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Research Article

Harmonising Indonesia's CBRN Policy with the IHR and WHO–UNODA Frameworks

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Abstract

Indonesia is increasingly vulnerable to chemical, biological, radiological, and nuclear (CBRN) threats, driven by regional tensions, natural disasters, and rapidly evolving biotechnologies. Although Indonesia has enacted several laws and sector-specific regulations to manage these risks, its current policy landscape is fragmented and lacks coherent alignment with global standards. The absence of an integrated national strategy limits Indonesia's ability to prevent, detect, and respond effectively to CBRN emergencies. This study investigates the extent to which Indonesia's existing CBRN policies align with two critical international frameworks: the International Health Regulations (IHR 2005) and guidance from WHO and UNODA in biosecurity and disarmament. Using a qualitative document-based approach, this research analysed national legislation, ministerial decrees, strategic plans, and relevant international conventions. Thematic content analysis was applied to evaluate policy alignment with IHR core capacities, including surveillance, legal infrastructure, inter-agency coordination, and emergency response mechanisms, as well as WHO–UNODA principles, including dual-use oversight, biological disarmament, and research governance. The analysis reveals major policy and institutional gaps. CBRN responsibilities in Indonesia are distributed among BNPB, BAPETEN, the Ministry of Health, BNPT, and the military (TNI), each functioning in isolation. There is no overarching coordinating body or comprehensive legal framework to unify efforts. Moreover, critical areas such as dual-use research oversight, bio-threat intelligence sharing, and international reporting obligations remain underdeveloped. Integration with IHR and WHO–UNODA protocols is limited and largely ad hoc. To improve national preparedness and resilience, Indonesia must pursue comprehensive legal reform and establish a national CBRN coordination body. Embedding international norms, such as the IHR and WHO–UNODA guidance, into domestic policy frameworks will improve coordination across agencies and align Indonesia's biosecurity systems with international best practices.

Keywords: biosecurity governance, CBRN, IHR 2005, policy harmonisation, WHO–UNODA

1. Introduction

In recent years, the threat landscape concerning Chemical, Biological, Radiological, and Nuclear (CBRN) incidents has intensified due to global instability, concerns over bioterrorism, dual-use technology challenges, and climate-induced disasters. These threats pose serious risks to both national security and public health systems, especially in low- and middle-income countries (1). The COVID-19 pandemic highlighted how biological events can spread across borders rapidly and unpredictably, creating renewed urgency to align domestic policies with international preparedness and response standards (2–3).

CBRN risks are particularly acute in Southeast Asia, especially for Indonesia, due to regional vulnerabilities such as dense urban populations, limited cross-sectoral surveillance infrastructure and frequent natural disasters. Indonesia has a fragmented institutional architecture addressing various components of CBRN: the National Disaster Management Authority (BNPB) leads disaster response, BAPETEN oversees nuclear safety, the Ministry of Health leads biological threat mitigation, and the National Counter Terrorism Agency (BNPT) covers aspects of intentional threats (4–6). However, these entities often operate in silos, without a cohesive framework for risk governance (7).

Internationally, two major frameworks guide biosecurity and CBRN governance: the International Health Regulations (IHR) 2005 by the World Health Organization (WHO), and the biosecurity and disarmament principles promoted by the United Nations Office for Disarmament Affairs (UNODA). The IHR provides legally binding obligations for states to develop core public health capacities, including surveillance, response, coordination, and legislation

for health emergencies (8). Meanwhile, WHO–UNODA frameworks emphasize biosafety, dual-use oversight, and biological weapons prohibition to prevent intentional misuse of science and technology (9).

Despite the presence of these global instruments, Indonesia's legal and institutional frameworks remain only partially aligned. Gaps persist in regulating dual-use research, establishing integrated surveillance mechanisms, and formalizing inter-agency coordination (10). These gaps may hamper national preparedness for CBRN threats and reducesthe country's capacity to comply with international obligations under IHR and the Biological Weapons Convention (BWC).

