CDC Global Health Security Agenda/Ebola Grantee Meeting

Accountability. Results. Sustainability.

GHSA Field Perspectives: Vietnam

Health Information System for Disease Surveillance:

Regional and Global Reach

Linda Venczel, Director
PATH GHS partnership
February 11, 2016

Background

- PATH's GHS partnership funded by CDC to work in Vietnam, Senegal and Tanzania

- PATH Mekong Region experience

  - Began with 1980's contraception programs

  - Presence currently expanded to Laos, Myanmar, Cambodia and Vietnam

  - Projects include flu vaccine production, JE vaccine introduction, Hepatitis B birth dose pilot, Optimize project cold chain and logistics improvement

Regional Implications
Mekong Region

Across border disease surveillance of 5 other countries along Mekong River

PATH/CDC GHS priorities in Vietnam

- Accelerate development of a **data warehouse** to provide access to surveillance data

- Leverage DHIS2 platform to create **data visualization** that enhances analysis and field application of surveillance information

- Link **indicator-based and event based surveillance** to improve ability to rapidly detect and respond to outbreaks

- **Train national and local staff**, including animal and human health networks: One Health and FETP

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Why a Data Warehouse?

Currently many sources of data are not aggregated or reside in vertical systems

A Data Warehouse will provide

- Central repositories of integrated data from one or more disparate sources
- Storage of *current and historical data*
- Sources integrated or kept as separate Data Marts
- Processing a lot of information quickly
- Near real time source system updates
- Automated updates; the system is not manual
- Maximized performance for data retrieval and analysis rather than data capture only
- Creation of analytical reports for knowledge **and to empower decision making**

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Vietnam Outbreak Disease Priorities

- Dengue
- Measles / Rubella
- Hand Foot and Mouth disease
- Avian Influenza
- Rabies
- Polio
- Ebola
- MERS-CoV
- Adverse Events Following Immunization (AEFI)
- Foodborne disease outbreaks
  - Salmonella
  - Shigella
  - Cholera
- Malaria
- Novel pathogens / Unknown

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Disease Reporting Requirements

- Policy Circular 54 (December 2015; public health policy)
- Diseases are grouped: Groups A, B, C

    A=dangerous, highly pathogenic

    B=dengue, etc.

    C=less dangerous

- Frequency and type of report is based on the group, which also determines response timing and type of response
- Immediate reporting is 10-24 hrs then goes up to 1 month for Group C
- Data flow will be collected at the commune and district level as well as provincial level (hospitals)

EBS and IBS Surveillance

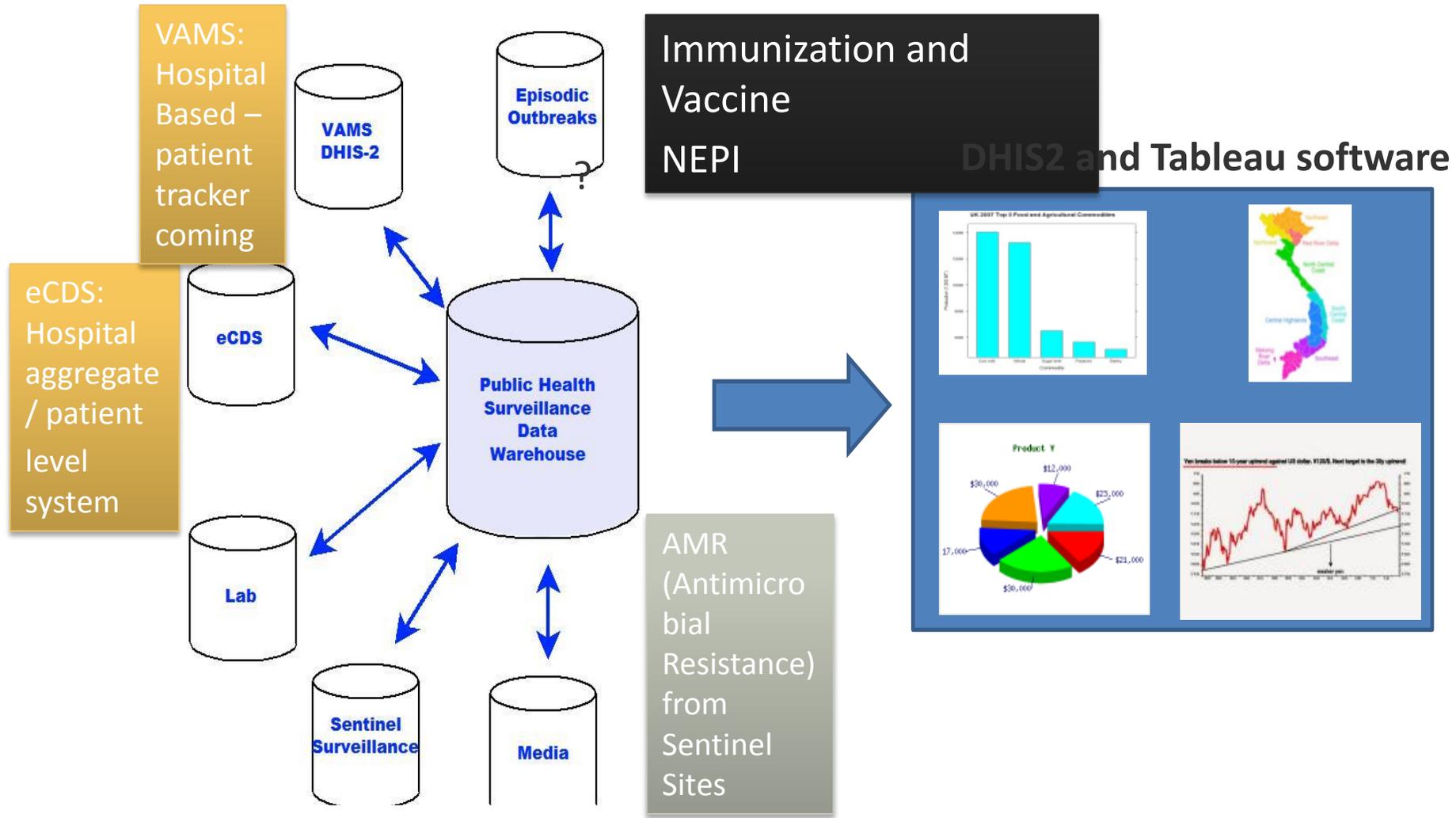Indicator Based Surveillance for monitoring (routine use of existing systems)

- **Sources: Hospital data, lab results, NGO reporting, diplomatic and military channels**
- Not good at detecting rare and emerging, unknown diseases, like Ebola quickly.

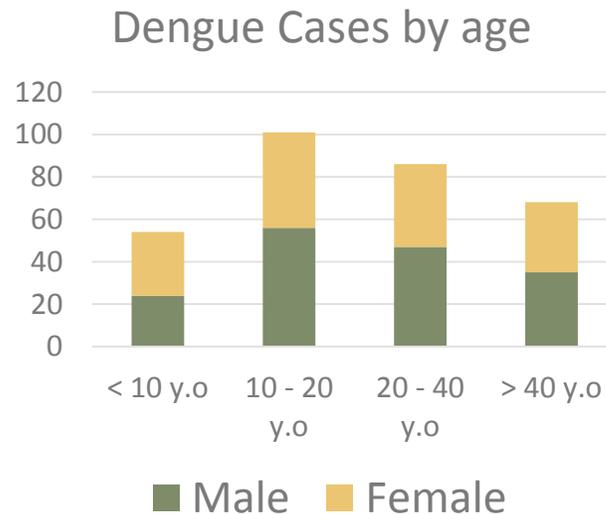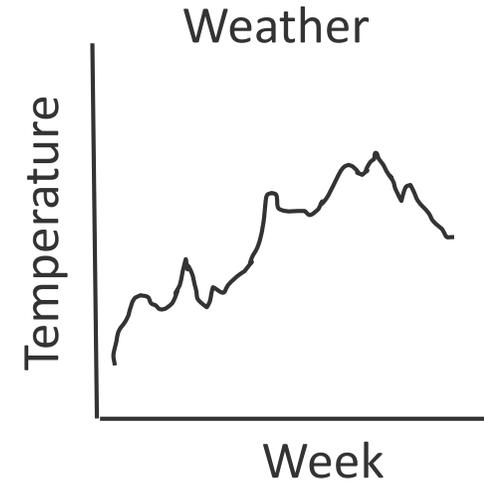Event Based Surveillance for immediate reporting and early detection
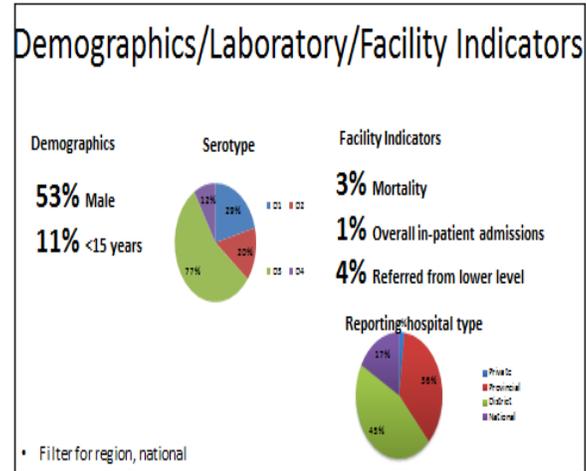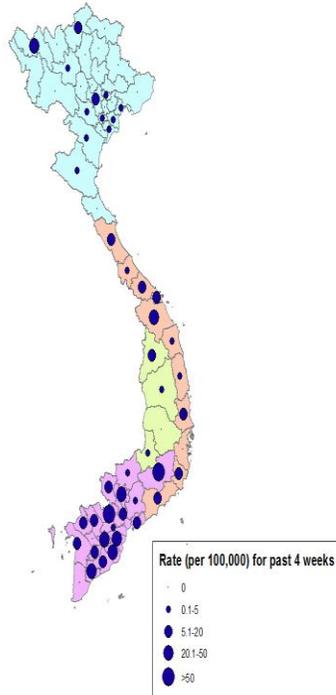
- **Sources: hospital data down to commune level as well as media, hotlines, drug sales, environmental measures, school absenteeism.**
- **Doctors, nurses, veterinarians also good sources of information.**
- Sensitive, not well defined, reporting forms flexible for qualitative and quantitative data.
- EBS has been used successfully in Laos, Thailand and Papua New Guinea

Vision for Vietnam

Health Surveillance Data Warehouse

VAMS: Hospital Based – patient tracker coming

eCDS: Hospital aggregate / patient level system

VAMS DHIS-2

eCDS

Lab

Sentinel Surveillance

Media

Episodic Outbreaks ?

