

# Preparedness of 21 African countries to respond to Emerging Zoonotic diseases at the time of the 2014 Ebola outbreak in West Africa.

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## **Introduction**

- ❑ Africa frequently experience outbreaks of zoonotic diseases & several emerging diseases have its origin in Africa.**
- ❑ During the Ebola outbreak 2014-2015, all countries were required to be identify and respond to potential cases.**
- ❑ This raised the question of how capable countries on the continent were to detect and respond to emerging diseases.**

## ❑ **Pandemic Preparedness:**

- Emergence of Avian Influenza H5N1 and SARS
- WHO, OIE and FAO tripartite agreement-One Health Approach
  - Collaborative response between human, veterinary and environmental sectors to respond to zoonotic diseases
- CDC & partners invested in supporting infrastructure in labs across the continent.
- Cooperation agreements with countries that had WHO National Influenza Centers or that were interested in establishing one.
- Realtime PCR machines placed, labs trained in Realtime PCR and virology and serological techniques; biosafety
- Building of BSL-3 laboratories for Avian Influenza supported.
- Advantage to many countries across the continent when the 2009 H1N1 pandemic occurred.

# Influenza lab network

- ❑ **Network of laboratories and epidemiologists with an interest in Influenza across the African continent**
  - ❑ WHO NICS, GISN
  - ❑ African Network for Influenza Surveillance and Epidemiology (ANISE)
- ❑ **Experienced in surveillance and outbreak response**
- ❑ **Emergence of MERS CoV, many countries able to test**
- ❑ **Can this and other networks be activated to detect and respond to emerging diseases?**

## Other zoonotic disease networks

- ❑ **WHO Afro: lab network for emerging and dangerous pathogens**
  - training for viral hemorrhagic fever and epidemic prone arboviruses in line with international health regulations.
- ❑ **One Health initiatives, SACIDS**
- ❑ **Veterinary networks:**
  - PREDICT; OFFlu (vet lab network for zoonotic Influenza)

## **AIM**

- ❑ **Determine if countries could build on Pandemic preparedness infrastructure to respond to other zoonotic diseases**
- ❑ **Build capacity in countries to deal on a routine basis with emerging diseases - contribute to Global Health Security and align with IHR.**

## Strategy:

- ❑ **Survey send out through the ANISE network and to targeted labs in the WHO Dangerous Pathogen Network.**
- ❑ **Questions in survey-monkey:**
  - focusing on infrastructure, training level and laboratory capacity to test for emerging and zoonotic diseases
- ❑ **Influenza lab director requested to describe capacity in Influenza lab on respiratory pathogens and other pathogens in institute**
  - distribute to Zoonotic disease VHF/Arbovirus/bacterial pathogens) lab director if not in the same laboratory
  - forward to veterinary counterpart.

# Results

Country:	Influenza	Zoonosis	Both	Vet-lab	No of labs responded
ALGERIA					2
Angola					1
Burkina Faso					4
Cameroon					2
Cote d'Ivoire					1
DRCongo					2
Ghana					1
Kenya					3
Madagascar					1
Malawi					1
MALI					1
Mauritius					1
Morocco					2
Mozambique					3
Nigeria					1
Seychelles					1
Senegal					1
South Africa					6
Tanzania					1
Uganda					1
Zambia					1*
21 countries					37



