Mapping Global Talent Pipelines in Biosecurity: Gaps, Opportunities, and Pathways for Growth

Farhan Azam · Tejaswini Dhurde · Vorathep Sachdev

fazam@alumni.stanford.edu · tejaswinidhurde21@gmail.com · vorathep112@gmail.com

SPAR Final Report - Spring 2026

EXECUTIVE SUMMARY

Biosecurity is in transition. Traditional training focuses on lab biosafety and outbreak response, which remain essential but are no longer sufficient. **Modern biosecurity must also address emerging risks** including AI-enabled design tools, commercial and benchtop DNA synthesis, lab automation, and dual-use research governance. Our analysis of **201 programs across 110+ countries** finds that the Global South pipeline has not kept up.

We identified three core gaps. First, **syllabi largely omit modern-biology risks**: only 4% of Global South focused programs cover AI×Bio and none cover DNA synthesis screening, while 85% still cover traditional lab biosafety. Second, **programs target professionals** and government officials, not early-career talent. Third, **Global South programs depend heavily on Global North funding**, leaving them vulnerable when donor priorities shift. But when training moves to the Global North, visa, language, and cost barriers exclude the people who most need it. The result is a cycle where the training best equipped to address modern-biology risks is least accessible to those who need it.

Based on these findings, we offer five recommendations to build more sustainable, paradigm-appropriate talent development in the Global South.

BACKGROUND & CONTEXT

Biosecurity as a distinct field traces its origins to the Biological Weapons Convention (BWC), the first multilateral treaty to prohibit an entire category of weapons of mass destruction (Beeckman & Rüdelsheim, 2020). Under the International Health Regulations (IHR), Member States are mandated to build and maintain core capacities to detect, assess, and respond to public health events, with workforce capacity-building positioned as central to pandemic preparedness (Bakanidze et al., 2010).

Recent technological developments exacerbate existing biosecurity risks and introduce new ones. **Tacit knowledge** has historically been a key barrier to bioweapon development,

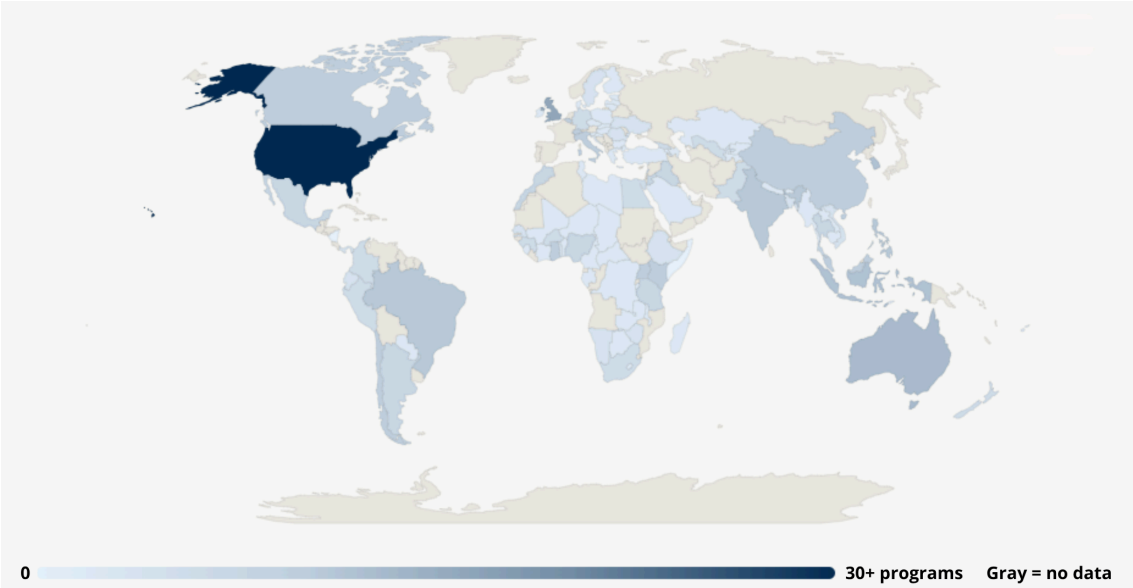


Figure 1: Global distribution of biosecurity training programs by country. Countries are shaded on a sequential single-hue scale (light to dark) proportional to the number of mapped programs; gray indicates no mapped programs. Based on 201 programs across 110+ countries; 44 programs with global reach and 25 with regional designations are excluded as they cannot be assigned to a single country.

but AI tools can now mimic the tutoring of an advanced scientist, making complex biological knowledge more accessible without the situational awareness and moral judgment that comes with expert mentorship (Sandbrink, 2023).

Concurrently, **advances in synthetic biology** have made it easier to procure custom DNA sequences and standardized reagents (Council on Strategic Risks, 2025; Rose & Nelson, 2023). Throughout this report we therefore distinguish between traditional biology (wet lab techniques and pathogen handling) and modern biology (AI-enabled design tools, commercial and benchtop DNA synthesis, and lab automation). The biosecurity risks from these two paradigms are distinct, and current training pipelines address them very unevenly.

