



Laboratory Response to the West African Ebola Virus Disease Outbreak in the Republic of South Africa, 2014-2015

Weyer J.¹, Msimang V.¹, Moolla N.¹, Leman P.¹, Grobbelaar A.¹, Ntshoe G.², Thomas J.²,
Blumberg L.², Paweska J.T.¹

¹Centre for Emerging and Zoonotic Diseases,

²Division of Public Health Surveillance and Response,

National Institute for Communicable Diseases/NICD, Republic of South Africa (RSA)

Transmission?

From reservoir to human population:

Contact with non-human primates? Bats? Bush meat?

From person-to-person:

Blood, bodily fluids, tissues of a person after first symptoms have developed

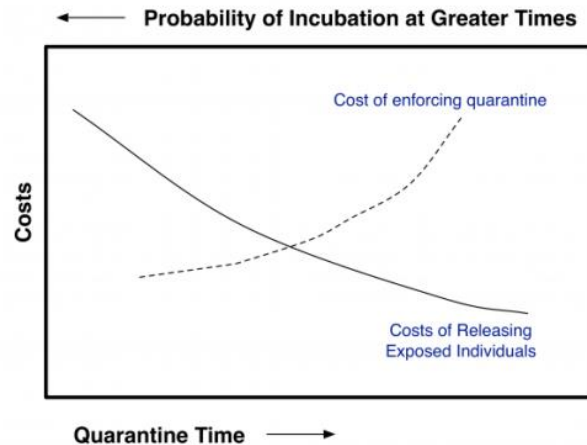
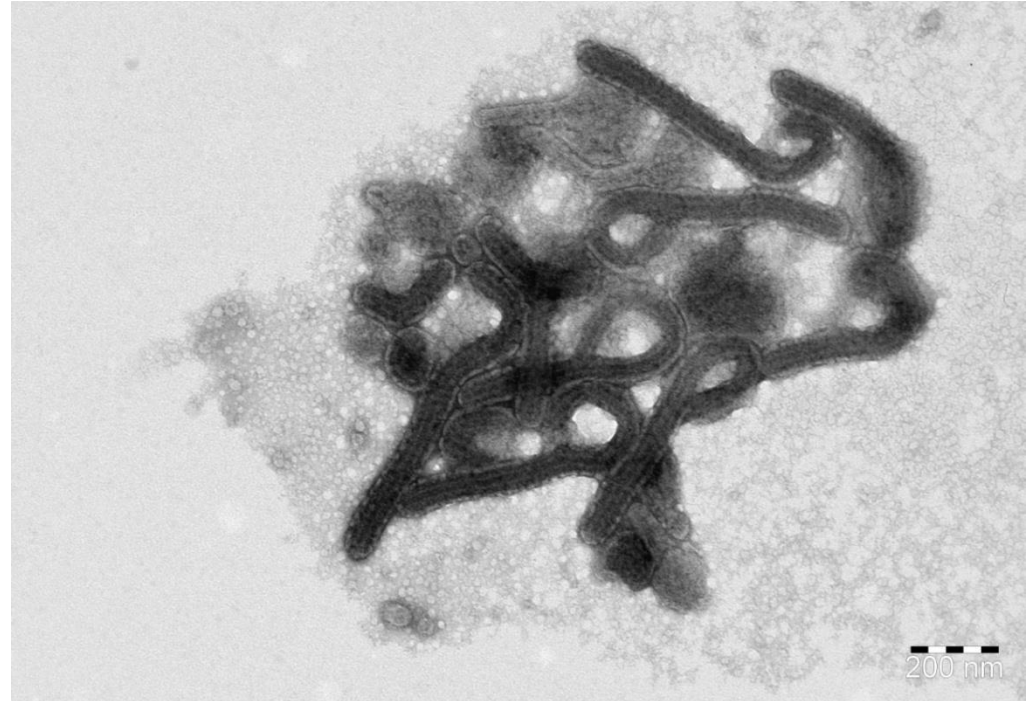
Cadavers: virus in dead bodies remain infectious for up to 60 days after demise

Semen (i.e. sexual contact): males may transmit virus for up to 3-7 months in convalescence

Nosocomial transmission: contaminated needles

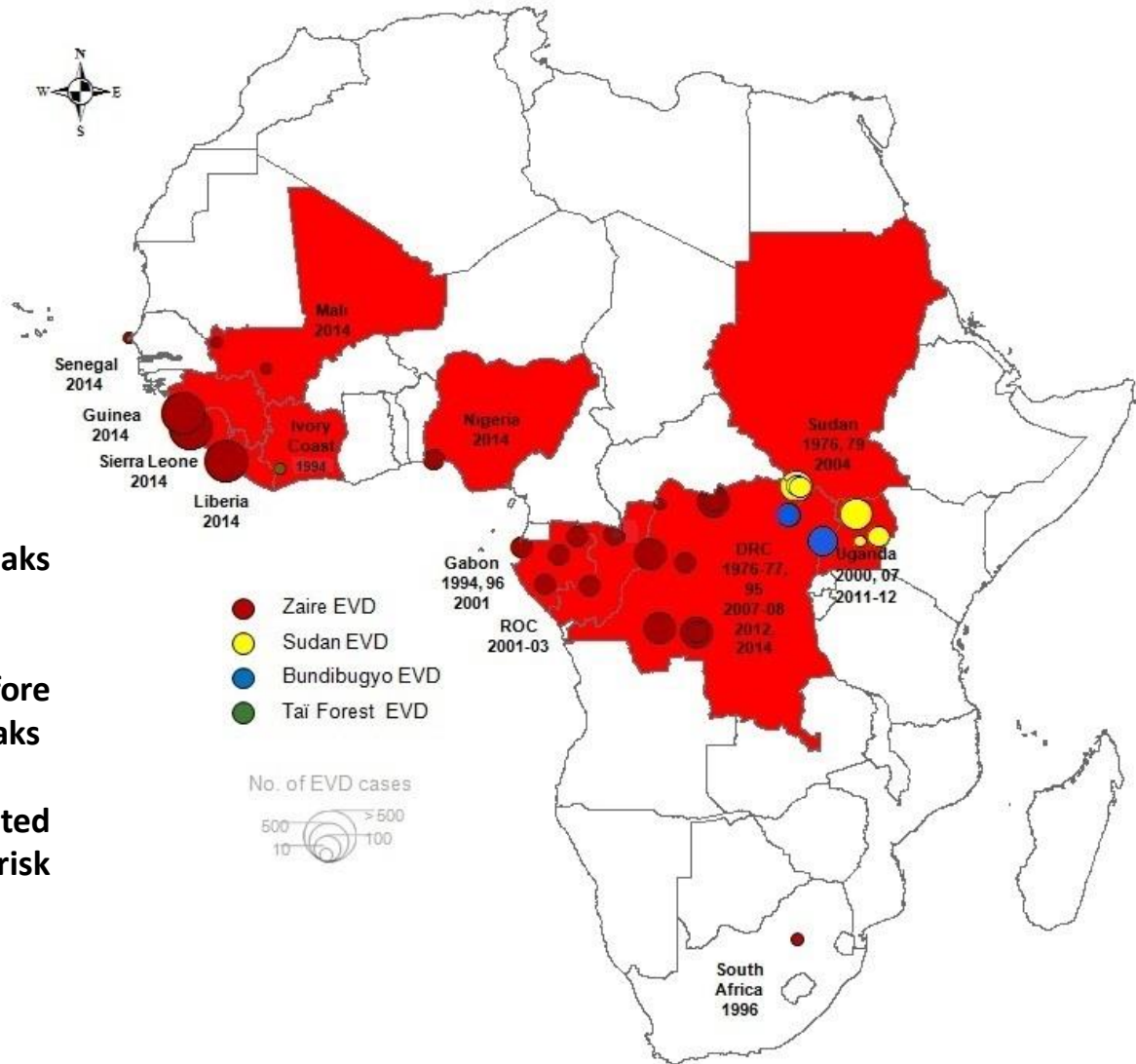
•Incubation period (m: 11.4 days, 2-21 d after exposure to virus)*

