Detecting, Responding and Preventing Epidemics in a Globalized World: Global First Requires Local Action

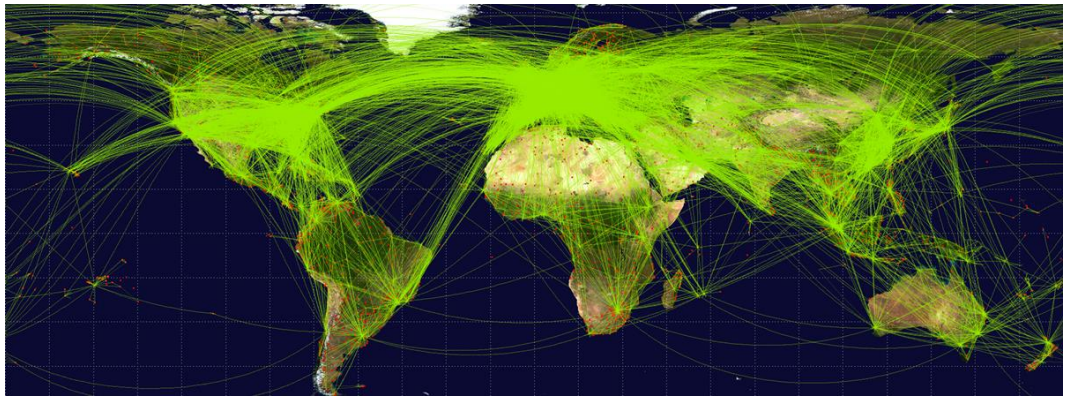
UCSIA Conference

22 March 2017

Dr Rebecca Martin
Director, Center for Global Health
US CDC

Global…

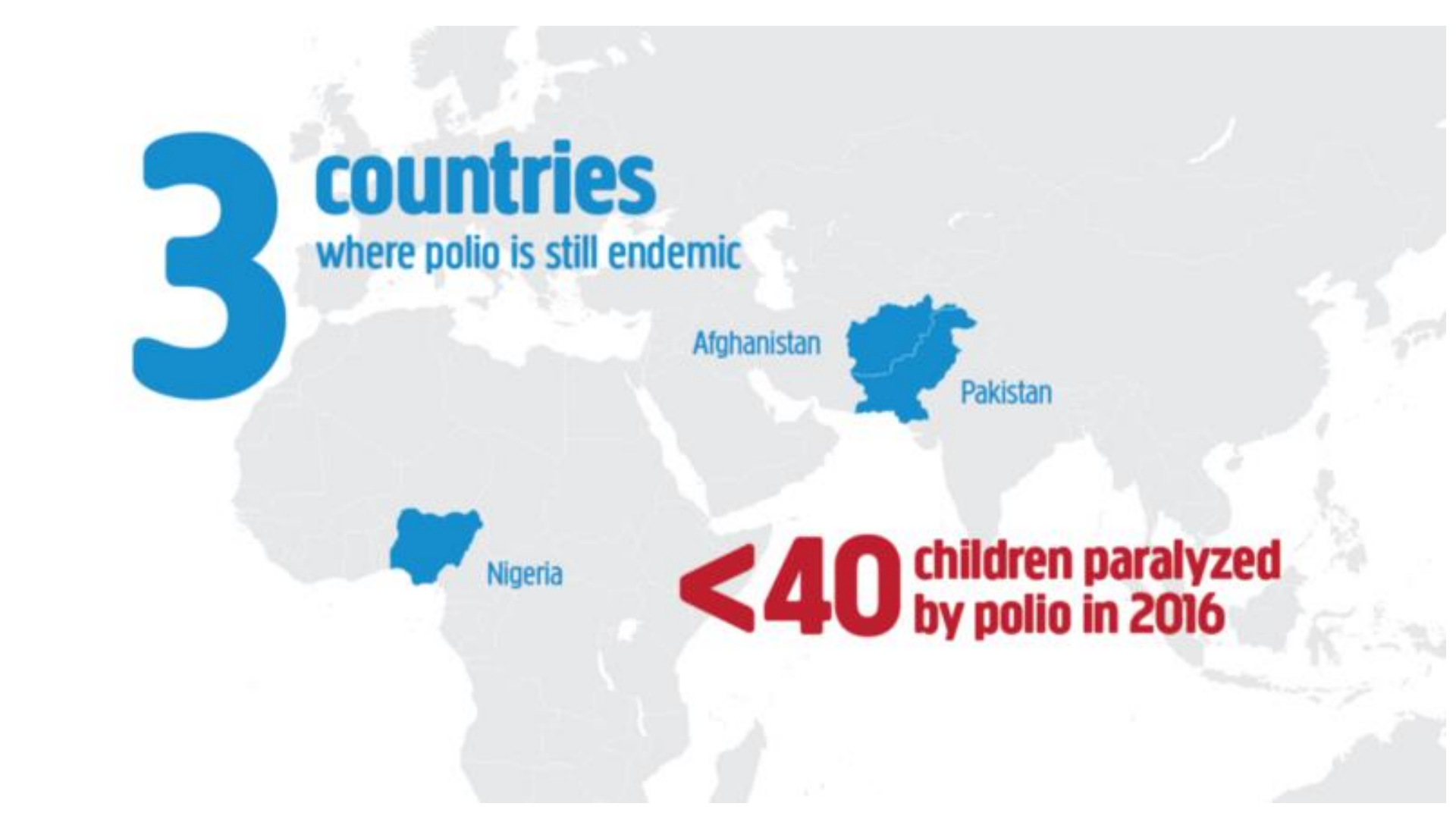
- Movement – air links



- Urban movement – 54% in 2014 →66% in 2050 expected
- Economies
- Commerce and trade

Global and Regional Displaced Populations in 2015*

*The New York Times: The Flight of Refugees Around the Globe, 20 June 2015


3 countries
where polio is still endemic
Afghanistan
Pakistan
Nigeria
<40 children paralyzed by polio in 2016

West Africa Ebola Epidemic: 2014-2015

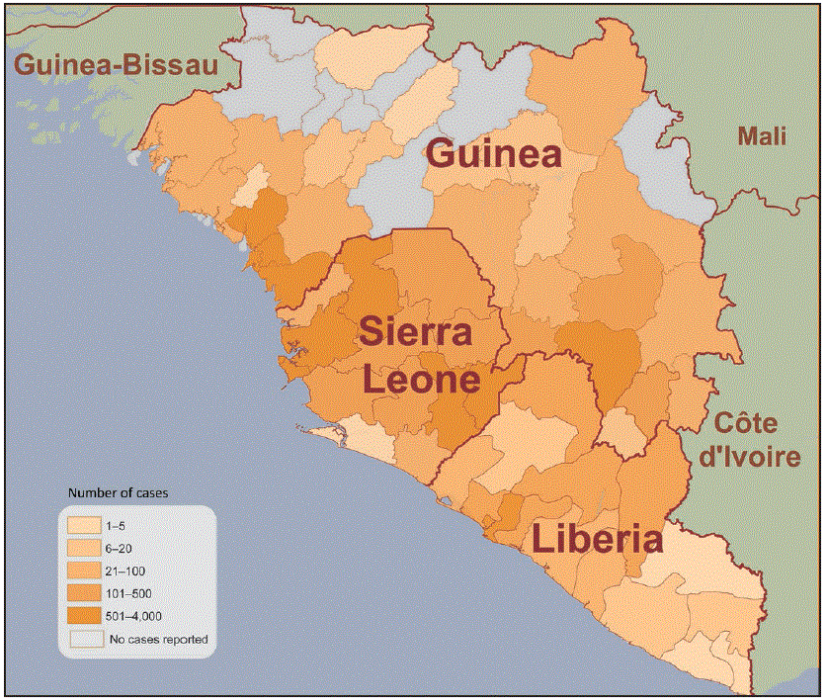
Decades of civil unrest in all 3 countries

A Perfect Storm

Weak public health infrastructure/Lack of IPC in health facilities/ Unrecognized cases in crowded cities

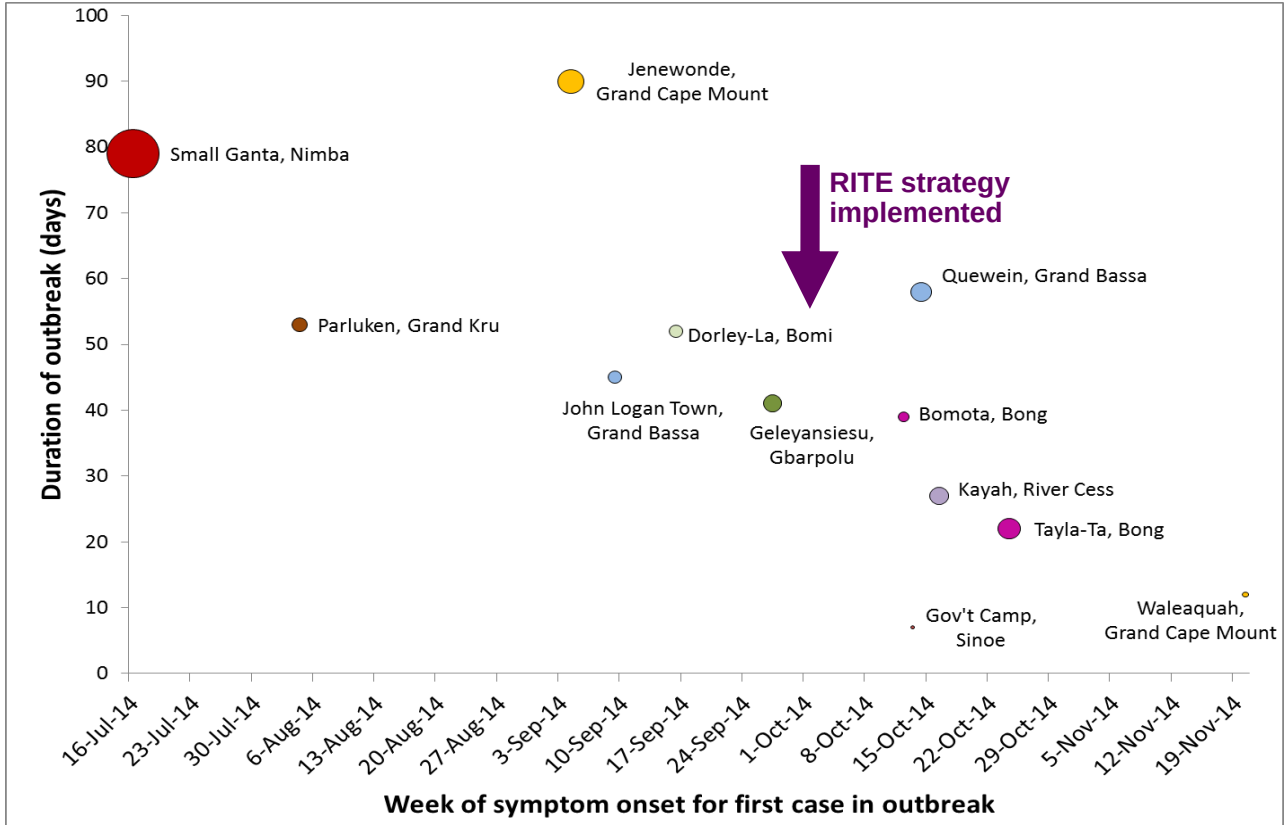
Spotty border control

Cumulative Confirmed Ebola Cases in Guinea, Liberia, and Sierra Leone, 2014-2016*



*By district, by county (Liberia), district (Sierra Leone), and prefecture (Guinea)

Rapid Isolation and Treatment of Ebola (RITE): *roll-out decreased duration of outbreaks in Liberia*

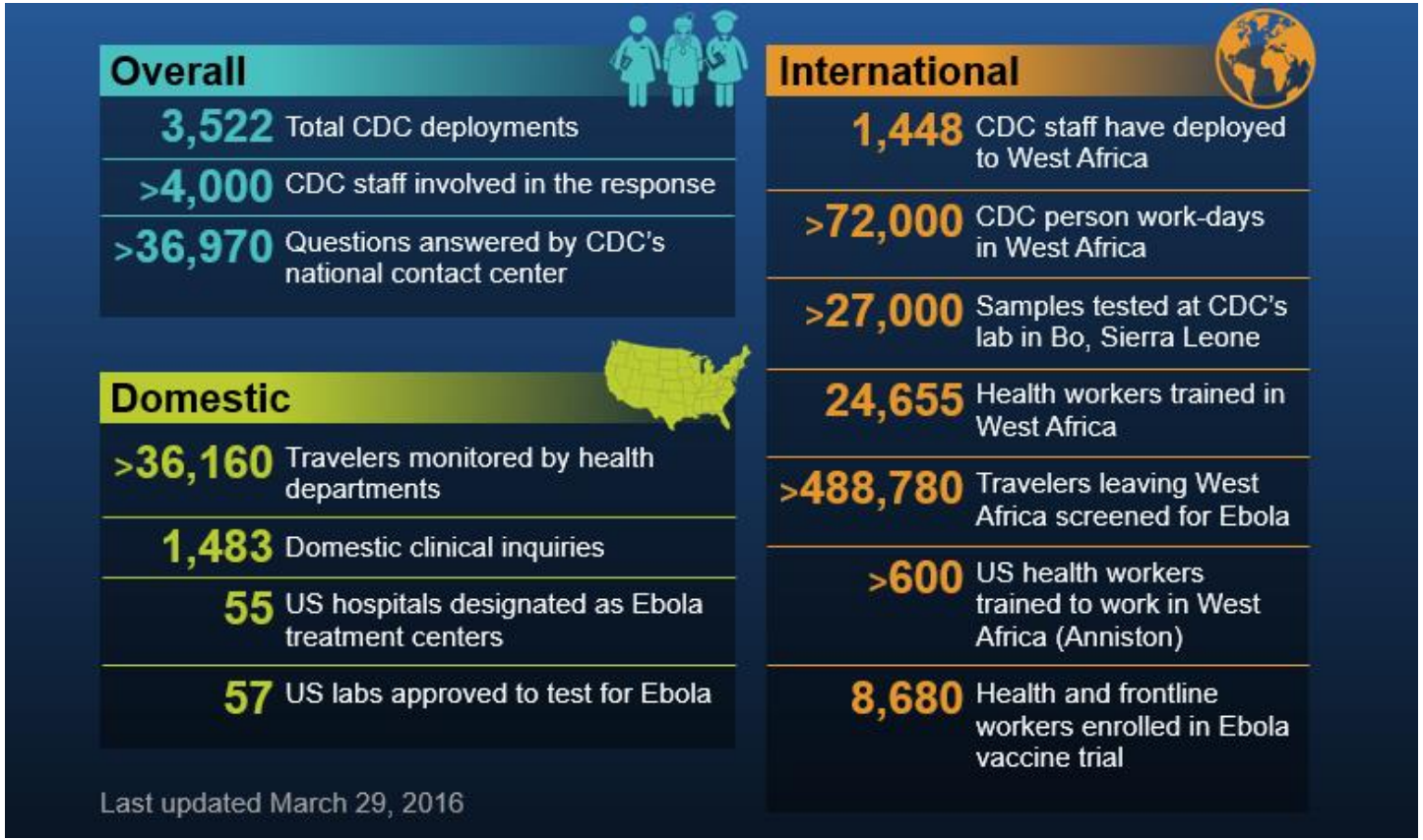


Size of circle proportional to number of cases in cluster; colors indicate different districts.

