

Biosecurity /,baɪ.əʊ.sɪ'kjʊə.rə.ti/ noun 1. the activities involved in preventing the spread of animal, human and plant diseases from one area to another

biosecurity

Ananda Impact Ventures

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Ananda
Impact Ventures

1.0 what is biosecurity?

Biosecurity is ‘a holistic term that includes policies and regulations to protect humans, food, agriculture, and the environment from potential biological threats’¹

Biosecurity encapsulates the idea that **human, animal and environmental health** are intimately connected – an idea referred to as “One Health”. In the same way national security can relate to geopolitical tensions and cybersecurity relates to technological advancements, biosecurity relates to biological threats to One Health.

Biosecurity has gained increasing importance over recent years, fuelled by climate change, globalisation, and the threat of novel infectious diseases. Global inter-connectedness, via travel and trade, now enables the rapid spread of pests, pathogens, and invasive species across borders, creating a continuous source of novel biosecurity threats. Collaboration across nations and public/private sectors is essential to standardise biosecurity practices, and ultimately protect human health, agricultural ecosystems, and the people and industries that depend on them.

Source: ¹Khalil, A et al., 2018



1.1 biosecurity vs biosafety

Often used interchangeably with the term biosecurity, in this context we define biosafety as the practical measures taken to prevent unintentional exposure to or release of biological agents, e.g., within a laboratory context. Whilst interlinked, we differentiate Biosecurity as relating to a broader range of unintentional and international biological threats which have a global impact.

1.2 goals of this report

This report aims to provide a comprehensive overview of biosecurity;

- illustrating its **importance** to us as consumers, as patients and as policymakers
- highlighting the **current state of biosecurity** and why change is needed
- outlining strategies for **biosecurity preparedness** and what change might look like
- exploring the **innovation** in the biosecurity sector, including the startup and VC landscape

“**Achieving a secure bioeconomy is imperative for protecting strategic interests, bolstering economic growth, and advancing collective well-being²**”

Source: ²ThinkGlobalHealth



1.3 three key takeaways

To secure a future of sustainable, actionable and effective biosecurity preparedness, we need...

To build capacity for detection, monitoring, and response

To foster collaboration between public and private sectors

To strengthen policy for biosecurity strategies

2.0 why is biosecurity important?

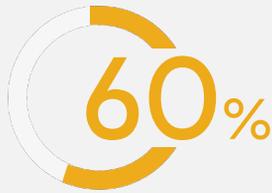
As biological organisms living in a complex ecosystem, we are equally as **vulnerable to biology** as we are reliant upon it.

COVID-19 reinforced the fact that biology does not respect borders. The pandemic provided a stark example of the high social and economic costs of poorly mitigated biosecurity threats, demonstrating that biosecurity is a global issue, demanding international attention, investment, and collaboration.

\$15.8 trillion

estimate of what the COVID-19 pandemic cost the global economy. This is 500 times more than what it would have cost to invest in proposed prevention measures.

Source: World Economic Forum



of global extinctions are thought to have been driven by invasive species. Invasion by non-native species is one of the top five drivers of global biodiversity loss.

Source: gov.uk

3.3 million

lives are expected to be lost each year from viral zoonotic diseases from 2022, without investment in appropriate biosecurity measures.

Source: Harvard T.H. Chan

2.1 four key themes in biosecurity

- 01** **food security**
E.g., pest- or pathogen-related famine, pandemics within livestock
- 02** **public health**
E.g., viral pandemics (COVI-19), anti-microbial resistant bacteria
- 03** **ecosystem health**
E.g., biodiversity loss due to invasive species, human activity including climate change
- 04** **biodefence**
E.g., intentional release of harmful pathogens, genetically engineered bioweapons

2.2 why is biosecurity undervalued?