Electron micrograph of cluster of Ebola virions
(Courtesy: Dr Monica Birkhead, NICD)



Relatives of sick person and mourners are at high risk
Healthcare workers are at high risk
Those who treat and bury the bodies of the dead are at high risk

25 EVD Outbreaks in Africa



- 2292 EVD cases from 23 outbreaks in Africa during 1976-2012

- > 40% of EVD cases reported before 2014 occurred during DRC outbreaks

- Most are confined to isolated pockets in remote areas where risk of transmission is slight.

Timeline: West Africa EVD Spread

- December 2013:** Outbreak started in Guinea (Guéckédou).

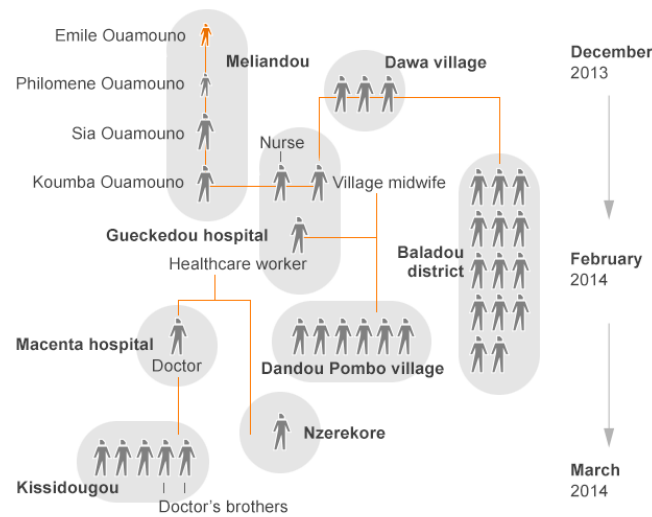


BBC NEWS
AFRICA

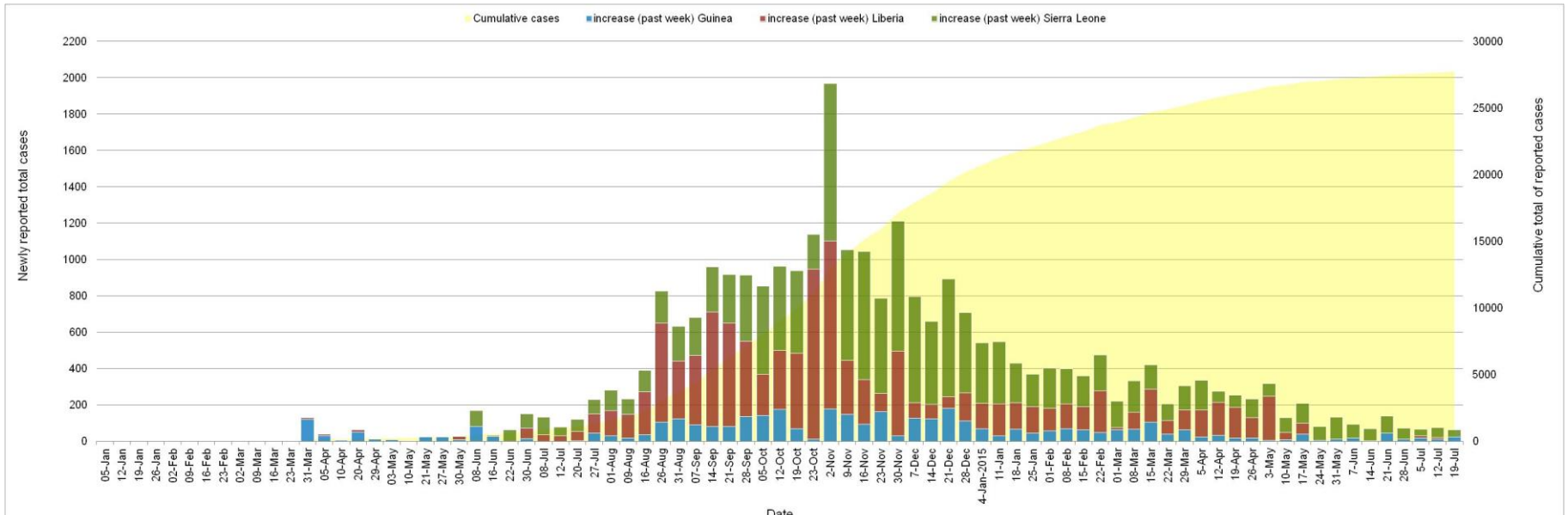
27 November 2014 Last updated at 00:32 GMT

How world's worst Ebola outbreak began with one boy's death

By Nassef Stylianou
BBC News



Source: New England Journal of Medicine



Graphs created from total case data reported by the Centers for Disease Control and Prevention and World Health Organisation as of 19 July 2015