Immunization and Vaccine

NEPI

Public Health Surveillance Data Warehouse

AMR (Antimicrobial Resistance) from Sentinel Sites

DHIS2 and Tableau software

Dengue Dashboard

Dengue Cases by Month
- Filter for specific region, national
- Emphasis for current year
- Select years to display

Demographics/Laboratory/Facility Indicators

Demographics
- **53%** Male
- **11%** <15 years

Serotype

Facility Indicators
- **3%** Mortality
- **1%** Overall in-patient admissions
- **4%** Referred from lower level

Reporting hospital type

- Filter for region, national

Weather
Temperature / Week

Dengue Cases by age
Male Female

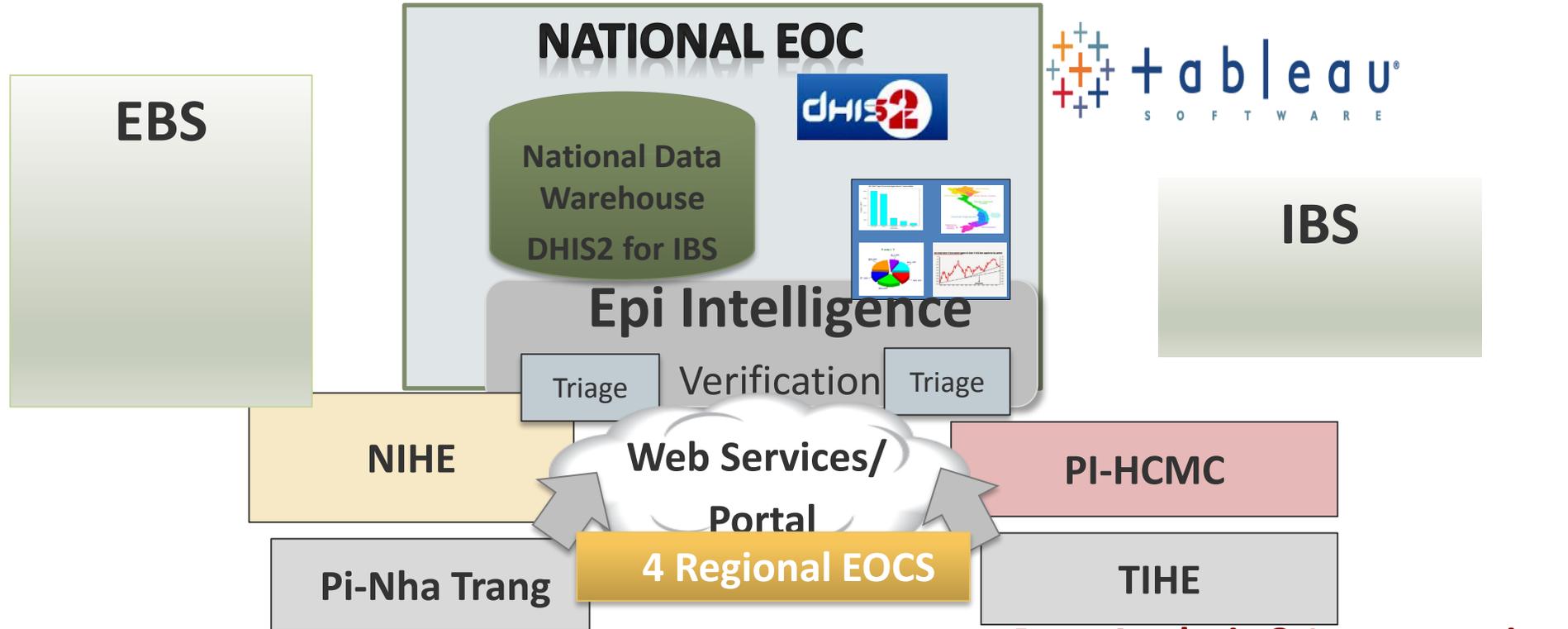Rate (per 100,000) for past 4 weeks
- 0
- 0.1-5
- 5.1-20
- 20.1-50
- >50

International Reports
- Thailand: increasing rates of Dengue across the country
- Malaysia: outbreak in Kuala Lumpur.
- Singapore: Dengue serotype 1 predominates.
- Indonesia: increased mortality over previous years.

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Vietnam Disease Surveillance

EBS

NATIONAL EOC

dhis2

+ableau
SOFTWARE

National Data Warehouse

DHIS2 for IBS

IBS

Epi Intelligence

| Triage | Verification | Triage |

NIHE

Web Services/ Portal

PI-HCMC

Pi-Nha Trang

4 Regional EOCS

TIHE

Filtering & Selection

Data Analysis & Interpretation

| Triage | | Triage |

EBS Data and Information

mostly Ad Hoc, informal, and formal

Sources

Methods

- Health Workers, vets/Ag, private health facilities, etc
- Schools
- Media
- Factories
- Border monitoring, migrant workers, international
- Internet systems

- Direct Communication
- Internet
- Email
- Faxes
- Phone
- SMS

dhis2

IBS Data and Information

Health based mandatory notifications, official, and formal

Sources

Methods

- **eCDS** (GDPM)
- DHIS2 (MOH/VAMS)
- Lab Data
- Sentinel (SARI, AMR)
- Mortality Data

- Web Service
- Data Export
- Email

Best Practices: Standardization & Regional Adoption

Policies and Governance

- Establish strong partnership with CDC country office, MOH, and GHS Partners
- Establish collaborations with other donors, partners, and solution providers (ADB, APHL, University of Oslo/HISP, Tableau)
- TOR for national TWG or Task Force HIS for Data Warehouse
- TOR for HIS Technical Leads – engagement, planning, development, implementation -> capacity building to inform TWG
- Identify the key GVN stakeholders, and engage early and consistently
- Data Access – establish policies that address confidentiality and security

Systems – Across Sectors

- One Health – Lab – HIS systems integration
- Utilize existing systems and information base as much as possible
- Enable response back/feedback loop mechanism to health workers

Lessons learned

- GVN must lead the process (HIS/EPI task force) and be empowered with clearly communicated information to make important decisions

- Communicate technical HIS/Informatics concepts to leadership in clear manner- jargon free!

- A proactive health systems strengthening approach will be critical in outbreak prevention, detection, and response

- PATH/CDC will share and adapt tools used for data warehouse from Vietnam with other countries—economy of scale

- Apply international systems and standards as much as possible (e.g. DHIS2, Data Exchange)

Questions?

Situation update and risk assessment

Acknowledgements
(not exhaustive)

- Government of Vietnam
  - General Department of Preventative Medicine- Dr. Phu and team
  - Vietnam Administrative and Medical Services- Dr. Son and team

- CDC Atlanta: Dr. Terrance Lo
- CDC Vietnam: Dr. Steven Becknell, Dr. Tony Mounts
- PATH:
  - PATH Vietnam office, Mona Byrkit, Dr. Huong Vu Minh, Quoc Nguyen
  - Donna Madeiros, HIS focal point

