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Letter to the Editor

The added value of long-lasting preparedness for the management of a patient with Ebola


In the interesting description of his experience in Sierra Leone, Satolli refers to an Italian physician from the Emergency team who developed the infection in Africa and was urgently airlifted by the Italian Air Force [1]. The patient, a 50-year old male, was admitted to the L. Spallanzani National Institute for Infectious Diseases (INMI) on November 25, 2014. During his stay which lasted 5 weeks, he received different experimental treatments and needed intensive care support for 7 days. The patient recovered fully and was discharged on January 2, 2015 [2]. No secondary cases occurred. Treating an Ebola patient in an effective and safe manner is a challenge, and requires a strong background in preparedness, including logistics, procedures and skills, all of which are available at INMI, thanks to a 20-year long preparedness activity for rapid diagnosis and appropriate caring of patients with highly infectious diseases (HIDs).

Over the years, INMI developed a hospital preparedness model, continuously refined and employed during all recent events involving emerging or re-emerging HIDs [3,4]. In 1995 INMI was identified by the Italian Ministry of Health as the national reference centre for the management of patients affected by naturally occurring HIDs, such as viral hemorrhagic fevers. A few years later, the Institute was made the national centre for cases of deliberate release of biological agents (in late 2001) and for severe acute respiratory syndrome (SARS) in 2003. INMI also became a WHO Collaborating Centre for clinical care, diagnosis, response and training on HIDs. Finally, in 2009 and in 2014 it was confirmed by the Ministry of Health as the national reference centre for patients with Ebola Virus Disease during the current West African outbreak.

Our hospital preparedness model is based on the following independent but mutually beneficial pillars.

Specific vehicles for transport: a long-lasting collaboration with the Italian Air Force, already employed in the past for the transport of other patients with suspected HIDs, was used for the bio-containment transport from Sierra Leone, using a dedicated aircraft with an air transport isolator (ATI). On the ground, the patient was transported by using a special ambulance, fitted with double chambers, isolated driving cabins, negative pressure and HEPA filters for expelled air, and was placed inside a stretcher transport isolator (STI) also fitted with HEPA filters. The patient was moved from the ATI to the STI in a way that preserved the biocontainment condition, following procedures already established and exercised in the past with the Italian Air Force.

Logistics for effective isolation: having arrived at INMI, the patient was admitted into a high isolation unit (HIU) placed inside a dedicated ward and later transferred to another special HIU with Intensive Care capabilities (HI-ICU, see figure) for seven days, when his condition worsened. Both units are sealed and equipped with anteroom, negative pressure, HEPA filtration of exhausting air, dedicated pathway for patient

admission, and two separate staff entry and exit routes with dedicated areas for PPE donning and doffing. The HI-ICU is also equipped with a dunk-tank for decontamination, and special procedures for autoclaving.

High-level infection prevention and control (IPC) expertise: during the last 20 years, IPC procedures have been updated several times, in consideration of the referral role of the Institute. In particular, during the SARS crisis in 2003 and the Influenza A-H1N1 pandemic in 2009, the PPE policies and patient admission flow were extensively revised. Since the start of the current EVD emergency, our protocols for the management of VHF patients have been reviewed and updated, covering all aspects of IPC (e.g. PPE policies, cleaning and disinfection, waste management, handling of bodies and policies for staff safety and surveillance) according to the evolving situation and knowledge.

A wide choice of PPE, i.e., boots, aprons, hoods (covering head, neck, and shoulders), head-to-foot impermeable biohazard coveralls, fluid-resistant FFP3/N95 respirators and goggles, or Powered Air-Purifying Respirators (PAPR) are used as appropriate for the necessary protection level.

Diagnostic capabilities: INMI can draw from consolidated experience and practice, and has the capacity to conduct advanced laboratory tests, including all agents of viral hemorrhagic fevers, other HIDs, and other relevant agents for differential diagnosis. The Institute has cabinet-line BSL-4, and BSL-3 laboratories. The virology laboratory operates within an international network of BSL-4 facilities that exchange data, specimens, reagents, and provide validation of diagnostic tests and research results [4]. The INMI is also equipped with a BSL 3-like autopsy suite, and has specific procedures for safely performing diagnostic medical imaging if necessary.

Well-trained and skilled clinical staff: a long-standing multidisciplinary task-force of infectious disease, epidemiology, laboratory and intensive care experts has been re-training intensively since August 2014, mainly focusing on PPE donning/doffing procedures. The rest of the staff, especially those working in the admission department received dedicated training sessions on the disease, in preparation for EVD triage procedures.