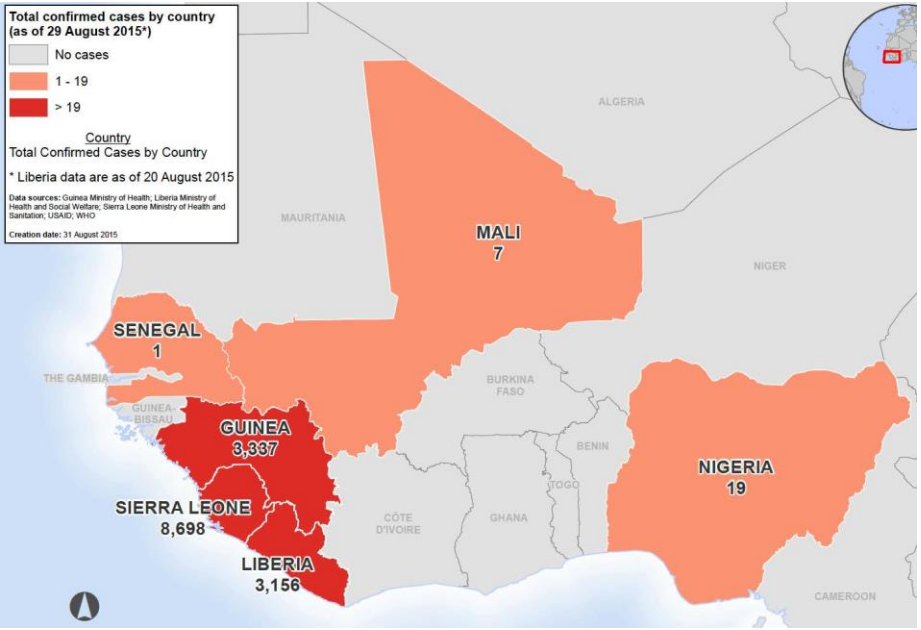
EPSMG: Ebola Private Sector Mobilization Group

- Developed in 2014
- Educated employees
- Active messages for families and communities
- Maintained momentum in economy
- Direct support
- Raised international awareness
- Advocacy

US CDC Ebola Response by the Numbers

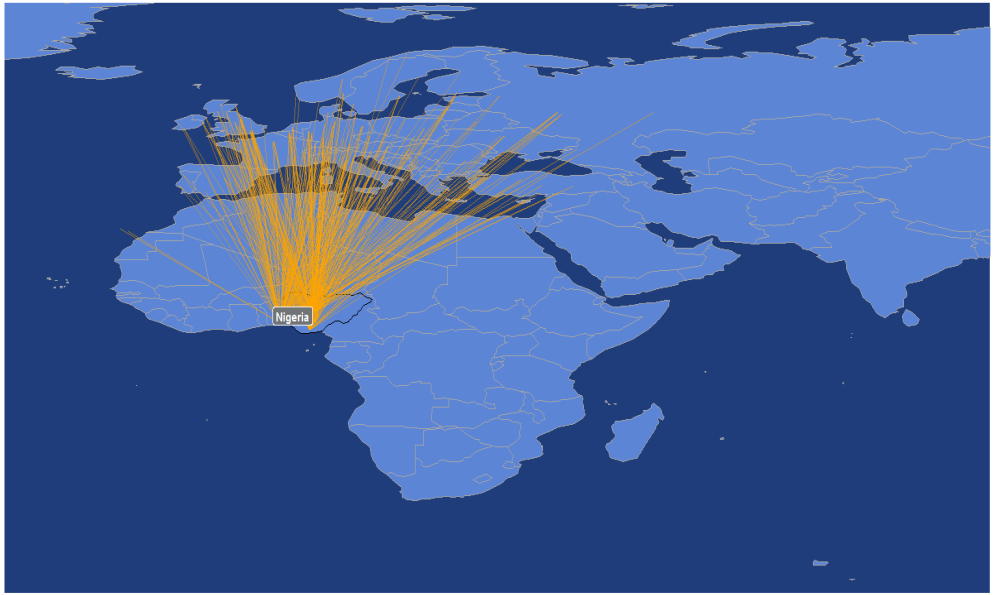


Ebola: What Might Have Been



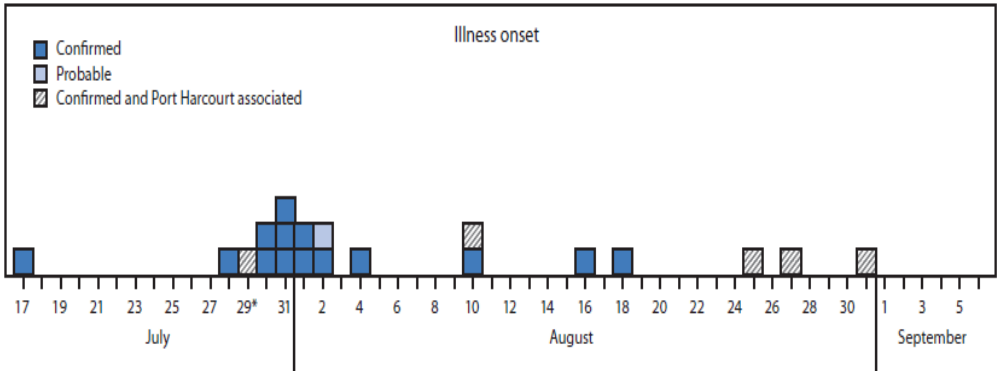
West Africa Ebola outbreak

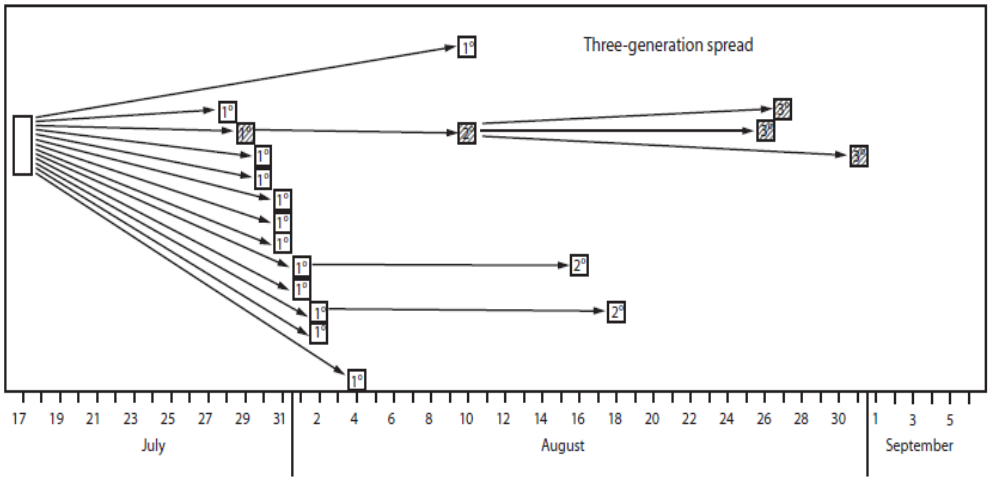
Confirmed cases as of Aug. 29, 2015



International flights originating from Nigeria

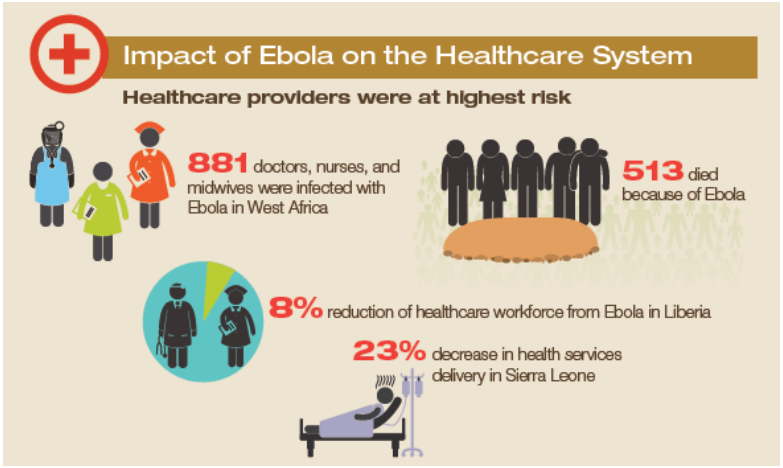
Ebola Outbreak in Nigeria was Stopped Quickly

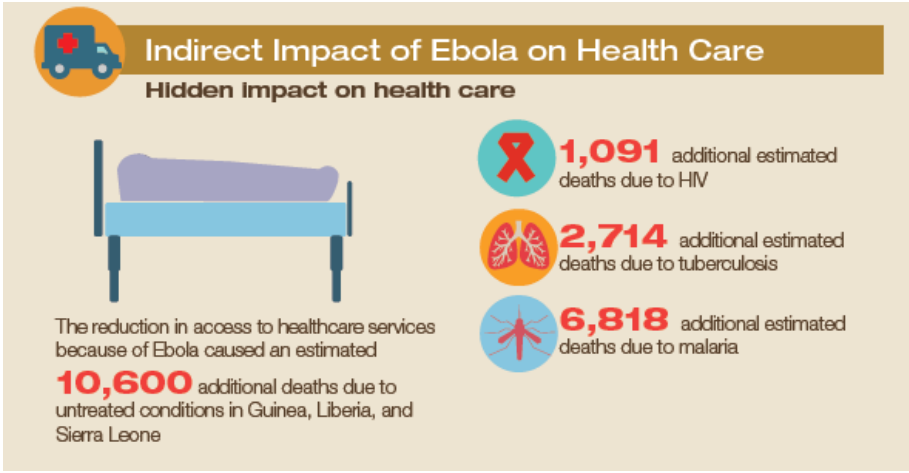


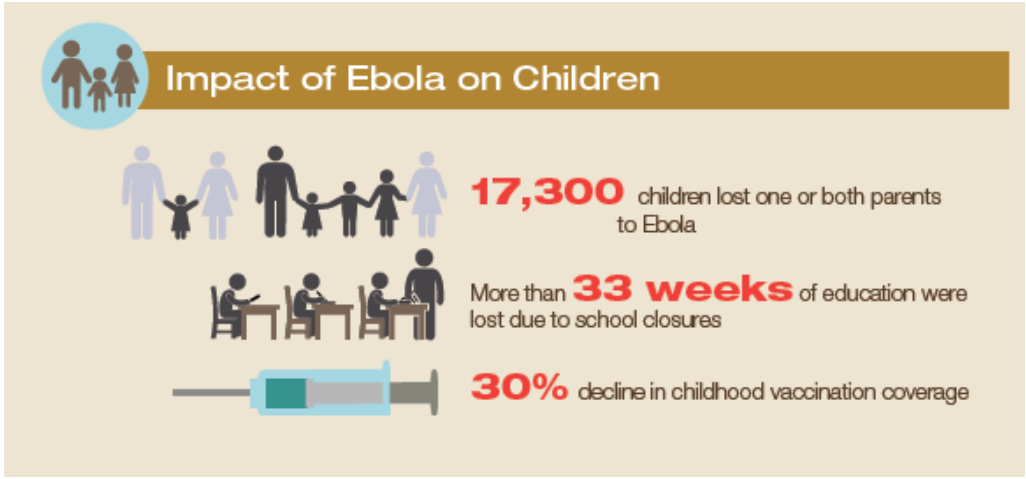


Nigeria Ebola response by the numbers	
Local staff mobilized	1020
FETP residents/graduates responding	80
Sites decontaminated by trained teams	>70
Travelers screened at airports	150,000
Local clinical staff trained in infection control	2300
Contacts identified	894
Home visits of contacts contacts conducted	19,000
Suspect cases isolated and tested	43
Number of cases (from (from index case)	19