This study aims to critically examine how Indonesia's current CBRN governance aligns with international standards, especially the IHR 2005 and WHO–UNODA frameworks. It uses qualitative analysis of national and international policy documents to identify gaps, overlaps, and opportunities for harmonisation. By doing so, it contributes to ongoing efforts in strengthening national biosecurity through integrated, legally coherent, and internationally consistent policy mechanisms.

2. Methods

This study adopted a qualitative document-based policy analysis to assess the alignment of Indonesia's Chemical, Biological, Radiological, and Nuclear (CBRN) policy landscape with international standards, specifically the International Health Regulations (IHR 2005) and frameworks developed by WHO and UNODA. Qualitative methods are particularly well-suited for examining policy coherence, legal gaps, and inter-agency coordination, especially in complex domains like biosecurity and health emergency preparedness (1).

2.1 Data sources

Two main groups of documents were analysed:

- *National Sources*: This included national legislation and government regulations such as Law No. 6/2018 on Health Quarantine, Law No. 10/1997 on Nuclear Energy, Government Regulation No. 74/2001 on Hazardous and Toxic Substances, along with various ministerial decrees and national contingency plans.
- *International Sources*: Key international references included the IHR 2005 core capacities (8), WHO Biosecurity Guidance (11), and UNODA protocols related to biological disarmament and dual-use oversight (12).

2.2 Analytical framework

Documents were analysed using thematic content analysis, using a deductive coding framework derived from the IHR and WHO–UNODA matrices (Figure 1). Coding was conducted manually using Excel and validated using NVivo software to ensure consistency.

A comparison matrix was used to map Indonesian legal instruments against:

- The IHR core capacities: surveillance, legal preparedness, coordination, and emergency response systems (13)
- The WHO–UNODA biosecurity pillars: control of dual-use research, public health protection, and alignment with the Biological Weapons Convention (13–14).

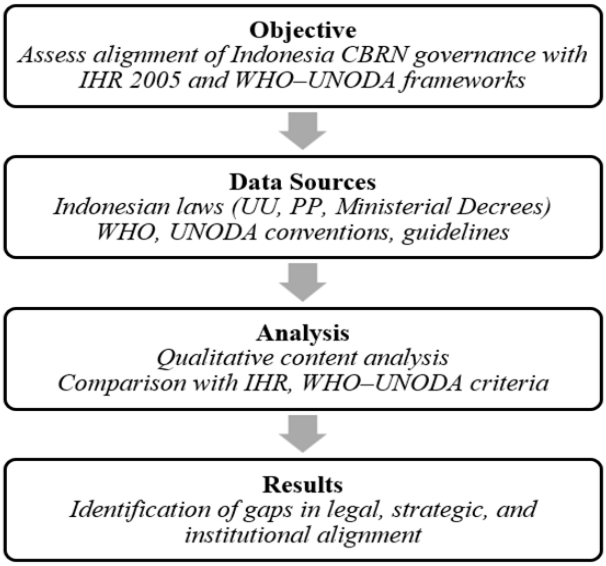

Figure 1: Policy analysis roadmap outlining objectives, data sources, analysis methods, and expected results. Source: Adapted from (1–2, 10) (WHO, (2013)

This visual roadmap underscores the structured approach taken to ensure analytical clarity and methodological coherence. By systematically comparing national policies with IHR and WHO–UNODA frameworks, the study identifies critical misalignments that inform subsequent findings and recommendations.

3. Results

The analysis of Indonesia's CBRN governance reveals critical institutional, legal, and strategic limitations in achieving full alignment with international frameworks such as the IHR 2005 and WHO–UNODA biosecurity principles. These findings point to structural gaps that, if left unaddressed, may hinder national preparedness and response to both natural and human-made CBRN incidents.

3.1 Institutional landscape

Indonesia's current approach to CBRN risk governance is managed by several agencies operating in parallel, each with a fragmented mandate. The National Disaster Management Authority (BNPB) is tasked with emergency response coordination but lacks sole authority over radiological or biological threats. BAPETEN oversees nuclear and radiation safety, Kementerian Kesehatan (MoH) manages disease surveillance and public health emergencies, while the Indonesian National Armed Forces (TNI) and National Counterterrorism Agency (BNPT) are involved in threat prevention and counterterrorism response.

