ASU Complex Adaptive Systems Initiative
Arizona State University

Stanford MEDICINE

Biosecurity: A Multi-Dimensional Challenge of Escalating Complexity and Urgency

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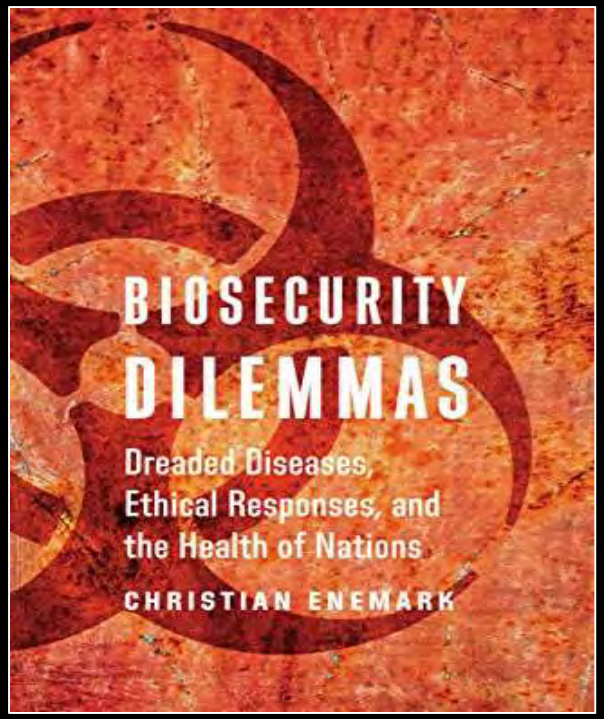
Biosecurity and Bioterrorism Response
BIOE 122, EMED122/222, PUBLPOL 122/222 Course Winter 2018:
Stanford University School of Medicine
24 January 2018

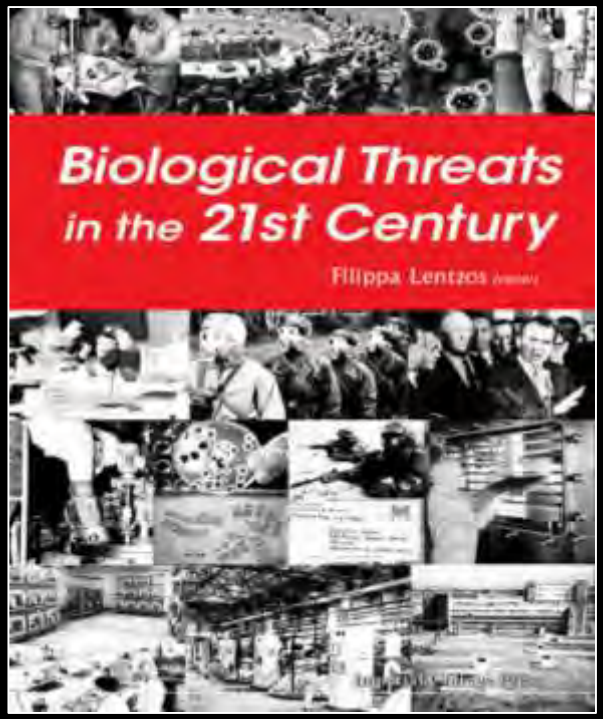
Biosecurity

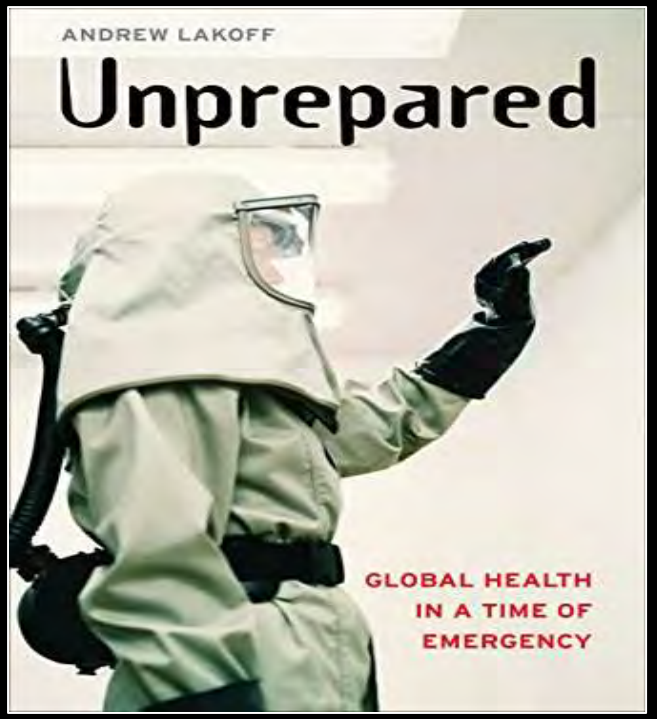
Broad Term for the Full Spectrum of 'Biological' Threats Whether of Natural or Nefarious Origin

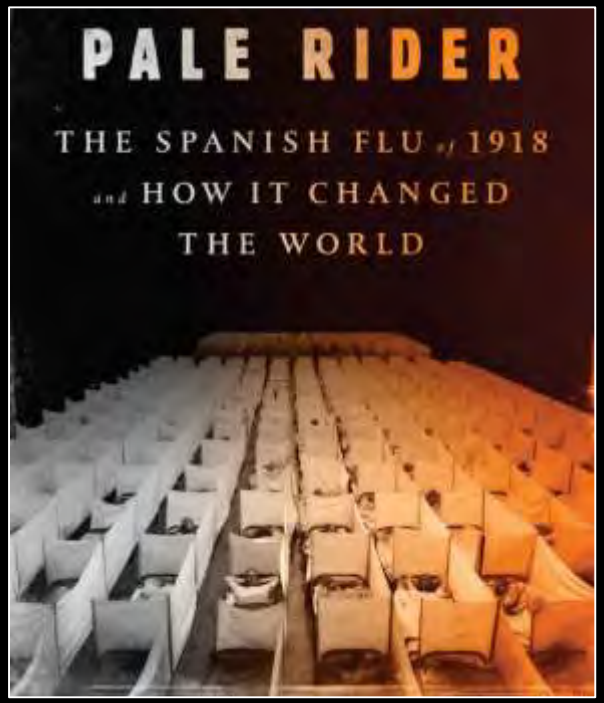
Natural Epidemics and Bioterrorism Share Same Features in Terms of Potential to Harm and Disrupt Society

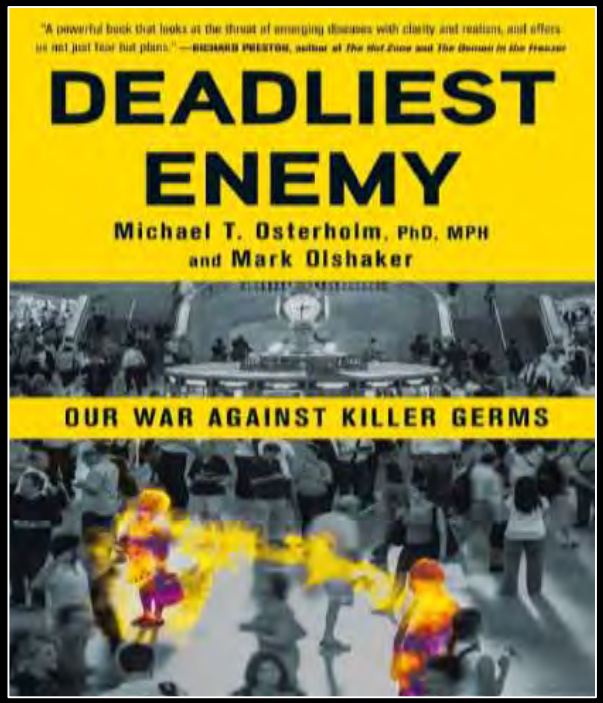
Preparedness and Response Capabilities Are Similar Irrespective of the Origin of the Biothreat

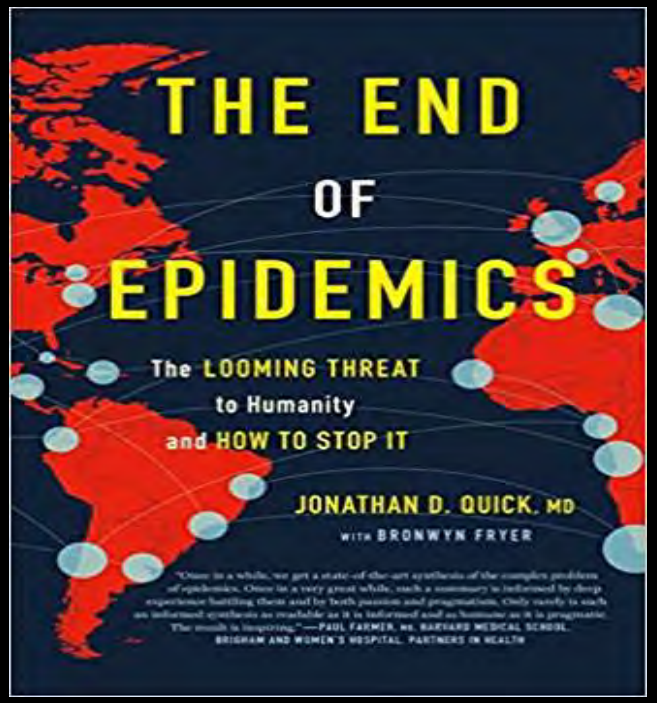

BIOSECURITY
DILEMMAS
Dreaded Diseases,
Ethical Responses, and
the Health of Nations
CHRISTIAN ENEMARK


Biological Threats
in the 21st Century
Filippa Lentzos


ANDREW LAKOFF
Unprepared
GLOBAL HEALTH
IN A TIME OF
EMERGENCY

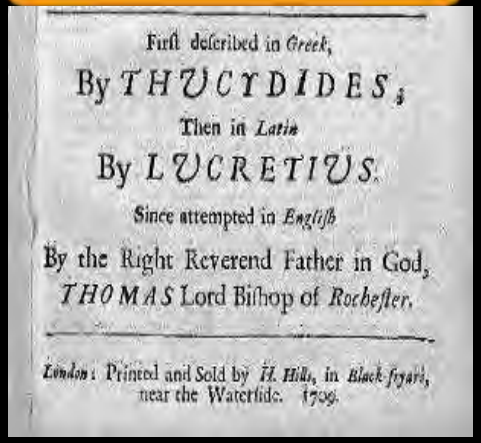

PALE RIDER
THE SPANISH FLU of 1918
and HOW IT CHANGED
THE WORLD


DEADLIEST
ENEMY
Michael T. Osterholm, PhD, MPH
and Mark Olshaker
OUR WAR AGAINST KILLER GERMS


THE END
OF
EPIDEMICS
The LOOMING THREAT
to Humanity
and HOW TO STOP IT
JONATHAN D. QUICK, MD
with BRONWYN FRYER

The Social, Economic and Political Impact of Epidemic and Epizootic Disease

Plague of Athens



Bubonic Plague

Small Pox

Pandemic Influenza

Foot and Mouth Disease

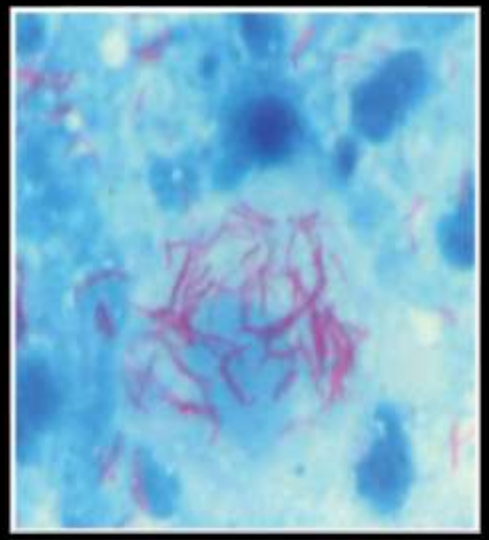
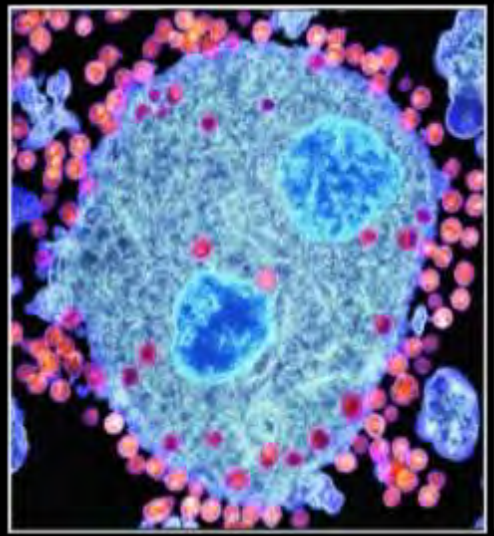
Rinderpest

African Swine Fever

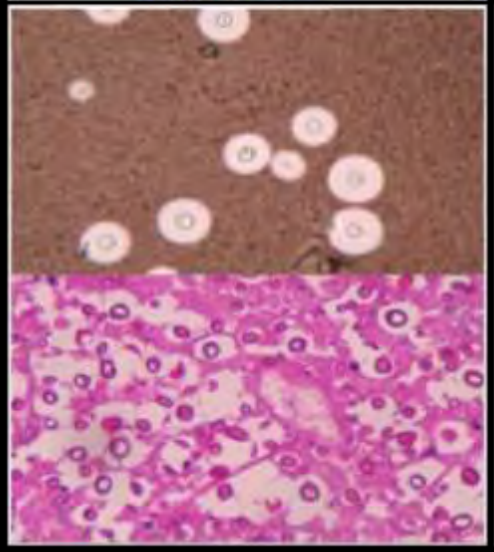
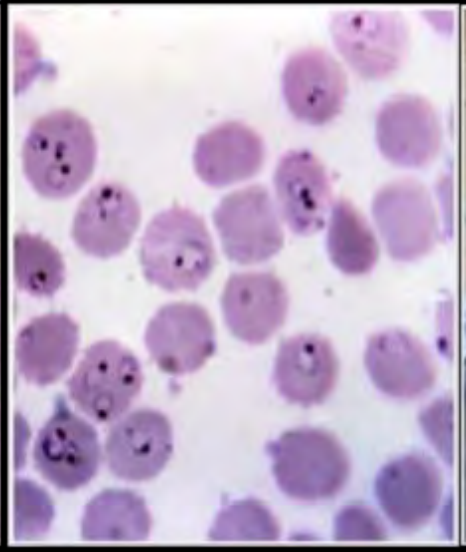
Rabies

“The Big Four”

TB	HIV	Malaria	Rx Resistance



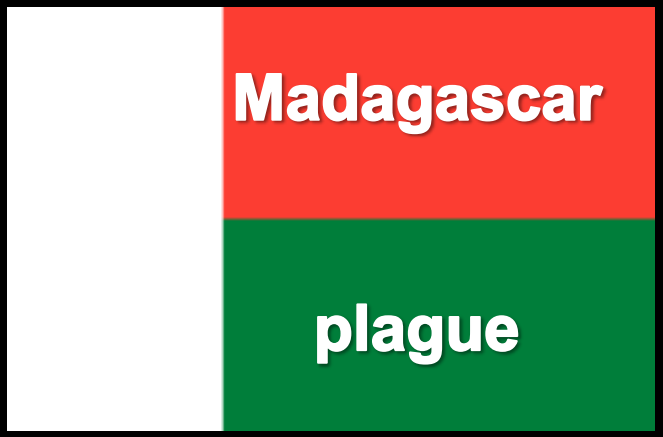



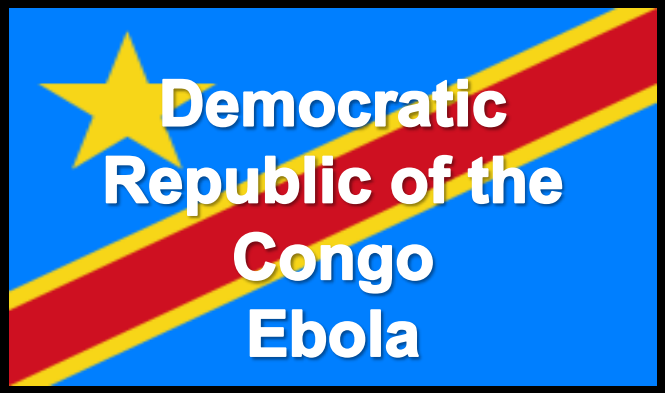

New and Resurgent Viral Threats

SARS-CoV	MERS-CoV	West Nile	Yellow Fever
			

Dengue	Chikungunya	Ebola	Zika
			

Resurgent Infectious Diseases (2017)