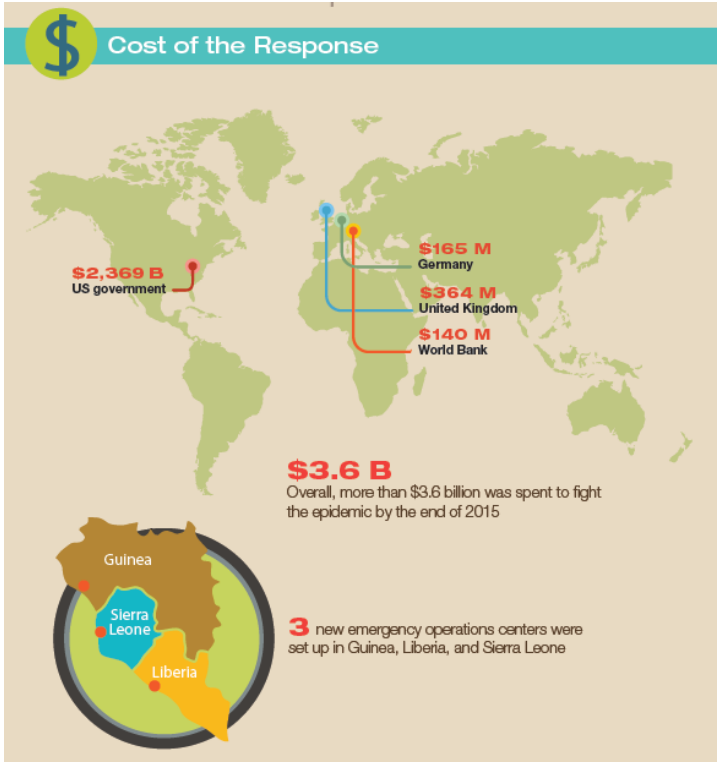
The Impact of Ebola

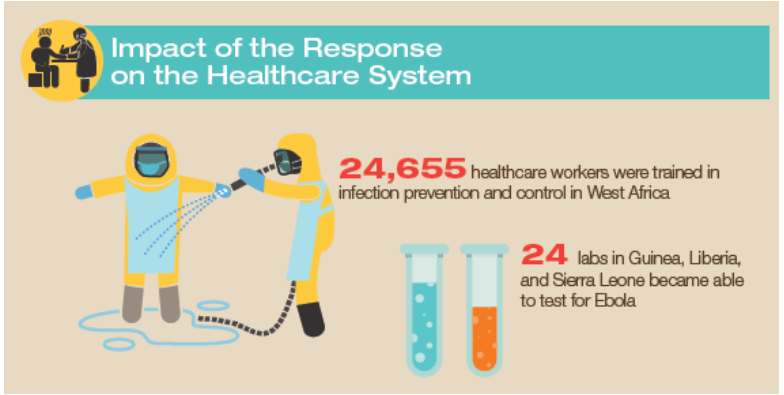




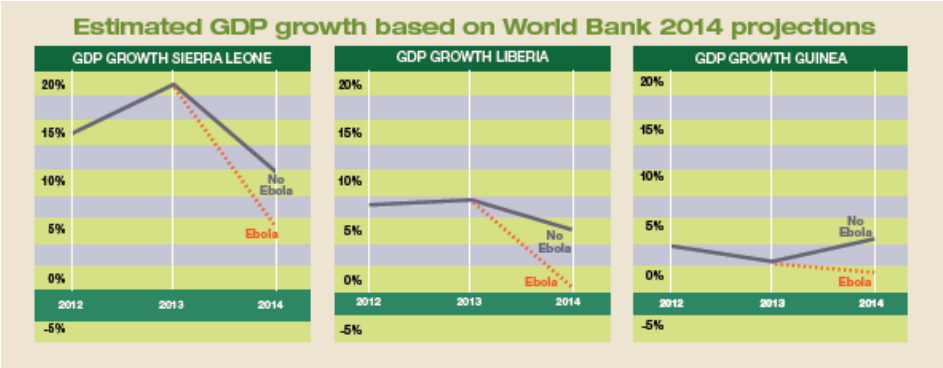


The Response





Ebola and the Economy



$2.2 billion in GDP was lost in Guinea, Liberia, and Sierra Leone in 2015, threatening not only macroeconomic stability but also food security, human capital development, and private sector growth.

Ebola Lesson #1: Countries Need Strong Public Health Infrastructure

- Each country has the responsibility to protect its people, and all countries need to be able to
  - **Find** a threat when it emerges (DETECT)
  - **Stop** it promptly (RESPOND)
  - **Prevent** it wherever possible (PREVENT)

- Meeting WHO IHR core capacities by 2012

Ebola Lesson #2: Infection Prevention and Control are Critically Important

- Protect health care workers
- Identify and report diseases
- Prevent disease transmission
- Control disease spread

- Ebola, MERS, and SARS are ***indicator diseases***
  - They indicate what is happening silently all over the world along with spread every day of many other diseases including tuberculosis, health care-associated and drug resistant bacteria, measles, *C. difficile*, and more

Ebola Lesson #3: Global Safety Net and Surge Capacity are Critical

- The international community is also responsible – epidemics are the world's problem, not only the problem of individual countries or regions
- When national capacities are overwhelmed, the world must move immediately and decisively
- Strengthening global capacity is not a short-cut to achieving Global Health Security
  - Country action is quicker, more efficient, and more cost-effective
  - Global action must strengthen and work through national systems to the greatest extent possible

Ebola Lesson #4: Need for Rapid, Ongoing Vaccine and Diagnostic Tests Development

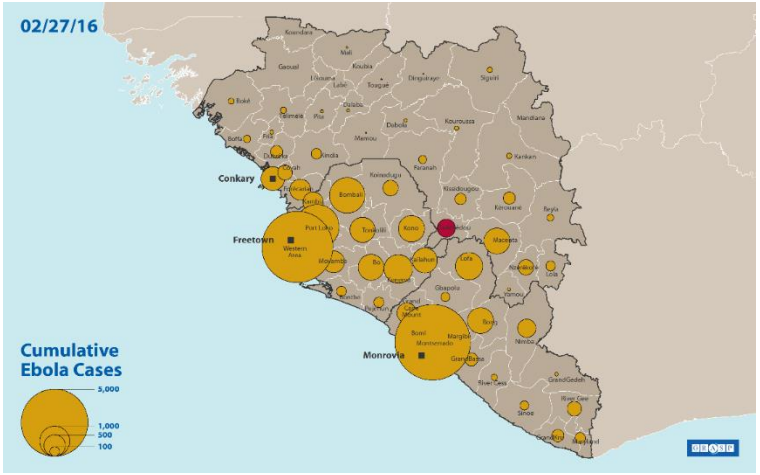
CEPI

New vaccines
for a safer world

A Tale of Two Outbreaks…..

March, 2014

- Host government and international response
- >28,000 cases, >11,000 deaths

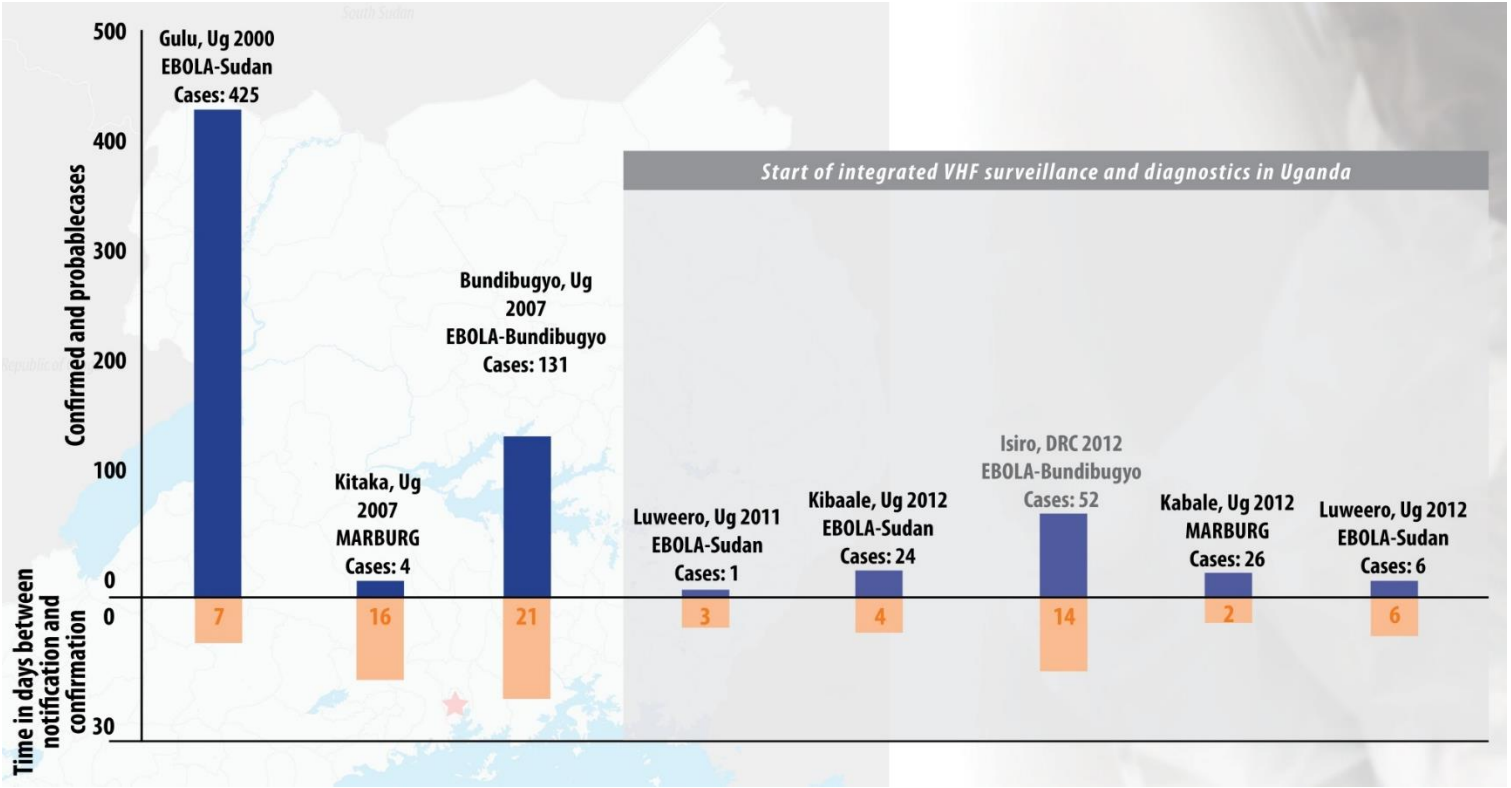


March, 2016

- Greater role played by host governments
- 13 cases, 9 deaths

Enhanced VHF surveillance and diagnostics reduced filovirus cases and time to confirm

Uganda, 2000-2012



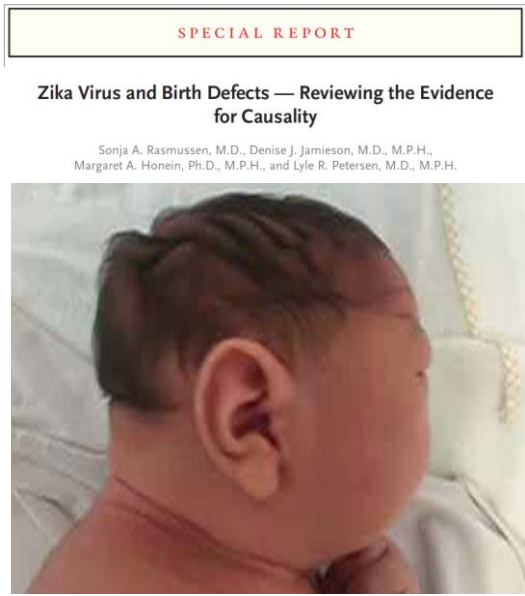
Zika

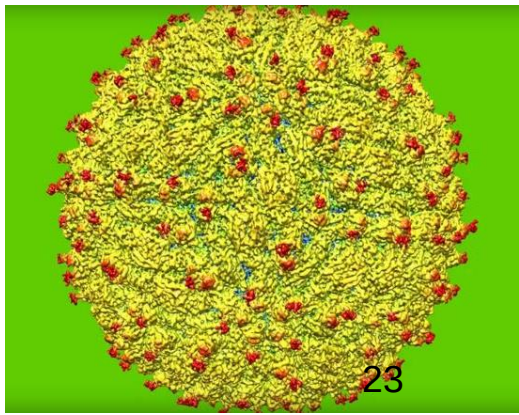
Zika: Latest in a Series of Unpredicted and Unpredictable Health Threats

- Unprecedented, extraordinary complexity, unique challenges
  - First time a mosquito-borne virus has been linked to microcephaly, other serious birth defects, and poor pregnancy outcomes
  - Sexual transmission occurs
  - Also associated with Guillain-Barré syndrome

