Biosurveillance - A Brief Overview

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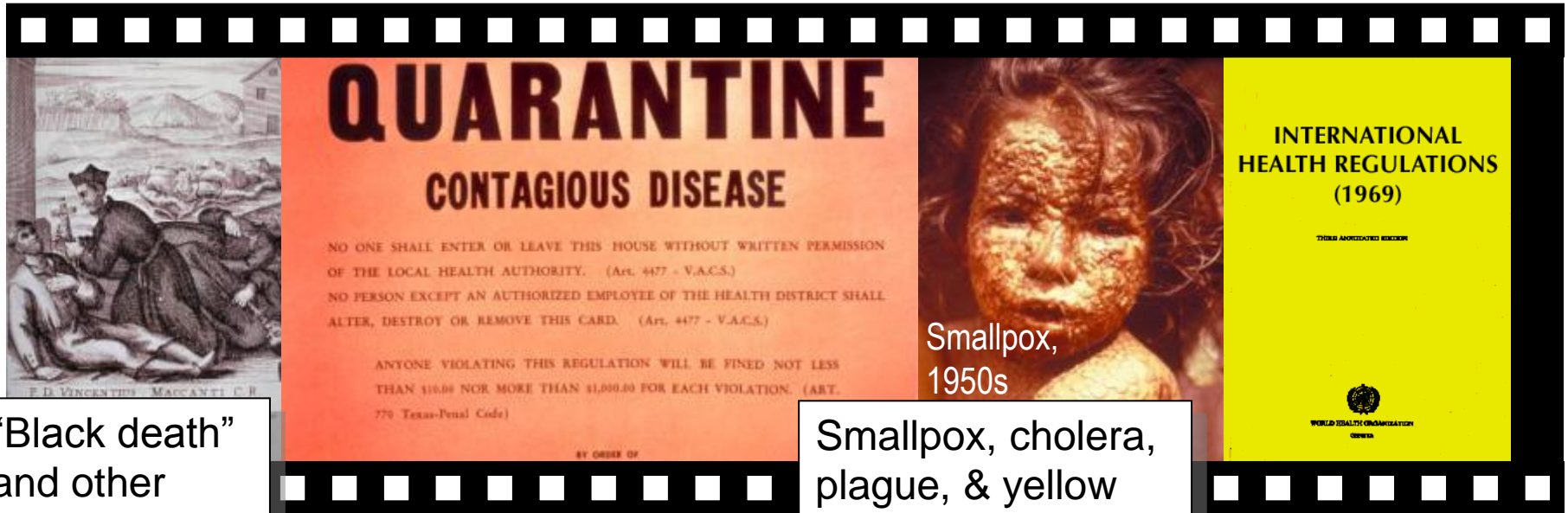*Guest Researcher, U.S. CDC*

Outline

1. Public health – from past to present

2. Biosurveillance – what is it?

3. Resources

Public health – from past to present

Global Health Milestones...

Smallpox, 1950s

"Black death" and other plagues spread across the world

The first effective **public health intervention**

Smallpox, cholera, plague, & yellow fever in **International Sanitary Regulations**

IHR 1951 revised in 1969

World Health Organization

Global Health Milestones...
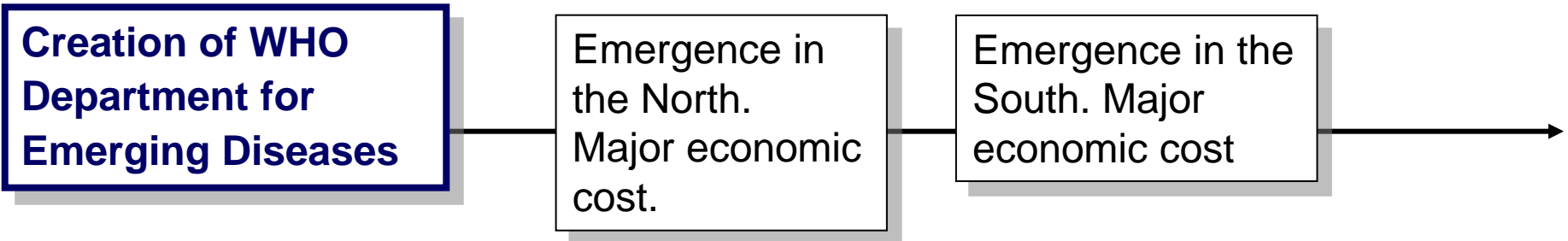

HIV/AIDS, 1980s

Plague, Surat, 1994

Ebola, Kikwit, 1995

Emergence of the AIDS **pandemic**

Major travel disruption.
WHO's DG on site

1st global response coordinated by WHO

World Health Organization

Global Health Milestones…

World Health Organization

1996

TIME
BAD TO THE BONE?

NvCJD, UK, 1998

Nipah, Malaysia, 2001

Creation of WHO Department for Emerging Diseases

Emergence in the North. Major economic cost.

Emergence in the South. Major economic cost

Global Health Milestones...

