

Reducing Global Biological Risks

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Senior Executive Seminar

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NTI:bio

Overview

- I. COVID-19 has highlighted global vulnerabilities to pandemics
- II. Biological risks & risk reduction
- III. Reducing emerging bio-risks associated with technology advances
- IV. Reducing the risk of bioweapons development
- V. Building biosecurity & pandemic preparedness capacity globally

I. COVID-19 has revealed global vulnerabilities.

- COVID-19 is not the first epidemic with global impact; it won't be the last.
- Future biological events could be as damaging as COVID-19, or potentially much worse.
- Future pandemics could emerge naturally, from a lab accident or a bioweapons attack.
- Pandemics threaten global public health, as well as economic and political stability.
- Now is the time to strengthen international capabilities to prevent and respond to future large biological events.

I. COVID-19 has exacerbated bio-risks

- Proliferation of research into SARS-CoV-2 and other pathogens with pandemic potential.
- Malicious actors may now recognize and act on the disruptive potential of highly transmissible pathogens and other biological agents.

II. Biological Risks & Risk Reduction

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Naturally
Emerging
Epidemics

Laboratory
Accidents

Deliberate
Bioweapons
Attacks



II. Biological Risks & Risk Reduction

Prevention

Early Detection

Response

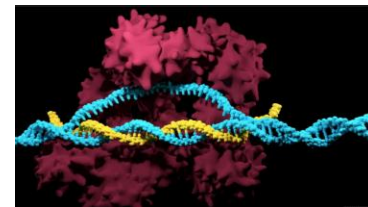
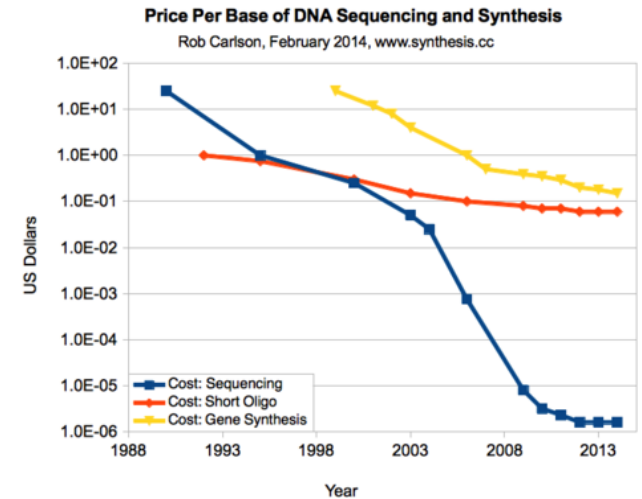
III. Reducing emerging bio-risks associated with technology advances

III. Technology Advances & Emerging Bio-Risks

Technology advances offer tremendous opportunities but also pose unique risks.

Easier to read, write, edit DNA & RNA - blueprint for all living organisms.

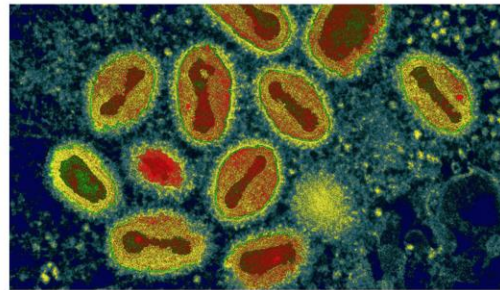
- Reading = DNA & RNA Sequencing
- Writing = DNA & RNA Synthesis
- Editing = Gene & Genome editing



III. Technology Advances & Emerging Bio-Risks

Easier to generate pathogens from scratch or modify virulence, transmissibility, susceptibility to medical countermeasures.

Some researchers are using new tools to synthesize and modify pathogens.



An unpublished study suggests that making variola, the virus that causes smallpox, is neither expensive nor difficult. EYE OF SCIENCE/SCIENCE SOURCE

How Canadian researchers reconstituted an extinct poxvirus for \$100,000 using mail-order DNA

nature

Explore our content ▾ Journal information ▾

nature > articles > article

Article | Published: 04 May 2020

Rapid reconstruction of SARS-CoV-2 using a synthetic genomics platform

Tran Thi Nhu Thao, Fabien Labrousseau, [...] Volker Thiel [✉](#)

Nature 582, 561–565(2020) | [Cite this article](#)

