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THE GEOPOLITICS OF BIOSECURITY: BIOLOGICAL RISKS AND THE CHANGING INTERNATIONAL SECURITY ENVIRONMENT

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Abstract

Biological risks have become an important part of the changing international security environment. This paper examines how geopolitical tensions, technological change, and differences in national preparedness shape biological risks and affect the ability of existing international and national systems to manage them. The study uses qualitative document analysis of international treaties, scholarly literature, and official reports, supported by descriptive analysis of the 2021 Global Health Security (GHS) Index and the Global BioLabs Report 2023. The findings show that biological risks mainly arise through three pathways: natural disease outbreaks, laboratory accidents, and deliberate biological use. These risks are closely linked with international politics, national security, and technological change. The analysis also shows that the Biological Weapons Convention remains limited by the absence of a formal system for verifying compliance, while geopolitical rivalry and disinformation create additional challenges for international cooperation. At the same time, advances in gene editing, synthetic biology, and artificial intelligence are changing the nature of biological risks, while high-security laboratory capacity is expanding, particularly in Asia. National preparedness remains highly uneven: the global average GHS Index score is 38.9 out of 100, while Pakistan scores 30.4. The paper argues that effective biosecurity requires stronger international cooperation, improved national preparedness, better laboratory security, responsible use of emerging technologies, and greater transparency. It concludes with seven practical policy measures for states and international organizations to strengthen global biosecurity.

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1. Introduction

A single infectious disease can cross borders faster than armies, making biology an important part of international security. In 2014, the United Nations Security Council described the Ebola outbreak in West Africa as a threat to international peace and security (United Nations Security Council, 2014). The outbreak resulted in more than 28,000 reported cases and over 11,000 deaths (WHO, 2016a). The COVID-19 pandemic later showed the wider effects of biological crises, with an estimated 14.9 million excess deaths worldwide in 2020 and 2021 (Msemburi et al., 2023). These experiences demonstrated that biological events can affect not only public health but also economies, governments, social stability, and public trust. In this paper, biosecurity refers to efforts to protect people, animals, and food systems from biological harm arising from natural outbreaks, laboratory accidents, or deliberate use (Koblentz, 2010; Enemark, 2017).

The importance of biosecurity has increased because of three major changes. First, geopolitical tensions have made international cooperation more difficult, while the Biological Weapons Convention (BWC) still lacks a formal system for verifying compliance (United Nations, 1972). Second, advances in biotechnology, including CRISPR gene editing, and the growing use of artificial intelligence are making biological research faster, more accessible, and potentially more difficult to control (Jinek et al., 2012; Urbina et al., 2022). Third, the number of high-security laboratories is increasing in different parts of the world, creating new demands for strong safety and security systems (Global BioLabs, 2023). These developments show that biological risks cannot be understood only as a public health problem; they are also linked to international politics, security, technology, and governance.

Against this background, the paper addresses three questions: RQ1: How have biological risks and their politics changed since the Cold War? RQ2: Which features of the current international security environment increase or reduce these risks? RQ3: How significant are gaps in national and international biosecurity capacity, and what do they mean for Pakistan? The paper contributes by bringing together three areas that are often studied separately: health security, biological weapons control, and technology governance. It also uses recent public data to examine differences in national preparedness and laboratory capacity. The analysis therefore connects international security developments with practical biosecurity challenges and provides a basis for policy recommendations at both national and international levels.

2. Literature Review and Conceptual Framework

2.1 Health, Security, and Securitization

Securitization theory says that an issue becomes a security issue when leaders present it as an urgent threat to survival, and when the audience accepts this claim (Buzan et al., 1998). Scholars have used this idea to study disease. Price-Smith (2009) argues that outbreaks can weaken states by hurting their economies and their legitimacy. Davies (2008) and Elbe (2010) show how infectious disease was moved into the security field, and how this brought both attention and money. Kelle (2007)

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adds that this move also changes the treaty rules against biological weapons, because health experts and arms-control experts begin to work in the same space.