Meningitis epidemic, West Africa

World Health Organization

Geneva, 2000

Ebola, Uganda, 2000 - 2001

World Health Organization

Lyon, 2001

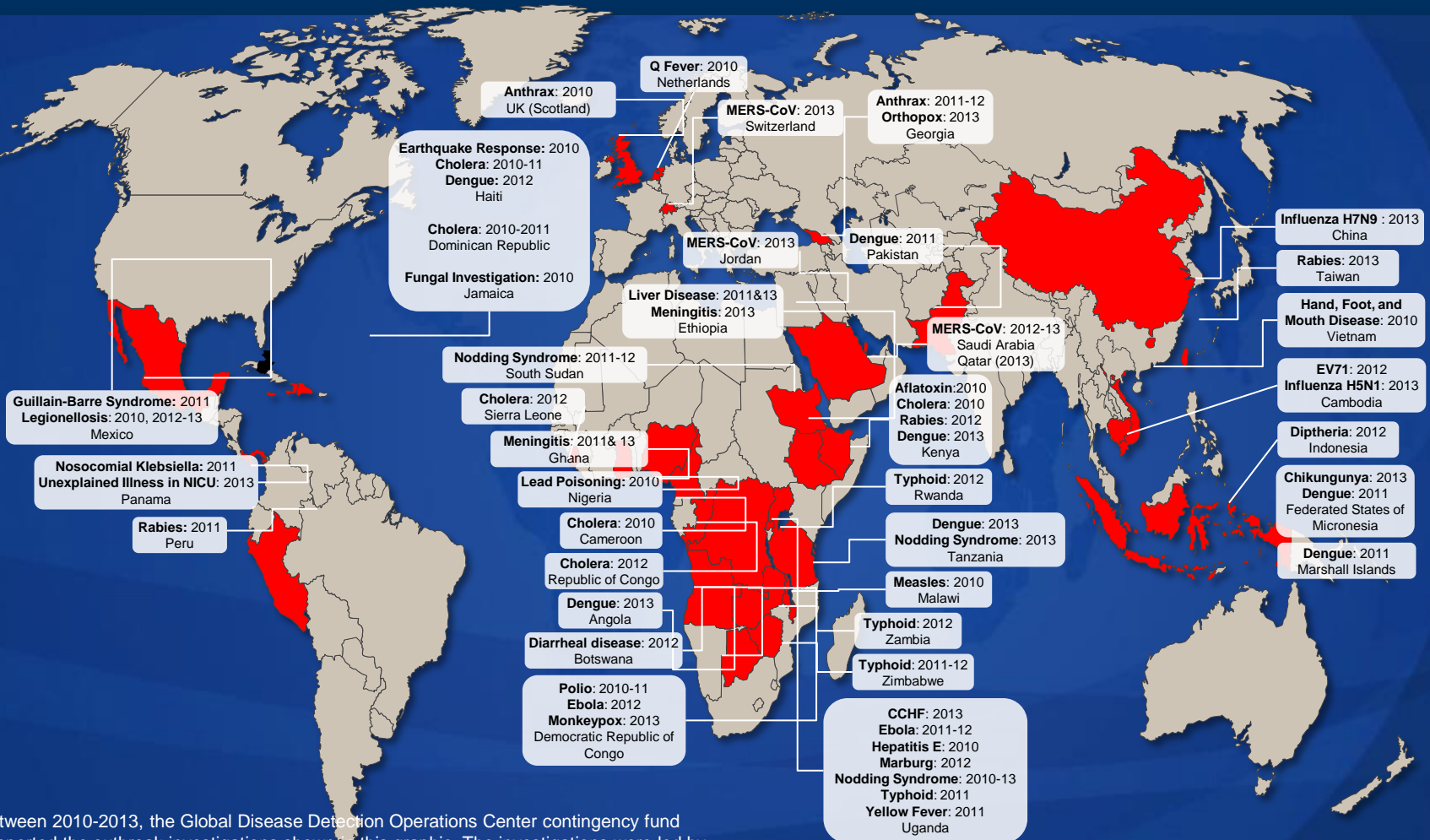New meningitis strain W135

The Global Outbreak Alert & Response (GOARN)

Major outbreaks continue to strike

WHO's Office for National Epidemic Preparedness and Response

Global Health Milestones...

SARS, 2003

INTERNATIONAL **HEALTH** REGULATIONS (2005)

Avian Influenza, 2005-2006

World Health Organization

15 June 2007

First 21st century's global epidemic. Major economic cost

The International Health Regulations (2005)

Influenza pandemic threat

Entry into force of IHR(2005)

Because Disease Knows No Borders

Q Fever: 2010
Netherlands

Anthrax: 2010
UK (Scotland)

MERS-CoV: 2013
Switzerland

Anthrax: 2011-12
Orthopox: 2013
Georgia

Earthquake Response: 2010
Cholera: 2010-11
Dengue: 2012
Haiti

Cholera: 2010-2011
Dominican Republic

Fungal Investigation: 2010
Jamaica

MERS-CoV: 2013
Jordan

Dengue: 2011
Pakistan

Influenza H7N9 : 2013
China

Rabies: 2013
Taiwan

Liver Disease: 2011&13
Meningitis: 2013
Ethiopia

MERS-CoV: 2012-13
Saudi Arabia
Qatar (2013)

**Hand, Foot, and
Mouth Disease**: 2010
Vietnam

Nodding Syndrome: 2011-12
South Sudan

Aflatoxin:2010
Cholera: 2010
Rabies: 2012
Dengue: 2013
Kenya

EV71: 2012
Influenza H5N1: 2013
Cambodia

Guillain-Barre Syndrome: 2011
Legionellosis: 2010, 2012-13
Mexico

Cholera: 2012
Sierra Leone

Meningitis: 2011& 13
Ghana

Lead Poisoning: 2010
Nigeria

Typhoid: 2012
Rwanda

Diptheria: 2012
Indonesia

Nosocomial Klebsiella: 2011
Unexplained Illness in NICU: 2013
Panama

Dengue: 2013
Nodding Syndrome: 2013
Tanzania

Chikungunya: 2013
Dengue: 2011
Federated States of
Micronesia

Rabies: 2011
Peru

Cholera: 2010
Cameroon

Cholera: 2012
Republic of Congo

Measles: 2010
Malawi

Dengue: 2011
Marshall Islands

Dengue: 2013
Angola

Typhoid: 2012
Zambia

Diarrheal disease: 2012
Botswana

Typhoid: 2011-12
Zimbabwe

Polio: 2010-11
Ebola: 2012
Monkeypox: 2013
Democratic Republic of
Congo

CCHF: 2013
Ebola: 2011-12
Hepatitis E: 2010
Marburg: 2012
Nodding Syndrome: 2010-13
Typhoid: 2011
Yellow Fever: 2011
Uganda

Between 2010-2013, the Global Disease Detection Operations Center contingency fund supported the outbreak investigations shown in this graphic. The investigations were led by CDC's Center for Global Health, the National Center of Emerging and Zoonotic Infectious Diseases and the National Center for Immunizations and Respiratory Diseases