Timeline: West Africa EVD Spread

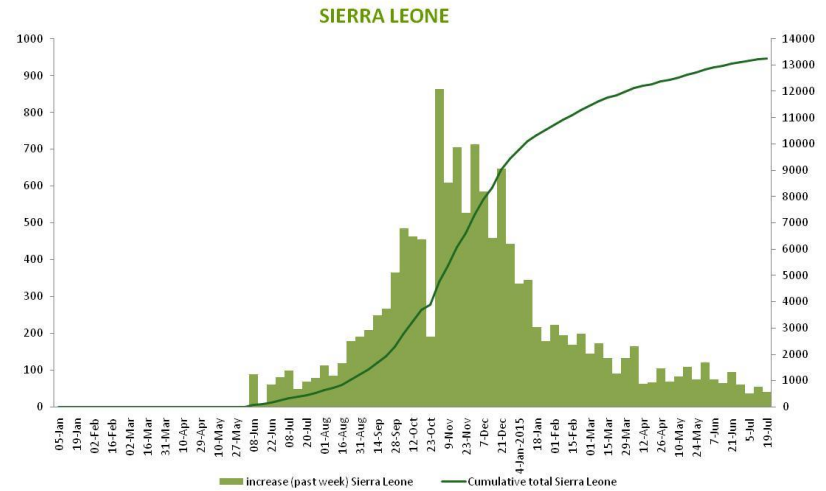
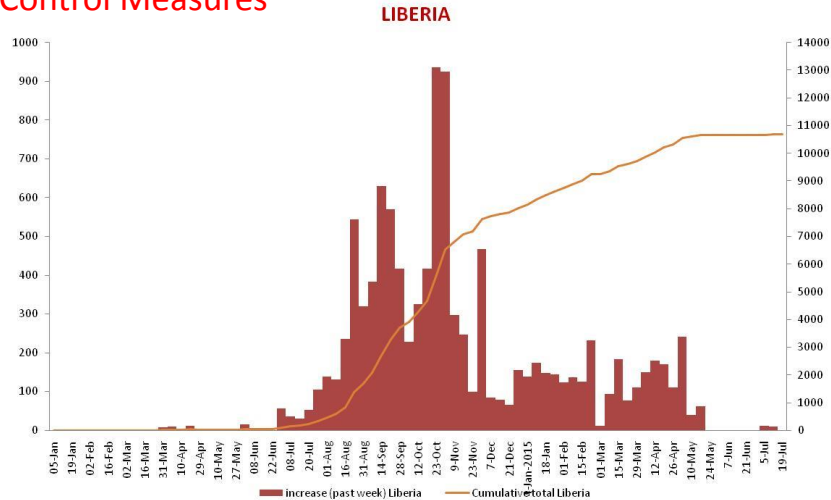
- **31 March 2014:** 122 cases in Guinea and 8 in Liberia when officially reported.
- **8 June 2014:** Sierra Leone first 89 cases reported.
- **20 July 2014:** First infected Ebola case introduced in Lagos, Nigeria ex Liberia. Nigeria >170 million people (Port Harcourt and Lagos).
- **6 August 2014:** Extra Ordinary Meeting of SADC Ministers of health on EVD in Johannesburg, South Africa: Concerted support in the event of an outbreak in any of the Member States as a way of containing EVD under WHO.
- **8 Aug 2014:** WHO IHR Emergency Committee meeting¹: Ebola outbreak declared as a Public Health Emergency of International Concern.
 - » Only the third time in the WHO's history: H1N1 declared as PHEIC in 2009 and Polio virus declared as PHEIC in 2014.
 - » Un preceded scale, geographic range, international spread to Nigeria, restrained public health capacity, dysfunctional health systems, a severe shortage of doctors, inexperience with Ebola outbreaks, high mobility and cross-border movement, high number of health care worker infections, high case-fatality ratio, extreme poverty and rampant fear.
 - » At that time in Guinea, 506 cases and in Liberia, 599 cases and in Sierra Leone 730 cases and in Nigeria, 12 cases (9-10 August 2014).
 - » No general ban on international travel or trade but no travel of EVD cases and contacts except for medical evacuation recommended by WHO.

¹ WHO. WHO statement on the meeting on the international health regulations emergency meeting emergency committee regarding the 2014 Ebola outbreak in West Africa. Geneva: World Health Organization Aug 8, 2014. <http://www.who.int/mediacentre/news/statements/2014-ebola-20140808/en> /(accessed Aug 20, 2014).

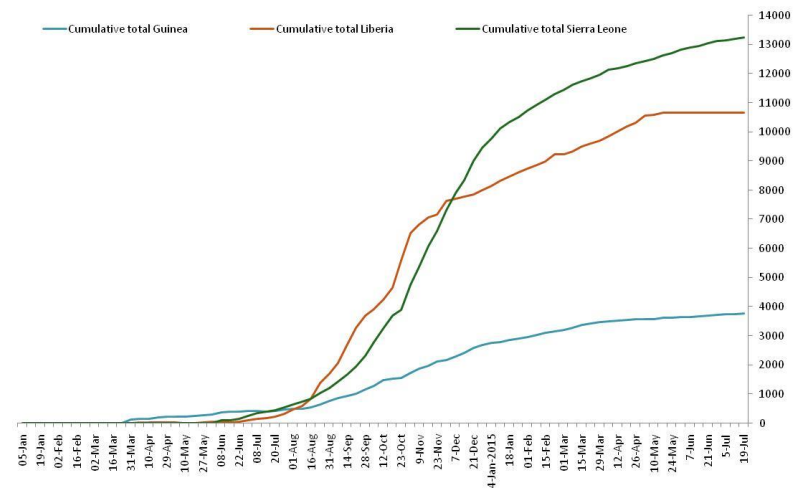
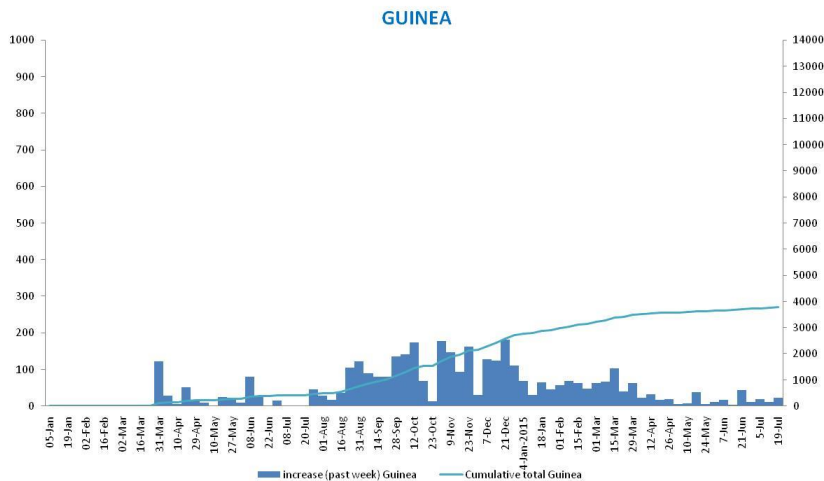
Widespread EVD transmission in Guinea, Liberia, Sierra Leone

Peak increase Liberia 935 cases 19-26 (23) Oct 2014
Former widespread transmission and Current, Established Control Measures