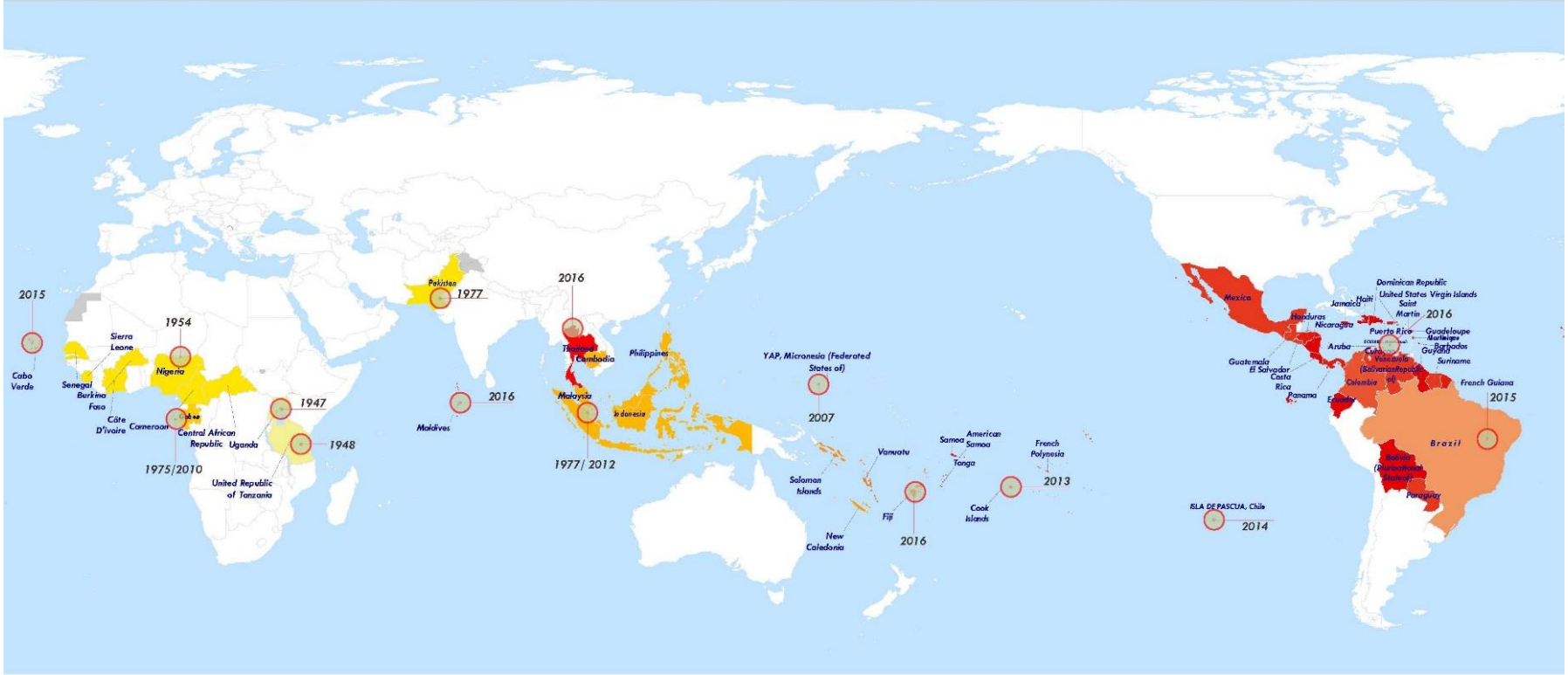
- Top priority - protect pregnant women

- The sooner we act, the better we can protect





Countries and territories showing historical distribution of Zika virus, 1947 - 2016



Available information does not allow measurement of the risk of infection, vectorial transmission among countries is not represented on this map.

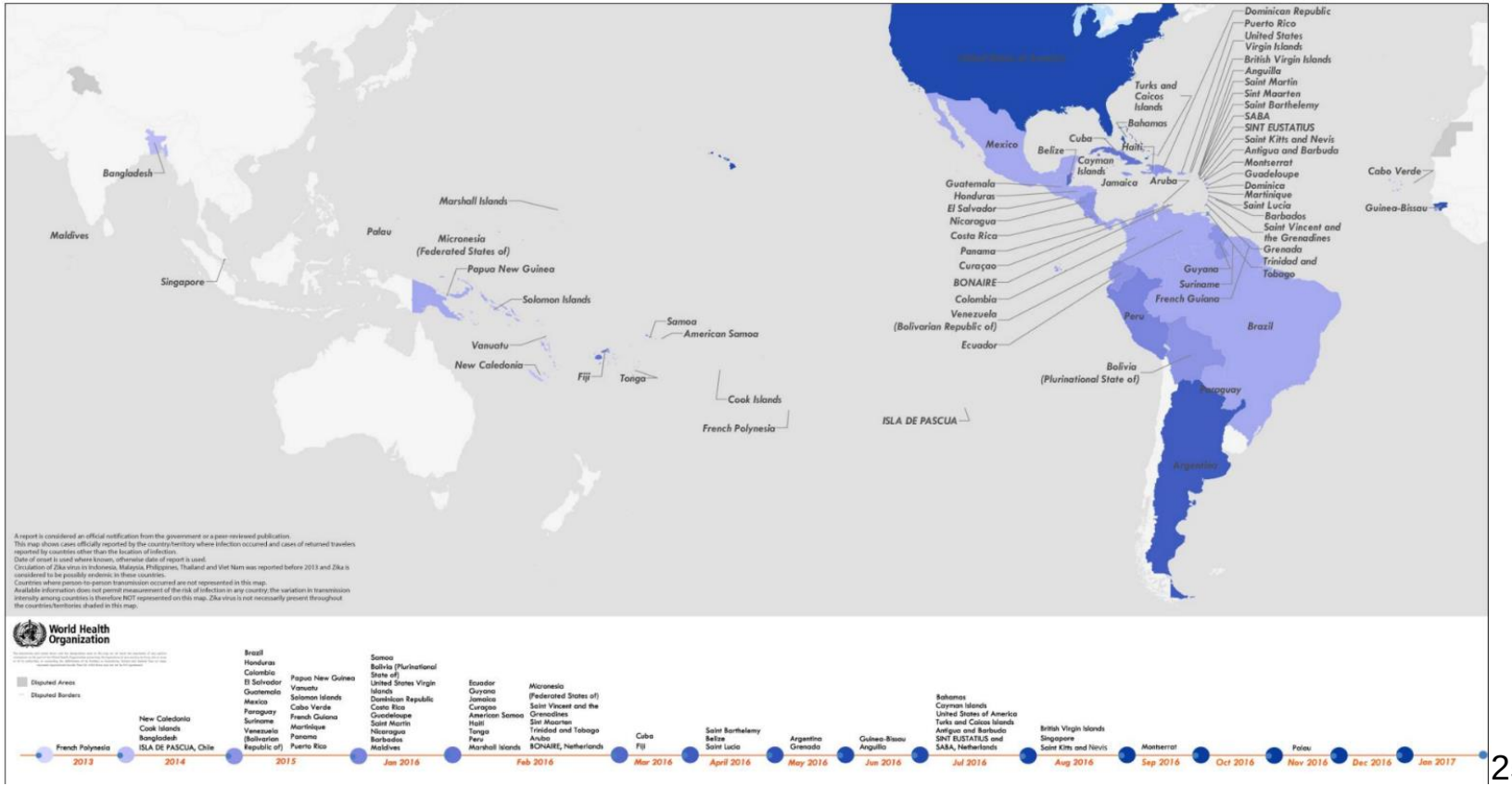
Disputed Areas

Disputed Borders

World Health Organization

Uganda, United Republic of Tanzania	Nigeria	Central African Republic, Senegal, Pakistan, Burkina Faso, Cote D'Ivoire, Cameroon, Sierra Leone, Gabon, Indonesia, Malaysia, Costa Rica, Cambodia	YAP, Micronesia (Federated states of), Gabon	French Polynesia, ISLA DE PASCUA, Chile, Cook Islands, New Caledonia, Malaysia, Philippines, Cambodia, Indonesia, Thailand	New Caledonia	Brazil, Solomon Islands	Vanuatu	Samoa, Fiji	Colombia, Cabo Verde	French Guiana, Martinique, Panama, Puerto Rico	Bolivia (Plurinational State of), United States Virgin Islands, Mexico, Dominican Republic, Costa Rica, Guadeloupe, Saint Martin, Nicaragua, Barbados, Maldives	Ecuador, Guyana, Jamaica, Curaçao, Samoa, American Samoa, Haiti, Thailand, Tonga	Aruba, BONAIRE, Netherlands
1947 - 1952	1954	1960 - 1983	2007 - 2009	2012 - 2014	Jan 2015	Feb 2015	Apr 2015	Jul 2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016

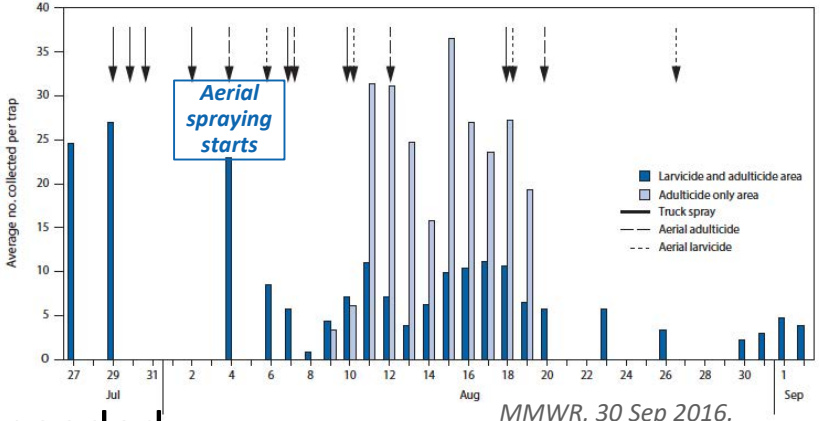
Zika Transmission as of 5 January 2017



Mosquito Control is Key to Zika Prevention

- *Aedes aegypti* control is hard but essential
  - Need to control larvae and adults
  - Aerial spraying + biological control

Average number of female Ae. aegypti mosquitoes per trap, Miami-Dade County, Florida, July-Aug 2016



MMWR, 30 Sep 2016.

- Comprehensive, sustained mosquito control needed
  - Surveillance of mosquito populations & resistance
  - Enhanced personal protection – **AND *community-wide approaches are essential***
  - Organized community action to reduce larval habitats
  - Larval and adult control
- New tools (biocontrol, traps, insecticides, more)

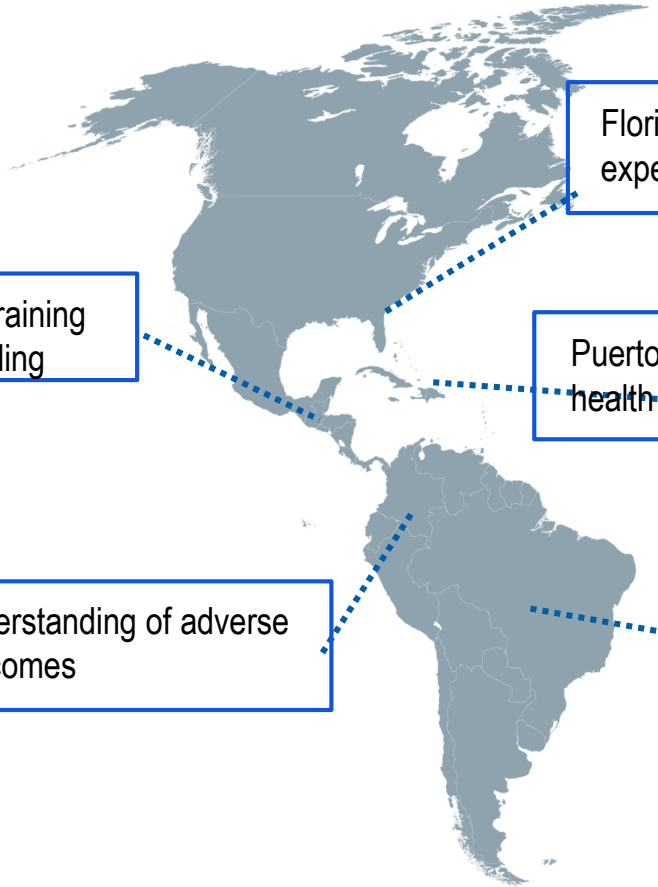
Laboratory-confirmed Zika Virus Disease Cases Reported to ArboNET by States or Territories — United States, 2015–2017 (as of 15 Feb 2017)

	States N=5,040		Territories N=37,023	
Travel-associated	4,748	(94%)	141	(<1%)
Locally acquired	220	(4%)	36,882	(99%)
Other routes*	72	(1%)	0	(0%)

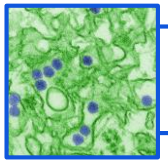
*Includes sexual transmission (n=44), congenital infection (n=26), laboratory transmission (n=1), and person-to-person through an unknown route (n=1)

http://www.cdc.gov/zika/geo/united-states.html

Sharing Lessons Learned: Local to Global



Florida: U.S. aerial spraying – experienced for other countries



Guatemala: Lab training and capacity building

Puerto Rico: Risk communication and health promotion

Colombia: Understanding of adverse pregnancy outcomes

Brazil: Innovations in vector control

Zika Interventions

	Zika-specific interventions
Prevent avoidable epidemics	▪ **Mosquito control** – Mexico, Brazil, Colombia, US, others piloting new means of tracking and controlling *Aedes aegypti* ▪ **Contraception** – Acceleration of access in many countries ▪ **Vaccine** – Brazil, US, Colombia, other PAHO countries collaborating on trials
Detect threats early	▪ **Diagnosis** – laboratory materials and networks in >100 countries (e.g., Thailand- capacity to test since 2013, identified cases promptly) ▪ **Surveillance** – Countries beginning/strengthening birth defect surveillance; Mexico best practices in mosquito surveillance
Respond rapidly and effectively	▪ **Travel advisories** ▪ **Protection** of pregnant women to prevent exposure and infection ▪ **Vector control** – Brazil, Colombia, Mexico and other countries trying new methods

Zika Diagnostics - Innovations

- Laboratory guidance, testing algorithms, technical assistance to build international laboratory capacity for Zika diagnostics

- Development of a rapid and specific assay for Zika
  - Validation with banked samples
  - Collaboration with Brazil
- Support Zika testing reagents in 118 countries
  - 1,179 Trioplex kits (500 tests/kit) to 117 countries; 70% in <10 days from request
  - MAC-ELISA reagents to 38 international laboratories
  - Ancillary reagents from International Reagent Resource (IRR) to >25 laboratories

What Have We Learned To Date?

