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

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Planning for the Future
Sars-CoV-2 Revealed Major Shortcomings in the US Public Health Capabilities

PREPARED? NO!

Key
- Most Prepared
- More Prepared
- Least Prepared
Building Robust Preparedness to Combat Epidemic and Pandemic Infectious Diseases

- shared requirements whether of natural or nefarious origin
  - “all-hazards”

- major vulnerabilities exist across the entire spectrum of required capabilities
  - global biosurveillance, pre-emptive detection and interdiction
  - rapid diagnosis, track and trace
  - healthcare resources for large scale bioincidents
  - drug and vaccine availability supply chain fragilities and mass distribution logistics
  - outdated public health laws: national and international
  - institutional competences and agility (international: WHO; and national: CDC, NIH, DoD, USDA)
  - inadequate proactive engagement of private sector expertise and production scale
COVID-19: The Past as Prologue and the Continued Present

- the quest for high levels of ‘herd immunity’ (>60%)
  - vaccination and/or natural infection
- will mutational drift in SARS-CoV-2 render current vaccine strategies ineffective and require constant vaccine redesign (cf. influenza)?
- strengthen diagnostic test, track and trace capabilities for rapid containment of future ‘hot spot’ flaring
- will SARS-CoV-2 show progressive reduction in virulence and become endemic to join the four other low virulence coronaviruses that circulate?
Global Preparedness to Combat Infectious and Parasitic Disease

- comparable vulnerabilities to shortcomings in human public health preparedness apply to protection of critical agricultural and ecological resources

- Swine Fever
- Crop diseases
- Increased famine risk from reduced agricultural productivity
Connectivities:
Climate Change and New Diseases Patterns

- Desertification and agricultural productivity
- Deforestation and depletion of natural resources
- New vector ranges for infectious disease transmission
Global food system emissions could preclude achieving the 1.5°C and 2°C climate change targets

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The Paris Agreement’s goal of limiting the increase in global temperature to 1.5°C or 2°C above preindustrial levels requires rapid reductions in greenhouse gas emissions. Although reducing emissions from fossil fuels is essential for meeting this goal, other sources of emissions may also preclude its attainment. We show that even if fossil fuel emissions were immediately halted, current trends in global food systems would prevent the achievement of the 1.5°C target and, by the end of the century, threaten the achievement of the 2°C target. Meeting the 1.5°C target requires rapid and ambitious changes to food systems as well as to all nonfood sectors. The 2°C target could be achieved with less-ambitious changes to food systems, but only if fossil fuel and other nonfood emissions are eliminated soon.
“One Health”

- the interdependencies of human health, animal health and ecosystems stability

- the increased importance of ‘spillover’ of animal pathogens as reservoirs of emerging infectious diseases with pandemic potential (zoonoses)
‘One Health’ Biosurveillance: The Need to Rebuild the Front Line in Biopreparedness

Natural reservoirs and ecological niches of emerging viruses

Susceptible human host

- range and physical contact
- environmental factors

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

The Longer-Term Economic Consequences of COVID-19

- Government and central bank policies
  - debt, taxation, inflation
- Business sector recovery
- PRC ascendancy?
The Baby Boomers and an Aging US Society An Unrecognized Biosecurity Threat?

- 10,000 boomers turn 65 every day
- 79% projected increase in boomers 80 or older by 2030
- dramatic growth in chronic disease burden
  - the toll of multiple-comorbidities
- $4 trillion US healthcare economy (c.19% GDP)
  - political reluctance to confront looming unsustainable cost of unlimited care-
- unchecked cost as a potential risk to needed investments in global public health, climate change mitigation, corporate innovation and military competitiveness in advanced technologies
technology acceleration and convergence

new great power rivalry for commercial and military superiority in next-generation technologies

expansion of the dual-use threat dilemma
New Technologies and Increased Complexity of Dual-Use Issues in Biosecurity: Synthetic Biology, Genome Editing and Manipulation of Biological Pathways

digital biology: “it from bits”
de novo synthesis of organisms
engineered virulence

targeted modification of any biological pathway in any organ
modulation of neural sensory and cognitive pathways
accelerating technological diffusion
Synthetic Biology, Gene Editing and Human Eugenic Modification
Cognitive Computing, Brain: Machine Interactions and the Enhanced Warfighter
The Quest for Commercial and Military Dominance in Advanced Technology
THE NEW COLD WAR?