Global Health Security Agenda Implementation in Kenya

Dr Eric Osoro
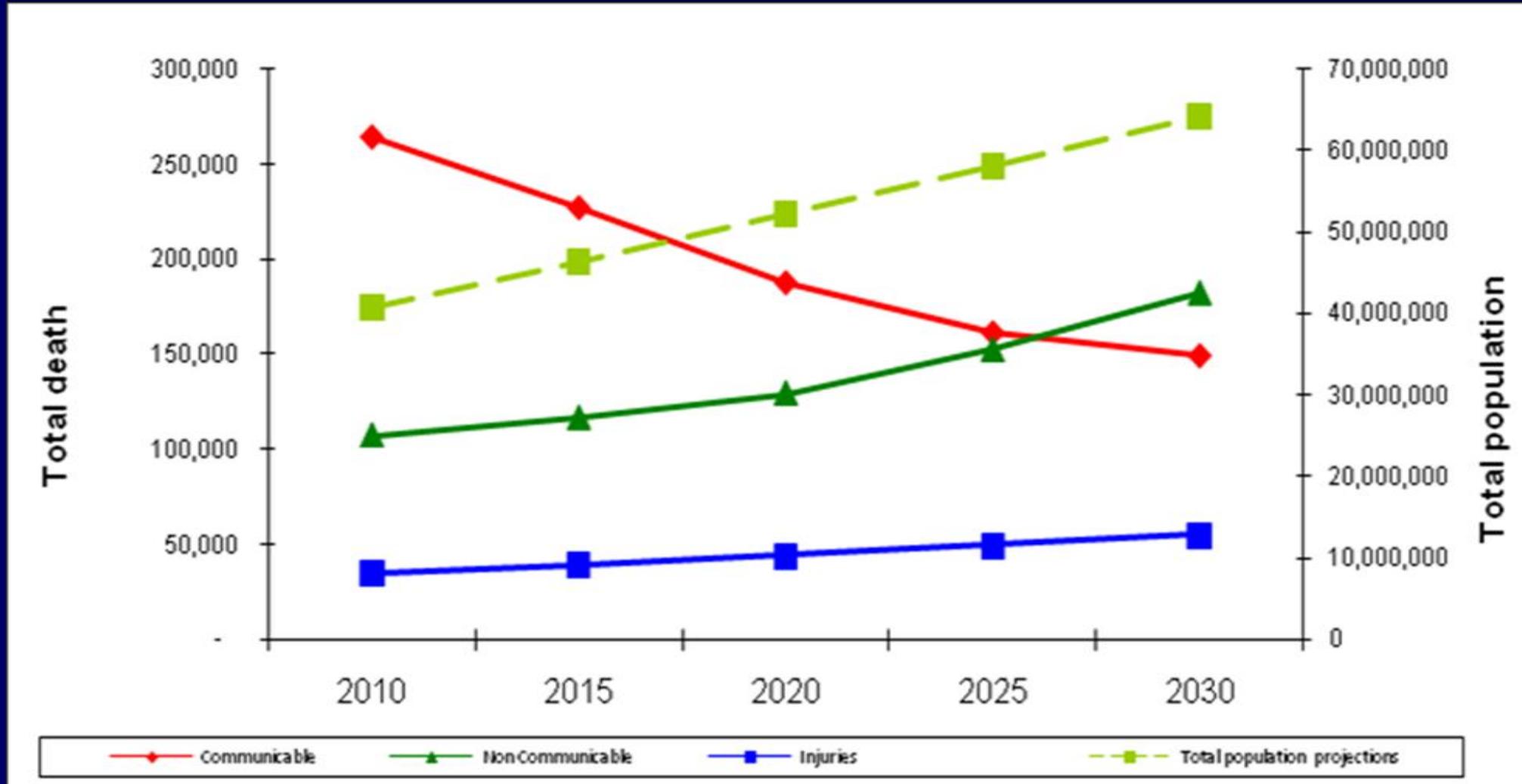**Antony Mugo**

Ministry of Health
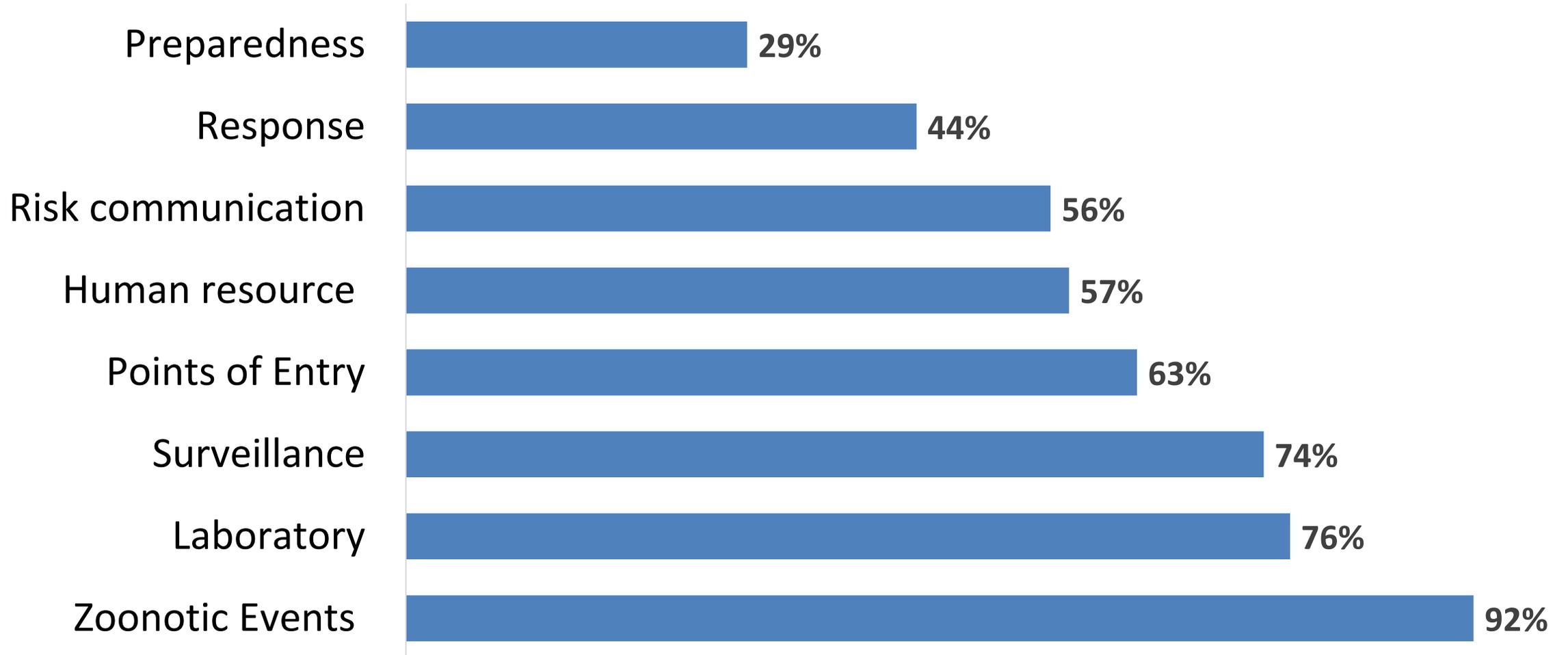
GHS/Ebola Grantees Meeting
10th - 12th February, 2016
Atlanta

Trends by Disease Domains (2010-2030)

Source: Kenya Health Policy Framework 2014-2030

IHR Core Capacities Assessment, Kenya, 2015

Category	Percentage
Preparedness	29%
Response	44%
Risk communication	56%
Human resource	57%
Points of Entry	63%
Surveillance	74%
Laboratory	76%
Zoonotic Events	92%

IHR/GHSA Processes, 2015-2016

Multi-Sectoral Working Group Reviews IHR

Consultations with WHO/FAO/OIE; Other partners

Baseline GHSA Assessment Conducted

5-Year Plan Drafted

Draft Plan Endorsed

Objective Assessment

Feb-April 2015

April 2015

May

June

July

2016

Revise
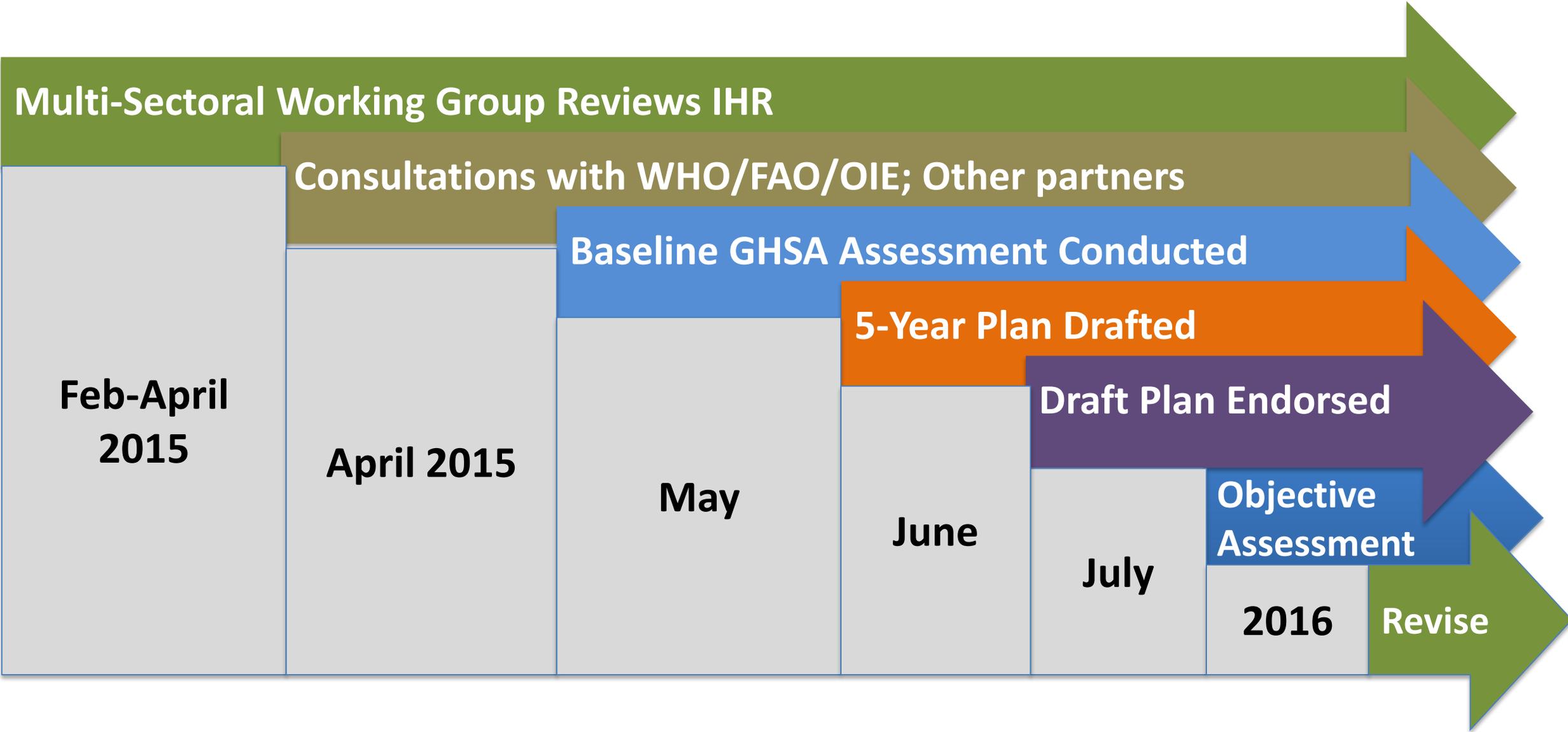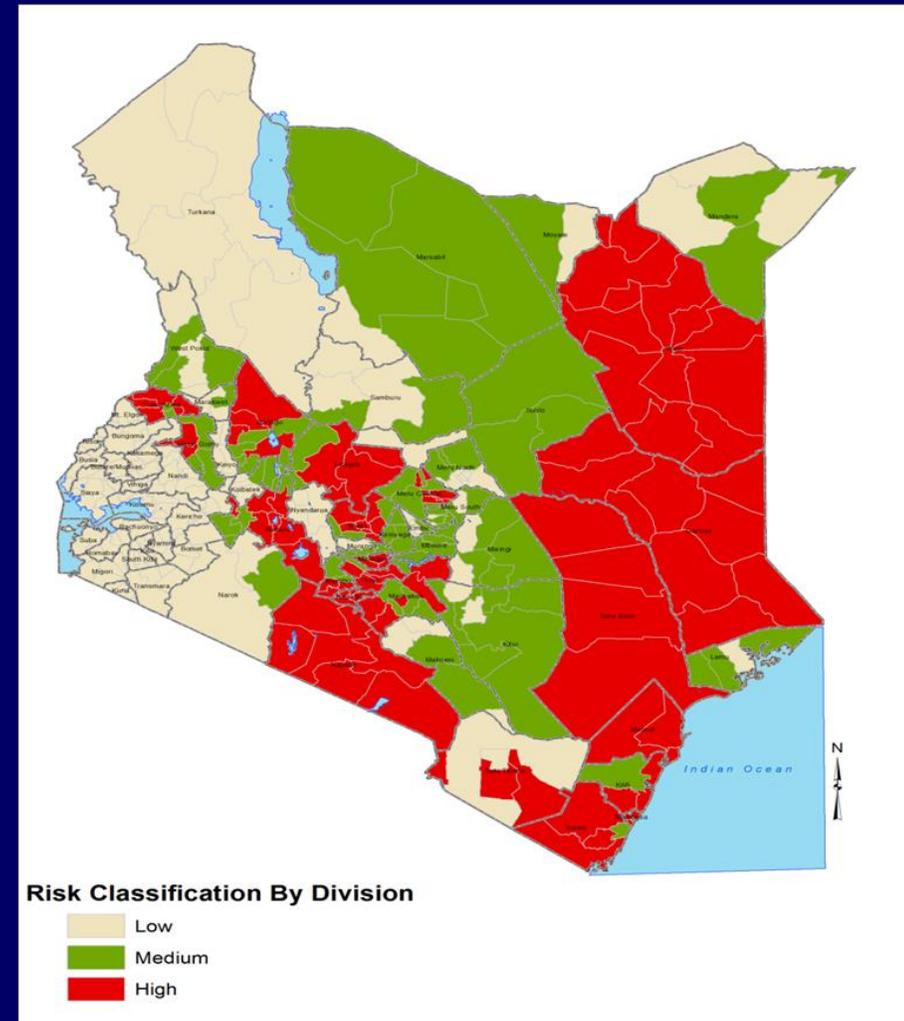
Rift Valley Fever Enhanced Passive Surveillance

