EMERGENCY EXPERIENCE AGAINST EBOLA

CASE SITUATION

EMERGENCY is present in Sierra Leone since 2001 running a Surgical and Paediatric Centre. Over the years, the hospital has become the main reference centre for trauma surgery in Sierra Leone and neighbouring countries.

2014 registered the largest epidemic of Ebola, dramatically affecting Western Africa. In April 2014, within the aim of guaranteeing continuation of medical services, EMERGENCY staff was specifically trained in EVD-oriented Infection Prevention Control (IPC) measures for containing the spread of the disease and preventing infection. The hospital was completely re-organised: a dedicated triage for screening EVD suspects was set up to limit contact between waiting patients and prevent suspected Ebola cases from entering the hospital; patients with possible Ebola symptoms were isolated in a dedicated Isolation Unit while waiting for laboratory results to confirm the diagnosis; visits from family members were stopped and new procedures were implemented to monitor the health conditions of all staff. Standard Operation Procedures (SOP) were implemented to prevent any possibility of spread of the virus inside the hospital or within the community. To bring to zero the cross infection of the facilities, EMERGENCY adopted specific measures: in every hospital room a strict list of authorized personnel was admitted; each department was organized with a mandatory flow from *clean to dirty*; drainage of blackwater was reinforced to avoid any maintenance in the period of the outbreak; the supply chain was reorganized to minimize the risk for workers and patients; training to mentor and motivate the staff took place weekly.

From the early beginning of the epidemic until the opening of the Lakka Ebola Holding and Treatment Centre, our staff selectively isolated 88 patients in triage area with suspected Ebola Virus Disease. Out of these, 19 were EVD-positive and were then referred to an Ebola Treatment Centre. This was a considerable undertaking, since the hospital usually receives an average of over 1,000 surgical outpatients per month and over 2,000 paediatric outpatients. The efficient selection of patients for isolation was challenging given that most of children asking for medical attention had symptoms very similar to Ebola: nausea, diarrhoea and high temperature. Unnecessary isolation of patients also increases the risk of infection by contact with positive patients and causes a delay in the provision of proper medical assistance.

The Goderich Surgical and Paediatric Centre has been one of the few health facilities fully operational during the epidemic. Indeed, in lack of adequate protection protocols over 106 health workers died of Ebola and many hospitals closed down due to the incapacity of dealing with EVD-positive patients. In virtue of our IPC procedures we have been able to continuously provide paediatric services and safe and qualified surgery, protecting the health and wellbeing of patients and personnel.

During the peak of the epidemic, the Ministry of Health of Sierra Leone asked EMERGENCY to build and run a field structure of 22 beds for Isolation of suspected EVD cases in Lakka.

The centre was open on 18 September 2014 and due to the dramatic lack of treatment beds in the country, it was immediately used as a treating facility: the **Lakka Holding and Treatment Centre**, the first unit in the Western Area. The treatment centre was operational until the opening of the EMERGENCY Ebola Treating Centre (ETC) in Goderich on 13 December 2014. With the opening of

the ETC, the Lakka Centre was converted in an Ebola Holding Centre, an isolation centre for suspected cases. Positive patients were referred to the ETC.
The Lakka Centre was built in only two weeks and was meant to last no more than six months. However, a continuous effort was made to improve the standard level of care: three back-up systems ensured functioning continuity of the electrical system; hydraulic systems (including the chlorine system) were designed to minimize the risk of cross infection and reduce the procedures that the staff had to perform in Personal Protection Equipment (PPE). Tents were progressively furnished with monitors, intravenous stands, infusion pumps and oxygen concentrators not only to allow a safe isolation for patients, but also to guarantee adequate levels of care according to the severity of the disease. Tents were additionally equipped with air-conditioning to guarantee medical staff to safely spend a longer time with patients. A biochemistry laboratory was set up to permit correction of electrolyte balance, monitor and treat organ dysfunctions caused by the disease.

EMERGENCY enlarged its activity in the fight against Ebola with the opening of the **First Aid Post in Waterloo**, a refugee camp where 22,000 people have lived for over 15 years, in the attempt of containing the spread of the virus, which had already infected more than a hundred people.
We had four nurses working at Waterloo using triage for suspected cases and transferring them to the Treatment Centre, if necessary. To tackle the spread of the virus, we involved the entire community: we trained 90 healthcare operators in IPC and contact tracing technique. Divided in thirty teams of three people each, healthcare operators were assigned specific sectors of the camp to identify people that had come in contact with Ebola patients and monitor them daily. Thanks to this project we were able to spread the basic knowledge of prevention measures within the community.
The Waterloo experience was a great success for the community and EMERGENCY. The community became Ebola-free in less than 70 days, starting with more than 150 confirmed cases.