Established that **Zika is a cause** of microcephaly, serious brain defects, and is linked to potentially other birth defects

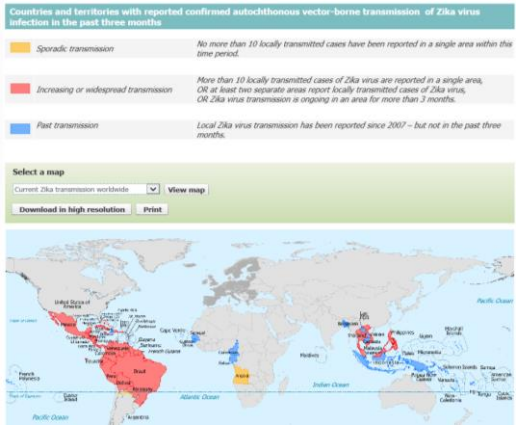
Estimated that among pregnancies with evidence of Zika infection in the 1st trimester, **about 11%** of fetuses and infants had birth defects

Recognized pattern of birth defects associated with Zika virus infection called **congenital Zika syndrome**

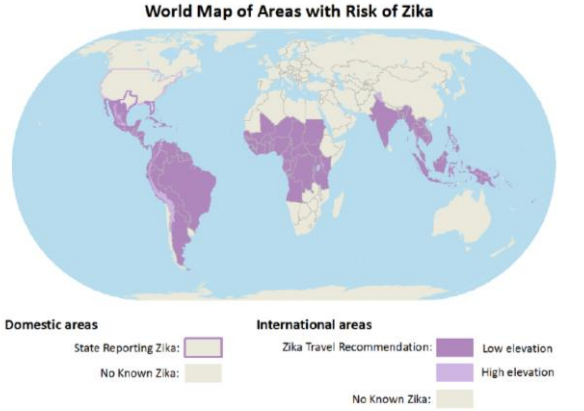
Identified that Zika infections during the **1st and 2nd trimester** have been associated with birth defects

Zika Guidance to Pregnant Women, March 2017

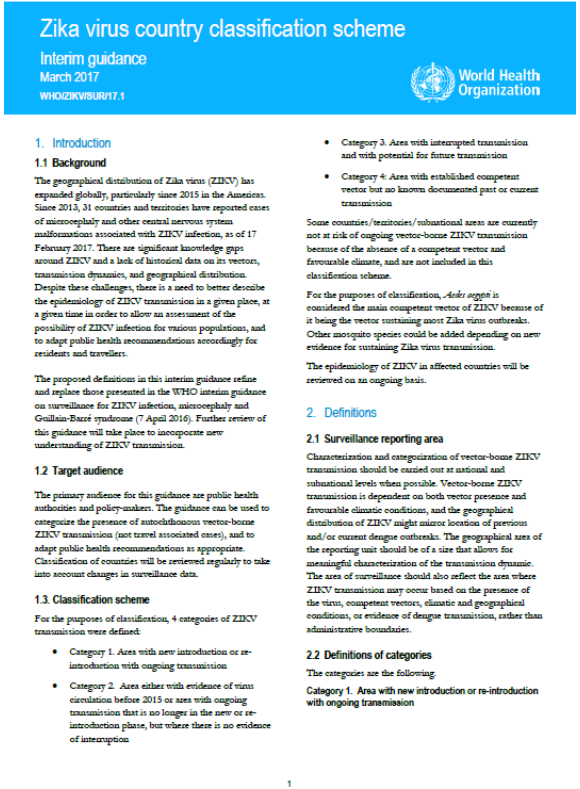
ECDC Guidance



CDC Guidance

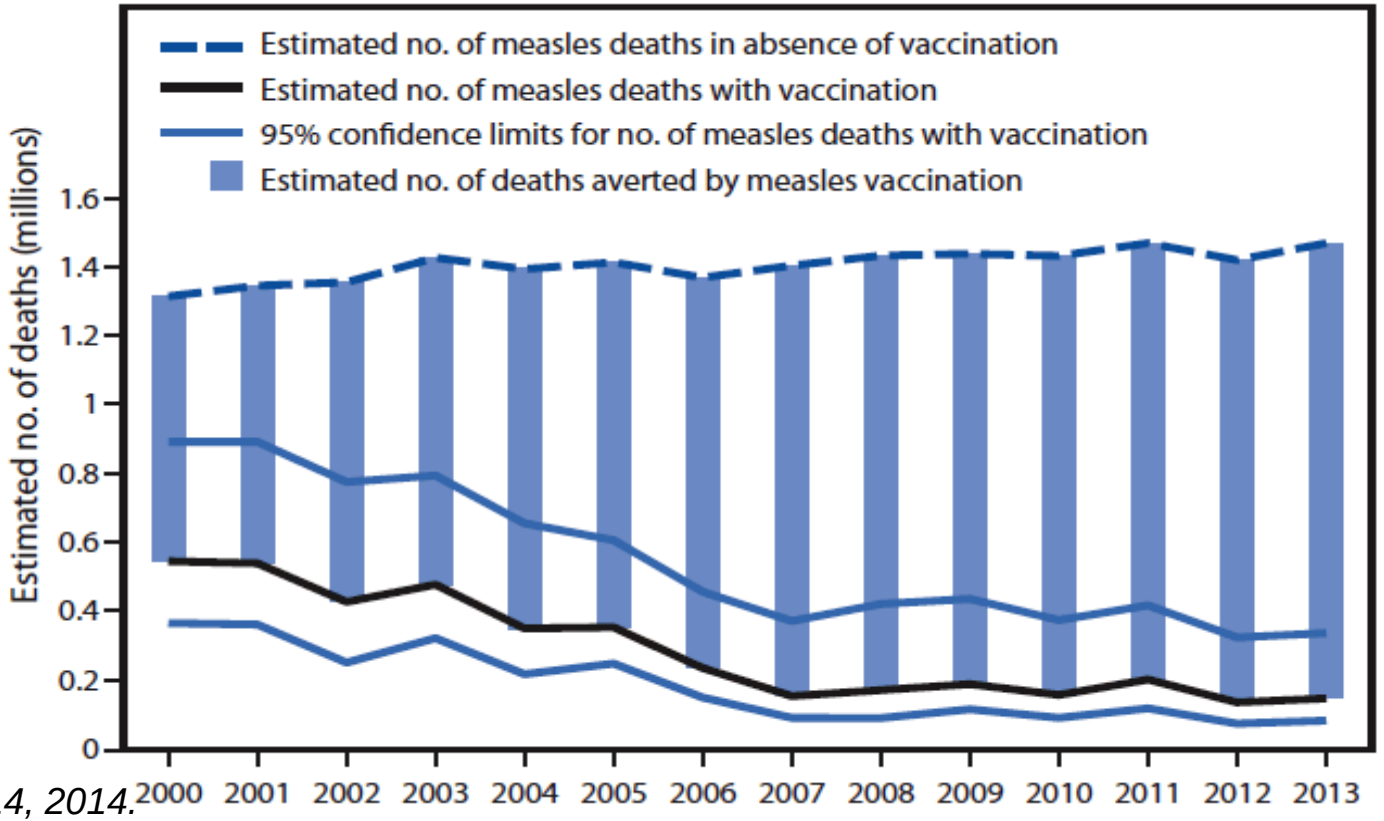


WHO Guidance



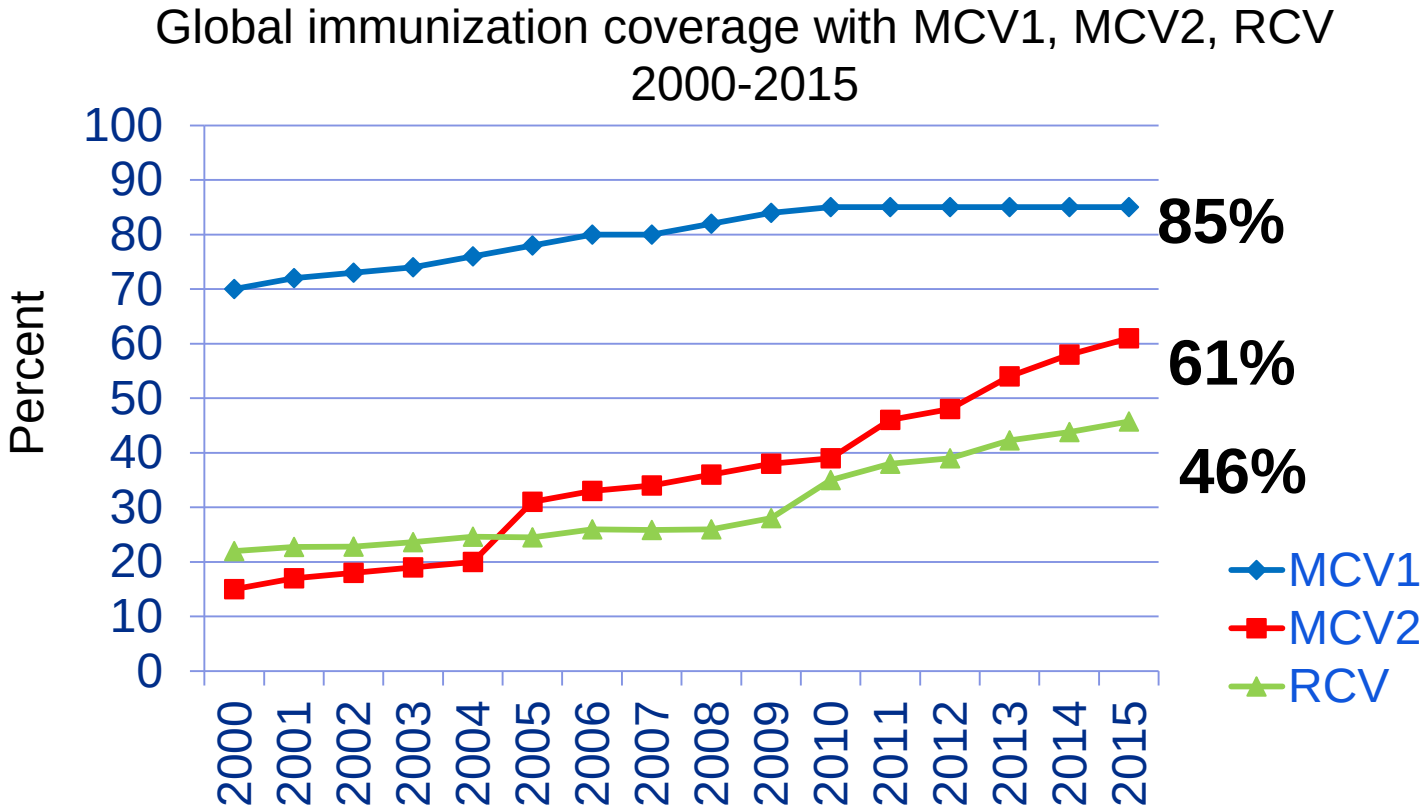
Measles

Measles Vaccine Prevented 15.6M Deaths
Reduced Infant Mortality Rates by 25% (2000-2013)



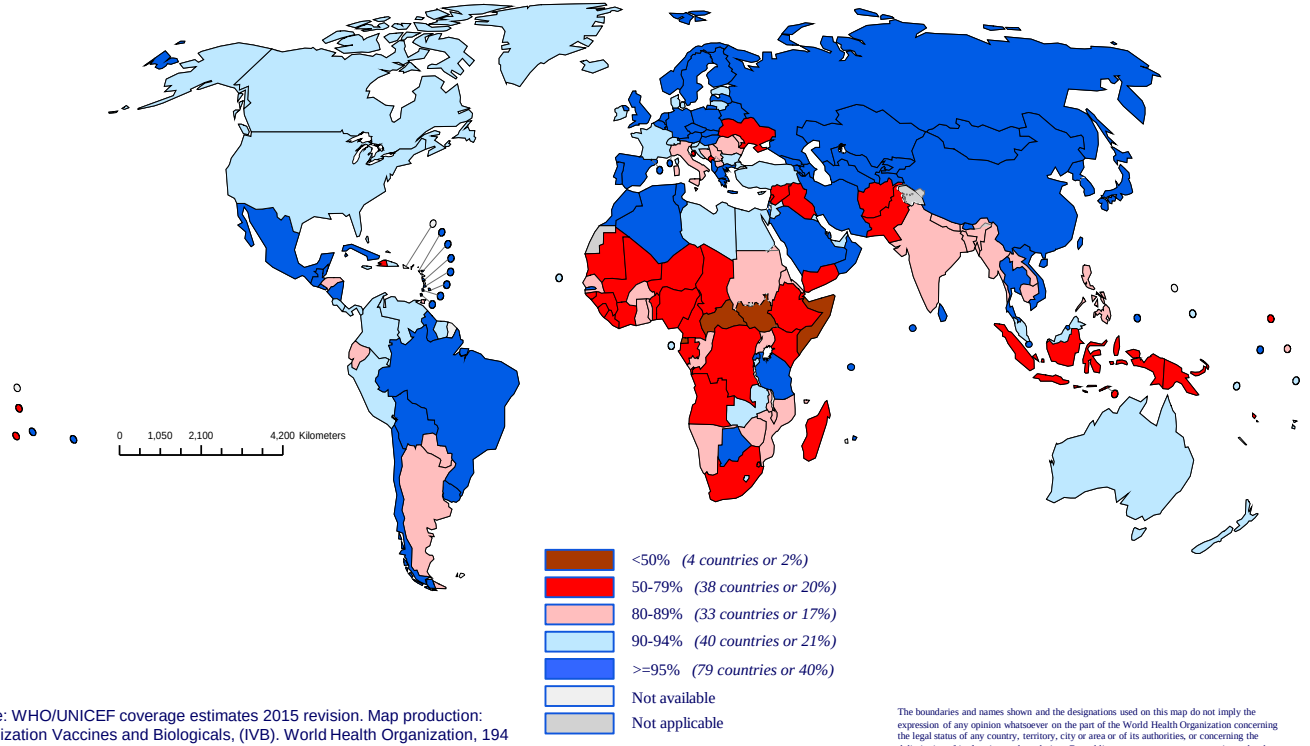
MMWR, Nov 14, 2014.