93k Accesses | 13 Citations | 1086 Altmetric | [Metrics](#)

nature
International journal of science

Letter | OPEN | Published: 02 May 2012

Experimental adaptation of an influenza H5 HA confers respiratory droplet transmission to a reassortant H5 HA/H1N1 virus in ferrets

Masaki Imai, Tokiko Watanabe, Masato Hatta, Subash C. Das, Makoto Ozawa, Kyoko Shinya, Gongxun Zhong, Anthony Hanson, Hiroaki Katsura, Shinji Watanabe, Chengjun Li, Eiryo Kawakami, Shinya Yamada, Maki Kiso, Yasuo Suzuki, Eileen A. Maher, Gabriele Neumann & Yoshihiro Kawaoka [✉](#)

REPORT

Airborne Transmission of Influenza A/H5N1 Virus Between Ferrets

Sander Herfst¹, Eefje J. A. Schrauwen¹, Martin Linster¹, Salin Chutinimitkul¹, Em...

[+ See all authors and affiliations](#)

Science 22 Jun 2012:
Vol. 336, Issue 6088, pp. 1534-1541
DOI: 10.1126/science.1213362

Editor's Pick Commentary | Therapeutics and Prevention

A Critical Analysis of the Scientific and Commercial Rationales for the *De Novo* Synthesis of Horsepox Virus

Gregory D. Koblenz

DOI: 10.1128/mSphere.00040-18 [Check for updates](#)

Horsepox synthesis: A case of the unilateralist's curse?

By Gregory Lewis, February 19, 2018



Rewriting Life

Top U.S. Intelligence Official Calls Gene Editing a WMD Threat

Easy to use. Hard to control. The intelligence community now sees CRISPR as a threat to national safety.



HEALTH INC.

Did Pox Virus Research Put Potential Profits Ahead of Public Safety?

4:48

PLAYLIST

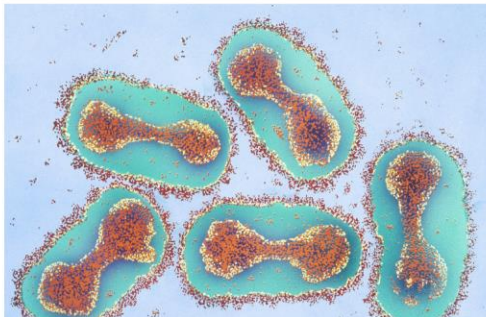
DOWNLOAD

EMBED

TRANSCRIPT

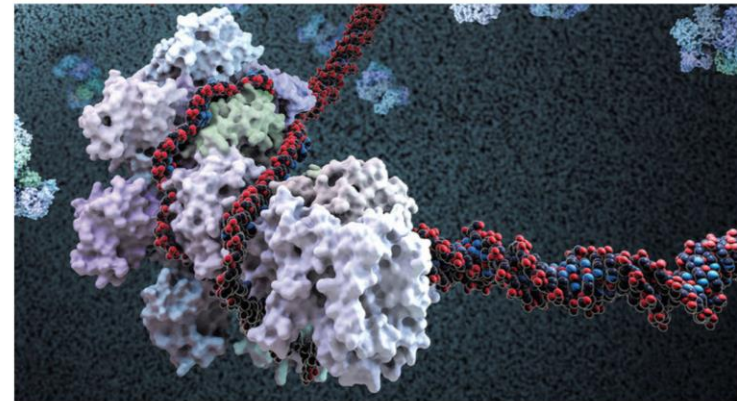
February 17, 2018 · 8:08 AM ET
Heard on Weekend Edition Saturday

NELL GREENFIELDBOYCE



The National Academies of
SCIENCES · ENGINEERING · MEDICINE
CONSENSUS STUDY REPORT

BIODEFENSE IN THE AGE OF Synthetic Biology



VAL ALTOUNIAN/SCIENCE

CRISPR—a weapon of mass destruction?

By Kelly Servick | Feb. 11, 2016, 4:45 PM

Deliberate & Accidental Release Risks

Democratized access enables a wider range of actors to engineer pathogens.