This lack of a unified national CBRN authority has led to overlapping responsibilities, siloed communication, and the lack of an integrated national contingency framework. Such fragmented architecture hinders effective decision-making in complex CBRN scenarios, as seen in other low- and middle-income countries with similar institutional profiles (1).

The institutional configuration of CBRN governance in Indonesia is characterized by multiple agencies operating in silos. To visualize this complex landscape, Figure 2 illustrates the fragmented distribution of CBRN-related responsibilities among agencies.

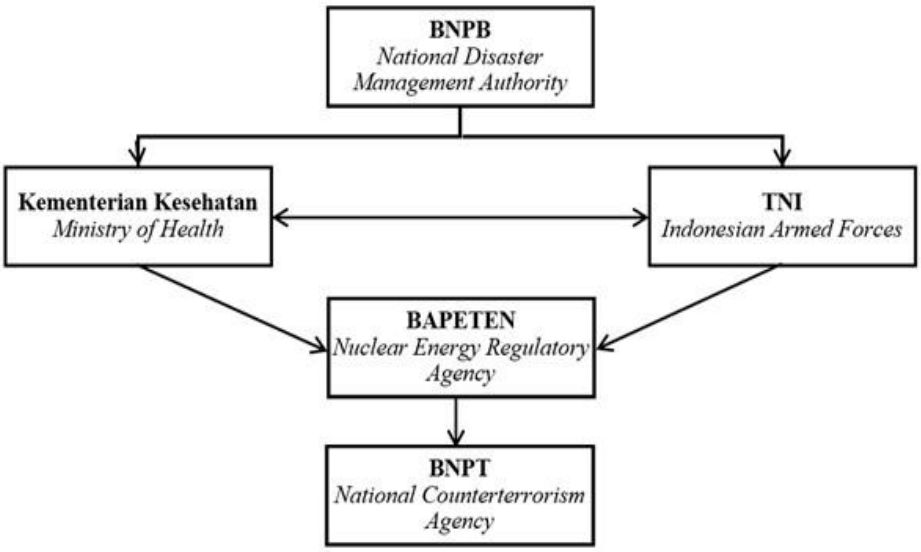

Figure 2: Institutional Mapping of CBRN Governance in Indonesia.
Source: Adapted from (13, 17–19)

As shown in the map, the absence of a centralized authority results in duplicated functions and gaps in inter-ministerial coordination. BNPB, MoH, TNI, BAPETEN, and BNPT all operate within distinct regulatory frameworks, limiting Indonesia's ability to execute a unified response to complex CBRN threats.

While Figure 2 reflects the actual institutional mapping of Indonesia's CBRN governance, its structure follows the original design of national documents and therefore may not be simplified without distorting the relationships depicted. Nonetheless, accompanying descriptions have been adjusted to enhance clarity for the reader.

3.2 Legal and strategic gaps

Indonesia does not have a unified national law governing CBRN risks. Instead, regulations are dispersed across various acts, such as Law No. 6/2018 on Health Quarantine, Law No. 10/1997 on Nuclear Affairs, and Government Regulation No. 74/2001 on Hazardous Substances, which do not sufficiently

interlink nor refer to international standards like the IHR.

There is a notable legal gap concerning the regulation of dual-use biological research. There is no legal mechanism or bioethics oversight body that reviews sensitive research or dual-use technologies, a critical omission given Indonesia's expanding biotechnology sector (10). Similarly, although the IHR requires core capacities for surveillance, emergency preparedness, and legal frameworks, implementation remains fragmented and lacks operational consistency, as summarized in Table 1.

Tables 1,2,3 reveal specific institutional and legislative gaps that hinder Indonesia's ability to meet international obligations and operationalize CBRN threat governance effectively.