Not all scholars welcome this. Wenham (2019) warns of "over-securitization," which means that fear-based language can push aside long-term work on health systems and can encourage secrecy. This debate matters for the paper, because a good biosecurity policy must protect people without closing science and health cooperation.

2.2 Threat Assessment: How Big Is the Danger?

Experts disagree on how likely a deliberate biological attack is. Koblentz (2009, 2010) says that policy should be based on a careful, evidence-based view of threats, not on worst-case fear. Ouagrham-Gormley (2014) shows that making a biological weapon is hard, because it needs tacit skill, teamwork, and organization, not only knowledge. Inglesby and Relman (2016) reply that the trend in technology means that leaders should still plan for serious events. Enemark (2017) adds that many actions taken to make people safe can also create new dilemmas, for example when a state's defensive research looks like an offensive program to others.

2.3 Technology and Dual-Use Research

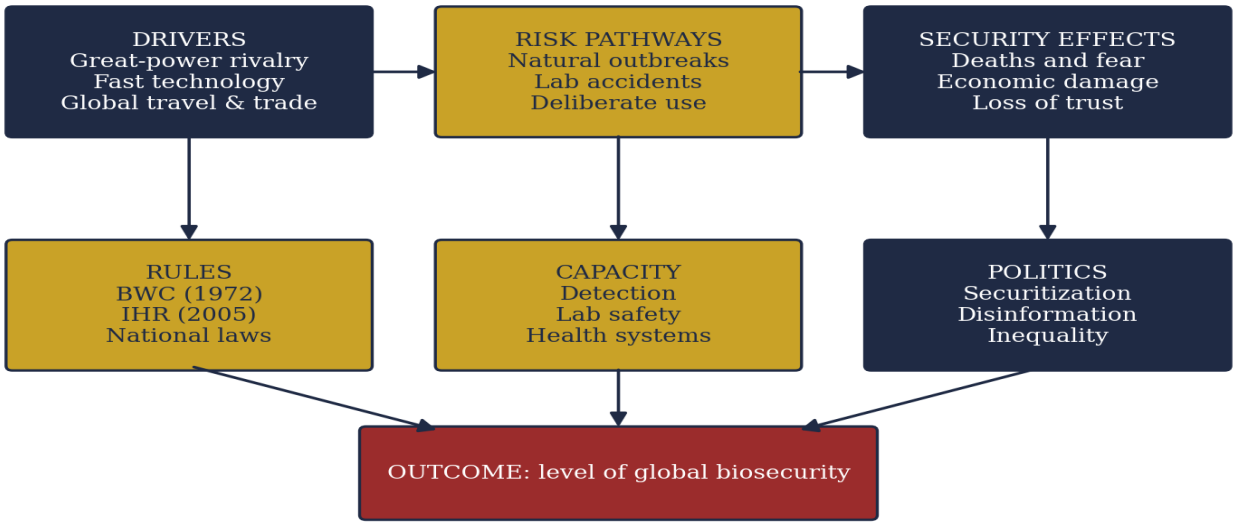
Dual-use research is work that can help society but can also be misused. A well-known case came in 2011 and 2012, when scientists showed that the H5N1 bird flu virus could be changed to spread between ferrets by air (Herfst et al., 2012). The studies started a long debate on whether such results should be published. A report by the National Academies of Sciences, Engineering, and Medicine (2018) reviewed the risks of synthetic biology and called for stronger, science-based biodefense. More recently, researchers showed that a drug-discovery AI could be turned to design toxic molecules, and it produced about 40,000 candidates in less than six hours (Urbina et al., 2022). Other studies ask whether large language models could help non-experts with harmful biological tasks (Sandbrink, 2023; Soice et al., 2023).

2.4 Conceptual Framework

Figure 1 puts these ideas together. Political and technical drivers create three risk pathways. The pathways lead to security effects. The effects are reduced or increased by rules, national capacity, and politics. The result is the overall level of biosecurity. The rest of the paper follows this chain.

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Figure 1 *A Framework for Analyzing the Geopolitics of Biosecurity*



Note. Drawn by the author from the concepts in Buzan et al. (1998), Koblentz (2010), and Enemark (2017).