Anthrax (2017)

Zambia/Namibia

Ivory Coast

Permafrost Thaw, Siberia

Threat Assessment: N. Korea

Infectious Diseases (Natural) and Bioterrorism (Nefarious)

Shared Features:
Stealth and Spread

Detection of Infectious Disease Threats:

Very Different From Device or Hazmat Events

Emergency Rooms and Farms Will be the Front Line

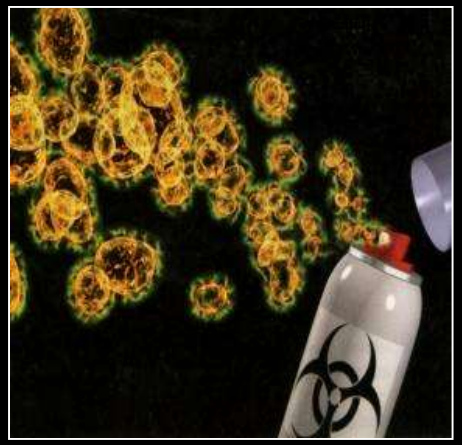
The Biosecurity Quartet

Infectious Diseases of Natural Origin

Urbanization and Environmental Impacts on Disease Emergence (EIDs)

Military and/or Humanitarian Missions in Dense Urban Areas and 'Hot Zones'

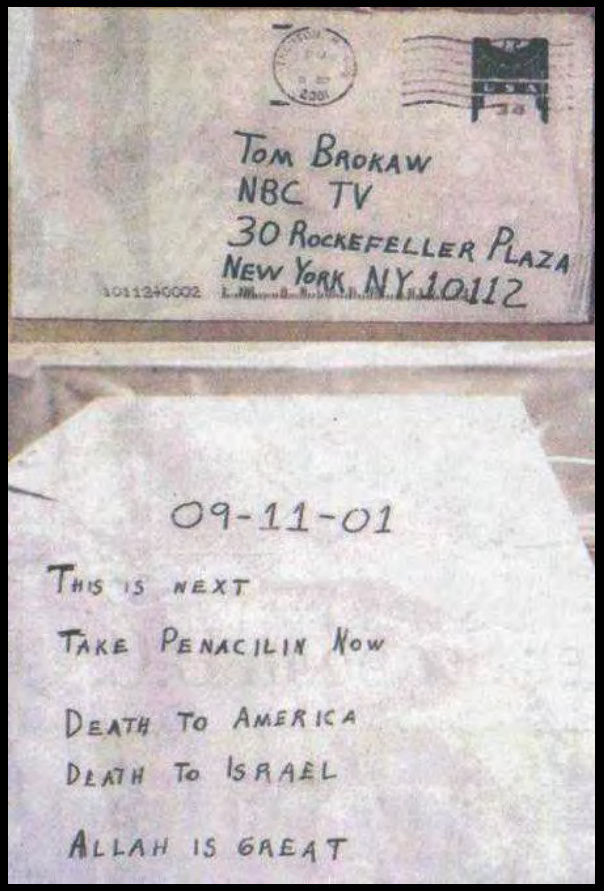
Bioterrorism, New Dual-Use Technologies and an Expanded Threat Spectrum



“Amerithrax” October 2001

“I will show you fear in a handful of dust”

-T. S. Elliot



The FSU Covert Biopreparat Program: Violation of 1972 BWC

The Appeal of CBW for Asymmetric Warfare and Terrorism

Diversification of the Biosecurity Threat Spectrum

Time	Low Probability: High Consequence	High Probability: High Consequence
Today		
• bioterrorism	X	
• natural infectious diseases(pandemic)		X
2025 (?)		
• bioterrorism		X ?
• natural infectious diseases(pandemic)		X

Anthropogenic Effects on Ecosystem Stability and Altered Patterns of Infectious Diseases

famine

contaminated water

no water and desertification

depletion of natural resources

climate change and new vector ranges

new vulnerabilities

Increased Refugee Migration and Humanitarian Disasters Created by Conflict

Global Urbanization

- estimated 180,000 people migrate to cities every day (employment, conflict)
- unprecedented demands (stresses) on infrastructure and services by 2030
  - food (35% ⬆), water (40% ⬆), energy (50% ⬆)
- susceptibility of megacities to extreme weather events/natural disasters
  - littoral locations of 8/10 top megacities
  - vulnerability of vertical structures and slum zones

Ebola: West Africa 2014-15

A Glimpse of the On-Ground Challenge of Managing Epidemic Disease In Locations With Inadequate Infrastructure and Frightened Populations

Still a Small Scale Epidemic and Relatively Easily Contained Versus the Challenge of a Global Pandemic

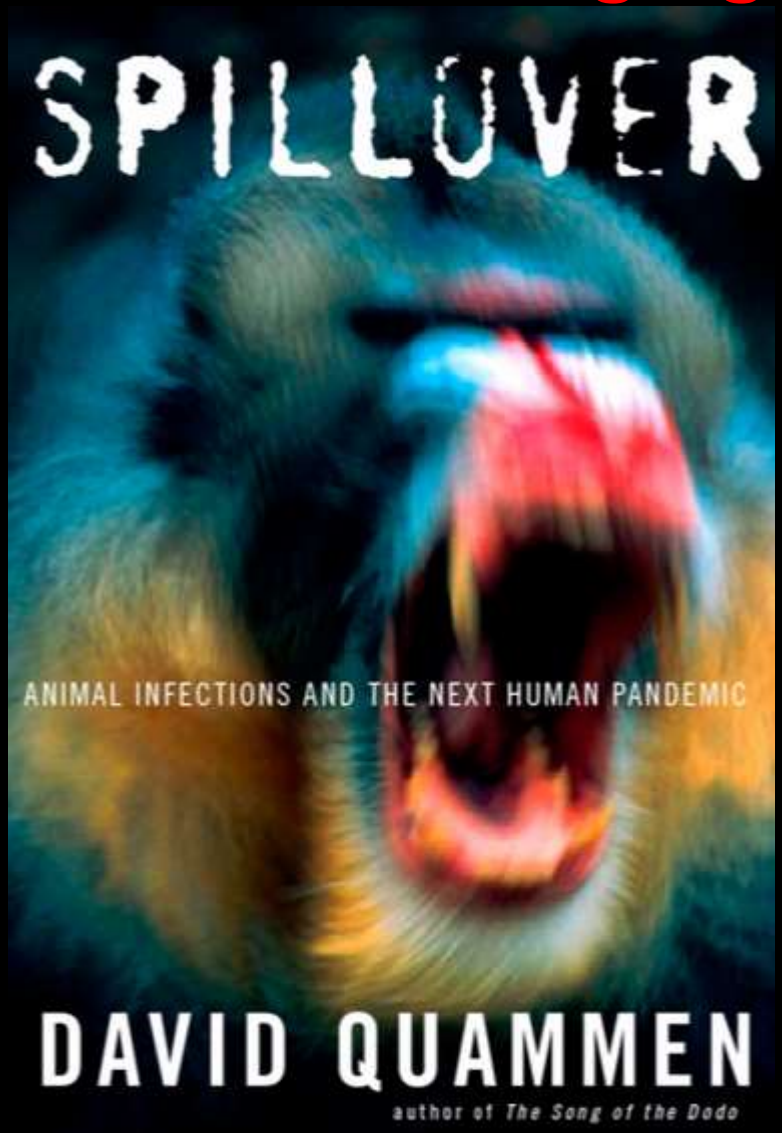
Ebola in West Africa (2014-15)

Ebola West Africa: 2014-15

The Logistics (and Risks) of Waste Disposal

Burial Practices

The Dominant Role of Zoonoses in Emerging Infectious Diseases



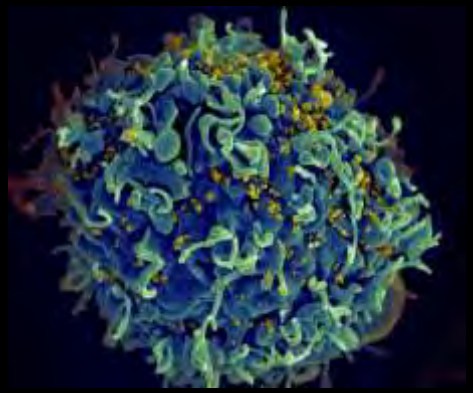
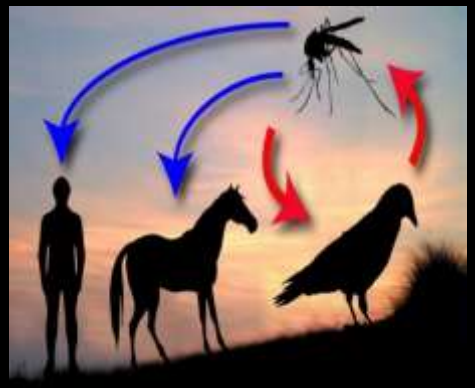
Urbanization and Mega-Cities in Developing Countries and the Increased Threat of Exotic Zoonotic Diseases

High Population Density With Inadequate Biosurveillance

Major Gaps in Health Infrastructure and Disease Reporting

Expanded Eco-niches and New Zoonotic Exposures/Risks

One Health:
Recognition of the Importance of Zoonotic Diseases as Human Health Threats

pandemic (avian) influenza	HIV	West Nile virus	MERS- CoV
			
			
Ebola virus	bush meat food chain	Zika virus	what's out there?

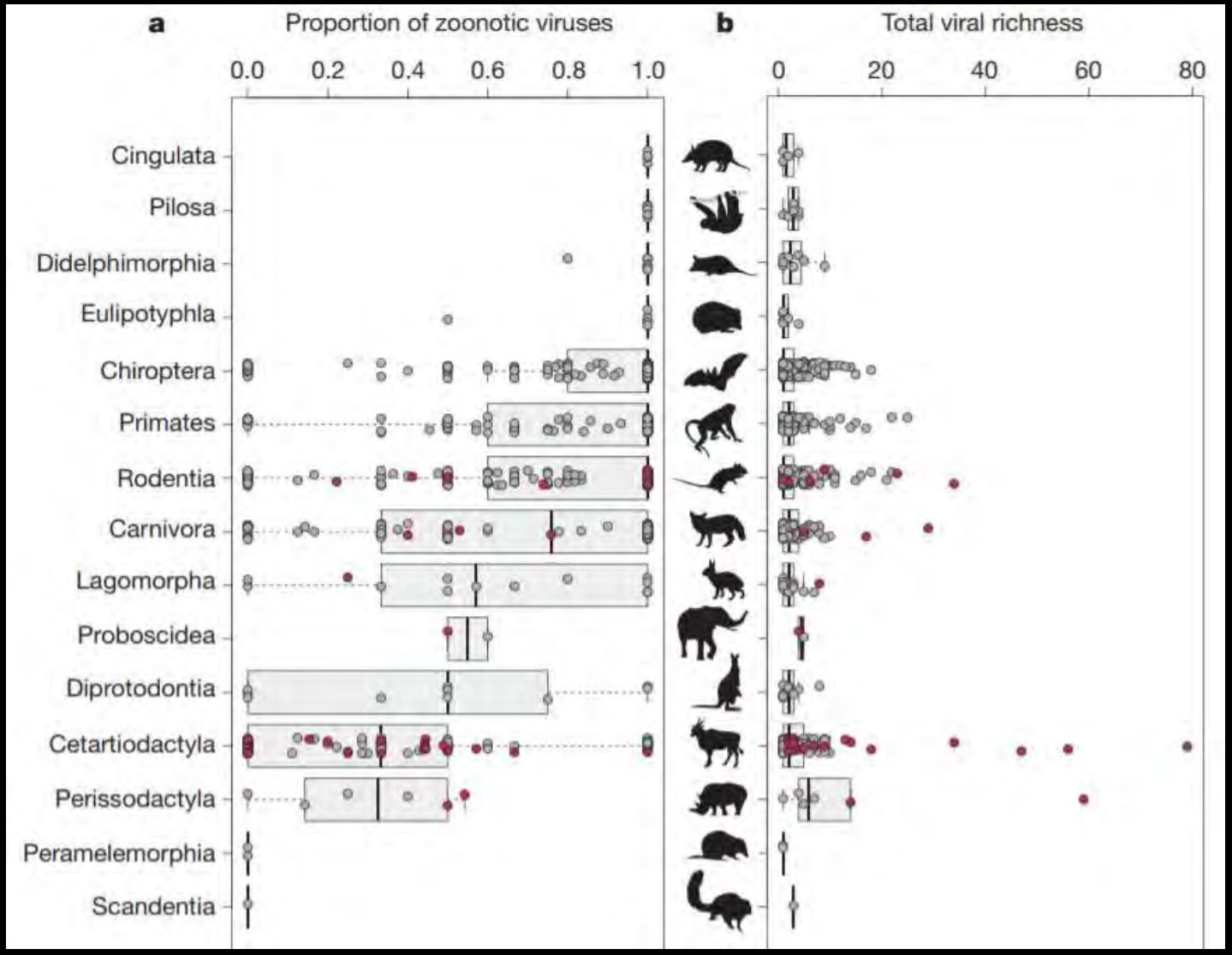
Mapping the Global Virome and Potential for Zoonotic Spillover to Humans

- 586 mammalian viruses in 28 families identified to date in 754 mammalian species
- 263 (44.9%) also detected in humans
  - 188 (71.5%) are zoonotic
- higher proportion of RNA viruses as zoonoses
- higher zoonotic potential for enveloped viruses that replicate in the cytoplasm
- viruses with arthropod vectors can infect a wider range of mammalian hosts

Data from: K.J. Olival et al (2017) Nature 546, 646

Bats as the Ebola Reservoir in W. Africa (2014)

The Global Virome: Analysis of 2805 Mammalian Host-Virus Association and Proportion of Zoonotic Viruses