Biosafety and biosecurity remain "one of the weakest core capacities of Member States identified by IHR monitoring and evaluation activities" (Caballero-Anthony et al., 2025; World Health Organization, 2022). The profession is also largely invisible to students entering the life sciences: there is no clear career roadmap, few dedicated degree programs, and the work is most often learned on the job rather than through formal education (Namdeo & Zhang, 2024). The Youth Declaration for Biosecurity, presented to the BWC community, identifies the **creation of a clear pipeline for biosecurity career advancement** as a priority for the next generation (Alexanian & others, 2021; Namdeo & Zhang, 2024).

Prior capacity-building efforts have been subject to two critiques directly relevant to this report. First, training has frequently been **theoretical, decontextualized, and limited in reach**, serving as a metric used in international evaluations rather than a reliable indicator of substantive workforce competence (Evans & Frow, 2015; Khan et al., 2016). Second, requirements have often been designed around **Global North standards** with insufficient attention to local conditions, and Global South programs frequently depend on Global North funding, leaving them vulnerable when donor priorities shift (Maehira & Spencer, 2019; Thorat, 2026).

This report tests whether these patterns persist in the current training landscape, with a particular focus on how well programs address modern-biology risks. Our analysis examines four questions: *where programs exist, how they are structured, who they train, and what they teach.*

METHODOLOGY

We searched for biosecurity programs across nine global regions, focusing on three categories: formal training/academic pipelines, fellowships/non-degree opportunities, and government/multilateral capacity-building programs. Using Gemini, we conducted 27 targeted searches (9 regions × 3 program types) to capture comprehensive program information including names, host institutions, and URLs.

We then processed the collected data through four sequential stages: ingestion of raw program data, classification of programs by biosecurity relevance, extraction of detailed program characteristics, and deduplication to remove redundant entries. This pipeline transformed the initial raw dataset into a standardized database suitable for data analysis, enabling us to examine geographic distribution patterns, structural program differences, and curricular content across the global biosecurity training ecosystem.

Data Collection

To comprehensively cover programs at a global scale, we divided our queries across **nine geographic regions** (North America, Latin America and the Caribbean, Sub-Saharan Africa, North Africa and the Middle East, Europe, South Asia, Southeast Asia, East Asia and the Pacific, and Central Asia) and **three program categories.**

1. **Formal training and academic pipelines** covers university

degrees, certificates, short courses, summer schools, and online offerings in biosecurity and adjacent fields.

2. **Fellowships and non-degree opportunities** cover competitive fellowships, research and postdoctoral positions,

internships, mentorship and cohort-based programs, competitions, scholarships, and professional associations with capacity-building functions.

3. **Government and multilateral capacity-building** cover

national government training programs, bilateral cooperation initiatives, multilateral and regional body programs, lab network training partnerships, and funder-led workforce development efforts.

For each region-category pair, we ran a structured Gemini Deep Research prompt designed for high recall over precision. The resulting outputs were Google docs containing program tables with program name, host organization, country, and URL. These documents were then preprocessed into a unified work queue CSV using Claude (claude.ai), yielding 831 candidate program URLs as inputs to the processing pipeline. The full work queue can be found in the appendix.

One notable caveat is that the Gemini docs served as discovery vehicles only, not as authoritative data sources. All substantive field extraction happened downstream against the actual program pages, and Gemini-provided hints were explicitly framed as unverified priors to be confirmed or corrected by the pipeline. Another point to note is that our search focused on English-language sources only which might have excluded Global South programs in regional languages and the actual number of programs may be more than currently represented.

Data Processing

We processed the collected URLs through four sequential stages, each building on the output of the previous. The full pipeline design, including configuration files and calibration scripts, is documented in the project repository attached in the appendix section.

Stage 1: Ingestion

Each URL was fetched using trafilatura, with a Playwright fallback for JavaScript-rendered pages. Each record preserved the raw page text alongside fetch metadata (method, timestamp, and status). Records that failed to fetch were passed through to the final output with a manual review flag rather than dropped.

Stage 2: Classification

All fetched records were submitted as a single Anthropic Batch API request to Claude Sonnet 4.6 with a forced tool call that returned a classification decision, confidence score, one-sentence reasoning, and an evidence snippet. The system prompt was cached across all records via prompt caching to reduce API costs. Records were routed into three tiers: auto-accept, auto-reject, and manual review, with thresholds tuned to err on the side of passing borderline records forward rather than silently dropping them. Classifier thresholds were calibrated against a labeled fixture set, minimizing wrong-rejects at a higher penalty weight than wrong-accepts, consistent with the high-recall design of the upstream prompts. The calibrated classifier achieved a precision of 0.88 and recall of 1.00 on the 40-record fixture set.

Stage 3: Extraction

Only auto-accepted records from Stage 2 proceeded to extraction. A second Claude Sonnet 4.6 API call used forced tool use to extract 17 fields per program, including pipeline type, career stage, financial support available, income classification, and content flags for AI biosecurity and dual-use risks. Hints from Stage 1 were passed in the system prompt as beliefs to verify rather than as answers, and each extracted field required a grounding evidence snippet matched against the raw page text. Unlike the classification and deduplication stages, extraction was not formally calibrated against a labeled dataset. Field values should be interpreted with that in mind, particularly for subjective fields like focus area.