"Contagion" in Real Life: Threats to Health Security
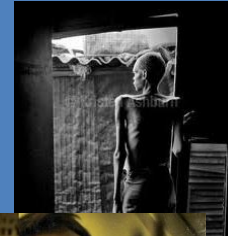
The old ones…

Cholera

Influenza
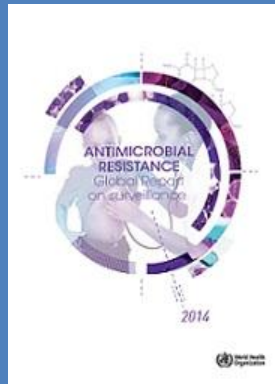
The new ones…

HIV

SARS

**A/H7N9
MERS-CoV
Chikungunya
Ebola**

The ones with resistance genes

MRSA

MDR-TB

Art. Resist. malaria

and…many other AMR organisms

The man made…

Dual Use Research of Concern

Synthetic Biology

Anthrax…and many more bioterrorism agents

…And "Contagion" can be Global

Global Aviation Network
24-H Pattern

Source: Kilpatrick AM, et al. Drivers, dynamics, and control of emerging vector-borne zoonotic diseases. The Lancet 380:9857, 1-7 Dec 2012, pp. 1946-55. www.sciencedirect.com/science/article/pii/S0140673612 611519

International Health Regulations (2005)

World Health Organization
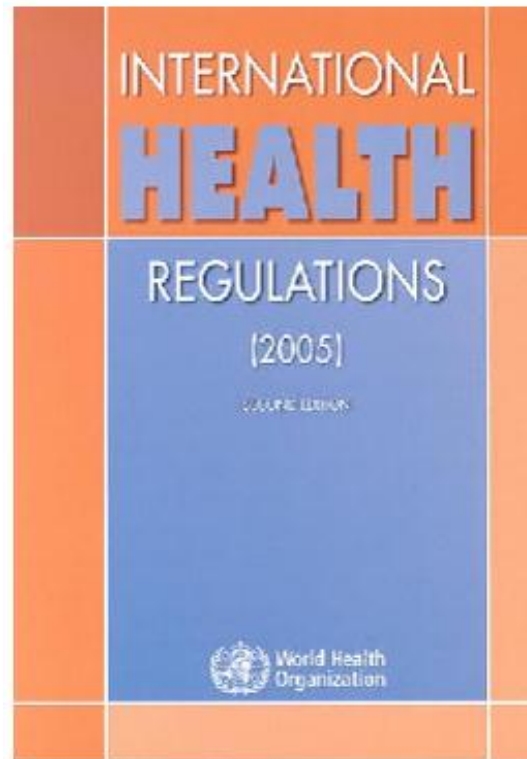
Purpose of IHR

" to prevent, protect against, control and provide a **public health response to the international spread of disease** in ways that are commensurate with and restricted to public health risks, and which **avoid unnecessary interference with international traffic and trade**"
(*Article 2*)

World Health Organization

Increased communication and coordination

- Health, defense, intelligence, law enforcement

- Private and public sectors

- Inter-agency and intra-agency

- Internationally

Biosurveillance – what is it?

Biosurveillance

Per the U.S. National Strategy for Biosurveillance (July 2012):
"... process of gathering, integrating, interpreting, and communicating essential information related to **all-hazards** threats or disease activity affecting **human, animal, or plant health** to achieve **early detection and warning**, contribute to overall **situational awareness** of the health aspects of an incident, and to enable **better decision making** at all levels."

Commonalities among multiple definitions: early warning, early detection, all-hazards, information integration, situational awareness

What is Biosurveillance?

- *Disease Surveillance*
- *Health Surveillance*
- *Public Health Surveillance*
- *Intelligence*
- *Surveillance of only events caused by biological means?*

A new field?

Biosurveillance - not a new field, but an evolving field at the intersection of:

- Epidemiology

- Microbiology; Vector Biology

- Computer science and artificial intelligence

- Statistics / Biostatistics

- Systems engineering

- Health and medicine for all species – *One Health*

Populations of interest

- Humans

- Animals

- Plants

- Vectors

- Microbes

Time scale of interest for biopreparedness- Surveillance Windows

Prevent   Detect   Respond   Manage

Event
T_0

T_{Detect}
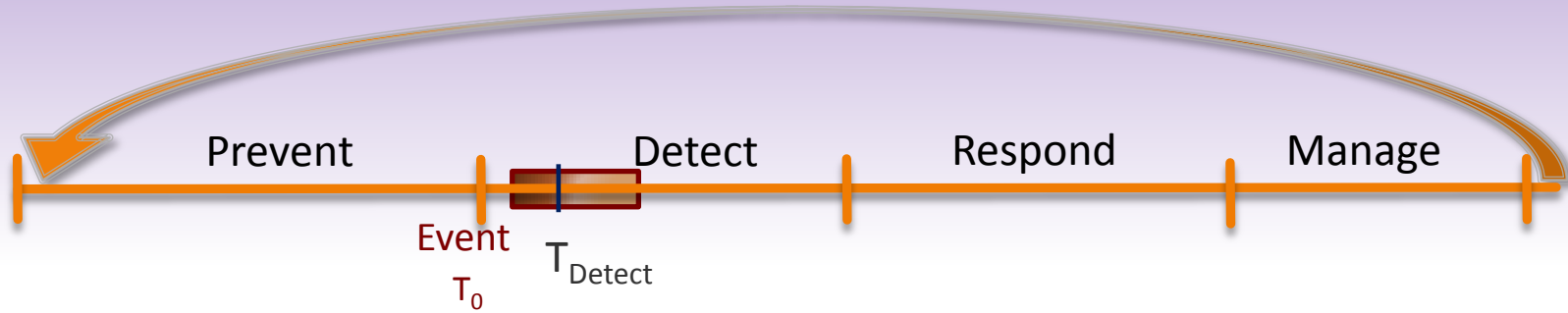
Who does biosurveillance?
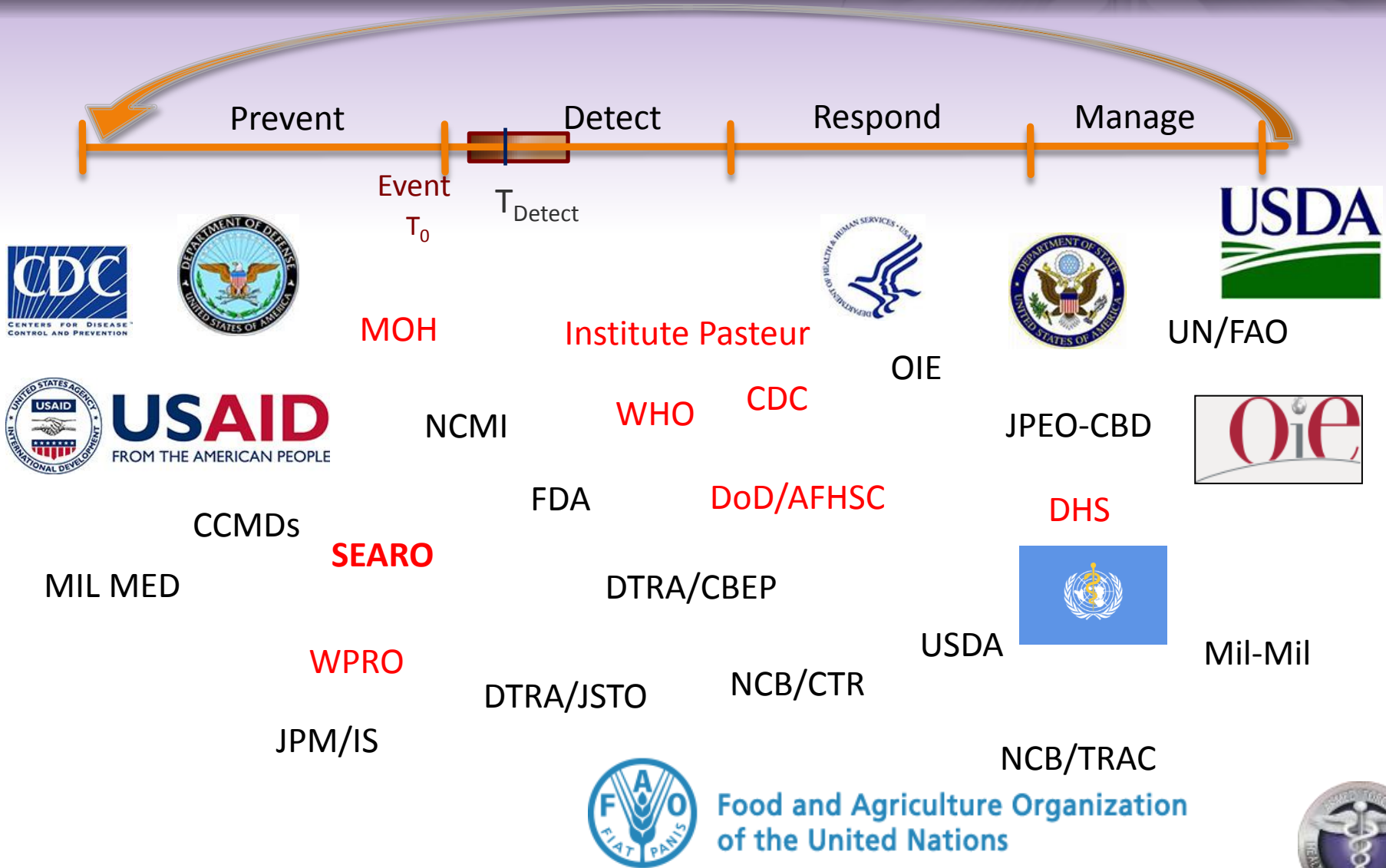
Epidemic Crowdsourcing

SMS
Messaging

Micro
blogging

Emailing

Internet
searching

Social
networking

Internet
chatting

Blogging

Online news
reporting

Video/radio
news reporting

Health expert
reporting
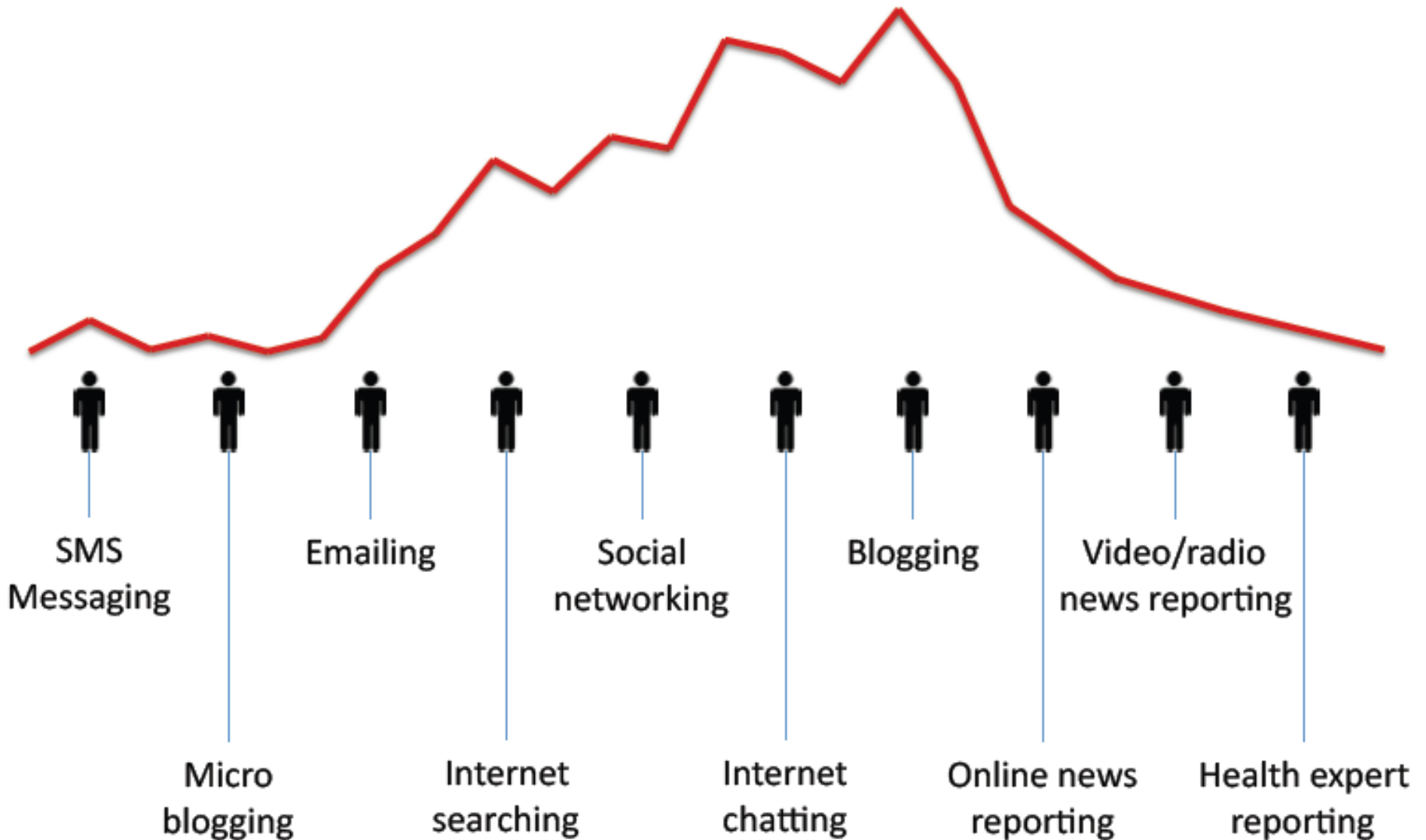
A mountain of data…