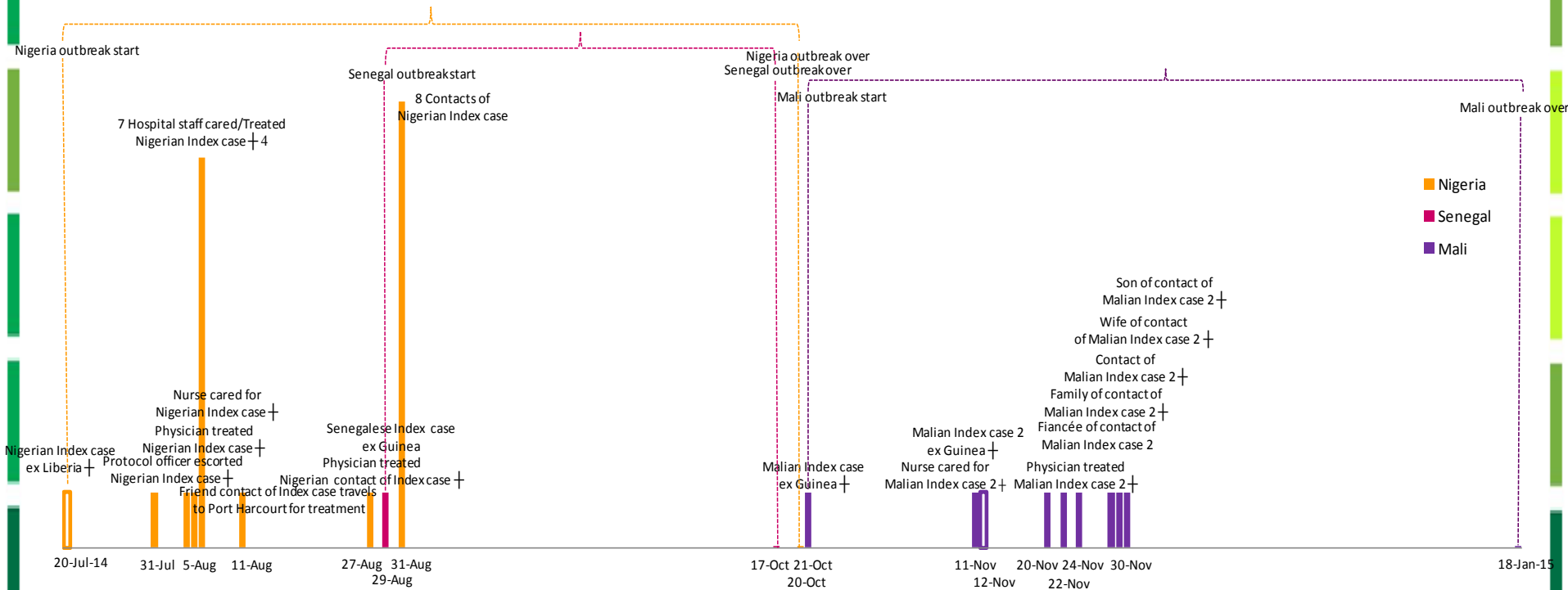
Peak increase Sierra Leone 863 cases 26 (23) Oct-02 Nov 2014



Peak increase Guinea 181 cases 14 -21 Dec 2014



Previously Affected: Nigeria, Senegal, Mali



- **17 October 2014:** Senegal declared Ebola-free
- **20 October 2014:** Nigeria declared Ebola-free
- **18 January 2015:** Mali declared Ebola-free

EXPORTATION OF EVD IN 2014-2015

Non-African countries	Total Cases	Lab Confirm Cases	Total Deaths
United States	4	4	1
Spain	1	1	0
UK	1	1	0
Italy	1	1	0
Total	10	9	7

..and so my fellow Americans the 2014 election really comes down to this..



... Are you safer today than you were four years ago?



African countries	Total Cases	Lab Confirm Cases	Total Deaths
Nigeria	20	19	8
Senegal	1	1	0
Mali	8	7	6
Total	22	21	8

100 nm

Risk of EVD Importation in South Africa?

- **South Africa top 15 country at risk of EVD case importation in the short term**

Gomes MFC, Pastore y Piontti A, Rossi L, Chao D, Longini I, Halloran ME, Vespignani A. Assessing the International Spreading Risk Associated with the 2014 West African Ebola Outbreak. PLOS Currents Outbreaks. 2014 Sep 2. Edition 1.

- **Ranks 17 in top ten final destinations from Guinea, Liberia Sierra Leone**

Poletto C, Gomes MF, Pastore y Piontti A, Rossi L, Bioglio L, Chao DL, Longini IM, Halloran ME, Colizza V, Vespignani A. Assessing the impact of travel restrictions on international spread of the 2014 West African Ebola epidemic. Euro Surveill. 2014;19(42):pii=20936.

- **21 August 2014: Travel ban** for non-SA citizens travelling from Guinea, Liberia and Sierra Leone to South Africa (except business and political). Medium risk Kenya, Ethiopia, Nigeria.



Timeline: African EVD spread and restrictions

- **17 August 2014:** The NICD establishes field Ebola Molecular Diagnostic Facility in Freetown-Lakka, Sierra Leone. Up to March 2015 eight teams deployed to operate the EMDF. Providing of local skills transfer for logistics, biosafety, diagnostic testing.



Timeline: African EVD spread and restrictions

- **24 August 2015:** Unrelated 7th EVD outbreak in Democratic Republic of Congo in Jeera County, Equateur Province since 1976
- **4-5 September 2014:** 2nd Extra Ordinary Meeting of SADC Ministers of health on EVD in Victoria Falls, Zimbabwe.
 - » Support to World Food Programme for provision of priority staple food to >1 million people under lockdown
 - » Considerable support from African countries under the U.N. - African problem
 - » Sub Saharan Africa's growth by 4.6% instead of 5% due to EVD, falling oil and commodity prices
 - » Diminished tourism throughout the African continent
- **22 September 2014:** 2nd WHO IHR Emergency Committee meeting
- **23 October 2014:** 3rd WHO IHR Emergency Committee meeting
- **20 November 2014:** DRC outbreak declared over with total of 66 cases.
- **21 January 2015:** 4th WHO IHR Emergency Committee meeting
- **10 April 2015:** 5th WHO IHR Emergency Committee meeting
- **9 May 2015:** Liberia declared Ebola-free
- **25 May 2015:** Travel ban lifted in South Africa from Liberia after declared EVD free on 9 May 2015
- **28 June 2015:** Man dies in Liberia of Ebola
- **7 July 2015:** 6th WHO IHR Emergency Committee meeting

South Africa's VHFs history and experience?