Adversary
- military
- economic fragility

Adversary
- military
- commercial
- post-COVID ascendancy
PRC: The Military-Civil Fusion Plan

- integrate civilian R&D to maximize the capabilities of the People’s Liberation Army
- Commission for Military-Civil Fusion Development - led by President Xi
- the “Digital Silk Road” as a component of the larger Belt-and-Road initiative
- 2019 China Standardization Development Report - 85 cooperation agreements with 49 countries
- major R.& D. investments and sophisticated biotechnology/computing expertise
- purposeful creation of large diaspora for training in US/EU universities
- relentless industrial espionage and relentless cyber-exfiltration efforts
- mapping the genetic diversity of human populations
National Security Implications of Genomic Data on Populations

Population Databanks

Individual Profiles

Foreign Access to Data

Data Security
MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Direct-to-Consumer Genetic Testing Advisory for Military Members

It has come to the attention of the DoD that some direct-to-consumer (DTC) genetic testing companies are encouraging DoD personnel to purchase genetic ancestry and health information through the offering of military discounts or other incentives. These DTC genetic tests are largely unregulated and could expose personal and genetic information, and potentially create unintended security consequences and increased risk to the joint force and mission.

Exposing sensitive genetic information to outside parties poses personal and operational risks to Service members. DTC genetic tests that provide health information have varying levels of validity, and many are not reviewed by the Food and Drug Administration before they are offered, meaning they may be sold without independent analysis to verify the claims of the seller. Possible inaccuracies pose more risk to DoD military personnel than the public due to Service member requirements to disclose medical information that affects readiness (see DoD Instruction 6025.19, “Individual Medical Readiness”). Testing outside the Military Health System is unlikely to include a clear description of this risk.

Moreover, there is increased concern in the scientific community that outside parties are exploiting the use of genetic data for questionable purposes, including mass surveillance and the ability to track individuals without their authorization or awareness.

Until notified otherwise, DoD military personnel are advised to refrain from the purchase and/or use of DTC genetic services.

Joseph D. Kernan
Under Secretary of Defense for Intelligence

James N. Stewart
Assistant Secretary of Defense for Manpower and Reserve Affairs, Performing the Duties of the Under Secretary of Defense for Personnel and Readiness
Deciphering China’s AI Dream

The context, components, capabilities, and consequences of China’s strategy to lead the world in AI.

Jeffrey Ding:
Centre for the Governance of AI
Future of Humanity Institute, University of Oxford
March 2018
Gray Zone Threats

An Emerging Dimension of Hybrid Warfare

New Risks in the Gray Zone Between Peace and Major Conflict

Implications for Biosecurity
‘Big Tech’ and the Global Digital Ecosystem

- increasing pervasive reach of data collection on individuals, institutions, societies and governments
Surrender of Personal Privacy and Autonomy For Access to the Conveniences of the Digital Economy

- the confessional of social media
- click-based commercial and political targeting
- opaque data use and distribution by large data companies/governments
- anticipate our “wants and needs”
- “access to your mental states”
Artificial Intelligence: What Algorithms Provide (Want?)

“I actually think most people don’t want Google to answer their questions. They want Google to tell them what they should be doing next.”

Eric Schmidt
Chairman, Google
Digital Surveillance: Access to Your Mental State(s)

- tracking of personal data, use patterns and predictive analytics
- insidious erosion of privacy and personal autonomy
- monitoring and tracking technologies outpacing regulatory/legislative protections
Big Data Analytics: From Consumerism to Control?
Big Data Meets Neuroscience – The Ultimate Technological Triad: Consumerism, Commerce and Control

- Social media profiling
- Artificial intelligence - surveillance, manipulation
- Neuroscience and mechanistic mapping of cognitive pathways
AI: Data Finding Data - “Intelligence at Ingestion”
Why Wait for the Slow (Human) Brain to Catch Up?

Feature Extraction and Classification

Context Analysis

Persistent Context

- Relevance Mapping
- Learning Systems

- Situational Awareness
- Rapid, Robust Decisions
“Explainable AI”
Keeping Humans in the Decision Loop

- need to better characterize the evolution of decision algorithms
- deconvolution of how and why machine learning algorithms reach flawed conclusions
- broad national security issues related to data integrity
- concern over AI-directed manipulation of social networks, advertising and personal data
- corruption of critical military and civilian systems and decision tools
Robotics, Automation, AI and Decision-Support: The Future of Work, Education and The Future Workforce
Biosecurity

- long predicted rude shock of a global pandemic and neglect of preparedness
- biosecurity is ‘more than bugs’
Biosecurity: A Complex System Nested in a Matrix of Multiple Complex Systems

- technology
  - public health, healthcare, agriculture, data science
- ecosystems
  - urbanization, natural resources depletion, water, food, climate change
- socio-economic
  - haves and have nots
- governance
  - domestic and foreign policies, regulation, international cooperation
  - industry and military
  - the quest for superiority in advanced technologies
Biosecurity

- escalating complexity imposes new challenges on governance and institutions
- decision-making in the face of accelerating change and accompanying uncertainties
- national leadership, governance and institutional relevance
  - integration of multi-dimensional complexity
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 (and advanced technologies at large)
• “quick fixes”, and unidimensional, short term policies
  - policy too often defined by length legislative terms
  - failure to address long term, multidimensional complexities
  - dangerous myopia of national vs global perspectives
PREPARE FOR TOMORROW'S THREAT TODAY
“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)