3. Research Design and Method

The study uses a qualitative, descriptive design. The first part is document analysis. The author read and compared treaties, peer-reviewed studies, books, and reports from international bodies, and used them to trace the history and the main arguments. Sources were chosen for three reasons: they are from recognized scholars or institutions, they are recent or foundational, and they can be checked by other researchers.

The second part is a simple descriptive analysis of two public data sets. The first is the 2021 GHS Index. It scores 195 countries from 0 to 100 on six categories: prevention, detection and reporting, rapid response, health system, compliance with international norms, and risk environment. It uses 37 indicators and 171 questions based on public information (Bell & Nuzzo, 2021). The second is the Global BioLabs Report 2023, which counts the most secure laboratories, called biosafety level 4 (BSL-4) labs, and scores national biosafety and biosecurity rules (Global BioLabs, 2023). The paper does not run new statistical tests. It reports the published numbers and shows them in charts and maps.

There are limits. Both data sets are built from public documents, so they measure what is written and reported, not always what is done. The authors of the GHS Index also state that the index is not a direct predictor of how a country will act in an emergency, because social, political, and cultural factors matter too (Bell & Nuzzo, 2021). The limits are discussed again in Section 9.

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4. From State Programs to a Wider Risk Field

4.1 The Cold War Legacy

The modern rules on biological weapons come from the Cold War. The Biological Weapons Convention (BWC) was opened for signature in 1972 and entered into force in 1975. It bans the development, production, and stockpiling of biological and toxin weapons (United Nations, 1972). It was a landmark, but it has a well-known weakness: it has no agency to inspect states and no formal verification system (Koblentz, 2009).

That weakness had real results. The Soviet Union kept a very large secret program through the civilian-looking organization Biopreparat, even though it had signed the treaty (Alibek & Handelman, 1999; Leitenberg et al., 2012). In April 1979, anthrax spores escaped from a military facility in Sverdlovsk, and at least 66 people died (Meselson et al., 1994). After the 1991 Gulf War, inspectors found that Iraq had also run a biological weapons program (Koblentz, 2009). These cases taught the world that a treaty without checking depends heavily on trust.

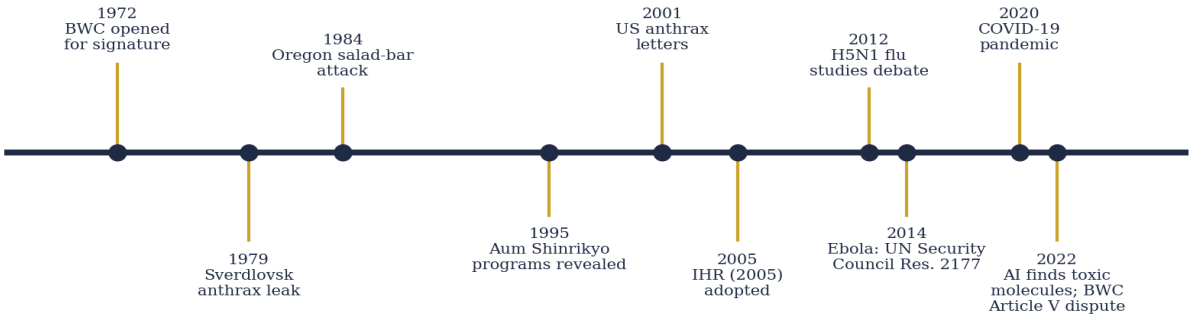
4.2 Non-State Actors and Biocrimes

The 1980s and 1990s brought a new worry, which was that small groups might use biology. In 1984, followers of a religious group in Oregon, United States, spread *Salmonella* on restaurant salad bars, and 751 people became sick (Török et al., 1997). In the early 1990s, the Japanese group Aum Shinrikyo tried to make and spread anthrax and botulinum toxin, but failed, before it used sarin gas in 1995 (Danzig et al., 2011). In 2001, letters with anthrax spores were sent through the US mail. Twenty-two people became ill and five died (Jernigan et al., 2002). These cases were small compared with a major pandemic, but they showed that the risk was not limited to states, and they led to large new biodefense spending.