Stage 4: Deduplication

The deduplication stage ran a two-pass process. The first pass used fuzzy string matching on normalized program name and organization, auto-confirming pairs that exceeded defined similarity thresholds. The second pass sent borderline pairs to Claude via the Batch API to catch cases that string matching cannot detect on its own, such as acronym versus full name matches. Deduplication thresholds were calibrated against labeled candidate pairs. The deduplication classifier achieved a precision of 1.00 on 36 labeled candidate pairs (24 duplicates, 12 non-duplicates).

The pipeline produced 215 unique programs, which were then manually reviewed to remove any remaining entries that did not meet our inclusion criteria, yielding a final dataset of 201 programs across 110+ countries. This dataset forms the basis for all analysis that follows. Guided by our four research questions — where programs exist, how they are structured, who they train, and what they teach — we examined the data for patterns in geographic distribution, pipeline type, career stage targeting, delivery format, and curricular content. The key findings from that analysis are presented below.

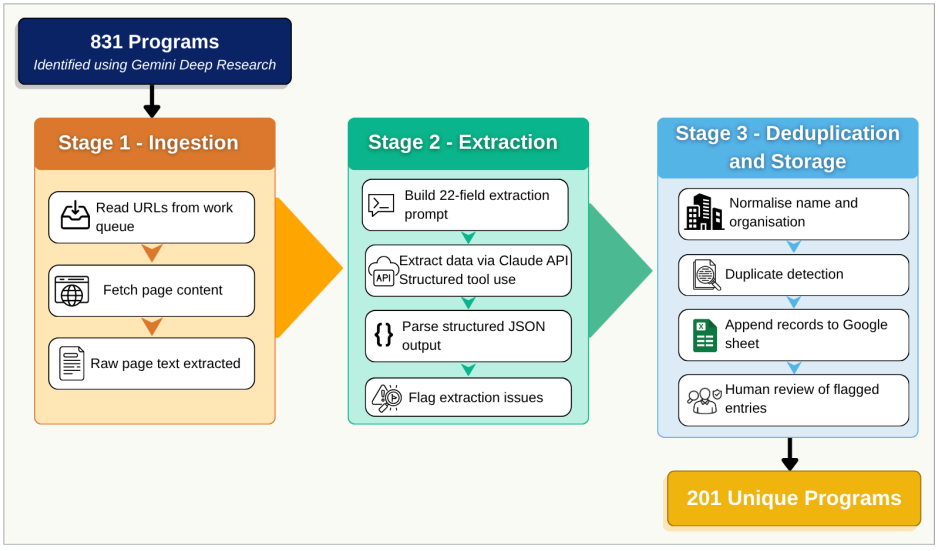


Figure 2: Four-stage data processing pipeline from 831 candidate URLs to 201 unique programs.

FINDINGS

Traditional biosecurity training focuses on lab biosafety protocols, pathogen handling, and outbreak response. These remain essential skills, but are no longer sufficient. Modern biosecurity must also address risks arising from AI-enabled design tools, commercial and benchtop DNA synthesis, lab automation, and dual-use research governance.

The gap between these paradigms is stark: 85% of Global South programs cover traditional lab biosafety, while only 4% address AI×Bio risks and none cover DNA synthesis screening as a primary focus. The tools most likely to cause the next major biological incident, such as mail-order DNA and automated labs, are barely covered in the training meant to prevent their misuse.

What kinds of biosecurity programs exist?

Biosecurity lacks true entry pathways

Short courses (29%), certificates (5.5%), and online self-paced courses (5%) together make up nearly 40% of programs. Degrees account for only 10%. The pipeline is built for people already in the field, not those entering it. Biosecurity relies on adjacent disciplines (biology, medicine, policy) to feed it talent rather than developing its own entry pathways.

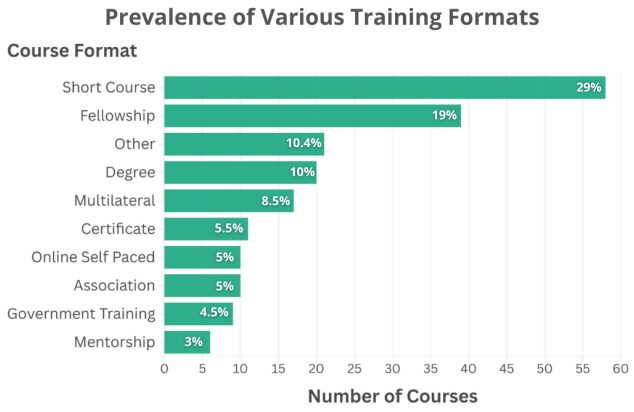


Figure 3: Distribution of 201 mapped biosecurity training programs by specific program type. Percentages represent the share of total programs. Short courses and fellowships together account for nearly half (48%) of all programs.

