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

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Biosecurity and Bioterrorism Response
BIOE 122, EMED 122/222, PUBLPOL 122/222
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23 January 2019
Infectious Diseases: A Powerful Force in Human Evolution
Climate Change, Ecosystem Disruption and Implications for Human Health
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
Disease and Famine as Weapons of War in Yemen

1,000,000 SUSPECTED CHOLERA CASES IN WAR-TORN YEMEN

80% of Yemenis lack access to:
- clean water
- food
- health care
- fuel

more than 2,200 are estimated to have died since late September

21 out of 22 governorates and 90% of Yemen’s districts have been affected
• SARS $ 30 billion
• Ebola W. Africa $ 53 billion
• Ebola U.S. $ 2.4 billion
• Amerithrax decontamination $320 million
• Projected cost of 1918 influenza – type pandemic
  - $683 billion US economy
  - $ 4 trillion global economy and 5% drop in GDP
The Relentless Changing Dynamics of Infectious Diseases

old foes resurgent: Rx – resistance

omnipresent pandemic threats

new foes: emerging infectious diseases

global connectivities

bioterrorism and bioweapons

expansion of dual-use technological risk
Biosecurity
Shared Feature of Natural and Nefarious Threats

• surprise, stealth, spread and speed
• ‘all hazards’ and ‘resilience’ the foundations of
  response preparedness and planning
• cross-agency coordination (within government)
• cross-sector inter-dependencies (public, private, NGOs)
• local events can quickly become global
• global coordination (public health, diplomacy, media, law enforcement, intelligence communities, military, industry supply chains)
“Amerithrax” October 2001

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

-T. S. Elliot
Strategic and Operational Objectives of Purposeful Bioattacks

- civilian and military targets
- confuse diagnosis
- frustrate treatment
- circumvent immunization protections
- overload healthcare and other incident response capacities
- economic disruption of supply chains of essential goods
- spread public panic and erode trust in authorities
- deception to hide attribution
- use of combinations of agents
The FSU Covert Biopreparat Program: Violation of 1972 BWC
“Armies of the future will need weapons based on new physical principles, including genetic and psychophysical science.”

President Vladimir Putin
essay, Rossiyskaya Gazeta, 2012
The Appeal of CBW for Asymmetric Warfare and Terrorism
Domestic Activists, Lone Wolf and Biohackers

“Win McCormack has put a penetrating spotlight on Indian guru Bhagwan Rajneesh and his bizarre and very dangerous cult. An utterly fascinating work.”
—Vincent Bugliosi, author of *Helter Skelter*

THE RAJNEESH CHRONICLES

The True Story of the Cult That Unleashed the First Act of Bioterrorism on U.S. Soil

WIN McCORMACK

ODYSSEY OF A Mad Genius

PLUS: OKLAHOMA CITY, A YEAR LATER
- The Survivors’ Tales
- Interview with McVeigh

TIME

ROB BROWN'S TRAGIC FLIGHT

BIOHACKERS

The Politics of Open Science

ALESSANDRO DELFANTI
A dramatic increase in the number of threats, incidents, and incursions by drones at NFL stadiums. We are all very fortunate that the drone over Levi’s Stadium dropped only leaflets.

CATHY LANIER
Senior VP of Security, NFL
Drone Swarms with Ordinance or CBW Payloads and Facial Recognition Homing
Use of Drones in Remote and Low Resource Regions for Delivery of Specimens, Blood, Drugs and Vaccines
### The Biosecurity Threat Spectrum

<table>
<thead>
<tr>
<th>Time</th>
<th>Low Probability: High Consequence</th>
<th>High Probability: High Consequence</th>
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<tbody>
<tr>
<td><strong>today</strong></td>
<td>• bioterrorism</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>• natural infectious diseases (pandemic)</td>
<td>X</td>
</tr>
<tr>
<td><strong>2029 (?)</strong></td>
<td>• bioterrorism</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>• natural infectious diseases (pandemic)</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>• convergent technologies</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>- synthetic biology</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>- artificial intelligence</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>- robotics/autonomous systems</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>- error/accident</td>
<td>?</td>
</tr>
</tbody>
</table>
Beyond Select Agents:
The Expanded Threat Spectrum

AGENT X

• exotic natural EID/zoonose?
• deliberately engineered agent?
• extended chronic morbidity and overwhelm healthcare resources?
“The Big Four”