- **Increased risk of non-state actor attack**
- **Increased risk of accidental release of engineered pathogen**
- **Could shape state bioweapons risks**



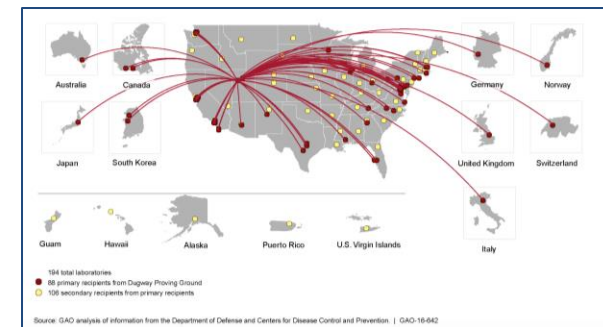
Aum Shinrikyo



2001 Anthrax Attacks



Sverdlovsk Accidental Anthrax Release



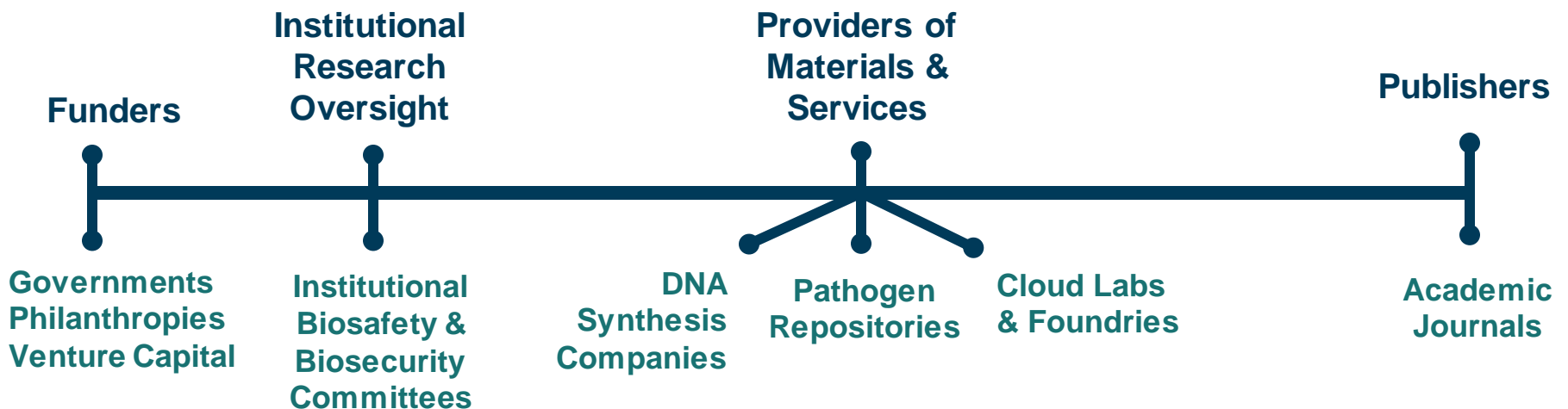
Shipment of insufficiently inactivated anthrax spores to 194 labs.

Government Efforts Are Not Keeping Pace

- **Global Health Security Index: Fewer than 5% of countries provide oversight for dual-use research of concern**
- **Governments & National Academies have done important work, but it has been too slow and insufficient to keep up with rapid technology development.**
 - European Academies Science Advisory Council & U.S. National Academies reports on gain of function research (2015)
 - U.S. government two-year moratorium on gain of function research → White House guidance on Potential Pandemic Pathogens (2017)
 - U.S. Dual Use Research of Concern policies (2012, 2014) and DNA Synthesis Screening Guidance (2010)

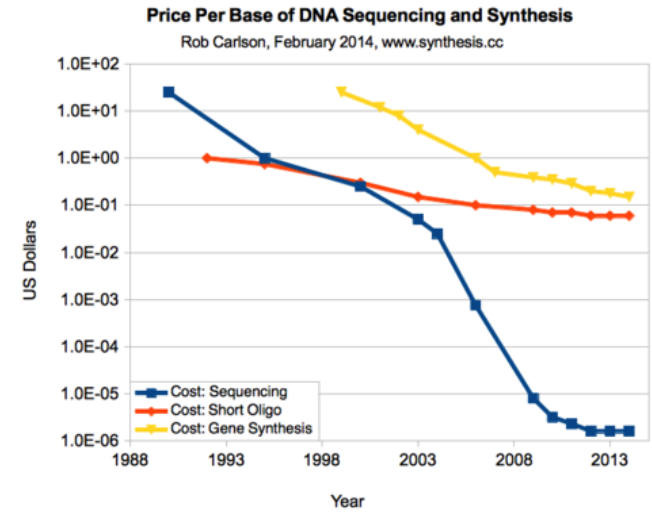
Proposed Solution Set

- Ensure that the legitimate global bioscience research & development enterprise is not exploited by bad actors
- Reduce accidental laboratory release risk for engineered pathogens
- *How?* Multiple intervention points throughout research lifecycle. Layered defense.