Gaps in Routine Coverage



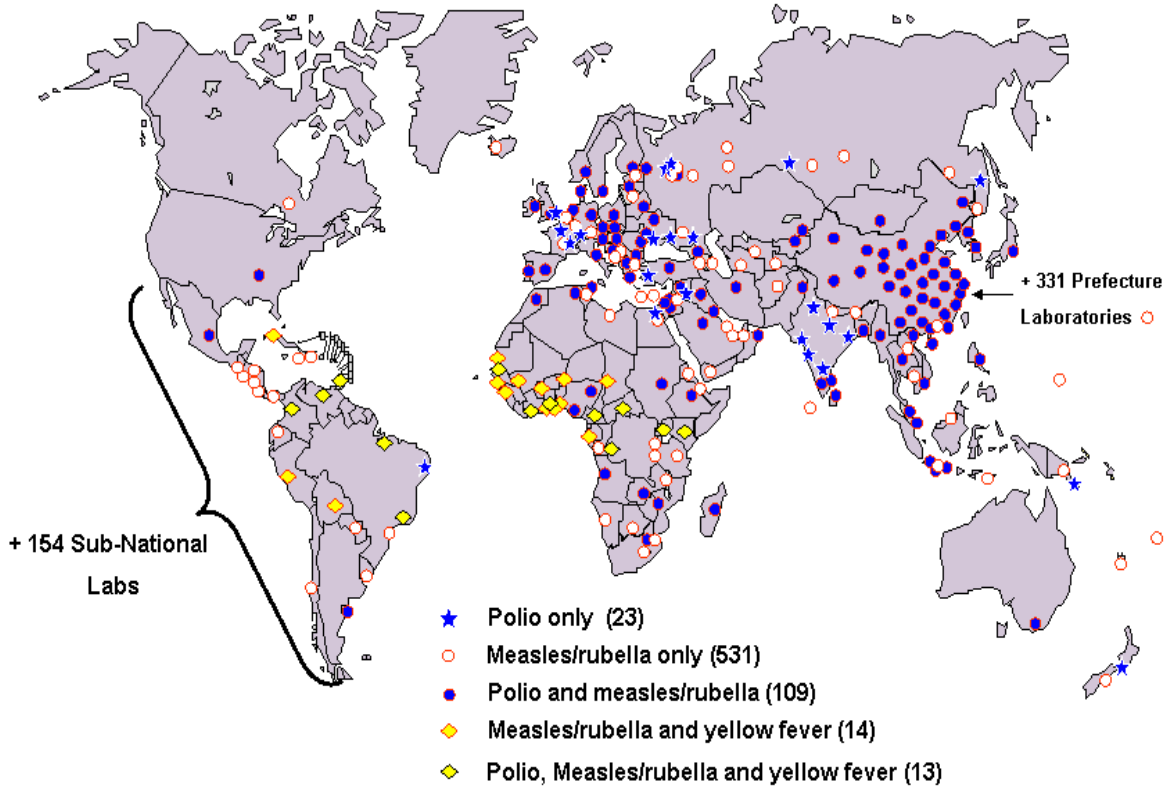
75 Countries Missing the GVAP MCV1 Coverage Target (≥90%)

Immunization coverage with 1st dose of measles containing vaccines in infants, 2015



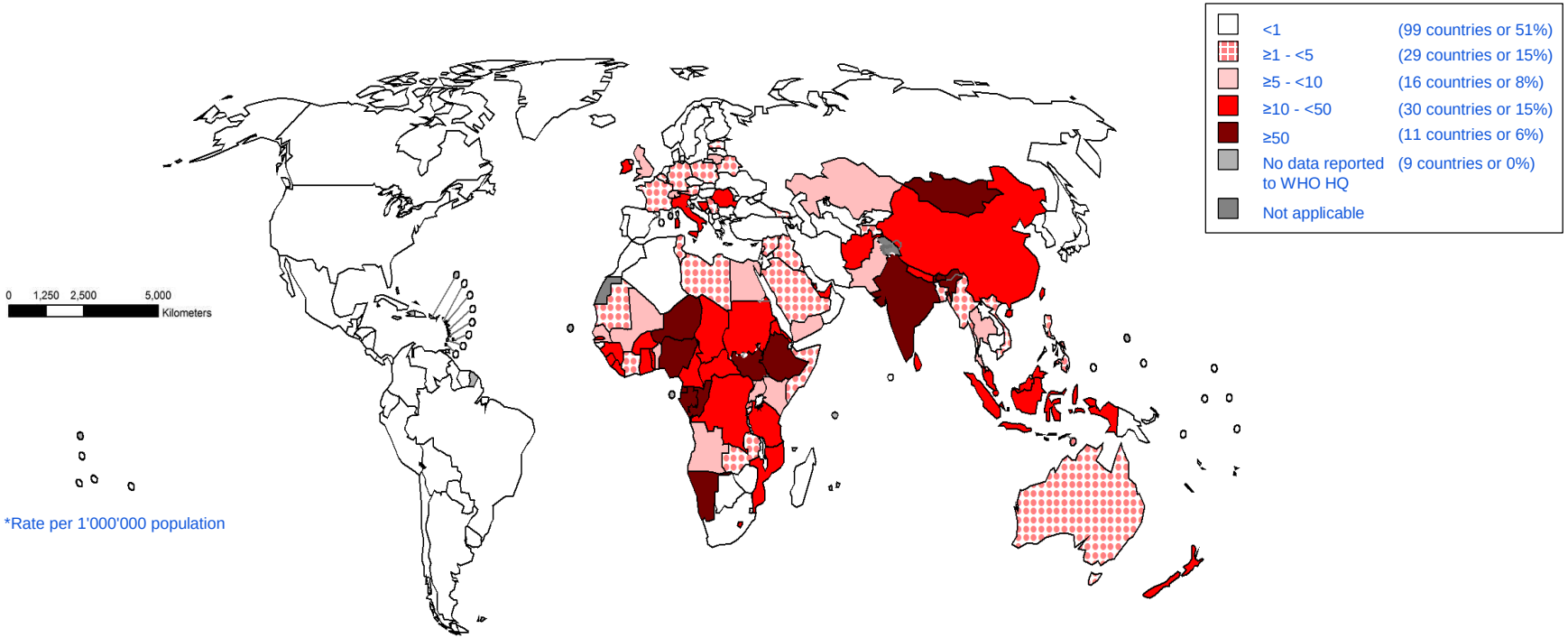
Source: WHO/UNICEF coverage estimates 2015 revision. Map production: Immunization Vaccines and Biologicals, (IVB). World Health Organization, 194 WHO Member States. Date of slide: 16 July 2016

Global Measles and Rubella Laboratory Network (GMRLN)



- The GMRLN started in 2000, and is now the largest globally-coordinated laboratory network supporting surveillance in 191 countries
- 723 GMRLN labs in 165 countries include:
  - 506 subnational
  - 180 national
  - 14 regional reference
  - 3 global specialized laboratories
- In 2015, 188 (97%) member states were implementing measles case-based surveillance
- As of Mar 2016, the GMRLN sequence databases contained 27,984 entries for measles viruses and 1,555 entries for rubella viruses.

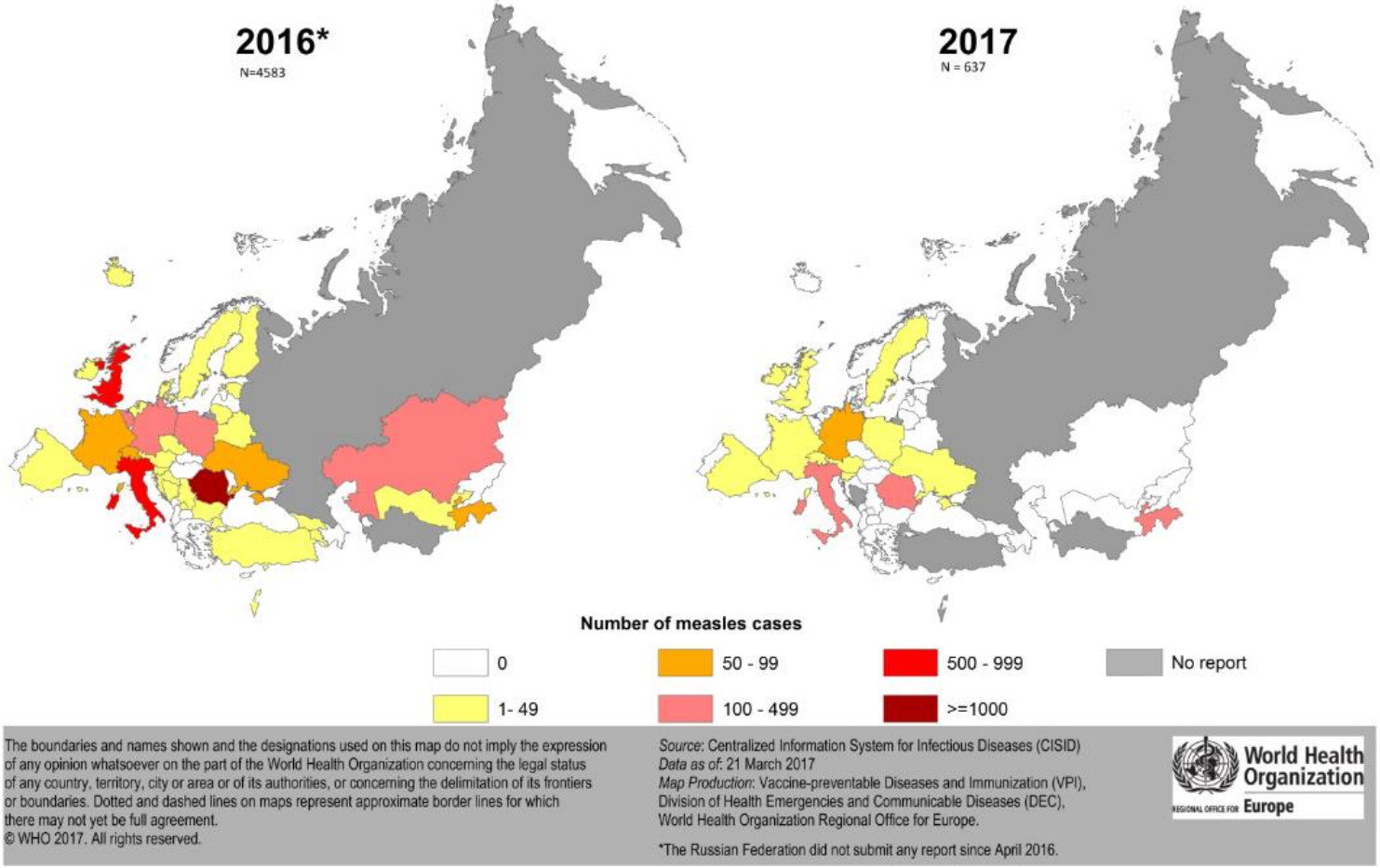
Large Outbreaks of Measles:
Reported Measles Incidence Rate*,September to August 2016