Viral Haemorrhagic Fevers

- **1996:** A physician who had been treating **EVD** patients in Gabon travelled back to South Africa. He developed **EVD** but recovered, however the nurse who was treating him in a Johannesburg hospital died of **EVD**.
- **2007:** A public health physician acquired **Lassa fever** infection while involved in an immunisation campaign in Nigeria. He was medevacuated and treated in South Africa. West Africa is endemic for this rodent borne arenavirus.
- **2008:** A patient with unexplained VHF was medevacuated from Zambia to South Africa. A new arenavirus, named **LuJo virus** was identified as the aetiologic agent. The index patient and three of the four healthcare workers involved died of **LuJo virus** infection.
- **1981-2015: CCHF** (Crimean-Congo Viral Haemorrhagic fever) is a tick-borne viral infection of animals and humans endemic in South Africa. Hundred-ninety-nine **CCHF** cases have been laboratory confirmed. **CCHF** is the most common VHF in South Africa, with an average of 7 cases reported annually.

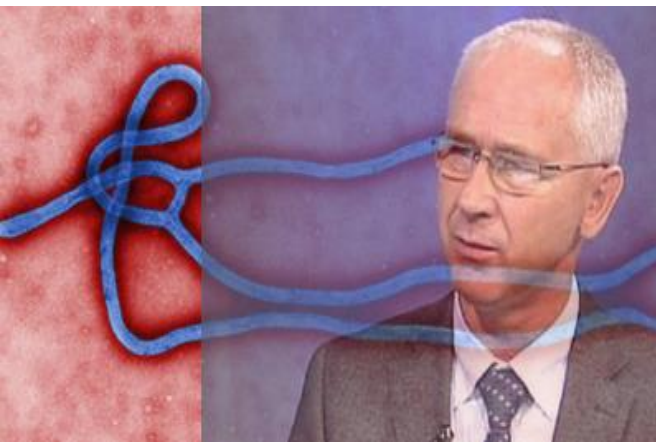
Preparedness: NICD responses

- Emergency Operating Centre established at NICD:
 - Co-ordination of multi-sectoral responses
 - Epidemiological investigations, Laboratory investigations; Social mobilization; Ports.
- SADC responses: appointment of NICD as referral laboratory

SADC Preparedness
Training held at NICD,
22-23 September 2014



Preparedness: NICD responses



JOHANNESBURG



PRETORIA



PRONTUIT

DR. JACQUELINE WEYER
WETENSKAPLIKE NIAS

Preventive Measures in South Africa



NATIONAL GUIDELINES FOR RECOGNITION AND MANAGEMENT OF VIRAL HAEMORRHAGIC FEVERS

2014

- MNORT
- NATHOC

Case definition:

Any person presenting with an acute onset of fever (greater than 38.6°C) with any of the following additional symptoms: severe headache, muscle pain, vomiting, diarrhoea, abdominal pain and unexplained haemorrhage who has: Visited or been resident in Guinea, Liberia, Sierra Leone or any other country reporting imported cases with local transmission in the 21 days prior to onset of illness **AND** Had direct contact or cared for suspected/confirmed EVD cases in the 21 days prior to onset of illness, or been hospitalized in Guinea, Liberia, Sierra Leone, Nigeria or any other country reporting imported cases with local transmission

OR Has unexplained multisystem illness that is malaria negative
Interview: Travel itinerary and activities, length of your stay and rate of transmission at the time

Preventive Measures in South Africa



PROCEDURE FOR SUBMISSION OF SPECIMENS FOR EBOLA VIRUS DISEASE INVESTIGATIONS IN SOUTH AFRICA

STEP 1: REPORT THE SUSPECTED CASE TO THE NICD TO ALLOW A RISK ASSESSMENT TO BE CARRIED OUT AND GUIDE LABORATORY TESTING

- Contact the NICD Hotline ☎ +2782-883-9920

STEP 2: COMPLETE THE CASE INVESTIGATION FORM

- Fully complete the case investigation form

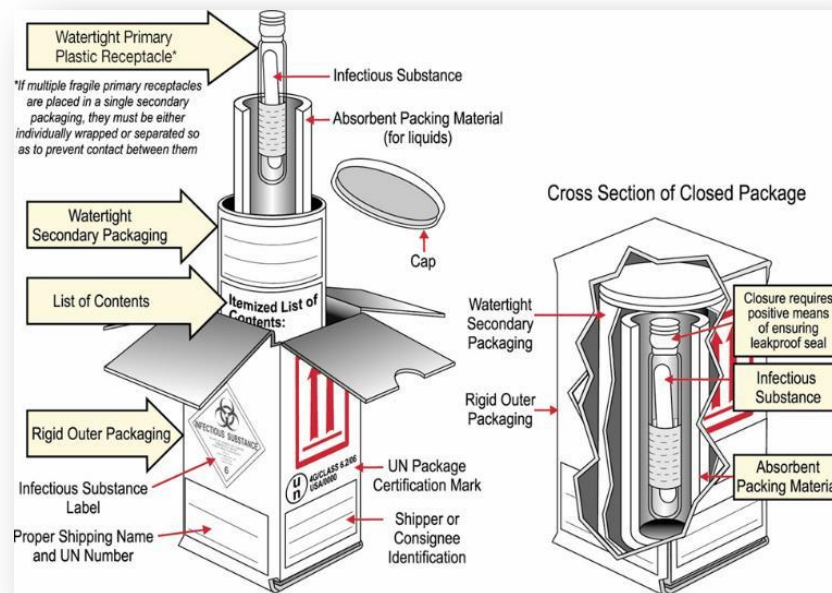
STEP 3: SUBMIT SPECIMENS FOR SPECIALIZED LABORATORY INVESTIGATION

- Submit both a clotted blood (red or yellow top tube) and EDTA treated tube (purple top tube) per patient
- The specimens should be packaged in accordance with the guidelines for the transport of dangerous biological goods (triple packaging using absorbent material) and transported directly and urgently to:

Centre for Emerging and Zoonotic Diseases
 Special Viral Pathogens Laboratory
 National Institute for Communicable Diseases (NICD)
 National Health Laboratory Service (NHLS)
 No. 1 Modderfontein Rd
 Sandringham, 2131

- Ensure the that completed case investigation form accompanies the specimens
- Samples should be kept cold during transport (cold packs are sufficient).
- Refer to guidelines available at www.nicd.ac.za for more information regarding transport arrangements.