DNA Synthesis & Screening

- DNA synthesis is getting faster, cheaper and more accurate over time.
- DNA synthesis screening is voluntary.
 - No country requires companies to screen DNA orders or customers.
 - ~80% of global market share is screened
- Experts anticipate commercially available benchtop synthesis within 2-5 years.
 - Currently unclear what controls will be in place for benchtop synthesis devices.



NTI Biosecurity Innovation & Risk Reduction Initiative

Challenge

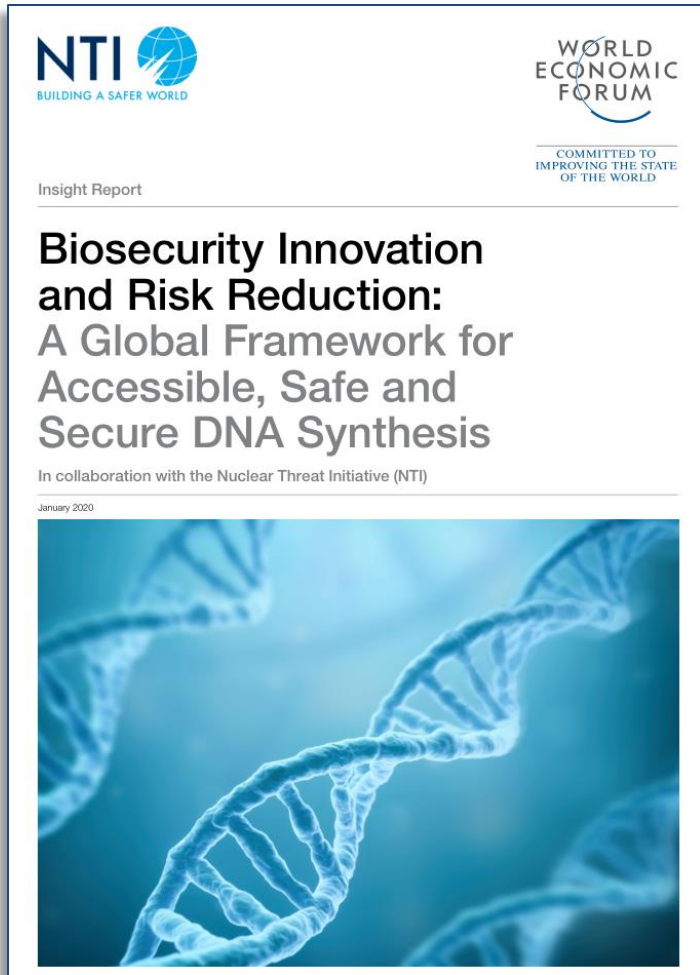
Advances in biotechnology **outpace governments' ability to provide effective oversight** to prevent accidents or deliberate misuse.

Engage **public and private sector leaders to catalyze biosecurity actions and technical approaches** to reduce risks associated with the bioscience research enterprise.

Action



Taking Action to Improve DNA Synthesis Screening & Bioscience Governance



NTI-WEF Report, January 2020

- Establish a **Technical Consortium** to develop International Common Mechanism for DNA Synthesis Screening
- Establish an **International Normative Entity** to help establish global norms and guidelines for governance of dual-use bioscience research.

NTI launched the Technical Consortium in May 2020.

NTI is working with international partners to explore the option of establishing an international normative entity.

IV. Reducing the risk of bioweapons development

IV. Biological Weapons Convention

- Prohibits development, production, acquisition, stockpiling of biological and toxin weapons
 - Articles I-X
 - 183 States Parties. Goal of universalization.
- National implementation and Confidence Building Measures
 - No verification provision
- BWC Review Conference every 5 years
 - 9th Review Conference in 2022
- Intersessional process
 - Annual Meeting of States Parties
 - Annual Meeting of Experts
- Secretariat: BWC Implementation Support Unit
 - 3 staff members



IV. BWC Key Provisions

Article	Provision
Article I	Never under any circumstances to acquire or retain biological weapons.
Article II	To destroy or divert to peaceful purposes biological weapons and associated resources prior to joining.
Article III	Not to transfer, or in any way assist, encourage or induce anyone else to acquire or retain biological weapons.
Article IV	To take any national measures necessary to implement the provisions of the BWC domestically.
Article V	To consult bilaterally and multilaterally to solve any problems with the implementation of the BWC.
Article VI	To request the UN Security Council to investigate alleged breaches of the BWC and to comply with its subsequent decisions.
Article VII	To assist States which have been exposed to a danger as a result of a violation of the BWC.
Article X	To do all of the above in a way that encourages the peaceful uses of biological science and technology.