- RVF an acute viral disease, 12 outbreaks between 1950-2014 in Kenya

- Outbreaks associated with flooding (>50% rainfall) in typically dry areas

- Kenya Met. department issued El Nino alert in Aug 2015

- Existing
  - Risk map
  - Contingency plan

Risk Classification By Division

- Low
- Medium
- High

Surveillance system: July-Sep 2015

- Existing system attributes performed poorly

- Low data quality
  - **40%** forms not-complete

- Low reporting rates
  - **<50%** counties reported

- Poor timeliness
  - Delayed reporting times

Response

- Established passive surveillance system
  - Trigger for active surveillance

- Commenced Nov 2015

- Collaborative effort
  - Department of Vet Services
  - Ministry of Health
  - Washington State University
  - CDC-Kenya

Syndromic surveillance and reporting of RVF
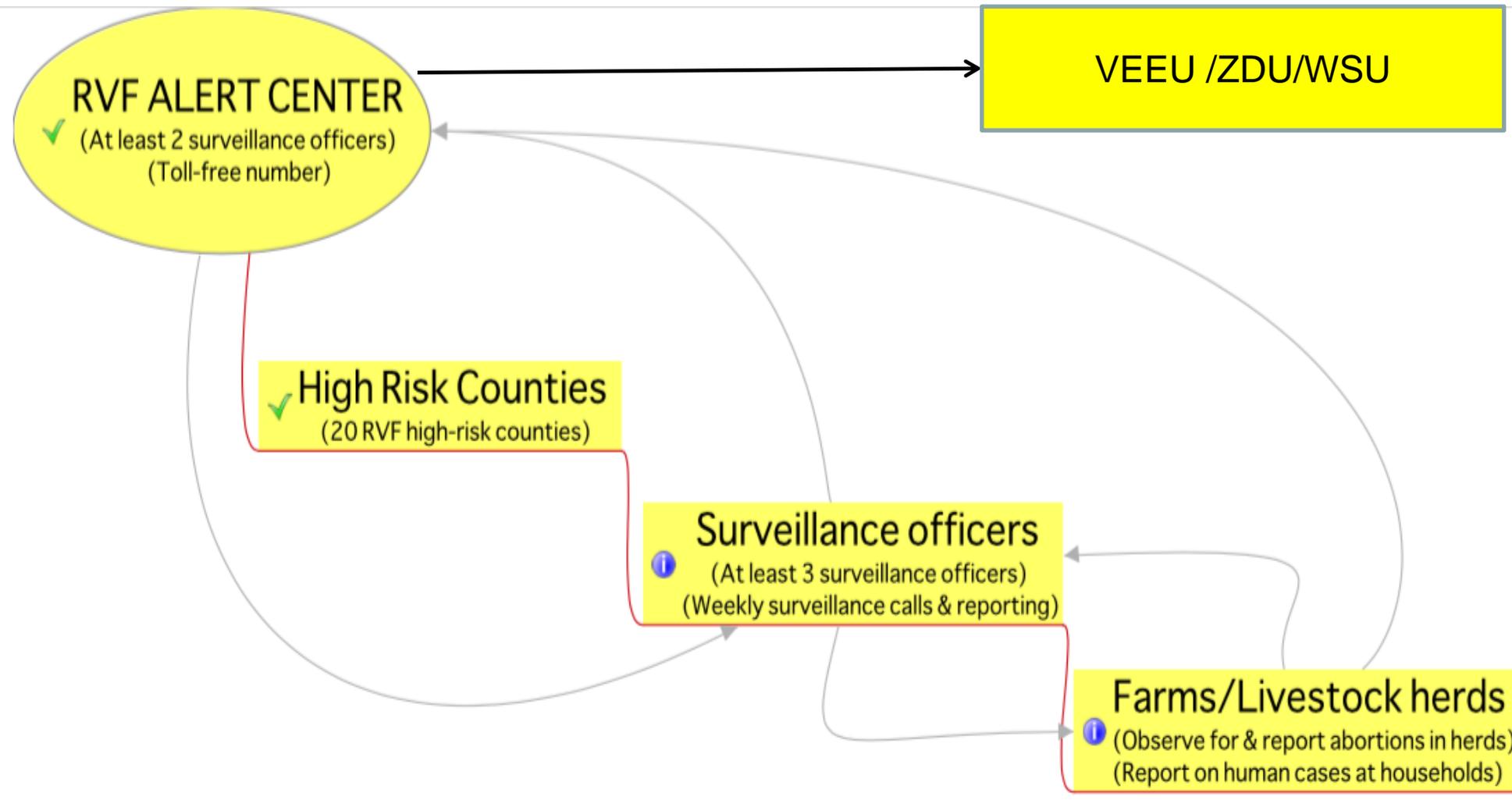
Active Surveillance Component

- Criteria based sample collection and field investigation
  - Storm of abortions with flooding
  - Die-offs or haemorrhagic syndrome in animals
  - Suspected human cases

- Animal samples submitted to the Central Veterinary Investigative Laboratories

- Follow up and feedback

Findings

- All 22 counties report regularly
- Total farmers in the database – **790**
- Average no. of rainy days/week 3.34 days (0-7 days)
- Flooding reported by 28% of farmers
- Abortions reported in 7% of the farms

- Haemorrhagic syndrome reported by 2% of farmers
- 29% of herds vaccinated
- No suspected human case
- Activities by other stakeholders mapped

GHSA Near-Term Deliverables

- Establish sentinel AMR surveillance

- Strengthen surveillance in human and animal health
  - Improve Reporting through DHIS and mobile platforms
  - Linking IDSR with Lab information system

- Operationalize the EOC
  - Event based surveillance

Lessons Learned

- Systems approach
  - Review of current status; IHR and GHSA
  - Action plans based on the review
- Coordination is key
  - Within government
  - Government and partners
- Monitoring framework
  - Challenge we need to address

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Thank You

CDC Global Health Security Agenda/Ebola Grantee Meeting

Accountability. Results. Sustainability.

