Artificial intelligence and biosecurity in ASEAN: implications for surveillance and response

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The rapid uptake of artificial intelligence (AI) in biomedical science research is enabling advances in bioinformatics, pathogen characterization, protein design and drug discovery in ways that were difficult to envision even 5 years ago. Nonetheless, these capabilities inherently have the potential to be misapplied to cause harm, and the pace of their evolution risks outpacing efforts at governance.[1]

In the near-to-medium term, AI tools may alter the biosecurity threat landscape in ways that directly challenge – but also facilitate – existing surveillance and response systems. Advances in protein design, for example, enable the rapid development and modification of biologically active molecules that may evade existing nucleic acid-based biosecurity screening tools.[2] As part of an international security conference, the drug development company Collaborations Pharmaceuticals, Inc. showed how AI could be used to generate over 40 000 highly toxic – including novel – molecules within hours by rewarding toxicity.[3] Although the novel molecules were *in silico* predictions that were neither synthesized nor validated, the process showed how AI tools could potentially be redirected towards harm.

Likewise, barriers to reconstructing and modifying known pathogens have also been lowered by the public availability of pathogen genetic sequences that can be coupled with AI-enabled design tools and accessible gene synthesis platforms.[1,2] As a silver lining, significant practical constraints remain, most notably access to materials as well as technical and laboratory capabilities, rendering the risk of misuse or accidental generation of high-consequence pathogens theoretical rather than imminent.

At present, most AI tools deployed in biomedical research lack embedded safeguards, including screening filters or output watermarking.[4] As the tools increasingly become part of laboratory workflows, they may introduce new vulnerabilities, particularly if pathogen inventory systems or synthetic biology platforms are involved.[1] Current biosecurity frameworks are mostly designed around physical containment and may not adequately address the risks in situations where life sciences, synthetic biology, AI and automation intersect.

National biosafety and biosecurity policy and legislation documents were reviewed for all Association of South-eastern Asian Nations (ASEAN) Member States that were available online as of 5 August 2026, including the Biological Weapons Convention implementation database and published literature; this pragmatic review is summarized in **Table 1**.[5–7]

Whereas most Member States have established biosafety frameworks aligned with the Cartagena Protocol on Biosafety,[8] many are largely focused on genetically modified organisms. Only Singapore (Biological Agents and Toxins Act; 2005) and Thailand (Pathogens and Animal Toxins Act; 2015) have comprehensive, dedicated biosecurity legislation. Others rely on sectoral regulations or non-binding guidelines that predate AI as a transformative research force. These governance and

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Published: 24 September 2026
doi: 10.5365/wpsar.2026.17.3.1475

Table 1. **National biosafety and biosecurity legal frameworks in ASEAN Member States**[a]