## Results: Description of respondents

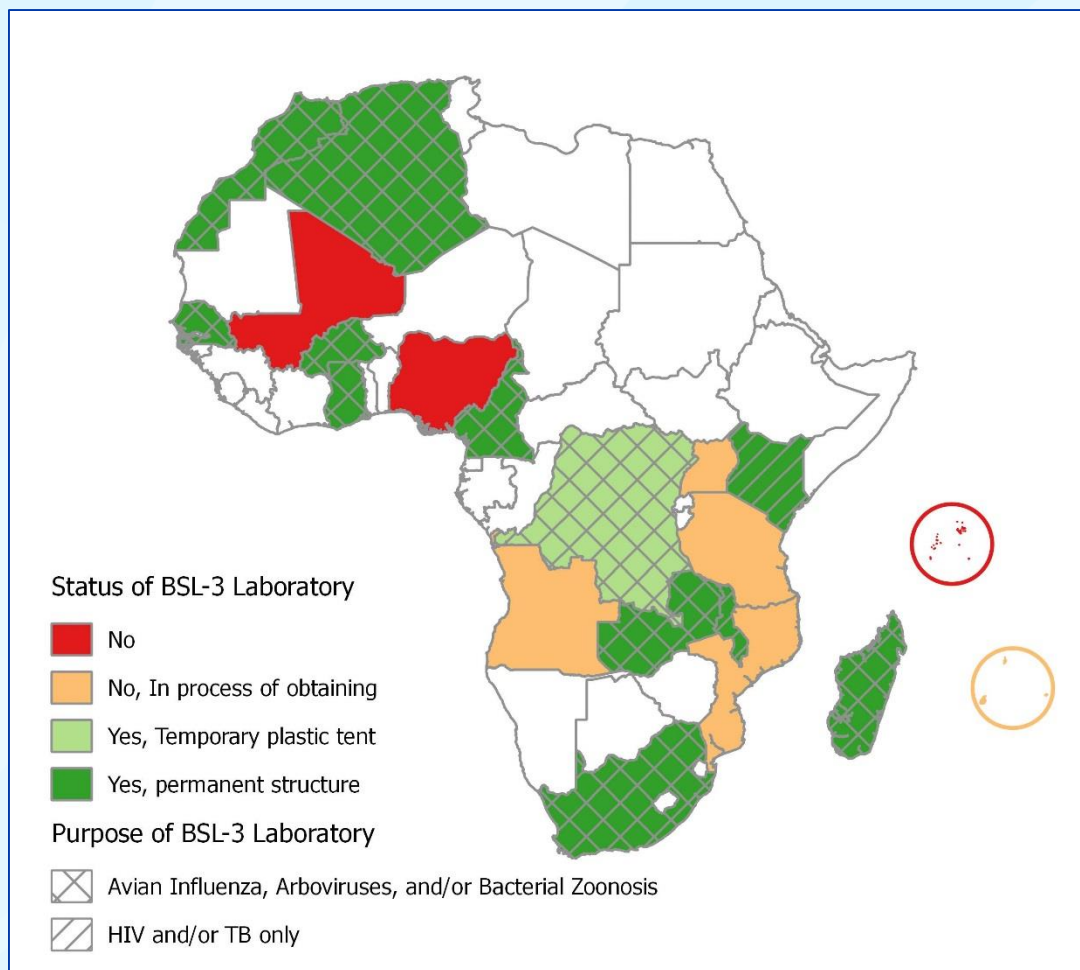
Variable	n (%)
<b>Primary Purpose of the Laboratory</b>	
Influenza	7 (20)
Zoonotic Diseases	3 (9)
Influenza and Zoonotic Diseases	21 (60)
Unspecified	4 (11)
<b>Nature of the Institution</b>	
Government	18 (51)
Parastatal	8 (23)
Academic	6 (17)
Private	2 (6)
<b>Function of the Laboratory<sup>1</sup></b>	
National Reference Laboratory	26 (74)
WHO Reference Laboratory	16 (46)
OIE Reference Laboratory	0 (0)
Diagnostics	27 (77)
Research	29 (83)
Surveillance	30 (86)

<b>How is your institute funded?</b>	
Government and Grants	26 (74)
Mainly Government	4 (11)
Purely Grants	4 (11)
No Response	1 (3)
<b>Do you have a CDC Co-Ag?</b>	
Yes	22 (63)
No	13 (37)
<b>Type of CDC Co-Ag</b>	
Influenza	19 (86)
HIV/PEPFAR	2 (9)
GDD	1 (5)