Infectious Disease Surveillance and Control at UVRI and in Uganda with CDC/GHSA assistance

Presented at the CDC GHSA/Ebola Grantee Meeting: Perspectives from the Field, Atlanta, GA, USA
10-12 February 2016,

by

Julius J. Lutwama, PhD and Jeff N. Borchert
Uganda Virus Research Institute, Entebbe

DEPARTMENT OF ARBOVIROLOGY, EMERGING AND RE-EMERGING VIRAL INFECTIONS

☐ **SERVES AS:**

- ■ **A National Reference Center for Vector Borne viral diseases**

- ■ **The National Influenza Center (NIC)**

- ■ **National Diagnostic Laboratory for Highly Infectious viral infections – Marburg, Ebola, CCHF, RVF, Hep E**

- ■ **A WHO Collaborating Center for Vector-Borne viral disease Reference and Research**

- ■ **A WHO Influenza and YF Collaborating Laboratory**

Activities/Mandate of the Department

☐ **Routine surveillance of arboviral infections and their vectors, including epidemic alert, response and prevention**

☐ **Field and laboratory research on arboviral infections**

☐ **Surveillance for Influenza viruses**

☐ **Support for epidemic outbreak investigations**

☐ **Assist in infection control of vector-borne diseases, and other infections, including VHFs**

☐ **Surveillance of viral diseases at the human/wild animal interface (working in NPs)**

☐ **Mapping of human and animal populations at risk of viral infections**

Uganda Arbovirus Studies Since 2007/2008

Mosquitoes/Other arthropods collected using various methods

Mosquitoes identified and pooled by species
(Pool size ≤ 25)

Engorged specimens processed for host blood species ID

All specimens processed for arbovirus isolation / identification

RODENTS AND BATS Studies

Rodents and bats collected using various methods (Tomahawk and Havahart traps and mist nets)

Animal statistics taken and identifications done

Blood samples and some tissues collected

specimens processed for molecular ID

specimens processed for arbovirus isolation / identification

Influenza surveillance activities

**Description of Influenza Surveillance System**

- Hospital based case investigation and sentinel surveillance system

- 9 sentinel sites (5 outpatient clinics where ILI is assessed and 4 hospitals where both ILI and SARI are assessed).

- All sentinel clinics and hospitals are public facilities.

- Testing for Human Influenza is carried out only at the NIC at UVRI in Entebbe
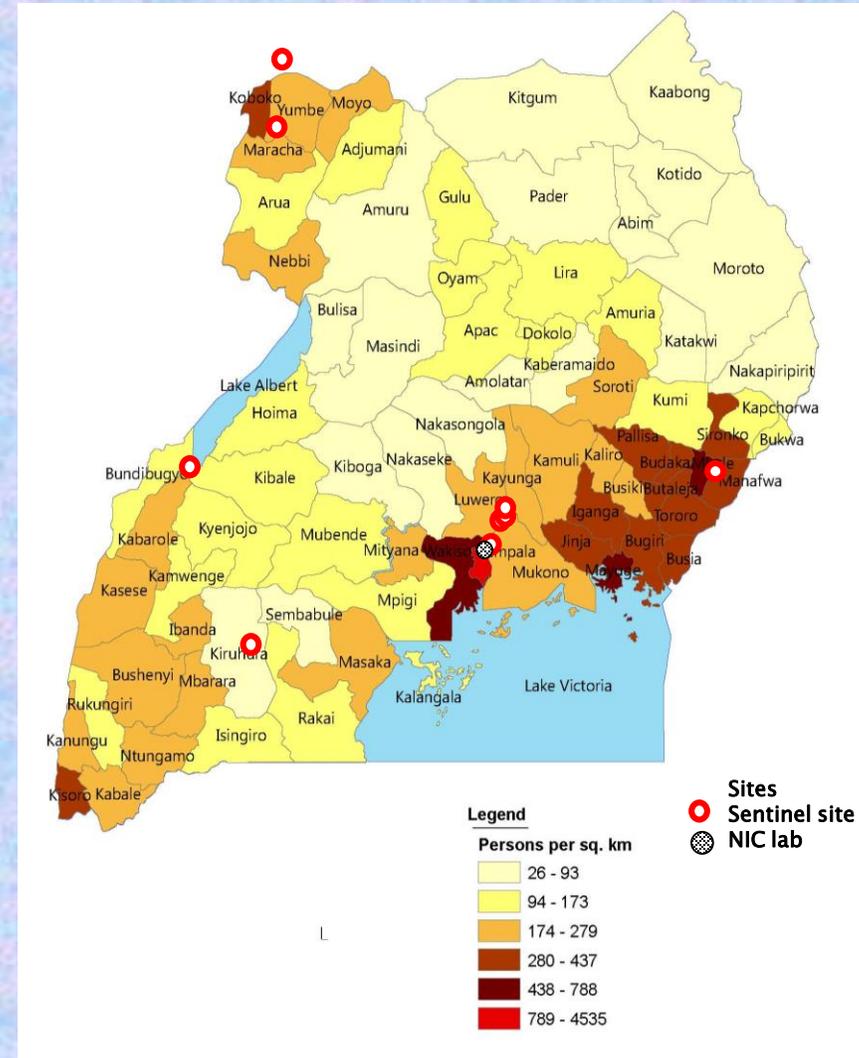
Plague program studies

Key Activities:

☐ Plague Surveillance,

☐ Case management.

☐ Capacity building to LG.

☐ Research to inform

effective preventive,

diagnostic & curative measures.
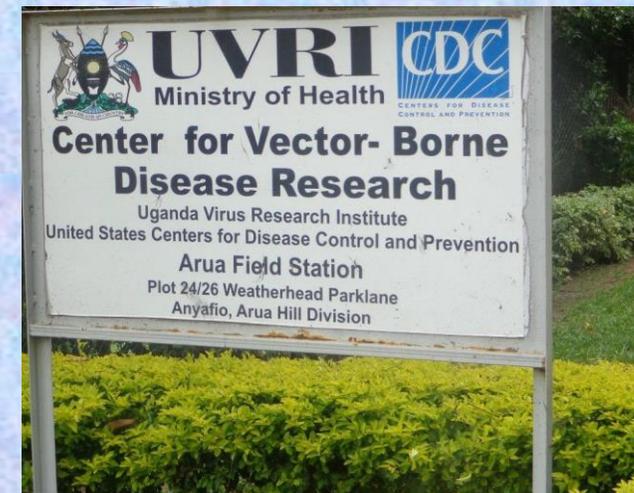
**Some of the on-going research include;**

- We are in final stages of evaluating RDT for rapid diagnosis of plague.

- Testing additional drugs for treatment of plague.

- AFI study to map out diseases other than malaria, which present with acute fever.

- Rat Fall Surveillance & IRS as an early warning & response strategy.

- A number of other research activities on plague epidemiology & Ecology

Uganda VHF Surveillance: Objectives

- ☐ Improve reporting capability for endemic viral hemorrhagic fever cases
- ☐ Improve laboratory capacity in identification of viral pathogens
- ☐ Detect incident cases of suspect viral hemorrhagic fevers
- ☐ Report to the National level in a timely and complete manner
- ☐ Improve case investigation and outbreak response
- ☐ Integrate with existing surveillance systems so that forms, personnel and resources are used more efficiently and effectively
- ☐ Generate and improve the quality of information for decision making and disease control efforts