Table 1. Comparison of IHR 2005 Core Capacities with Indonesian Frameworks

IHR 2005 Core Capacities	Indonesian Status
Surveillance	Partial (event-based and indicator-based surveillance not fully integrated)
Legislation and Policy	Fragmented across multiple laws (UU No. 6/2018, UU No. 10/1997)
Coordination	Multiple agencies involved; no single coordination mechanism
Emergency Response	Response mechanisms exist but lack CBRN specificity
Risk Communication	Limited to pandemic communication; CBRN risks not widely socialized

Source: Adapted from (20–22)

Table 2. Comparison Matrix: Indonesian CBRN Frameworks vs IHR & WHO–UNODA

Thematic Area (IHR/UNODA)	Relevant Indonesian Laws / Status	Compliance Level
Surveillance (IHR Core Capacity 1)	Regulated in UU No. 6/2018, but lacks integration with environmental, animal, and military surveillance systems.	Partial
Legislation & Policy (IHR Core Capacity 2)	Spread across UU No. 6/2018 (Health Quarantine), UU No. 10/1997 (Nuclear), and PP No. 74/2001 (Toxic Substances)	Partial
Coordination Mechanisms (IHR Core Capacity 3)	No unified CBRN command; BNPB, BAPETEN, Kemenkes, and TNI work independently.	Weak
Emergency Response (IHR Core Capacity 6)	Covered in UU No. 24/2007 (Disaster Management) but lacks CBRN-specific protocols.	Partial
Risk Communication (IHR Core Capacity 10)	Defined generally in UU No. 36/2009 (Health); no specialized messaging for CBRN threats.	Weak
Dual-Use Oversight (UNODA)	No law regulates dual-use biological research; synthetic biology remains unregulated.	Absent
Biological Disarmament (UNODA)	Indonesia is a BWC signatory, but national laws like *UU Pertahanan* or *UU Terorisme* don't address implementation.	Weak
Oversight of High-Risk Research (WHO Guidance)	No review board or legal mechanism exists for assessing high-risk biological studies.	Absent
Biosecurity/Biosafety Legal Framework (WHO–UNODA)	No biosafety/biosecurity law or binding national standards exists.	Absent
CBRN in National Planning	RPJMN, RAN-PE, RPJPN, and other strategic plans do not explicitly mention CBRN or integrate threat-specific modules.	Absent

Source: Adapted from (8–10)

Table 3. Alignment Matrix of WHO–UNODA Principles vs Indonesian Policies

WHO–UNODA Principle	Indonesia Policy Alignment
Dual-Use Oversight	Absent (no national bioethics or biosafety commission)
Public Health Protection	Basic health protocols in place, but lack CBRN-specific measures
Biological Disarmament	No reference in national defence or disaster laws
Regulation of Sensitive Research	No specific regulation or mandatory review boards
Security Risk Governance	No integrated national strategy for CBRN threat governance

Source: Adapted from (9–10)

While Indonesia has enacted several laws addressing aspects of CBRN risks, these legal instruments operate in silos and lack interconnectivity. Figure 3 illustrates how core regulatory domains, such as health quarantine, hazardous substances, and nuclear oversight, are governed under separate laws with limited cross-reference or integration.

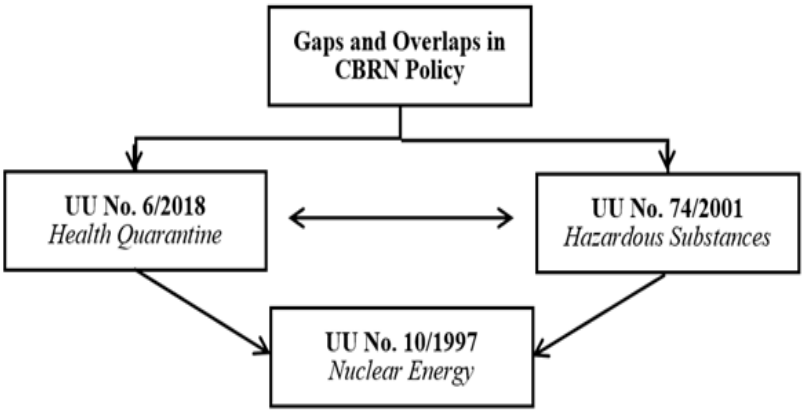

Figure 3: Legal Fragmentation in Indonesia's CBRN Framework.
Source: Adapted from (23–25)

This fragmented legal architecture leads to inefficiencies, ambiguous mandates, and weak implementation coherence aligned with international frameworks. Without a cohesive legal foundation or harmonizing statute, Indonesia's CBRN governance remains vulnerable to both overlap and omission across ministries and sectors.