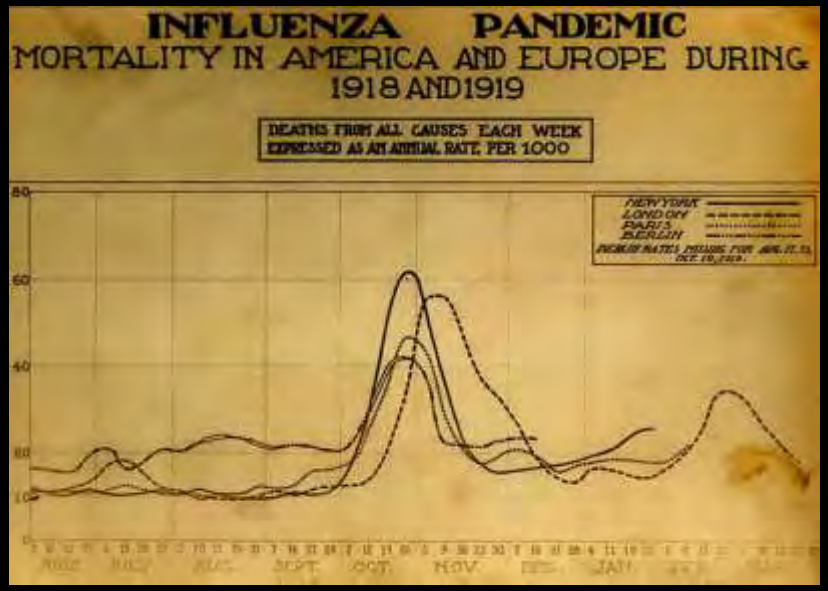


From: K. J. Olival et al. (2017) Nature 546, 646

Mapping the Global Virome and Potential for Zoonotic Spillover to Humans

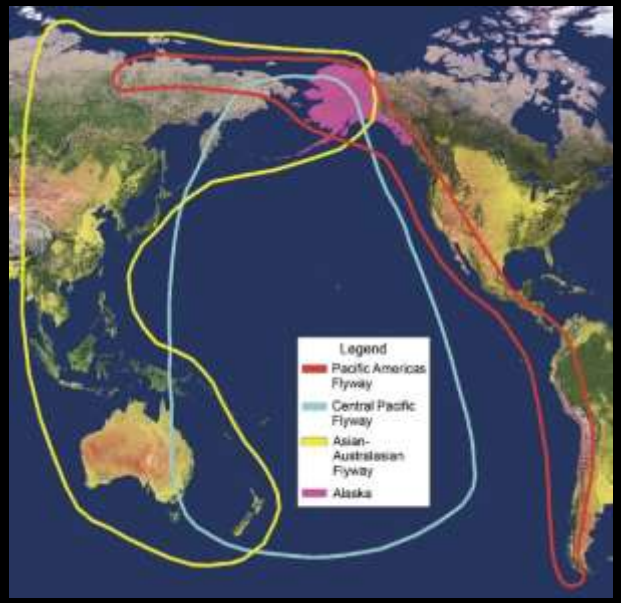
- bats (chiroptera) harbor higher proportion of zoonotic viruses than other mammalian orders
  - Flavi-, Bunya- and Rhabdoviruses
- primates and rodents next two highest reservoirs
  - rodents (Bunya-, Flavi- and Arenaviruses)
- phylogenetic relatedness and cross-species spread (viral receptor affinities)
- higher mutation frequency in RNA viruses and cross species spillover
- sympatry (two or more species in same location)
- increased risk with rural to urban migration

The #1 Global Pandemic Threat?
The Omnipresent Risk of Pandemic Influenza



The Evolution of Pandemic Influenza Strains: The Bird → Pig → Human Transmission Chain

Avian Reservoirs and Global Flyways

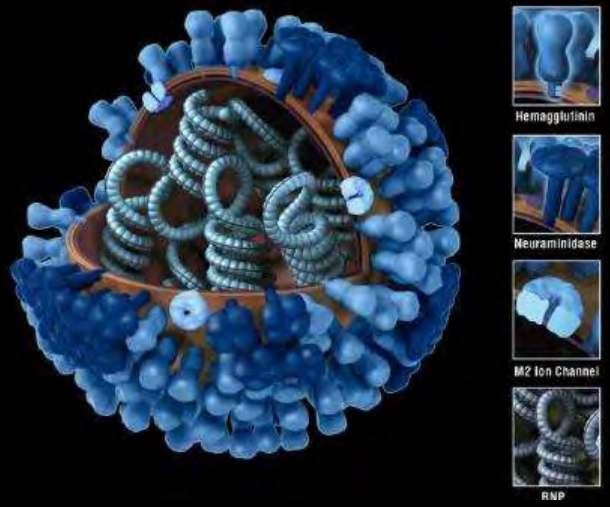


Sporadic Transmission to Mammalian Hosts

Episodic Zoonotic Human Infections

The Evolution of Pandemic Influenza Strains by Continuous Mutation and Genetic Reassortment

High Frequency Mutation and Genetic Reassortment in Zoonotic Strains



high virulence

x

low transmissibility

high virulence

x

high transmissibility

Biosecurity Implications of the Rise of Intensive Agriculture in BRIC Countries

- consumer desire for animal protein (versus plant protein)
- diversion of grain to animal feed, disruption of global food chains and increased famine risk in Africa and new humanitarian crises
- juxtaposition of large numbers of birds(ducks/chickens) and pigs in same production centers
- increased cross-species influenza transfer and human zoonotic risk via genetic recombination(s) with pandemic potential

The Core Triad in Combating Infectious Diseases

threat spectrum	robust public health capabilities	counter-measures

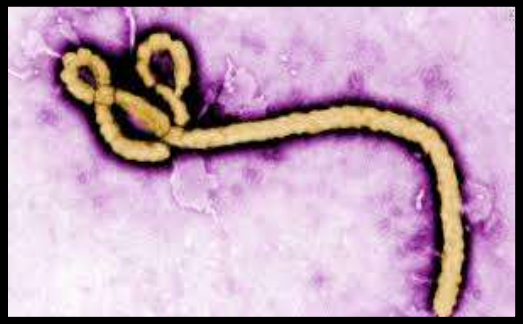
Biosurveillance

What's Out There?

Early Detection Saves Lives!

PON/POC Diagnostic Tests, Population Triage and Managing the Worried Well

Ebola in West Africa 2013-15: Underinvestment and Bureaucratic Sclerosis of International Public Health Responses to New Threats



26 December 2013

- index case zero
- Emile Ouamouno (Meliandou, Guinea)

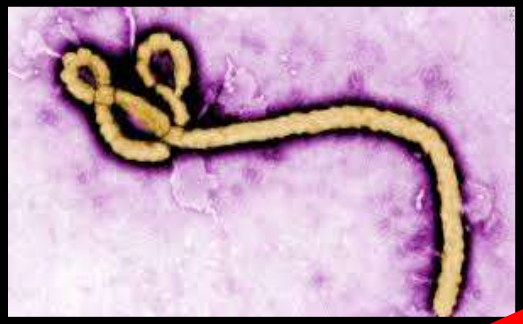
21 March 2014

- first report by WHO-AFRO region

8 August 2014

- WHO declaration of Public Health Emergency of International Concern (PHEIC)

Ebola in West Africa 2013-15: Underinvestment and Bureaucratic Sclerosis of International Public Health Responses to New Threats



Over 11,000 Deaths

26 December 2013

- index c
- (Meliandou, Guinea)

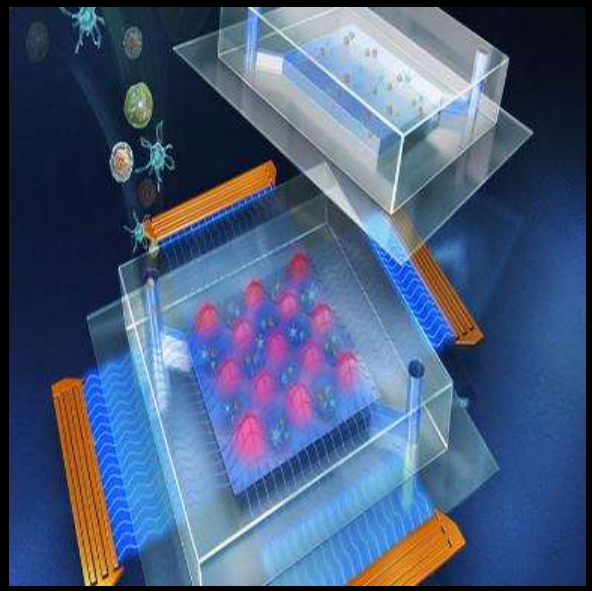
2014

- first report by WHO-AFRO region

8 August 2014

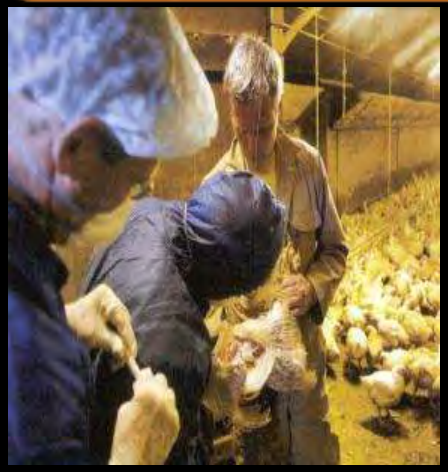
- WHO declaration of Public Health Emergency of International Concern (PHEIC)

Faster Diagnosis Saves Lives: The Primacy of Early Detection and Preparedness Mobilization

Profile	Detect	Act
		
Signatures of Infectious Agents	Rapid Automated PON/POC Diagnostics	Real-time Situation Awareness and Decision Authority

Ground Zero Biosurveillance Data

Comprehensive Front Line Sampling of Sentinel Species





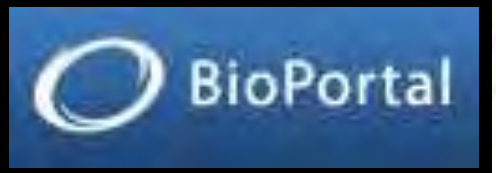


Real-time Intelligence and Faster Response Mobilization

Global Disease Surveillance

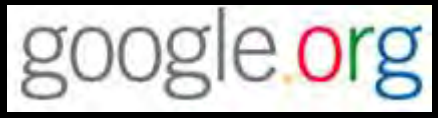
EMERGEncy ID NET

U.S. Influenza Sentinel Provider Surveillance Network



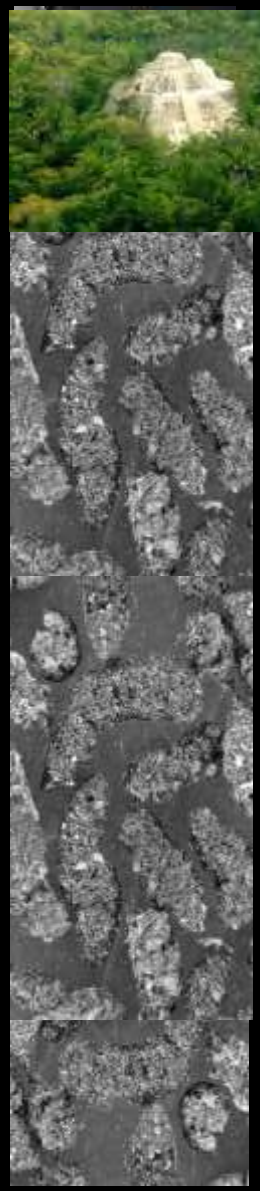
Quarantine Activity Reporting System (QARS).

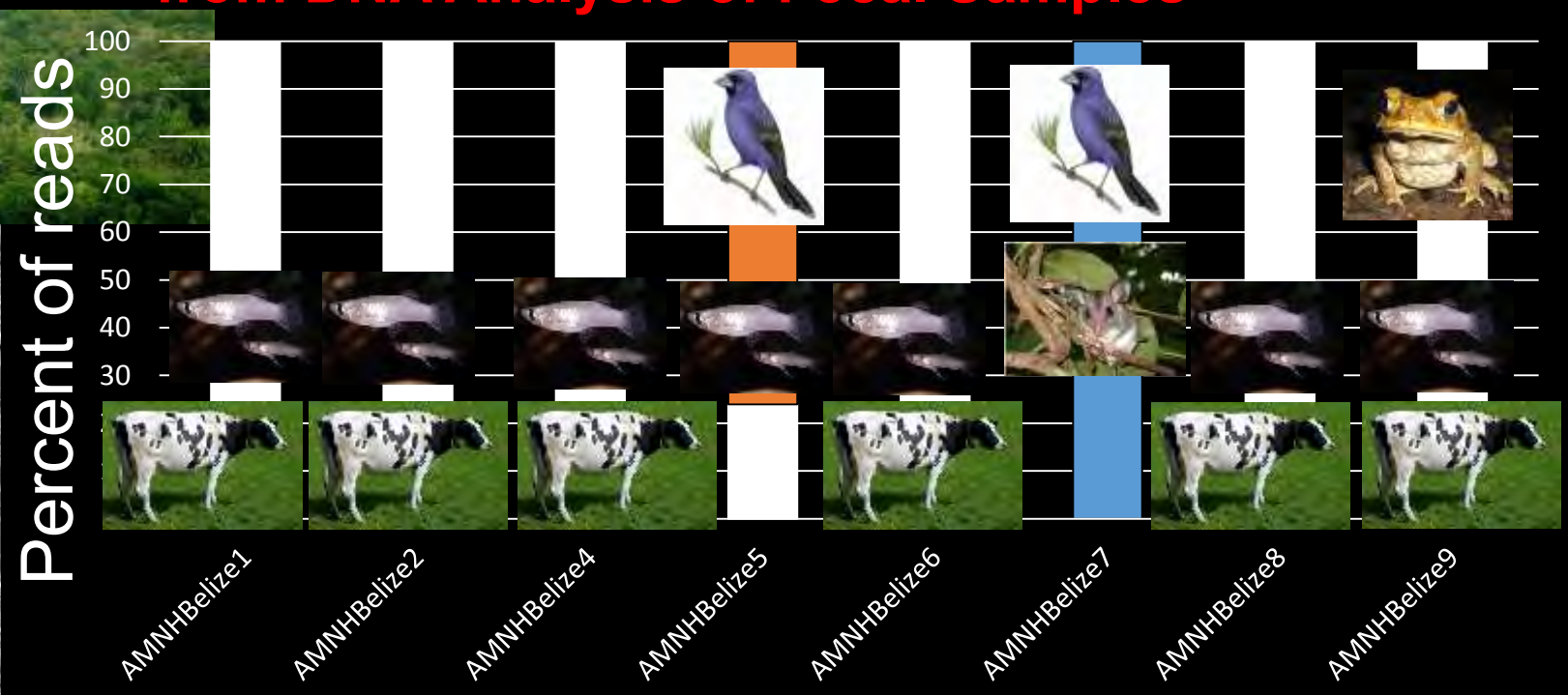
Public Health Department's Surveillance



GEIS

Species From Feces: Identification of Predator-Prey Relationships from DNA Analysis of Fecal Samples

