Biosecurity:
Enhancing Security in an Increasingly Unsecure World

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Guest Lecture
Biology and Society: Bio 311/HPS 340
Arizona State University
30 September 2014

Biosecurity and Global Health: Understanding the Implications of Major Economic Disparities and Environmental Dislocations











Seeking Security in an Unsecure World: The Military and National Security Calculus

Expanding Conflict Zones, Political Instabilities and Terrorism

WMD Proliferation

New Power Centers

US Retrenchment: Geopolitical/Fiscal

The VUCA World

- **V**olatility
- **U**ncertainty
- **C**omplexity
- **A**mbiguity

The Biosecurity Triad

Infectious Diseases of Natural Origin

Urbanization, Environmental and Ecological Impacts on Disease Emergence

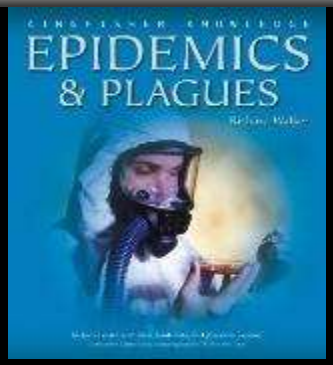
Bioterrorism and Dual-Use Technologies

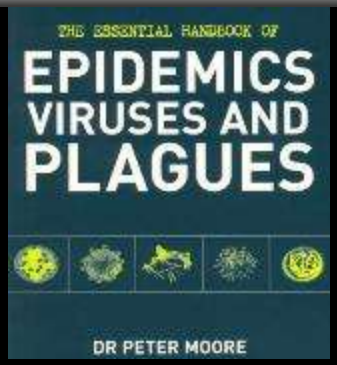
The Multi-Dimensional Complexity of Biosecurity

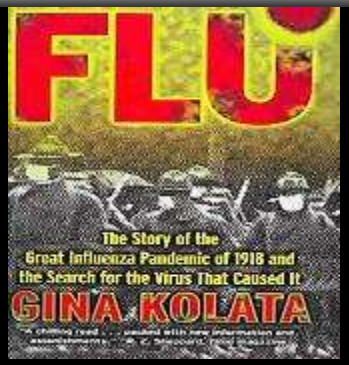
- host-pathogen interactions
- ecosystem shifts and new host-pathogen interactions
- human health, animal and plant health, ecosystem health
- trade and transport: every local incident is a potential global threat
- poverty, illiteracy and inadequate biosurveillance and public health systems in DCs
- out of sight and out of mind: complacency and neglect of Western public health systems for infection control
- conflicts and terrorism: from accelerated spread of natural disease to bioterrorism

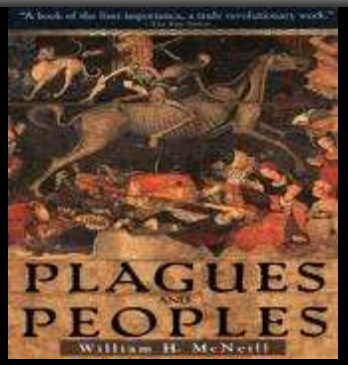
Preparedness:
The “All Hazards” Challenge
and
Building Resilient Systems

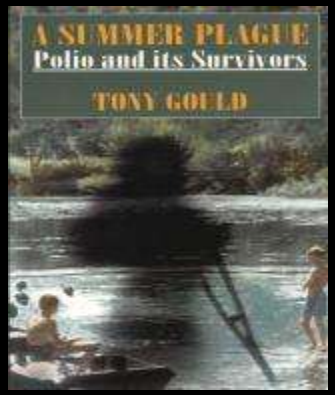
Infectious Disease: A Powerful Force in Human Evolution

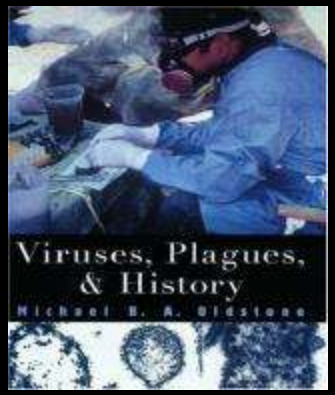


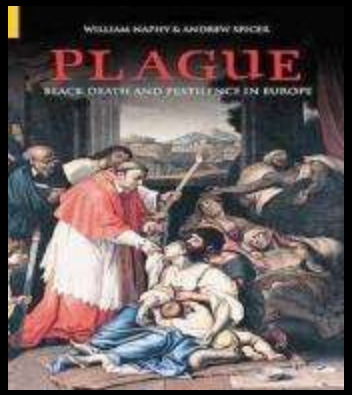


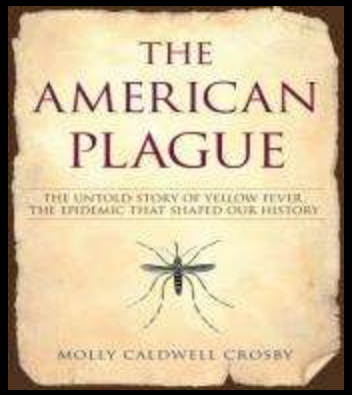


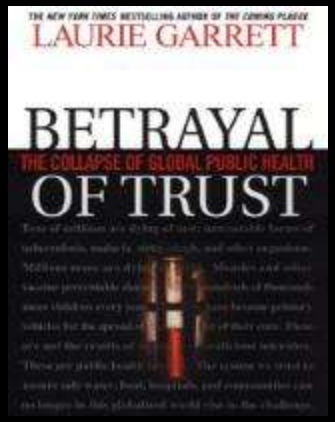


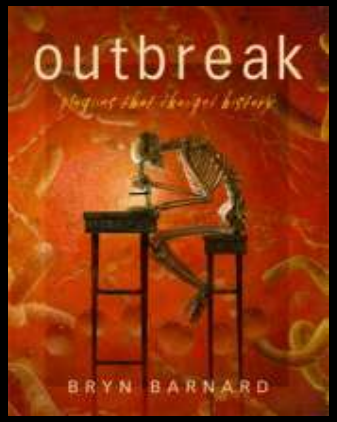


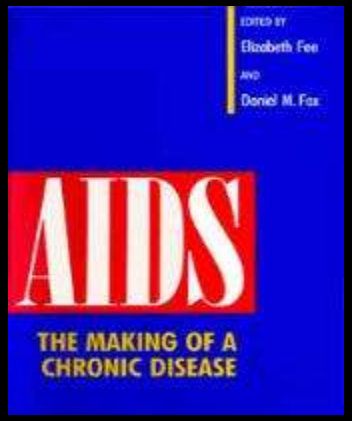


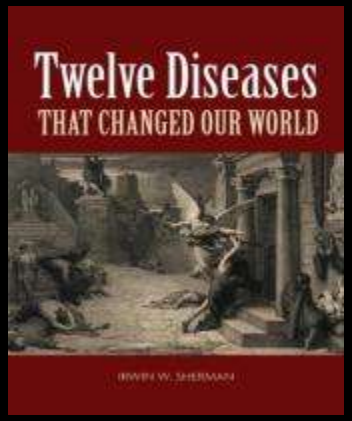




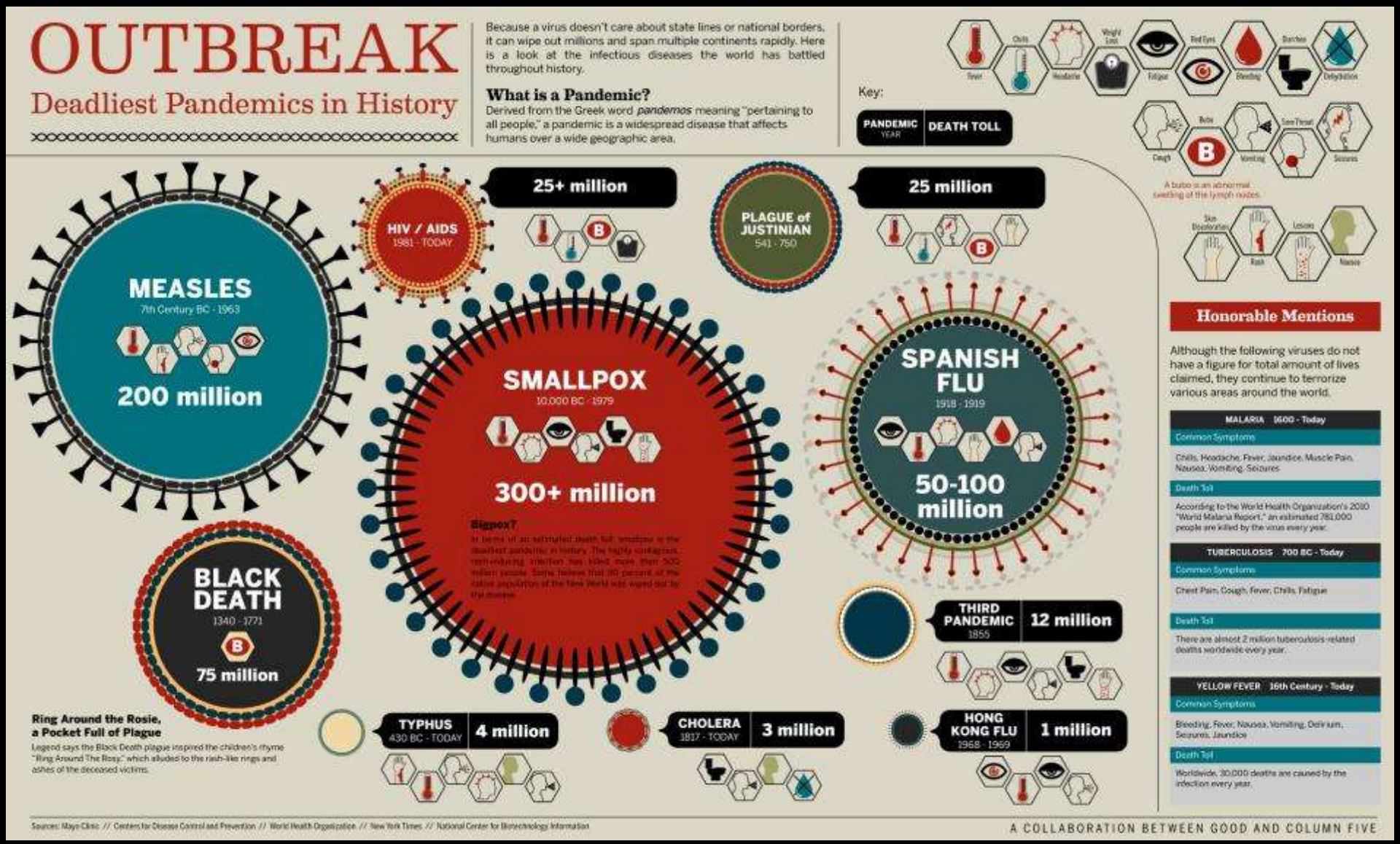








OUTBREAK: Deadliest Pandemics in History



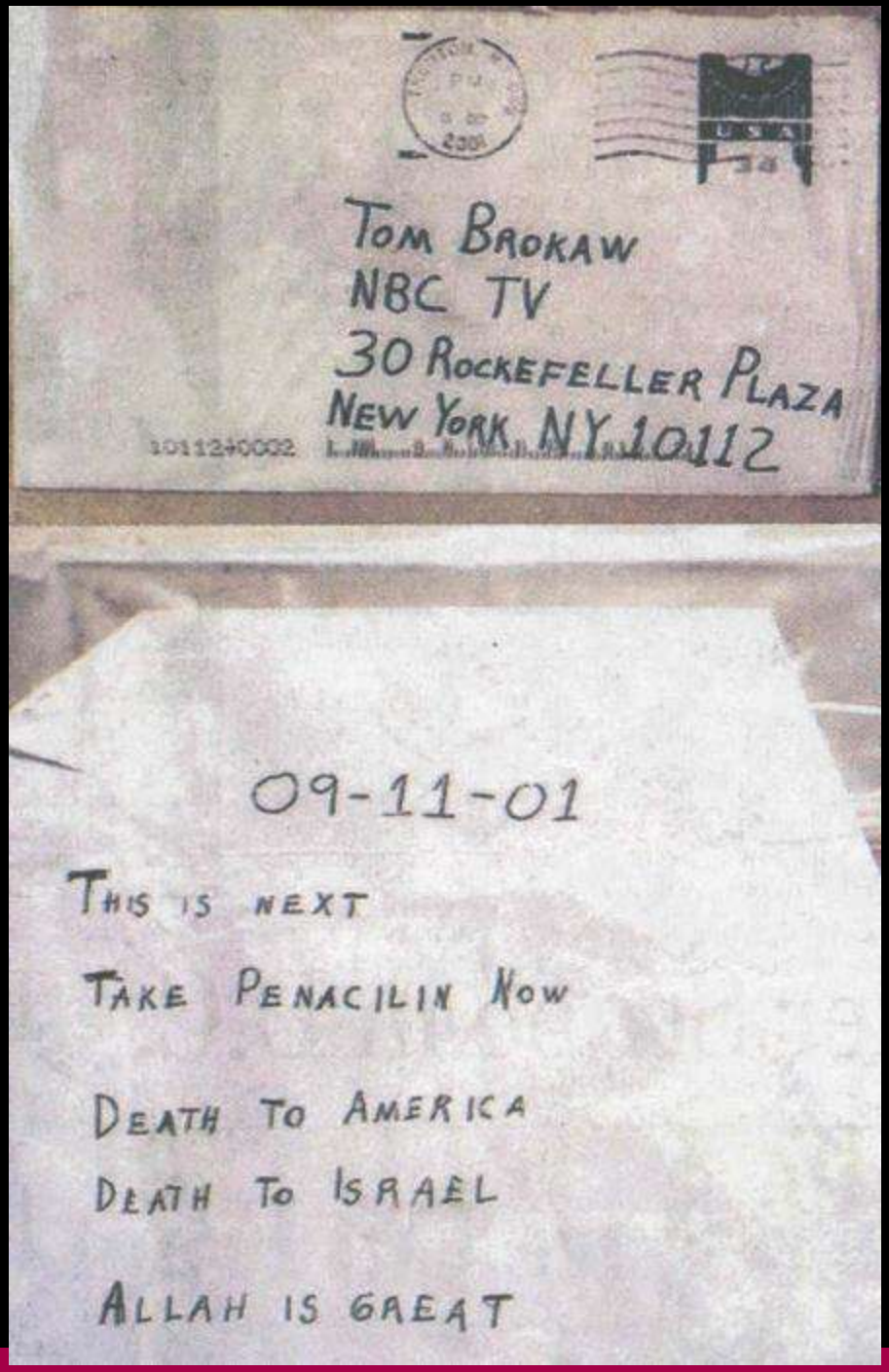
The Major Infectious Disease Pathogens

Today

- malaria
- TB
- HIV/AIDs
- cholera
- enteric diarrhea pathogens
- Leishmaniasis

EIDs of Concern

- pandemic (avian) influenza
- dengue
- chikungunya
- engineered agents (bioterrorism)
- antibiotic resistance and HAI