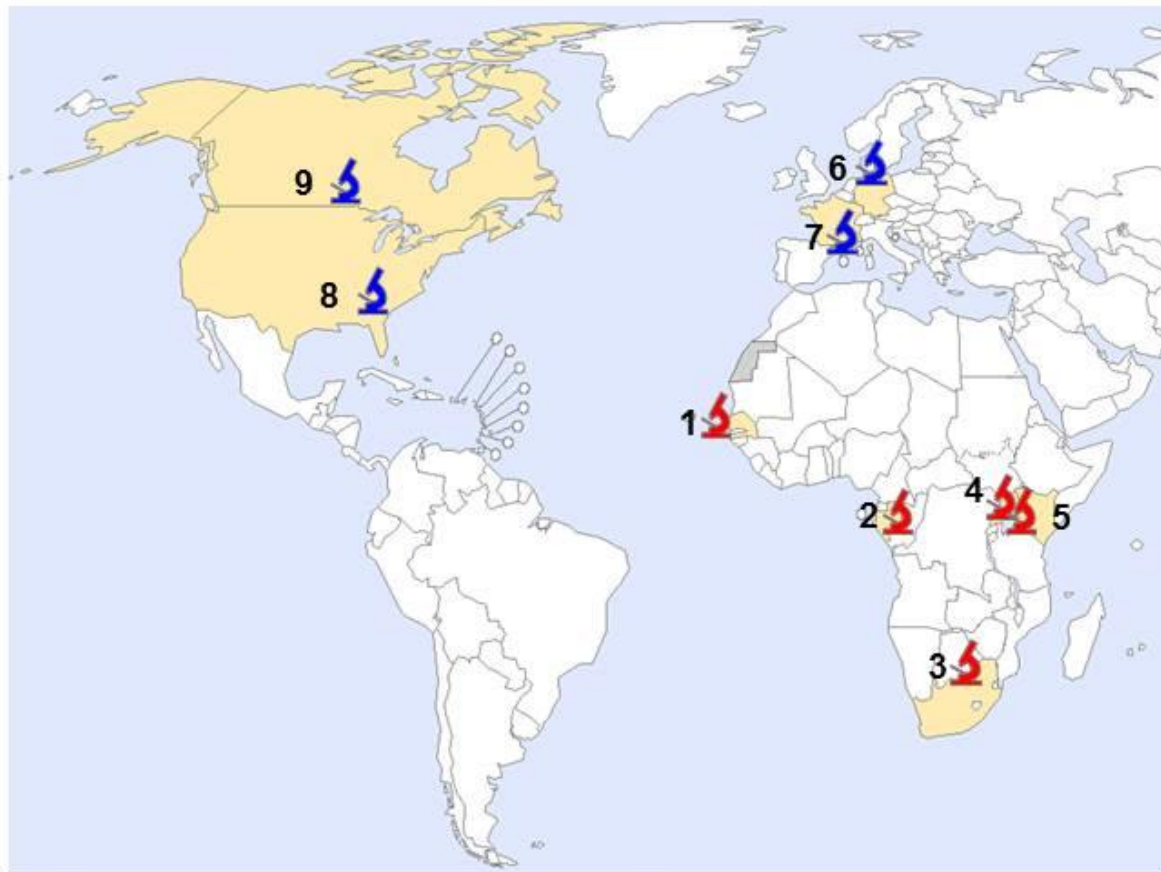
FOR MORE INFORMATION REFER TO THE GUIDELINES
 AVAILABLE FROM WWW.NICD.AC.ZA



Training offered to national participants and SADC in IATA Regulations for shipping of hazardous materials, December 2014
Training offered in EVD diagnosis, 2014: Ethiopia, Mozambique


Ebola Virus Disease in West Africa


EDPLN laboratories for Ebola or Marburg virus diagnostic



EDPLN : Emerging and Dangerous pathogens Laboratory Network

- 1  **Senegal**
Institut Pasteur de Dakar
- 2  **Gabon**
Centre International de Recherches Médicales de Franceville
- 3  **South Africa**
National Institute for Communicable Diseases
- 4  **Uganda**
Uganda Virology Research Institute
- 5  **Kenya**
Kenya Medical Research Institute (KEMRI)
- 6  **Germany**
Bernhard-Nocht-Institut für Tropenmedizin (BNI)
- 7  **France**
Institut Pasteur Lyon et Paris
- 8  **United States of America**
Centers for Disease Control and Infection
- 9  **Canada**
National Microbiology Laboratory
Public Health Agency of Canada

 AFR-EDPLN laboratories with capacity for Ebola or Marburg virus diagnostic

 Global EDPLN laboratories supporting the Guinea Ebola outbreak response

Source: WHO, 10 April 2014

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.
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Centre for Emerging and Zoonotic Diseases, Special Viral Pathogens Laboratory, Sandringham

Scientists working at Biosafety-level-4-facility at NICD



World Health Organization Collaborating Centre
for Reference and Research on Viral Haemorrhagic
Fevers & Arboviruses