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Legislation, Regulations, Biosecurity and Biosafety



International Assistance and Cooperation

Munich Security Conference Exercise on High-Consequence Bio-Threats

Goals: Address biotech risks & root causes of BW development

Action: Convene tabletop exercise with senior global leaders

Recommendations:

- I. Implement global norms, governance
- II. Enhance transparency
- III. Investigate bio-events of unknown origin



How to strengthen capabilities to investigate bio-event origins during a crisis?

Options:

- Strengthen UN Secretary-General's Mechanism
- Joint Assessment Mechanism to investigate bio-events of unknown origin



How to enhance transparency for bioscience research?

- **Goals:** Avoid dangerous misperceptions
- **Challenge:** BWC lacks verification
- **Proposed Approach:** Governments, academia, industry develop & test enhanced transparency measures

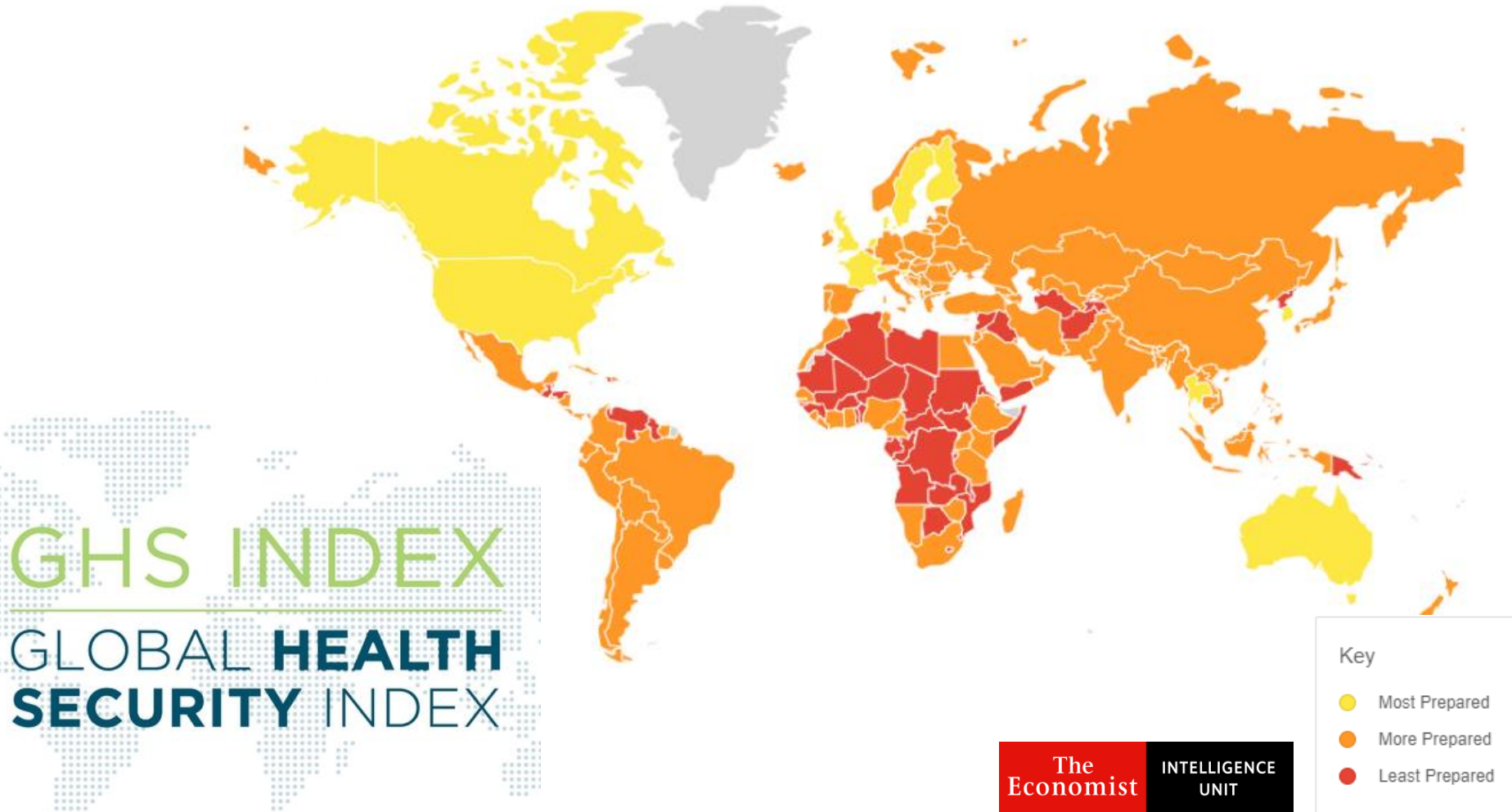


V. Building Biosecurity and Pandemic Preparedness Capacity Globally

National health security is fundamentally weak around the world.

No country is fully prepared for epidemics or pandemics; every country has important gaps.