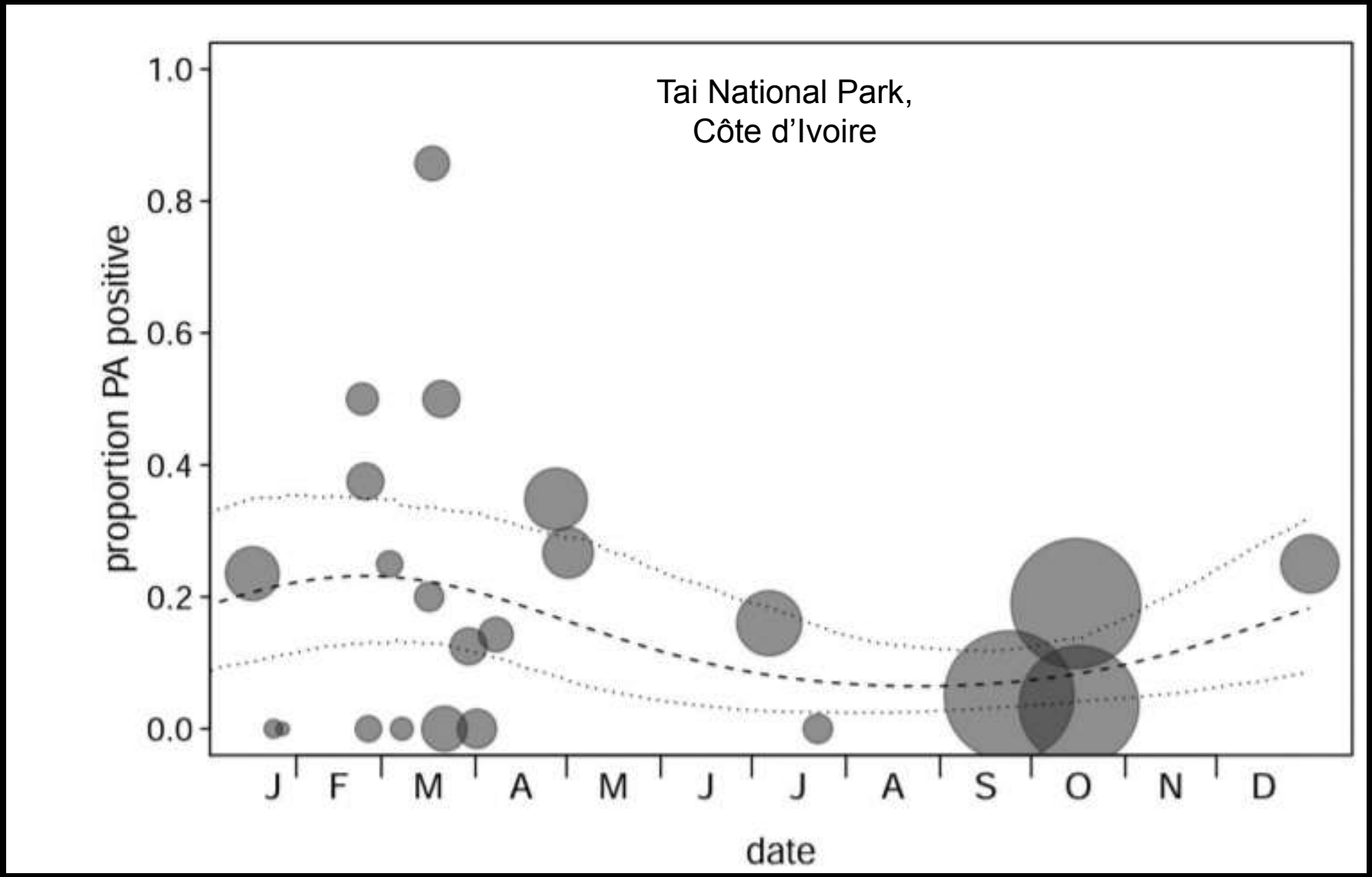




■ *Desmodus rotundus* ■ *Natalus stramineus* ■ *Chrotopterus auritus*

Courtesy of Drs. F. Walker and N. Simmons NAU.edu/batdna

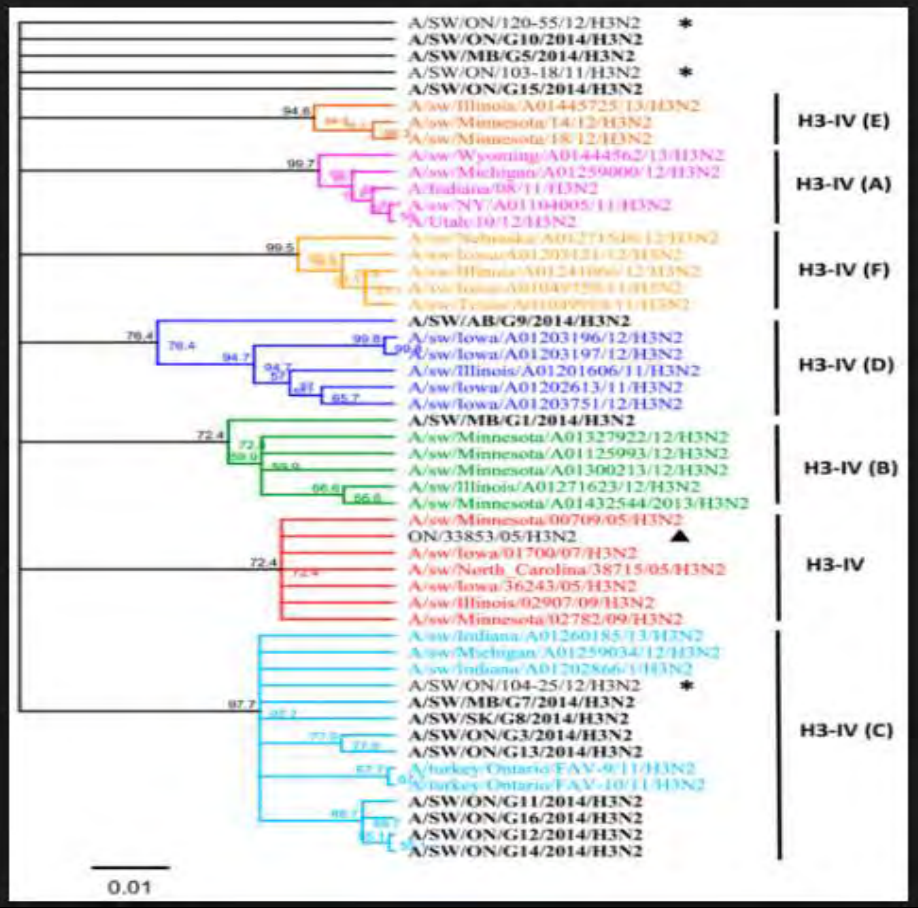
Detection of *Bacillus cereus* biovar *anthracis* in Carrion Flies Feeding/Ovipositing on Mammalian Carcasses as Proxy Marker for Anthrax Endemicity



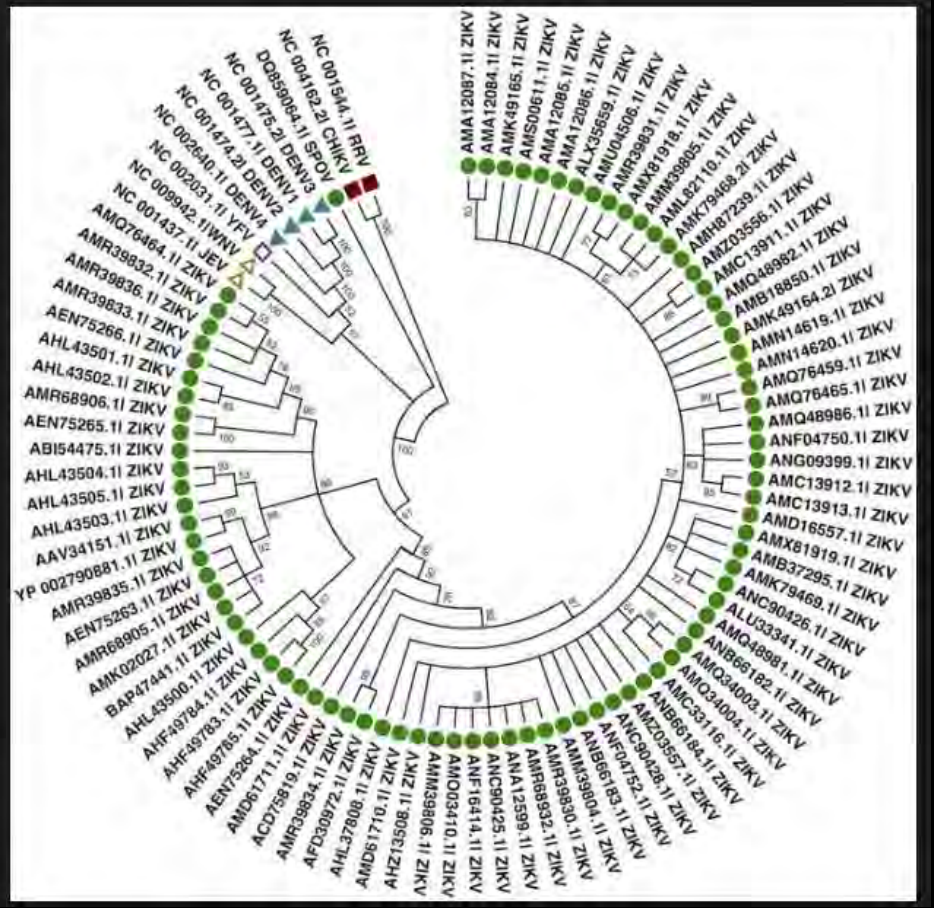
From: C. Hoffmann et al. (2017) Nature 548, 82

Metagenomic Identification of Pathogens and Their Evolution

Influenza Virus



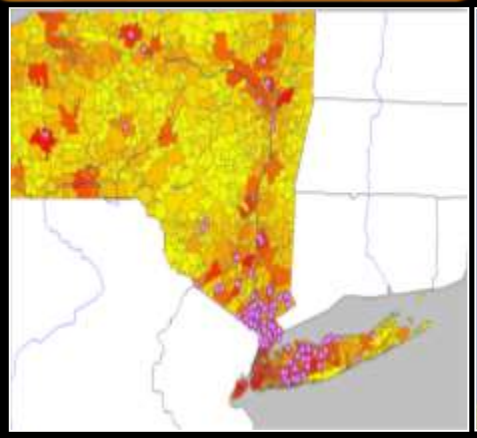
Zika Virus

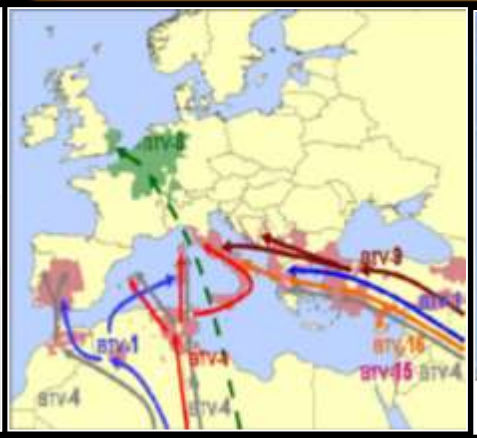


Geodemographic Information Systems(GIS): Mapping Disease Patterns and Modeling Trends

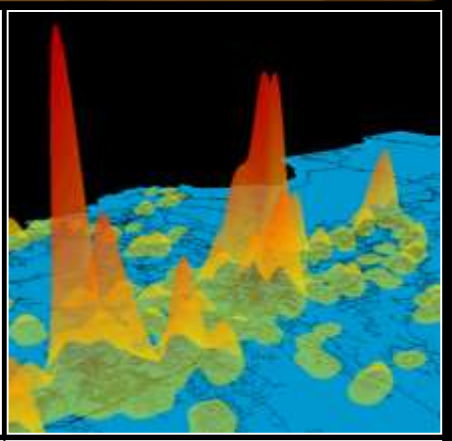
Anomaly Detection and Early Alert

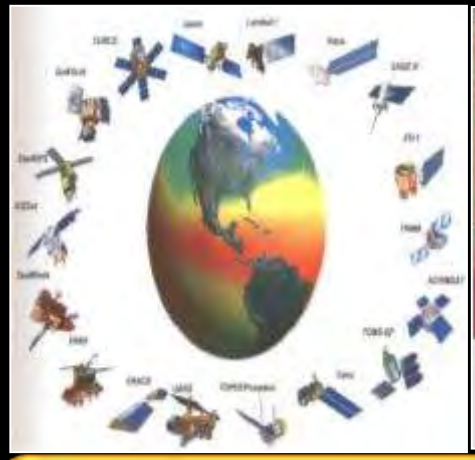
Disease Progression

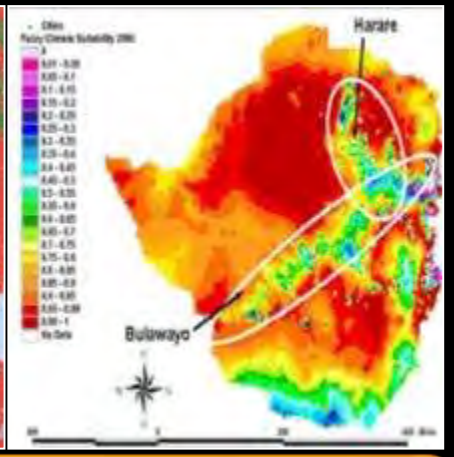




Type O (blue), A (green), Asia-1 (orange), SAT2 (purple)

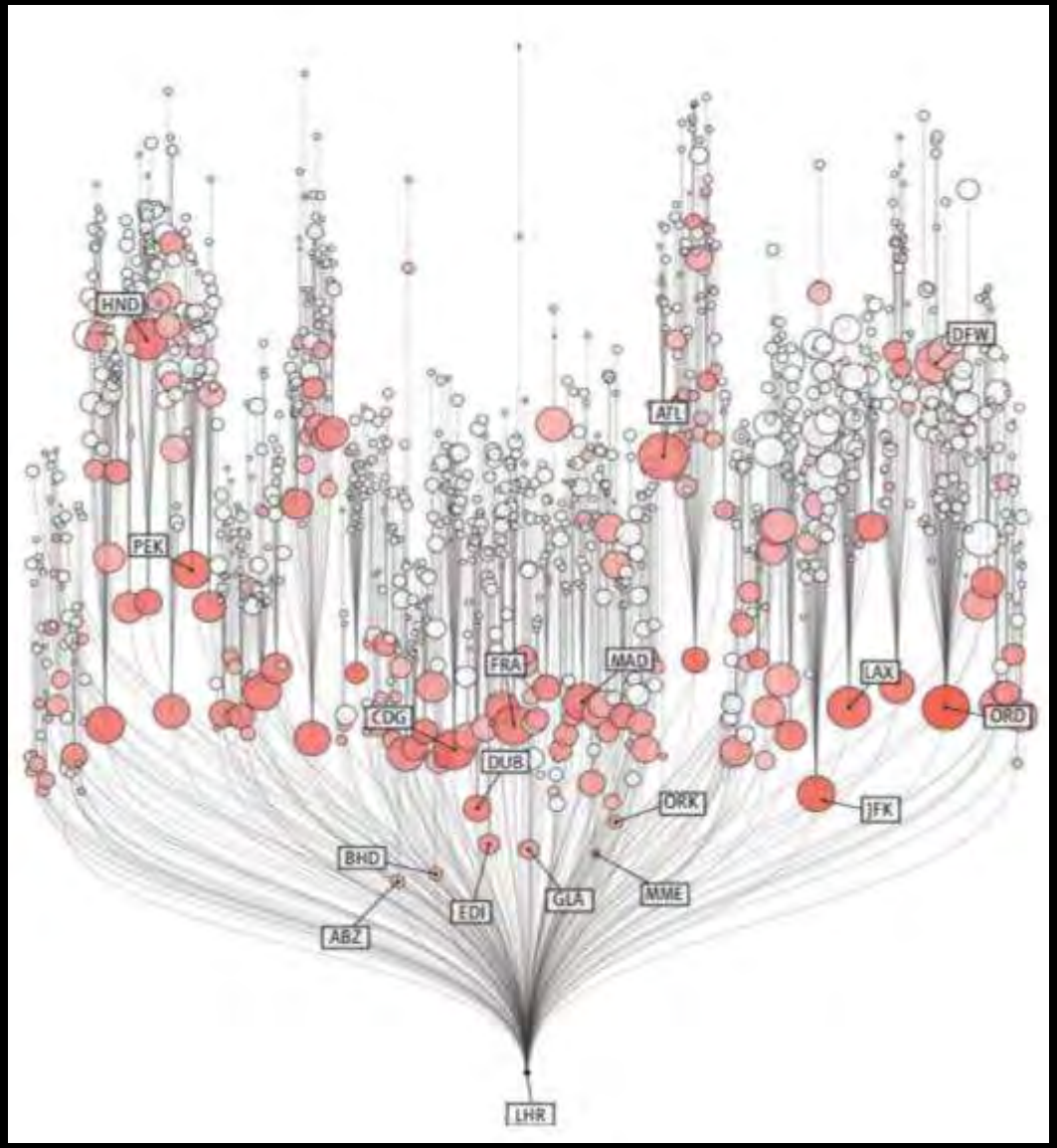






Satellite Surveillance and Predictive Modeling of Disease Trends

Coming to an Airport Near You:



Modeling Airport Connectivities, Traffic and Distance Relationships and Implications for Epidemic Spread via the Global Aviation Network

From: A. R. McLean (2013) Science 342, 1330

Mobile Devices, Disease Tracking, Contact-Tracing and Education

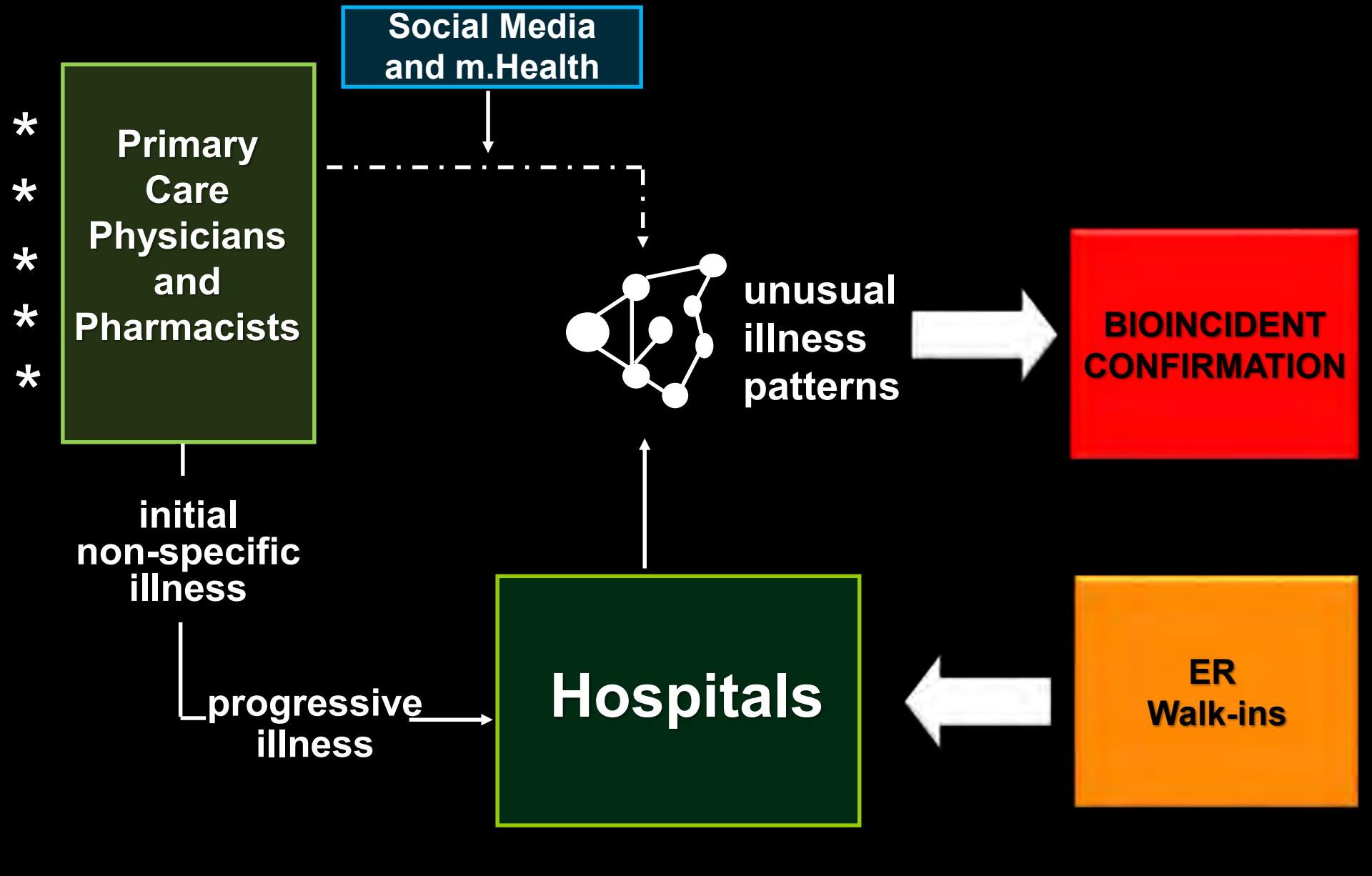
Street Vendors of Pharmaceuticals: Haiti

Detection of Infectious Disease Threats:

Very Different From Device or Hazmat Events

Emergency Rooms and Farms Will be the Front Line

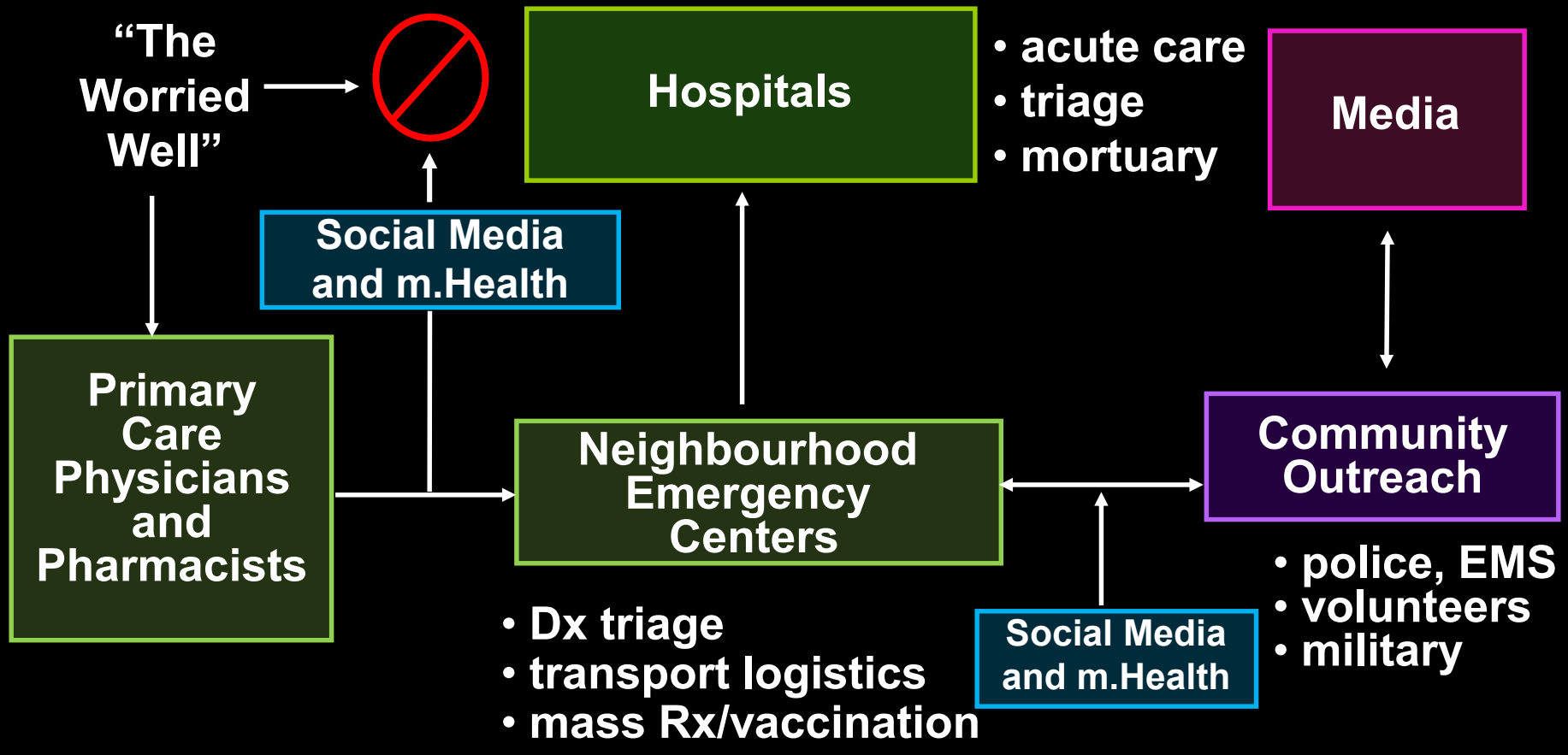
The Lag Phase in Bioincident Detection



Consequence and Crisis Control in a Bioincident

Command Center

- public health
- logistics
- communications
- medical
- law enforcement
- coordination
- local
- national
- international
- regional



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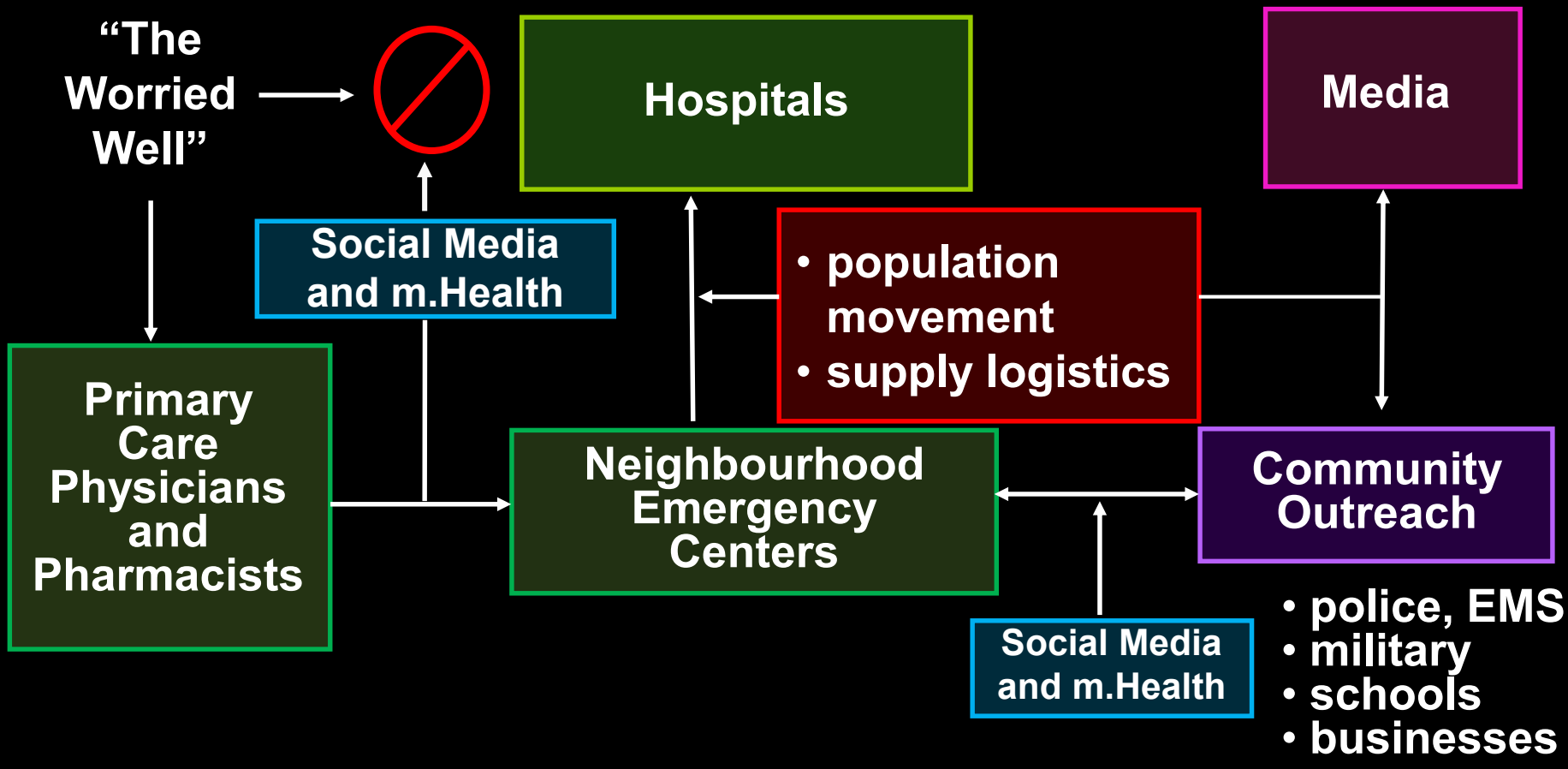
- international
- regional



Management of Major Bioincidents

Key Success Factors

- tested incident management plan
- responder training and education
- command structure
  - demarcated roles, responsibilities, authority
  - robust communication channels
- single source POC for key interfaces
  - ground zero staff (multiple ground zeros in CBW)
  - emergency services and first responders
  - medical/public health
  - politicians and inter-agency coordination
  - conventional media and social media

Who's In Charge?

- ill-defined responsibilities and accountabilities lead to operational confusion
- delusional to believe that optimum disaster response is a physician/health system-centric process
- crucial medical component but multi-disciplinary, multi-sector 'bigger picture' complexities requires sophisticated integration of diverse expertise and proficient large scale logistics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UNITED STATES OF AMERICA


National Security Council


U.S. DEPARTMENT OF HOMELAND SECURITY


DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA


DEPARTMENT OF JUSTICE
FEDERAL BUREAU OF INVESTIGATION


DEPARTMENT OF HEALTH & HUMAN SERVICES
USA


Central Intelligence Agency
Top
Secret


NO
ENTRY
SIS

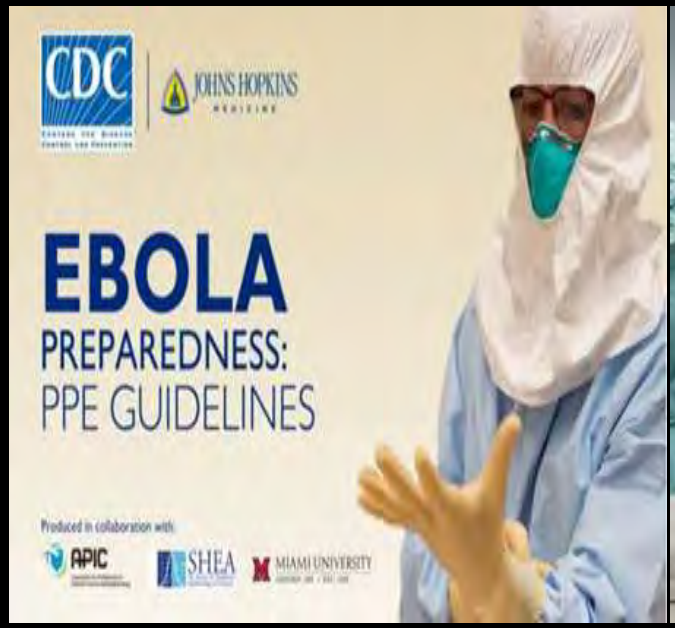

CALIFORNIA REPUBLIC

US High Level Isolation Units (HLIU's)*

- 56 designated hospitals by CDC as Ebola Treatment Centers (ETC's) in response to W. Africa Ebola (2014-2016)
- subsequently 1 ETC designated in each HHS region as Regional Ebola and other Special Pathogens Treatment Centers (RESPTC)
  - capable of managing highly infectious diseases for extended periods
- economic sustainability of maintaining 'warm' facilities
  - lack of funding for non-RESPTCs
  - high absorbed non-reimbursed standup costs