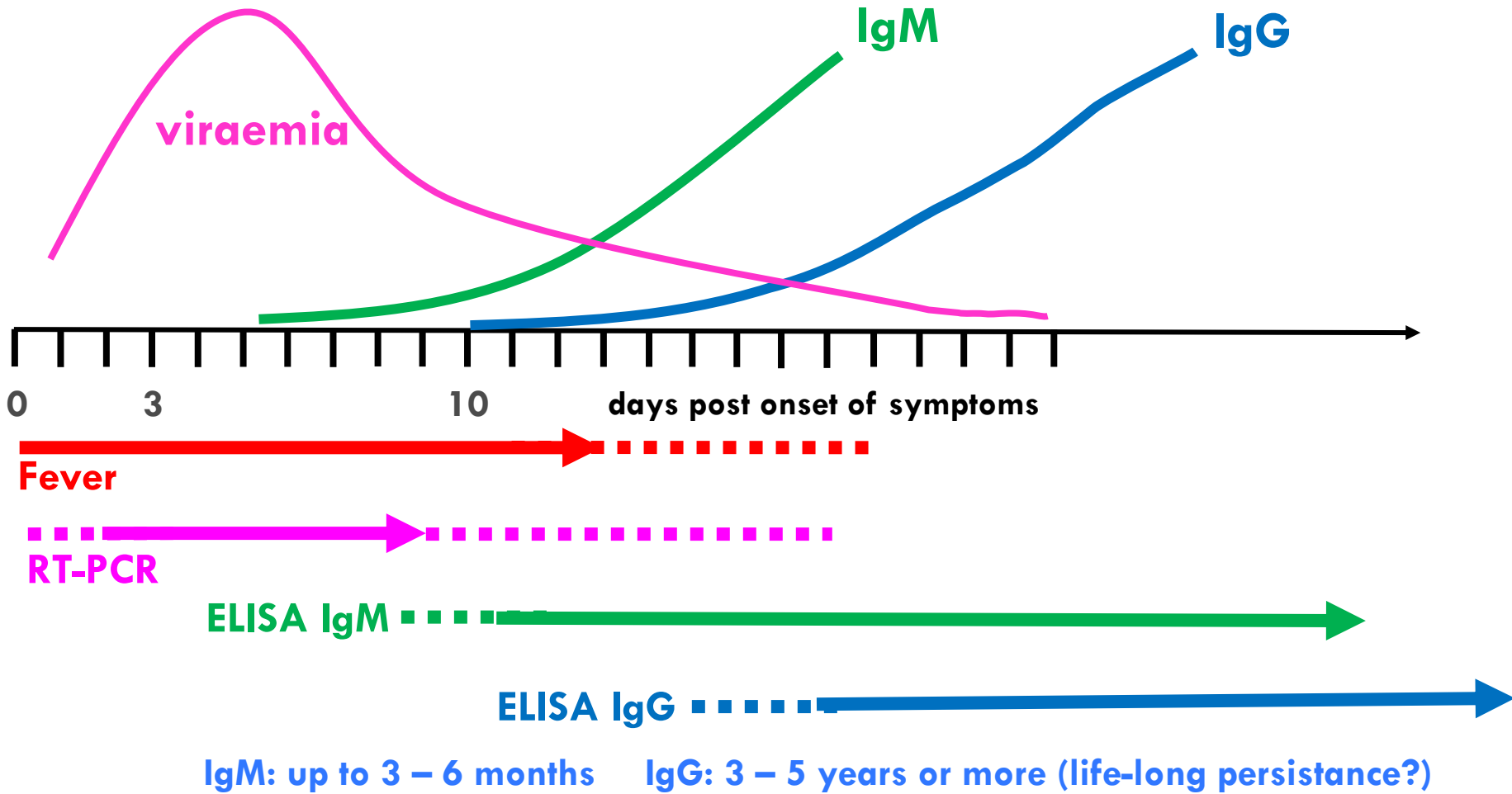


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COMMUNICABLE DISEASES**

Division of the National Health Laboratory Service

Comprehensive Diagnostic Approach

Critical information: Date of onset of fever/symptoms
Epidemiological link to EVD cases, or other relevant epidemiological history
Differential diagnosis?



Laboratory Investigations

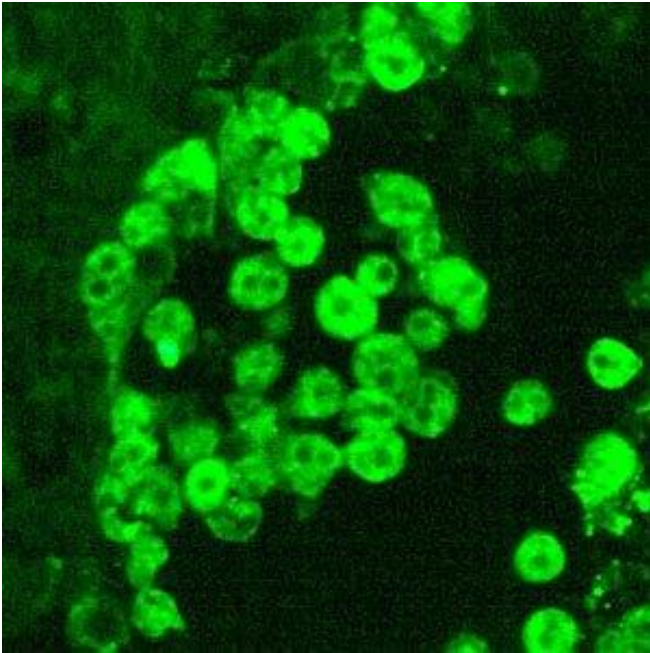
Molecular

NICD scientists performing RT-PCR on inactivated samples of suspected EVD patients