Country	Biosafety legislation	Biosecurity or related legislation
Brunei Darussalam	• No primary biosafety law • National biosafety and biosecurity guideline and National Laboratory Strategic Plan 2026–2031 under development, with support from the Regional Public Health Laboratory Network	• Laws of Brunei Darussalam, Chapter 87, Biological Weapons (1983)
Cambodia	• Biosafety Act 2008 – superseded by the 2023 Environment and Natural Resources Code (Royal Kram NS/RKM/0623/007 of 29 June 2023) • National Medical Laboratory Biosafety Guidelines 2016	• Law on the Prohibition of Chemical, Nuclear, Biological and Radiological Weapons (2009) implements BWC obligations • Draft Prakas on laboratory biosafety/biosecurity (2017, not finalized) • No comprehensive legislation governing pathogen possession, handling and transfer
Indonesia	• Omnibus Health Law (Law No. 17 of 2023) • Indonesian National Standard 8340:2016 on Laboratory Biorisk Management • GMO biosafety regulations (Cartagena Protocol)	• Omnibus Health Law (Law No. 17 of 2023) repealed former Law No. 6 of 2018 on Health Quarantine • No dedicated pathogen possession/transfer legislation
Lao People's Democratic Republic	• National Biosafety Regulation 2019 • National Laboratory Quality Standard 2018	• National Biosafety Regulation 2019
Malaysia	• Biosafety Act 2007 (Act 678, GMO-focused) • Biosafety (Approval and Notification) Regulations 2010 • Laboratory Biosafety and Biosecurity Policy and Guideline 2015	• Strategic Trade Act 2010 (Act 708) • Prevention and Control of Infectious Diseases Act 1988 (Act 342)
Myanmar	• No primary biosafety legislation identified	• No primary biosecurity legislation identified • The Environmental Conservation Law (2012) includes provisions for hazardous substances, including "substance which may be used as a biological weapon"
Philippines	• Executive Order 514 (2006) on the National Biosafety Framework (GMO-focused) • 2023 Manual of Laboratory Biosafety and Biosecurity Standards (2nd edition)	• No primary biosecurity legislation identified • Section 4(d) Anti-Terrorism Act of 2020 prohibits the development, possession, export, supply and use of biological weapons when committed with a terrorist purpose • Strategic Trade Management Act 2015 covers export, import and transshipment of biological agents
Singapore	• Biological Agents and Toxins Act 2005 • Infectious Diseases Act • Singapore Standard ISO 35001:2021+A1:2024 biorisk management standard	• Biological Agents and Toxins Act 2005 also serves as primary biosecurity law for dangerous pathogens and toxins
Thailand	• Pathogens and Animal Toxins Act B.E. 2558 (2015) • GMO biosafety regulations under Cartagena Protocol	• Pathogens and Animal Toxins Act B.E. 2558 (2015) covers possession, production, import/export and transit
Timor-Leste	• Decree-Law No. 41/2023 on the General Regulation on Quarantine covers import/export controls on animals and animal products with biosafety provisions for animal disease prevention	• No primary biosecurity legislation identified • Penal Code Article 211 from Decree-Law No. 19/2009 prohibits biological weapons-related activities
Viet Nam	• Decree No. 103/2016/ND-CP Regulating Biosafety in Laboratories • Law on Biodiversity 2008 (Law No. 20/2008/QH12) • Decree 118/2020/ND-CP amended Decree 69/2010/ND-CP on Biosafety for GMOs and GMO products (G/SPS/N/VNM/175, 2025 on gene editing in progress)	• Law No. 114/2025/QH15 on Disease Prevention (2026)

ASEAN: Association of South-eastern Asian Nations; BWC: Biological and Toxin Weapons Convention; GMO: genetically modified organisms.

[a] Compiled from the BWC Implementation Database and national legislative sources.[5] All Member States are States Parties to the BWC.

regulatory gaps could affect ASEAN's capacity to detect, assess and respond to emerging biological threats, including those enabled by AI.

ASEAN's consensus-based governance model offers both strengths and constraints in shaping how the region might address these emerging risks.[9] The preference for non-binding declarations and frameworks accommodates diverse institutional capacity and encourages regional alignment, but the lack of enforcement has historically resulted in uneven implementation.[9]

The 2024 ASEAN Leaders' Declaration on Strengthening Regional Biosafety and Biosecurity was an important political commitment, recognizing the need for stronger national frameworks and regional commitment.[10] It has heightened policy attention and catalysed the establishment of the ASEAN Network on Biosafety and Biosecurity with international support.[10,11] However, the Declaration does not address AI-related biosecurity risks, and these have not been incorporated into existing surveillance and response systems, as recommended by the World Health Organization (WHO) publication Asia Pacific health security action framework (APHSAF).[12]

Without deliberate integration of biosafety, biosecurity and AI policies and regulations, there is a real risk that future AI biosecurity initiatives – policy, governance and other measures to prevent the misuse or creation of AI tools that can facilitate the development or deployment of harmful biological agents – might evolve parallel to, rather than in alignment with, existing frameworks and surveillance and response systems. Whether from deliberate misuse or accidental release, AI-enabled biological risks – hazards whose probability or impact are materially increased by AI – may manifest as public health events within the scope of national outbreak and APHSAF operational frameworks. Recommended initiatives for AI biosecurity in ASEAN Member States are summarized in **Box 1** and described in detail below.

