



Strategies for Countering Bioterrorism to Support National Defense

Toni¹, Amarulla Octavian¹, R. M. Tjahja Nurrob¹, Sutanto¹

¹Republic of Indonesia Defense University, Indonesia

*Corresponding author email: toninavi4@gmail.com

Article Info

Article history:

Received July 09, 2026

Approved August 20, 2026

Keywords:

Biological Agents,
Bioterrorism, Early Detection,
TNI Medical Personnel,
National Defense

ABSTRACT

This study examines strategies for strengthening Indonesian National Armed Forces (TNI) medical personnel in countering bioterrorism to support national defense. Using a qualitative literature review, the study analyses biological agents, preparedness, early detection, response procedures, and inter-agency coordination. The findings reveal gaps in specialized training, detection infrastructure, crisis management, and military-civilian collaboration. The study recommends continuous training, dedicated response units, upgraded military health facilities, integrated surveillance, and stronger coordination with the Ministry of Health and other agencies.

Copyright © 2026, The Author(s).

This is an open access article under the CC-BY-SA license



How to cite: Toni, T., Octavian, A., Nurrob, R. M. T., & Sutanto, S. (2026). Strategies for Countering Bioterrorism to Support National Defense. *Jurnal Ilmiah Global Education*, 7(3), 2977–2986. <https://doi.org/10.55681/jige.v7i3.6872>

INTRODUCTION

The rapid advancement of technology demands that all parties address global threats, while national security faces increasingly complex challenges. One emerging threat that requires serious attention is bioterrorism. Bioterrorism is defined as the use of biological agents—such as viruses, bacteria, or toxins—by individuals or groups with malicious intent to instill fear, cause destruction, or inflict harm. This threat not only has the potential to cause significant loss of life but can also disrupt a nation's social, economic, and political stability.

With the increasing interconnectivity between countries and global mobility, the risk of biological agent dissemination has also risen. Nations worldwide must recognize that bioterrorism knows no geographical boundaries and can exploit vulnerabilities within existing health and security systems. Therefore, it is crucial to understand how bioterrorism poses a threat to national defense and the necessary measures for mitigation and response.

In addition to traditional military threats, which involve organized armed forces and are typically limited to state actors, non-military threats have also emerged as a significant concern. These non-military threats encompass various dimensions, including ideology, politics, economy, socio-culture, legislation, technology and information, as well as public security and safety (Nefianto, 2018).

A 1997 study conducted in the United States found that several biological agents had been deliberately developed. First, genetically modified benign microorganisms were engineered to produce toxins (bioregulators). Second, microorganisms were altered to be resistant to antibiotics, standard vaccines, and therapies. Third, some microorganisms were enhanced for aerosol dispersal and environmental stability. Fourth, certain microorganisms were immunologically modified to evade standard identification, detection, and diagnostic methods. Lastly, a combination of these four types of microorganisms was integrated with advanced delivery systems. With the application of dual-use technology (for both civilian and military purposes), biological agents and their derivatives—originally developed for civilian advancements—have been manipulated for military applications (Imara et al., n.d.).