Figure 2 shows the main events. Notice that the events move from state programs (1970s), to small groups (1980s to 2001), to global health emergencies and new technologies (2005 to 2022).

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Figure 2 *Timeline of Key Events in the Politics of Biosecurity, 1972–2022*



Note. Dates are from the sources cited in Section 4 and Section 5: United Nations (1972); Meselson et al. (1994); Török et al. (1997); Danzig et al. (2011); Jernigan et al. (2002); WHO (2016a); Herfst et al. (2012); Urbina et al. (2022); Sundelson et al. (2025).

4.3 Three Risk Pathways

The history shows three pathways to biological harm. Table 1 sets them side by side. The key lesson is that the same laboratory skills, and often the same germs, can sit behind all three. This is why governance must cover public health, lab safety, and arms control together.

Table 1 ***Three Pathways of Biological Risk and Their Political Meaning***

Pathway	Examples	Main political effect	Key sources
Natural outbreak	Ebola in West Africa (2014–2016); COVID-19 (2020–)	Strains health systems and trust; UN Security Council involvement	United Nations Security Council (2014); Msemburi et al. (2023)
Accident	Sverdlovsk anthrax leak (1979)	Raises doubts about lab safety and secrecy	Meselson et al. (1994)
Deliberate use	Oregon (1984); Aum Shinrikyo (1990s); US anthrax letters (2001); state programs	Drives arms control, biodefense, and suspicion between states	Török et al. (1997); Danzig et al. (2011); Jernigan et al. (2002); Koblentz (2009)

Note. Table compiled by the author from the sources listed in the last column.

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5. The Changing Security Environment

5.1 Great-Power Rivalry and a Weakening Treaty Regime

Today's environment is marked by mistrust. In its 2023 compliance report, the US Department of State (2023) said that it assessed that Russia and North Korea keep offensive biological weapons programs, and that it had concerns about China and Iran. These are one government's judgments, and other states dispute them, but they show how compliance itself has become a point of political conflict.

The BWC has also become a stage for propaganda. In 2022, Russia asked for a formal consultative meeting under Article V of the treaty, and asked for an investigation under Article VI, about alleged US-funded biological weapons laboratories in Ukraine. Scholars and diplomats reject these claims as false. The facilities are public health labs that work on disease monitoring and diagnostics (Sundelson et al., 2025). An analysis of the Ninth Review Conference found that discussion of the claims took over three hours and helped produce a weak Final Document (Sundelson et al., 2025). The lesson is clear: in a low-trust world, the rules meant to solve disputes can be used as tools of political pressure. The same conference did agree to set up a working group on strengthening the Convention, which is a hopeful sign, but its results are still unclear.

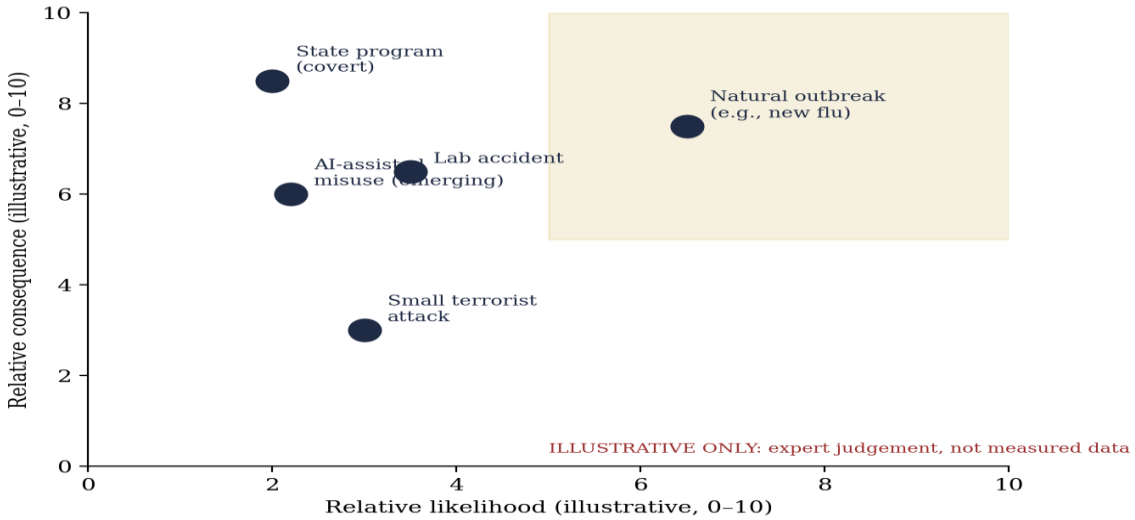
5.2 Fast Technology, Lower Barriers?