Fellowships are where the innovation lives, but the cohort is narrow

Fellowships make up 19% of programs and, as Table 1 shows, carry almost all of the AI×Bio curriculum. They are competitive, time-limited, and disproportionately accessible to people already in well-networked, high-income institutions. The innovation is concentrated where it is least urgently needed.

These structural patterns, prioritizing short courses for practitioners, fellowships for researchers, and almost nothing for students, raise a sharper question: who, exactly, is the field designed to serve?

Who do biosecurity programs serve?

The pipeline upskills rather than recruits

78% of programs target mid-to-senior professionals. Only 21% reach early-career audiences and 11% reach undergraduates. The field is structured to maintain existing practitioners rather than identify and develop new ones, and it depends on people who trained in adjacent disciplines first.

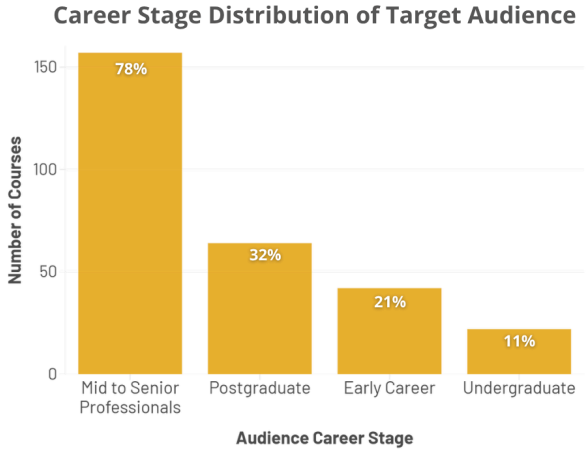


Figure 4: Proportion of biosecurity training programs targeting each career stage (n = 201). Values sum to more than 100% as programs may target multiple career stages simultaneously.

Global South countries face a compounding talent gap

Adjacent pathways into biosecurity (biology, public health, policy, journalism) are relatively accessible in the Global North (Calkins, 2021; Crisp & Chen, 2014; Jansen & Roquas, 2008). In Global South countries, where those adjacent pipelines are often fragmented or under-resourced, the gap compounds: fewer adjacent disciplines to draw from and fewer dedicated programs to receive them.

Understanding who gets trained is one part of the picture. How programs are structured and where they are located shapes whether the people who need them can actually access them.

How does program structure differ between the Global North and Global South?

Formal training is concentrated in the Global North

61% of Global North programs are formal training (degrees, certificates, accredited short courses), compared to 28% in the Global South. The most career-legitimizing forms of biosecurity education are least available where they are needed the most.

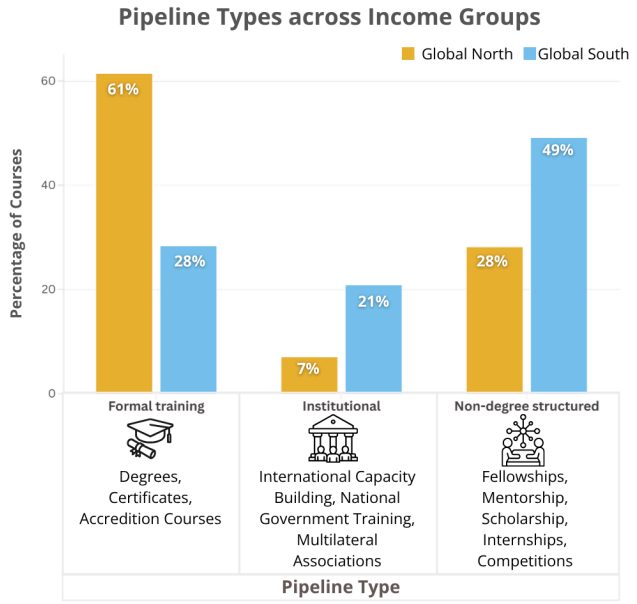


Figure 5: Percentage of biosecurity training programs by pipeline type for countries in the Global North and countries in the Global South. Based on 201 programs (n = 57 Global North, n = 53 Global South; programs serving both income groups excluded).

As a whole, there is a notable disparity between the number of biosecurity training courses available in the Global North in comparison to the Global South. Figure Figure 1 exhibits a higher density of programs present in North America and European nations, followed by regional hotspots in Australia, Southeast Asia, Latin America, and parts of the African subcontinent. There are also significant sections of gray regions where we did not find any documented biosecurity training courses, notably in Southwest Asia and Africa.

Non-degree programs carry the Global South pipeline

Nearly half of Global South programs (49% vs 28% in the Global North) are non-degree structured (e.g. fellowships, mentorships, internships, and competitions). These formats are flexible but typically supplement careers rather than build them, raising questions about long-term retention and depth of expertise.

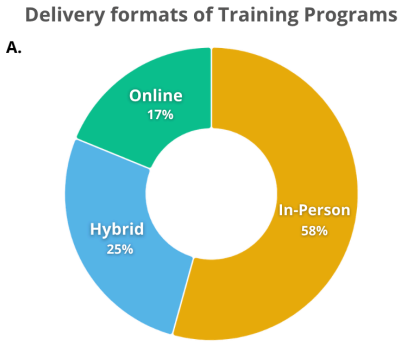
International bodies shape Global South training agendas

Multilateral and government-led institutional programs are three times more common in the Global South (21%) than the Global North (7%). Organizations like UNODA, BWC, and NTI play an outsized role in setting Global South training priorities. Those priorities (heavily weighted toward lab biosafety and outbreak response) may not reflect locally identified capacity gaps, particularly around governance and emerging risks.