"I will show you fear in a handful of dust"
T.S. Elliot

The FSU Covert Biopreparat Program in Violation of 1972 BWC

Asymmetric Warfare and The Appeal of CBW to Extremists

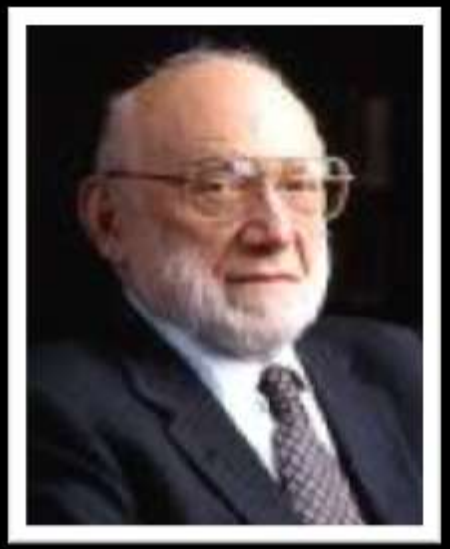
Synthetic Biology and the Potential of Dual-Risk Research and Bioterrorism

Delusion and Reality

"It is time to close the book in infectious diseases and declare the war against pestilence won"

U.S. General William H. Stewart (1966)

Source: http://www.lhncbc.nlm.nih.gov/apdb/phsHistory/faqs.html



"The future of humanity and microbes will likely evolve as episodes of our wits versus their genes"

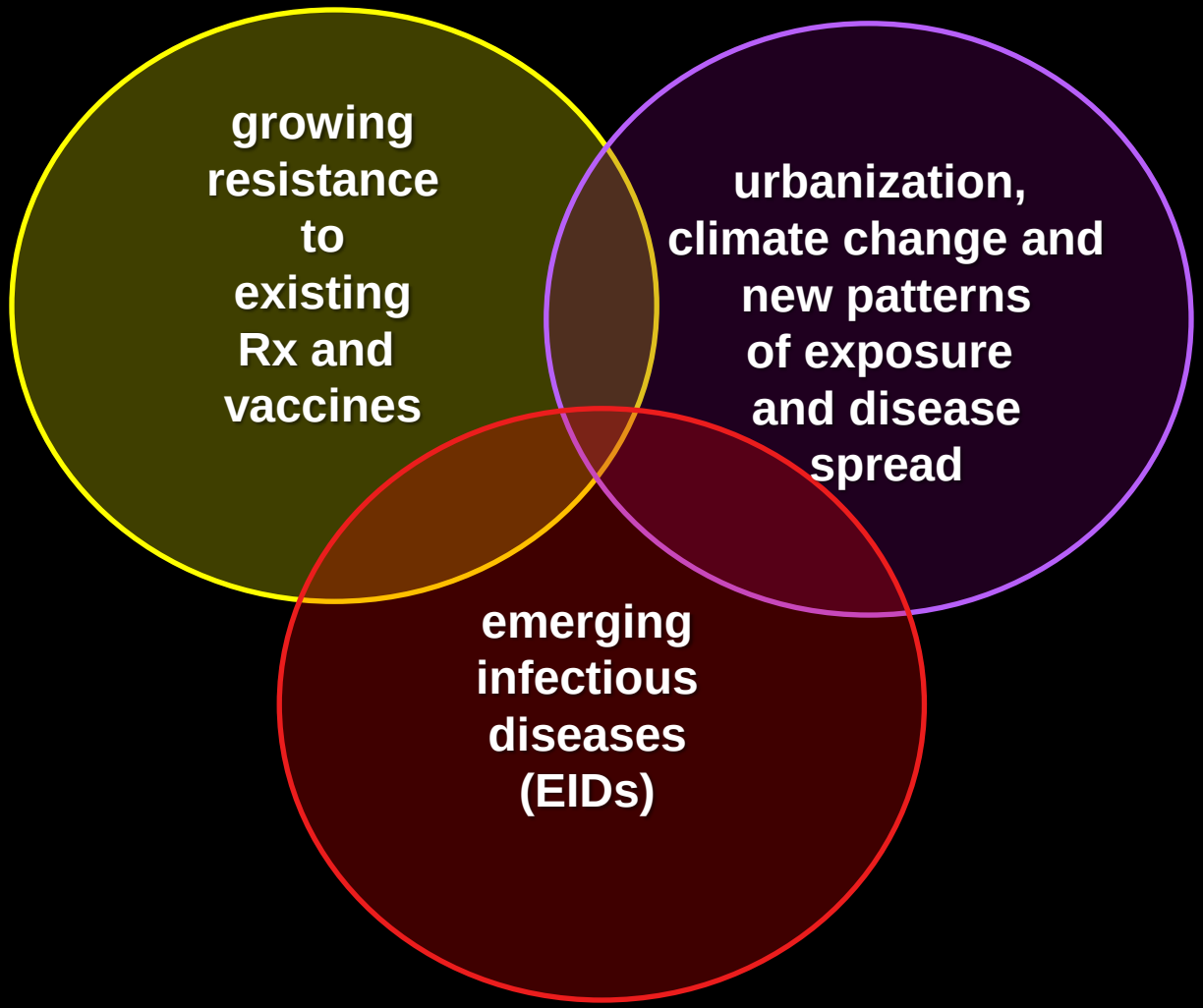
Dr. Joshua Lederberg,
Nobel Laureate
Science (2000) 6, 427-30

The Relentless Challenge of Natural Infectious (and Parasitic) Diseases

The Constantly Changing Dynamics of Global Infectious Diseases

Host-Pathogen Interactions as Classical Example of Evolutionary Dynamics (variation, adaption, selection)

Outpacing Infectious Diseases



The Ever Shifting Dimension of EIDs

West Nile Virus, New York 2001

Monkeypox, USA May-June 2003

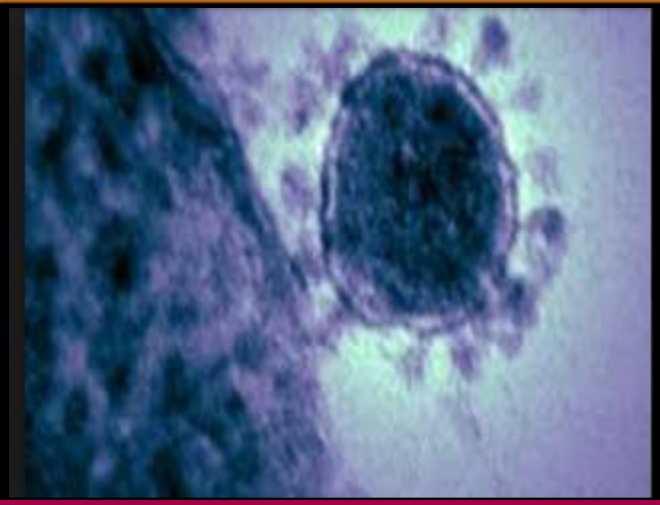
West Nile Virus, Dallas, TX 2012

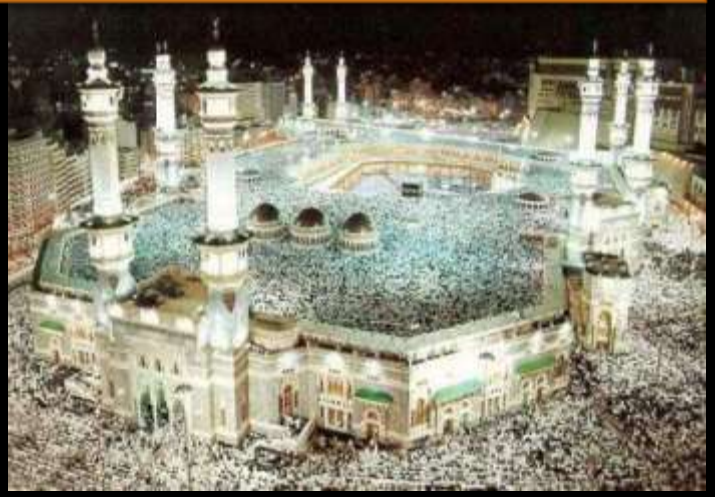
African Swine Fever, Russia 2012

Human Coronaviruses

Emergence of SARS-CoV (PRC 2003)

Emergence of MERS-CoV (KSA 2012)





Pandemic Influenza: Still the Largest EID Threat?

- H1N1: high transmissibility - low virulence/mortality
- H5N1: low transmissibility – high virulence/mortality
- H5N1 x (H1N1) or (X): potential for devastating pandemic

Understanding Animal to Human Transmission

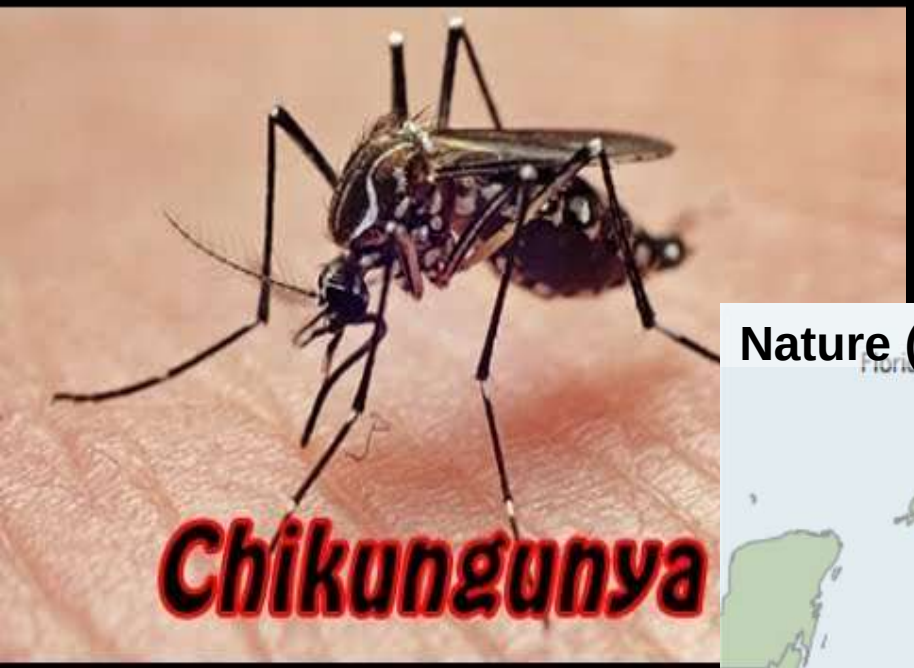
The Shifting Geographic Range of Pathogens and Their Vectors

Global Trade and Travel

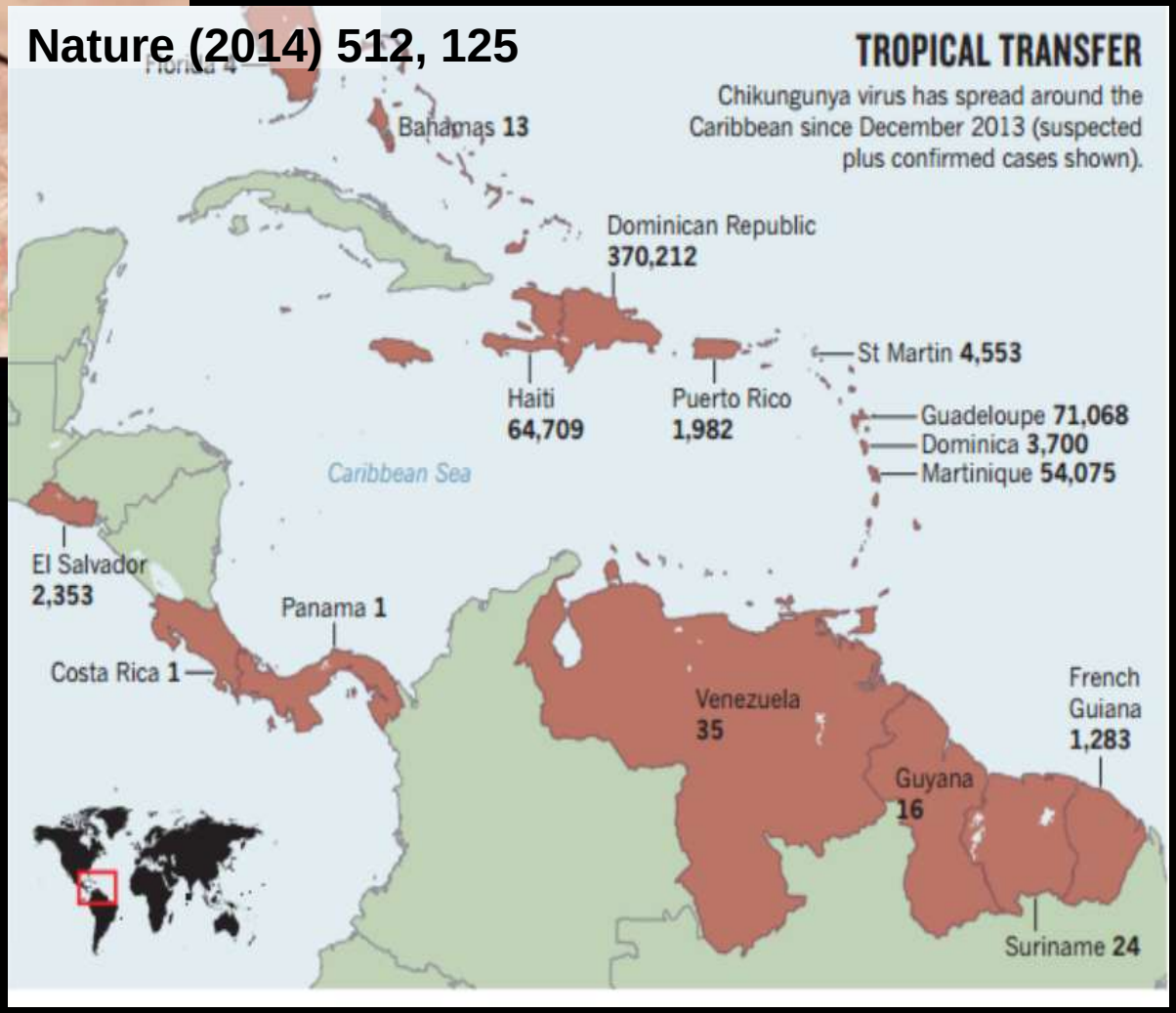
Ecosystem and Climate-Shifts

The Most Lethal Animal Species (Except Humans): Major Mosquito Classes for Vector-Borne Disease

Anopheles gambiae	Aedes albopictus	Culex pipiens
		



Nature (2014) 512, 125



Common Features of Urban Epidemic Transmission of Dengue and Chikungunya Viruses

- same vectors: *Aedes aegypti* and *Ae.albopictus*
- anthroponosis: does not require a non-human amplifier host
- estimated 3.6 billion people in 124 countries now at risk
- no vaccines or therapies
- public health focus on vector control
- potential need to initiate screening of US blood supply (cf. HIV, Hep. C)

No Shortage of Vectors for Infectious and Parasitic Diseases

Aedes aegypti

Aedes albopictus

Culex pipiens

Sand Flies (Psychodidae)

Triatominae Bugs

Ixodes Ticks

Will Citrus Greening Eliminate the Florida Citrus Industry?