- Increasing
  - data demands
  - data collection

- Cheaper
  - data acquisition
  - software and hardware

- "Big data"
  - Still unclear how useful it will be

Biosurveillance can be done through:

- Systems and networks

- Technology

- Policy and regulations

FY14 DoD GEIS Surveillance (n=71)

- Antimicrobial Resistance
- Capacity Building
- Enterics
- Febrile & Vector-borne
- Malaria
- Sexually Transmitted Infections
- Respiratory
- Respiratory Embassy Sites
- Enterics Embassy Sites
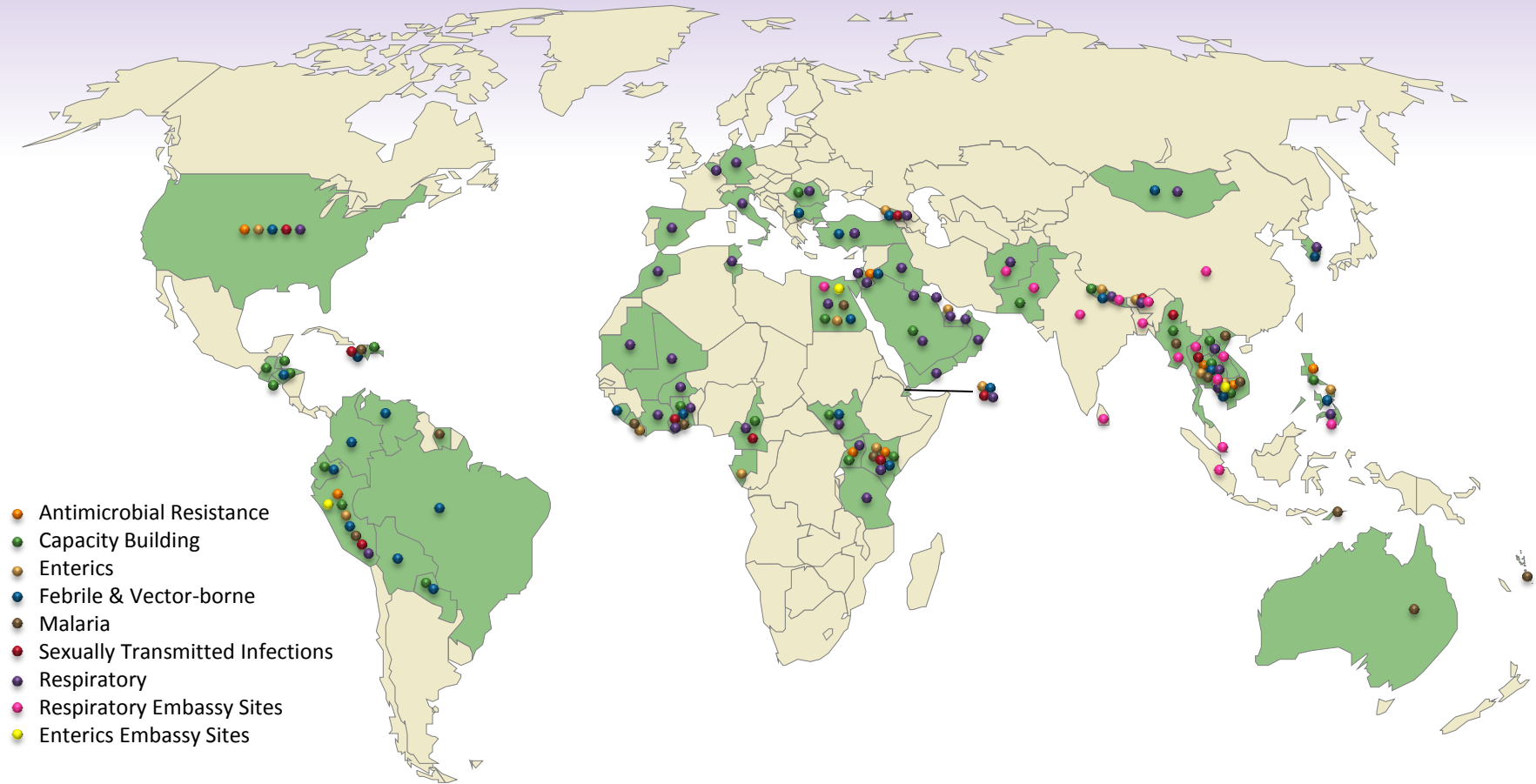
CDC's Global Presence and Focus