*Rate per 1'000'000 population

Data source: surveillance DEF file
Data in HQ as of 11 October 2016

Measles Cases, WHO European Region



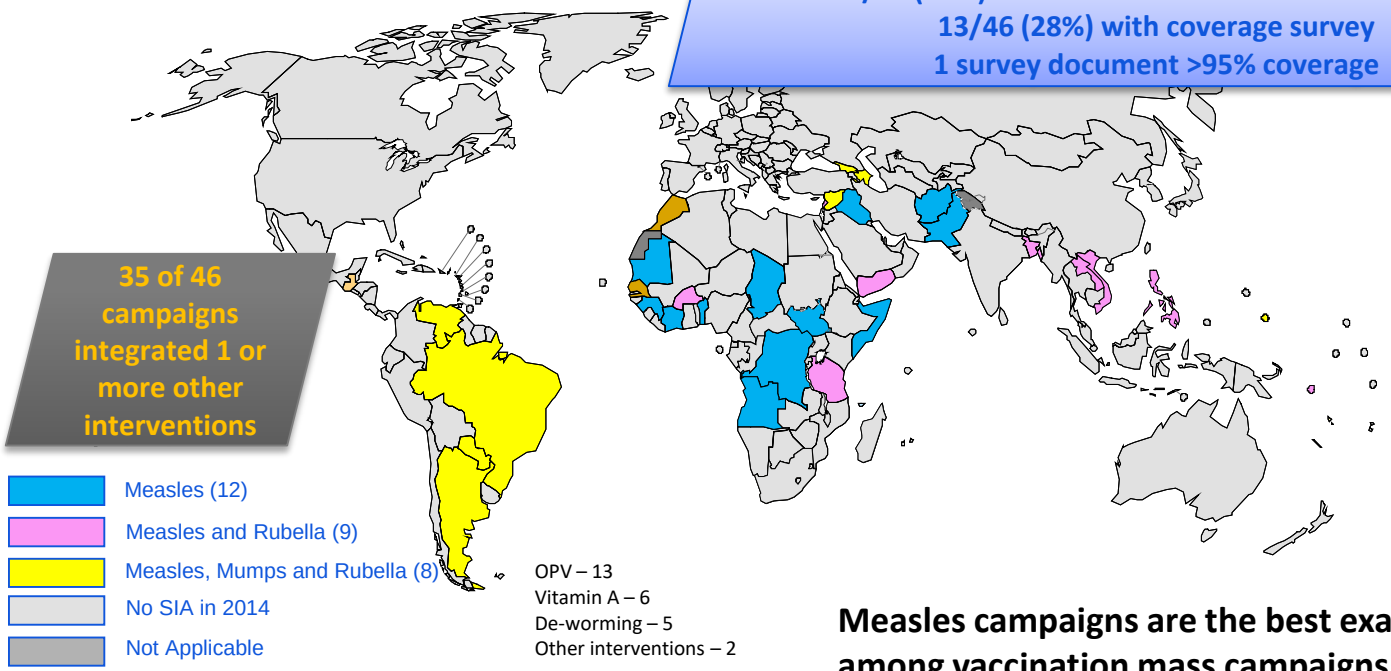
Source: Centralized Information System for Infectious Diseases (CISID)
Data as of: 21 March 2017
Map Production: Vaccine-preventable Diseases and Immunization (VPI), Division of Health Emergencies and Communicable Diseases (DEC), World Health Organization Regional Office for Europe.

*The Russian Federation did not submit any report since April 2016.

World Health Organization
REGIONAL OFFICE FOR Europe

Prevent: 46 Measles Campaigns in 29 Countries reached 221 million children in 2014

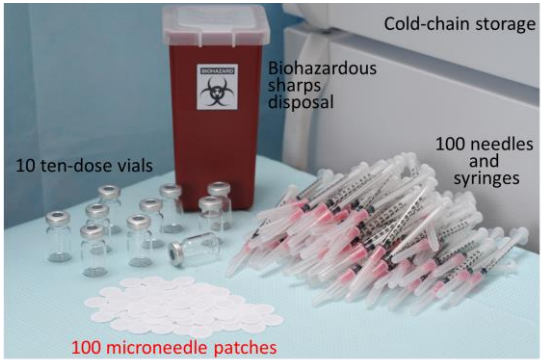
25/46 (54%) attained 95% administrative coverage
13/46 (28%) with coverage survey
1 survey document >95% coverage

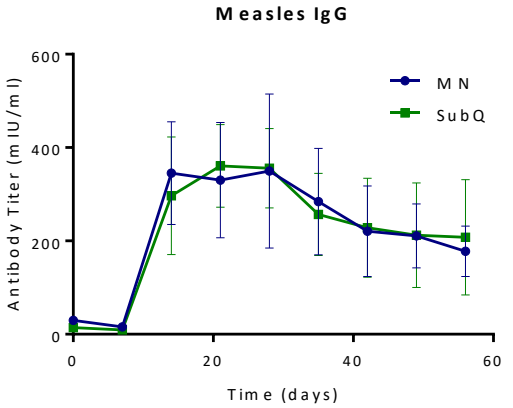


Measles campaigns are the best example among vaccination mass campaigns (polio Men A, yellow fever, etc.) of integrating other health interventions with measles vaccination.

Innovation, Evaluation, Research “Game Changer”: Microneedle Patch

- **Thermostable -** reduced or no cold chain
- **Single-dose -** no reconstitution, minimal waste
- **Minimal training -** house-to-house campaigns
- **No sharps -** no sharps disposal or injuries
- **Small package size - s**torage, transport, disposal
- **Increased immunogenicity -** potential dose-sparing
- **Cost-effective manufacturing -** cost similar to that of lyophilized vials





Global Health Security Agenda 2014

“Detect, Respond, and Prevent” is smart spending

BY THE NUMBERS

$6 Trillion

Estimated cost of pandemics in the 21st century

$60 Billion

Annual expected loss from potential pandemics

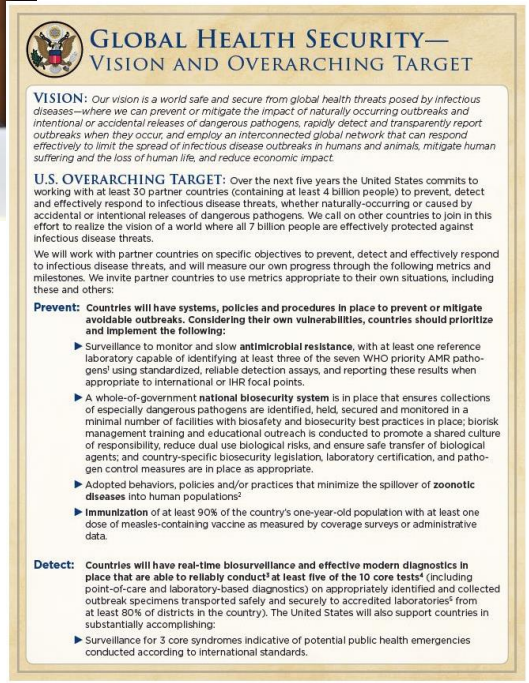
$0.65

Annual cost per person for protection against current global health threats

Sources: The Neglected Dimension of Global Security. GHFR Commission 2016.
Gostin et. al., Neglected Dimensions of Global Security. JAMA 2016

Global Health Security Agenda is a Unifying Framework to Improve our Global Response to Disease Outbreaks

Vision: *A world safe and secure from global health threats posed by infectious diseases…*



GLOBAL HEALTH SECURITY— VISION AND OVERARCHING TARGET

VISION: *Our vision is a world safe and secure from global health threats posed by infectious diseases—where we can prevent or mitigate the impact of naturally occurring outbreaks and intentional or accidental releases of dangerous pathogens, rapidly detect and transparently report outbreaks when they occur, and employ an interconnected global network that can respond effectively to limit the spread of infectious disease outbreaks in humans and animals, mitigate human suffering and the loss of human life, and reduce economic impact.*

U.S. OVERARCHING TARGET: Over the next five years the United States commits to working with at least 30 partner countries (containing at least 4 billion people) to prevent, detect and effectively respond to infectious disease threats, whether naturally-occurring or caused by accidental or intentional releases of dangerous pathogens. We call on other countries to join in this effort to realize the vision of a world where all 7 billion people are effectively protected against infectious disease threats.

We will work with partner countries on specific objectives to prevent, detect and effectively respond to infectious disease threats, and will measure our own progress through the following metrics and milestones. We invite partner countries to use metrics appropriate to their own situations, including these and others:

Prevent: **Countries will have systems, policies and procedures in place to prevent or mitigate avoidable outbreaks. Considering their own vulnerabilities, countries should prioritize and implement the following:**

- Surveillance to monitor and slow **antimicrobial resistance**, with at least one reference laboratory capable of identifying at least three of the seven WHO priority AMR pathogens[1] using standardized, reliable detection assays, and reporting these results when appropriate to international or IHR focal points.
- A whole-of-government **national biosecurity system** is in place that ensures collections of especially dangerous pathogens are identified, held, secured and monitored in a minimal number of facilities with biosafety and biosecurity best practices in place; biorisk management training and educational outreach is conducted to promote a shared culture of responsibility, reduce dual use biological risks, and ensure safe transfer of biological agents; and country-specific biosecurity legislation, laboratory certification, and pathogen control measures are in place as appropriate.
- Adopted behaviors, policies and/or practices that minimize the spillover of **zoonotic diseases** into human populations[2]
- **Immunization** of at least 90% of the country's one-year-old population with at least one dose of measles-containing vaccine as measured by coverage surveys or administrative data.

Detect: **Countries will have real-time biosurveillance and effective modern diagnostics in place that are able to reliably conduct[3] at least five of the 10 core tests[4]** (including point-of-care and laboratory-based diagnostics) on appropriately identified and collected outbreak specimens transported safely and securely to accredited laboratories[5] from at least 80% of districts in the country). The United States will also support countries in substantially accomplishing:

- Surveillance for 3 core syndromes indicative of potential public health emergencies conducted according to international standards.

"This [the Global Health Security Agenda] is indeed a timely initiative. It raises the political profile of the threat from emerging and epidemic-prone diseases. And it energizes efforts to improve health security… in line with WHO International Health Regulations…."

World Health Organization
Director General Margaret Chan
February 13, 2014

INTERNATIONAL HEALTH REGULATIONS (IHR)

– from policy to people's health security

What are the IHR?

The IHR are legally binding and help countries work together to protect lives threatened by the spread of diseases and other health risks, including radiation and chemical hazards

5 reasons why the IHR matter

1 HEALTH THREATS HAVE NO BORDERS

The IHR strengthen countries' abilities to control diseases that cross borders at ports, airports and ground crossings

2 TRAVEL AND TRADE ARE MADE SAFER

The IHR promote trade and tourism in countries and prevent economic damage

3 GLOBAL HEALTH SECURITY IS ENHANCED

The IHR establish an early warning system not only for diseases but for anything that threatens human health and livelihoods

4 DAILY THREATS ARE KEPT UNDER CONTROL

The IHR guide countries to detect, assess and respond to threats and inform other countries quickly

5 ALL SECTORS BENEFIT

The IHR prepare all sectors for potential emergencies through coordination and information sharing

World Health Organization
REGIONAL OFFICE FOR Europe

Until all sectors are on board with the IHR, no country is ready

www.euro.who.int/ihr

GHSA is the Roadmap for IHR

Global Health Security – *"...the activities required, both proactive and reactive, to minimize vulnerability to acute public health events that endanger the collective health of populations living across geographical regions and international boundaries" (World Health Assembly Report, 2007)*

More than fifty countries have committed to the Global Health Security Agenda (GHSA)

- GHSA launched in Feb 2014 with leaders from 28 countries, WHO, OIE and FAO
- G7 committed to assist at least 76 countries
- The GHSA drives a set of concrete and achievable actions to help actualize the International Health Regulations
- Countries committed to reaching public health goals through the prevent, detect and respond model

11 Global Health Security Action Packages ▸ **… across 3 priority areas** ▸ **… to achieve 3 critical health security impacts**

- Antimicrobial Resistance
- Zoonotic Diseases
- Biosafety & Biosecurity
- Immunization

PREVENT → **Prevent avoidable outbreaks**

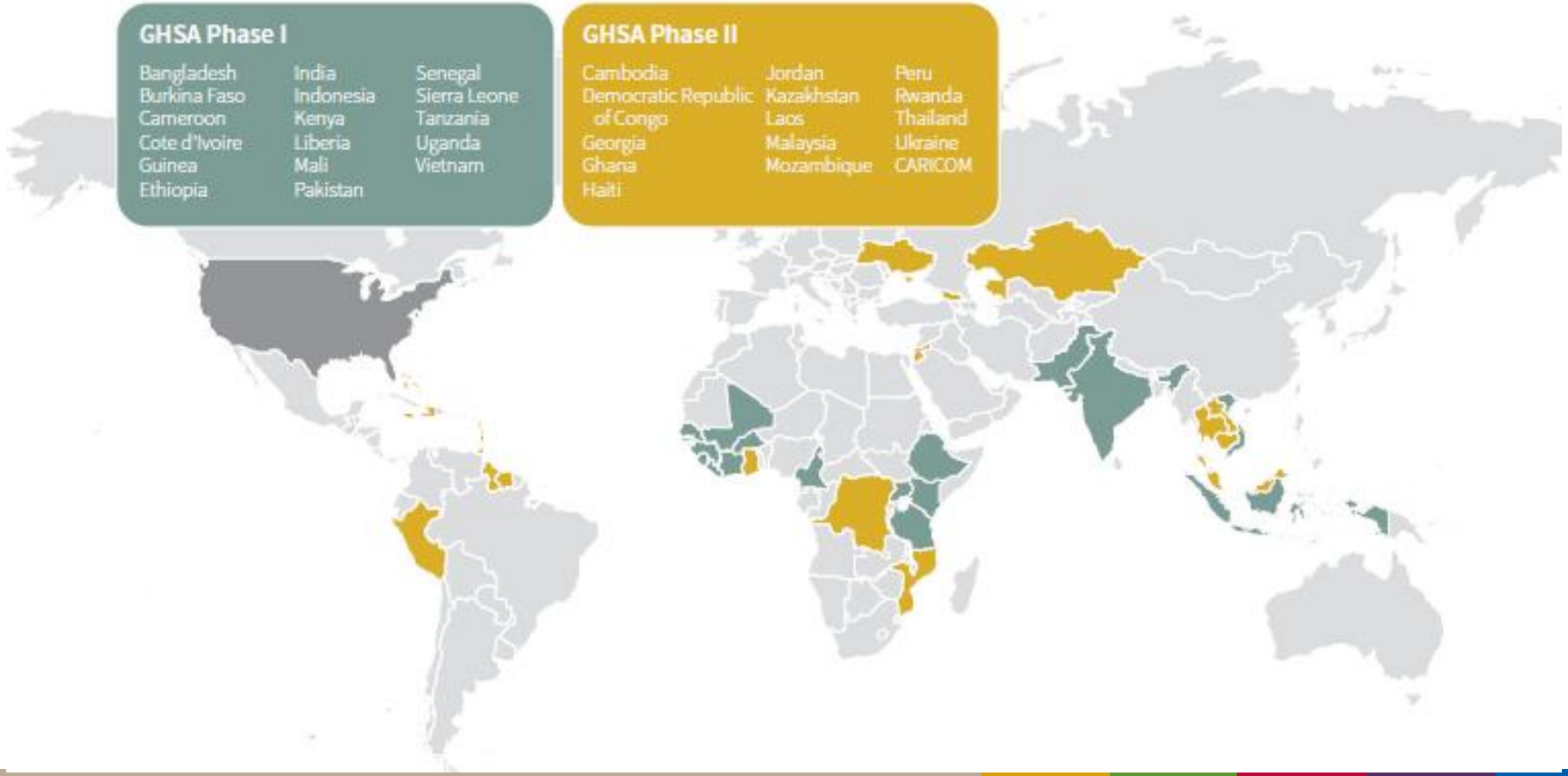
- National Laboratory System
- Real-time Surveillance
- Reporting
- Workforce Development

