

**THE NICD/NHLS EBOLA MOBILE DIAGNOSTIC LABORATORY IN SIERRA LEONE ON THE
FRONTLINE OF THE WAR AGAINST EBOLA CRISIS
(NICD MLU SECOND REPORT)**

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The first and wide-spreading emergence of Ebola virus disease (EVD) in West Africa has severe and increasing impact on public health, social life, national education programmes, and socio-economics, including trade, and tourism. EVD cases in West Africa are rising faster than the ability to contain the outbreak, and there is a great international concern that the exponential rise in new cases in recent weeks can become a worldwide disaster. In the three most affected countries, Guinea, Liberia and Sierra Leone, the number of new EVD cases is increasing faster than the capacity to manage them. There is an urgent need for rapid and larger international support, including doctors, nurses, medical supplies, diagnostic support, and other related aid to contain and control the EVD epidemic in West Africa, and consequently to prevent wider international spread. The deployment and sustainable long-term operation of mobile diagnostic laboratories is critical to bring the unprecedented EVD outbreak in West Africa under control. Would the EVD outbreak continue with recent trends, the case burden may gain an additional 77 181 to 277 124 cases by the end of 2014¹. The high toll of death amongst skilled and experienced healthcare workers severely impairs health care and research in affected regions². Establishment of rapid and more widely accessible diagnostic capacity in West African countries affected by EVD epidemic is one of the urgent priorities to prevent further acceleration of Ebola crisis. A current bottleneck in testing for Ebola virus infection leave patients stranded in isolation wards for days and thus contributes in raising fears of seeking treatment³.

The Centre for Emerging and Zoonotic Disease (CEZD) of the National Institute for Communicable Diseases (NICD), department of the National Health Laboratory Service (NICD/NHLS) has developed capacity for mobile diagnostic laboratory deployment in areas affected by outbreaks caused by highly dangerous pathogens. The NICD Mobile Laboratory Unit (MLU) for EVD diagnosis was established in Sierra Leone, Freetown-Lakka in the second half of August 2014 (see first report: www.nicd.ac.za)⁴ as a part of WHO-GOARN EVD outbreak response in West Africa. The operation of the NICD MLU in Sierra Leone is financially supported by the Ministry of Health of the Republic of South Africa. Some of the advantages of the MLU include: 1/ provision of rapid diagnostic capacity on the scene of EVD outbreak, 2/ alleviating the problem of logistics that may lead to delayed testing during outbreaks in remote areas when specimens have to be shipped to regional or international reference laboratories for testing, and 3/ aiding in patient management

The first team of the NICD MLU consisting of four NICD/NHLS staff members (Ms Chantel Le Roux, Mr Günther Meier, Dr Petrus Jansen van Vuren and Prof. Janusz T. Paweska, the MLU team leader) will continue the operation until 26 of September 2014, and then it will be replaced by the second NICD team (Ms Nadia Storm, Mrs Phumza Lekhuleni, and Mr Alan Kemp) after onsite training provided by the 1st team. The 2nd team is scheduled to arrive at NICD MLU at Freetown-Lakka on 23 September.

The NICD MLU in Sierra Leone is fully operational since 25 August 2014. The current optimal maximum Ebola diagnostic capacity of the laboratory is 58 specimens/per day. Specimens from suspected EVD cases are submitted throughout the day, sometimes until late night. The MLU operates in excess of 12 hours daily, and the major daily activities include: 1/operational checklists of biocontainment devices, preparation of decontamination solutions, logistical arrangements to ensure uninterrupted operation (e.g. timely purchasing and delivery of petrol for the generators, diesel for incinerator), 2/ reception of specimens, data logging and matching of blood samples with EVD case investigation forms, 3/ hot processing and aliquoting of specimens, 4/ RNA extraction and RT-PCR Ebola virus testing, 5/ Interpretation, recording, and updating of Ebola report database, 6/ reporting and consultation of results to the National Disease Prevention Center, the WHO Ebola Coordination Center, local doctors and hospitals/Ebola treatment facilities, 7/ incineration of laboratory bio-waste, and 8/ training of local staff: 4 local staff members are trained in RT-PCR Ebola diagnostic, data capture, MLU operation and logistics, including bio-hazard protection and bi-waste disposal.

During the period of 25 August to 21 September (four weeks of operation) the NICD MLU tested 910 specimens (752 whole blood samples, and 158 oral swabs) from EVD suspected cases originating from north and west regions of Sierra Leone. Of the total of 910 suspected EVD cases, 548 (60.22%) were positive by RT-PCR, (Table 1, Figure 1). Of the total of 158 buccal swabs, 62 (39.2%), and of the total of 752 blood specimens, 486 (64.62%) were positive. On average 32.5 specimens were tested daily, increasing from 18.43 in the first week of operation to 51.29 in the fourth week of operation (Table 1, Figure 2). During the latter optimal maximum daily diagnostic capacity was exceeded on two occasions from 58 to 85 specimens. By allocating extra working time this increasing demand for testing could be addressed, but such effort is not sustainable for a longer period of time. The increasing demand for Ebola diagnosis (Figure 2) and high expectation for shorter turn-around time necessitates up scaling the operation of the NICD MLU in Sierra Leone. This could be only achieved by provision of additional funding, training and deploying of more staff, the use of additional PCR and other related laboratory equipment, including automated system for RNA extraction.