Average Overall Score: 40.2 out of 100



The Post's View • Opinion

The world is flunking in the fight against disease



Decontamination after health-care workers entered the house of an 85-year-old woman, suspected of dying of Ebola, in the eastern Congolese town of Beni on Oct. 8. (Zohra Bensemra/Reuters)

By **Editorial Board**

Oct. 28, 2019 at 4:06 p.m. PDT

THE THREAT of a disease disaster has arisen in the past two decades in an unfortunate cycle of panic followed by neglect. The panics have been real: the anthrax letters; severe acute respiratory syndrome and Middle East Respiratory syndrome, both coronaviruses; the swine flu pandemic; the Ebola



Key Findings - Examples

Most countries lack foundational health system capacities vital for epidemic and pandemic response: Average score of 26.4 out of 100

More than half of countries face major political and security risks that could undermine national capability to counter biological threats.

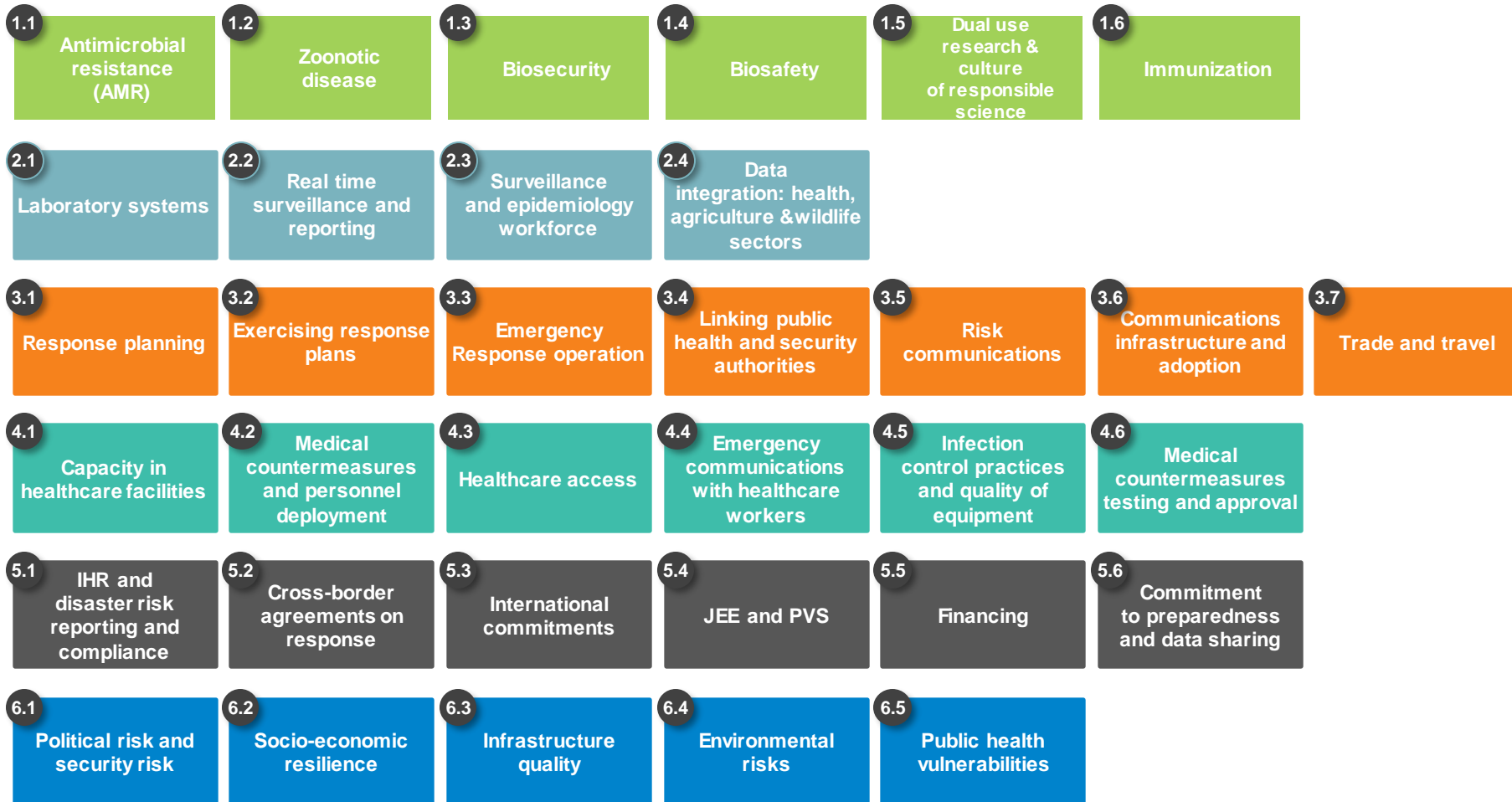
There is little evidence that most countries have tested important health security capacities or shown that they would be functional in a crisis.