New tools can make biology faster, cheaper, and more open. This helps medicine, but it also raises questions about misuse. Gene-editing tools are easier to use than older methods (Jinek et al., 2012). Software can now suggest new molecules in hours (Urbina et al., 2022). Analysts also separate two kinds of AI risk: language models, which might give advice, and specialized biological design tools, which might help design new agents (Sandbrink, 2023). Early tests suggest that chatbots can already provide some relevant information to non-experts (Soice et al., 2023).

It is important not to overstate this. Ouagrham-Gormley (2014) reminds us that information alone is not enough, since making and using a biological weapon needs skilled teams, equipment, and testing. So a fair reading is that technology may lower some barriers, but not all, and that the speed of change is what makes advance planning wise (Inglesby & Relman, 2016; National Academies of Sciences, Engineering, and Medicine, 2018). Figure 3 gives an illustrative view of how experts might compare the pathways. It is a thinking tool, not measured data.

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Figure 3 *Illustrative Comparison of Biological Risk Pathways (Conceptual Only)*



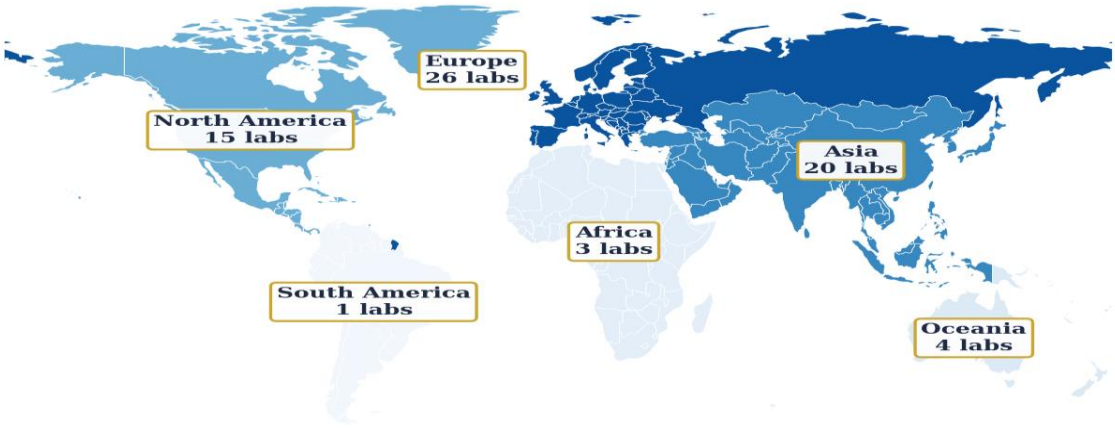
Source: Compiled by Author

5.3 The Spread of High-Security Laboratories

A third change is the growth of BSL-4 laboratories, which work with the most dangerous germs, such as Ebola and Lassa virus. In 2021, the Global BioLabs project counted 59 such labs in operation, under construction, or planned, in 23 countries. By early 2023 there were 69 in 27 countries, with 51 in operation (Global BioLabs, 2023). Since the start of COVID-19, nine countries have announced plans for 12 new labs, and most of these are in Asia (Global BioLabs, 2023). About three-quarters of operating BSL-4 labs are in cities, which could make any accident more serious (Global BioLabs, 2023). Figure 4 and Table 2 show where they are.

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Figure 4 *BSL-4 Laboratories by Continent (Operating, Under Construction, or Planned), 2023*



Note. Counts are from Global BioLabs (2023): Europe 26, Asia 20, North America 15, Oceania 4, Africa 3, South America 1 (total 69). The map data place Russia in Europe, so continent boundaries may differ slightly from the report.