DETECT → **Detect threats early**

- Emergency Operations Centers
- Linking Public Health with Law Enforcement & Multisectoral Rapid Response
- Medical Countermeasures & Personnel Development

RESPOND → **Respond rapidly and effectively**

The US is Supporting GHSA in Regions and 32 Partner Countries



Cameroon: EOC activated within 24 hours to respond to outbreak of avian influenza

India: Better prevention and detection of AMR through systematic IPC, surveillance, and lab

Dr Purva from AIIMS and site investigators review HAI data

Mali: Frontline responders immediately implemented vaccination campaigns for measles and suspected yellow fever

Vaccination clinic for suspected Yellow Fever

Tanzania: Fighting cholera

Emergency responders atop a water truck collecting samples

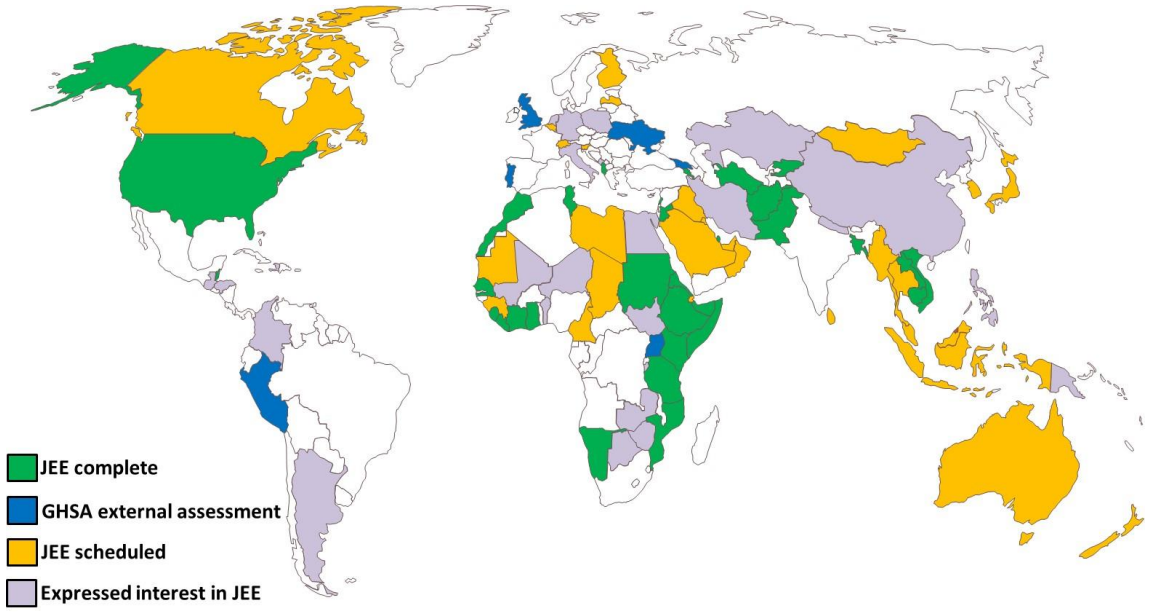
US CDC Global Disease Detection: Operations Center and Surge Capacity

- Monitors 30-40 public health threats a day
- Detection and verification of international disease events and threats
- Operational support for rapid deployment of CDC assets and field teams
- U.S. compliance with International Health Regulations
- CDC's liaison with the Global Outbreak Alert Response Network (GOARN)

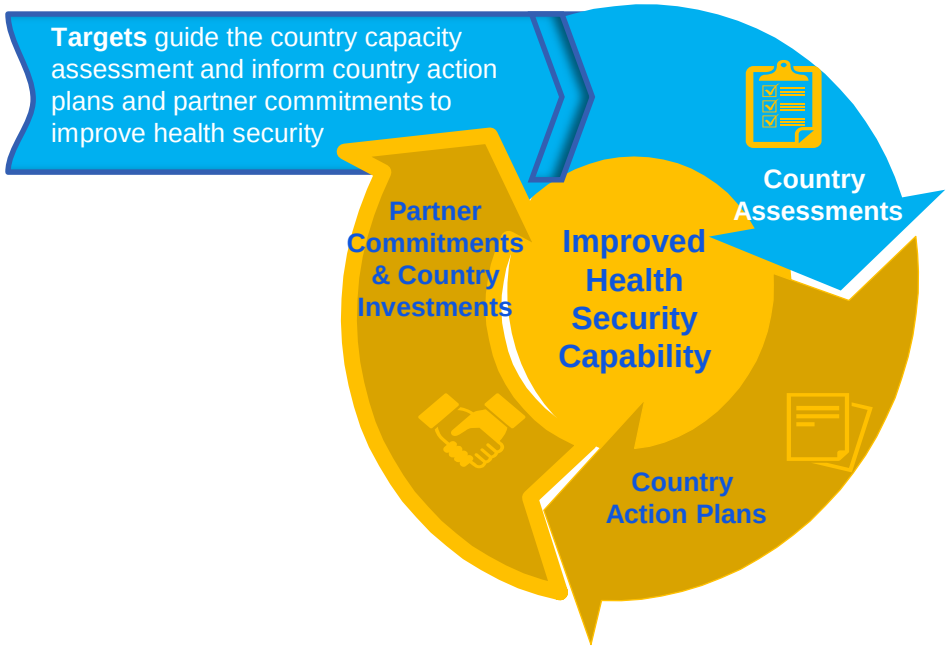
GDD Operations Center Team

Global Health Security Starts with Strengthening IHR Core Capacities and Progress is Measured through WHO/Joint External Evaluations (JEE)

- Transparent, independent, and objective
- Accountability and partnership
- Baseline to measure progress and identifies gaps



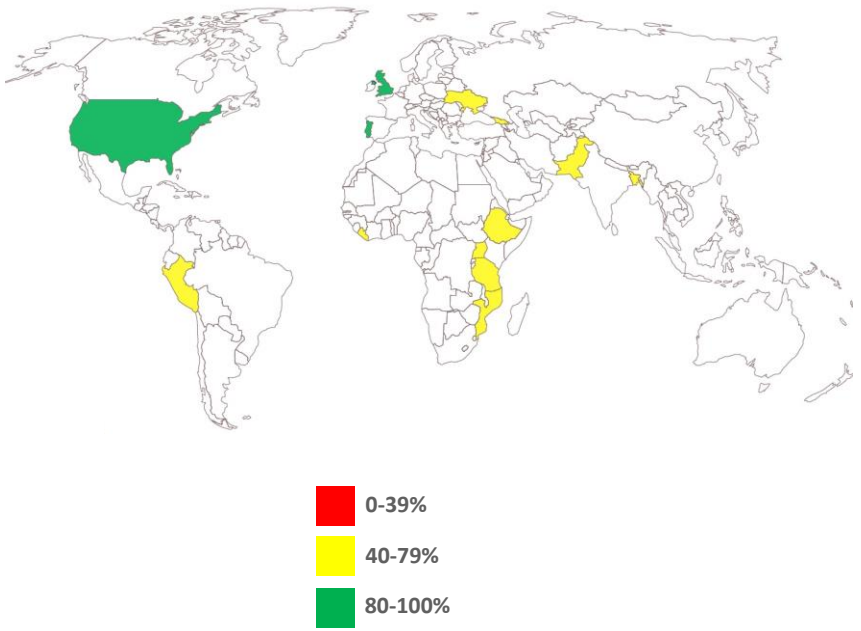
Joint External Evaluation Process



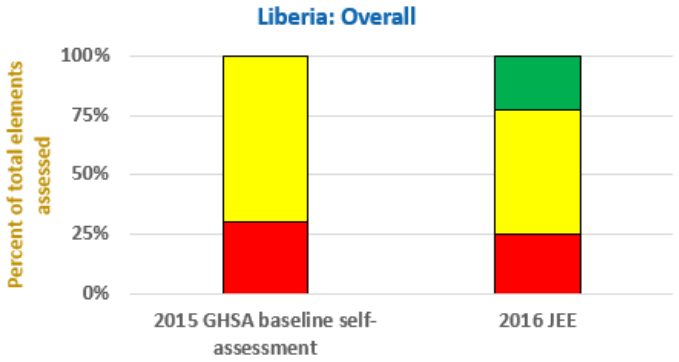
JEE Results

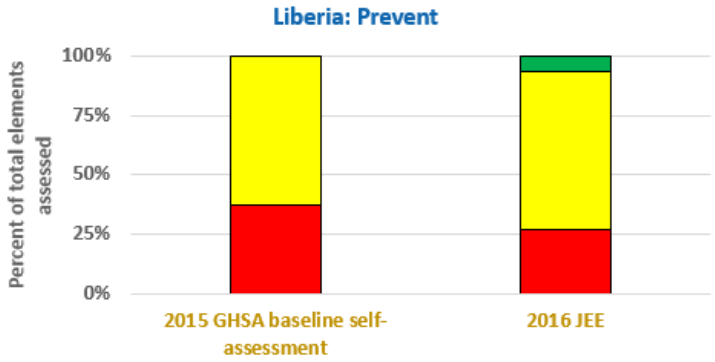
Many countries are somewhat prepared – but none are 100% prepared

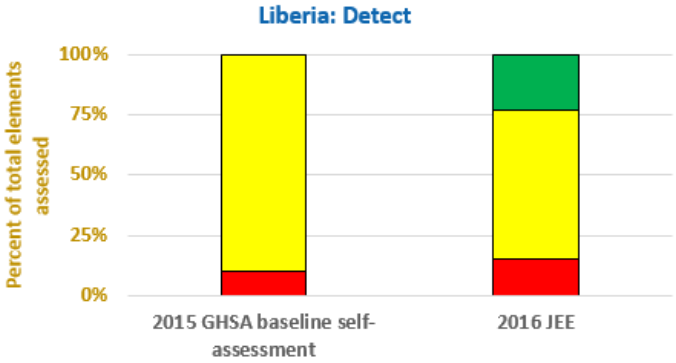
Country	Overall	Prevent	Detect	Respond
Joint External Evaluation				
Bangladesh	50%	58%	70%	33%
Ethiopia	52%	56%	59%	45%
Liberia	47%	42%	50%	49%
Mozambique	47%	46%	51%	46%
Pakistan	50%	46%	51%	53%
Tanzania	50%	51%	54%	48%
United States	87%	87%	91%	85%
GHSA External Assessment				
Georgia	65%	72%	68%	51%
Peru	67%	59%	76%	67%
Portugal	88%	88%	79%	100%
Uganda	55%	44%	77%	42%
Ukraine	55%	58%	54%	51%
United Kingdom	96%	97%	98%	92%

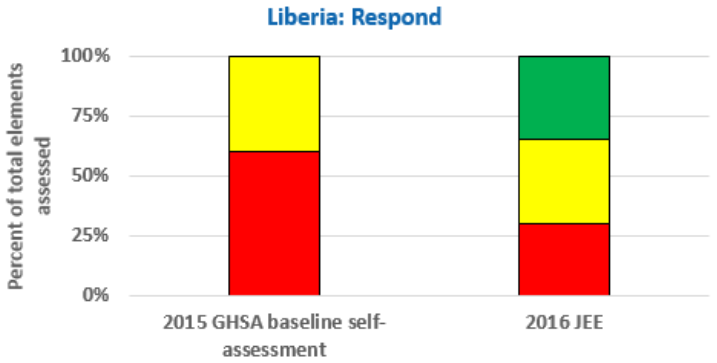


Results from Liberia JEE show progress from GHSA baseline assessment









Country: Sustainability and Accountability

- Complete JEEs, implement corrective action plans, and begin follow up assessments
- Meet IHR core capacities and maintain accountability
- Enhance partnerships to strengthen multi-sectoral support to countries
- Globally support countries in closing gaps

Globally: Development, Accountability, and Surge

- Global safety net
  - WHO Health Emergency Programme
  - Regional institutions – “CDCs”
- G7 and G20 commitments
- GHSA Private Sector Roundtable, Non-Governmental Organizations, and Peer Network
- Innovation and development
  - CEPI
  - WHO R&D Blueprint
  - Diagnostics

Thank you