TB

HIV

Malaria

Rx Resistance
A Decade of New and Resurgent Viral Threats

SARS-CoV
MERS-CoV
West Nile
Yellow Fever
Dengue

Chikungunya
Ebola
Zika
Monkeypox
Acute Flaccid Myelitis (AFM)
Urbanization and Mega-Cities in Developing Countries and the Increased Threat of Exotic Zoonotic Diseases

- High Population Density With Inadequate Biosurveillance
- Expanded Eco-niches and New Zoonotic Exposures/Risks
- Major Gaps in Health Infrastructure and Disease Reporting
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?
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
Intensive Agriculture and Juxtaposition of Poultry and Pigs as a Potential Zoonotic Pathway for Pandemic Influenza
Detection of Infectious Disease Threats: 

Not A Hazmat Incident 

Emergency Rooms and Farms Will be the Front Line
The Core Domains of Preparedness

**threat spectrum and awareness**
- global biosurveillance

**adaptive, resilient response**
- prevention and incident management

**counter-measures and mitigation**
- protection, response and recovery

**resource prioritization and distribution logistics**
- managing the ‘worried well’, proficient communication, and critical services

**sustained community resilience**
- integrated real time data and rapid, robust decisions

**situational awareness**
- surge management

**counter-measures and mitigation**
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Biosurveillance and Threat Awareness

What's Out There?

Early Diagnosis Saves Lives!
Faster Diagnosis Saves Lives: The Primacy of Diagnostics in Biosurveillance and Preparedness Mobilization

Profile: signatures of infectious agents

Detect: rapid automated PON/POC diagnostics

Act: real-time situation awareness, decisions

surveillance sans frontières

pathogen evolution

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

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

26 December 2013

- first report by WHO-AFRO region

21 March 2014

- WHO declaration of Public Health Emergency of International Concern

8 August 2014

- 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

Over 11,000 Deaths
Global Disease Surveillance

- EMERGEncy ID NET
- HealthMap
- World Health Organization
- IDSA
- Oie
- CDC
- ProMED-mail
- GIDEON
- JPE-CBD
- GPHIN RMISP
- Biocaster
- DoD-GEISWeb
- GeoSentinel
- ESSENCE
- Quarantine Activity Reporting System (QARS)
- BioPortal
- RABNET
- Human and Animal Rabies
- NNDSS
- National Center for Medical Intelligence
- EUNiD
Ground Zero Biosurveillance Data

Comprehensive Front Line Sampling of Sentinel Species

Real-time Intelligence and Faster Preparedness
‘One Health’ Biosurveillance

Natural reservoirs and ecological niches of emerging viruses

- range and physical contact
- environmental factors

Susceptible human host

- demographics
- cultural, political and economic factors
- health system capacity to detect/respond

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

“Going to Waste”
The Human Observatory and EPA National Sewage Sludge Repository (NSSR)

- metagenomics analysis of vital species in sewage
- identification of 900 unknown viruses in EPA-NSSR samples
- virome 200:1 ratio of unknown to knowns
POC-PON Testing for Infectious Diseases

- rapid (< 1hr), actionable information
- point-of-care (POC)
  - use in healthcare settings
- point-of-need (PON):
  - portable, field deployable units
  - in-home; austere, rugged and remote environments; low resource settings
  - high automation and use with minimum technical expertise
- move to multiplex, profiling capabilities
- integration with mobile technology and telemedicine for real-time biosurveillance and incident situational awareness
Integrated Consortium of Laboratory Networks (ICLN): 450 Laboratories
The Shift in Diagnostic Technologies

**Historical Plating and Culture**
- 24-96 hours
- potential overgrowth of slower growing species
- slow detection of resistance and other engineered features
- limited phylogenetic tracing

**Rapid Genome Sequencing and Metagenomics**
- 30 mins. to 4 hr.
- profiling of all organisms
- rapid ID of resistance markers and other atypical features
- molecular fingerprints for phylogenetic epidemiology
The logic of the (Ebola) elbow greeting
Metagenomic Profiling of Pathogens and Their Evolution

Influenza Virus

Zika Virus
Evolution of a Single Amino Acid Substitution (Glycoprotein A82V) and Increased Ebola Binding to NPC1 Receptor and Reduced Infectivity in Bat Reservoir

Mobile Devices, Disease Tracking, Contact-Tracing and Education
Remote Monitoring of Health Status: Faster Detection of Prodromal Infection Saves Lives
Coming to an Airport Near You!