One of the major problems encountered during the first 3 weeks of operation was the lack of consistent electricity supply; in fact during the first 3 weeks of operation, biocontainment negative pressure chamber, refrigerators, laboratory equipment, and including two Smart Cycler PCR machines were most of the time run using the generator shipped from South Africa. During the 3rd week of operation the SA generator broke down after 24 hours run for 6 consecutive days, resulting in suspension of MLU operation for half a day on the 4th of September. Extraordinary efforts were made by local authorities to supply an emergency generator and eventually the MLU resumed its operation the same day late at night. Since then the building where the NICD MLU operates is directly connected to the national electricity power grid as well as to emergency generator provided by the Sierra Leone Government.. Communication via internet, including reporting of results is very time consuming due to highly inefficient 3G cell phone network.

Table 1. Summary of RT-PCR Ebola results over a four week operation (25 August – 21 September 2014) of NICD MLU in Sierra Leone, Freetown-Lakka.

Week of operation	Tested	Positive	% Pos.	No.tested /day
Week 1	129	85	65.89	18.43
Week 2	171	95	55.56	24.43
Week 3	251	153	60.96	35.86
Week 4	359	215	59.89	51.29
Total	910	548	60.22	32.50

Figure 1. Daily RT-PCR Ebola results over a four week operation of NICD MLU in Sierra Leone, Freetown-Lakka.

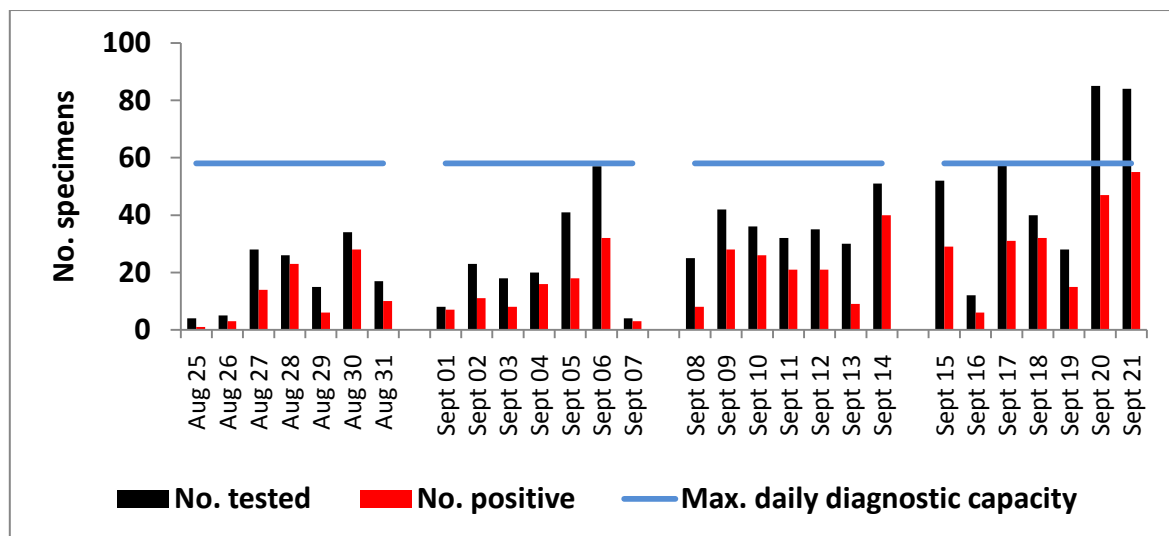
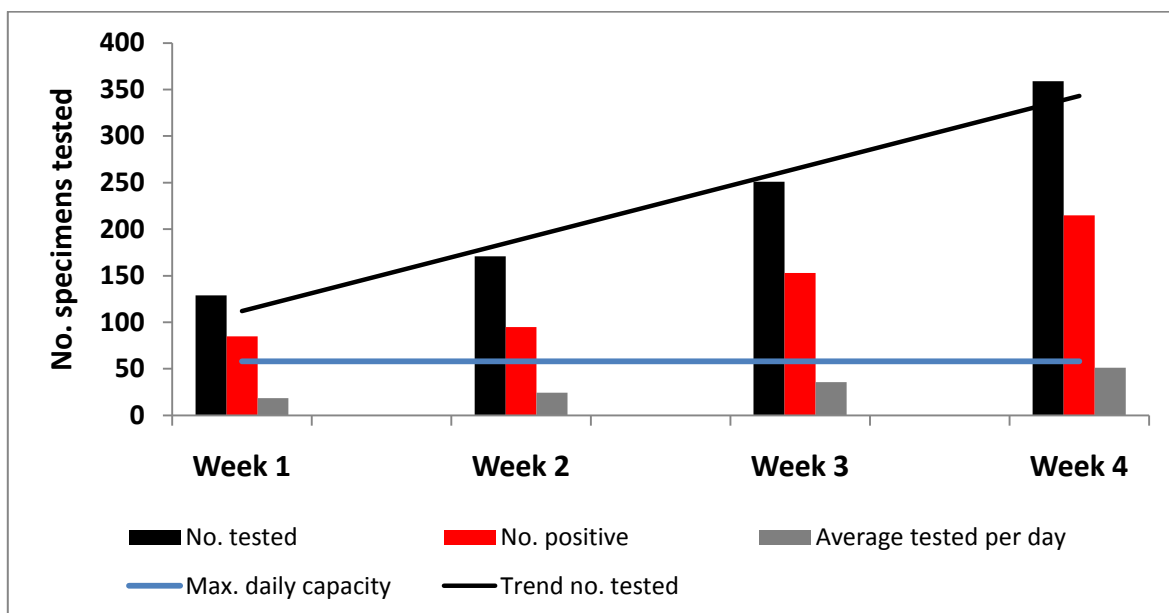