- transmission of *Candidatus liberibacter* by Psyllid insects
- $4.6 billion cost and loss of 6000 jobs since 2006

The Global Public Health Challenge Posed by Rapid Urbanization in Developing Countries

High Disease Transmission

Lack of Safe Water

Bush Meat Food Chain

Major Deficits in Health Infrastructure

Expanded Eco-niches and Increased Zoonotic Risks

Fruit Bats: Growing Recognition as Reservoir for Novel Zoonoses: SARS, MERS, Hendra, Nipah and Ebola


Nouakchott
MAURITANIA
Rosso
Senegal
Kaédi
'Ayoûn el 'Atroûs
Néma
Tombouctou
Gao
Saint-Louis
Thiès
Dakar
Diourbel
Kaolack
SENEGAL
Kayes
MALI
Tambacounda
Gambia
GAMBIA
Banjul
Ziguinchor
Bissau
GUINEA-BISSAU
Bamako
Niger
BURKINA FASO
Ouagadougou
Sikasso
Bobo-Dioulasso
Dabola
Boke
GUINEA
Kindia
Kankan
Conakry
Korhogo
Tamale
Volta
Sokode
TOGO
BENIN
Djougou
Parakou
Savalou
Abuja
NIGERIA
Kaduna
Gombe
Benue
Tahoua
NIGER
Niamey
Dosso
Zinder
Maradi
Diffa
CHAD
Lake Chad
Birnin Kebbi
Kano
Maiduguri
Potiskum
SIERRA LEONE
Freetown
Bo
Bonthe
CÔTE D'IVOIRE
Bouaké
Lac de Kossou
Lake Volta
GHANA
Kumasi
Ogbomosho
Oshogbo
Ibadan
Ngaoundéré
LIBERIA
Yamoussoukro
Monrovia
Buchanan
Gagnoa
Agboville
Koforidua
Accra
Lomé
Porto-Novo
Lagos
Benin City
Enugu
Bight of Benin
Niger
Bandama
Sassandra
Abidjan
Takoradi
Cape Palmas
Cape Three Points
Port Harcout
Calabar
CAMEROON
Douala
Yaoundé
Malabo
Bight of Biafra
EQUATORIAL GUINEA
Campo
GABON
CONGO
SAO TOME AND PRINCIPE
ATLANTIC OCEAN
Gulf of Guinea
0 100 200 300 400 500 km
0 100 200 300 mi
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

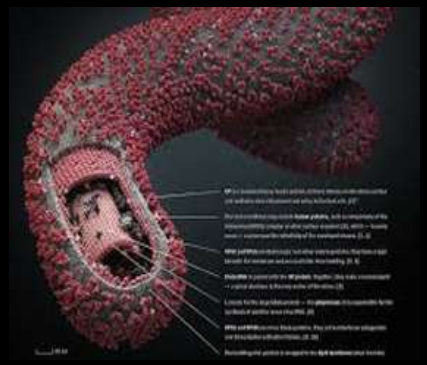

AMBULANCE


FACE MASK

Ebola Virus Disease: West Africa 2014

- first outbreak outside East and Central Africa
- simultaneous spread across multiple borders
- fragile health systems ill-equipped to implement surveillance and containment measures
- mistrust and violence against healthcare workers
- mistrust exacerbated by military enforcement of quarantine zones
- orphans, food shortages
- 28 million children already orphaned in region due to conflict and HIV/AIDS

Denial, Fear and “Shadow Zones”: Ebola Virus Epidemic W. Africa 2014



- many of the few available treatment centers and clinics closed
- shortage of biohazard control materials
- families hide stricken individuals
- corpses buried in rural villages without adequate containment
- health workers attacked as perceived Ebola carriers
- community resistance, lack of personnel and vehicles hinder both investigation and containment in the “shadow zones”

Death in Ebola Healthcare Workers

Science Express (28 August 2014)

Genomic surveillance elucidates Ebola virus origin and transmission during the 2014 outbreak

Stephen K. Gire,[1,2*] Augustine Goba,[3*†] Kristian G. Andersen,[1,2*†] Rachel S. G. Sealfon,[2,4*] Daniel J. Park,[2*] Lansana Kanneh,[3] Simbirie Jalloh,[3] Mambu Momoh,[3,5] Mohamed Fullah,[3,5‡] Gytis Dudas,[6] Shirlee Wohl,[1,2,7] Lina M. Moses,[8] Nathan L. Yozwiak,[1,2] Sarah Winnicki,[1,2] Christian B. Matranga,[2] Christine M. Malboeuf,[2] James Qu,[2] Adrianne D. Gladden,[2] Stephen F. Schaffner,[1,2] Xiao Yang,[2] Pan-Pan Jiang,[1,2] Mahan Nekoui,[1,2] Andres Colubri,[1] Moinya Ruth Coomber,[3] Mbalu Fonnie,[3‡] Alex Moigboi,[3‡] Michael Gbakie,[3] Fatima K. Kamara,[3] Veronica Tucker,[3] Edwin Konuwa,[3] Sidiki Saffa,[3] Josephine Sellu,[3] Abdul Azziz Jalloh,[3] Alice Kovoma,[3‡] James Koninga,[3] Ibrahim Mustapha,[3] Kandeh Kargbo,[3] Momoh Foday,[3] Mohamed Yillah,[3] Franklyn Kanneh,[3] Willie Robert,[3] James L. B. Massally,[3] Sinéad B. Chapman,[2] James Bochicchio,[2] Cheryl Murphy,[2] Chad Nusbaum,[2] Sarah Young,[2] Bruce W. Birren,[2] Donald S. Grant,[3] John S. Scheiffelin,[8] Eric S. Lander,[2,7,9] Christian Happi,[10] Sahr M. Gevao,[11] Andreas Gnirke,[2§] Andrew Rambaut,[6,12,13§] Robert F. Garry,[8§] S. Humarr Khan,[3‡§] Pardis C. Sabeti[1,2†§]

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‡Deceased.

§These authors jointly supervised this work.

The five co-authors of a *Science* study who contracted Ebola and died.

Ebola in West Africa (2014)

- traditional cultural beliefs in shamanic medicine
- fear of sending loved ones to treatment centers to die alone
- rumors and hostility to role of health workers (particularly westerners) in disease spread
- denials about existence and cause of infection

Ebola in West Africa (2014)
Superstition, Suspicion and Fear

- Shaman's claim of plague created when a white snake was killed but all could be cured by sacrificing seven cows
- myth created by President Condé to delay pending elections
- President Condé introduced the virus to kill the Kissi tribe
- white foreigners in yellow space suits had brought the disease
- yellow suited aliens at the treatment clinics were harvesting organs and limbs

Aliens in Our Midst!

Health workers in Liberia Push an Ebola Patient Who Escaped from Quarantine Into an Ambulance

Reuters Sept. 18, 2014

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

Bubonic Plague
Physician 15th Century

Ebola, Liberia
21st Century

The Vital Importance of Biosurveillance

Early Detection Saves Lives!

Ebola in West Africa (2013-2014)

- patient zero: a child's death in the jungle (Meliandou, Guinea, Dec. 2013)
- last known outbreaks more than 2000 miles away
  - Uganda and DRC in 2012
- January 2014
  - more Meliandou deaths but spread to Gueckedon by member of patient zero
  - Gueckedon major trading post with Liberia and Sierra Leone
  - Doctor from Gueckedon dies but body shipped to Kissdougon for funeral (town of 100,000 people)

Ebola in West Africa (2014)

- Guinea, Sierra Leone and Liberia have world's highest incidence of Lassa Fever
- 3.5 months into the epidemic no one suspected Ebola
- February 2014 suspicion discounted when 9 patients had positive malaria test

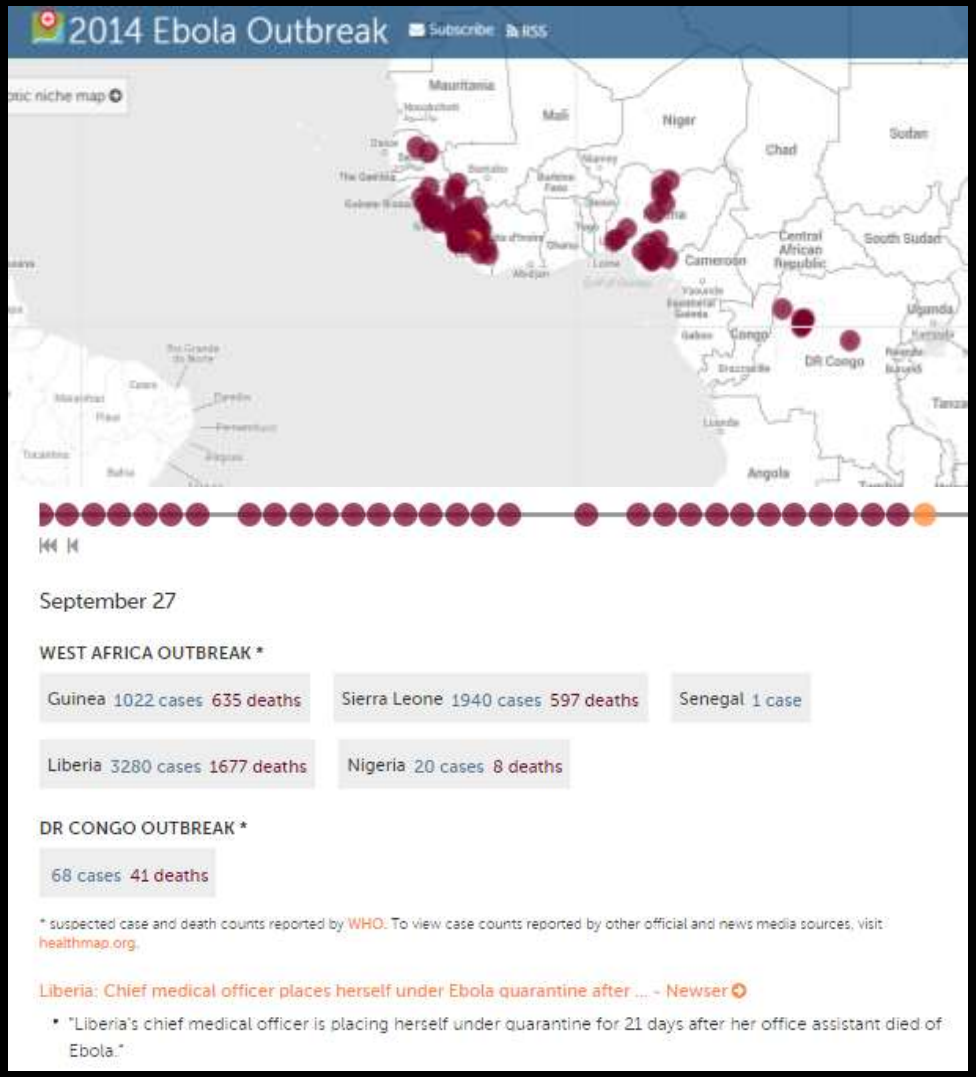
Ebola in West Africa (2014)

- for reasons unknown hiccups are feature of Ebola
  - Medecins sans Frontiéres physician in Geneva sensed the clue in March 2014
- blood sample flown to Institut Pasteur March 20 tested positive for Ebola

Ebola in West Africa (2014)

- early May 2014 number of cases declined dramatically and Guinea MoH reported no cases in mid-May
- President of Guinea announced ‘worst is over’
- CDC team cycled out back to Atlanta
- May 27-June 2 new cases arriving at the main treatment center in Conakry from hundreds of miles away
- spread to Sierra Leone, Liberia and Nigeria (Senegal)
- August 2014 WHO declares ‘public health, emergency of international concern’

Predicting (Modeling) the Scale of the Epidemic



Ebola cases could reach 1.4 million in 4 months, CDC estimates

Ebola in West Africa
Declaration of International Health Emergency
August 2014

- reverse case numbers within 3 months
- stop transmission in cities and major ports
- stop all transmission within 6-9 months
- stop all transmission with 8 weeks of an index case in any affected new countries
- invoke IHR to prevent international spread
  - exit screening at airports, seaports and major land crossing
  - SOP for travelers arriving overseas from ‘hot zone’ with unexplained febrile illness

The Logistical Complexity of Large Scale Disinfection and Decontamination

How do you go from decontaminating a few ambulatory, protected responders…

…to hundreds of incapacitated, unprotected civilians?