Laboratory Investigations

Serology

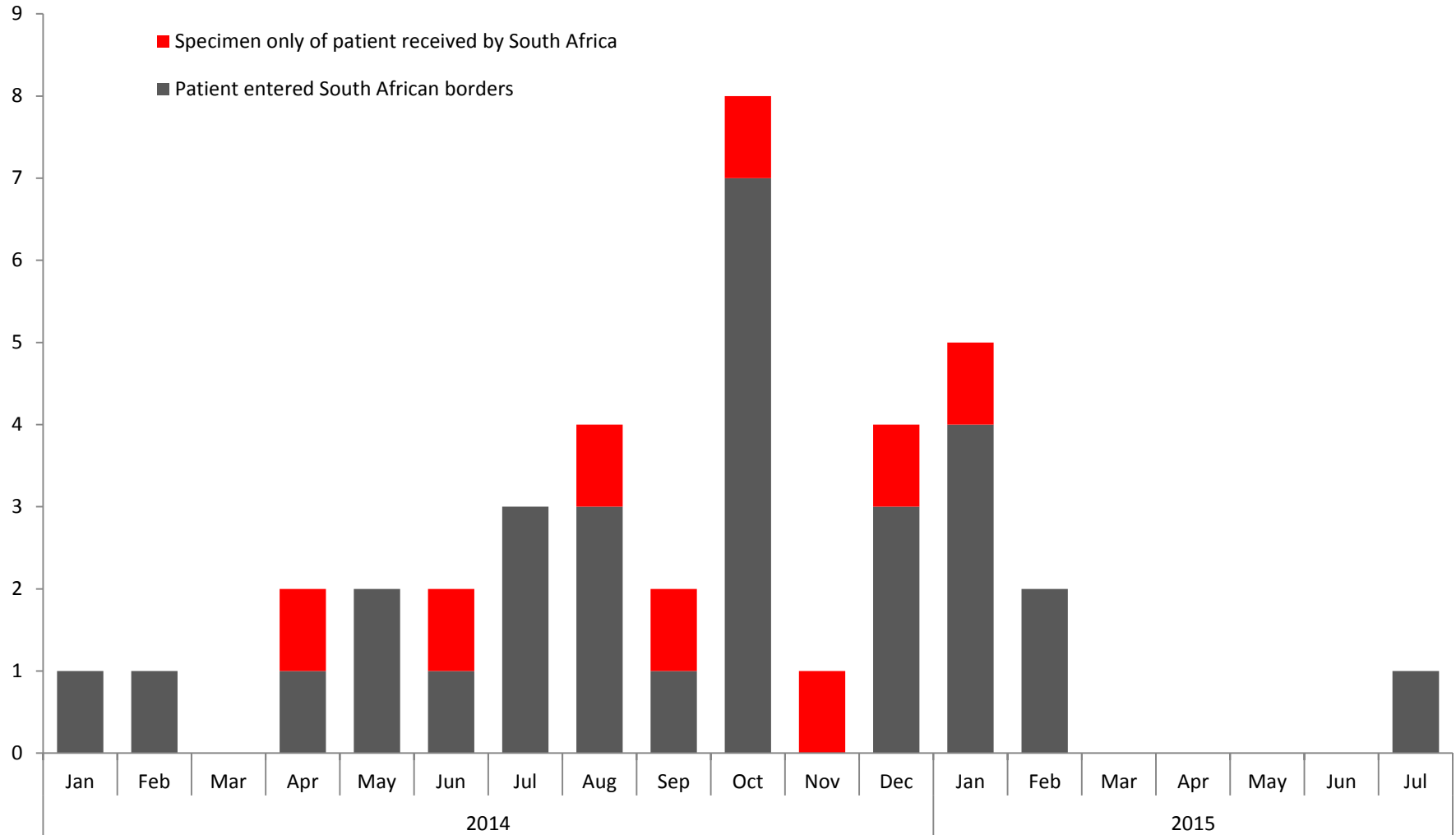


Laboratory Investigations

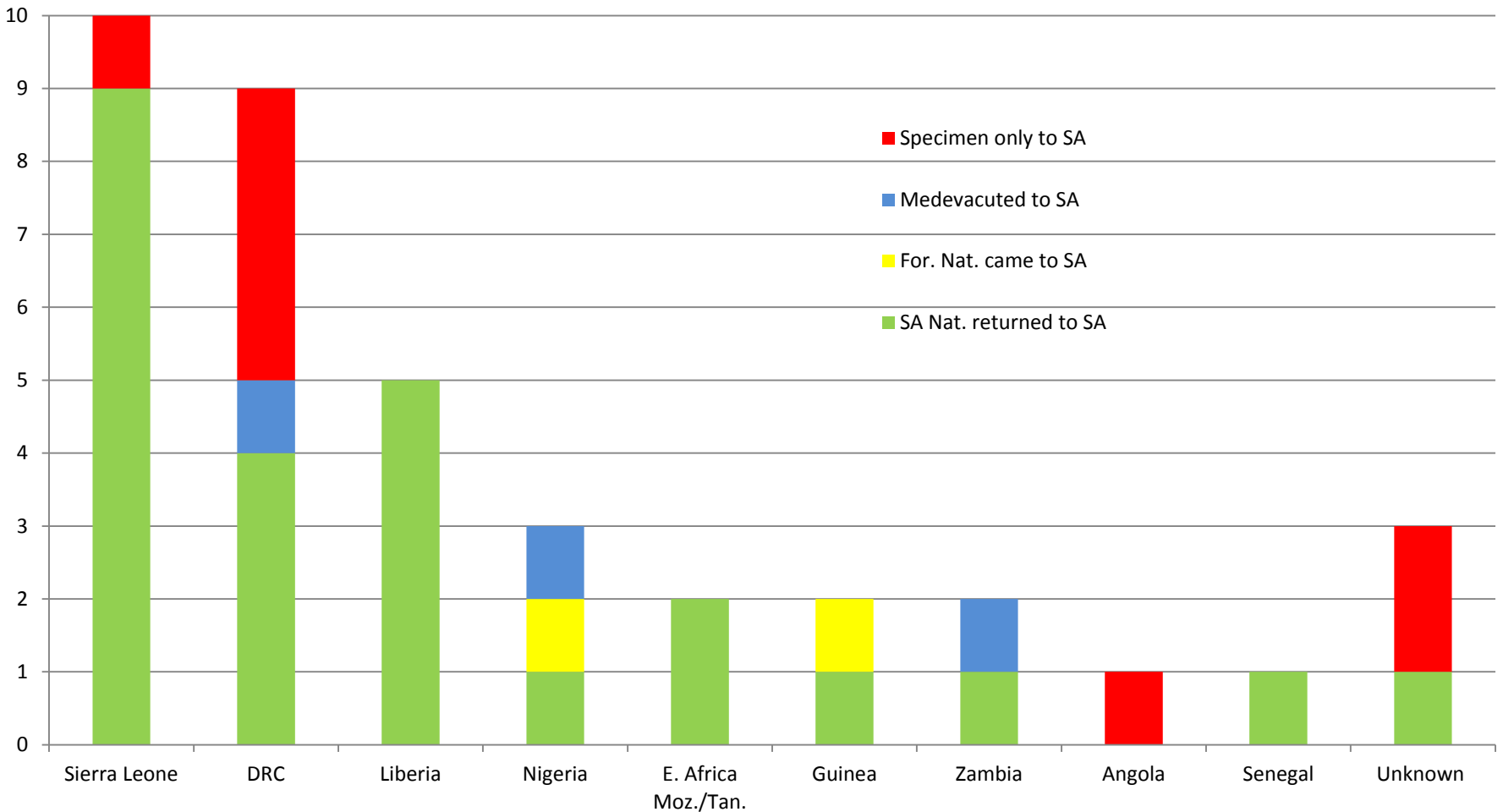
Virus Isolation



38 patients investigated for EVD in South Africa 2014-2015



Travel histories of EVD investigated cases in South Africa 2014-2015



Diagnoses of 38 patients investigated for EVD in South Africa

Diagnosis of 38 patients tested for Ebola virus disease	Tested & Confirmed at the NICD**
Ebola virus disease (38 tested)	0 cases confirmed
Possible differential diagnoses for Ebola virus disease	
Malaria	11 cases confirmed
Trypanosomiasis	1 case confirmed
Dengue fever	1 case confirmed (7 tested negative**)
Yellow fever	0 cases confirmed (2 tested negative**)
Congo-Crimean haemorrhagic fever	0 cases confirmed (16 tested negative**)
Tick bite fever	0 cases confirmed
Lassa fever	0 cases confirmed (17 tested negative**)
Leptospirosis	0 cases confirmed
Typhoid fever	0 cases confirmed
Meningococcal (bacterial) septicaemia	0 cases confirmed (1 tested negative**)
Hepatitis A	0 cases confirmed (2 tested negative**)
HIV with sepsis	0 cases confirmed
URTI, GIT, UTI, bacterial infection	6 cases diagnosed
Parvovirus B19 infection	1 case confirmed
Sickle cell anemia	2 cases diagnosed
Non-infectious aetiology	3 cases diagnosed

Most common observed EVD symptoms: Fever (87%), fatigue (76%), arthralgia (39%), myalgia (39%), Headache (53%), Chest pain (37%), Cough (30%), vomiting (68%), diarrhoea (66%), anorexia (65%), abdominal pain (44%), dysphagia (33%), Any unexplained bleeding (18%), Conjunctivitis (21%)*, Death (50-90%)* WHO Ebola Response team. *NEJM*. 2014

Symptoms observed in patients with differential diagnoses: Fever, arthralgia, diarrhoea, vomiting, abdominal pain, thrombocytopenia, bleeding, rash, jaundice, raised LFT, kidney failure, death

Conclusions

- Efforts to respond to the Ebola outbreak in West Africa far exceeded the borders of the countries reporting EVD cases
- South Africa and SADC have put jointly measures in place to try and prevent introduction of EVD in the Region. The NICD was appointed as laboratory for confirmation of all EVD cases that may occur in SADC
- Many African countries have imposed travel ban or restrictions. South Africa has lifted the ban for Liberia
- Numbers of EVD cases are declining in the affected countries, but ongoing vigilance and efforts are required to ensure that the last cases of EVD of the 2014/15 outbreak are managed appropriately.
- Analysis of outbreak data will revise and update epidemiologic parameters of EVD

Acknowledgements

- NICD- Staff of the Centre for Emerging and Zoonotic Diseases, Division for Surveillance and Public Health Response, members of the Emergency Operating Centre and others
- National Department of Health of South Africa



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