Figure 2. Trend in submission of specimens from suspected EVD cases to NICD MLU in Sierra Leone, Free Town-Lakka.





Local news papers describing the Ebola outbreak situation in Sierra Leone. One of the major contributory factors to the unprecedented spread of EVD in Sierra Leone is inefficient contact tracing. For example, as per a 15 September 2014 report, a total of 204 known EVD contacts had not been seen in the preceding 24 hours for daily monitoring⁵. Each untraced EVD contact represents a possible new transmission chain in the epidemic.



Training of local staff in using PPE (left), isolation and treatment facility at Freetown-Lakka located in close proximity to the NICD Ebola diagnostic laboratory (middle). It was opened on 18 Sept., and four days later all isolation and treatment wards (total 22 beds) were filled with EVD patients. Ambulance used for transportation of Ebola cases (right). As on 22 September 2014, all hospital wards designated for isolation and treatment of EVD patients in Freetown, the capital of Sierra Leone, were full.



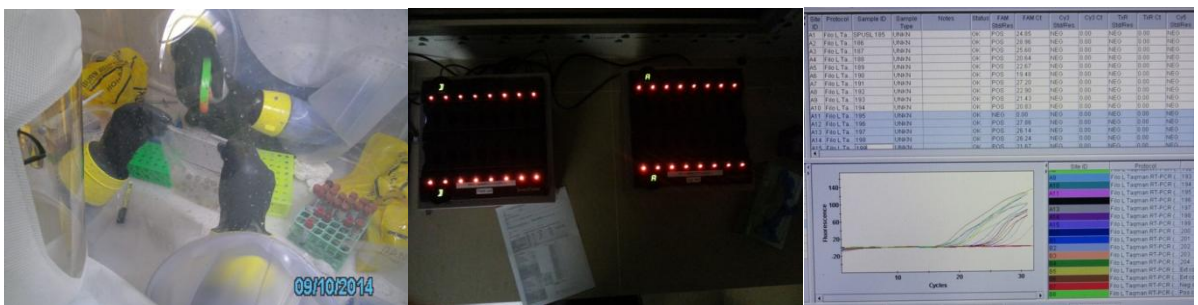
Specimens from suspected EVD cases are delivered by different modes of transport to the NICD Ebola diagnostic laboratory, often late at night and from locations far away from Freetown (left, middle). Reception of specimens from suspected EVD cases at NICD MLU (right).



Training of local staff in Ebola RT-PCR, biocontainment and logistic operational procedures.



Labelling of tubes for sample hot extraction (left), transportation of centrifuged blood tubes into negative pressurized glove box (middle), and sampling of blood for RNA extraction (right).



Tubes containing blood samples in RNA extraction buffer are placed in zip-lock bag filled with decontamination solution (“dunk tank”) before transportation out of glove box and biocontainment negative pressure chamber for further processing and RT-PCR testing (left). Two PCR Smart Cyclers fully loaded with samples from Ebola suspected cases, representing one full PCR run during which 29 specimens are tested. Optimal maximum capacity of NICD MLU is two full PCR runs, equal to testing of 58 submissions daily (middle). Most runs are very “hot” – high percentage of positive results of which many show a very high load of Ebola virus RNA copies per ml/blood (right).



Constant use of the SA petrol generator eventually led to its broke down. Local mechanics were called upon to source the required spares and to repair the unit operating the NICD MLU for 3 weeks (left). The 60kVA emergency generator to run the laboratory was supplied the same day by the Sierra Leone Energy Ministry (middle). The field incinerator used for the destruction of laboratory bio-waste (right).



Soldiers (left) and police (middle) patrolling the streets of Freetown during the 3-day “lock-down” of Sierra Leone for house to house Ebola sensitization. NICD MLU member being checked for fever by a security guard with an optical thermometer (right).



Visit to NICD MLU by Drs Marta and Andre involved in isolation and treatment of Ebola patients (left); Dr S. Kamara, Deputy Chief Medical Officer Ministry of Health SL (middle); Dr . A. Demby, U.S. Department of Health and Human Services and Prof. T. Ksiazek, University of Texas Medical Branch (right).

References

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