Table 2 *BSL-4 Laboratories by Region, 2023*

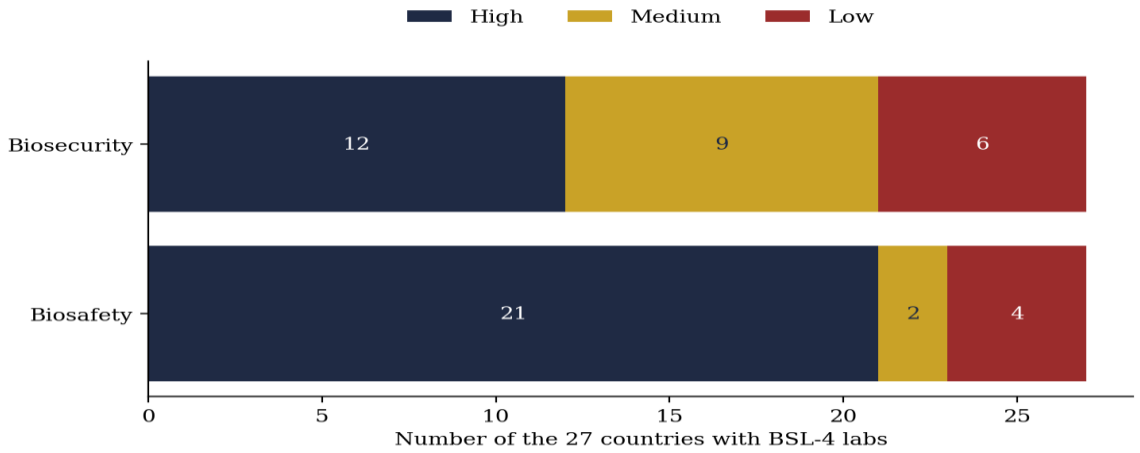
Region	Number of labs	Share of world total
Europe	26	38%
Asia	20	29%
North America	15	22%
Oceania	4	6%
Africa	3	4%
South America	1	1%
World total	69 (in 27 countries)	100%

Note. Counts from Global BioLabs (2023). Shares calculated by the author and rounded, so they may not add to exactly 100%.

Rules have not kept up with this growth. Figure 5 shows that, among the 27 countries with BSL-4 labs, 21 scored high on biosafety rules, but only 12 scored high on biosecurity rules. Most important, only one of the 27 has full national oversight of dual-use research (Global BioLabs, 2023). This is a governance gap, not a technical one.

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Figure 5 *Biosafety and Biosecurity Scores of the 27 Countries With BSL-4 Labs, 2023*



Note. Data are from Global BioLabs (2023) as reported in the published summary: biosafety, 21 high, 2 medium, 4 low; biosecurity, 12 high, 9 medium, 6 low.

5.4 Non-State Actors: Real but Limited

Non-state actors remain a concern, but the evidence suggests a careful view. The Oregon, Aum Shinrikyo, and anthrax-letter cases (Török et al., 1997; Danzig et al., 2011; Jernigan et al., 2002) show intent and some skill, but also many failures. Ouagrham-Gormley (2014) explains why: groups face organizational and knowledge barriers that new tools do not remove overnight. Policy should therefore watch technology trends closely without treating every advance as a certain danger (Koblentz, 2010).