How does delivery mode create or reduce access barriers?

In-person delivery is the norm, and it disadvantages Global South countries by design

58% of all programs are delivered in person, imposing travel costs, visa constraints, and time away from employment. The access problem is not simply that there are fewer programs in Global South countries; the dominant delivery model makes Global South participation structurally harder regardless of where a participant is based.



B. Table: Delivery format of biosecurity training programs by income group

Format	Global North	Global South	Both	Total
In-person	38 (32.8%)	32 (27.6%)	46 (39.7%)	116
Hybrid	10 (20.0%)	18 (36.0%)	22 (44.0%)	50
Online	9 (25.7%)	3 (8.6%)	23 (65.7%)	35
Total	57	53	91	201

Figure 6: A: Proportion of all 201 programs delivered in-person (58%), hybrid (25%), and online (17%). B: breakdown of each delivery format by income group (Global North n = 57, Global South n = 53, Both n = 91), showing the number and share of programs within each format category.

Online delivery exists but is not designed for Global South contexts

Only 3 of 53 Global South based programs are delivered online. The remaining online offerings (23 of 35) use a globally accessible open-access model, which carries a self-selection bias toward participants already well-networked enough to find them. The format best equipped to reduce access friction is almost entirely absent from the cohort that needs it most.

Hybrid is the underutilized equity lever

Hybrid programs are the most Global South leaning format (36% vs 20% Global North), suggesting program designers reach for hybrid formats when they explicitly try to broaden access. Converting existing in-person programs to hybrid is a more realistic near-term intervention than building new online infrastructure from scratch.

Delivery format determines access, but content determines relevance. Even a program that is hybrid and locally based fails to prepare practitioners if its curriculum hasn't kept pace with how biosecurity risks are evolving.

What content gaps follow income lines?

Global South programs are anchored in traditional biology

Lab biosafety appears in 85% of Global South programs (vs 67% Global North) and pandemic preparedness in 55% (vs 46%). Only half cover policy and governance, pointing to a gap in policy readiness and institutional integration.

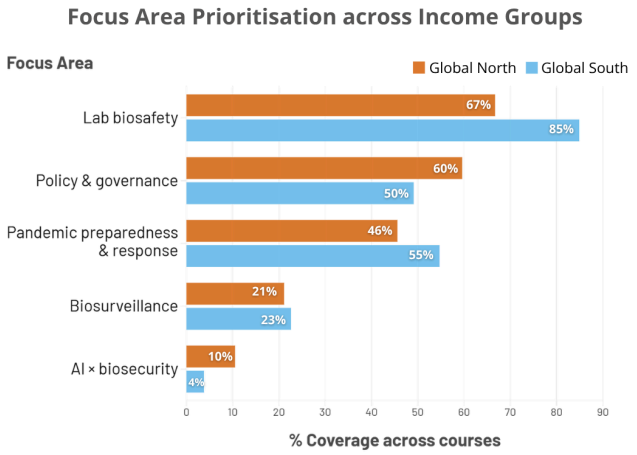


Figure 7: Focus area coverage by income group. Percentages indicate the share of programs in each group covering each topic area (Global North n = 57, Global South n = 53).

Modern-biology risks are absent everywhere, but unevenly so

AI×Bio coverage sits at 4–10% globally, and DNA synthesis screening does not appear in any Global North or Global South specific program. It exists only in globally-facing 'Both' programs (refer to Figure 6A in appendix). Current training is not preparing practitioners for the risks most likely to define biosecurity over the next decade. This gap motivates the program catalogue in Table 1.

Taken together, these content gaps are most visible at the frontier of the field, in the small number of programs explicitly addressing AI and biosecurity, where the structural problems identified above are most acute.

What does the current AI×biosecurity training ecosystem look like?

To our knowledge, no publicly available resource systematically maps the emerging AI×biosecurity training landscape. Table 1 is an attempt to fill that gap. We catalogued every program in our dataset with explicit AI×biosecurity content to understand which formats, regions, and career stages these programs target, and where the gaps in the talent pipeline remain most acute. Thirteen programs met the threshold. As the table shows, they are heavily concentrated in fellowship and competition formats, skewed toward Global North institutions, and oriented toward postgraduate researchers rather than practitioners. The catalogue is not a comprehensive directory, and it will date quickly as the field develops, but as a current snapshot, it makes visible just how thin the coverage is and where it is most absent.

Fellowships carry the entire AI×Bio training burden

Of 13 programs with explicit AI×biosecurity content, 10 are fellowships or competitions. No dedicated degree or certificate program exists. The field's most critical emerging curriculum area is delivered entirely through competitive, time-limited, non-credentialed formats, with no direct entry into formal career pipelines.