Operation United Assistance: Announced 16 Sept. 2014

- $750 million
- deploy up to 3000 US military personnel under US Africa Command
- build Ebola treatment centers
- recruit and train medical personnel and healthcare workers

Ebola in West Africa (2014):

- poverty, illiteracy and dysfunctional health services
- impact of decades of war and political corruption
- domestic problems compounded by delayed international mobilization
- reinforces vital role of biosurveillance
- no therapy or vaccines
- dependence on isolation and quarantine
- dislocation of fragile agriculture and future threat to food supply
- long-term adverse economic, social and political impacts

Ebola Containment Challenges

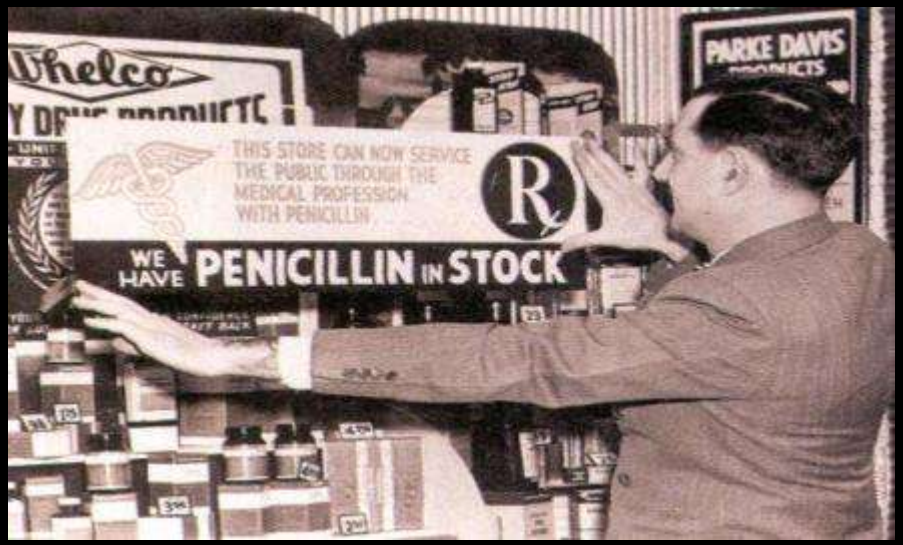
- scale of 2014 W. Africa epidemic creates risk of endemic disease reservoir
- mutational drift
  - over 300 mutations in last five months
  - no major shifts in transmission/virulence
  - implications for future vaccine coverage
- the game changer: shift to aerosol person-to-person transmission

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



The Evolving Nature of Human Infectious and Parasitic Diseases

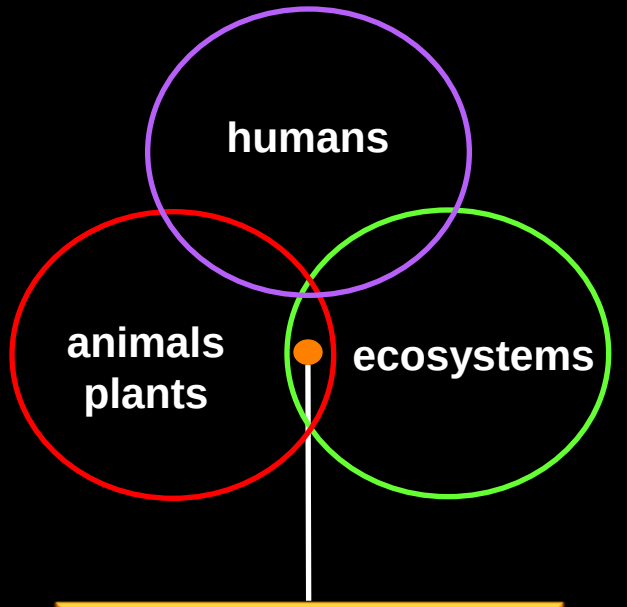
1407 species of human pathogens

- 538 bacteria
- 208 viruses
- 317 fungi
- 57 protozoa
- 287 helminth worms
- 60% are zoonoses
- over 70% zoonoses arise from interactions with wildlife
- Emerging Infectious Diseases (EIDs)
  - 58 in last 25 years
  - viruses significantly over-represented
  - RNA viruses most variable and rapidly changing
  - helminths under-represented

One Health

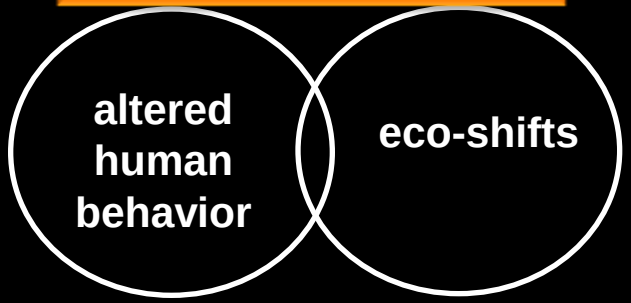
The Need for a Holistic View of Host-Pathogen Ecology

One Health: The Need for Holistic Approaches to Address the Complexity of Biosecurity Challenges



- urbanization
- travel
- trade
- intensive agriculture
- food security

Anthropogenic Effects



- conflict
- refugees

- climate change

- urbanization
- deforestation
- desertification
- water use
- water contamination
- invasive species
- weather

Asleep at the Switch and Pay the Consequences or Proactive Preparedness?

Growing Number of Wakeup Calls That Biosecurity Matters!

Detection and Management of a Major Bioincident

Trade and Transport Make Every ‘Local’ Event a Potential ‘Global’ Risk

Need for Similar Response Capabilities Irrespective of Whether Incident of Natural of Nefarious Origin (Terrorism)

Preparedness: Building Resilient Systems

- are the risks known and analyzed?
- are there actions for meaningful intervention?
  - tractable, measurable
- if not, how can these be developed and implemented (resources, infrastructure, logistics, cost)?
- what are the principal risks and obstacles to success? (technical, economic, political, social, legal)
- how are these barriers being addressed and, if not, what is needed to reduce/eliminate them? (vulnerability assessment and mitigation)

Comfort, Complacency and Consequences Versus Proactive Preparedness

"But I must go and meet the danger there,
or it will seek me in another place,
and find me worse provided."

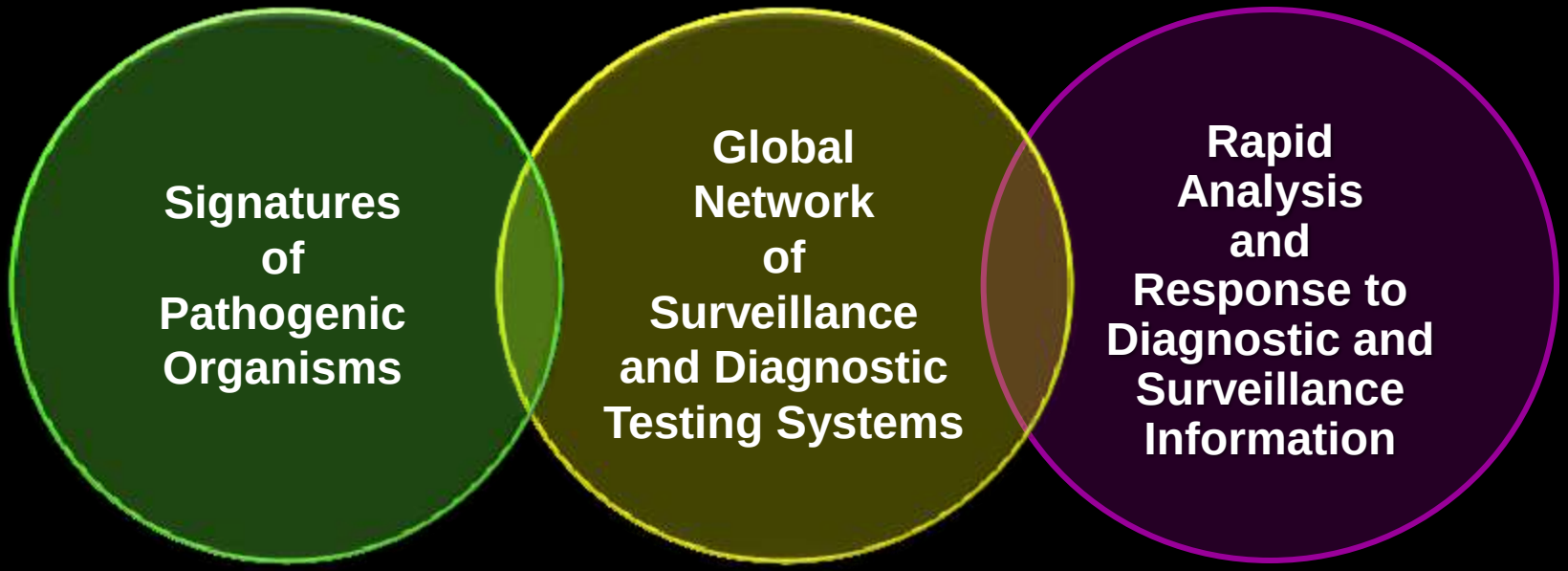
- William Shakespeare, Henry IV

Biosurveillance: the Value of Early Detection

Early Detection Saves Lives!

POC Diagnostic Tests, Population Triage and Managing the Worried Well

Surveillance Systems for the Rapid Detection and Control of Infectious and Parasitic Diseases



Profile

Sense

Act

Global Disease Surveillance

EMERGEncy ID NET

Public Health Department's Surveillance

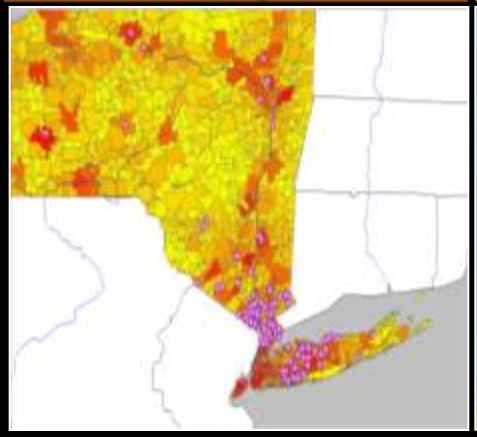
U.S. Influenza Sentinel Provider Surveillance Network

Quarantine Activity Reporting System (QARS).

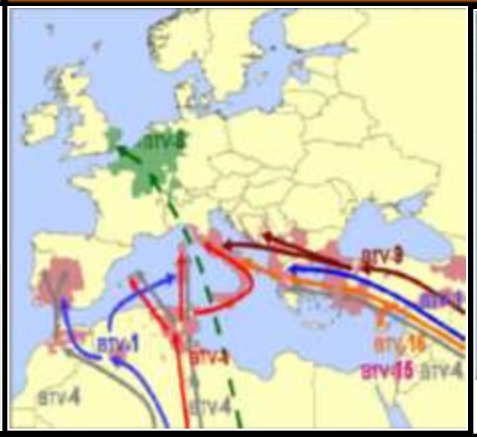
Geodemographic Information Systems (GIS): Real-Time, Front Line, Ground Zero Data from Field Sampling and Sentinels

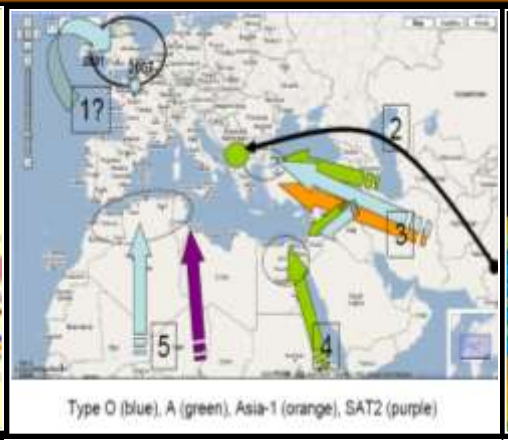
Geodemographic Information Systems: Mapping Disease Patterns and Modeling Trends

Anomaly Detection and Early Alert

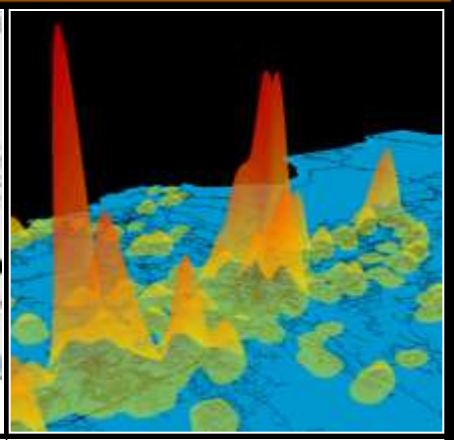


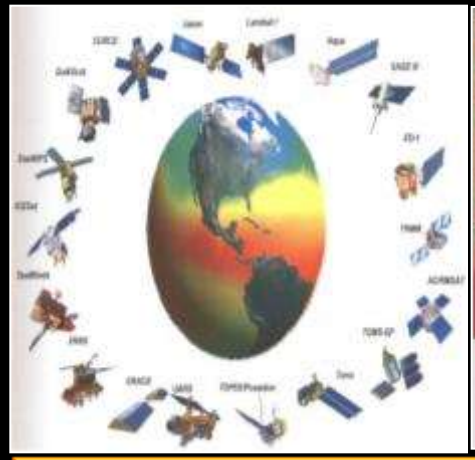
Disease Progression

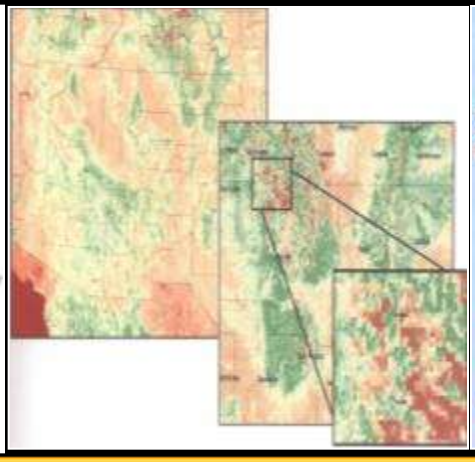


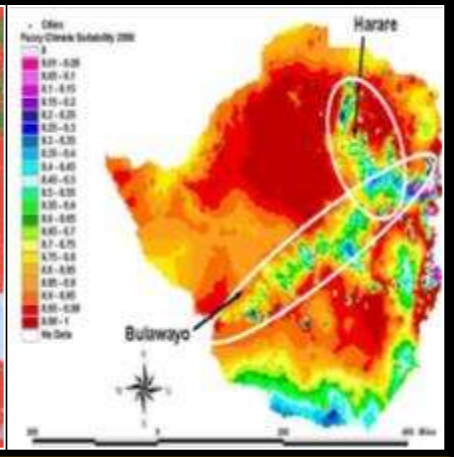


Type O (blue), A (green), Asia-1 (orange), SAT2 (purple)







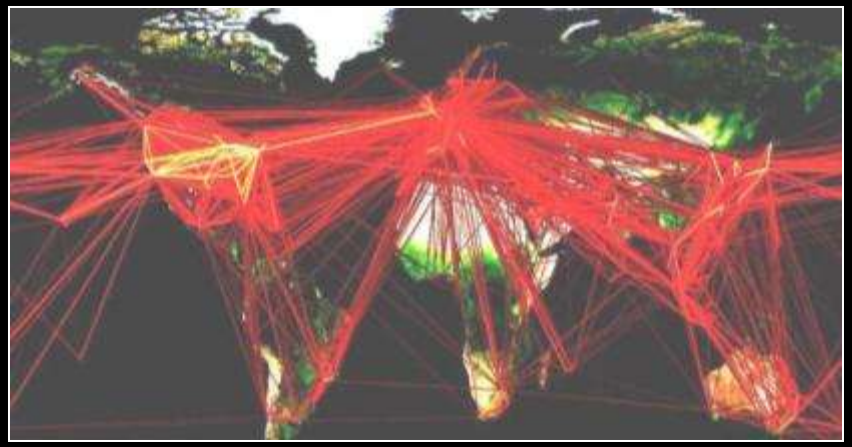


Satellite Surveillance and Predictive Modeling of Disease Trends

Global Transport and Trade: New Interactions of People, Animals and Product Supply Chains