Most countries have not allocated funding from national budgets to fill identified preparedness gaps.

GHS Index assesses six areas of health security



GHS Index: Thematic Indicators, 140 Questions



GHS Index: Numbers

195 countries benchmarked

27,000+ data points collected

5,000+ source documents consulted

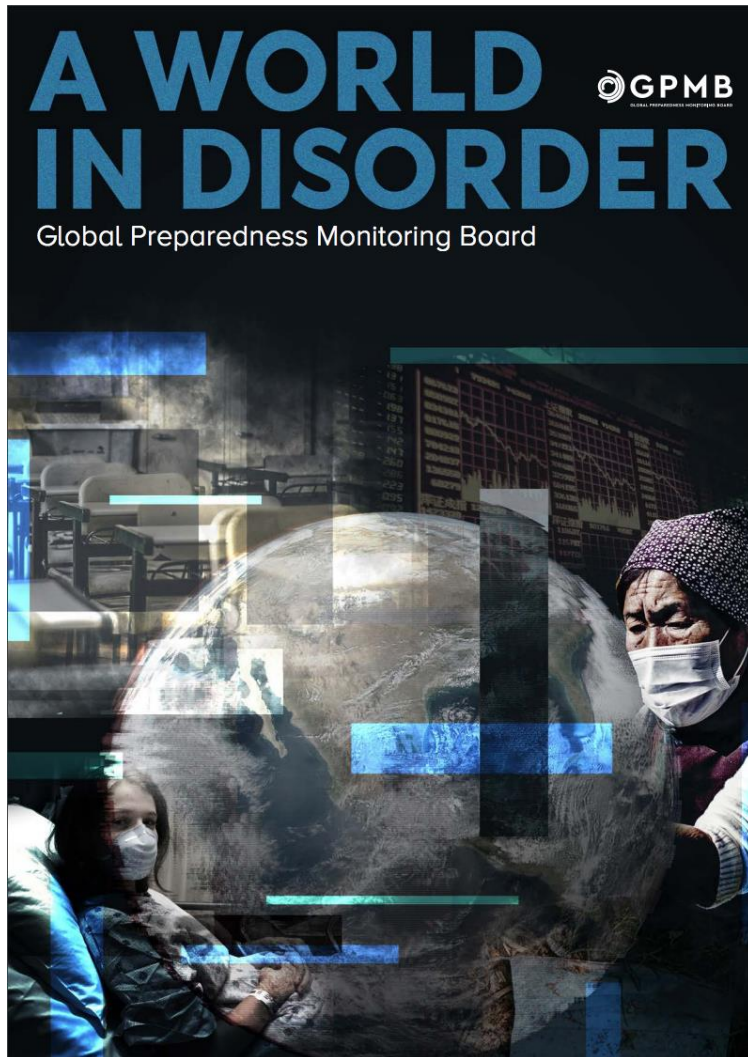
90+ new data series created (qualitative indicators)

~110 researchers and reviewers worldwide

~50 languages spoken by researchers

15,000+ hours of research

Global Preparedness Monitoring Board: 2020 Report



Report released September 14, 2020

“... the GPMB provides a harsh assessment of the global COVID-19 response, warning that the world cannot afford to be unprepared again when the next pandemic hits.”