# Infrastructure for Realtime PCR

Equipment (Manufacturer)	Number of countries (%)
<b>Any RT PCR Machines</b>	
Applied Biosystems 7500 (Life Technologies)	19 (90)
Applied Biosystems 7500 Fast (Life Technologies)	13 (62)
StepOnePlus (Life Technologies)	4 (19)
Applied Biosystems ViiA 7 (Life Technologies)	3 (14)
LightCycler 96 Instrument (Roche Life Systems)	3 (14)
Light Cyclor 2.0 Instrument (Roche Life Systems)	3 (14)
Light Cyclor 480 Instrument (Roche Life Systems)	3 (14)
CAP/CTM v2.0 (Roche Life Systems)	2 (10)
Other	9 (43)
<b>Any Automated Nucleic Acid Extraction Systems</b>	
QIAcube (Qiagen)	16 (76)
MagNA Pure LC 2.0 (Roche)	3 (14)
easyMag (bioMerieux)	3 (14)
MagNA Pure 96 (Roche)	1 (5)
EZ1 (Qiagen)	1 (5)
Other	8 (38)

## Status of Biosafety Level 3 laboratories in 21 African countries.



All 35 responding laboratories indicated that they had a functioning BSL-2 facility. The presence of BSL-3 facilities varied across countries (Figure 1a); 12 of the 20 countries indicated that they had a BSL-3 facility, though 1 only had a temporary isolation tent and in another country it was not functional. Of the 8 countries without a BSL-3 facility, 5 indicated that they were in the process of obtaining a permanent facility. 11 countries had a permanent and functioning BSL-3 facility (Algeria, Burkina Faso, Cameroon, Cote d'Ivoire, Ghana, Kenya, Madagascar, Malawi, Morocco, South Africa, and Zambia). Of the 11 countries with a functioning BSL-3 facility, 3 were only used for the diagnosis of HIV and/or TB

# Laboratory capacity for serology, virus isolation, and sequencing in 21 African countries

Capability	n (%)
<b>Any Serological Technique</b>	19 (90)
<b>Specific Serological Techniques<sup>1</sup></b>	
ELISA	18 (86)
IFA	14 (67)
HAI	15 (71)
Viral Neutralization Assays	10 (48)
Western Blots	7 (33)
<b>Any Viral Isolation Technique</b>	16 (76)
<b>Specific Viral Isolation Techniques<sup>1</sup></b>	
Tissue Culture	15 (71)
Mice	5 (24)
Egg Isolation	5 (24)
<b>Any Sequencing Technique</b>	13 (62)
<b>Specific Sequencing Techniques on site<sup>1</sup></b>	
Sanger sequencer on site	8 (38)
Next generation sequencer on site	3 (14)
Bioinformatics skilled	6 (29)
<b>No on site Sequencing<sup>1</sup></b>	8 (38)
Sequencer on site but not functioning	2 (10)
Sending specimens for sequencing	6 (29)