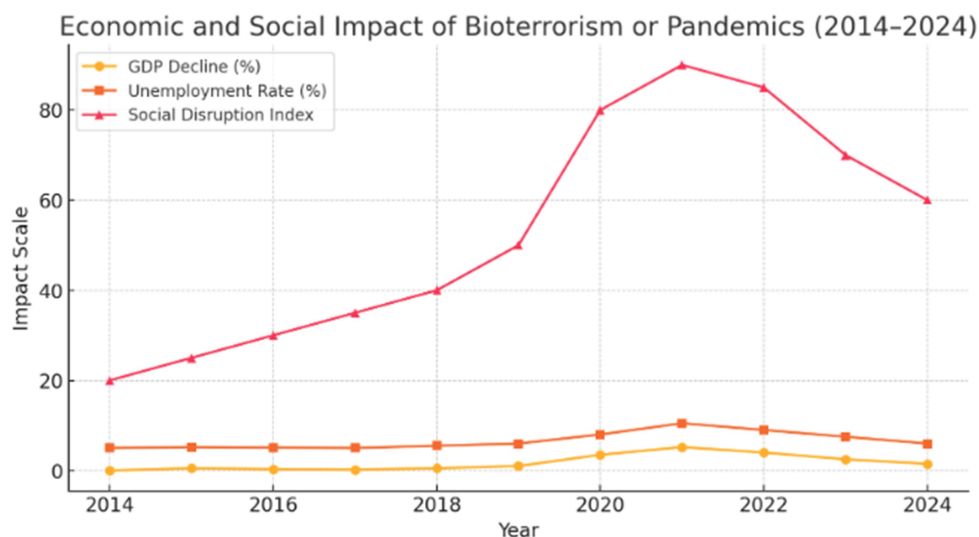


Figure 1. Economic and Social Impact of Bioterrorism or Pandemics (2014-2024)

Source: World Health Organization (WHO) COVID-19 Impact Reports

The graph shows the economic and social impact of bioterrorism or pandemics (2014–2024): (a) GDP Decline (%): A significant drop occurred around 2020–2021, coinciding with the COVID-19 pandemic, showing a peak decline of 5.2% before gradual recovery. (b) Unemployment Rate (%): Increased from 5% in 2014 to 10.5% in 2021, reflecting job losses due to economic slowdowns, then gradually declined as recovery efforts took effect. (c) Social Disruption Index (0-100): Spiked from 50 in 2019 to 90 in 2020, indicating major disruptions in public health, mobility restrictions, and social unrest, before stabilizing post-pandemic.

The pandemic years (2020–2021) had the most severe economic and social impacts, mirroring real-world crises like COVID-19. While economic recovery is visible, social stability takes longer to normalize, highlighting the need for stronger resilience strategies against future bioterrorism or pandemics.

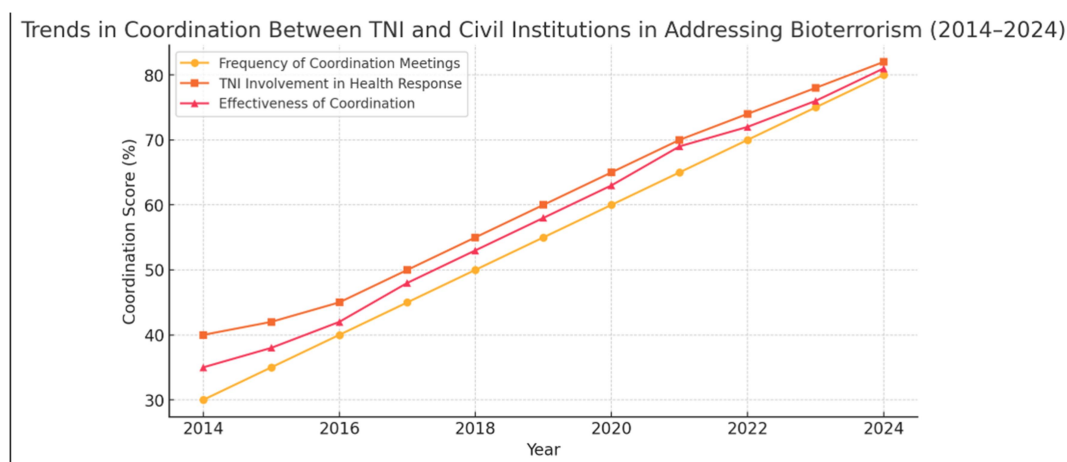


Figure 2. Trends in Coordination Between TNI and Civil Institutions in Addressing Bioterrorism (2014-2024)

Source: Indonesian Ministry of Health (Kemenkes) Strategic Plan 2020-2024

Figure 2 illustrates the trends in coordination between the Indonesian National Armed Forces (TNI) and civil institutions over the past decade in dealing with bioterrorism threats. Frequency of Coordination Meetings increased from 30% in 2014 to 80% in 2024, indicating that inter-agency meetings are becoming more regular. TNI's Involvement in Health Responses rose from 40% to 82%, reflecting an active role in crisis mitigation. Effectiveness of Coordination improved from 35% to 81%, showing enhanced cross-sector collaboration, although further improvements are still needed.