International collaborations: INMI is involved in several preparedness and research projects and networks, works in close collaboration with the European Commission, ECDC, WHO and other International Public Health bodies, and is an active member of the Global Outbreak Alert and Response Network. The Institute has coordinated EU co-funded projects on different aspects of preparedness and response to infectious disease emergencies since 2004 (EUNID and EuroNHID: two networks of European isolation facilities for HIDs; EuroNet-P4, ENP4-Lab, and QUANDHIP as co-coordinator: networks of BSL 3/4 laboratories; and ETIDE, a European Programme for training on HIDs) [5]. These long-term connections have been very useful, for example, in obtaining experimental drugs.

Field experience: soon after the identification of the EVD outbreak, INMI participated in the deployment and management of 4 mobile laboratories (in Guinea, Nigeria, Liberia and Sierra Leone) under the

“European Mobile Laboratory for BSL4 agents” project, providing teams of virologists for a total of 19 shifts in 1 month. In August 2014, answering a WHO request, INMI sent an experienced clinician to Nigeria, in order to provide clinical expertise and technical support for the management of the special Ebola isolation unit in Lagos. In February 2015 an IPC expert went to Sierra Leone, to support the re-opening of a local general hospital in the context of the EVD outbreak. In October 2014, an experienced project manager from INMI was appointed by the Italian Ministry of Foreign Affairs as Chief and Project Manager of the Italian intervention in Sierra Leone.

In conclusion, the preparedness model of the INMI hospital represents an example of well-functioning collaboration and coordination. The rapidly and continuously evolving pattern of infectious diseases represented a constant challenge for our Institute. Tackling an epidemic event today, as well as a single case of HID, requires a broader view, not limited to medical management. Given this scenario, INMI has planned its development with a focus on technological innovation, multidisciplinary integration and international collaborations. All these activities represent an added value for the Institute and for the whole country, and contributed to the successful management of the EVD patient, in a collaborative and safe environment for the whole staff.

Conflict of interest

All authors declare no conflict of interest.

Acknowledgements

The INMI's preparedness and response has been supported over the years by grants from: Italian Ministry of Health (Ricerca Corrente and Ricerca Finalizzata ICS 120.5/RF 98.87, 102/2001, PF/DIPIA/UO10/1999, 138/2002, 4AD/F8; 528/C3/2005, 4118/2005; 28C5/2006, 76/2006; 07.109-9AAF/P2); CCM (PISEB2006); European Commission DG RTD, SANCO and DEVCO (EUNID 2003207, EURONET-P4 2003214, ETIDE 2005202, EuroNHID 2006205, ENP4Lab 2006208, ESF 245214FWC2009/2, ESF 258614FWC2011/2, HEIBL 20084152, PREDEMICS 278433, EPISARS SP22-CT-2004-511063, ENIVD 2004206; RiViGene SSPE-CT-2005-022639, EPISOUTH plus 20091105, ERINHA 262042-2010, EVA 228292;

QUANDHIP EAHC2010-21-02, ML4CB/EMLab, IFS/2011/272-372); WHO (FMGOCT2009); and Italian Ministry of Foreign Affairs- (DGCS AID 8282, 8785, 9562, AID 010398/02/1).

References

- [1] Satolli R. Ebola seen up-close. *Eur J Intern Med* 2015 Feb;26(2):80–1.
- [2] INMI. Medical report of January 2nd. [Italian]. Available at http://www.inmi.it/file/00_bollettino_medico_n24.pdf; 2015.
- [3] Ippolito G, Nicastrì E, Capobianchi M, Di Caro A, Petrosillo N, Puro V. Hospital preparedness and management of patients affected by viral haemorrhagic fever or smallpox at the Lazzaro Spallanzani Institute, Italy. *Euro Surveill* 2005 Mar; 10(3):36–9.
- [4] Nisii C, Castilletti C, Raoul H, Hewson R, Brown D, Gopal R, et al. Biosafety level-4 laboratories in Europe: opportunities for public health, diagnostics, and research. *PLoS Pathog* 2013 Jan;9(1):e1003105.
- [5] Ippolito G, Fusco FM, Di Caro A, Nisii C, Pompa MG, Thinus G, et al. Facing the threat of highly infectious diseases in Europe: the need for a networking approach. *Clin Microbiol Infect* 2009 Aug;15(8):706–10.

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