RSIS S. RAJARATNAM SCHOOL OF INTERNATIONAL STUDIES
Nanyang Technological University, Singapore

RSIS COMMENTARY

www.rsis.edu.sg No. 184 – 14 December 2023

Advances in Biotechnology: The Need to Strengthen Biosecurity

By Julius Cesar Trajano, Jeselyn, and Mely Caballero-Anthony

SYNOPSIS

Innovations in biotechnology are expected to have significant implications, both in terms of benefits and risks, for sustainable development and international security. However, these advances have rapidly outpaced national governments' ability to enhance biosecurity norms and technical approaches to prevent accidents or deliberate misuse of biological material.

COMMENTARY

Modern biotechnology is one of the critical technological advancements today, along with others like artificial intelligence and quantum computing. Innovations in these fields are expected to have significant implications, both in terms of benefits and risks, for sustainable development and international security.

Advances in life sciences and biotechnology are taking place at an unprecedented rate, contributing vitally in addressing major challenges such as disease eradication. However, these innovations are advancing and proliferating at a rate faster than the ability of companies and governments to shape the institutions and norms needed to regulate their use and to provide protection from the misuse of, for example, biological materials and pathogens.

The publication, *Our Common Agenda: A New Agenda for Peace,* issued recently by the United Nations Secretary-General Antonio Guterres, cited the insufficiency of biosecurity governance frameworks to prevent new and emerging technologies from being weaponised. It warned that advances in the life sciences have potentially granted individuals the capability to go beyond the direct hostile use of biology, including the development of biological weapons, possibly using sophisticated and dangerous pathogens.

Southeast Asian countries recognise the benefits of the rapidly developing biotechnology sector. But they are also concerned that emerging innovations in biotechnology have also increased the risk that non-state actors could develop biological weapons. It is therefore more important than ever to strengthen the biosecurity regime by keeping track of the opportunities and risks posed by these advances.

As defined in the 2020 Biosafety Programme Management by the World Health Organization (WHO),the biosecurity regime is a set of "principles, technologies and practices that are implemented for the protection, control and accountability of biological materials and/or the equipment skills and data related to their handling". Its main goal is to prevent any unauthorised access, loss, theft, misuse, diversion, or release of biological materials, including dangerous pathogens.

Peaceful Uses and Biosecurity Risks

Advancements in technology are being utilised to bring about a future that is more resilient to diseases, food insecurity, and environmental instability. However, these advancements and their relationship with physical security are creating opportunities for the development of cheaper biological weapons using dangerous pathogens, which nefarious groups could more easily lay their hands on.

A threat assessment report by the US intelligence community highlights the risks posed by rapid advances in dual-use biotechnology, including bioinformatics, synthetic biology, nanotechnology, and genomic editing. These developments are vulnerable to exploitation by malicious actors, making it necessary to have timely prevention, detection, attribution, and response systems in place.

In the past, the weaponisation of biological materials and technology revolved primarily around military and defence concerns. The landscape has since shifted. Innovations in biotechnology are no longer limited to military use, but now offer a wide range of solutions to critical problems such as the eradication of most common diseases, improving food security, and addressing environmental challenges.

Closely associated with the new domain of biotechnological development are gain-of-function (GoF) research and dual-use research of concern (DURC), which also perfectly encapsulate both the risks and opportunities of biotechnological advancement. GoF research involves altering a biological pathway within a pathogen or an organism with the aim of improving its transmissibility or virulence. On one hand, it can lead to breakthroughs in understanding diseases, aiding in vaccine development and improving public health preparedness. On the other hand, the same research can be harnessed for harmful purposes such as in the making of potent bioweapons.

This dual-use nature underscores the importance of responsible oversight. DURC not only encompasses the potential misuse of scientific knowledge to create hazardous pathogens, but also the inadvertent release of these pathogens into the environment. As biosafety laboratories for peaceful research increase globally, accidental or deliberate leaks from them can have far-reaching consequences.