2015 VHF Surveillance Sites
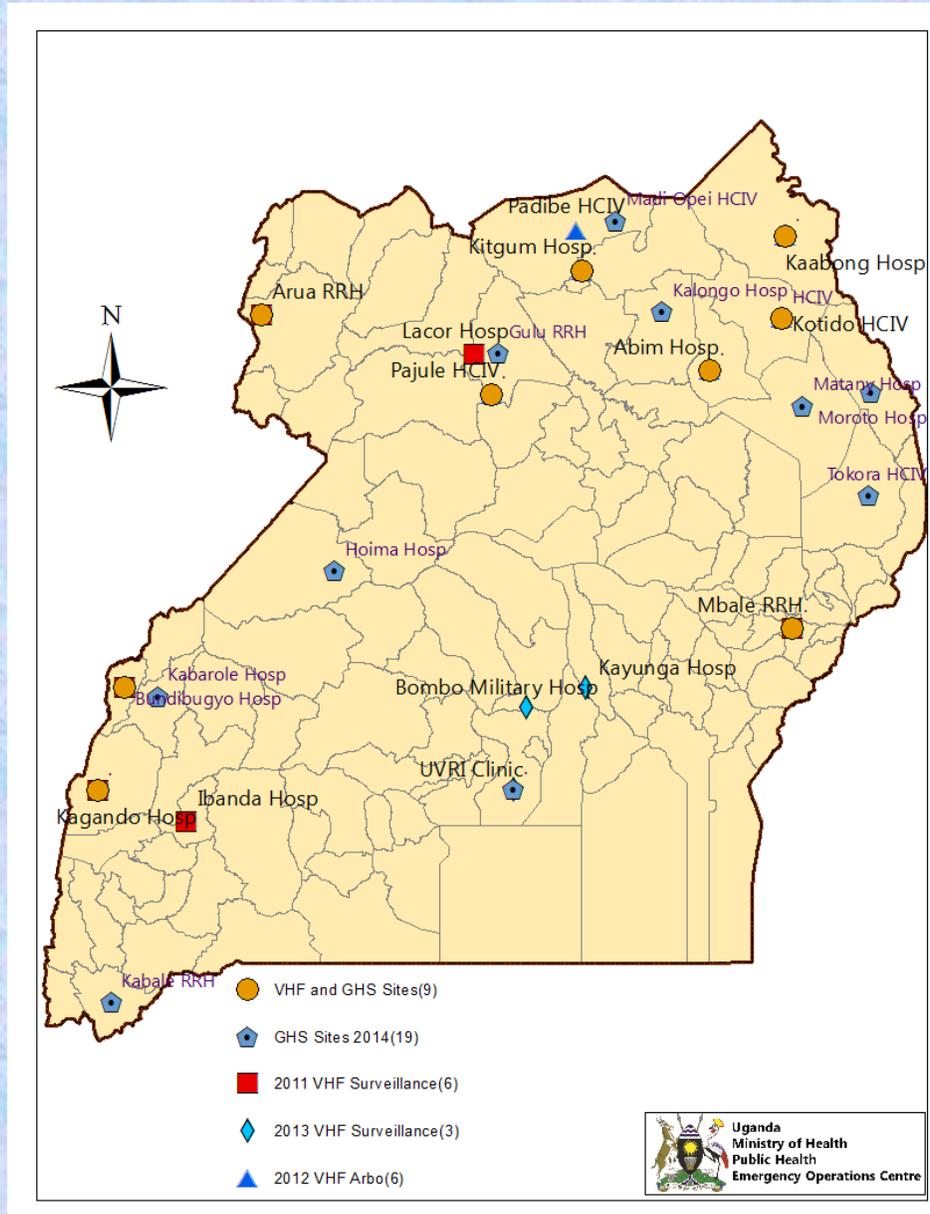
Pre- and post-implementation of enhanced VHF surveillance and diagnostics in Uganda, 2000-2014
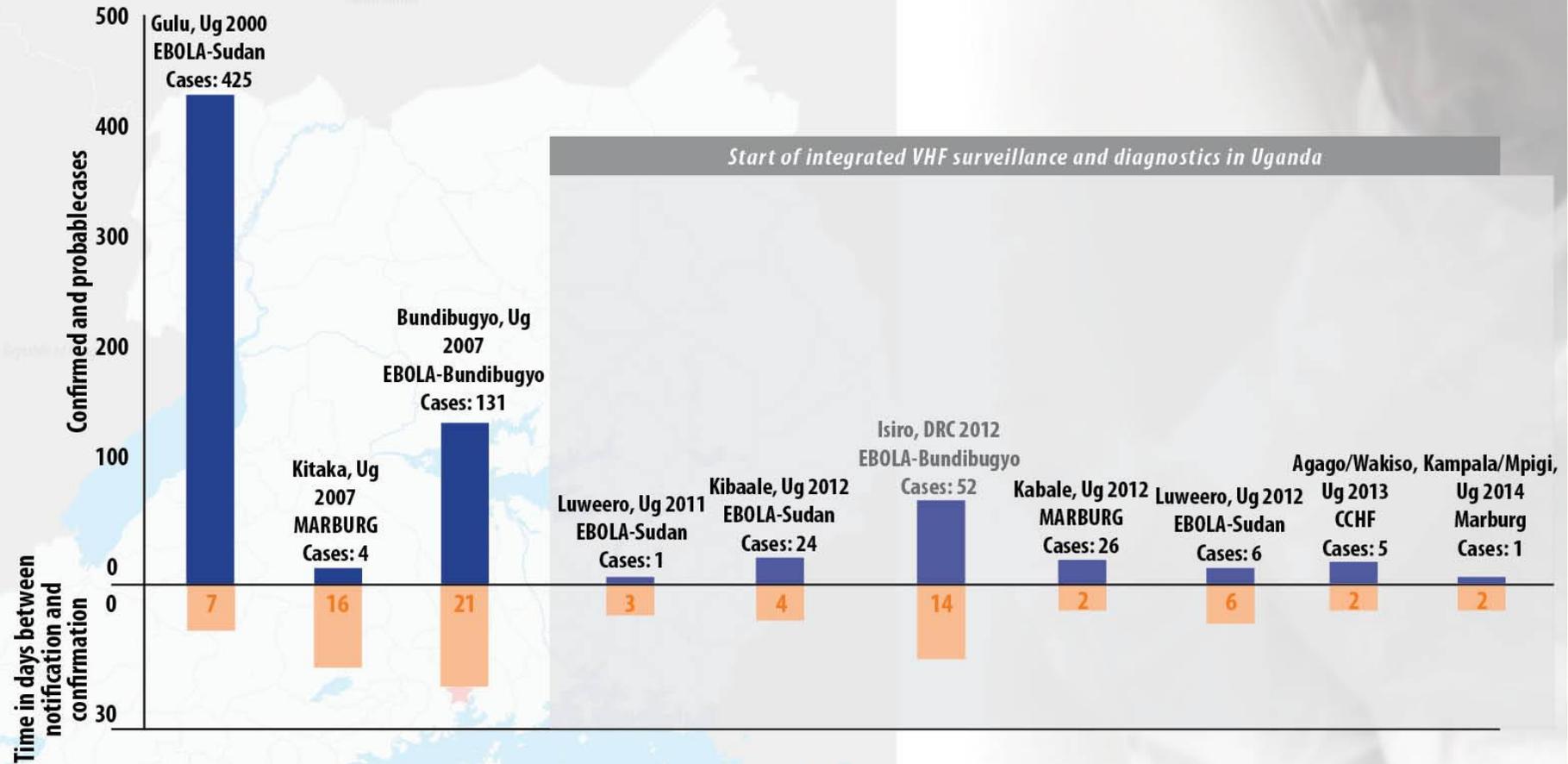
GHSA

Prevent Avoidable Epidemics

Antimicrobial Resistance	Zoonotic Diseases	Biosafety/ Biosecurity	Immunization
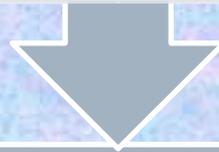
Detect Threats Early

Laboratory Systems	Surveillance	Reporting	Workforce Development

Respond Rapidly and Effectively

Emergency Operations Centers	Law Enforcement and Multisectoral Response	Medical Countermeasures & Personnel Deployment

Adapted from Frieden et al., NEJM 2014 Aug 20.

Uganda GHSA External Assessment Results

Action Package	Action Package Component	No Capacity 0	Limited Capacity 1	Developed Capacity 2	Demonstrated Capability 3	Sustainable Capability 4
Prevent 1: Antimicrobial Resistance	Surveillance Plan Implementation	■				
	Laboratory testing			■		
Prevent 2: Zoonotic Disease	Surveillance systems in place for priority zoonotic diseases/pathogens			■		
	Veterinarians		■			
Prevent 3: Biosafety and Biosecurity	Whole-of-government biosafety and biosecurity system is in place			■		
	Biosafety and biosecurity training and practices		■			
Prevent 4: Immunization	Vaccine coverage (measles)				■	
	National vaccine access				■	
Detect 1: National Laboratory System	Laboratory testing capacity for 10 core tests for detection of 10 priority diseases				■	
	Specimen referral and transport				■	
	Effective modern point of care and laboratory based diagnostics			■		
Detect 2/3: Real Time Surveillance	Syndromic surveillance systems				■	
	Inter-operable, interconnected, electronic real-time reporting system				■	
Detect 4: Reporting	System for efficient reporting to WHO, FAO and OIE					■
	Reporting network and protocols in country					■
Detect 5: Workforce Development	Trained field epidemiologists – Human				■	
	Field Epidemiology Training Program or other applied epidemiology training program in place				■	
	Workforce strategy			■		
Respond 1: Emergency Operations Centers	Status of EOC (space)			■		
	Status of EOC (staff)			■		
	Emergency Operations Program			■		
Respond 2: Linking Public Health and Law Enforcement	Public Health and Law Enforcement are linked during a suspect or confirmed biological event			■		
Respond 3: Medical Countermeasures and Personnel Deployment	System is in place for sending and receiving medical countermeasures during a public health emergency		■			
	System is in place for sending and receiving health personnel during a public health emergency		■			

GHS - UVRI Laboratories

Prevent – Detect - Respond
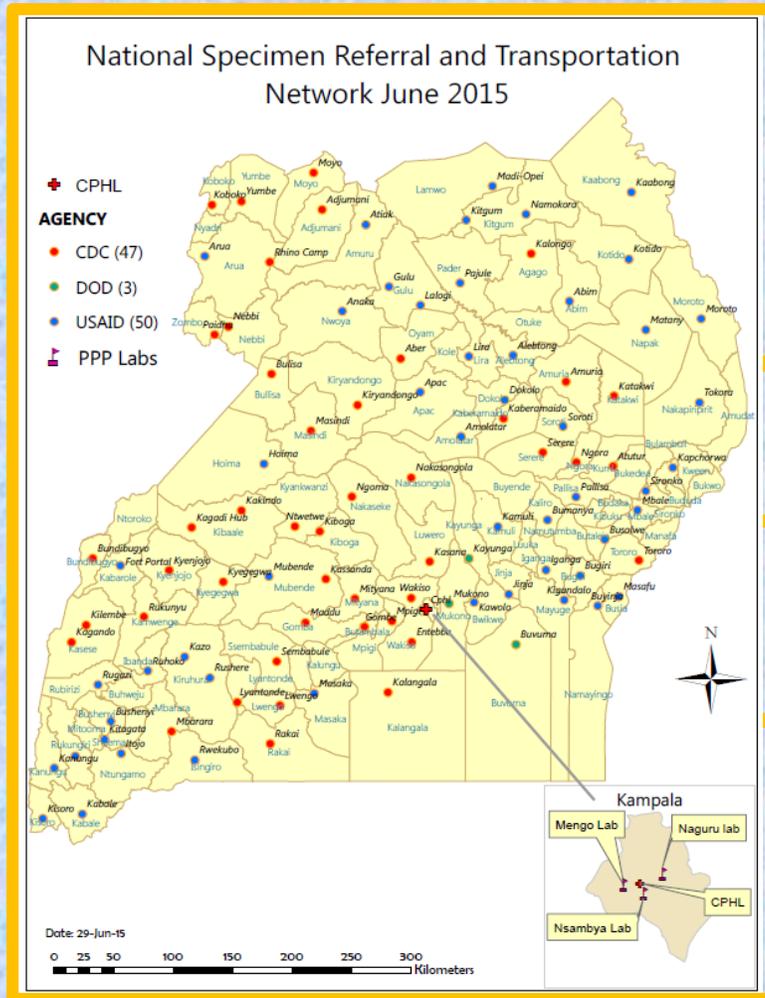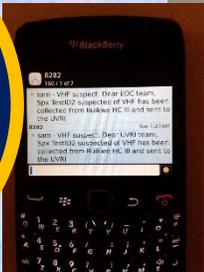
Acknowledgements

- Department of Arbovirology, Emerging and Re-Emerging Viral Infections
- UVRI
- MOH
- Sentinel site staff
- Sentinel site in-charges
- CDC Atlanta
- CDC Uganda
- WHO- County Office
- WHO AFRO
- USA DoD
- All collaborators, service providers and suppliers