ACTION PROPOSED

From the experience gained in treating patients at the Lakka Centre, EMERGENCY understood that EVD commonly causes critical illness, which requires advanced organ supportive care.
Indeed, all EVD-positive patients treated in Western countries received intensive care resulting in a better outcome as compared with patients treated in West Africa.
Considering these elements, EMERGENCY decided to approach the treatment of patients improving existing standards of care. First step was building an appropriate environment for an ICU, furnishing units with proper equipment and guaranteeing continuous and specialised clinical staff presence at the bedside.
We based our action on the scheme proposed by some international intensive care specialist (figure 1).
Since EMERGENCY mission is to deliver the best possible care in low resource settings, our approach focused on rapidly achieving the desired standards of treatment in order to be effective during the peak of the outbreak (figure 2).

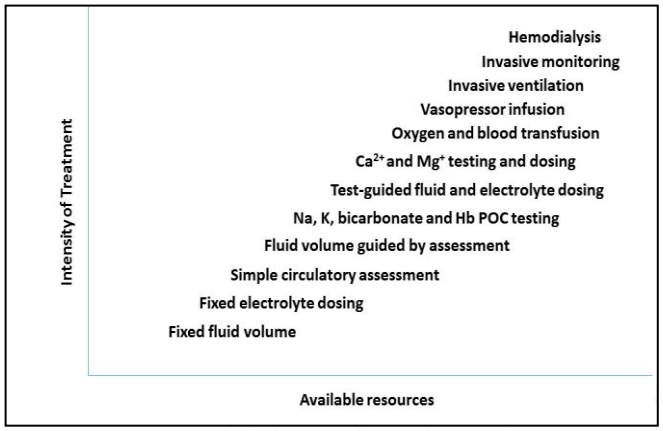

Fig. 1 From Pemer et al. Ebola care and research protocols Intensive Care Med (2015) 41:111–114

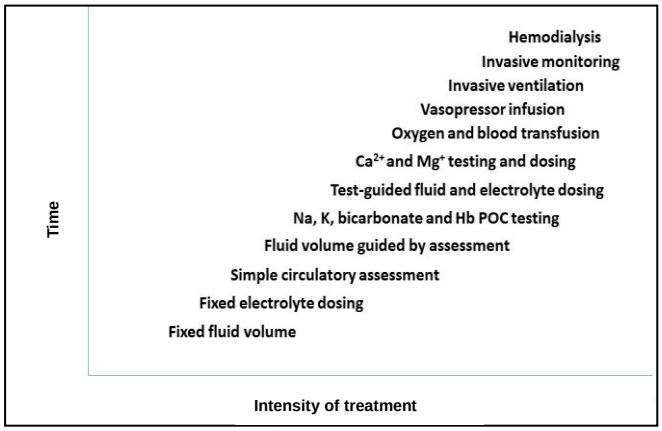

Fig. 2 EMERGENCY approach

METHODOLOGY

On 13 December, EMERGENCY opened a 100-bed Ebola Treatment Centre in Goderich. The Centre was constructed in just 6 weeks and funded by the British Government's Department for International Development (DFID). The Centre was divided in different areas according to the different levels of the disease: the ICU with 24 beds for most severe patients, a ward of 48 beds for less difficult patients and 28 beds for convalescents. With the closure of the Lakka Holding Centre on 28 February 2015, we transferred the Holding Unit to the ETC of Goderich.

The Intensive Care Unit set up a revolutionary standard for the treatment of EVD in West Africa. Two specific designed buildings were realized in few weeks to treat up to 24 severe cases with the highest treatment standards. The logistic team designed and improved every technical aspect of the facility in constant cooperation with the clinical staff.

The intensive care unit was equipped to the standard of hospitals in Western nations, with ventilators, dialysis machines, infusion pumps and monitors.

EMERGENCY hospital was the only centre for EVD designed in West Africa to guarantee an isolated, air-conditioned and clean environment, which could allow sterile manoeuvres and invasive procedures. The ICU was built to have a temperature of 21°C and a maximum of 40% of humidity 24 hours per day (weather conditions could reach 38°C and 75% humidity). These conditions allowed for the first time to have a high number of operators working safely in a red area ensuring the best possible care to EVD patients.

This highly technological equipment required the adoption of an innovative approach since there were no previous experiences and *know-how* about how to manage an ICU in a comparable context. Energy supply and management of sophisticated equipment were the most demanding technical aspect. For instance, the transportation of CVVH machines required a good quality of stabilized electricity, a perfectly levelled floor, controlled temperature and humidity and protection from chlorine (the most common solution to deactivate the virus).

At the Centre, we set up a polymerase chain reaction (PCR) test laboratory, working together with the "Lazzaro Spallanzani" National Institute of Infectious Diseases to test patient blood samples for the Ebola virus. Laboratory activity fastened PCR results and diagnosis so as to decrease the risk of infection during isolation and provide proper treatment both for negative and positive patients.

During the peaks of the outbreak, one of the main challenges is the clinical management of severe patients in need of intensive care simultaneously admitted at the ETC. This implied the need for a high number of qualified health personnel in order to guarantee a high-quality medical treatment on 24/7 basis. ICU services included bedside nursing and physician presence, non-invasive and invasive monitoring for heart and respiratory rate, blood pressure, pulse oxygen saturation, neurological status, temperature, electrocardiographic monitoring, ultrasound and digital X-ray capabilities.