*J.J. Herstein et. al. (2017) Emerge. Inf. Dis. 23, 965

Biocontainment Protocols and HCP Training

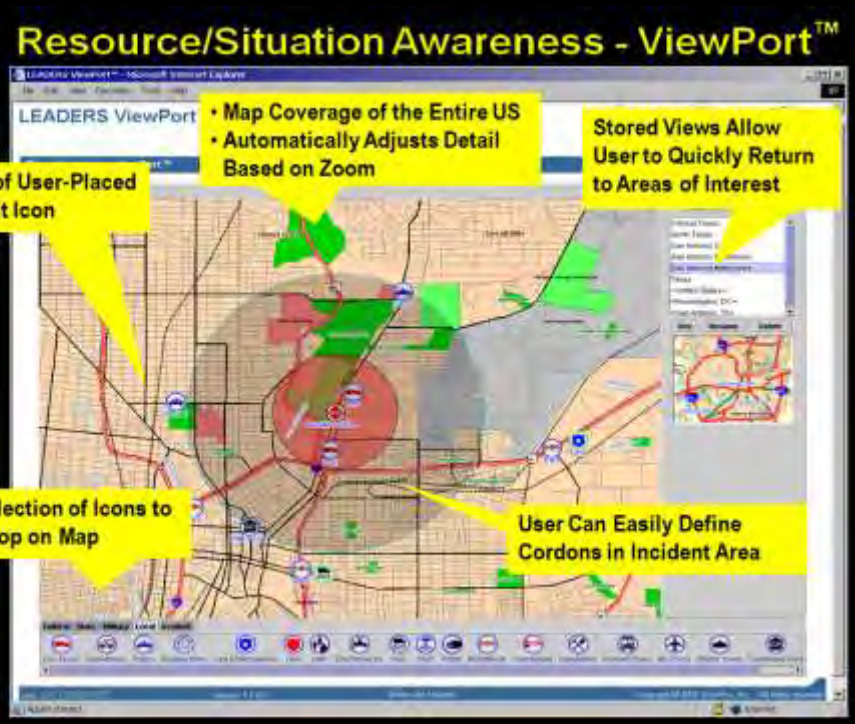


Resource Asymmetries in Management of Global Bioincidents

Distribution of Medical Emergency Supplies for a Major Epidemic/Pandemic

- pre-positioning for known threats: The Strategic National Stockpile (select agents only)
- rapid movement by commercial carriers

Use of GIS for Management of Population Movement, Healthcare Facilities and Supply Chains for Optimum Bioincident Control

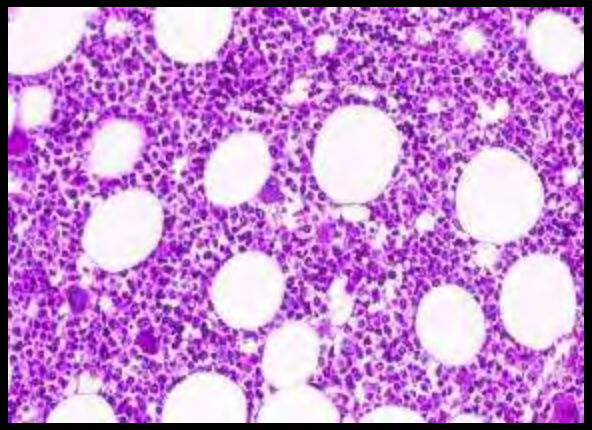


Vulnerability of Global, National and Local Supply Chains in a Major Epidemic/Pandemic

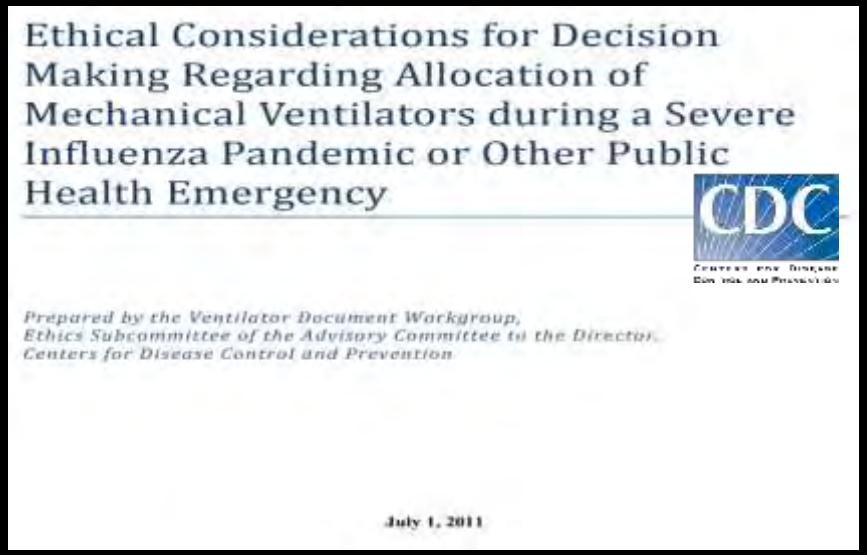
Medicines

- "just-in-time" supply networks
  - major hospitals 2 or 3 deliveries per day
- out-patient prescription drugs
  - insurance company limits on prescription volume (USA)
- majority of drug intermediates, excipients and final products sourced off-shore
- 95% generic drugs used in US (80% of total Rx) are made off-shore, primarily in PRC and India
- no national stockpile for routine prescriptions

Medical Countermeasures (MCMs) for Special Populations: Emergency Use Authorization

Children	Pregnant	Aged
		
		
Immunosuppressed	Impaired Major Organ Function	ICU-Critical Care

Stockpiling Ventilators for Influenza Pandemics: Estimated Deaths and Hospitalization



1918

- estimated 675,000 US deaths, 50 million globally

moderate pandemic:1957,1968

- 865,000 ILI hospitalizations

severe pandemic:1918 like

- projected 9.9 million hospitalizations

Modeling of Peak-Week Ventilator Demand in an Influenza Pandemic

Parameter	Mild (2009-like)	Moderate 1957/68-like	Severe 1918-like
Hospitalization Overload	1	x 3	x 36

Constraining Capabilities for Effective Mechanical Ventilation for Large Scale Public Health Emergency

Components/subcomponents		Number of additional patients that can be ventilated national by capacity level		
		Conventional Capacity Level	Contingency Capacity Level	Crisis Capacity Level
Space	Beds	8,200 – 16,400	26,200 – 52,400	88,600 – 177,300
Staff	Physicians	6,300 – 18,900	47,800 – 143,400	114,700 – 229,500
	Respiratory Therapists	22,500 – 67,500	39,400 – 101, 300	56,300 –135,000
	Critical care Nurses	25,200 – 50,300	50,300 – 100,600	75,500 – 301,900

Indicate the constraining component at each capacity level.

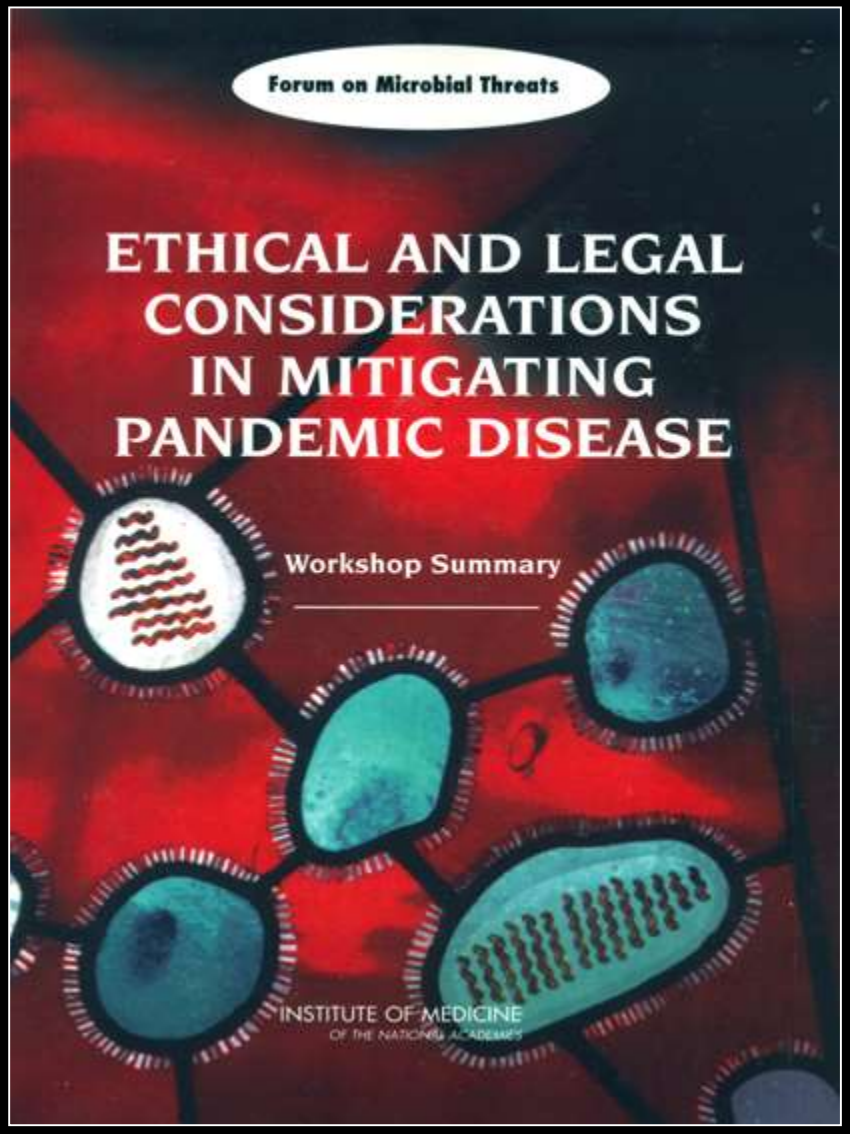
From: A. Ajao et al. (2015) Disaster Med Public Health Prep 9, 634

The Challenge of Vector Control

“For most of us design is invisible until it fails”
Bruce Mau

The ‘Fog of Disaster’: Crisis Standards of Care and Proliferation of Unanticipated Events and Consequences

Legal Aspects of Public Health and Counter-Terrorism Actions to Contain Bioincidents



- suspension of civil liberties
- imposition of quarantine
- triage decisions and R_x/vaccine rationing
- mandatory medical examination and treatment
- mandatory treatment with unapproved drugs and vaccines
  - informed consent
  - indemnification
  - special populations

Sustaining Critical Systems and Infrastructure

Control of Population Movement and Supply Chain Networks

Supply Chain Logistics in Disaster Management

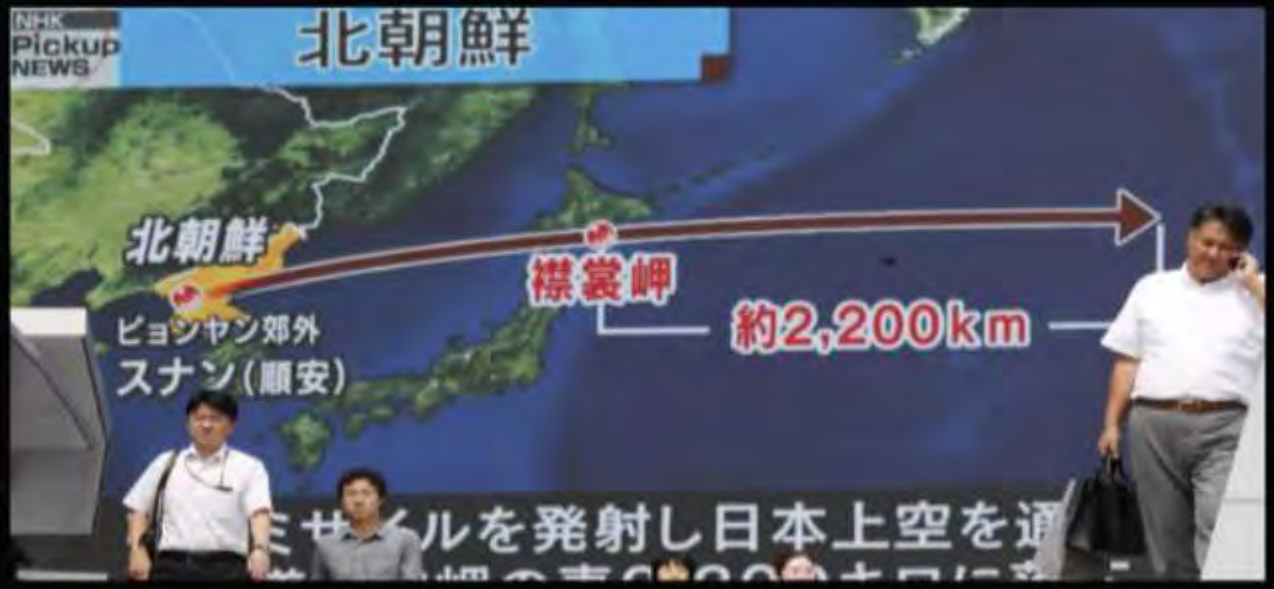
The Critical Role of Communication and Gaining Public Trust in a Major Bioincident

Managing the “Worried Well”

Timely, Authoritative and Accurate Information

False Threat Alerts and Public Panic

Hawaii, 13 January 2018



Japan, 16 January 2018

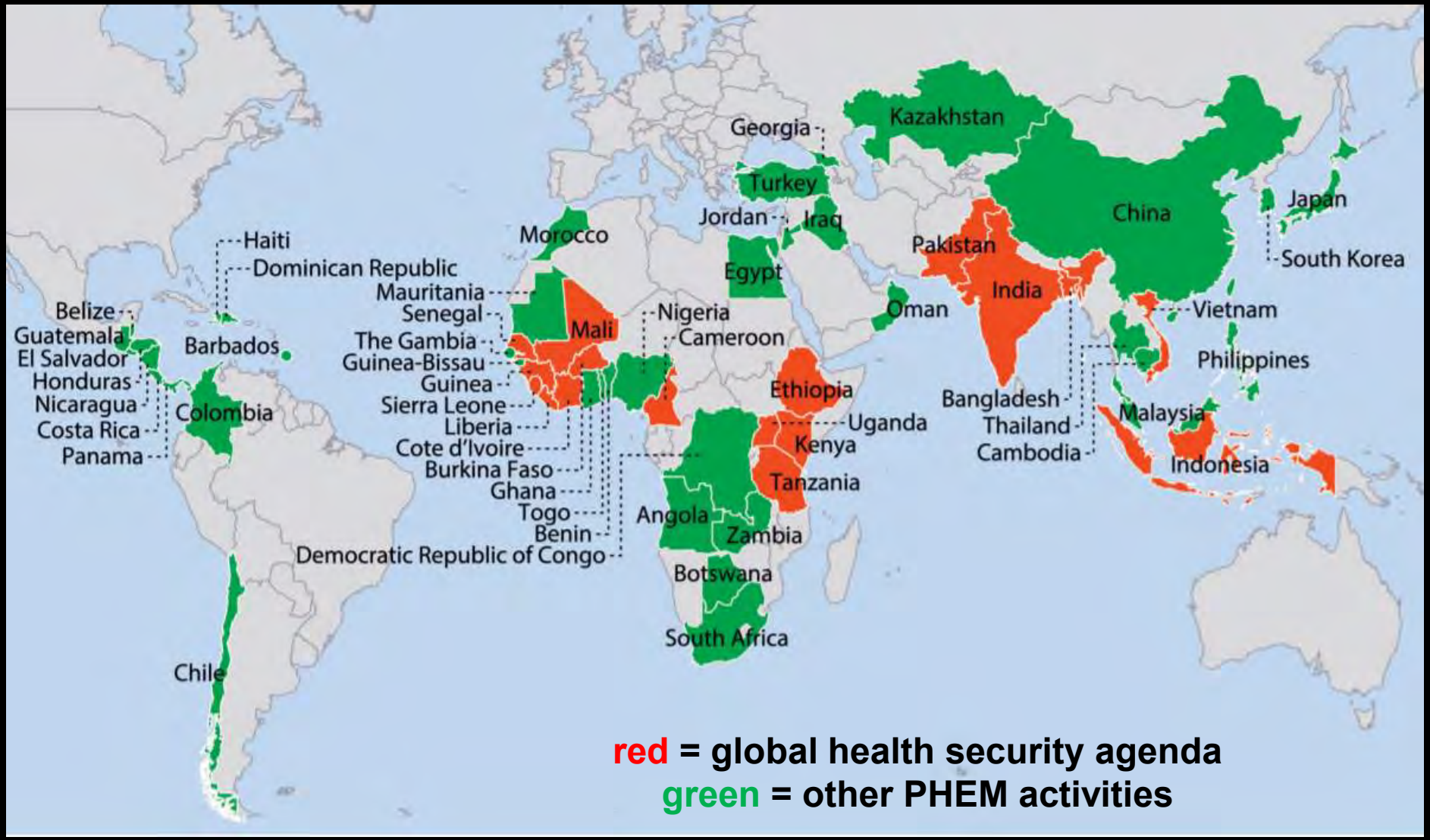
Public Awareness of Potential Risk

Political Media Sensationalism, Public Fear and Irrational Populist Decisions by Political Leadership