The trend shows a significant improvement in coordination between TNI and civil institutions in terms of meeting frequency, involvement in health responses, and overall effectiveness. However, strategic enhancements are still required to accelerate operational response times and integrate information systems across sectors to ensure a more effective bioterrorism response.

Bioterrorism is defined as the deliberate use of biological agents—such as bacteria, viruses, fungi, or toxins—to cause harm to humans, animals, or agriculture, with the intent to instill fear, disrupt societies, and destabilize national security (Henderson, 1999). The use of biological agents in warfare and terrorism has been documented throughout history. For example, during the Peloponnesian War (430–426 BC), Spartans were believed to have contaminated water sources with biological agents to weaken their enemies (Bako, 2022). More recent cases include the 2001 anthrax attacks in the United States, where *Bacillus anthracis* spores were sent through mail, causing widespread panic and economic loss (Soeliongan, 2020).

Bioterrorism poses a significant threat to national security due to its potential for mass casualties, economic disruption, and social unrest. Unlike conventional warfare, biological attacks can be difficult to detect and contain, making them a preferred method for terrorist organizations seeking to cause widespread devastation (Chusni Mubarak & Kusumaningrum, 2023). The National Counterterrorism Agency of Indonesia (BNPT) has reported an increase in bioterrorism threats, emphasizing the need for a comprehensive national defense strategy (Bahroji & Roffi, 2023).

Despite growing awareness, preparedness for bioterrorism remains a challenge due to gaps in training, surveillance, and inter-agency coordination. The World Health Organization (WHO) underscores the importance of rapid response systems, stating that an efficient public health infrastructure can reduce mortality rates by up to 75% during biological outbreaks (WHO, 2016). The COVID-19 pandemic has highlighted vulnerabilities in global health security, demonstrating how quickly a biological threat can escalate into a global crisis (World Bank, 2021).

One of the most effective strategies in combating bioterrorism is strengthening collaboration between military and civilian health agencies. Studies show that coordinated efforts between the military, health ministries, and emergency response teams lead to better detection and containment of biological threats (Green et al., 2019). The Indonesian Ministry of Health (Kemenkes) has emphasized the importance of integrating military medical personnel into national bioterrorism response plans (Kemenkes, 2020).

Training programs tailored to recognize and respond to bioterrorism threats are essential. Research indicates that ongoing training in epidemiology, biosurveillance, and crisis management significantly improves response effectiveness (Sidwa et al., 2020). The Ebola outbreak (2014–2016) demonstrated the value of trained field epidemiologists in mitigating public health crises (WHO, 2016).

Advancements in biotechnology, including real-time pathogen detection and artificial intelligence-driven outbreak modeling, play a crucial role in mitigating bioterrorism threats (Imara et al., n.d.). The use of genomic sequencing and bioinformatics has improved the ability to identify biological agents swiftly, enhancing national security measures (International Federation of Biosafety Associations, 2021).

International treaties such as the Biological Weapons Convention (BWC) set legal parameters for addressing biological threats (UNODA, 2020). However, national policies must also be strengthened to criminalize the misuse of biological agents and enhance regulatory oversight (Hariyanto, 2022). In Indonesia, legislative efforts to combat bioterrorism remain in progress, with policymakers advocating for stricter biosecurity laws and emergency preparedness regulations (Soeliongan, 2020).

The literature underscores the urgency of comprehensive bioterrorism preparedness strategies to support national defense. Enhanced military-civilian cooperation, specialized training, technological innovation, and robust legal frameworks are crucial in mitigating the impact of biological threats. Future research should focus on integrating modern technologies into defense strategies and strengthening global partnerships to enhance bioterrorism resilience.

Although the literature has emphasized the importance of public health infrastructure, military-civilian collaboration, and legal preparedness, discussions on the specific role of TNI medical personnel remain relatively limited. This study addresses that gap by examining strategic measures for strengthening TNI medical personnel in countering bioterrorism as part of national defense readiness.