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


Monitoring System for Environmental Aerosol Detection of Select Agent Pathogens in US Cities: ‘Detect to Protect’

- introduced in response to Amerithrax 2001
- launched 2003 for air sampling in 30+ US cities and high profile events (S. Bowl)
- low statistical probability of detection of focal release away from detectors
- up to 36 hours from sampling to BAR decision (Biologically Actionable Release)
- continued investment despite multiple negative assessments of performance/utility
DECEMBER 13, 2018

The Government’s Bioterror-Response Website May Be Leaking Sensitive Data

Super Bowl anti-terrorism documents left on plane

By Scott Glover and Drew Griffin, CNN Investigates

© Updated 1:24 PM ET, Mon February 5, 2018
The Three Core Components of Bioincident Management

- Command and Decision Authorities
- Healthcare System Resources and Public Health Capabilities
- Supply Chains and Maintenance of Public Trust and Civil Order

- 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

Primary Care Physicians and Pharmacists

Social Media and m.Health

Hospitals

unusual illness patterns

BIOINCIDENT CONFIRMATION

ER Walk-ins

* *

initial non-specific illness

progressive illness
Consequence and Crisis Control in a Bioincident

Command Center

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

Primary Care Physicians and Pharmacists

“The Worried Well”

Social Media and m.Health

Hospitals

- acute care
- triage
- mortuary

Neighbourhood Emergency Centers

- Dx triage
- transport logistics
- mass Rx/vaccination

Media

Community Outreach

- police, EMS
- volunteers
- military

Social Media and m.Health
The Critical Role of Communication and Gaining Public Trust in a Major Bioincident

Managing the “Worried Well”

Timely, Authoritative and Accurate Information

Gaining and Sustaining Public Trust
Political Media Sensationalism, Public Fear and Irrational 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
Data Sharing and Inter-Operable Databases

- despite the obvious theoretical appeal of real time sharing of critical public health data significant obstacles remain

- data siloing in multiple databases with no inter-operability
  - variable data quality and lack of standardization of data formats

- concerns over reuse by third parties
  - privacy, commercialization

- cybersecurity

- gray zone threats
Biocontainment Protocols and HCP Training
Large Scale Decontamination and Disposal
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
- managing political/public/media responses for bioincidents caused by pathogens caused by pathogens with limited or no $R_x$/vaccine options
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

- **“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**
Control of Population Movement and Supply Chain Networks
Supply Chain Logistics in Disaster Management
1 Juncos: Amgen’s Juncos site is the largest in its manufacturing network, with roughly 2,700 people working across its five plants to produce 13 of the company’s drugs.

2 Las Piedras: Merck & Co., which employs roughly 600 people on the island, shipped over a 1,500-kW generator from its West Point, Pa., site to support operations in Las Piedras.

3 Jayuya: Many employees living near Abbvie’s site in Jayuya were still without power 11 months after the hurricane.

4 Barceloneta: Abbvie’s Barceloneta site benefited from a cogeneration plant, which allowed it to power another company and the local bakery after the storm.

5 Vega Baja: Pfizer’s Vega Baja site, one of three that collectively employ about 1,900 people plus contractors, packed its first batch of medicines on Nov. 2nd, about six weeks after the storm.

6 Guaynabo: J&J’s Guaynabo site, home to corporate and commercial functions, is part of a broad network on the island, with some 3,700 employees working across six manufacturing sites.

7 Carolina: Eli Lilly & Co. is one of six companies to manufacture biologic products, like the insulin made at its Carolina site.
Stockpiling Ventilators for Influenza Pandemics: Estimated Deaths and Hospitalization

- Estimated 675,000 US deaths, 50 million globally
- 865,000 ILI hospitalizations
- Projected 9.9 million hospitalizations

1918

- Estimated 675,000 US deaths, 50 million globally

Moderate pandemic: 1957, 1968

- 865,000 ILI hospitalizations

Severe pandemic similar to 1918

- Projected 9.9 million hospitalizations

Ethical Considerations for Decision Making Regarding Allocation of Mechanical Ventilators during a Severe Influenza Pandemic or Other Public Health Emergency

Prepared by the Ventilator Document Workgroup, Ethics Subcommittee of the Advisory Committee to the Director, Centers for Disease Control and Prevention.