5.5 Pandemics as Security Shocks

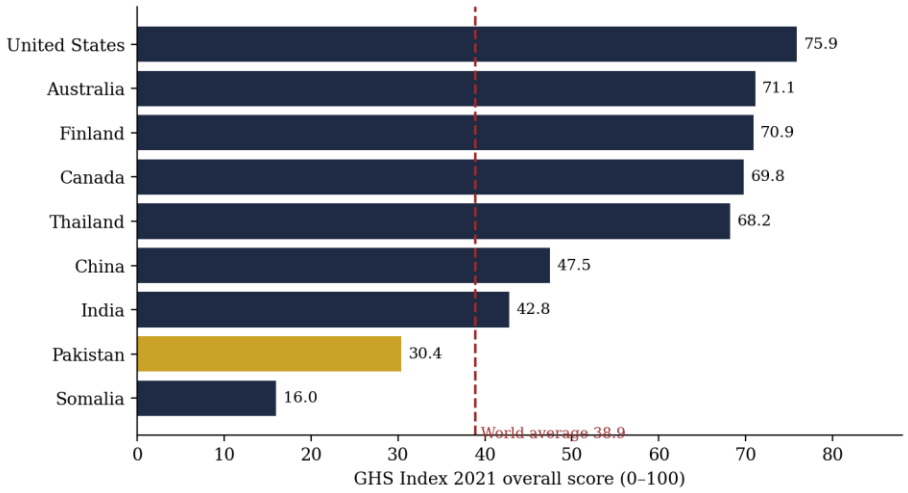
Natural outbreaks now sit inside the security field. The Security Council's Ebola resolution in 2014 was a turning point (United Nations Security Council, 2014). COVID-19 went further. It also produced a deep political dispute about its origin. Relman (2020) argued that the world needs a full and open investigation of the origins, whether natural or laboratory-related, to prepare for the next pandemic. The origin question is still debated, and this paper takes no side on it. What matters here is the political effect: the dispute made states more suspicious of each other's laboratories and data, at the very time when cooperation was needed most.

6. Uneven Capacity: Evidence from the GHS Index

If threats are shared, the capacity to face them is not. The 2021 GHS Index shows how big the gap is. The world average score was 38.9 out of 100, down from 40.2 in 2019. No country reached the top tier, and the highest score, held by the United States, was 75.9 (Bell & Nuzzo, 2021). The lowest score was Somalia's, at 16.0. Figure 6 shows selected countries.

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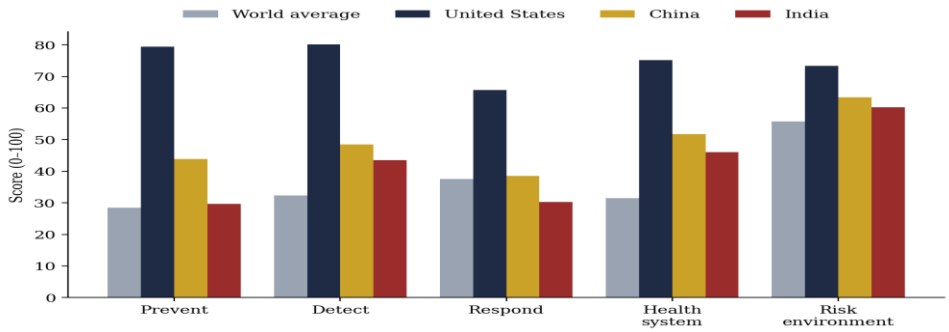
Figure 6 *Overall Global Health Security Index Scores for Selected Countries, 2021*



Note. Scores are from Bell and Nuzzo (2021).

Figure 7 breaks the scores into categories. The world average for "prevention," which includes the control of dangerous pathogens and laboratory biosecurity, is only 28.4. This is the lowest of the categories reported here. Detection (32.3), health systems (31.5), and rapid response (37.6) are also low. In contrast, the risk environment score is higher, at 55.8 (Bell & Nuzzo, 2021). In simple words, the world is weakest exactly where it should stop problems before they start.

Figure 7 *Global Health Security Index Category Scores: World Average, United States, China, and India, 2021*



Source: Developed by research scholar

6.1 A Regional Look: Pakistan and Its Neighbors

For Pakistan, the 2021 overall score was 30.4, which is below the world average of 38.9 and below neighbors India (42.8) and China (47.5) (Bell & Nuzzo, 2021). Pakistan's scores for detection and reporting (29.2) and for health system (26.8) are also low, and its risk-environment score is 44.8 (Bell & Nuzzo, 2021). Figure 8 shows the regional picture.

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Figure 8 *GHS Index 2021 Overall Scores for Pakistan and Two Large Neighbors*



Note. Scores from Bell and Nuzzo (2021). Only the three countries with verified scores are colored. Other countries are shown in grey for geographic context only.