# Diagnostic capabilities for respiratory viruses in 21 African countries.

Virus	n (%)							
	Any Method	Rapid Test	In-House PCR	Commercial PCR	CDC PCR Kit	Direct IFA	HAI	Virus Isolation (Cell Culture)
<b>Influenza (any pathogen)</b>	20 (100)	5 (25)	7 (35)	8 (40)	19 (95)	4 (20)	10 (50)	11 (55)
<b>A/B</b>	20 (100)	5 (25)	7 (35)	6 (30)	19 (95)	4 (20)	9 (45)	11 (55)
<b>H3 (seasonal strains)</b>	19 (95)	0 (0)	5 (25)	3 (15)	19 (95)	2 (10)	8 (40)	8 (40)
<b>H3 (variable)</b>	18 (90)	0 (0)	2 (10)	4 (20)	15 (75)	2 (10)	4 (20)	6 (30)
<b>H1N1pdm09</b>	20 (100)	1 (5)	4 (20)	6 (30)	19 (95)	1 (5)	8 (40)	8 (40)
<b>H5</b>	17 (85)	0 (0)	6 (30)	2 (10)	16 (80)	1 (5)	3 (15)	1 (5)
<b>H7</b>	12 (60)	0 (0)	4 (20)	3 (15)	10 (50)	2 (10)	3 (15)	2 (10)
<b>H9</b>	10 (50)	0 (0)	4 (20)	2 (10)	6 (30)	0 (0)	1 (5)	0 (0)
<b>H7N9</b>	9 (45)	0 (0)	1 (5)	1 (5)	8 (40)	0 (0)	1 (5)	0 (0)
<b>N typing</b>	7 (35)	0 (0)	2 (10)	3 (15)	4 (20)	0 (0)	0 (0)	0 (0)
<b>Full genome sequencing</b>	6 (30)	0 (0)	2 (10)	2 (10)	2 (10)	0 (0)	0 (0)	0 (0)
<b>RSV</b>	14 (70)	3 (15)	10 (10)	8 (40)	3 (15)	3 (15)	-	5 (25)
<b>Adenovirus</b>	14 (70)	2 (10)	9 (45)	7 (35)	3 (15)	2 (10)	-	4 (20)
<b>Human metapneumovirus</b>	13 (65)	0 (0)	9 (45)	8 (40)	3 (15)	2 (10)	-	3 (15)
<b>PIV 1/2/3</b>	13 (65)	0 (0)	7 (35)	7 (35)	3 (15)	2 (10)	-	4 (20)
<b>Coronaviruses (OC43; 229E; HKU1)</b>	13 (65)	0 (0)	9 (45)	8 (40)	2 (10)	0 (0)	-	1 (5)
<b>Coronaviruses (MERS CoV)</b>	15 (75)	0 (0)	8 (40)	7 (35)	6 (30)	0 (0)	-	0 (0)
<b>Coronaviruses (SARS CoV)</b>	11 (55)	0 (0)	8 (40)	5 (25)	2 (10)	0 (0)	-	0 (0)

# Diagnostic capabilities for zoonotic viruses, arboviruses, and other viruses in 21 African countries.

Virus	n (%)						
	Any Method	Rapid Test	In-House PCR	Commercial PCR	CDC PCR Kit	Direct IFA	Virus Isolation (Cell Culture)
<b>Ebola</b>	15 (71)	0 (0)	10 (48)	9 (43)	3 (14)	1 (5)	1 (5)
<b>Marburg</b>	13 (62)	0 (0)	7 (33)	7 (33)	3 (14)	1 (5)	1 (5)
<b>Crimean Congo Hemorrhagic Fever</b>	8 (38)	0 (0)	6 (29)	1 (5)	2 (10)	1 (5)	1 (5)
<b>Lassa Fever</b>	8 (38)	0 (0)	6 (29)	1 (5)	1 (5)	1 (5)	1 (5)
<b>West Nile</b>	14 (67)	0 (0)	12 (57)	3 (14)	1 (5)	0 (0)	3 (14)
<b>Chikungunya</b>	14 (67)	0 (0)	12 (57)	4 (19)	2 (10)	0 (0)	3 (14)
<b>Dengue</b>	18 (86)	2 (10)	12 (57)	5 (24)	7 (33)	0 (0)	3 (14)
<b>Yellow Fever</b>	16 (76)	1 (5)	9 (43)	4 (19)	6 (29)	2 (10)	5 (24)
<b>Rift Valley Fever</b>	13 (62)	0 (0)	9 (43)	2 (10)	4 (19)	0 (0)	2 (10)
<b>Monkey Pox</b>	2 (10)	0 (0)	1 (5)	0 (0)	1 (5)	0 (0)	0 (0)
<b>Rabies</b>	8 (38)	1 (5)	6 (29)	1 (5)	0 (0)	6 (29)	3 (14)