3.3 International misalignment

Despite Indonesia being a signatory to both the IHR and the Biological Weapons Convention (BWC), national preparedness documents seldom make explicit reference to these obligations. National emergency and public health contingency plans lack incorporation of WHO–UNODA guidance on bio-disarmament, dual-use oversight, and CBRN-related risk governance.

Table 2 presents a detailed comparison matrix that maps key elements of the IHR and WHO–UNODA thematic pillars against the existing Indonesian legal and institutional frameworks.

As illustrated above, Indonesia's existing frameworks reveal structural weaknesses and an alarming absence of comprehensive national strategies for high-risk biological threats. Without integrating WHO–UNODA principles into national policy and regulation, Indonesia may face significant vulnerabilities in both compliance and emergency response.

Table 3 illustrates how poorly current Indonesian regulations align with key elements of WHO–UNODA principles. The absence of a centralized biosecurity framework not only limits Indonesia's compliance with global norms but also hinders cooperation with international partners during cross-border biological events (8–9).

This misalignment is particularly alarming given the regional rise in biosecurity threats and the global push for "One Health" preparedness frameworks, which call for legal harmonization across sectors (2–3). While Indonesia has demonstrated strong pandemic responsiveness, the lack of structural legal backing for intentional CBRN threats poses a growing risk to national and global security.

To visualize the gaps in Indonesia's alignment with international frameworks, two comparison matrices were developed. The first compares Indonesia's current implementation status of the IHR 2005 core capacities, and the second contrasts key WHO–UNODA biosecurity principles with corresponding national policies.

Table 3 demonstrates that although Indonesia has made strides in legal reforms post-COVID-19, implementation remains fragmented. Surveillance systems are not consistently integrated, and while public health laws exist, they often do not encompass radiological or chemical risks, thereby limiting holistic CBRN readiness (8).

As shown above, Indonesia's policy architecture does not currently reflect the biosecurity imperatives embedded in WHO–UNODA guidance. The absence of regulatory oversight for dual-use biological research, in particular, could leave the country vulnerable to both accidental and deliberate biological events (26). Moreover, the lack of reference to biological disarmament within defence and disaster frameworks illustrates a normative disconnect

between Indonesia's global commitments and its domestic legal ecosystem.
Together, these findings reinforce the urgent need for coordinated legal harmonization, centralized oversight structures, and capacity-building mechanisms, particularly in light of increased global attention to biological risks and the weaponization of science (27–28).

4. Discussion

The findings of this study highlight a significant gap in Indonesia's biosecurity governance, particularly in the context of CBRN (Chemical, Biological, Radiological, and Nuclear) threats. While the country has made measurable progress in pandemic response and public health regulation, the fragmented and sectoral nature of its current CBRN framework remains misaligned with the comprehensive frameworks advocated by international standards such as the IHR (2005) and WHO–UNODA principles. This lack of coherence hinders not only national preparedness but also international collaboration in preventing and responding to cross-border CBRN events.

The implications are substantial. Without an integrated national strategy, coordination across key institutions, BNPB, BAPETEN, Kemenkes, BNPT, and TNI, remains fragmented and inefficient. This disjointed system results in duplication of efforts, regulatory blind spots, and operational delays during critical phases of emergency response. In light of emerging threats, ranging from synthetic biology to bioterrorism, the lack of legal instruments regulating dual-use research and the lack of institutionalized surveillance over high-risk materials weakens Indonesia's compliance with the IHR core capacities (1,8).

A comparative analysis of other ASEAN states offers valuable insights. For instance, Malaysia has implemented the National CBRNe Action Plan (NCAP), integrating defence, public health, and scientific agencies under a unified national framework. The plan explicitly references international standards, ensures a single coordinating agency, and includes standard operating procedures for responding to biological or chemical threats (11,29). Similarly, the Philippines has incorporated biosafety and biosecurity measures into its national disaster risk reduction strategy, backed by legal instruments that enable coordinated civilian and defence responses to CBRN incidents (30).