Strengthening Laboratory Diagnostics and Surveillance of Acute Encephalitis Syndrome in India

India

Dr. V. Ravi, MD, FAMS, FAsc

Dean (Basic Sciences), Professor and Head,
Department of Neurovirology
National Institute of Mental Health and Neuro Sciences (NIMHANS)
Bangalore 560029, India

GHSA Grantee Conference
Early Successes Panel
February 11, 2016

Centers for Disease Control and Prevention

Center for Global Health

CDC

Background

- **Acute Encephalitis Syndrome (AES) is a major public health problem in India**
  - **Defined as acute onset fever with altered sensorium or seizures**
  - **Japanese Encephalitis (JE) is one of the leading causes of AES**

- **Laboratory-based testing of serum or cerebrospinal fluid (CSF) essential for confirming JE diagnosis**
  - **Frequently not performed at district level in India**

- **Lack of capacity to systematically test for other pathogens that may cause AES in India**
  - **The causes and burden of AES remain poorly understood**

- **NIMHANS has experience as a Regional Reference Laboratory for WHO SEARO JE Lab Network (2006-2010)**

AES and JE Cases in India, 2008 – 2013
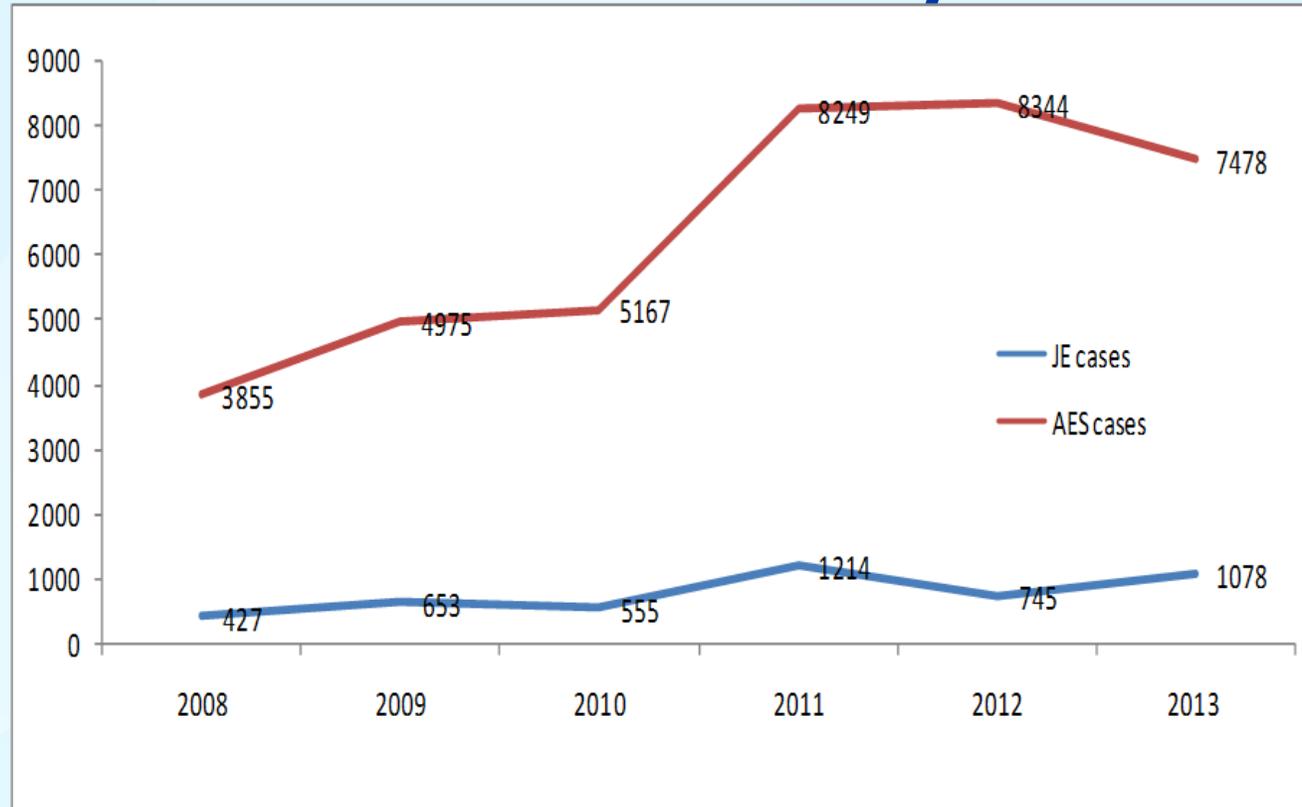
- **National Vector Borne Disease Control Programme (NVBDCP) initiated sentinel surveillance in 2006**
  - **Primary focus is detection of JE at 50 sentinel sites**
  - **Testing for non-JE pathogens is not routinely conducted**
  - **JE accounts for ~15% of AES cases**
  - **Etiologies of majority of AES cases undiagnosed**

Data: NVBDCP

NIMHANS AES Surveillance Network: Project Objectives

1. **Establish a tiered network to support strengthened laboratory-based surveillance of JE /AES in India**

   - **Strengthen district laboratory capacity for JE testing**
   - **Strengthen referral laboratory capacity for testing additional (non-JE) pathogens that may cause AES**
   - **Establish external quality assurance program with proficiency testing**
   - **Establish and enhance specimen transport and results reporting**

2. **Enhance the understanding of etiologies and epidemiology of AES in highly affected states**

   - **Standardized algorithm based testing for JE and non-JE pathogens**
   - **Data can be used to:**
     - **Guide modification of routine surveillance**
     - **Develop appropriate public health and clinical interventions**

Establishing a Tiered Laboratory AES Surveillance Network

- **Collaboration:**
  - **Ensure participation of NVBDCP and State Health Authorities**
- **District:**
  - **Selection of districts in highly affected states: Uttar Pradesh, West Bengal, and Assam**
  - **Periodic wet lab training on quality JE testing methods**
- **Apex Referral laboratories:**
  - **Assessment and selection of referral labs within each state**
  - **Development of a standardized testing algorithm for AES**
  - **Periodic wet lab training for testing of non-JE pathogens**
- **Linking the district and referral laboratories**
  - **Evolve a robust specimen and data referral mechanism**
  - **Ensure timeliness of reporting with defined turn around times**
  - **Provide quality assurance through implementation of a proficiency testing program**

NIMHANS AES Laboratory Network

- **Tiered Network**
  - **Four apex laboratories linked to 15 district-level laboratories**
- **Workshops**
  - **Three hands-on wet lab diagnostic training programs on JE testing**
  - **Two workshops on molecular diagnosis of non-JE pathogens for referral labs (Apex)**
  - **One workshop for review and analysis of AES data from network**

AES LAB NETWORK
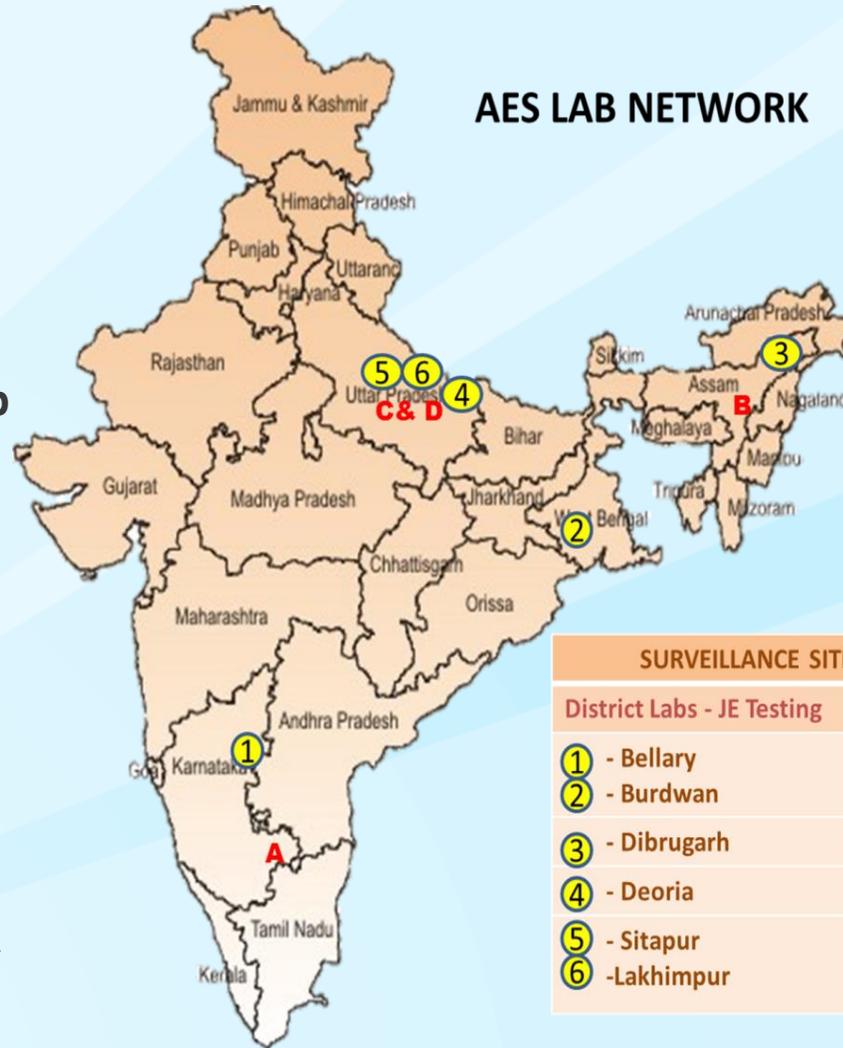
SURVEILLANCE SITES AND ATTACHED LABS

District Labs - JE Testing	Apex Labs - Non JE Testing
① - Bellary	A - NIMHANS, Bangalore
② - Burdwan	
③ - Dibrugarh	B - AMCH, Dibrugarh
④ - Deoria	C - SGPGI, Lucknow
⑤ - Sitapur	D - KGMU, Lucknow
⑥ - Lakhimpur	

Standardized Laboratory Testing Algorithm

Suspected AES case: Prompt CSF, blood and serum collection

CSF
Clinical tests: Glucose, Protein, Cytology-cell count/ differential, Gram stain*, Culture/sensitivity (*if available)

Microbiology/Virology: JEV virus IgM Assay (ELISA)
Store aliquots for referral lab testing/characterization

Blood/Serum
Clinical tests: Hb, WBC count, total/differential, platelets, Serum electrolytes/glucose, LFT, MP and/or malaria rapid diagnostic test
Microbiology/Virology: JEV virus IgM Assay (ELISA)
Store aliquots for referral lab testing/characterization.