July 1, 2011
### Constraining Capabilities for Effective Mechanical Ventilation for Large Scale Public Health Emergency

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

<table>
<thead>
<tr>
<th>Components</th>
<th>Number of Additional Patients that can be Ventilated at Capacity Level</th>
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<tbody>
<tr>
<td>beds</td>
<td>177,300</td>
</tr>
<tr>
<td>staff/physicians</td>
<td>229,500</td>
</tr>
<tr>
<td>respiratory therapists</td>
<td>135,000</td>
</tr>
<tr>
<td>critical care nurses</td>
<td>75,000 - 301,900</td>
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</table>
The ‘Fog of Disaster’: Crisis Standards of Care and Proliferation of Unanticipated Events and Consequences
Breakdown of Civil Order and Incident Management

Constrained Mobility

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

Still a Small Scale and Relatively Easily Contained Epidemic Versus the Challenge of a Global Pandemic Incident(s)

Ebola: West Africa 2014-15
Fear and Distrust: Proliferation of Myth and Misinformation

- deliberate spread by Governments
  - delay elections
  - genocidal assault on Kissi tribe
- treatment centers as organ harvesting operations for western countries
- deliberate spread by healthcare workers (HCW)
- attacks on HCW and contact tracers
Ebola West Africa: 2014-15

The Logistics (and Risks) of Waste Disposal

Burial Practices
Ebola (DRC: 2018-19)

- epicenter in Butembo
- concern over shift to more dangerous N. Kivu province
- assaults on HCW by armed militia
- large number of unregistered clinics that offer traditional medicine
  - no infection control and high exposure rate
- greater challenge in contact tracing versus Ebola in W. Africa
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: Myopic and Flawed Policy
Comfort and Complacency: The Enemies of Vigilance and Preparedness
Who Pays for Preparedness?

The Obligate Role of Private-Public Partnerships in Biosecurity Policy

Engaging the Private-Sector Health Care System in Building Capacity to Respond to Threats to the Public’s Health and National Security

The National Academies of Sciences • Engineering • Medicine
NO ESKAPE!: Resistant Bugs and Few New Drugs

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

- the ESKAPE pathogens
  - *Enterococcus faecium*
  - *Staphylococcus aureus*
  - *Klebsiella pneumoniae*
  - *Acinetobacter baumanii*
  - *Pseudomonas aeruginosa*
  - *Enterobacter species*
New Incentives to Accelerate Investment in Drugs and Vaccines for Public Health
Global Health Security Agenda

- prevent, detect and respond to infectious disease
- safeguard economies
- end the cycle of panic and neglect
- need for sustained investment commitment
- essential public health capacities represent recurring cost
The Joint External Evaluation Exercise (JEE):
January 2016*

- major deficits in 89% of the 55 countries evaluated to date
- surveillance for highly antibiotic resistant pathogens and antimicrobial stewardship
- biosecurity and surveillance for zoonotic diseases, food poisoning and water-borne illness
- insufficient personnel and training
- investment levels
- major risks to cross-border disease spread

*V. Gupta et al. (2018) J. Global Health 8, e.020416
China Has Withheld Samples of a Dangerous Flu Virus

Despite an international agreement, U.S. health authorities still have not received H7N9 avian flu specimens from their Chinese counterparts.

Aug 27, 2018

Health workers attending to an H7N9 avian flu patient in Wuhan, China, in 2017.

Agence France-Presse -- Getty Images
Sharing of Specimens and Data is Crucial for Global Biosurveillance and Real Time Situational Awareness

- PRC
  - obfuscation about SARS
  - current H7N9 influenza strains in human
  - highly pathogenic avian influenza (HPAI) strains
  - African Swine Fever virus isolates

- Indonesia
  - H5N1 influenza

- Saudi Arabia
  - MERS-CoV
Dual-Use Applications of Synthetic Biology and the Expanded Spectrum

• beneficial and maleficent applications of same knowledge
• potential to cause profound societal disruptions based on misuse, error or accident
De Novo Synthesis of Pathogens

Chemical Synthesis of Poliovirus cDNA: Generation of Infectious Virus in the Absence of Natural Template
Jeronimo Cello, Aniko V. Paul, Eckard Wimmer*

Construction of an infectious horsepox virus vaccine from chemically synthesized DNA fragments
Ryan S. Noyce¹, Seth Lederman², David H. Evans¹*

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
Digital Biology

- biology at internet speed
- transmission of digital instruction code to any location
- geographic uncoupling of design (code) from manufacture (synthesis and assembly)
Policy Frameworks for Dual-Use Research of Concern (DURC): Primary Focus on Pathogenic Microorganisms
Editing the Human Germ Line: No Longer An Abstract Question