In addition to these country-specific efforts, regional frameworks such as the ASEAN Regional Forum (ARF) Work Plan on Bio-Preparedness and Disaster Response and the ASEAN Health Sector Cooperation on Biosecurity and Biosafety offer useful models that Indonesia can draw upon to improve its regional alignment and cooperation mechanisms. By contrast, Indonesia still lacks a centralized coordinating entity or formal policy framework uniting all stakeholders under a shared operational doctrine. In this regard, the establishment of a National CBRN Coordination Agency, perhaps under the Office of the Vice President or the Ministry of Political, Legal, and Security Affairs, could serve as a crucial institutional anchor. This body could ensure inter-agency standardization, align national guidelines with IHR and UNODA, and act as a focal point for international reporting and emergency assistance.

Second, there is a pressing need to formally mandate the integration of international frameworks such as IHR (2005) and WHO–UNODA guidance into Indonesia's contingency planning and legal instruments. Many of Indonesia's existing laws and emergency protocols rarely incorporate or explicitly reference these frameworks., which undermines the country's global standing and weakens its preparedness posture (2–3). Other middle-income countries that have successfully harmonized their national laws with the IHR, such as Thailand, have demonstrated improved early warning capacities and faster international coordination during outbreaks.

Lastly, legal reform is required to address the regulatory gap surrounding dual-use biological research. While Indonesia has ethical review boards for clinical research, there is currently no national mechanism to evaluate dual-use or high-risk experiments involving synthetic biology, recombinant pathogens, or toxin-producing organisms. This exposes the country to significant biosecurity risks and places it at odds with international standards on responsible scientific conduct (31–32).

In summary, Indonesia's position as a regional leader in global health diplomacy must be matched by robust, coherent, and internationally aligned biosecurity governance. This requires more than capacity building, it demands legal innovation, institutional integration, and a whole-of-government approach. With regional threats growing and international scrutiny intensifying, harmonizing national CBRN policies with IHR and WHO–UNODA frameworks is no longer optional, it is imperative.

5. Limitations

This research was based solely on secondary data, including publicly accessible legal and policy documents. It excluded stakeholder interviews, site visits, and empirical case studies due to limitations in time and access. As a result, the findings may not adequately capture informal practices or undocumented procedures within Indonesian agencies.

Despite this limitation, the document-based methodology offered a structured basis for evaluating normative alignment and institutional preparedness., both of which are critical for strengthening CBRN governance in a globalized biosecurity landscape.

To provide a clearer overview of the research strategy, the following policy analysis roadmap

illustrates the step-by-step methodological flow adopted in this study, from objective formulation to legal-policy gap identification.

6. Conclusion

This study reveals that harmonising Indonesia's CBRN policy with international frameworks, particularly the International Health Regulations (IHR 2005) and the WHO–UNODA principles, remains fragmented and inconsistent. Despite Indonesia's active involvement. in global health diplomacy and disaster response, its national policy and legal instruments lack coherence, integration, and strategic alignment with the standards expected in a globalized biosecurity environment.

The current regulatory ecosystem is fragmented, with overlapping institutional mandates and insufficient legal mechanisms to address dual-use research, biological disarmament, and inter-agency coordination. Strengthening this system will require more than isolated reform. It demands a multisectoral legal overhaul, .the formal integration of international frameworks into national protocols, and the establishment of a unified CBRN coordination body capable of driving coherent policy across institutions.

To support future reforms, we propose a phased roadmap that includes:

(1) enacting a comprehensive national CBRN law to unify legal instruments,
(2) establishing a national-level bioethics and biosafety authority to regulate high-risk research, and
(3) integrating ASEAN-level frameworks into national strategic and contingency planning.

These steps would provide Indonesia with a clearer operational doctrine, enhanced international credibility, and a more coherent domestic response system for CBRN threats. This paper offers a roadmap toward a more resilient and internationally aligned biosecurity governance system, capable of enabling Indonesia to effectively respond to complex and emerging CBRN threats. By through alignment with IHR and WHO–UNODA frameworks, Indonesia can reinforce its role as a regional leader in global health security, while ensuring the safety, sovereignty, and preparedness of its people in the face of future crises.

Competing interests

The authors declare no competing interests.

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