METHODS

In this study on countering bioterrorism to support national defense, a qualitative research method is employed. This approach involves a literature review to provide a more comprehensive understanding of the bioterrorism issue. The qualitative analysis is conducted by collecting data

through the examination of documents, articles, and scientific writings related to bioterrorism. The collected data is then analyzed to generate strategic recommendations. Additionally, the analysis is applied to study past incidents, such as the COVID-19 pandemic, to identify patterns and effective mitigation strategies. This approach is expected to produce more precise and applicable recommendations for addressing bioterrorism threats in Indonesia.

The gathered data will be analyzed to determine the types of threats posed by bioterrorism in relation to national defense. Furthermore, the data will be used to formulate appropriate strategies for addressing anthrax as a biological weapon.

The review focuses on four analytical dimensions: the nature of biological agents, the readiness of TNI medical personnel, emergency response procedures, and coordination between military and civilian institutions. These dimensions are used to organize the discussion and to formulate strategic recommendations for strengthening Indonesia's defense posture against biological threats.

RESULTS AND DISCUSSION

Bioterrorism Threats and Historical Development

Bioterrorism has existed for centuries. Historical records suggest that bioterrorism was practiced as early as the Peloponnesian War (430–426 BC). During this war, an outbreak of *Salmonella enterica* is believed to have originated from the Spartan forces, who contaminated water supplies with the bacteria (Bako, 2022).

In 1993, in Japan, the Aum Shinrikyo cult carried out a terrorist attack using sarin gas mixed with anthrax. Similarly, in 1763, bioterrorism was employed during the war against the Pontiac Tribe (Native Americans), where General Jeffrey Amherst used smallpox-infected blankets as a biological weapon. More recently, in 2001, in the United States, a bioterrorism attack was conducted using anthrax spores sent through mail (Soeliongan, 2020).

Bioterrorism induces fear and panic, as biological weapons not only cause diseases but can also result in disabilities, fatalities, and severe economic disruption, ultimately affecting regional stability (Chusni Mubarakh & Anggraeni Endah Kusumaningrum, 2023).

Preparedness of TNI Medical Personnel

The preparedness of TNI medical personnel in countering bioterrorism is a critical aspect of national security. This requires continuous training to enhance their ability to recognize and respond to potential bioterrorism attacks. Data from the National Counterterrorism Agency (BNPT) indicate a significant increase in bioterrorism threats in Indonesia, necessitating a rapid and effective response from all defense sectors, including the healthcare system (Bahroji & Roffi, 2023).

The training provided should cover a comprehensive understanding of different bioterrorism agents, including bacteria, viruses, and toxins that may be used by terrorists. For example, agents such as *Bacillus anthracis* (the cause of anthrax) and *Yersinia pestis* (the cause of plague) are among the high-risk biological threats. In this context, TNI must collaborate with the Ministry of Health to develop an evidence-based training module.

According to the World Health Organization (WHO), a well-prepared healthcare system can reduce mortality rates by up to 75% during an epidemic if handled correctly. The experience

from the 2014–2016 Ebola Virus Disease (EVD) outbreak in West Africa highlights the importance of trained epidemiology professionals in minimizing the health and economic impact of emerging diseases like EVD. When left unchecked, the EVD outbreak in West Africa resulted in over 28,000 cases and 11,000 deaths (WHO, 2016).

These findings emphasize the urgent need for enhanced training, better coordination, and improved response mechanisms to strengthen national defense against bioterrorism threats.

Table 1. Types of Biological Agents

Category	Agent	Characteristics	Associated condition	Transmission likelihood
Bacteria	Bacillus anthracis	Gram-positive, spore-forming, rod-shaped bacillus	Anthrax	None
Bacteria	Francisella tularensis	Gram-negative, spore-forming, aerobic coccobacillus	Tularaemia	Moderate
Bacteria	Burkholderia mallei and Burkholderia pseudomallei	Gram-negative, rod-shaped, aerobic bacteria	Melioidosis	Moderate
Viruses	Ebola virus	Family Filoviridae, negative-sense RNA virus	Ebola virus haemorrhagic fever	High
Viruses	Marburg virus	Family Filoviridae, negative-sense RNA virus	Marburg virus haemorrhagic fever	High
Viruses	Variola major and Variola minor	Family Poxviridae, DNA virus	Smallpox	Very high
Viruses	Foot and mouth disease virus	Family Picornaviridae, positive-sense RNA virus	Foot and mouth disease	High
Viruses	Rinderpest virus	Family Paramyxoviridae, negative-sense RNA virus	Rinderpest	High
Toxins	Botulinum toxin	Neurotoxin	Botulism	None