Informing the Public: A Critical and Unenviable Challenge

- media sensationalism and public panic
- pressure on governments to make illogical but politically expedient decisions
- in a severe outbreak the shock factor from any major level of fatalities will be unprecedented in modern peace times with unpredictable consequences for public responses
- unpredictable unilateral decisions by other governments, restricting trade, travel and shipment of goods
- extended supply chains might break down completely

CDC Engagements in Public Health Emergency Management: 2008-2016



From: D. J. Brencic et al. (2017) Emerg. Inf. Dis. 23, 5183

“Aliens Have Landed”

Fear and Distrust:
Proliferation of Myth and Misinformation

- deliberate spread by Governments
  - delay elections
  - genocidal assault on Kissi tribe
- deliberate spread by healthcare workers (HCW)
- treatment centers as organ harvesting operations for western countries
- attacks on HCW and contact tracers

Amplifying Fears and Resentment

forceful capture of individual who fled from treatment center

military enforcement of quarantine zone and public hostility

Breakdown of Civil Order and Incident Management

Constrained Mobility

Constrained Access

Containing Epidemics Without Effective Drugs or Vaccines

Notice the Resemblance?
Hygiene and Quarantine as the Only Effective Containment Absent Drugs or Vaccines

Bubonic Plague
Physician 15th Century

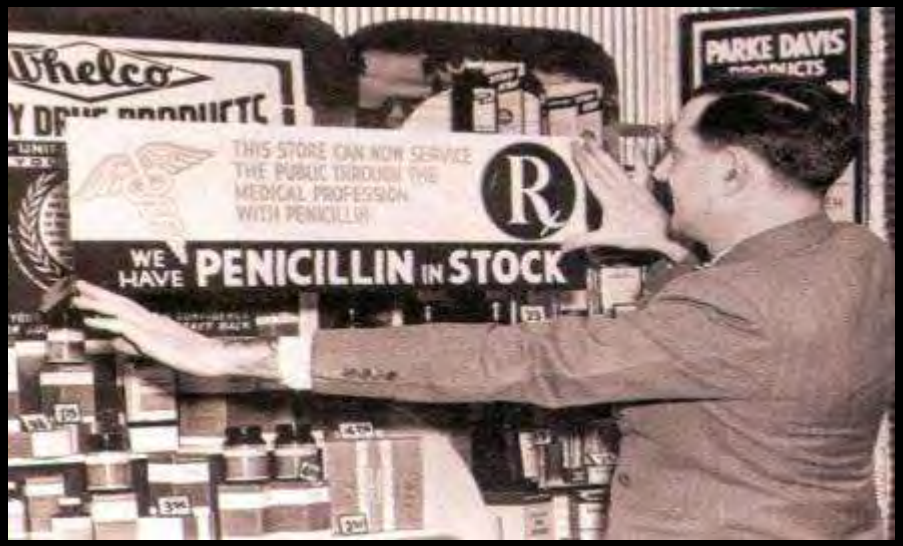
Ebola, Liberia
21st Century

Out of Sight: Out of Mind!

The Cocoon of Protection: How Quickly We Forget Past Epidemics and Their Toll

Reduced Investment in Public Health and Biosecurity: A False Economic Gain

Comfort and Complacency: The Enemies of Vigilance and Preparedness



Drug Discovery and Development: One of the Most Complex Intellectual and Logistical Exercises Undertaken by Modern Industry

- $750 million to $2 billion R&D cost/drug
- $400 million to $1 billion R&D cost/vaccine
- multi-year R&D cycles
- market incentives
  - vaccines vs. Viagra
  - antibiotics vs. alopecia
  - diseases of the developing world
  - EIDs of epi(pan)demic potential

NO ESKAPE!: Resistant Bugs and Few New Drugs

- increasing resistance in G^+ and G^- pathogens in hospital and community settings

- the **ESKAPE** pathogens
  - ***E**nterococcus faecium*
  - ***S**taphylococcus aureus*
  - ***K**lebsiella pneumoniae*
  - ***A**cinetobacter baumanii*
  - ***P**seudomonas aeruginosa*
  - ***E**nterobacter species*

Multidrug Resistant Organisms (MDROs): Growing, Spreading and Killing

These images depict a patient with septic shock and purpura fulminans caused by β-lactamase-negative ampicillin-resistant *Hemophilus influenzae*. *Images A and B*: Day 1 of hospitalization. *Image C*: Hospital day 9, in which gangrene of the bilateral limbs, the facial region, and penis progressed gradually. All the limbs were complicated with infection and eventually amputated. The patient succumbed to sepsis on hospital day 34.

http://reference.medscape.com/slideshow/multidrug-resistant-organisms-6008781?src=wnl_critimg_170616_mscpref&uac=143073MZ&impID=1368816&faf=1#6

Images from Endo A, Shiraishi A, Aiboshi J, Hayashi Y, Otomo Y. J Intensive Care. 2014;2(1):13. [Open access.] PMID: 25520829, PMCID: PMC4267704.

Safety Fears Threaten Global Dengue Vaccine Control Efforts

Responding to Agent-X

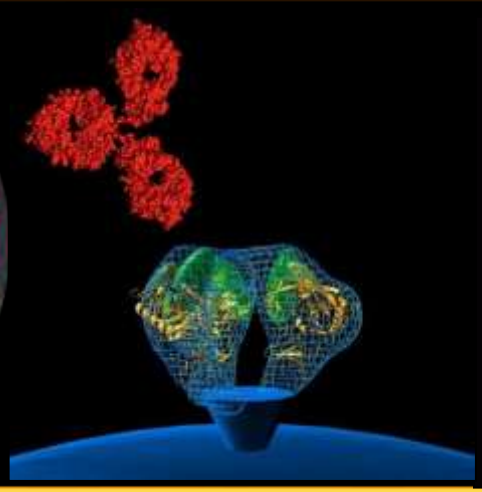
The Imperative for New Technology Approaches to Vaccine Development

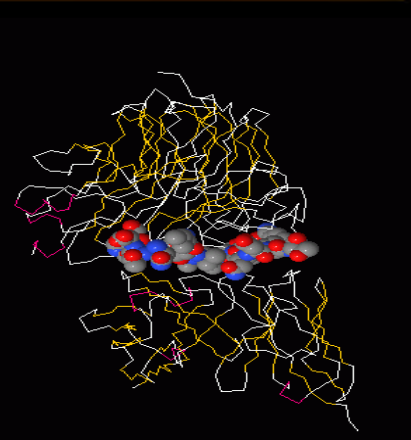
Speed: Reduce Vaccine Development Cycle from Years to Weeks

Scalability: From Millions of Doses to Billions

Combating Agent–X:
Agile Adaptive Manufacturing for Rapid Preparedness Against Novel Infectious Agents

From Pasteur to Computationally Predicted Epitopes





From Biological to Chemical Vaccines

FDA

EUROPEAN MEDICINES AGENCY

SCIENCE MEDICINES HEALTH

Who Pays for Preparedness?

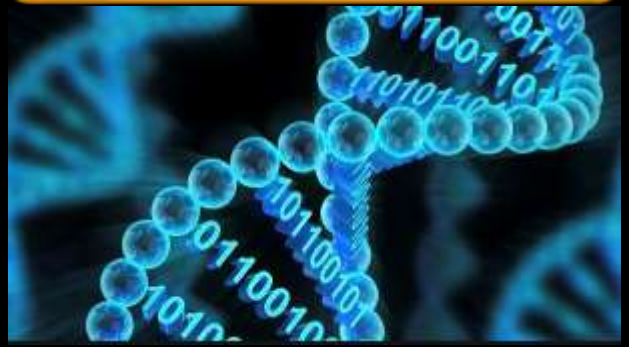
The Obligate Role of Private-Public Partnerships in Biosecurity Policy

The Coalition for Epidemic Preparedness Innovations (CEPI)

- launched at WEF, Davos, January 2017
- 200 organizations
- develop 4-6 candidate vaccines to end of Phase 2 by 2021
  - non-Zaire strains(s) of Ebola
  - Lassa Fever
  - MERS-CoV
  - Nipah
- preclinical status of candidate vaccines
  - Lassa (7), Nipah (20), MERS-CoV (8 plus 8 in Phase 1)

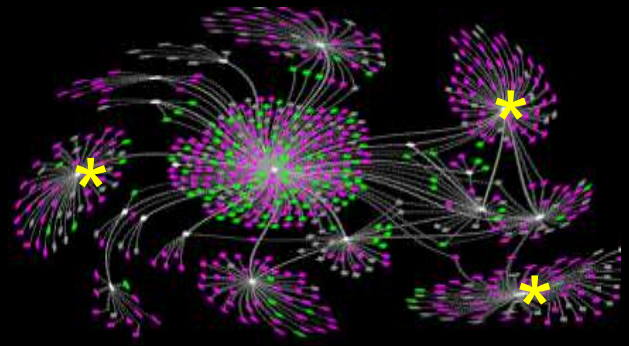
New Technologies and Increased Complexity of Dual-Use Issues in Biosecurity: Synthetic Biology, Genome Editing and Manipulation of Biological Circuits

digital biology: "it from bits"



de novo synthesis of organisms

engineered virulence



华大基因学院
BGI college
华大基因研究院
BGI research

targeted modification of any biological circuit in any organ

mapping neural circuitry and brain – machine interfaces

accelerating technological diffusion

Synthetic Biology, Genome Editing and National Security: The Ultimate Dual-Use Technology for Modification of Biological Systems?

Statement for the Record

Worldwide Threat Assessment
of the
US Intelligence Community

Senate Select Committee on Intelligence

James R. Clapper

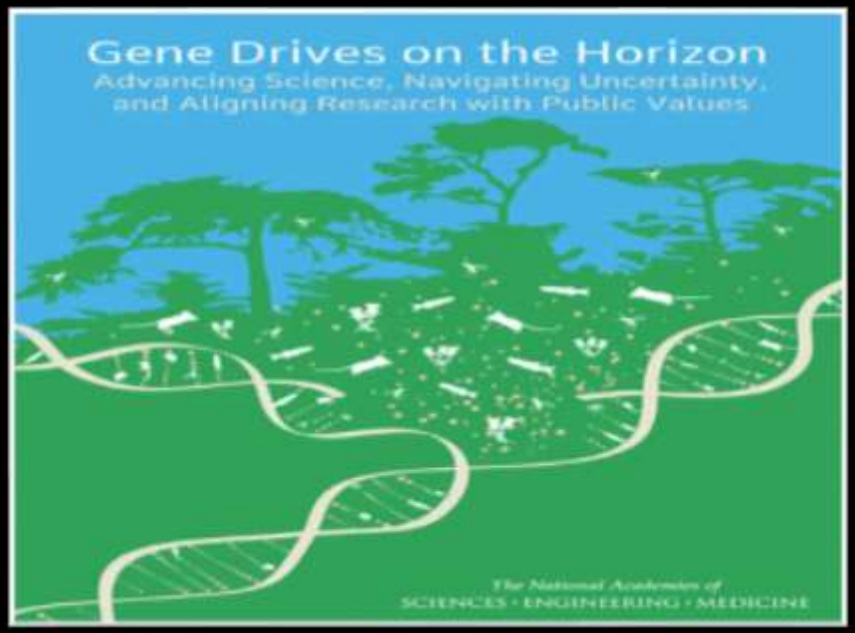
Director of National Intelligence

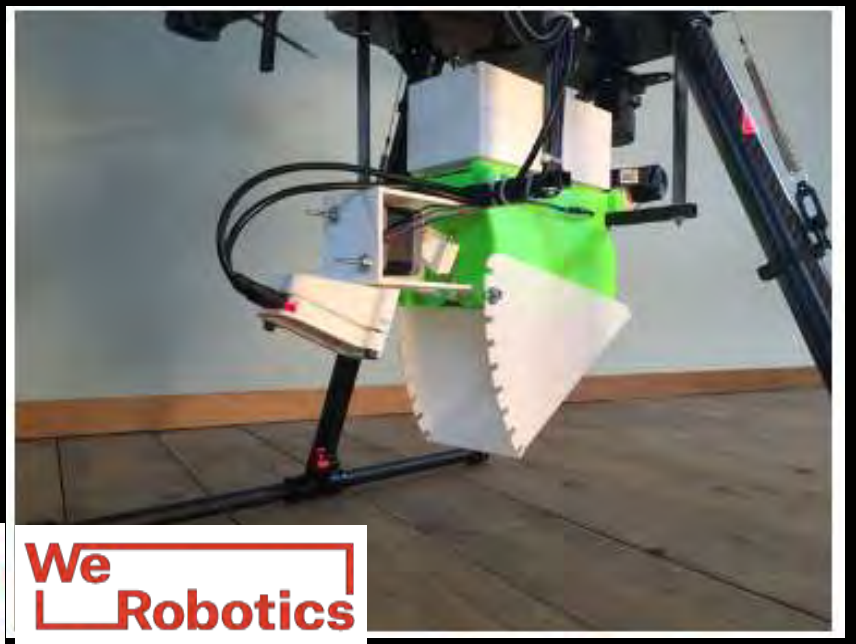
February 9, 2016

Technology Diffusion, Automation, Simplification and Cost Reduction

New Oversight Mechanisms and International Harmonization

Gene Drives and Sterilization of Mosquitoes

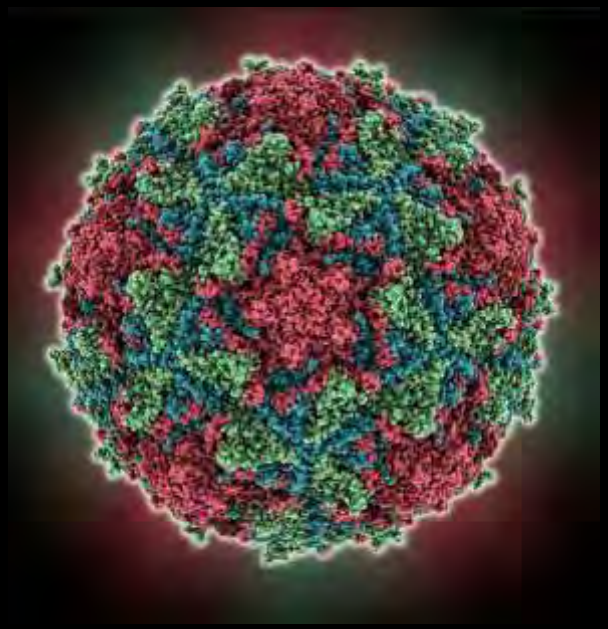




USAID
FROM THE AMERICAN PEOPLE

We Robotics

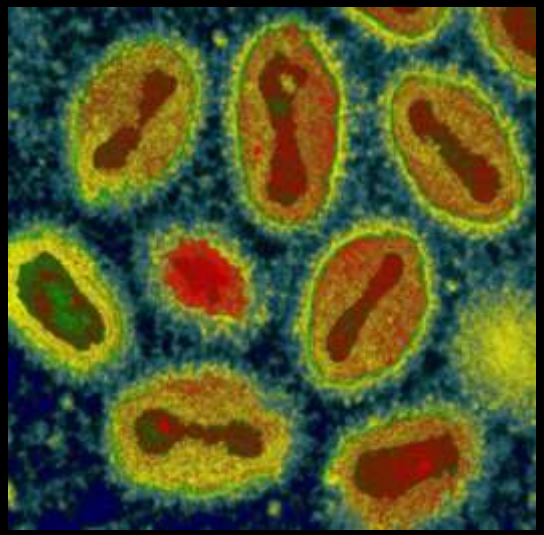
De Novo Synthesis of Pathogens



Science (2002) 297, 1016

Chemical Synthesis of Poliovirus cDNA: Generation of Infectious Virus in the Absence of Natural Template