The ASEAN Network provides a potential platform for future dialogue, technical leadership and cooperation, as well as for the incorporation of AI biosecurity into national and regional health security systems. To prevent fragmentation and inefficiency, other ASEAN platforms, such as the ASEAN Centre for Public Health Emergencies and Emerging Diseases (ACPHEED), should also play complementary roles.

Supplementary protocols addressing AI in the biomedical sciences that are aligned with existing international biosafety and biosecurity guidelines, such as WHO's *Laboratory biosecurity guidance*, should be developed by the Network in collaboration with ACPHEED and other international partners.[13] These protocols should include guidance for governance and policy, in addition to technical guidance for AI-enabled laboratory systems and predeployment risk assessments of biological design models, especially for high-consequence material.

Box 1. **Recommended initiatives for AI biosecurity in ASEAN member states**

- Integrate biosafety, biosecurity and AI policy and regulation so that AI biosecurity aligns with existing frameworks and surveillance and response systems, rather than being developed in parallel.
- The ASEAN Network on Biosafety and Biosecurity should lead the development of policies and frameworks to embed AI biosecurity in national and regional health security systems; to avoid fragmentation, other platforms should be involved, such as ACPHEED.
- Establish an incident-reporting mechanism for AI-related biosecurity events via the Network and ACPHEED, linked to International Health Regulations (2005) event-based surveillance, so that novel risks are detected and reported early.
- Invest in regional capacity to complement the 2024 ASEAN Leaders' Declaration on Strengthening Regional Biosafety and Biosecurity.[10]
- Develop supplementary AI protocols aligned with the World Health Organization's *Laboratory biosecurity guidance*, covering governance and policies, technical guidance for AI-enabled laboratory systems, and predeployment risk assessments.[13]
- Engage AI developers as partners with shared responsibilities, and ensure that adherence to AI biosecurity standards is a condition of procurement and deployment.

ACPHEED: ASEAN Centre for Public Health Emergencies and Emerging Diseases; AI: artificial intelligence; ASEAN: Association of Southeast Asian Nations.

The responsibility for biosecurity should be shared by global authorities and the developers of AI tools, in accordance with emerging international consensus, such as the Asilomar principles for governing AI applications in nuclear and biological security.[1] In particular, AI developers must bear a special responsibility for anticipating biological risks that may arise from rapid commercial innovation,[1] including through red-teaming (i.e. deliberately testing AI systems for vulnerabilities or ways they could be misused to facilitate biological harms) and perhaps implementing clear reporting and notification mechanisms that enable suspected misuse attempts to be identified and reported to appropriate national authorities. ASEAN Member States should make adherence to these responsibilities a condition of procurement or deployment.

Sustained investment in regional capacity development on AI biosafety and biosecurity that complements the existing commitment within the Declaration will be necessary.[10] A reporting mechanism and monitoring for AI-related biosecurity incidents could be established by the Network and implemented by ACPHEED alongside existing International Health Regulations (2005) event-based surveillance systems, increasing the likelihood that novel AI-related risks are detected early rather than remaining outside existing reporting structures.

Finally, predeployment biosecurity reviews should be mandated for AI models identified to have significant dual-use potential, especially for those to be deployed within biomedical laboratory settings. These review processes should operate at the national level, focus on misuse potential and downstream risk, and involve regional coordination and expertise running through the Network, if needed.

In conclusion, the growing convergence of AI and biomedical research is inevitable and largely beneficial. However, this potentially accelerates and expands the challenges of mitigating dual-use scenarios. Building on the Declaration and establishment of the Network, ASEAN can close the gaps identified here, adding AI biosecurity within and strengthening existing national and regional surveillance and response systems in preparation for the emerging AI era, while contributing to wider international efforts.

Acknowledgements

The authors thank the staff of the Asia Centre for Health Security for their support in organizing the activities that led to the conception of this article.

Conflicts of interest

The authors have no conflicts of interest to declare.

Ethics statement

Ethics approval was not required for this work. This Perspective draws on a review of publicly available legislation, official policy documents and published literature, and did not involve human participants, identifiable personal data or animal subjects.

Funding

None.

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