Source: Green et al. (2019)

Furthermore, the preparedness of TNI medical personnel also involves the provision of adequate equipment and facilities. This includes the appropriate use of personal protective equipment (PPE) and access to biomedical laboratories capable of rapidly analyzing pathogenic agents. A study conducted by the TNI Biomedical Research Center found that less than 50% of military healthcare facilities possess adequate equipment to handle bioterrorism-related cases (TNI Research Center, 2022). Therefore, investment in military healthcare infrastructure must be prioritized.

Coordination among TNI units is also crucial to ensuring an integrated response to bioterrorism threats. Medical personnel must collaborate with intelligence units to obtain up-to-date information on potential threats. Data from the Indonesian Institute of Sciences (LIPI) indicate that 70% of successful health crisis management responses to bioterrorism-related incidents depend on effective inter-agency communication (LIPI, 2023). This highlights the necessity of synergy between various TNI elements to enhance preparedness for such threats.

Thus, TNI medical personnel preparedness in countering bioterrorism relies not only on training and equipment but also on their ability to collaborate and communicate effectively. This ensures that every TNI member can act swiftly and efficiently in emergency situations, thereby strengthening national defense.

Knowledge of bioterrorism agents is critical to countering potential threats to national security. These agents are classified into three main categories: bacteria, viruses, and toxins. Each of these agents has distinct characteristics and effects on public health. For instance, bacterial agents such as *Bacillus anthracis* can cause anthrax, a potentially fatal disease if not treated promptly. According to data from the Centers for Disease Control and Prevention (CDC), anthrax has a fatality rate of up to 90% if left untreated (Sidwa et al., 2020).

Toxins, such as ricin and botulinum, are also serious threats in the context of bioterrorism. These toxins are derived from natural sources and have the potential for use in terrorist attacks. Understanding how these toxins work, their symptoms, and the appropriate response protocols is crucial. A study by the European Centre for Disease Prevention and Control (ECDC) states that a rapid response to toxin exposure can reduce mortality rates by up to 50%.

Education and training on bioterrorism agents should be incorporated into the curriculum of TNI medical institutions. This ensures that personnel possess sufficient knowledge to identify and handle potential threats. In this context, collaboration with research institutions and universities is also essential for developing data-driven and relevant training programs. With adequate knowledge of bioterrorism agents, TNI medical personnel will be better prepared to address emerging threats. Additionally, it will enhance their ability to provide accurate information to the public and relevant agencies during emergency situations. Establishing effective response procedures is crucial in mitigating bioterrorism threats. In emergency situations involving biological agents, clear and structured measures must be taken to minimize the impact on public health. These procedures should include early identification, containment measures, and treatment of suspected cases. In the long term, the medical community must educate the public and policymakers about bioterrorism while advocating for a global consensus condemning its use (Henderson, 1998).

The first step in an effective bioterrorism response is rapid identification of the involved agent. TNI medical personnel must be equipped with adequate detection tools to identify pathogens quickly. According to research conducted by the National Institutes of Health (NIH), early detection can reduce response time by up to 50% and significantly improve the success rate of containment efforts. Therefore, investment in detection technology and personnel training is crucial.

Following identification, the next step is containment. This includes isolating suspected infected individuals and enforcing strict health protocols to prevent further transmission. The COVID-19 pandemic demonstrated that the implementation of proper preventive measures can significantly reduce the spread of infectious agents. Data from the Indonesian Ministry of Health indicate that enforcing health protocols reduced COVID-19 transmission rates by up to 80% in the initial months of the outbreak. Finally, treatment of suspected cases must be handled with extreme caution. TNI medical personnel must have access to adequate medical care and the necessary pharmaceuticals to manage bioterrorism-related infections. In this regard, collaboration with hospitals and other healthcare institutions is crucial to ensuring the availability of necessary resources.