Jeronimo Cello, Aniko V. Paul, Eckard Wimmer*



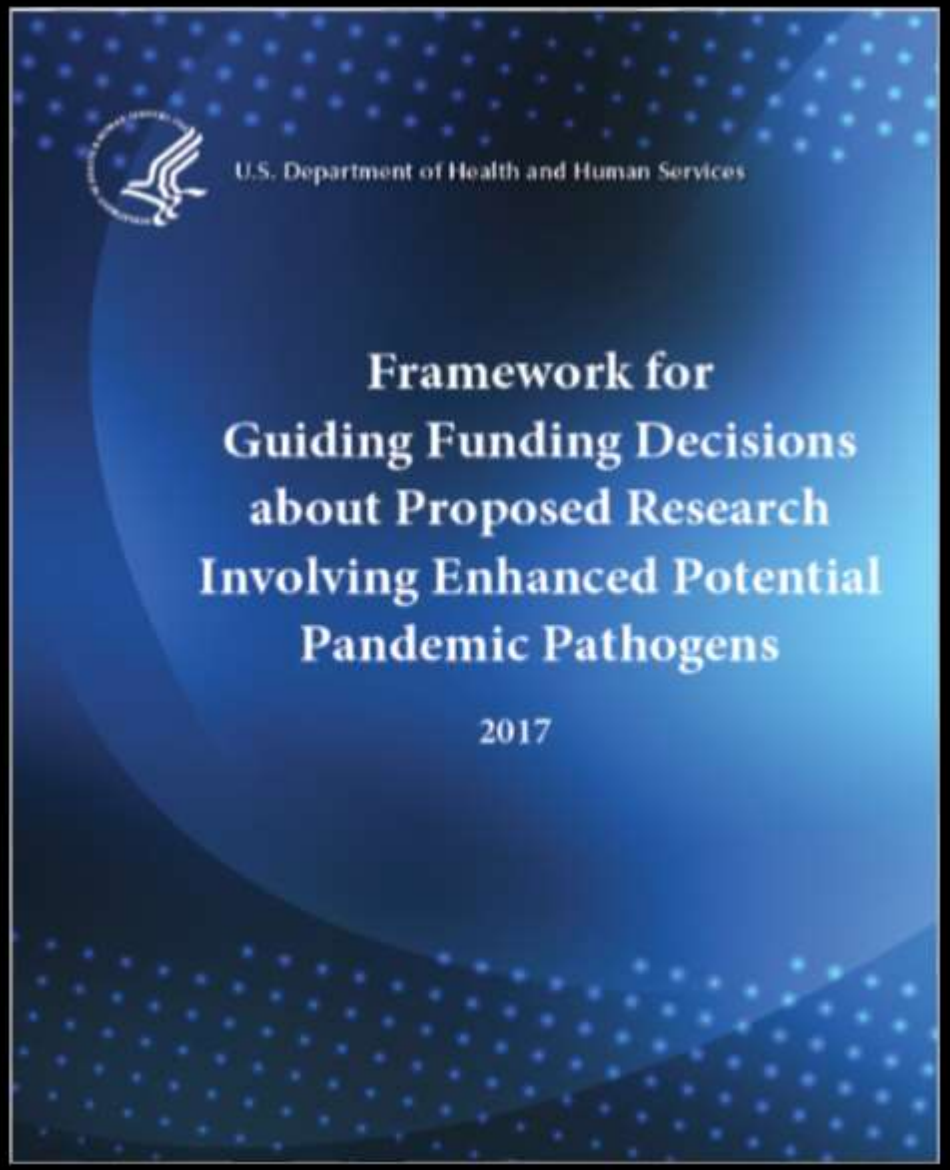
PLOS ONE https://doi.org/10.1371/journal.pone.0188453 January 19, 2018

Construction of an infectious horsepox virus vaccine from chemically synthesized DNA fragments

Ryan S. Noyce[1], Seth Lederman[2], David H. Evans[1]*

1 Department of Medical Microbiology & Immunology and Li Ka Shing Institute of Virology, University of Alberta, Edmonton, Alberta, Canada, 2 Tonix Pharmaceuticals, Inc., New York, New York, United States of America


The National Academies of
SCIENCES · ENGINEERING · MEDICINE
CONSENSUS STUDY REPORT
DUAL USE RESEARCH OF CONCERN IN THE LIFE SCIENCES
Current Issues and Controversies


U.S. Department of Health and Human Services
Framework for Guiding Funding Decisions about Proposed Research Involving Enhanced Potential Pandemic Pathogens
2017

Functional Genomic and Computational Assessment of Threats (Fun GCAT)

The Functional Genomic and Computational Assessment of Threats (Fun GCAT) program intends to develop new approaches and tools for the screening of nucleic acid sequences, and for the functional annotation and characterization of genes of concern, with the goal of preventing the accidental or intentional creation of a biological threat. Advances in biotechnology and synthetic biology over the past decade have the potential to address important societal challenges in food, energy, and medicine. Despite the promising advances these technologies might enable, the potential for their deliberate or accidental misuse exists, warranting the development of approaches to help prevent the creation of biothreats. Currently, biological threats are organized based on genetic relatedness, resulting in static, threat-based lists that fail to emphasize biological functions, or assess the risks of unknown sequences. In order to better address biosecurity concerns, the Fun GCAT program intends to develop next-generation computational and bioinformatics tools to improve DNA sequence screening, to augment biodefense capabilities through the characterization of threats based on function, and to advance our understanding of the relative risks posed by unknown nucleic acid sequences. These tools will enhance the ability to computationally and functionally analyze nucleic acid sequences, ascribe threat potential to known and unknown genes through comparisons to the functions of known threats, and facilitate the ability to screen and identify sequences of concern, including genes responsible for the pathogenesis and virulence of viral threats, bacterial threats, and toxins.

Program Manager

John Julias

Program Information

IARPA-BAA-16-08

Research Area(s)

- Bioinformatics
- DNA sequence screening
- Functional genomics
- Systems biology
- Infectious disease
- Synthetic biology

Related Publications

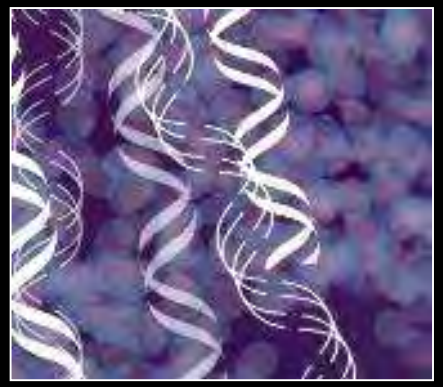
To access Fun GCAT program-related publications, please visit Google Scholar.

Related Article(s)

UMIACS Partners with Fraunhofer, Signature Science on DNA Screening Technologies

Intelligence Agency Wants to Keep 'Novel Organisms' From Threatening Humans

The Expanded Dimension of the 'Bio' Challenge



- thinking beyond 'bio' as just infectious agents
- systems biology
  - targeted disruption of ANY body function
  - novel C and B threats
- synthetic biology
  - exploring biospace: designing new life forms
  - designer organisms to attack materials/infrastructure

Munich Security Conference 2017

MEDECINS SANS FRONTIERES

"Is global health intended to improve population to health, or to be a diplomatic tool for countries to exert their soft power?

The securitization of global health is little more than fear mongering. …..(and) justifies government violations of human rights in the name of health."

Andre Heller Perache
Head of Programmes, MSF
cited in Lancet 2017 389, 892

Biosecurity

one health:
humans
animals
ecosystems

urbanization
and
environmental
impacts on
disease
emergence

economic
and
political
instabilities
and
escalating
conflict risk

bioterrorism
dual use
technologies
and expanded
threat spectrum

**International Engagement,
Commitment and Political Resolve**

Escalating Biosecurity Risks

Can No Longer Be Relegated to the
'Too Hard' Class of Strategic Challenges

Lack of Preparedness, Inadequate Institutions and Strategic Policy for Robust Domestic and Global Engagement in Addressing the Biosecurity Challenge

Preparing for the Long Game/the Long Emergency

Governing Frameworks for Global Health Security

1851 to 1938

- 14 conferences
- International Sanitary Convention (ISC) (1892)
  - cholera, plague, yellow fever
- influential in formation of WHO (1948)

World Health Organization

1951

- International Sanitary Regulations

1969

- renamed International Health Regulations

2005

- International Sanitary Regulations

2014

- only 64 states met core capacities
- 48 failed to even provide information to WHO

Global Health Security Agenda

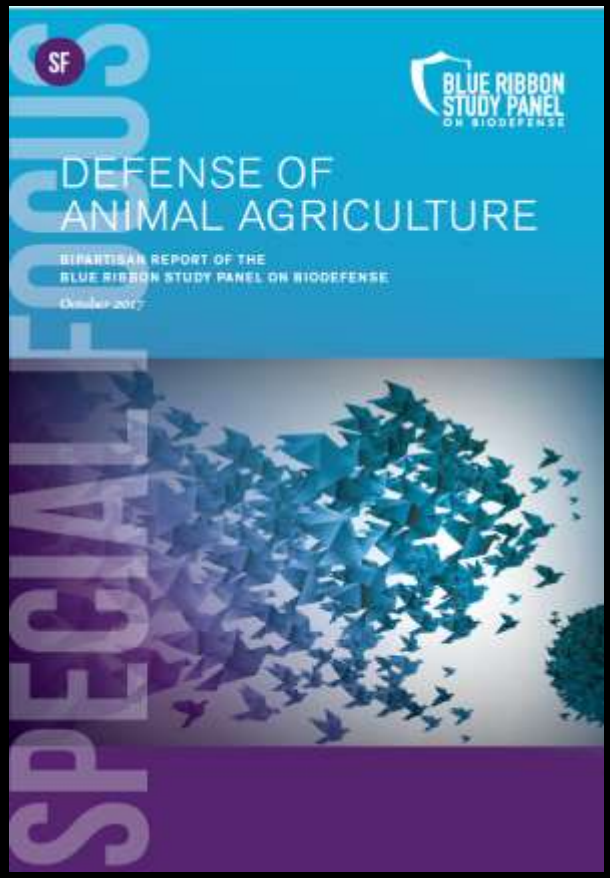
2017

- G7 Global Health Security Agenda and strategy for prioritized international support to ‘hot zone’ regions

- launched February 2014
- partnership of 64 nations, international organizations, NGOs
- elevate global health security as a national and global priority
- strengthen global capacity to prevent, detect and respond to infectious diseases
- WHO Joint External Evaluation to assess national capacities


A NATIONAL BLUEPRINT FOR BIODEFENSE:
LEADERSHIP AND MAJOR REFORM NEEDED TO OPTIMIZE EFFORTS
BIPARTISAN REPORT OF THE BLUE RIBBON STUDY PANEL ON BIODEFENSE
Institutional Sponsors:
Hudson Institute


BIODEFENSE INDICATORS
BLUE RIBBON STUDY PANEL ON BIODEFENSE
ONE YEAR LATER: EVENTS OUTPACING FEDERAL EFFORTS TO DEFEND THE NATION
A Bipartisan Report of the Blue Ribbon Study Panel on Biodefense
December 2016
Hudson Institute


SF
SPECIAL FOCUS
BLUE RIBBON STUDY PANEL ON BIODEFENSE
DEFENSE OF ANIMAL AGRICULTURE
BIPARTISAN REPORT OF THE BLUE RIBBON STUDY PANEL ON BIODEFENSE
October 2017

The Curse of Contemporary Governance: 'Quick Fixes' and the Retreat from Complexity

- society increasingly "cocooned" from complexity and risk
- pervasive and dangerous scientific illiteracy among legislative and policy makers about biosecurity
- "quick fixes": unidimensional, short term policies that do not address long term, multidimensional complexity
- public policy defined increasingly by length of legislative terms
- influence of media in shaping public policy priorities and potential compromise of operational preparedness and incident management

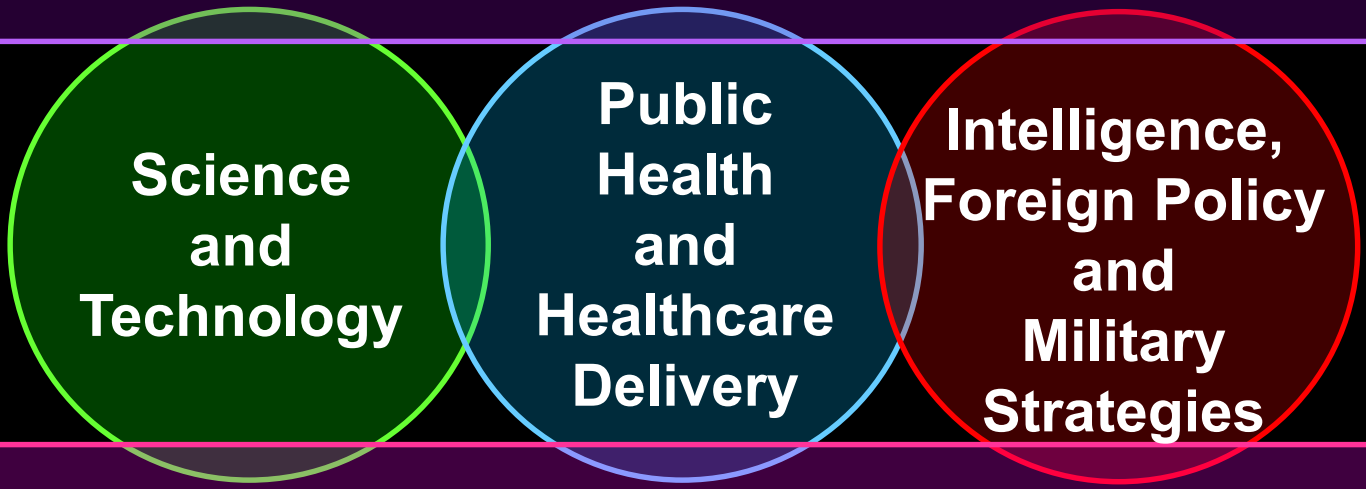
Building Robust Defenses for Biosecurity

- governments must accord higher priority to ‘biosecurity’ as a integral component of national security and foreign policy

- (re)building a national and international infrastructure for the surveillance, diagnosis and containment of infectious diseases is fundamental to future protection against major instabilities triggered by infectious agents, whether of natural or malevolent origins

Biosecurity:
A Classic Complex System of Systems Challenge

- global perspectives
- biological, socio-economic, and political ecosystems



- societal priorities and cost of biosecurity
- proactive preparedness
- conflicting political ideologies, intents and capabilities

“Politics is the art of the possible,
the calculated science of survival”

Prince Otto von Bismarck

“Survival owes little to the art of politics,
but everything to the calculated application
of science”.

Professor Rudolph Virchow
(in reply)

Slides Available @ http://casi.asu.edu/