The Super Vector

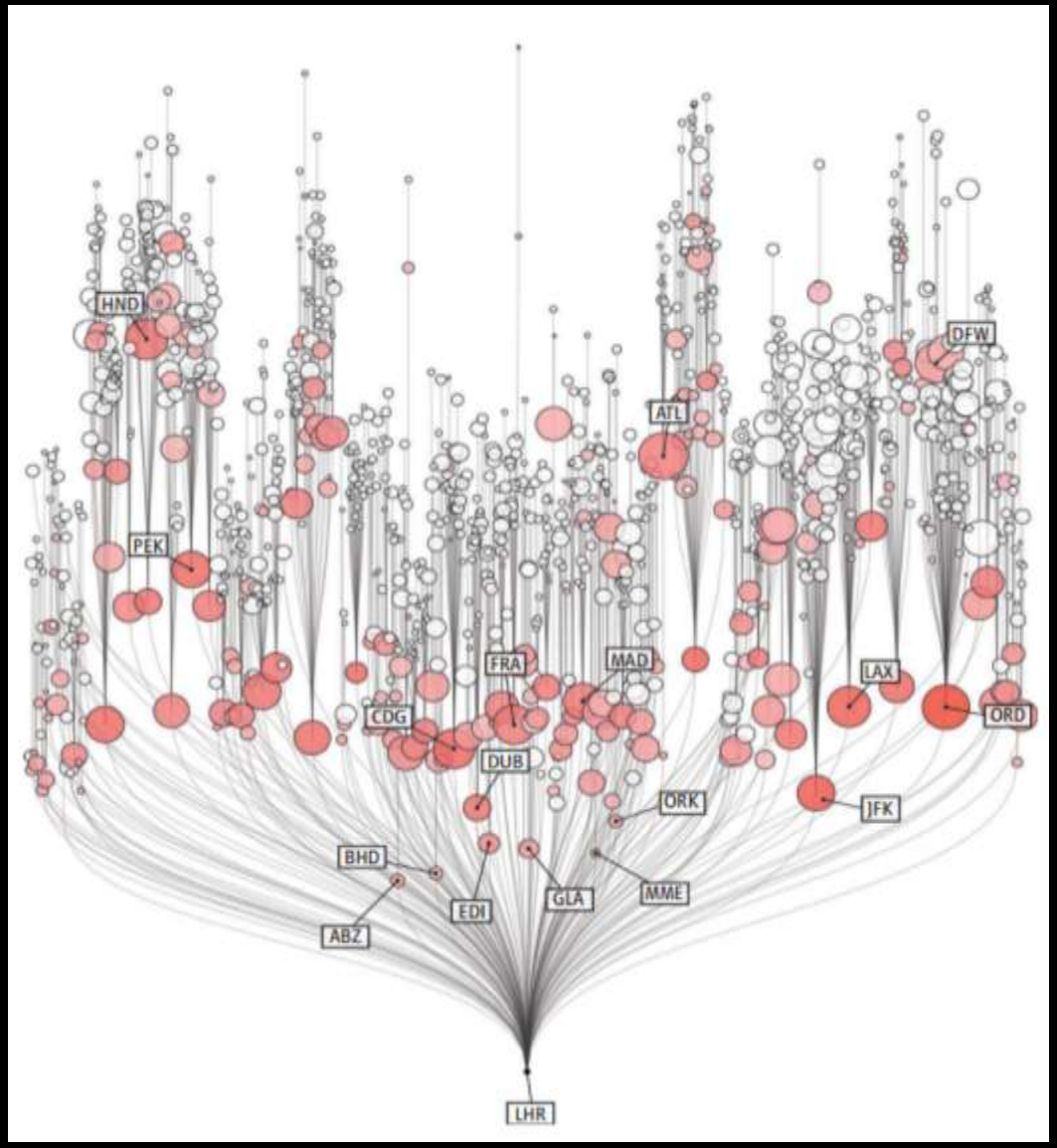
Billion Cross-Border Travelers



World Container Traffic Doubled Since 1997

Global Food Networks

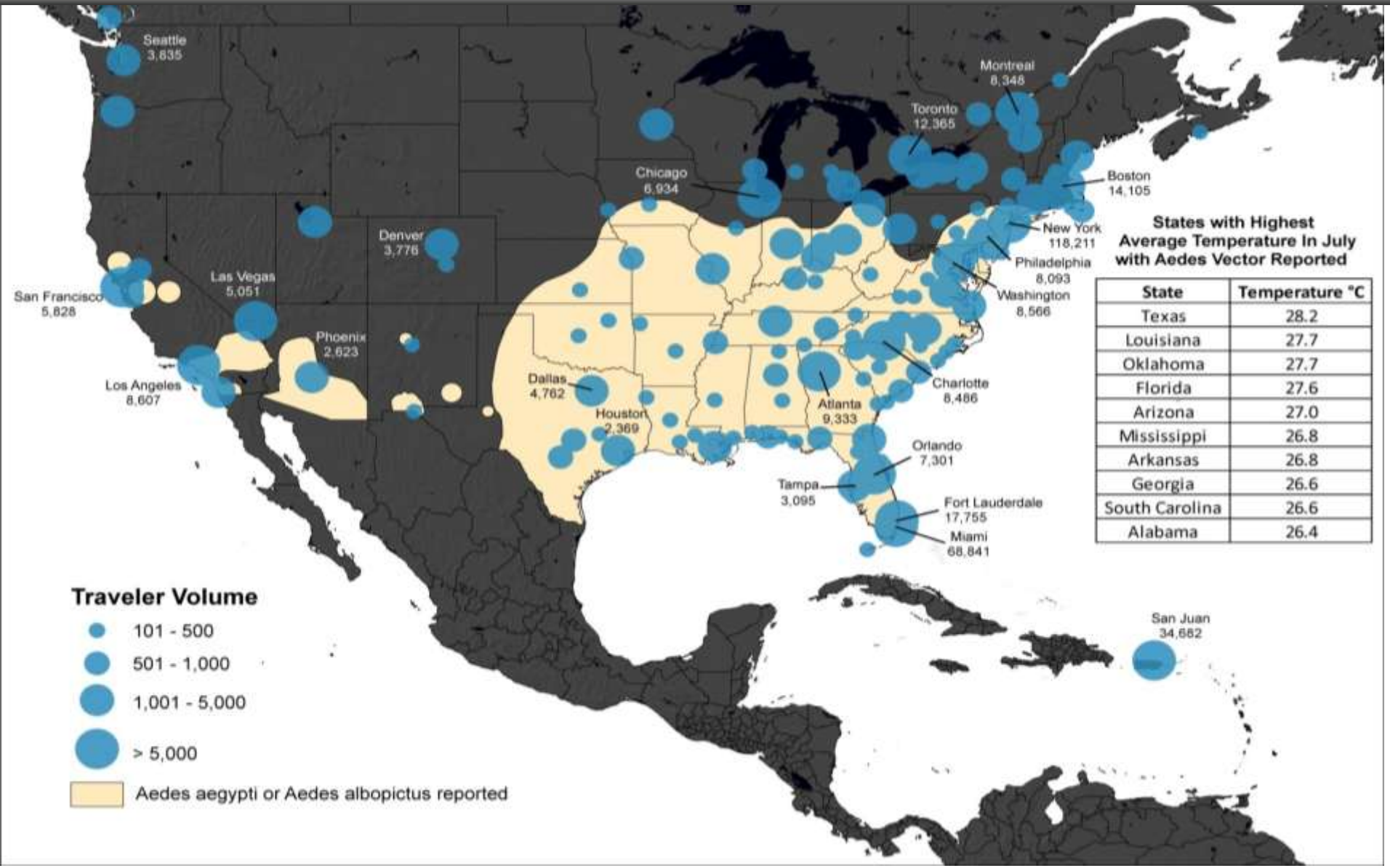
Coming to an Airport Near You:



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

Tracking Arrivals from Chikungunya 'Hot Spots' in the Caribbean



States with Highest Average Temperature In July with Aedes Vector Reported

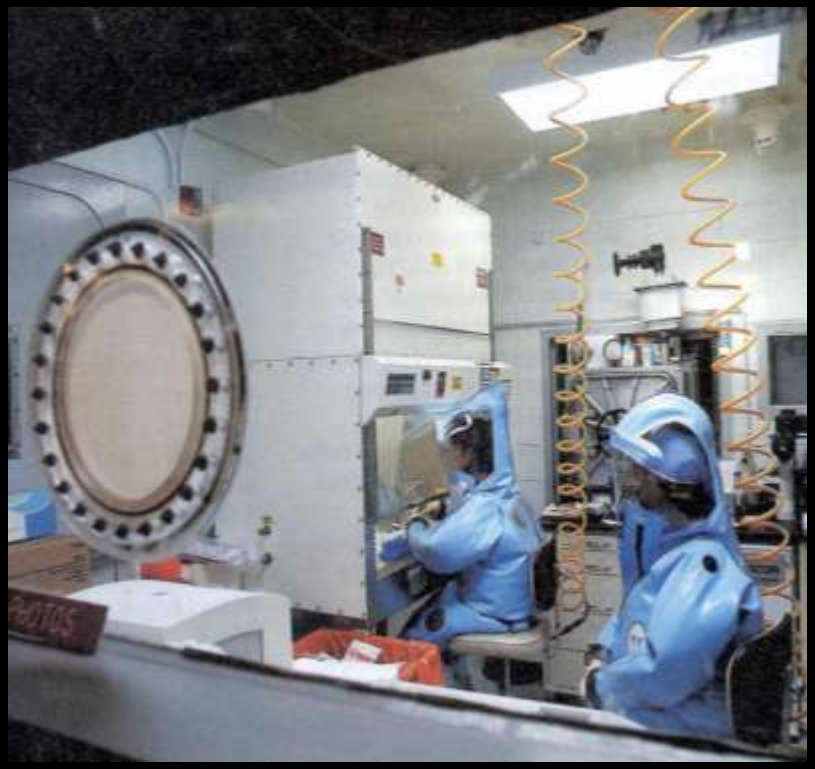
State	Temperature °C
Texas	28.2
Louisiana	27.7
Oklahoma	27.7
Florida	27.6
Arizona	27.0
Mississippi	26.8
Arkansas	26.8
Georgia	26.6
South Carolina	26.6
Alabama	26.4

http://currents.plos.org/outbreaks/files/2014/05/Chikungunya_US_July_140516.jpg

Global Surveillance Against Infectious Disease Outbreaks
E.H. Chen et. al. (2010) PNAS 107, 21701

- 398 WHO-verified outbreaks 1996-2009
- median times
  - 23 days for event detection
  - 32 days for public communication
  - 35 days for official laboratory confirmation
  - 48 days for inclusion in WHO Disease Outbreak News

US States Poorly Prepared to Manage Infectious Disease Threats: Trust for America's Health and Robert Wood Johnson Foundation*



- 33 states scored 5 or lower on scale of 10
- failure to ID select agent pathogens
- lack of common data reporting formats and/or obligations
- one-third do not have mandatory reporting of HAI
- failure to meet vaccination herd immunity levels (>90%)
- impact of fiscal austerity (State, Federal)
- 40,000 jobs lost in last 5 years

Infectious Diseases (Natural) and Bioterrorism (Nefarious)

Shared Features: Stealth and Spread

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Recommendations and Reports / Vol. 63 / No. 6
September 26, 2014

Updated Preparedness and Response Framework for Influenza Pandemics

Continuing Education Examination available at http://www.cdc.gov/mmwr/cme/conted.html.

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

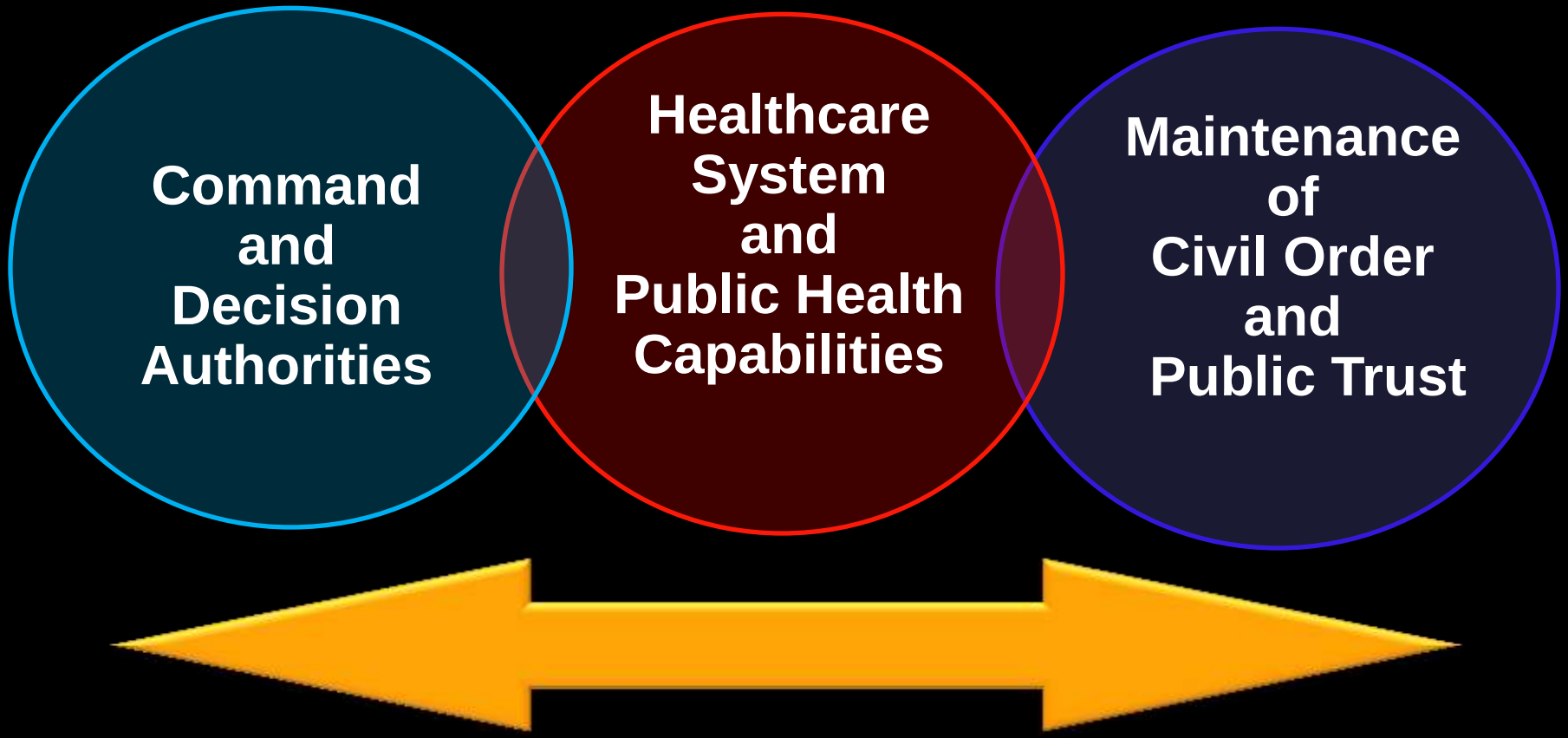
Are We Really Ready for a Major Bioincident?