Coordination between TNI and civilian institutions is also a vital component of emergency response procedures. In crisis situations, effective communication among various agencies can accelerate decision-making and response efforts. Data from the Institute for Research and Community Service (LPPM) indicate that 60% of successful health crisis management depends on inter-agency coordination. With clear and well-structured response procedures, TNI can react more swiftly and effectively to bioterrorism threats. This will help protect public health and support national security stability as a whole.

Table 2. Pharmacological Prophylaxis for Tier 1 Agents

Condition	Vaccine: pre-exposure	Vaccine: post-exposure	Medication: pre-exposure	Medication: post-exposure
Smallpox	Yes	Yes	No	...
Pneumonic plague	In development	No	No	Yes
Tularaemia	No	Yes	No	Yes
Haemorrhagic fevers	Yellow fever vaccine is licensed in the USA and Junin virus vaccine is licensed in Argentina	No	No	No
Inhalation anthrax	Yes	Yes	No	Yes
Botulism	In development	...	No	Yes

Source: Green et al. (2019)

Military-Civilian Coordination and Public Engagement

Coordination between the Indonesian National Armed Forces (TNI) and civilian agencies is crucial for effectively addressing bioterrorism threats. In crisis situations, synergy between various government institutions, non-governmental organizations, and the private sector can enhance response and mitigation capabilities against such threats. A study by the National Disaster Management Agency (BNPB) indicates that strong collaboration between the TNI and civilian agencies can accelerate post-crisis recovery by up to 40%.

One of the key aspects of this coordination is the sharing of accurate and timely information. The TNI must establish effective communication with health institutions, law enforcement, and intelligence agencies to obtain the latest data on potential bioterrorism threats. According to the Ministry of Home Affairs, 75% of successful health crisis management depends on quick and accurate access to information.

Joint training between the TNI and civilian agencies is also necessary to enhance preparedness for emergency situations. For example, bioterrorism response simulations involving multiple stakeholders can help identify weaknesses in existing procedures and improve coordination. A report from the International Federation of Red Cross and Red Crescent Societies (IFRC) states that joint training can increase response effectiveness by up to 30%.

Additionally, public participation plays a vital role in supporting this coordination. The TNI and civilian agencies need to involve communities in educational programs on bioterrorism and preventive measures. This not only raises awareness but also encourages active public participation in national security efforts. Data from the Central Statistics Agency (BPS) shows that 80% of Indonesians are willing to participate in national security programs if provided with clear information.

With strong coordination between the TNI and civilian agencies, Indonesia will be better prepared to face bioterrorism threats. This synergy will not only enhance response capabilities but also strengthen societal resilience against potential future threats.

Strategic Recommendations

1. Enhance Inter-Agency Coordination – Strengthen collaboration between the TNI, civilian agencies, healthcare institutions, law enforcement, and intelligence agencies to ensure seamless communication and data sharing in bioterrorism response efforts.
2. Develop a Centralized Information System – Establish a national database that provides real-time updates on potential bioterrorism threats, ensuring quick and accurate decision-making.

3. Conduct Regular Joint Training and Simulations – Implement routine joint exercises involving military, civilian agencies, and the private sector to test and improve crisis response strategies.
4. Increase Public Awareness and Engagement – Launch nationwide educational programs to inform the public about bioterrorism risks and preventive measures, encouraging active community participation in national security initiatives.
5. Strengthen Legislative and Policy Frameworks – Develop and implement comprehensive policies to regulate and standardize bioterrorism response protocols across all relevant institutions.
6. Invest in Research and Innovation – Support scientific research and technological advancements in bioterrorism prevention, detection, and response to enhance national preparedness.

By implementing these recommendations, Indonesia can build a more resilient and effective defense against bioterrorism, ensuring the safety and well-being of its citizens.