Global Health Security Agenda (GHSA)

- Network of 70 countries. Launched in February 2014.
- Key Goals:
 - Accelerate development of national capacity to prevent, detect, respond to infectious disease
 - Emphasize GHS as a national priority, galvanize high-level commitments
 - Measurable targets
 - Multi-sectoral engagement
- Activities: 7 Action Packages
 - Antimicrobial Resistance
 - Biosafety & Biosecurity
 - Immunization
 - Laboratory Systems
 - Surveillance
 - Workforce Development
 - Zoonotic Disease
 - Sustainable Financing



III. Global Health Security Agenda (GHSA)

Task forces

- (1) Multi-Sectoral Stakeholder Engagement, (2) Accountability & Results, (3) Advocacy & Communications, (4) *Action Package Coordination

Led by GHSA Steering Group

- 2021 Chair: Thailand
- Permanent Members (2019 – 2023): Indonesia, Italy, Kenya, Kingdom of Saudi Arabia, Republic of Korea, Senegal, Thailand, United States, GHSA Consortium, Private Sector Round Table
- Rotating Members (2019 – 2021): Argentina, Australia, Canada, Finland, Netherlands, Pakistan, World Bank

**GHSA commitments renewed
in 5-year cycles (2019-2024)**

<https://ghsagenda.org/>



NTI Global Biosecurity Dialogues

A new international forum to promote & track national commitments to advance biosecurity around the world. Launched in 2018.

- NTI partnership with Africa CDC & African Union to develop biosecurity capacity on the continent.
 - May 2019 – Launch of Africa CDC Initiative to Protect Africa Against Dangerous Pathogens - Biosecurity focus
- NTI is in discussion with ASEAN about potential global biosecurity dialogue meetings in 2021.



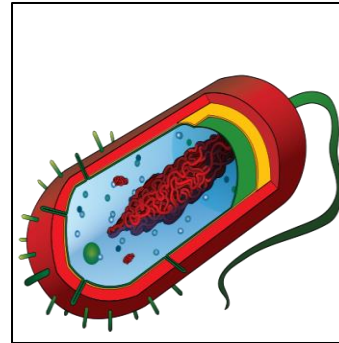
Thank you!

www.nti.org/bio

Backup Slides

Background: Technical Concepts

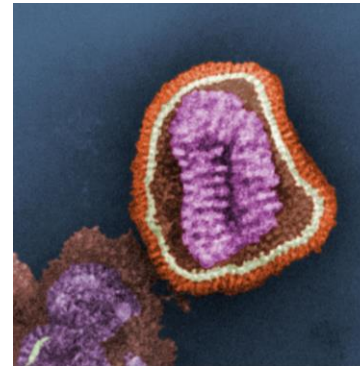
- **Bacteria** are living, single-celled organisms.
 - e.g. Anthrax
- **Viruses** are comprised of genetic material tightly packed into a protein and lipid shell.
 - e.g. Influenza, Smallpox, Ebola, SARS-CoV-2
- **Toxins** are poisonous compounds produced by cells or living organisms. The most potent toxins, such as botulinum toxin and ricin, are lethal in small quantities.



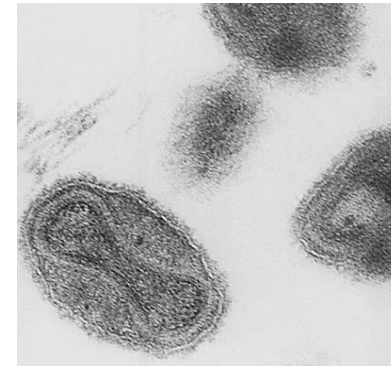
Bacterium diagram



Bacillus anthracis (Anthrax)



Influenza virus



Smallpox virus