- editing humanity: moral and legal constraints or hubris and irresistible inevitability?
- long standing science fiction scenarios and philosophical, religious, ethical, legal debates on the societal implications
- no longer a theoretical debate
Synthetic Biology and DURC: Thinking “Beyond Bugs”

- precision medicine
  - mapping the molecular networks (circuit diagrams) of every cell type in the body and disruptions in disease
- roadmap for next-generation chemical warfare agents to target specific molecular circuits and body functions
Dual-Use Implications of Advances in Brain Science

Mapping Sensory, Motor and Cognitive Functions

Chemical or Electronic Modulation of Specific Neural Circuity:
New Warfare Capabilities and Societal Vulnerabilities

- fear, depression, suicidal ideation
- aggression
- disruption of sleep patterns
- memory modulation
- lethargy
- addiction
Purposeful Societal and Economic Disruptions Via Synthesis of Ever-Changing Pipeline of Addiction Drugs by Synthetic Biology

![Drug bag and addictive substances](image)

- **Morphine**
- **Oxycodone**
- **Fentanyl**
- **Furanyl fentanyl**
- **5-Methyl fentanyl**

**POTENCY compared to MORPHINE**
- Morphine: 1
- Oxycodone: 1.5x
- Fentanyl: 50-100x
- Furanyl fentanyl: 1,000,000x

There are over 40 analogues (variations) of fentanyl.

To evade prosecution, chemists alter the fentanyl molecule to create new analogues.

![Chinese and Mexican flags](image)
China’s Export of Fentanyl and Derivatives: A New Biosecurity Threat
Gray Zone Threats

The Emerging Dimension of Hybrid Warfare

New Risks in the Gray Zone Between Peace and Major Conflict

Implications for Biosecurity
Darker Shades of Gray: The Emerging Dimension of Hybrid Warfare

- weaponized narratives
- deception, disinformation and propaganda
- lawfare; exploiting loopholes and seeding ambiguity
- plausible deniability
- exploit Western public reluctance for formal military deployments
Hybrid Warfare: The Putin-Gerasimov Military Doctrine
Gray Zone Tweets and Biosecurity: Russian Trolls and Twitter Bots

- weaponized health communications
  - anti-vaxxer campaigns
  - anti-GMO movements
- compromise health care computer systems and or other critical computing capabilities in bioincidents
- Novochok chemical attack UK 2018
  - Salisbury UK hospital computers
  - thwarted hack of Organization for Prohibition of Chemical Weapons (The Hague) conducting forensic analysis
Gray Zone Threats

- between peace (zero) and major military conflicts (five)
- are we already facing level one/two – level escalation?
BIOTHERMAL WEAPONS
CONVENTION
Export Controls on Technologies for WMD Threats and CBW Weaponization
Screening of Gene Sequences of Concern

- screening orders to synthesize potentially dangerous sequences
  - focus on select agents
- likely increasing irrelevance as a biosafety/surveillance tool
  - lower cost of synthesis machines
  - digital genome computer codes bypass screening and surveillance tools
  - new gene editing tools makes any gene a target
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
“Fits and starts: Reactionary Biodefense”

October 2018
PROCRASTINATE NOW AND PANIC LATER
The Biosecurity Challenge

- complex, multi-dimensional problems cannot be solved by uni-dimensional approaches
- danger of episodic investment and/or uni-dimensional interventions versus sustained systems-based investment to develop and sustain resilient systems
- strong preparedness and attribution capabilities are a deterrent to adversaries
The Changing Biosecurity Landscape

- need for higher priority of biosecurity in national security strategy and international engagement
- development of more sophisticated threat assessment capabilities
- strengthen surveillance, analysis deterrence capabilities in national security, IC, law enforcement
- greater investment in robust and agile threat mitigation capabilities
  - obligate private sector engagement
  - logistics and operational integration (and training) for complex bioincident management
- more relevant oversight mechanisms and international harmonization

COMPLACENCY!!
Escalating Complexities in Biosecurity

- All Hazards Analysis
- Synthetic Biology, Digital Biology
- Biosurveillance and Diagnostics
- Meta–Data, Advanced Computing, AI
- Agent X and Proliferation of Dual-Use Risks

“Threat Space”
“Design Space”
“Detection Space”
“Analysis Space”
“Preparedness Space”
“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/