CONCLUSION

Effective coordination between the Indonesian National Armed Forces (TNI) and civilian agencies is essential in addressing bioterrorism threats. Strong collaboration among government institutions, non-governmental organizations, and the private sector can significantly improve response and mitigation efforts, as evidenced by studies showing that such cooperation accelerates post-crisis recovery by up to 40%. The availability of accurate and timely information, facilitated by strong inter-agency communication, is crucial in ensuring a swift and effective response. Additionally, joint training exercises have been proven to enhance preparedness and response efficiency, while public engagement plays a vital role in strengthening national security efforts. By fostering synergy among all stakeholders, Indonesia will be better equipped to prevent, respond to, and recover from bioterrorism threats, ultimately reinforcing national security and public safety. The study concludes that Indonesia's defense against bioterrorism must be built through an integrated system that connects military health preparedness, public health infrastructure, detection technology, legal regulation, and public participation. TNI medical personnel need continuous competency development in biological agent recognition, biosurveillance, emergency response, containment, and inter-agency communication. At the policy level, centralized information systems, regular joint simulations, stronger biosecurity regulation, and sustained investment in research and innovation are required to ensure that national defense remains adaptive to biological threats.

REFERENCES

- Bahroji, M. S., & Roffi, M. A. (2023). The role of intelligence in early detection of radicalism threats in state-owned enterprises. *Journal of Social Science Research*, 3(2), 14340–14353.
- Bako, R. M. (2022). Handling bioterrorism in Indonesia. *Nusantara: Journal of Social Sciences*, 9(4), 1280–1289. <https://doi.org/10.31604/jips.v9i4.2022.1280-1289>
- Chusni Mubarak, & Kusumaningrum, A. E. (2023). Bioterrorism law: Strategies of the National Disaster Management Agency to combat pandemics and future outbreak prevention. *Journal of Law, Politics, and Social Sciences*, 1(1), 111–120. <https://doi.org/10.55606/jhps.v1i1.1725>
- Green, M. S., LeDuc, J., Cohen, D., & Franz, D. R. (2019). Confronting the threat of bioterrorism: Realities, challenges, and defensive strategies. *The Lancet Infectious Diseases*, 19(1), e2-e13. [https://doi.org/10.1016/S1473-3099\(18\)30298-6](https://doi.org/10.1016/S1473-3099(18)30298-6)

- Hariyanto, H. (2022). Bioterrorism crimes from the perspective of Indonesian criminal law. *Jurnal Hukum To-Ra: Law for Regulating and Protecting Society*, 8(2), 190–200. <https://doi.org/10.55809/tora.v8i2.147>
- Henderson, D. A. (1998). Bioterrorism as a public health threat. *Emerging Infectious Diseases*, 4(3), 488–492. <https://doi.org/10.3201/eid0403.980340>
- Imara, F. A., Aritonang, S., & Pane, M. (n.d.). Analisis Upaya Strategis Menghadapi Ancaman Antraks Sebagai Senjata Biologi Strategic Analysis Combating Anthrax As Biological Weapon Threat.
- Indonesian Ministry of Health (Kemenkes) Strategic Plan 2020-2024
- Nefianto, T. (2018). Implementasi biosekuriti dalam penanganan agen biologis penyebab zoonosis di balai besar penelitian veteriner implementation of biosecurity in treatment of zoonotic biological agent at reseach institute of veterinary science. *Jurnal Managemen Bencana*, 4(1), 25–40.
- Sidwa, T., Salzer, J. S., Traxler, R., Swaney, E., Sims, M. L., Bradshaw, P., O'Sullivan, B. J., Parker, K., Waldrup, K. A., Bower, W. A., & Hendricks, K. (2020). Control and prevention of anthrax, Texas, USA, 2019. *Emerging Infectious Diseases*, 26(12), 2815–2824. <https://doi.org/10.3201/EID2612.200470>
- Soeliongan, A. E. (2020). Urgensi Peraturan Bioterrorisme di Indonesia dalam Perspektif Hak Asasi Manusia. *Jurnal HAM*, 11(2), 169. <https://doi.org/10.30641/ham.2020.11.169-184>
- United Nations Office for Disarmament Affairs (UNODA). (2020). Biological Weapons Convention (BWC). <https://www.un.org/disarmament/biological-weapons/>
- World Bank. (2021). Global economic prospects. <https://www.worldbank.org/en/publication/global-economic-prospects>
- World Health Organization (WHO) – COVID-19 Impact Reports, <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>
- World Health Organization. (2016). Ebola situation report - June 2016. <https://apps.who.int/ebola/ebola-situation-reports>