Biosecurity is an issue that doesn't affect our day-to-day until it's too late. Threats to biosecurity are generally abstract and intangible to the public and policymakers - it is only when flights are cancelled, and quarantines are imposed that the word 'biosecurity' enters the public lexicon. In a 2022 review, the WHO highlighted biosafety and biosecurity awareness as one of the "weakest core capacities" of its member states.

Due to this lack of attention, the history of biosecurity is one defined by cycles of complacency and crisis. The goal, in our post-COVID era, is to smooth out these oscillations and reach a point of preparedness, monitoring and rapid response.



3.0 what is the state of biosecurity?

In the post-COVID era, **Biosecurity holds a new importance**, highlighting both the nature of biosecurity threats we face, as well as the gaps in our preparedness.

Historically, biosecurity has been an under-recognised and under-funded part of national security, and the COVID-19 pandemic exposed a stark lack of global biosecurity preparedness. Whilst some countries have begun to address these gaps, particularly in public health, the implementation and effectiveness of these measures vary widely.

3.1 what major biosecurity threats do we face?

The major biosecurity threats of the next two decades will be defined by infectious disease and climate change.

Infectious Disease

COVID demonstrated the scale of the threat that viral pandemics pose to human and societal health. A 2021 paper from the White House suggests that there is a “reasonable likelihood” of another serious pandemic within the next decade¹, particularly of zoonotic origin – when a disease ‘jumps’ from animal to human.

Beyond viral threats, misuse of antibiotics in healthcare and veterinary settings is driving growth in antimicrobial resistance (AMR). AMR is considered one of the top global public health and development by the WHO, affecting all aspects of One Health. AMR already costs over 1.3m lives per year and, if unaddressed, is projected to drive up to \$3.4 trillion in GDP losses p.a. by 2030³.

These threats highlight the need for robust biosecurity strategies, but also the need for policy-level change across the health, food and agricultural sectors.

Source: ¹‘American Pandemic Preparedness’, The White House ²Chatham House ³WHO

“
A new pandemic could begin anywhere where there is close interaction of people and either domesticated or wild animals²”

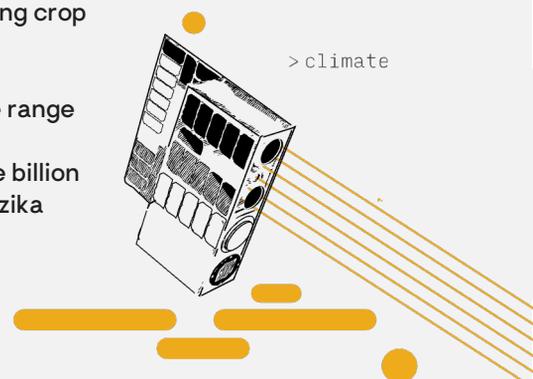
Climate Change

Climate change is a complex global threat whose impact traverses human, animal and environmental health. Changing weather patterns are forcing a shift in global species distribution, with consequences for food security, public health and ecosystem dynamics.

Climate change enables populations of pests, pollinators, and disease vectors to survive in regions previously unsuitable for them, resulting in novel and harmful inter-species contact. For example, enabling the spread of invasive species, driving extinctions and biodiversity loss across global ecosystems, or changing the spread of pests and pollinators, impacting crop yields and food security.

In addition, rising global temperatures are driving an expansion in the range of disease vectors, such as mosquitoes, into hitherto naïve human populations, posing risks to public health. New data suggest up to one billion people could be newly exposed to diseases like malaria, dengue and zika within the century, if action is not taken⁴.

Source: ⁴Ryan, S.J et al., 2019



4.0 how can we manage biosecurity risk?

Biosecurity preparedness relies upon putting **the right data** in front of the right decision-makers at the right time.

Biosecurity needs to be looked at the same way as national security. Just as radar gives early warning of incoming military threats, we need a similar early detection system in place to warn of incoming biothreats. Biosurveillance is the process of gathering this 'right' data in a sustainable, actionable way and informs biosecurity decision-making.

