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

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Introduction to Core Concepts and Challenges to be Reviewed in Weeks 2 to 7
The Biosecurity Quartet

- Infectious Diseases of Natural Origin
- Globalization Trends and Environmental Impacts on Disease Emergence (EIDs & Zoonoses)
- Military and/or Humanitarian Missions in Dense Urban Areas and ‘Hot Zones’
- New Dual-Use Technologies and the Expanded Threat Spectrum: Biowarfare; Bioterrorism; Bioerror

- natural and non-natural infections share same needs for threat assessment, deterrence, detection, containment, mitigation (counter-measures) and recovery
- additional forensics requirements for attribution (and retribution?) for non-natural events
Biosecurity

- global public health and biosecurity as a highly complex system nested in a web of other inter-connected and inter-dependent complex systems (systems of systems)
- intimate biological/ecological linkages: human health, agriculture, food and water security, natural resources depletion, climate change (‘One Health’ concept)
- urbanization, global transport and expanding threats from emerging infectious diseases (EIDs)
- risk of profound disruption of critical global supply chains
- potential major economic disruptions: direct and indirect
- trigger geopolitical (ins)stabilities/military conflict
- new technologies and an expanded threat spectrum and risk assessment needs
The Global Risks Report 2020

Insight Report | 15th Edition
In partnership with Marsh & McLennan and Zurich Insurance Group
The Relentless Ever-Changing Dynamics of Infectious Diseases

old foes resurgent: Rx – resistance

omnipresent pandemic threats

new foes: emerging infectious diseases

climate change and new vector ranges

bioterrorism and bioweapons

dual-use research of concern

SARS-CoV-2
Presidential Encounters with Infectious Disease

WH Directives and Memoranda
- Presidential Policy (PPD)
- National Security (NSPD)
- Homeland Security (HSD)
- National Security Memoranda (NSPM)

- HIV
- Military Medicine: force protection and projection
- West Nile
- PPD (x3)
- Anthrax
- PEPFAR
- SARS
- HSD 4,10,18, 21
- NSPD 17,33
- PPD 10
- H1N1 influenza
- MERS
- Ebola
- Zika
- Chikungunya
- NSPM 7, 14
- PRC - espionage
- SARS-COV-2
- ???
- PDD (X2)
# 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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<tr>
<td><strong>today</strong></td>
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<td>• bioterrorism</td>
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<td>- artificial intelligence</td>
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<td>- robotics/autonomous systems</td>
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<td>- error/accident</td>
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What’s Out There?

- A Global Inventory of Natural Microbial Threats to Humans and Vital Agricultural/Ecological Resources

- The Predominance of Zoonoses as Emerging Infectious Disease Threats: The “One Health” Perspective

- Natural Pathogens as Attractive Substrates for Engineering New Bioterrorism and Biowarfare Threats
Recent Emerging Infection Diseases

Cell 182, D. Morens, A. Fauci (2020), 1082
“One Health” - The Importance of Zoonotic Diseases as Human Health Threats: A Rich Reservoir for EIDs and Genetic Manipulation
“One Health” - The Importance of Zoonotic Diseases as Human Health Threats: A Rich Reservoir for EIDs and Genetic Manipulation

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

COVID-19
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 Rapid Disease Reporting
The COVID-19 Pandemic and the Primacy of Rapid Detection in International Cooperation and Transparency

- lack of transparency and IHR compliance reporting (12/19-1/20)
- Wuhan/Hubei lockdown (1/23/20) but extensive flights to foreign countries for prior 2 weeks
- constraints on export of PPE while US still exporting
- new lockdown in Shulan (pop 600k; 5/21/20)
- ongoing aggressive global disinformation campaign

- reluctance to demand data from PRC (early 1/20)
- misplaced praise for PRC “extraordinary control measures”
- slow declaration of Public Health Emergency of International Concern (PHEIC) (1/30/20)
Fundamentally Different Threat Categories:

**Bombings and Hazmat-Incidents: Immediate Damage Assessment**

**Bioincidents: An Unfolding (Rolling) Event - EDs and Farms Will Be the Front Line**
The Evolution of a Bioincident

- detection of atypical event (speed of alert)
- containment (stamp out at the source)
- prevent spillover (sparks to ignite a fire)
- mitigation (flatten the curve and reduce demand on finite resources)
  - large scale testing and contact tracing
  - slow the spread and assess herd immunity
- maintenance of essential services and public order
- surge capacity, supply chain logistics and triage priorities for allocations of finite resource
- reliable information and public trust in actions by authorities (managing the worried well)
Ugly but Predicted Realities

- media sensationalism and proliferation of social media disinformation
- public confusion, panic, and erosion of trust in authorities
- 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
- unpredictable consequences for public responses and societal stability
- unpredictable unilateral reciprocal decisions by other governments to restrict trade, travel and shipment of essential goods
- dislocation of supply chains might break down completely – national, international
Who's in charge?
The conflicts and confusion in Trump's coronavirus response
The Intrinsic Tension Between Public Health Containment Actions & Cascading Adverse Effects on Economic/Social/Health Care Systems
Faster Detection 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

genomics of pathogen evolution
dual-use research and engineered biothreats
COVID-19 Pandemic and Major Gaps in US Diagnostic and Containment Capabilities

- First official US death (1/29/20) but virus probably circulating from early December
- WHO Dx test rejected: hubris and technological arrogance
- Failure of first CDC-produced Dx test kits (2/4/20): the lost month
- No surge capacity for widespread Dx tests and track/trace programs
- Tardy reachout to mobilize private sector/academic Dx test resources for surge/scalability
- State/local PHS labs underfunded, under-resourced and not operational until 3/8/20
Global Tracking of Mutational Changes in SARS-CoV-2 Samples
Notice the Resemblance?
Hygiene and Quarantine as the Only Effective Containment Absent Drugs or Vaccines

Bubonic Plague
Physician 15th Century

Ebola, Liberia
21st Century

COVID-19
21st Century
MEMORANDUM FOR THE SECRETARY OF HEALTH AND HUMAN SERVICES
THE SECRETARY OF HOMELAND SECURITY
THE ADMINISTRATOR OF THE FEDERAL EMERGENCY MANAGEMENT AGENCY

SUBJECT: Allocating Certain Scarce or Threatened Health and Medical Resources to Domestic Use
Unfortunate Truisms in Public Health: Comfort and Complacency Erode Robust Preparedness

- Out-of-Sight, Out-of-Mind
- If Nothing Happens, the Preparedness Budget Gets Cut
- Why Don’t We Learn from History?
Comfort and Complacency: The Enemies of Vigilance and Preparedness
“Fits and Starts: Reactionary Biodefense”
The Endless Cycle: From Complacency to Crisis and Back to Complacency

U.S. Funding for Global Health Security

- Zika appropriations
- Ebola appropriations
- Global health security

2006: $390
2007: $321
2008: $376
2009: $417
2010: $486
2011: $397
2012: $390
2013: $366
2014: $499
2015: $909
2016: $146
2017: $407
2018: $402
2019: $353

Who Pays for Preparedness?

The Obligate Role of Private-Public Partnerships in Biosecurity Policy

PROCEEDINGS OF A WORKSHOP

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

The Long Predicted Rude Shock of a Global Pandemic

A Dangerously Too Long Ignored Core Element of National and Global Security Policy and Preparedness Planning

Complex Multi-Dimensional System Embedded in a Large Matrix of Complex Systems That Affect All Aspects of Societal, Economic and Geopolitical Stability

Future Prospects of An Expanded Threat Spectrum Driven by New Technologies and National Competitiveness (US vs PRC)

Escalating Complexity and Urgency for Proactive Policies, Institutional Reforms and Investment
The Imperative for Proactive Actions for Robust Biosecurity

● need for higher priority of biosecurity in national security strategy and international engagement

● development of more sophisticated threat assessment capabilities

● strengthen and integrate surveillance, analysis deterrence capabilities in national security, IC, and public health

● greater investment in robust threat mitigation capabilities
  - obligate private sector engagement
  - logistics and operational integration (and training) for complex bioincident management

● agile oversight mechanisms and international harmonization