Global South representation is near-absent

Only one program (SMART Fellowships, delivered by ICGEB) specifically targets the Global South. The remaining programs are either Global North focused or globally accessible but largely Global North based. A practitioner in West Africa, South Asia, or Latin America has essentially no dedicated AI×biosecurity training pathway.

The knowledge base is building in research communities, not the wider ecosystem

Only 3 of 13 AI×Bio programs are practitioner-facing (workshops or short courses). The other 10 target postgraduate and early-career researchers with existing alignment or biosecurity backgrounds. The knowledge is accumulating in research circles but not reaching the policy, laboratory, and public health professionals who would implement safeguards.

Taken together, the findings tell a consistent story about a training landscape structured around the traditional-biology paradigm which reaches people already in the field rather than those entering it, and concentrates its most advanced curriculum in formats and geographies that are hardest to access from the Global South.

The AI×biosecurity ecosystem, examined in Table 1, is the sharpest illustration of this with thirteen programs, ten of them fellowships or competitions, and only one explicitly targeting the Global South. The field is building knowledge in the places least likely to need it most urgently. The five recommendations that follow are oriented around closing that gap: in curriculum, in access, in career structure, and in funding design.

LIMITATIONS

Two features of the dataset are worth keeping in mind when reading the findings. Our search relied on English-language sources, which tend to underrepresent programs in Global South countries. This means the Global South pipeline is probably larger than what we captured here and our estimates of the gaps are, if anything, conservative. We also inferred

Table 1: Catalogue of all 13 identified biosecurity training programs with explicit AI×biosecurity content.

No.	Program	Target Audience	Region
Fellowships			
1	CBAI AIxBiosecurity Research Fellowship Program	UG, PG, Early Career, Mid-Career	Global North
2	Horizon Fellowship	PG, Early Career, Mid-Career	Global North
3	ICGEB Fellowships for Scientists in Biosecurity	Early Career, Professional	Global South
4	Pivotal Research Fellowship	PG, Early Career	Global North
5	AIxBio Research Fellowship (ERA)	PG, Early Career, Mid-Career	Both
6	Supervised Program for Alignment Research (SPAR)	UG, PG, Early Career, Professional	Both
7	MATS Program (ML Alignment & Theory Scholars)	PG, Early Career, Mid-Career	Global North
8	Strengthening Biosecurity & PPR Dialogue	UG, PG, Early Career	Both
9	RAND CAST Fellowship	Early Career, PG	Global North
10	AIxBio Hackathon (Apart Research)	UG, PG, Early Career, Professional	Both
Workshops			
11	AI for Biorisk Management Workshop (BRMI)	Professional, Mid-Career, Senior	Global North
12	AIxBio Governance Workshops (INHR)	Professional, Senior	Both
13	AI × Bio Safety Workshops (GCP)	UG, PG	Both

curricular content from public-facing program pages rather than actual syllabi, so programs that cover topics like AI×Bio without highlighting them online may be missed. Both of these biases indicate the real gaps are likely no smaller than what we report.

Within the dataset, findings about objective facts including country, career stage, and delivery format, are reliable. Findings about program content should be read as indicative rather than precise, since that part of the extraction process was not formally tested for accuracy. We use 'Global South' and 'Global North' as shorthand for the World Bank's income classifications, while acknowledging these are imperfect labels. Programs open to both regions are excluded from income-group comparisons and noted where relevant. The dataset also reflects a snapshot from April 2026, so programs launched afterward will not appear.

RECOMMENDATIONS

The findings reveal a biosecurity training landscape organized around the traditional-biology paradigm, with modern-biology risks largely absent. The pipeline also recruits mid-career professionals rather than early-career talent, relies heavily on in-person delivery, and concentrates formal credentials in the Global North. The five recommendations below address these gaps directly.

(1) Integrate emerging biology risks into existing syllabi

The content gap here is the sharpest in the dataset: 85% of Global South programs cover lab biosafety; only 4% cover AI×Bio risks; none cover DNA synthesis screening. The thirteen AI×Bio programs that exist are almost entirely fellowships and competitions, which means the practitioners who would actually implement safeguards — lab staff, public health officials, policy officials — are not being reached. The near-term fix is to integrate AI×Bio and synthesis screening modules into structured courses and workshops that already exist.

Two bodies are well positioned to move quickly. Africa CDC operates the Regional Training and Certification Program for Biosafety and Biosecurity (RTCP-BPP), a continent-wide credentialing initiative run in partnership with the African Society for Laboratory Medicine (ASLM). Africa CDC and ASLM have committed to expanding the RTCP-BPP to include AI and cyberbiosecurity (African Society for Laboratory Medicine, 2026), but public evidence of follow-through remains limited (Africa Centres for Disease Control and Prevention, 2022).

Similarly, WHO has named AI as an emerging risk (World Health Organization, 2024), but that recognition has not propagated into training curricula. LBM4, the operative training reference that regional programs draw from, was last updated in 2020 — before large language models, accessible protein design tools, and scalable nucleic acid synthesis were practical concerns (World Health Organization, 2020). Both bodies should be held to their own stated commitments.