4.1 data is the key to biosecurity

Robust biosecurity strategies are built around preparedness, monitoring, and rapid response. Public health decision-makers should be able to identify and track emerging threats, buying time to mount an appropriate response. It is thus important to define which data are being collected and ensure monitoring infrastructure is in place to identify as wide a breadth of threats as possible.



4.2 challenges in biosecurity preparedness

Global Standards and Coordination

We currently face a stark lack of international standardisation across biosecurity practices. Given that biosecurity threats are inherently cross-border, this global coordination is paramount. For example, data collection is mostly disparate, throughout the academic, private and public sectors, yet decisions are made centrally. Standards around data collection would ensure interoperability of biosecurity data, allowing easy interpretation by international decision-makers.

Funding Strategies

The challenge of financing biosecurity measures is yet to be solved. We need to ask what lessons can be learnt from national and cyber-security, where costs have been effectively distributed across the economy. Ultimately, there needs to be a transition from purely public biosecurity funding to a mix of public and private capital.

Technology Risk

With advances in AI/ML, data generation, and our ability to engineer biological systems comes the potential for both significant progress and significant threats. International biosecurity regulation should aim to put 'guardrails' around bio-innovation to avoid its intentional and unintentional misuse, without stifling innovation itself.



5.0 innovation in the biosecurity sector

Managing biosecurity risk requires timely availability of data at scale. Therefore, innovation in the sector primarily focuses on **data generation and analysis**.

The role of innovation in biosecurity should be to expand data availability to decision makers, and to allow a rapid response to biosecurity threats. As data availability increases so does the demand for its analysis, making AI solutions particularly powerful. However, given that biosecurity is a cross-border issue, it is essential that ensuring novel innovation is widely available, not solely accessible to high-income nations.

5.1 case study: wastewater surveillance

The CDC's wastewater surveillance programme during the COVID-19 pandemic exhibits the importance of rapidly accessible biosecurity data, the power this data gives decision-makers, and the value of wastewater as a biosurveillance modality.

During the pandemic, tracking the spread of novel variants was a public health priority. Travellers were identified as a key vector for cross-border transmission, however voluntary sampling programmes at travel hubs experienced low uptake. Monitoring viral RNA in wastewater from aeroplanes, and other modes of transport, proved an innovative and scalable means by which spatiotemporal patterns of viral transmission could be monitored. It is estimated that wastewater surveillance can buy public health officials up to 3 months prior warning of incoming biosecurity threats, thus allowing proactive public health decisions¹.

Source: ¹ CDC

5.2 key innovation areas

The key innovation areas that capital is flowing into. Where are VCs placing their bets?

Monitoring & Prediction

re§istomap

Water biosecurity platform for detecting and monitoring antimicrobial resistance.

€ 2m Pre-seed

Genpax

Genomic surveillance platform enabling detection and tracking of bacterial pathogens

\$ 2.5m Seed

ExoFlare.

Biosecurity threat management platform specialising in food and agricultural sectors

\$ 3.6m Seed

PathoSense

Diagnostics platform for real-time tracking of veterinary infectious disease

N/A

solu

Genomic pathogen surveillance platform positioned for epidemic prevention

€ 1 m Pre-seed



Real-time detection and prevention of respiratory infections in clinical settings

\$ 163k Pre-seed

Biosecurity Interventions

BioCentis

Genetic engineering solutions to control invasive insect populations

€ 3m Seed

FABENTECH

Emergency treatments to combat bioterrorism and emerging pandemics

€ 7.7m Grant

phagos

Bacteriophage therapeutics platform to combat antimicrobial resistance

€ 2.4m Pre-seed

Biosafety Interventions

aclid

Controlling the safety and efficacy of cell and gene therapies

\$ 3.3m Seed

Broken String Biosciences

Preventing misuse of synthetic genes through comprehensive threat assessment

€ 14m Series A

> education



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