About 300 assignees across the world

Legend:

- 🟦 CDC Global Presence
- 🟣 CDC Global HIV/AIDS Program
- 🟢 CDC Global Immunizations-measles/polio
- 🟥 Global Disease Detection Centers
- 🔵 CDC Malaria Program
- 🟢 CDC Field Epidemiology Training Program (FETP)
- 🟡 CDC Influenza International Program
- 🟡 CDC Tuberculosis Program
- 🔴 CDC Noncommunicable Diseases
- 🟠 U.S. Dept. of Defense Collaborations

Global Reach to 70 countries

- 6 WHO regions
- 10 Regional Centers
- Expanding regional coverage

CORDS- Connecting Organizations for Regional Disease Surveillance

A key 'event-based surveillance' tool

Global Public Health Intelligence Network (GPHIN)

A secure internet-based early warning system that gathers preliminary reports of public health significance on a near real-time, 24/7 basis. Covers six languages, and is hosted and maintained by Health Canada.
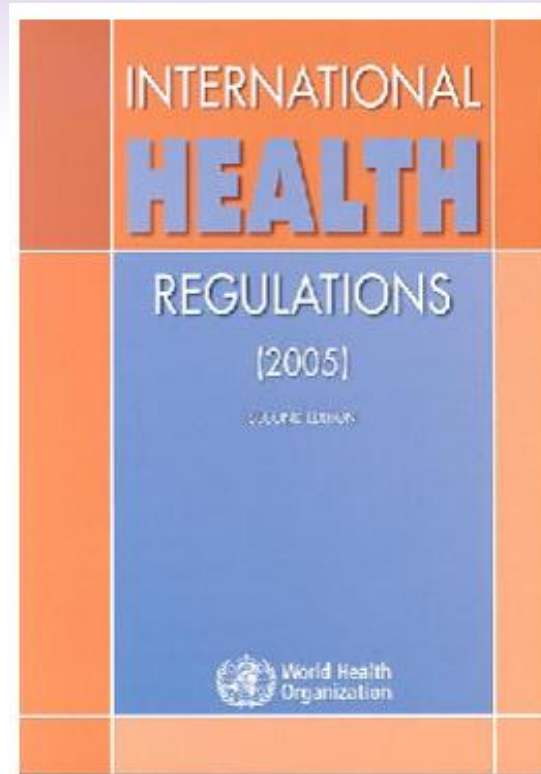
The Global Health Security Agenda:
A Framework to Accelerate IHR Implementation

Prevent Avoidable Epidemics	1. Preventing the emergence and spread of antimicrobial drug resistant organisms and emerging zoonotic diseases and strengthening international regulatory frameworks governing food safety 2. Promoting national biosafety and biosecurity systems 3. Reducing the number and magnitude of infectious disease outbreaks
Detect Threats Early	1. Launching, strengthening and linking global networks for real-time biosurveillance 2. Strengthening the global norm of rapid, transparent reporting and sample sharing in the event of health emergencies of international concern 3. Developing and deploying novel diagnostics and strengthen laboratory systems 4. Training and deploying an effective biosurveillance workforce
Respond Rapidly	1. Developing an interconnected global network of Emergency Operations Centers and multi-sectorial response to biological incidents 2. Improving global access to medical and non-medical countermeasures during health emergencies

Resources

U.S Government Global Health website: http://www.globalhealth.gov/world-regions/middle-east/me_priorities.html

WHO : U.S. CDC GDD program / GDD Center in Egypt:
http://www.cdc.gov/globalhealth/countries/egypt/

CDC Yellow Book: http://wwwnc.cdc.gov/travel/page/yellowbook-home-2014

Global Burden of Disease Study: http://www.thelancet.com/themed/global-burden-of-disease

Global Public Health Intelligence Network (GPHIN): http://www.hc-sc.gc.ca/ahc-asc/pubs/_intactiv/gphin-rmisp/index-eng.php

Global Infectious Disease Epidemiology Network (GIDEON): http://www.gideononline.com/

SAGES (surveillance tool): http://www.jhuapl.edu/sages/

International Health Regulations (IHR) 2005: http://www.who.int/ihr/about/en/

Global Health Security Agenda (GHSA): http://www.globalhealth.gov/global-health-topics/global-health-security/ghsagenda.html