JE POSITIVE

JE NEGATIVE

1. Report Results to Apex Lab
2. Send 20% of positive specimens for confirmation at Apex lab

1. Report Results to Apex lab
2. Send ALL specimens to Apex lab for further testing
3. Confirmatory testing on 5% of JE Negative specimens

CSF

Serum

Whole Blood

Molecular Test (PCR)
1. Bacterial PCR (Hib, Spn, Nm)
2. Scrub Typhus PCR
3. Herpesvirus DNA PCR
4. Enterovirus RNA PCR
5. Leptospira

IgM ELISA Assays
1. Dengue IgM/NS1
2. Scrub Typhus IgM
3. West Nile virus IgM
4. Chikungunya

Molecular Test (PCR)
1. Bacterial PCR (Hib, Spn, Nm), (IF NO CSF)
2. Scrub Typhus PCR

Molecular Test (PCR)
Scrub Typhus PCR

ANY POSITIVE
Report to Hospitals, AES Site Coordinators, State

CONVALESCENT SERUM SPECIMEN (2, 4, or 6 WEEKS): JE IgM and SCRUB TYPHUS IFA (if applicable)

Results of NIMHANS AES Laboratory Network, 2014

- **Specimens collected from 8 districts across four states**
  - **Linked to four apex laboratories**
  - **Testing conducted between September – December 2014**

- **1,253 patients clinically suspected of AES investigated**
  - **CSF and serum samples: 639 (51%) patients**
  - **CSF only: 352 (28%) patients**
  - **Serum only: 262 (21%) patients**
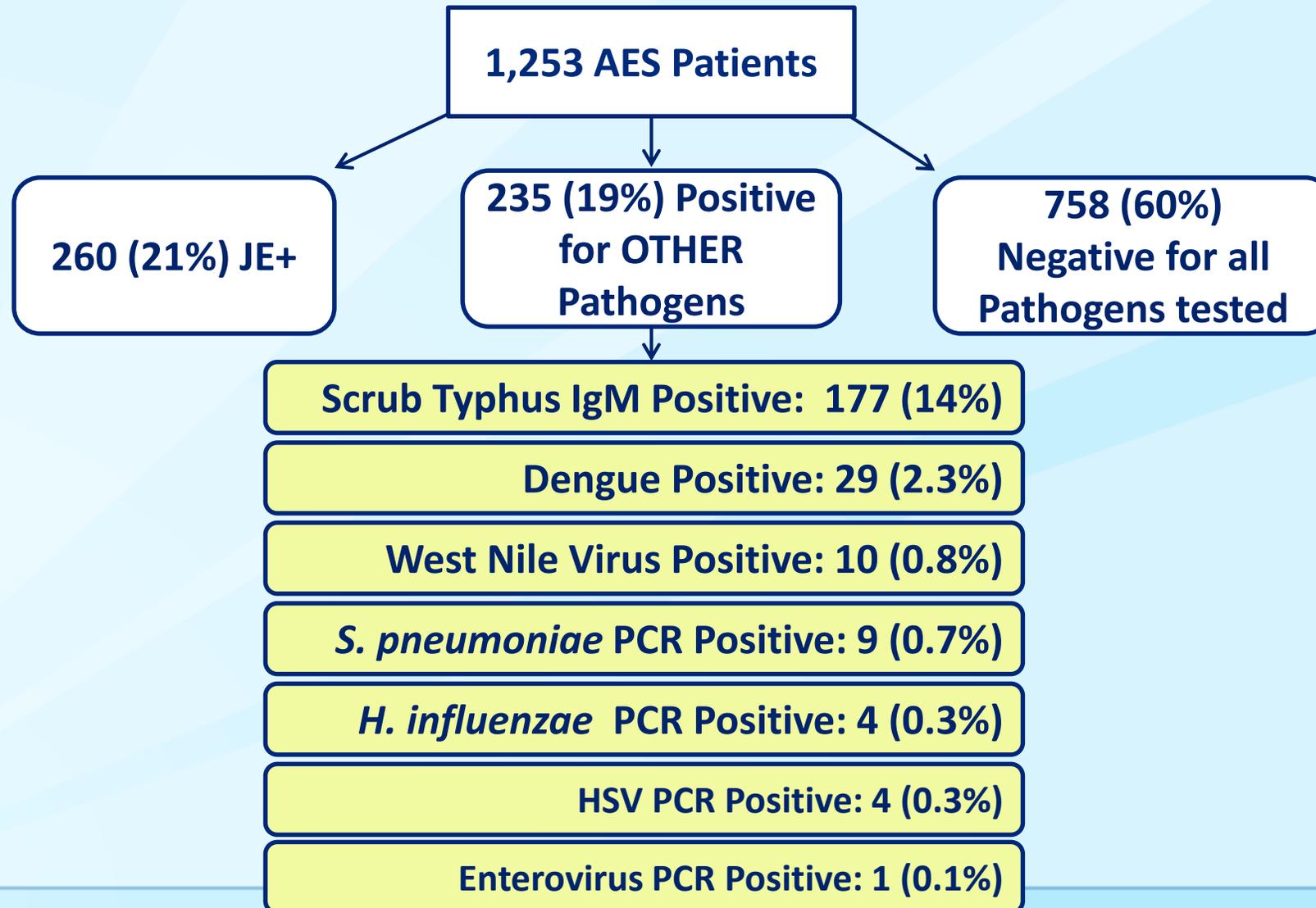
NIMHANS AES Surveillance Network: Next Steps

- **Expanding an AES surveillance platform to 15 districts**
- **Year-round surveillance**
- **Refining diagnostic testing algorithm**
- **Intensified prospective surveillance in 3 districts:**
  - **More detailed clinical, epidemiologic, data**
    - **UP: Deoria and Kushinagar**
    - **Assam: Dibrugarh**

State	Apex Labs	District Labs	Districts
Assam	2	4	Dibrugarh, Jorhat, Barpeta, Sonitpur
Uttar Pradesh	2	6	Deoria, Kushinagar, Maharajganj, Siddharth Nagar, Sitapur, Lakkhimpur
West Bengal	1	4	Burdwan, Bankura, Darjleeing, Jalpaiguri
Karnataka	1	1	Bellary
Total	5	15	

GHSA Early Successes: Laboratory Systems Action Package

1. <u>Effective modern laboratory-based diagnostics</u>
   a. Establishment of a tiered network of labs in districts hospitals linked with state level referral labs, linked with NIMHANS (national level reference laboratory)
   b. Laboratory testing conducted according to a standardized algorithm using quality-assured diagnostic methods and kits
   c. Set up a proficiency testing program for JE testing and detection of non-JE pathogens
2. <u>Laboratory testing for detection of priority diseases in a tiered surveillance network</u>
   a. District laboratories reliably conduct serologic testing for JE
   b. Referral laboratories reliably conduct serologic and molecular testing for non-JE pathogens
3. <u>Specimen referral and transport</u>
   a. Developing a system of specimen referral and transport with standard SOPs and turnaround times (within 72 hours)

GHSA Early Successes: Surveillance and Reporting Action Packages

1. Indicator-based surveillance
   a. Enhancing routine existing NVBDCP surveillance systems to detect and report AES pathogens beyond JE
      i. 2014 findings suggest potential importance of scrub typhus and other febrile illness pathogens; cross-cutting area for meningitis
2. Analysis of surveillance data
   a. Establishing a system to ensure laboratory specimen and basic epidemiologic data are linked and collected accurately
   b. Strengthening capacity for analysis of surveillance data at district and state level
3. Reporting network and protocols
   a. Districts within surveillance network report diagnostic testing results according to established protocols (daily to state in epidemic period)

Opportunities Across the GHSA India Platform for Enhancing Laboratory Quality Systems

- Laboratory workshops and training programs across all key stake holders amongst the GHSA awardees in India to standardize and strengthen laboratory quality systems and services
  - Training workshops to establish standardized testing methods and SOPs for key pathogens across the network
    - Focus on building expertise for a group of pathogens at each centre
      - Emerging viral infections at NIV and NCDC
      - Febrile illness pathogens at Manipal University
      - AES pathogens at NIMHANS
  - Establish quality assurance methods and standards
  - Determine key questions related to diagnostics and develop a plan to address these issues
- Provide training for testing samples of unknown aetiology
  - Develop a plan to build next generation sequencing capacity in partner institutions with the assistance of CDC Atlanta

Challenges and Lessons Learned

Challenges
- **Working with State Governments and the National program officials in consonance**
- **Building capacity of laboratories in the network**
- **Evolving an acceptable algorithm for testing**

Opportunities
- **Strengthening specimen referral mechanisms and linkages within the various laboratory networks of GHSA awardees in India to facilitate early detection and response to emerging threats**
- **Provide technical assistance for continued Quality Management Systems (QMS) approach to strengthening the public health response in India**
  - **Provide technical support in the implementation of 12 quality systems elements (QSEs) in labs**

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