(2) Expand hybrid delivery and reduce in-person access barriers for Global South participants

In-person programs account for 58% of the total and impose travel, visa, and employment costs that structurally disadvantage Global South participants. Hybrid is already the most Global South-leaning delivery format in the dataset (36% vs. 20% Global North), which suggests program designers reach for it when they are trying to broaden access. Converting existing in-person programs to hybrid is more realistic in the near term than building new online infrastructure from scratch. That said, hybrid is not sufficient for hands-on

lab training, and remote formats carry a self-selection bias toward participants already well-networked enough to find them.

The Johns Hopkins Center for Health Security's Emerging Leaders in Biosecurity (ELBI) shows the limits of relying on hybridization alone. The program historically reserved roughly 24 of 28 slots for US citizens (Johns Hopkins Center for Health Security, 2018), and while it has since dropped this requirement, the 2026 cohort of 25 fellows appears to include only one participant clearly based in the Global South (Johns Hopkins Center for Health Security, 2026). The ERA AIxBio Research Fellowship similarly skews toward Global North institutions (ERA AIxBio Research Fellowship, 2026). We assume this trend is common across biosecurity fellowships based in the Global North. All such programs should consider explicitly allocating a larger share of places to participants from the Global South.

(3) Develop dedicated entry pathways for early-career talent

Biosecurity is currently considered a mid-career specialization. Since a majority of programs target mid-to-senior professionals (Figure 2), the pipeline is structured to upskill rather than develop new talent. The gap can further compound because of fragmented adjacent pipelines in biology, public health, and policy in the Global South. Changing that requires explicit early-career access built into program design and the use of non-degree structured formats that Global South pipelines already rely on.

We recommend that funders prioritize early-career and undergraduate training in funding calls and existing fellowships reserve slots for participants without prior biosecurity experience. Non-degree structured programs such as fellowships, mentorships, internships, competitions (iGEM and AIxBio Hackathons, for instance) are particularly well placed to deliver this since they already account for 49% of Global South based programs (versus 28% in Global North countries) and are flexible to include undergraduate and early-career audiences directly. Scaling these formats with explicit early-career targeting is therefore the most realistic short- to medium-term route to widening the Global South recruitment base.

The Youth for Biosecurity Initiative and ICGEB Fellowships for Scientists in Biosecurity are the two programs best positioned to scale.

(4) Invest in formal degree programs in Global South countries as a long-term career anchor

Formal training is more than twice as concentrated in Global North countries as in Global South countries (Figure 3), and degree programs account for only 10% of the global total. While non-degree structured programs, as mentioned earlier, are the most accessible immediate route into the field for Global South participants, they are also more vulnerable to funding-cycle attrition, contributing to the problem of inactive programs once short-term grants end.

Formal degrees embed biosecurity within national higher education systems and provide an institutional base that does not rely on continuous external funding. The IFBA–MMUST undergraduate program in Biosafety & Biosecurity demonstrates one viable model.

India presents a distinct institutional challenge: "biosecurity" is not recognized as a standalone field in the national higher education system. The Centre for Society and Policy at IISc has addressed this directly, framing the work as "bioresponsibility" to cover biosafety, biosecurity, and responsible research and innovation together (Centre for Society and Policy, Indian Institute of Science, 2026). Any formal degree program developed in India could adopt the same framing, positioned around responsible innovation in the life sciences rather than biosecurity as a discrete field. Once such a program is developed, its proponents should seek recognition through the University Grants Commission (UGC), India's higher education regulator.

(5) Reorient donor funding toward multi-year, locally co-designed programs

Multilateral and government-led institutional programs are three times more prevalent in the Global South than in the Global North (Figure 3), indicating that external bodies play an outsized role in shaping Global South biosecurity training. Short, externally driven funding cycles risk producing inactive programs and curricula that do not track locally identified needs.

We suggest that Global North donors, including Coefficient Giving, Wellcome Trust, Sentinel Bio, and Longview Philanthropy, focus on funding multi-year initiatives with transition plans that hand ownership to local actors before the funding period ends.

REFERENCES

Africa Centres for Disease Control and Prevention. (2022). *The Regional Training and Certification Program for Biosafety and Biosecurity Professionals* [Technical report]. https://africacdc.org/download/the-regional-training-and-certification-program-for-biosafety-and-biosecurity-professionals/

African Society for Laboratory Medicine. (2026,). *Africa CDC and ASLM Convene Regional Laboratory Equipment Maintenance and Calibration Training in Tanzania*. https://aslm.org/africa-cdc-and-aslm-convene-regional-laboratory-equipment-maintenance-and-calibration-training-in-tanzania/

Alexanian, T., & others. (2021). *Youth Declaration for Biosecurity* [Technical report].