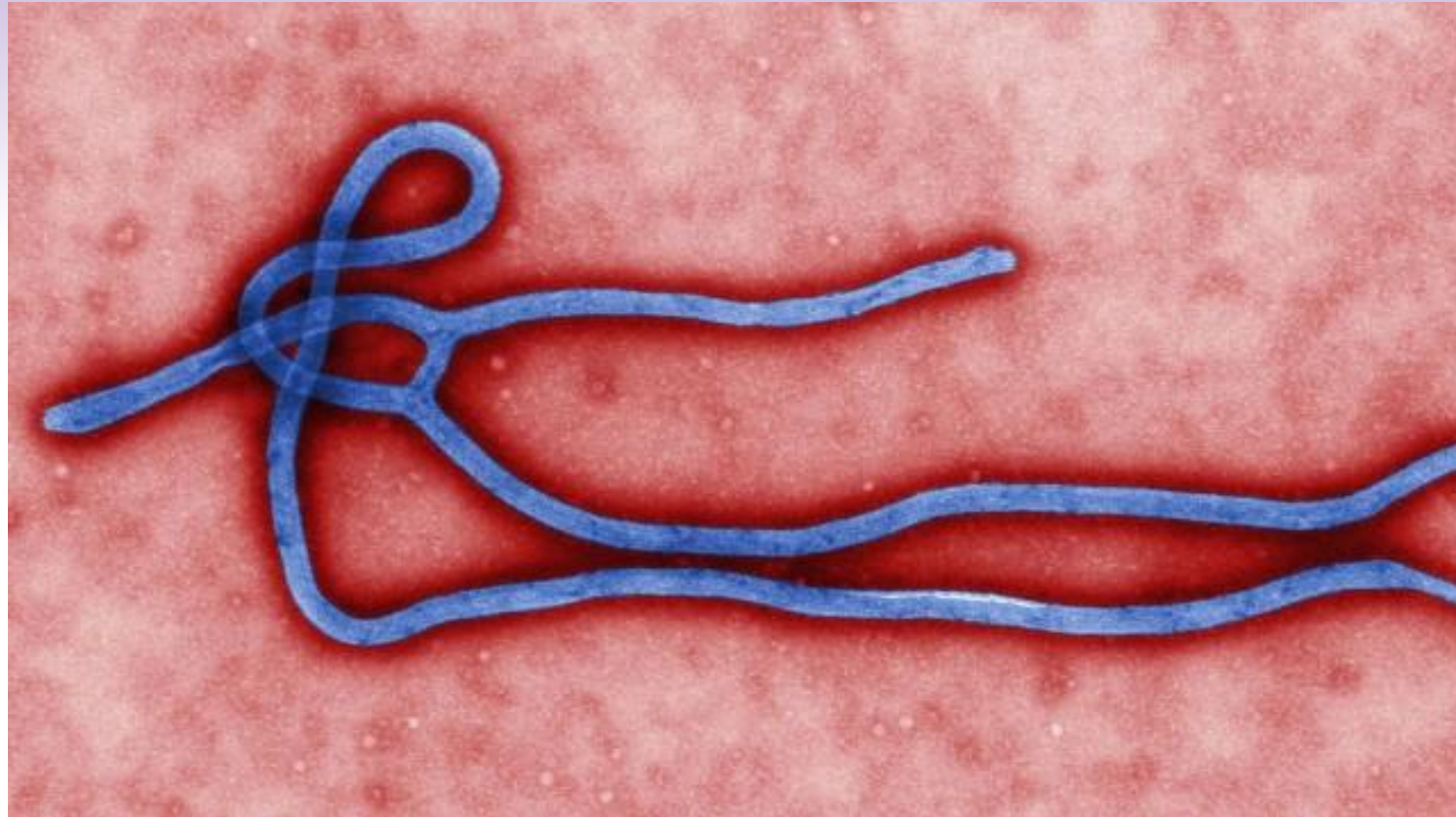*Two worlds –*
Maybe not that different?

