patients with EVD in an austere environment revolved on continuous, high-level acute nursing care. Many patients were managed with a CVC, and therefore a nursing group where most, but not necessarily all, are experienced with the use and care of CVCs is desirable. In Canada, nurses with intensive care unit training, or extensive emergency room experience, would typically be comfortable managing a CVC. Other duties that are part of the general nursing skill set in Canada include the insertion of peripheral intravenous lines and placement of Foley catheters and faecal management systems. They are also qualified to prepare and administer intravenous medications, perform phlebotomy and manage intravenous fluids.

There is a significant risk to medical personnel from exposure to an infectious patient with EVD while performing an unpracticed medical procedure such as needle sticks or a splash of body fluid. It was mandated by the medical command that the best personnel to perform procedures were those with the most experience rather than merely having the credential to perform the procedure.

Managing complex medical patients in a hot and humid climate while wearing the full body PPE would accelerate physical degradation and limited the amount of useful clinical time.
with the patient. Military training and service selects for personnel that better tolerate working in such conditions as all staff must be physically fit and pass fitness tests prior to deployment.

Military medical personnel may have worked in similar environments prior to participating on this mission, providing valuable experience in dealing with such conditions. Despite the advantages a military team offered, a larger staff of medical personnel was required than might otherwise be expected to counter the effects that the environment had on workload within the facility and shift length. Given that the overall management of these patients was supportive and most of the necessary medical interventions were of a basic and routine nature (ie, taking vital signs, helping with patient hygiene, delivering meals and fluids, cleaning patient bed spaces and psychosocial support), HCW manpower was supplemented with allied healthcare providers from disciplines that do not usually participate in hospital-based patient care. In the case of the RCMS, this extra manpower was most readily found in the skill set of the medical technician.

The military medical technician paired with either a nurse or occasionally a physician could perform a number of necessary interventions in either a directly or indirectly supervised setting depending on the task. In addition, the real-world experience and practical knowledge of the medical technician brought a unique element to the multidisciplinary team approach in the management of a patient with EVD.

It is also worthy of mention that the rapid dissemination of new knowledge is key to the optimal management of patients and the outbreak in general, and therefore a rapid approval process for research was needed. A senior clinician co-ordinated research efforts and met regularly with those involved in the process to facilitate forwarding research proposals to the relevant offices for approval. Canadian clinicians supported the UK-led research initiatives.

CONCLUSIONS

Based on our experience at the Kerry Town EVDTU, the necessary HCW clinical skill set required for the optimal management of patients with EVD in an austere environment, such as the Kerry Town facility, includes the ability to provide supportive management including establishing intravenous access (peripheral or central), the resuscitation of critically ill patients, the investigation and management of complex medical problems with limited diagnostic modalities and the diagnosis and management of infectious diseases common in the geographic region.

The entirety of this skill set need not necessarily be found in each individual clinician, but the team as a whole. It was also seen that a team of physicians, regardless of specialty background, who were experienced and current in the management of medically complex patients was capable of supporting and treating patients at the Kerry Town EVDTU.

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REFERENCES