Detection of Infectious Disease Threats:

Not A Hazmat or Wide Area Sensor Network Solution

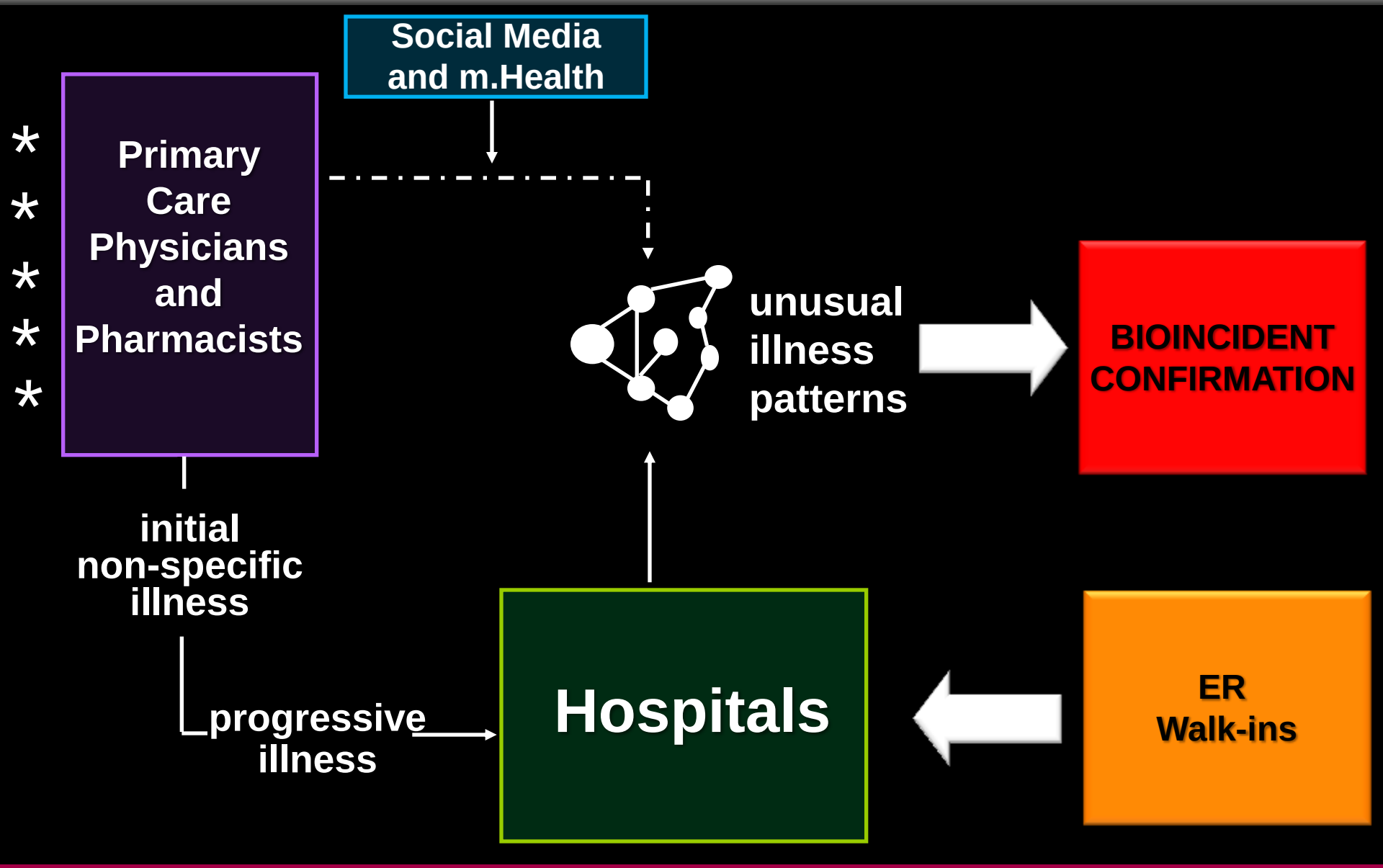
Emergency Rooms and Farms Will be the Front Line

The Three Core Components of Bioincident Management



- robust inter-operable communication networks for real-time situational awareness and rapid actions
- managing the media and the 'worried well'
- transparency, credibility and public trust

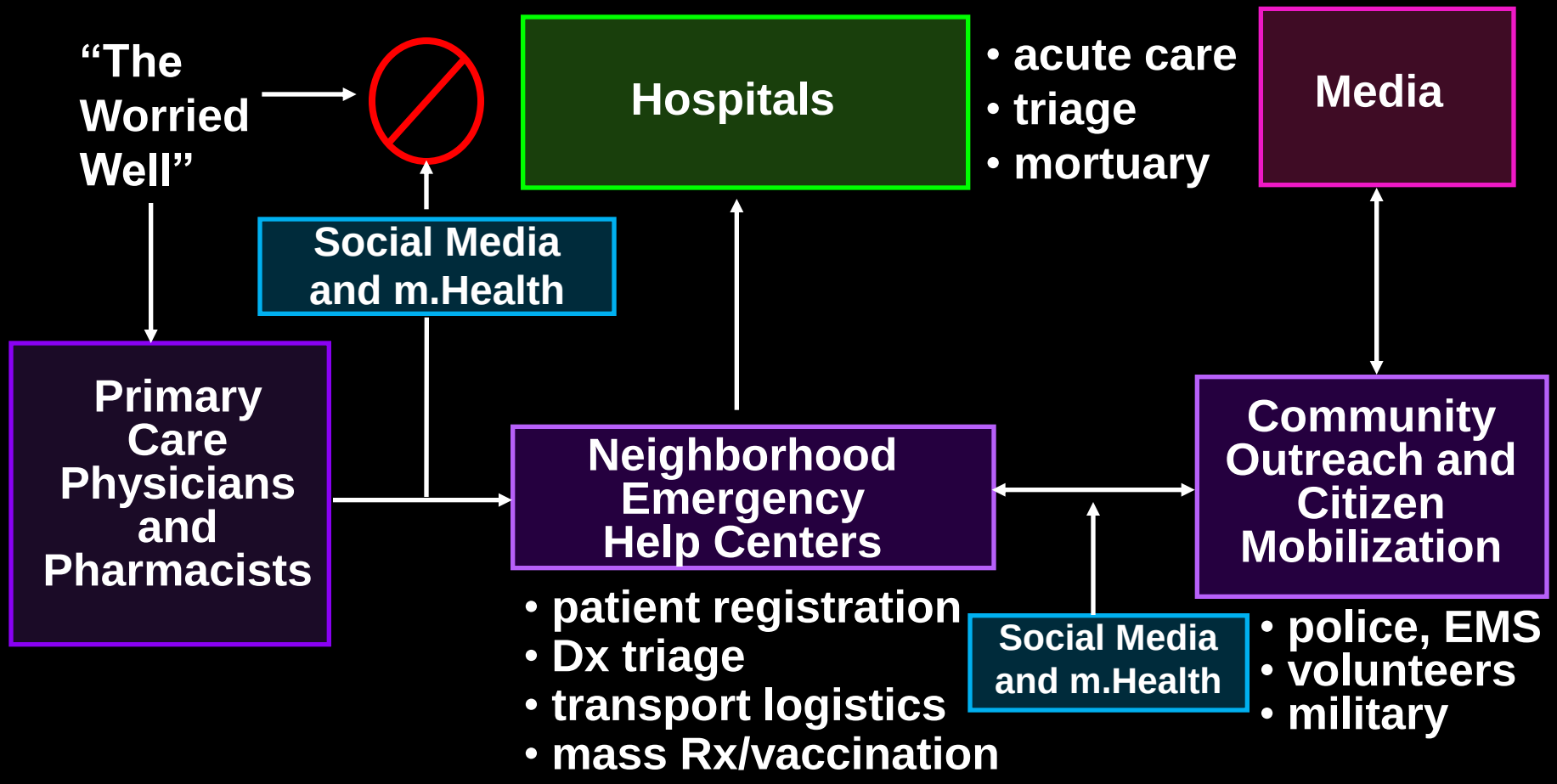
The Lag Phase in Bioincident Detection



Consequence and Crisis Control in a Bioincident

COMMAND CENTER

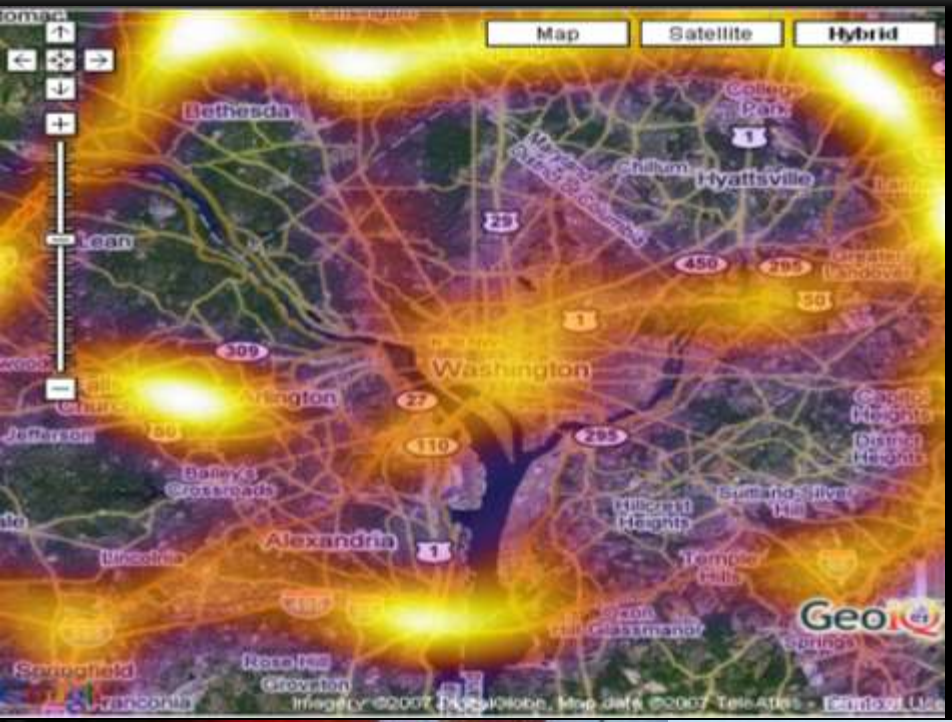
- public health
- logistics
- communications
- medical
- law enforcement
- coordination
- local
- national
- international
- regional

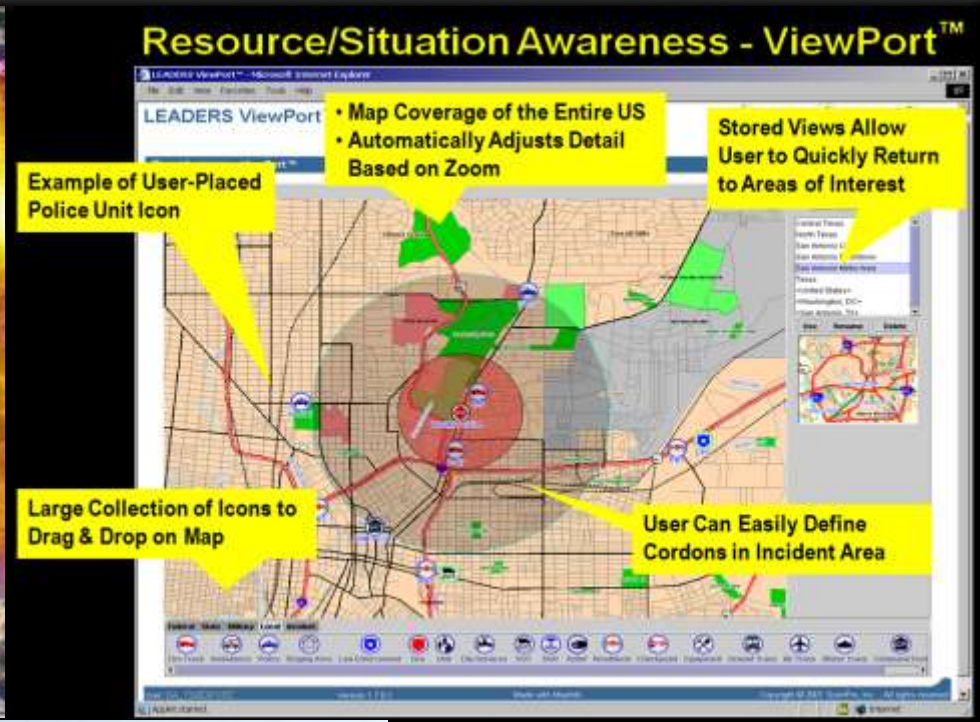


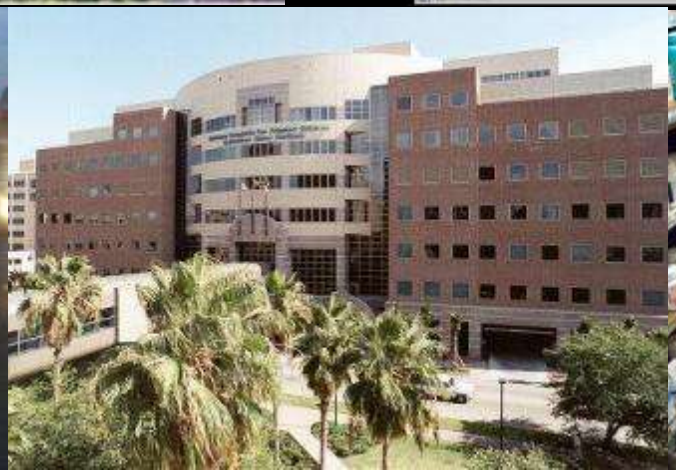
Sufficient Care

- provide the most good for greatest number of people under adverse conditions and constrained resources
- clinical triage
- rationing of health resources/pharmaceutical
- omnipresent vulnerabilities and risks from public panic and civil disorder

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





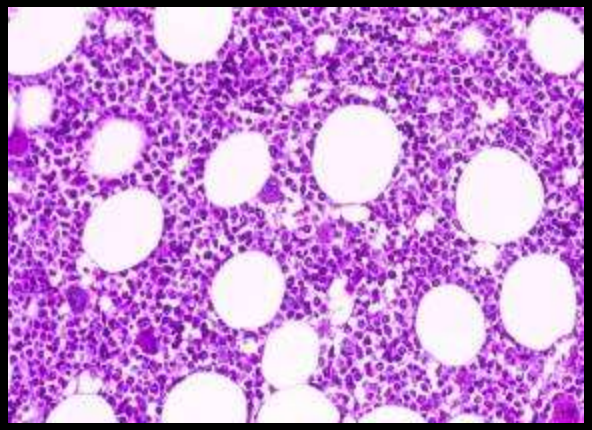


Vulnerability of Global, National and Local Supply Chains in a Major Epidemic/Pandemic

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 (64% 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

Building Resilience: Complex Systems-Based Integration of Diverse Functions and Organization

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

The Likely Real Picture!