# Diagnostic capabilities for other viruses and pathogens in 21 African countries.

Pathogen	n (%)						
	Any Method	Rapid Test	In-House PCR	Commercial PCR	CDC PCR Kit	Direct IFA	Pathogen Isolation (Cell Culture)
<b>Polio</b>	13 (62)	0 (0)	7 (33)	3 (14)	6 (29)	0 (0)	10 (48)
<b>Measles</b>	14 (67)	2 (10)	8 (38)	3 (14)	1 (5)	1 (5)	6 (29)
<b>HIV</b>	17 (81)	10 (48)	8 (38)	13 (62)	2 (10)	1 (5)	2 (10)
<b>Rubella</b>	14 (67)	5 (24)	5 (24)	6 (29)	1 (5)	0 (0)	3 (14)
<b>Hepatitis A, B, C, or E</b>	16 (76)	8 (38)	6 (29)	10 (48)	1 (5)	0 (0)	0 (0)
<b>Malaria</b>	17 (81)	17 (81)	9 (43)	3 (14)	0 (0)	3 (14)	4 (19)
<b>Meningococcus</b>	14 (67)	9 (43)	8 (38)	4 (19)	0 (0)	1 (5)	3 (14)
<b>Plaque</b>	5 (24)	4 (19)	2 (10)	1 (5)	1 (5)	1 (5)	2 (10)
<b>Anthrax</b>	3 (14)	0 (0)	2 (10)	0 (0)	0 (0)	0 (0)	2 (10)
<b>Brucellosis</b>	3 (14)	1 (5)	2 (10)	1 (5)	0 (0)	0 (0)	0 (0)
<b>Leptospirosis</b>	5 (24)	0 (0)	4 (19)	1 (5)	0 (0)	0 (0)	1 (5)
<b>Rickettsial Disease</b>	5 (24)	1 (5)	3 (14)	1 (5)	0 (0)	2 (10)	1 (5)

# Training for hazardous specimens and Ebola RTPCR in 21 African countries.

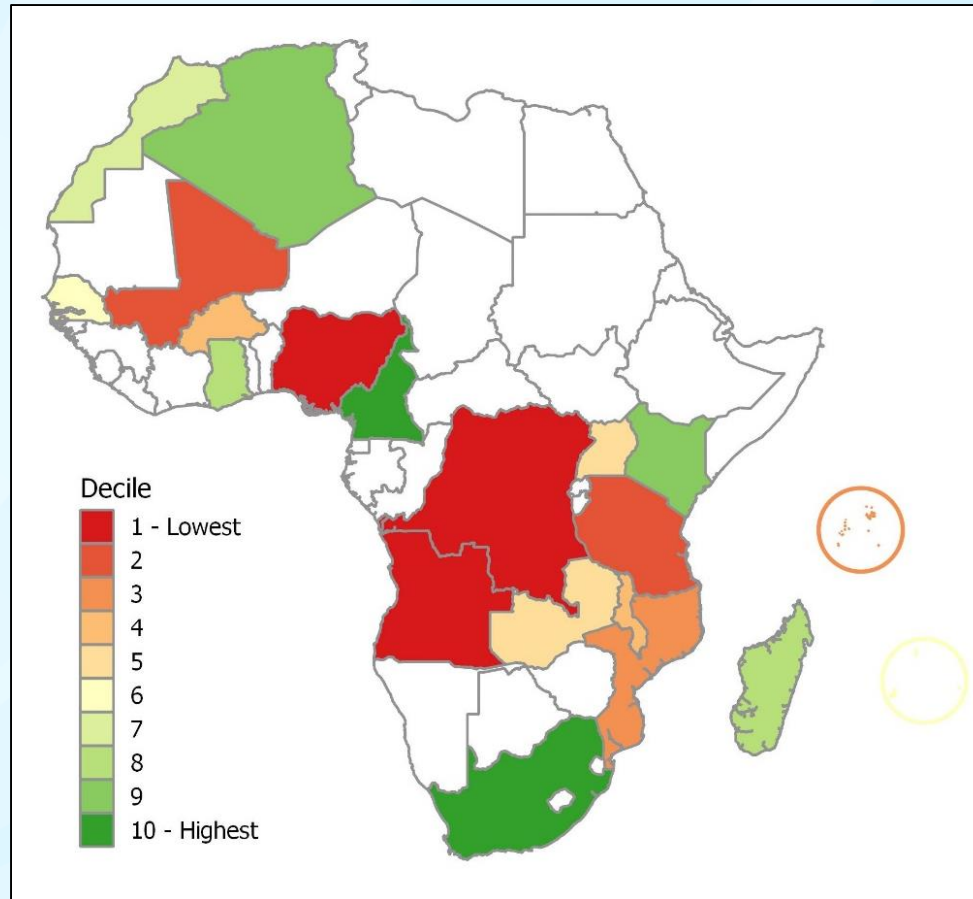
Capability	n (%)
<b>Someone trained in safe packaging of hazardous specimens</b>	19 (90)
<b>    In the last 2 years</b>	16 (76)
<b>    Certified training</b>	16 (76)
<b>Someone trained for Ebola RTPCR</b>	
<b>    Yes</b>	15 (71)
<b>    No, but sends specimens elsewhere for testing</b>	4 (19)
<b>    No</b>	1 (5)
<b>    No response</b>	1 (5)