The advancement of synthetic biology further amplifies the complexity of GoF research and its dual-use concern. As an interdisciplinary field, synthetic biology encompasses the creation, modification and reproduction of biological systems and organisms, often from scratch. The fabrication of the world's first synthetic yeast, production of renewable sources of electricity, and the development of anticancer drugs, have been attributed to this. Although synthetic biology is intended to be harmless, its ability to generate new life forms and organisms has ushered in new biosecurity concerns.

Today, advanced genetic engineering technologies such as CRISPR has radically reduced the cost and complexity of gene editing to the point where even amateurs can modify the genes of viruses. CRISPR is being explored as a possible technique to eliminate disease-carrying mosquito populations. But with the sliding cost and increasing accessibility of biotechnology, rogue actors could misuse life science research to produce lethal biological agents easily, and be a grave threat to international peace and security.

These evolving biosecurity risks, which arise from the growing developments in biotechnology, and their potential misuse by malicious actors, compel stronger biosecurity measures.

The Need to Enhance Biosecurity Measures

Global institutions have established important frameworks such as the Cartagena Protocol on Biosafety, the Biological Weapons Convention (BWC), and the United Nations Security Council Resolution 1540 (UNSCR 1540), to help mitigate the potential risks.

While these international regimes form a solid foundation in the disarmament and non-proliferation of biological weapons, their provisions (particularly that of the BWC), were drafted decades ago when dual-use innovations in biotechnology were not yet a significant concern. Furthermore, recent advances in biotechnology have rapidly outpaced national governments in their ability to strengthen the biosecurity norms and technical approaches needed to prevent accidents or the deliberate misuse of biological material.

The existing global conventions are insufficient to provide comprehensive biosecurity governance covering new technologies. State and non-state stakeholders, including the scientific community, can turn to the Tianjin Biosecurity Guidelines for Codes of Conduct for Scientists (2021) and the WHO Global guidance framework for the responsible use of the life sciences: mitigating biorisks and governing dual-use research (2022) for the governance of biorisks and dual-use research.

The Tianjin guidelines delve into a wide array of biosecurity concerns, including guidance on responsible conduct for scientists, laboratory safety, security measures for handling biological materials, and considerations for preventing accidental or deliberate misuse of life sciences research.

Similarly, the WHO global guidance framework prioritises ethical factors, risk assessments, and management strategies to strike a balance between the potential

benefits from scientific advancements and the risks to biosecurity and biosafety. This emphasis on ethical considerations, risk evaluations, and management approaches is notably absent in existing international conventions.

Biosecurity in Southeast Asia

Given the need to boost biosecurity measures and the implementation of international regimes, especially the BWC and recently issued biosecurity guidelines, several countries in Southeast Asia have begun revising their biosecurity legal frameworks in light of rapid advances in biotechnology.

In October 2023, biosecurity experts from ASEAN Member States convened for a regional workshop to deepen the understanding of the BWC, to share good practices on its national implementation, and information about capacity-building opportunities available to strengthen biosafety and biosecurity.

A strategic multilateral biosecurity dialogue between Southeast Asian countries and the United States have been conducted annually since 2014 to encourage informal Track II discussions among experts and officials on biosecurity risks in the region.

The lack of awareness and disparities in resources among member states pose significant hurdles in crafting timely biosecurity standards. There is a need for awareness-raising regarding risks associated with dual-use research among researchers, the scientific community, government officials, the private sector, and the general public.

The establishment of a permanent regional biosecurity and biosafety association, comprising experts from ASEAN Member States, can provide invaluable guidance and raise awareness. This association would serve as a dynamic platform for information exchange and policy advocacy. Collaborative research projects, with an emphasis on emerging threats, can fortify the region's scientific capabilities. Moreover, technological advancements should be leveraged to augment surveillance and response mechanisms. This approach not only bolsters regional security but also stimulates innovations in biotechnology for peaceful uses.

Julius Cesar Trajano and Jeselyn are Research Fellow and Research Analyst, respectively, at the Centre for Non-Traditional Security Studies (NTS Centre), S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University (NTU), Singapore. Mely Caballero-Anthony is Professor of International Relations and Associate Dean (International Engagement) at RSIS and Head of the NTS Centre.