Thank you / Salamat po

rohit.a.chitale.civ@mail.mil
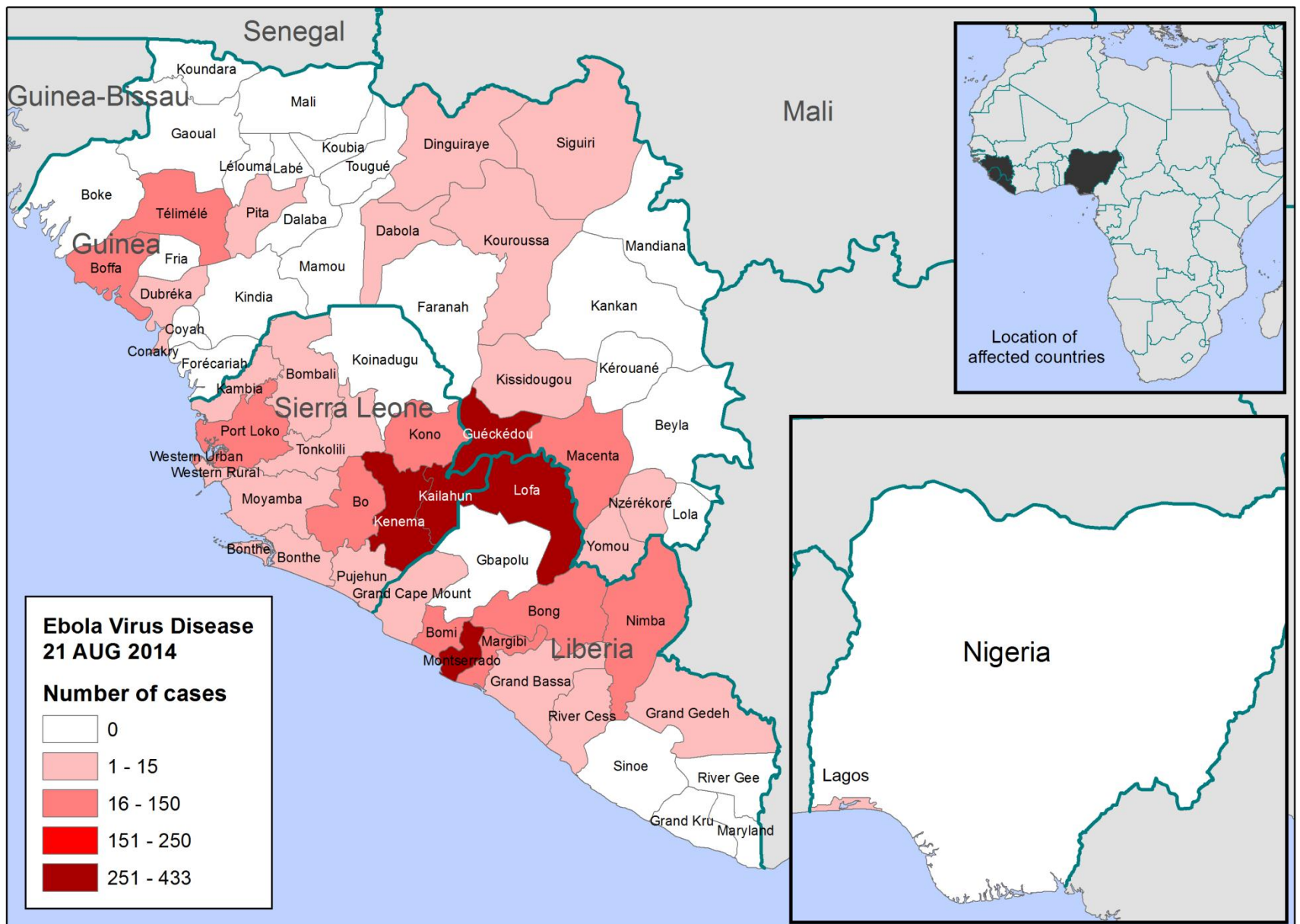*rchitale@gmail.com*
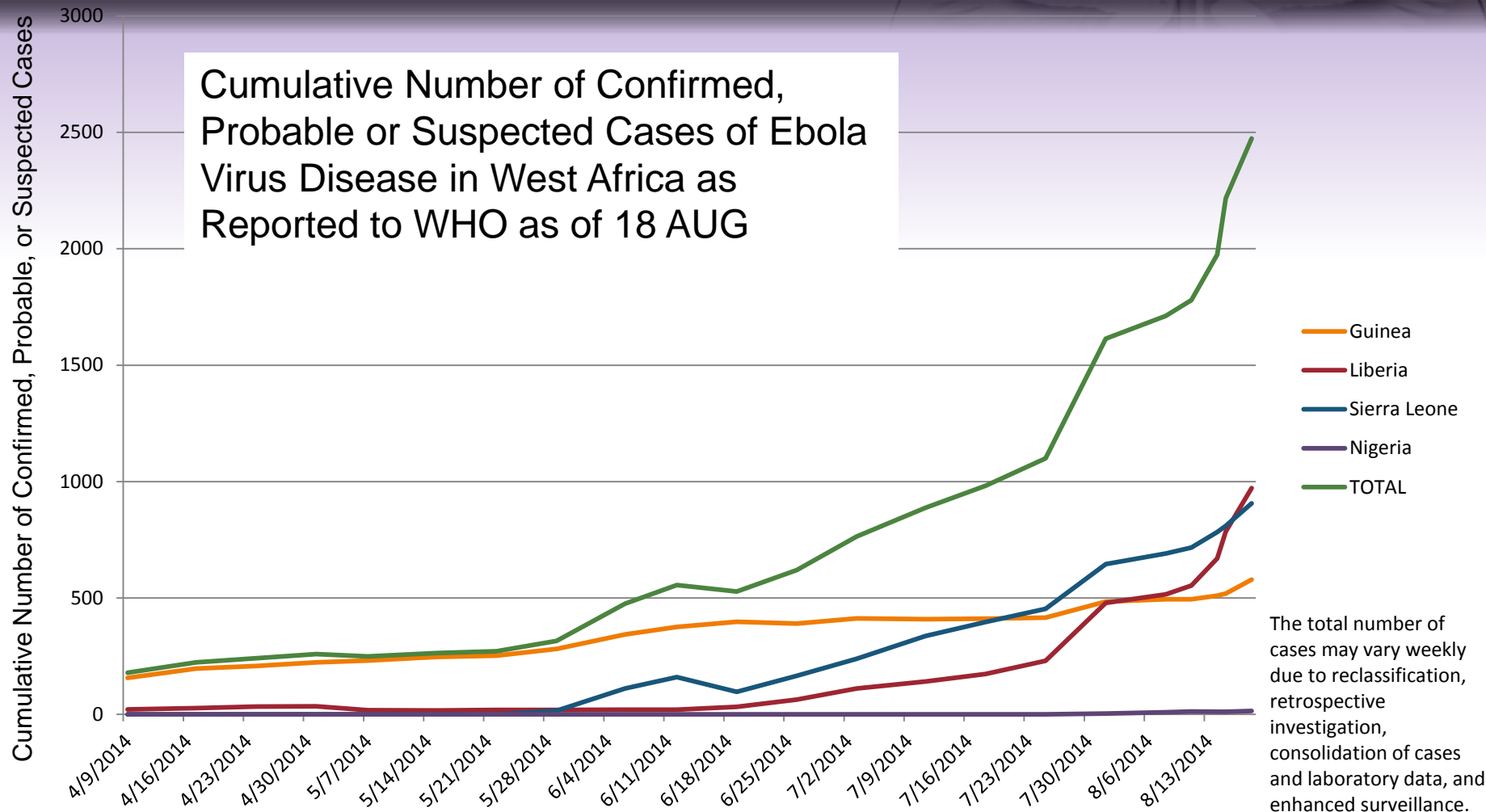
A bit about the Ebola Outbreak

Location of affected countries

Nigeria

Lagos

Ebola Virus Disease 21 AUG 2014

Number of cases

- 0
- 1 - 15
- 16 - 150
- 151 - 250
- 251 - 433

Cumulative Number of Confirmed, Probable or Suspected Cases of Ebola Virus Disease in West Africa as Reported to WHO as of 18 AUG

Cumulative Number of Confirmed, Probable, or Suspected Cases

Guinea
Liberia
Sierra Leone
Nigeria
TOTAL

The total number of cases may vary weekly due to reclassification, retrospective investigation, consolidation of cases and laboratory data, and enhanced surveillance.

All information has been verified unless noted otherwise. Sources include WHO, CDC, and others.

Current Ebola Case Counts in West Africa

Country	EVD Cases All / Lab Confirmed	Deaths All / Lab Confirmed	Case Fatality Proportion All / Lab Conf.
Guinea (as of 19 AUG)	599 (+80) / 430 (+54)	400 (+20) / 259 (+14)	67% / 60%
Liberia (as of 18 AUG)	972 (+186) / 242 (+52)	576 (+163) / 212 (+58)	59% / 88%
Sierra Leone (as of 18 AUG)	907 (+97) / 783 (+50)	374 (+26) / 335 (+26)	41% / 43%
Nigeria (as of 18 AUG)	15 (+3) / 12 (+1)	4 (+0) / 4 (+0)	27% / 33%
Total	2,493 (+366) / 1,467 (+157)	1,354 (+209) / 810 (+98)	55% / 55%

The total number of cases is subject to change due to reclassification, retrospective investigation, consolidation of cases and laboratory data, and enhanced surveillance.

Ebola: What is being done and what is future?

- Extremely large response effort: USAID/DART is leading

- Local spread in 4 countries; may see more countries
  - Suspect cases imported to S Africa, others
  - Cases may come to your countries; suggest working with national authorities to reduce impact

- U.S. is reviewing entry screening and triggers

- You may be able to help
  - Clinical care; other support

- Epidemic will get worse, before it gets better, and last at least 6 more months