Bakanidze, L., Imnadze, P., & Perkins, D. (2010). Biosafety and biosecurity as essential pillars of international health security and cross-cutting elements of biological nonproliferation. *BMC Public Health*, *10*(Suppl1), S12. https://doi.org/10.1186/1471-2458-10-S1-S12

Beeckman, D., & Rüdelsheim, P. (2020). Biosafety and Biosecurity in Containment: A Regulatory Overview. *Frontiers in Bioengineering and Biotechnology*, *8*, 650. https://doi.org/10.3389/fbioe.2020.00650

Caballero-Anthony, M., Montesclaros, J. M. L., & Trajano, J. C. (2025). Dual-Use Research of Concern Landscape in Southeast Asia: Prioritization, Gaps, and Challenges. *Applied Biosafety*. https://doi.org/10.1089/apb.2024.0055

Calkins, S. (2021). Toxic Remains: Infrastructural Failure in a Ugandan Molecular Biology Lab. *Social Studies of Science*, *51*(5), 707–728. https://doi.org/10.1177/03063127211011531

Centre for Society and Policy, Indian Institute of Science. (2026,). *Bioresponsibility: Biosafety, Biosecurity and Responsible Research and Innovation*. https://csp.iisc.ac.in/bioresponsibility

Council on Strategic Risks. (2025). *Assessing Dual-Use Issues at the AIxBio Convergence: Future Risks and Opportunities for the United States* [Technical report]. https://councilonstrategicrisks.org/2025/07/31/the-aixbio-landscape/

Crisp, N., & Chen, L. (2014). Global Supply of Health Professionals. *New England Journal of Medicine*, *370*(10), 950–957. https://doi.org/10.1056/NEJMra1111610

ERA AIxBio Research Fellowship. (2026,). *Fellows W26*. https://www.aixbiosecurity.com/fellows-w26

Evans, S., & Frow, E. (2015). Taking Care in Synthetic Biology. In B. Rappert & B. Balmer (Eds.), *Absence in Science, Security and Policy: Absence in Science, Security and Policy*. Palgrave Macmillan. https://doi.org/10.1057/9781137493736_7

Jansen, K., & Roquas, E. (2008). Biosafety Regulation and Global Governance: The Problem of Absentee Expertise in Latin America. In G. Otero (Ed.), *Food for the Few: Neoliberal Globalism and Biotechnology in Latin America: Food for the Few: Neoliberal Globalism and Biotechnology in Latin America* (pp. 91–114). University of Texas Press. https://doi.org/10.7560/717701-006

Johns Hopkins Center for Health Security. (2018,). *Emerging Leaders in Biosecurity Fellowship*. https://centerforhealthsecurity.org/education-training/emerging-leaders-in-biosecurity-fellowship

Johns Hopkins Center for Health Security. (2026,). *Emerging Leaders in Biosecurity Fellowship*. https://centerforhealthsecurity.org/education-training/emerging-leaders-in-biosecurity-fellowship

Khan, E., Ahmed, N., Temsamani, K., El-Gendy, A., Cohen, M., Hasan, A., Gastfriend, H., & Cole, J. (2016). Biosafety Initiatives in BMENA Region: Identification of Gaps and Advances. *Frontiers in Public Health*, *4*, 44. https://doi.org/10.3389/fpubh.2016.00044

Maehira, Y., & Spencer, R. (2019). Harmonization of Biosafety and Biosecurity Standards for High-Containment Facilities in Low- and Middle-Income Countries: An Approach From the Perspective of Occupational Safety and Health. *Frontiers in Public Health*, *7*, 249. https://doi.org/10.3389/fpubh.2019.00249

Namdeo, S. K., & Zhang, J. Y. (2024). Rethinking Science Diplomacy and Global Biosecurity: Challenges, Emerging Practices and the Way Forward. *International Affairs*, *100*(6), 2623–2635. https://doi.org/10.1093/ia/iiae187

Rose, S., & Nelson, C. (2023). *Understanding AI-Facilitated Biological Weapon Development* [Technical report].

Sandbrink, J. B. (2023,). *Artificial Intelligence and Biological Misuse: Differentiating Risks of Language Models and Biological Design Tools*.

Thorat, K. (2026). Building the Future from the South: Technology, Diplomacy, and Global Health. *Science and Diplomacy*. https://doi.org/10.1126/scidip.aeg8771

World Health Organization. (2020). *Laboratory Biosafety Manual, Fourth Edition*. World Health Organization. https://www.who.int/publications/i/item/9789240011311

World Health Organization. (2022). *Global Guidance Framework for the Responsible Use of the Life Sciences: Mitigating Biorisks and Governing Dual-Use Research*. World Health Organization.

World Health Organization. (2024,). *WHO Updates Laboratory Biosecurity Guidance*. https://www.who.int/news/

item/04-07-2024-who-updates-laboratory-biosecurity-guidance

APPENDIX

This section serves as an index of documents relevant to the research which did not fit the main focus of the report. It also includes additional project outputs which may be of interest to some readers.

Table 2: Appendix index.

Resource Title	**Summary**	**Document Link**
Figure 6A	Focus Area Prioritization across Income Groups extended	Appendix: Focus area prioritization
Project Repository	Full documented pipeline design	github.com/farhanazam98/biosec-talent-pipeline
Full work queue	831 candidate program URLs	biosecurity_programs
Final database	201-program structured dataset with all extracted fields	biosecurity_database
Poster for SPAR Demo Day	Quick view outline of findings and recommendations	SPAR_Poster_Final.pdf