“FOG”

“FUBAR”

Ill-Defined Responsibilities and Accountabilities

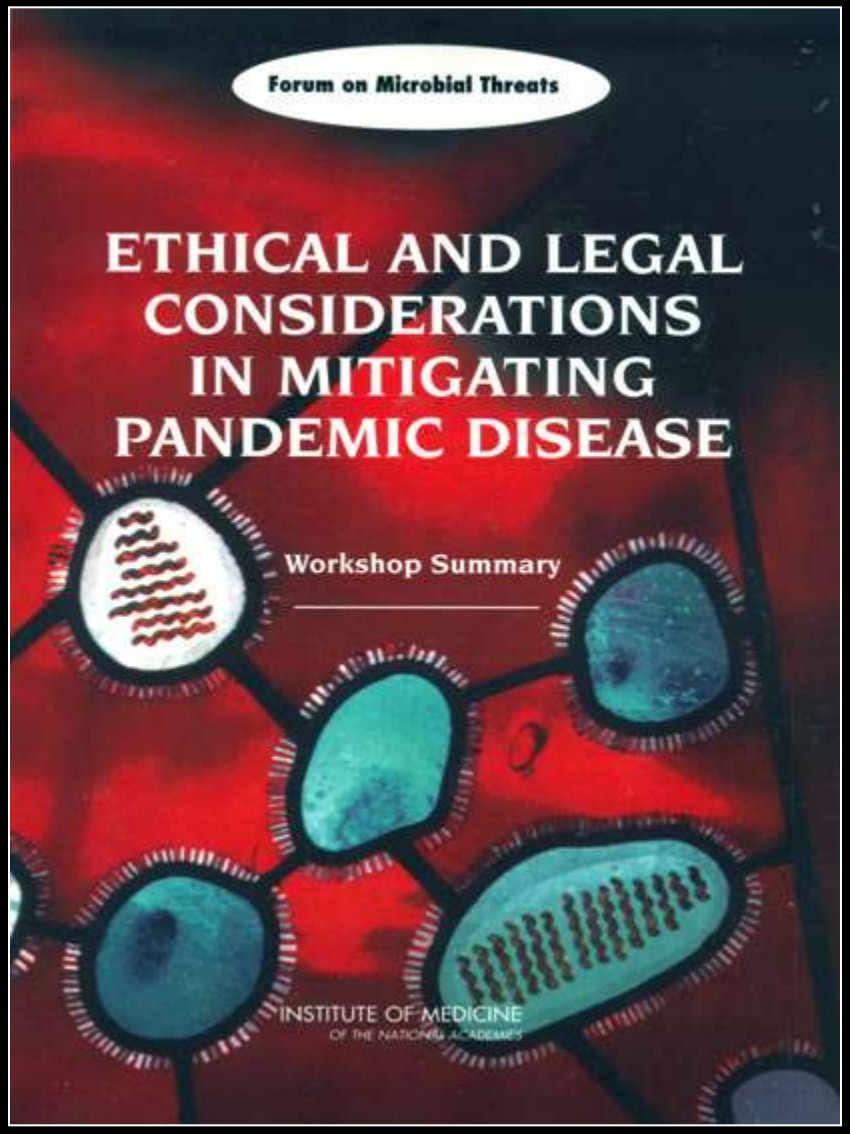
Lack of Well-Rehearsed Master Plans:
Federal, State and Local

“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

Failure of Power Generators in Major NYC Hospitals During Superstorm Sandy 1 November 2012

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



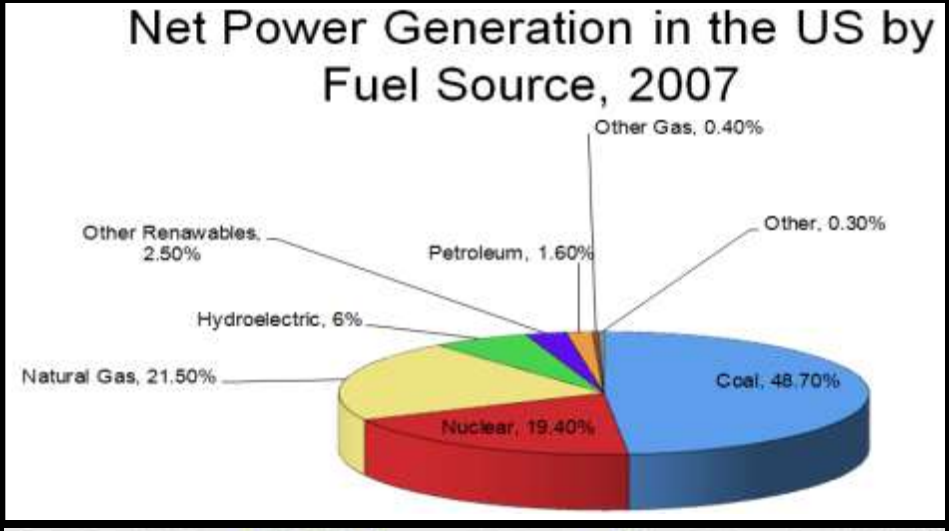
- suspension of civil liberties
- imposition of quarantine
- triage decisions and rationing
- mandatory medical examination and treatment
- mandatory treatment with unapproved drugs and vaccines
  - informed consent
  - indemnification
  - special populations

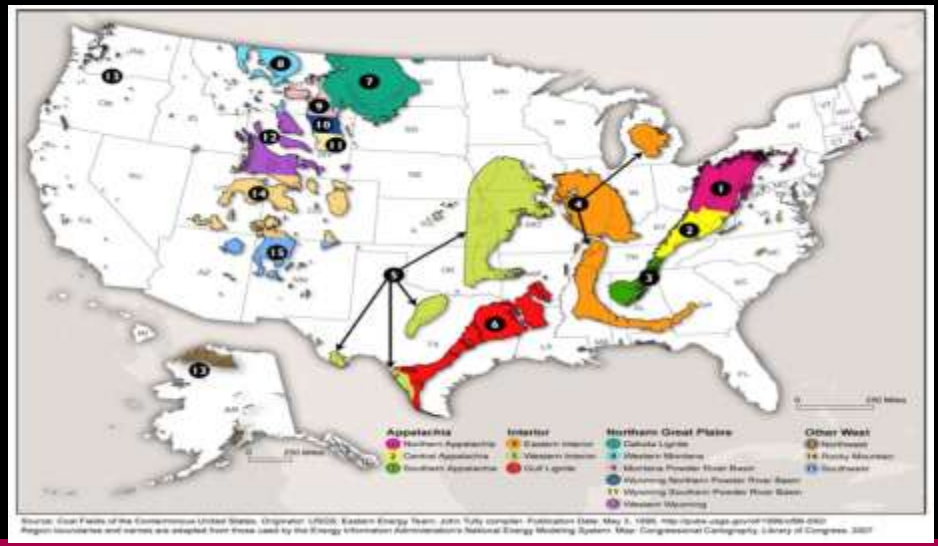
Control of Population Movement and Supply Chain Networks

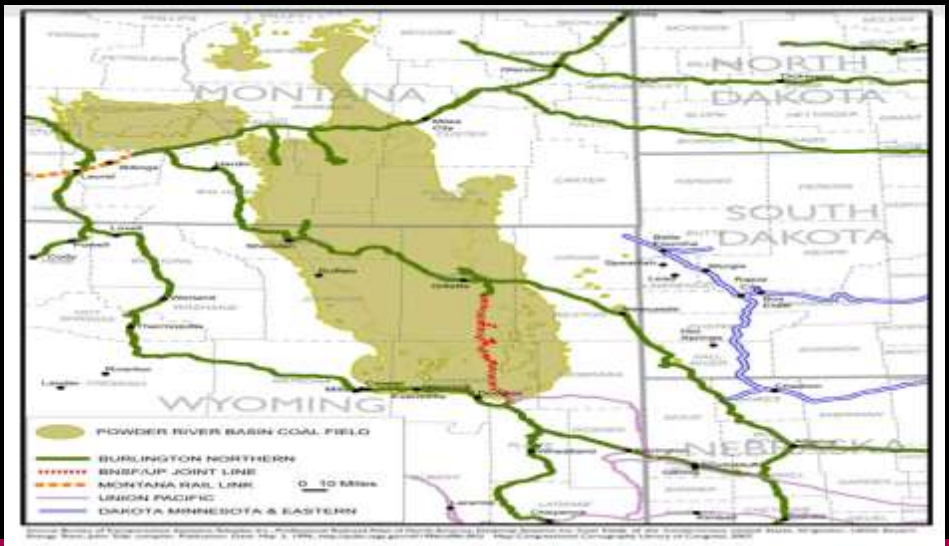
Compromising Critical Systems

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

Energy







Bad Bugs
and
Few New Drugs

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*

Antibiotic Resistance (Rx^r)

- adds estimated $35 billion in healthcare costs
- 8 million additional hospital days per year
- Relentless rise in lethal Rx^r
- major gaps in new Rx pipeline

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
- 9-15 year R&D cycle

"Fewer countries have discovered,
developed and registered drugs
to an international standard,
than have developed atomic bombs"

Chris Hentshel
Medicines for Malaria Venture: Lancet (2004) 363, 2198

Treatment of US Missionary Healthcare Workers With Experimental Ebola Drug (ZMapp)

Ethical Challenges

- “Should US workers receive an (experimental) drug in scarce supply when Africans are affected in far greater numbers?”
- “Should an experimental drug/vaccine that has not been tested in humans be given to Africans first?”

Compassionate and Emergency Use Exemptions of Investigational Drugs and Vaccines

- “Right to Try” ballot proposition Nov. 2014
- access for patients with terminal illness

Next-Generation Vaccine Technologies

pan-vaccines

- protection against diverse strains of a pathogen
- protection against closely related classes of pathogens

combating “Agent-X”

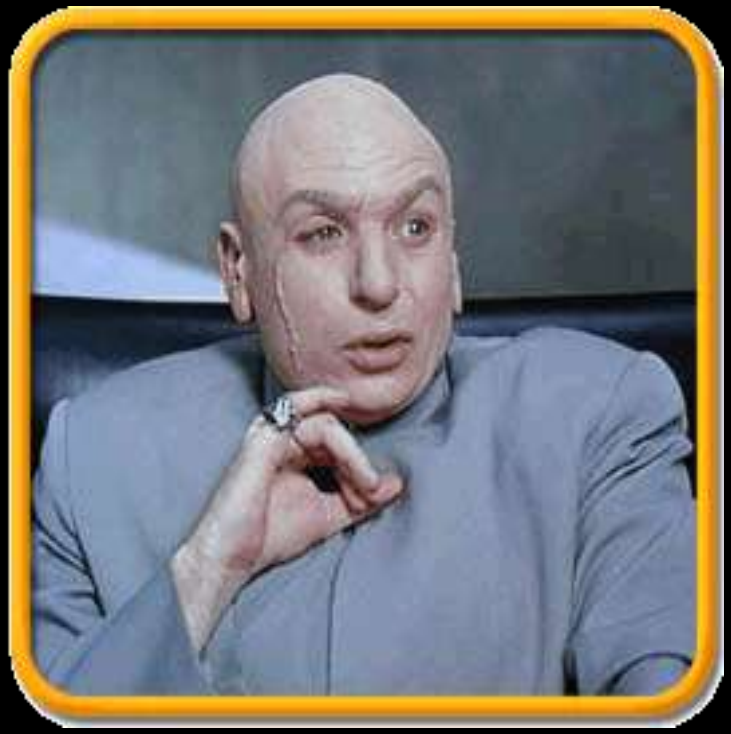
- rapid design and large scale production (weeks versus years) for protection against sudden emergence of an unprecedented pathogen (Agent-X)

Vaccine Safety:
Media Sensationalism and Celebrity Quackery

Jihadist Campaign Against Polio Vaccination in Pakistan

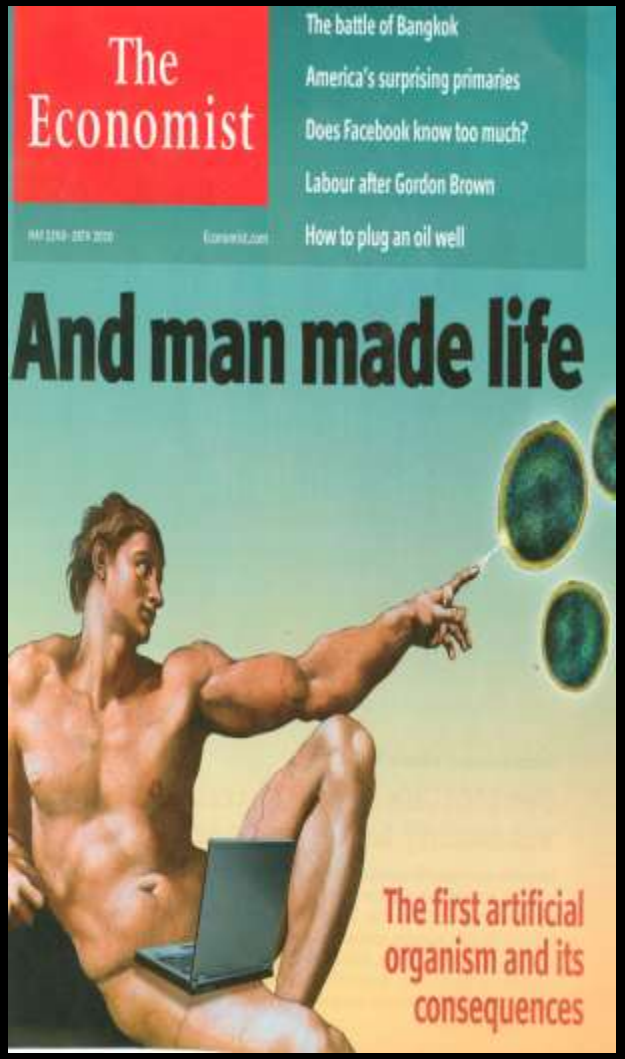
Suspicion of Polio Vaccine Campaign in Pakistan Heightened by Use by CIA as Cover in Hunt for Osama bin Laden