These numbers matter for regional security in a simple way. Disease moves with people and trade, and the region has long borders and heavy movement across them. A weak link in one country is a risk for all its neighbors, even when their own scores are higher. It also means that regional health-security cooperation is a security policy, not only a health policy. At the same time, the analysis should not be read as a ranking of blame: these scores measure capacity and public documents, and low scores often reflect limited resources, not lack of will (Bell & Nuzzo, 2021).

7. Discussion

Three tensions emerge from the evidence. The first is between security and openness. Stronger controls can reduce misuse, but too much secrecy can slow research and hurt trust, which is the concern in the over-securitization debate (Wenham, 2019). The 2012 H5N1 case (Herfst et al., 2012) is a clear example, because it forced scientists, publishers, and governments to balance public benefit against possible misuse.

The second is between rules and trust. The BWC and the International Health Regulations (IHR) are the two main global frameworks. The IHR (2005) require states to build core public health capacities and to report certain events to the WHO (WHO, 2016b; Fidler & Gostin, 2006). But neither system has strong tools to force compliance. The Ukraine disinformation episode (Sundelson et al., 2025) shows that a system built on good faith can be strained when good faith is low.

The third is between capacity and fairness. The GHS results (Bell & Nuzzo, 2021) show that the gap between the strongest and weakest states is very large. Yet the risk is shared. If new laboratories are

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being built fastest in Asia (Global BioLabs, 2023), while national oversight of dual-use research is almost absent, then the world's security depends partly on how well those countries are supported to build safe systems. Security framing can bring money to this task (Elbe, 2010), but it works best when it also funds ordinary health systems, and not only emergency defense (Wenham, 2019).

8. Policy Recommendations

The evidence supports seven practical steps. Table 3 links each step to the gap it answers.

Table 3 *Gaps in Biosecurity Governance and Recommended Actions*

Gap identified	Recommended action	Main actors
No verification in the BWC (United Nations, 1972; Koblentz, 2009)	Build step-by-step transparency and assurance measures, such as data exchange and voluntary peer review, and protect Articles V and VI from misuse	BWC states parties
Small institutional capacity and a weak Ninth Review Conference (Sundelson et al., 2025)	Give the BWC secretariat more staff and funding, and set up a regular science advisory process	BWC states parties; donors
Only 1 of 27 countries has full dual-use oversight (Global BioLabs, 2023)	Pass national laws on dual-use research review, pathogen lists, and whistleblower protection	National governments; universities
Fast growth of BSL-4 labs, many in cities (Global BioLabs, 2023)	Require licensing, a public lab registry, independent risk assessment before building, and strong safety culture training	Regulators; lab operators
Emerging AI and synthetic biology risks (Sandbrink, 2023; Urbina et al., 2022)	Test AI models for biological misuse, screen orders for synthetic DNA, and share safety findings across developers and states	AI developers; regulators; scientists
Low prevention, detection, and health-system scores (Bell & Nuzzo, 2021)	Fund IHR core capacities, especially in lower-income states, and support regional cooperation, for example among Pakistan, India, China, and Afghanistan	WHO; donors; regional bodies

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Gap identified	Recommended action	Main actors
Disinformation about biological activities (Sundelson et al., 2025)	Publish clear information about public health labs, and respond quickly and factually to false claims	Governments; WHO; media

Note. Table compiled by the author. Sources of each gap are shown in the first column.

9. Conclusion

Biological risks have become an important part of international security. These risks no longer come only from biological weapons programs but also from natural outbreaks, laboratory accidents, rapid technological change, and mistrust among states. The main international treaty still lacks a strong system to verify compliance, while high-security laboratories are increasing faster than many national rules and safety systems. In Pakistan and the wider region, limited preparedness shows that stronger cooperation is needed for both health and security. Fear alone is not a good policy, but ignoring these risks is also dangerous. Effective action requires reliable evidence, stronger and verifiable rules, support for weaker health systems, responsible scientific research, and greater international cooperation to reduce risks that no country can manage alone.

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