Treating a high number of EVD patients also entailed the responsibility to collect an important amount of clinical data (e.g. blood analyses, PCR results, vital signs, clinical observation). Data collection is indeed crucial to allow the scientific community to study the disease. Since the very beginning of its initiative, EMERGENCY adopted a rigorous clinical approach. This innovative (at least in Africa) methodology required as many innovative solutions to ensure an effective data collection and communication system from the high-risk area to other departments of the hospital. Radio, WI-FI, intranet systems and dedicated software were set up and tested to overcome this challenge.

The construction of the ICU and this scientific approach also had the effect of attracting qualified professionals *in loco* for studying the pathology and trying to understand the impact of the virus on different organs and human systems.

RESULTS

Focusing on improving the level of care in a limited timeframe, EMERGENCY was able to progressively provide patients with higher and higher standards of treatment during the peak of the outbreak.

EMERGENCY admitted patients both in Holding Unit and Treatment Centre.

Altogether we isolated 431 patients for suspected EVD at the Lakka Holding Centre and 239 patients at the ETC Holding Unit.

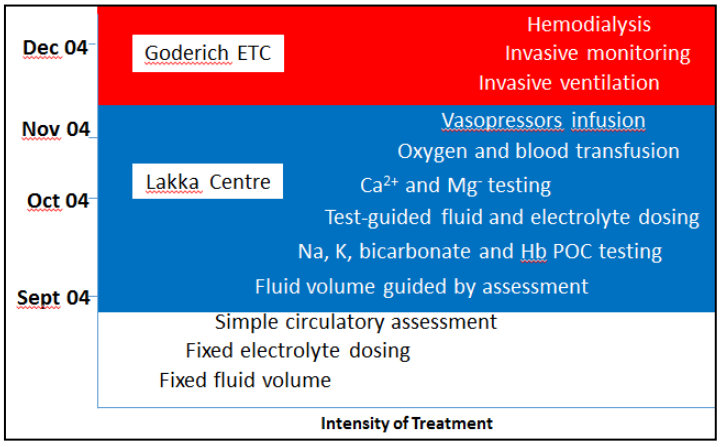

Fig. 3 EMERGENCY level of care throughout the epidemic

From 18 September to 13 December, we treated 107 patients at the Lakka Treatment Centre, while, from 13 December to 31 May, 106 patients were admitted in the ETC of Goderich. Out of latter, 53 survived. All patients were admitted in the ICU, where they had initial clinical and laboratory tests to

assess disease severity, in addition to a minimum of 24-hour continuous vital signs monitoring and intravenous treatment. Disease severity and consequent need of treatment largely varied among our patients, ranging from very mild symptoms to *walk and die* patients. One of the main challenges was to simultaneously and intensively support clusters of patients arriving in critical conditions.

EBOLA TREATMENT CENTRE OF GODERICH - 13 December 2014 – 31 May 2015	
	PATIENTS
Admitted	106 (54 female, 52 male)
Survived	53 (26 female, 27 male)
Dead	53 (28 female, 25 male)
Average age mean +/- SD (range)	31,80 ± 16,2 (1,5 – 80)
Average age of dead patients mean +/- SD (range)	32,84 ± 18,06 (1,5 – 80)
Average age of survivors mean +/- SD (range)	30,80 ± 14,18 (4 – 62)
Overall average length of stay (days)	8,9 ± 7,4
Average length of stay (days) – Survived patients	13,5 ± 7,8
Average length of stay (days) – Dead patients	4,3 ± 2,5
Central Venous Catheter monitoring	62
Intubation and mechanical ventilation	33
Continuous Renal Replacement Therapy (CVVH)	21
Indwelling arterial catheter	37
PICCO catheter monitoring	16

The intensive care made possible to safely deliver advanced and recent therapies used to treat different organ failures, such as Sepsis and Septic shock. For example, 6 EVD patients received the infusion of anti-endothelial damage drug FXO6 and 3 patients were treated with the extracorporeal cytokine adsorber Cytosorb.
In the light of the high level of clinical standards implemented at the ETC of Goderich, EMERGENCY was also eligible to take part to the Zmapp trial.

CONCLUSIONS

In the fight against Ebola, EMERGENCY thoroughly trained national and international staff and set up an efficient logistic system capable of increasing preparedness and improving the response to such a fatal disease.
Given the valuable experience acquired by our staff in simultaneously treating many patients in an ICU, our professionals represent a key resource for the international medical community in developing procedures and protocols to contain and treat the virus.
This model both in terms of technical knowledge and human capital will be easily transferable in the event of future epidemics not only in developing countries, but also in Europe.
Furthermore, thanks to the development of Standard Operation Procedures and the implementation of strict protective and preventive measures, EMERGENCY was able to ensure the continuity of activity at its Surgical and Paediatric Centre without admitting any EVD-positive patient.
With an efficient and transparent allocation of resources, we successfully ensured the provision of high-quality services and demonstrated that proper treatment of EDV-positive patients is possible even in low resource settings.