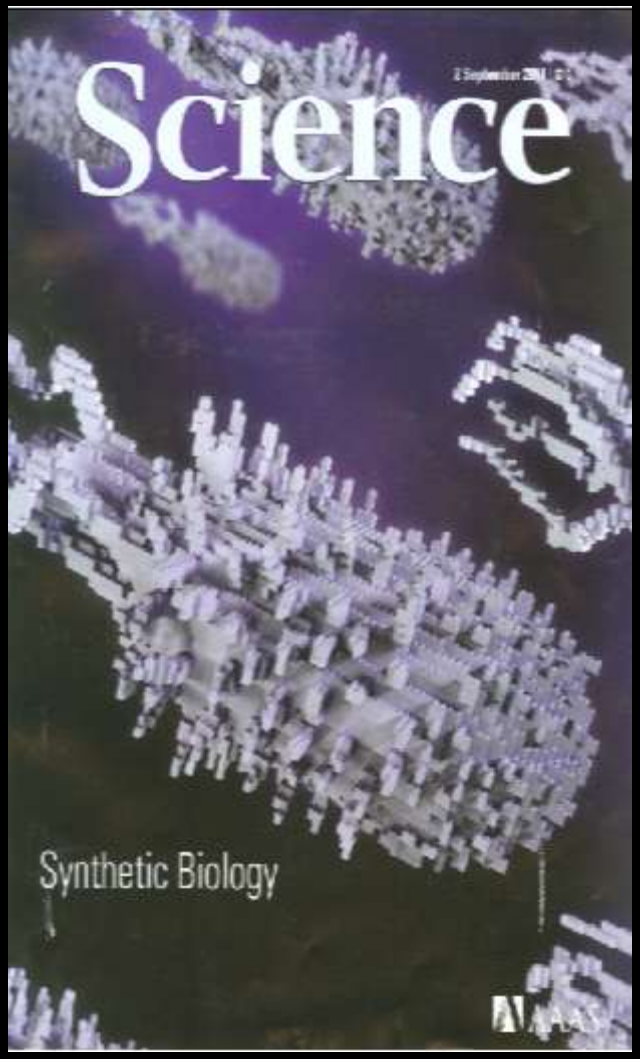
Future Trajectory Trends and Threat Expansion



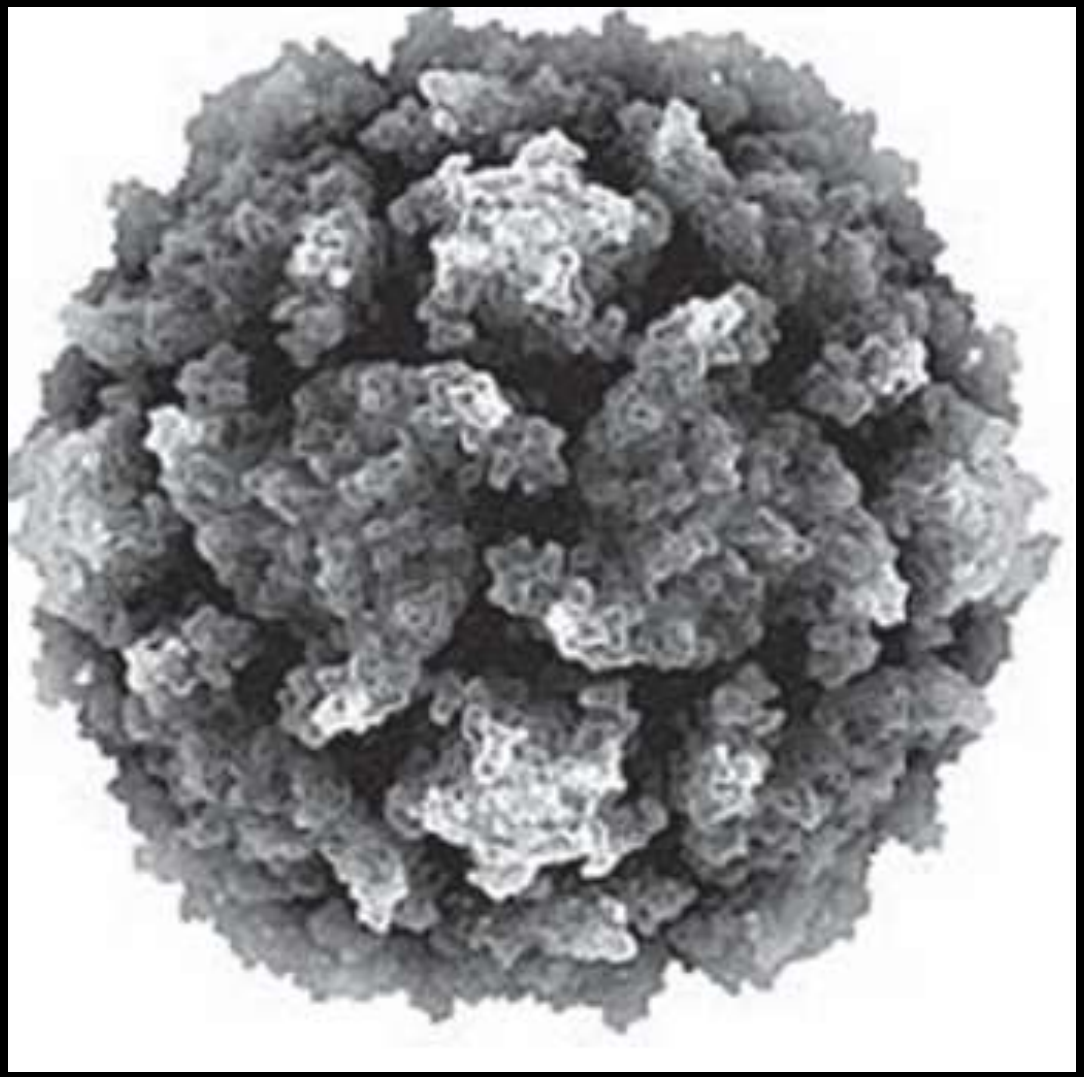
New ‘Dual-Use’ Technologies and Engineered Biothreats

Synthetic Biology



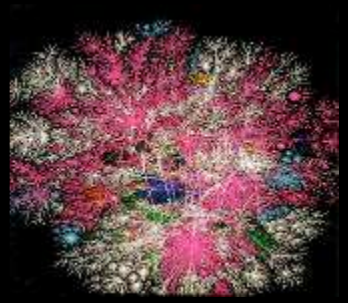


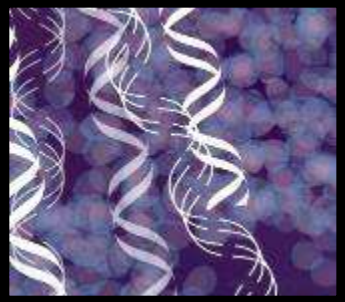
C332,652; H492, 388; N98, 245; O131, 196 P7, 501; S2,340
(a.k.a. poliovirus)



ATTGACTGCAA ……(design specifications)

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

Dual-Use Research of Concern (DURC)

Nature (2012) 482, 153

COMMENT

INFLUENZA Further explanation of the NSABB recommendations p.159

PRIMATES Imitation and social learning in apes p.159

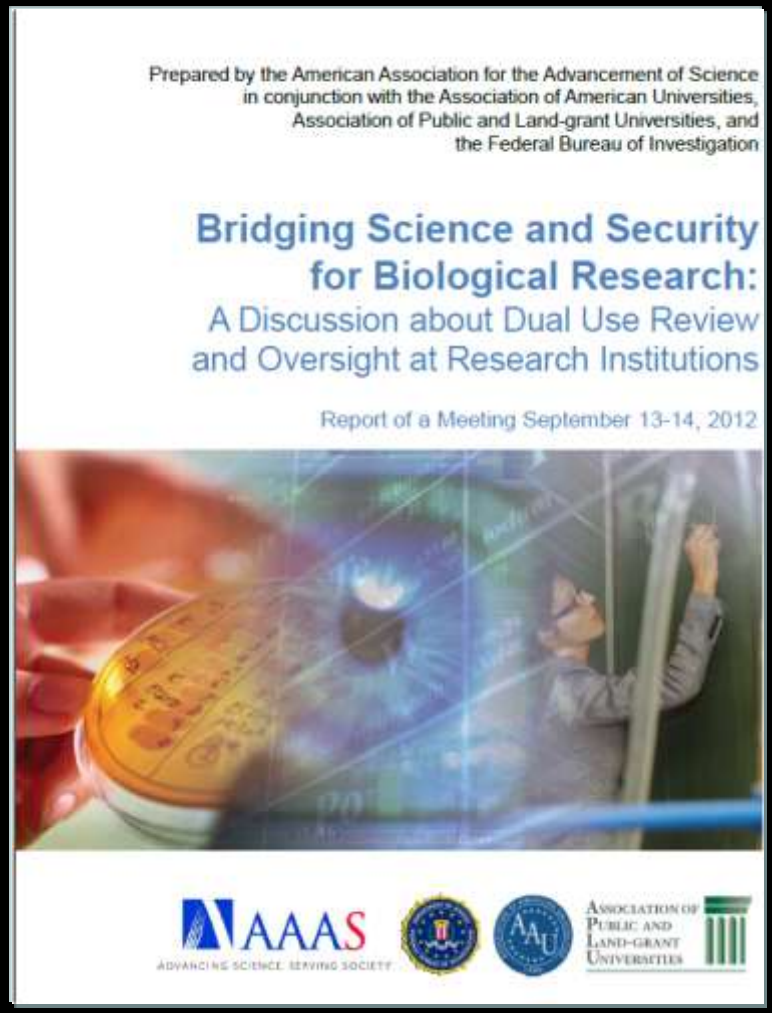
HISTORY John Dee's sweaving of scientific magic in the Elizabethan court p.160

CONSERVATION Trade in whale 'quotas' may be insufficient protection p.162

Pathogenic H5N1 avian influenza has led to the culling of hundreds of millions of birds. A human-transmissible form could have much worse consequences.

Adaptations of avian flu virus are a cause for concern

Members of the US National Science Advisory Board for Biosecurity explain its recommendations on the communication of experimental work on H5N1 influenza.



Prepared by the American Association for the Advancement of Science in conjunction with the Association of American Universities, Association of Public and Land-grant Universities, and the Federal Bureau of Investigation

Bridging Science and Security for Biological Research:

A Discussion about Dual Use Review and Oversight at Research Institutions

Report of a Meeting September 13-14, 2012

AAAS

ADVANCING SCIENCE, SERVING SOCIETY

Association of Public and Land-grant Universities

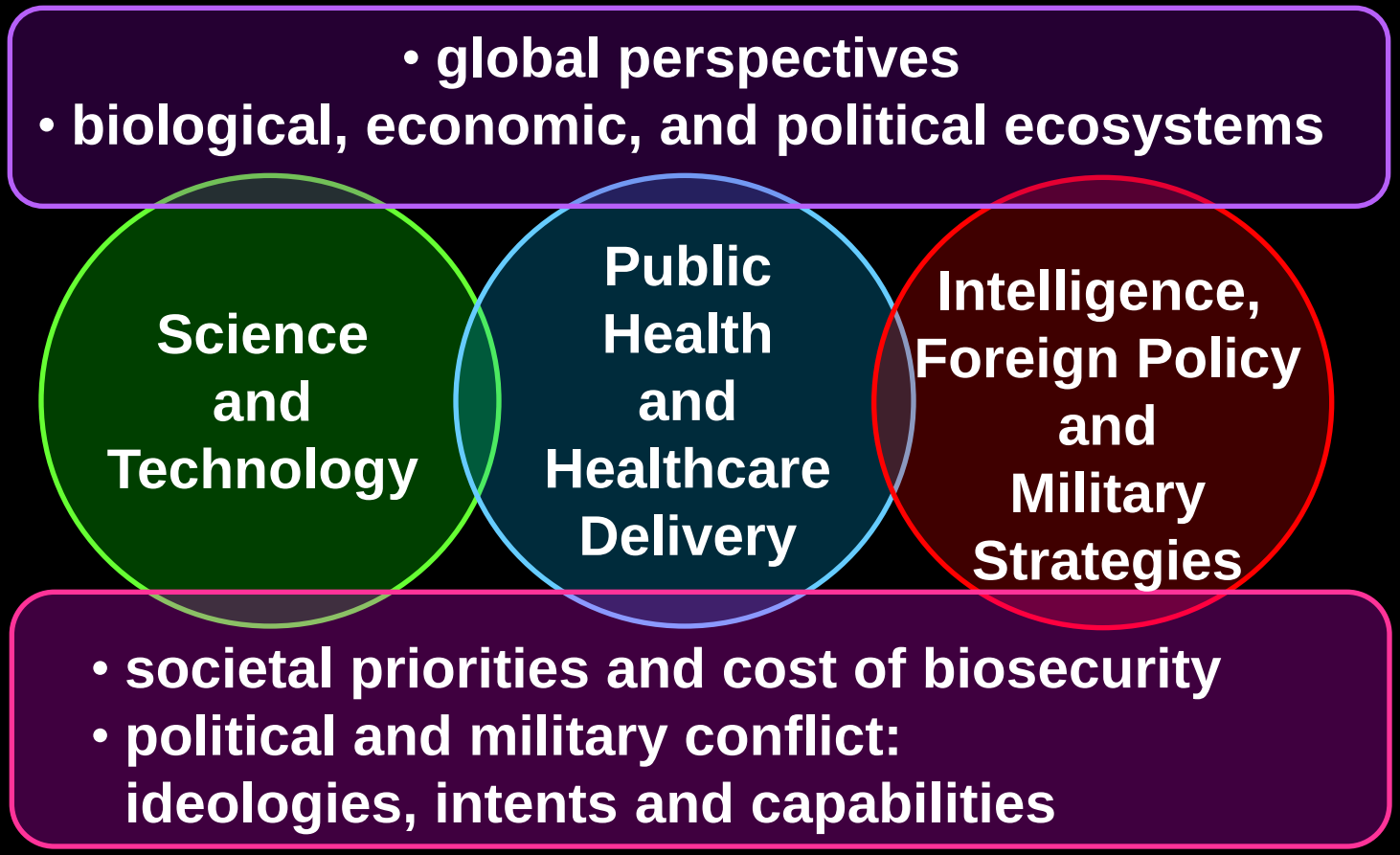
Biosecurity

- collective term embracing biodefense, public health and dual-use technologies
- fundamental but still politically neglected component in national security
- understanding how changes in biological systems threaten health and societal stability
  - directly and indirectly
  - infectious disease, food production
  - disruption of transportation and supply chains, economic loss and risk of civil disorder
  - ecosystem shifts and new patterns of disease
- chronic social and economic instabilities as triggers of political turmoil and military conflict

Biosecurity

- infectious diseases as dynamic foes
- relentless dynamic shifts in pathogen biology and geography (evolution at work!)
- reality: outpacing infectious diseases versus conquest
- preparedness: surveillance, infrastructure, personnel
- innovation and investment incentives: drugs, diagnostics and vaccines
- new (dual use) technologies and engineered threats
- risk assessment and proactive actions: public health and national security

Biosecurity:
A Classic Complex Systems Challenge



International (Re)Engagement, Commitment and Political Resolve to Address Biosecurity as a Foundational Element of Global Public Health, Diplomacy and National Security

Biosecurity

one health:
humans
animals
ecosystems

urbanization,
environmental
sustainability
and
depletion of
non-renewable
resources

economic
and
political
instabilities
and
escalating
conflict risk

terrorism
and
international
security

**International Engagement,
Commitment and Political Resolve**

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

“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/