# Presence of surveillance programs in 21 African countries

Pathogen	n (%)
Influenza (Seasonal)	20 (95)
Influenza (Zoonotic)	6 (29)
Other Respiratory Viruses	12 (57)
Arboviruses	14 (67)
West Nile	10 (47)
Chikungunya	10 (47)
Dengue	14 (67)
Rift Valley Fever	10 (48)
Yellow Fever	5 (24)
Other Zoonosis	18 (86)
Rabies	12 (57)
Ebola/Marburg	11 (52)
Brucellosis	6 (29)
Leptospirosis	3 (14)
Plague	7 (33)

# Ranking of country laboratory capacity by principal components analysis.



## Discussion

- ❑ Investment in infrastructure and training in Influenza had capacitated many countries in molecular diagnostics and virology training in last 10 years
- ❑ BSL2 facilities well established; BSL3 exist, not all labs active
- ❑ Building on existing capacity and infrastructure when implementing new techniques could rapidly enable countries to test for new pathogens
- ❑ Africa build on pandemic and Ebola experiences to strengthen diagnostic and response capacity.
- ❑ Using existing networks to enhance One Health approach to respond to zoonotic diseases linking veterinary and human laboratory capacity.

## **Limitations of study**

- ❑ Not all countries that is part of ANISE responded.**
- ❑ Countries that did respond main ones with CoAg agreement with CDC and capacity to respond?**
- ❑ Lab advisor requested to respond on other pathogens that can be tested in the institute.**

## **Conclusion**

- ❑ Survey done in midst of Ebola outbreak, helped to identify labs to support and map capacity on the continent.**
- ❑ Building on Influenza and WHO dangerous pathogen networks capacity on the continent will allow countries to deal with new emerging and zoonotic problems irrespective of viral pathogen.**
- ❑ Enhance linking human and veterinary laboratories to establish surveillance in humans and animals**
- ❑ Data useful for GHS and identify labs that need further support and training in line with IHR**

## **Acknowledgements**

- ❑ **All members of ANISE and other laboratories that responded to the questionnaire**
- ❑ **Co-authors for support**
- ❑ **High Risk uninfected country team, CDC**

Regional Global Disease Detection Centre, Global Health Protection, CDC, South Africa

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## **CDC support initiatives:**

- ❑ **Biological institution biosafety and biosecurity risk evaluation of a high containment facilities, GHS**
  - comprehensive and detailed report on findings with recommendations. Based on institutional standards along with supplemental international guidelines and standards.
  - U.S. CDC – Division of Select Agents and Toxins, Von McClee, [vmcclee@cdc.gov](mailto:vmcclee@cdc.gov)
  
- ❑ **Future plans: CDC/DTRA supported initiatives: NICD VHF training Centre**



**Regional Global Disease Detection Centre,  
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