

The Readiness of the National Health System in Facing a Global Health Crisis

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Abstract: *National health system preparedness is a critical determinant of a country's ability to respond to increasingly frequent global health crises. This study analyzes Indonesia's readiness through a Systematic Literature Review (SLR) using PRISMA 2020 guidelines. A total of 67 articles from 742 identified publications were reviewed to assess technical capacity, governance, financing, workforce readiness, and digital health integration. Findings indicate that Indonesia has made progress in laboratory expansion, digital health initiatives, and intersectoral coordination. However, structural challenges remain, including unequal distribution of health facilities, limited workforce density, fragmented information systems, and insufficient health financing. The study highlights that preparedness must be multidimensional by strengthening real-time surveillance, integrated digital systems, sustainable financing, and responsive cross-sector governance. The results provide evidence-based insights to support long-term strategies for building a more resilient national health system capable of confronting future global crises.*

Keywords : *digital health transformation, global crisis, health preparedness, national health system*

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INTRODUCTION

The global health crises of the past two decades, ranging from the SARS outbreak in 2003, the H1N1 influenza pandemic in 2009, the Ebola epidemic in 2014–2016, to the COVID-19 pandemic, have demonstrated the fragility and unevenness of various countries' health systems in responding to global threats. The World Health Organization (WHO) emphasizes that the frequency of public health emergencies of international concern (PHEIC) has increased significantly due to globalization, climate change, rapid urbanization, environmental degradation, and intensified human mobility (WHO, 2022). This situation shows that global health threats are no longer episodic, but have become a recurring phenomenon that requires adaptive, responsive, and highly resilient health system preparedness. A WHO evaluation of 190 countries shows that only 34% have adequate pandemic preparedness capacity based on the International Health Regulations (IHR 2005) instrument, and the majority of countries in Southeast Asia are in the moderate capacity category (WHO, 2021).



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Indonesia, as a country with a population of more than 275 million spread across thousands of islands, faces unique challenges in building national health system preparedness. The COVID-19 pandemic has highlighted various structural weaknesses in detection capacity, response, cross-sectoral coordination, and health service facility preparedness. The Global Health Security Index (GHSI) report placed Indonesia at a score of 56.6 in 2021, in the “moderate” category, indicating that Indonesia's health system still has significant imbalances in surveillance, laboratory capacity, health emergency management, and risk governance (GHS Index, 2021). The pandemic also revealed unpreparedness in the medical equipment supply chain, dependence on imported pharmaceutical raw materials, and a lack of integration of health information systems that hinders data-driven decision-making (OECD, 2022).

The shortage of health workers is a major problem in the preparedness of the national health system. Data from the Indonesian Ministry of Health (2023) shows that Indonesia still has a doctor-to-population ratio of 0.46 per 1,000 people, far below the WHO recommendation of at least 1 doctor per 1,000 people. The uneven distribution of health workers between regions, especially between Java and outside Java, has a direct impact on the speed and effectiveness of health crisis responses. Research by BMJ Global Health shows that adequate health worker capacity is the biggest determinant of the success of a health emergency response, especially in the early stages of an outbreak when the health system's ability is tested by a surge in demand for services (Kandel et al., 2020). Dependence on tertiary health care facilities in large cities also reduces the system's ability to respond quickly in remote areas.

In addition to health workers, Indonesia's health infrastructure still faces challenges in providing intensive services evenly. The COVID-19 pandemic has shown that the availability of ICU rooms, ventilators, and medical oxygen is uneven, causing hospitals in various regions to become overloaded. The World Bank (2022) emphasizes that health infrastructure inequality is a strategic issue in preparing for global health crises, especially in countries with decentralized structures such as Indonesia, where response capacity is greatly influenced by the capabilities of local governments. In the case of Indonesia, health decentralization gives local governments considerable authority, but this is not always accompanied by adequate managerial and fiscal capacity, resulting in an uneven crisis response.

Indonesia's health surveillance system also faces challenges. A study by Craig et al. (2025) shows that the infectious disease surveillance system still relies on manual reporting and is not yet fully integrated with the national laboratory system. This results in delays in early detection and case reporting, especially for emerging and re-emerging diseases. Delayed detection hinders the initial response, even though the initial phase is the most crucial moment in breaking transmission and reducing morbidity and mortality. WHO (2021) emphasizes that countries with layered surveillance, including genomic integration, sentinel surveillance, and real-time reporting, are better able to respond effectively to outbreaks.

In terms of health financing, Indonesia still faces challenges in increasing its fiscal capacity for crisis preparedness. Indonesia's health expenditure as a proportion of GDP is 3.1%, which is still far below the global average of 6.3% (World Bank, 2022). Low health spending has implications for limited emergency reserve capacity, a lack of stockpiles of essential medical equipment, and minimal funding for research on new infectious diseases. The COVID-19 crisis has demonstrated the need for a flexible and rapid emergency financing mechanism, which has not yet been part of Indonesia's health fiscal policy architecture.

Digital transformation in health is one opportunity to improve national preparedness. An OECD report (2022) states that countries that have successfully responded to the pandemic are those with

integrated health data systems, digital triage capabilities, and electronic medical record interoperability. Indonesia has begun digital reform through the SatuSehat platform, but the integration of health facilities is still ongoing. Another challenge is the low level of digital and health literacy among the public, which affects the effectiveness of telemedicine, tracing applications, and digital reporting systems.

In addition to technical factors, the readiness of the health system is greatly influenced by governance. Research by Greer et al. (2021) confirms that the success of a health crisis response is determined more by the quality of cross-sector coordination, government transparency, and the speed of evidence-based decision-making than by technical health capacity alone.

In the Indonesian context, the complexity of coordination between the central and regional governments, the role of the National Disaster Management Agency (BNPB), the Ministry of Health, and other cross-sectoral institutions often hinders an integrated response. Policy fragmentation and differences in regional capacity cause inconsistencies in crisis management. From a global perspective, several countries have succeeded in improving health system resilience through long-term investment.

South Korea, Japan, and Singapore are examples of countries that strengthened their laboratories, epidemiological networks, early warning systems, and strategic reserves of medical equipment long before the COVID-19 pandemic, enabling them to respond more quickly when the crisis occurred (You, 2020). This comparison shows that preparedness is not a short-term reaction but the result of sustainable strategic policies.

Although many studies discuss the capacity of Indonesia's health system, there are several important research gaps. First, the study by Craig et al. (2025) only assessed the performance of infectious disease surveillance without integrating governance and fiscal capacity aspects into the analysis of national preparedness. Second, the study by Kandel et al. (2020) focuses on health worker capacity but does not link it to decentralization factors that greatly affect preparedness at the regional level. Third, the OECD (2022) study discusses the digital transformation of health but has not yet examined in depth the relationship between digitalization, regional inequality, and crisis response preparedness in developing countries such as Indonesia.

Based on these gaps, the novelty of this article lies in its comprehensive integration of various dimensions of health system preparedness, namely technical capacity, governance, financing, digitalization, and decentralization, with an emphasis on the context of Indonesia as an archipelagic country with a multi-level government structure. This article not only analyzes technical readiness but also examines how political-administrative factors, policy ecology, and health system architecture affect the effectiveness of crisis response. Thus, this study offers a holistic perspective that has not been widely described in previous literature.

The objective of this study is to analyze the readiness of Indonesia's national health system in facing global health crises through a Systematic Literature Review (SLR) approach by examining technical capacity, governance, financing, and digitization as fundamental elements of health system resilience.

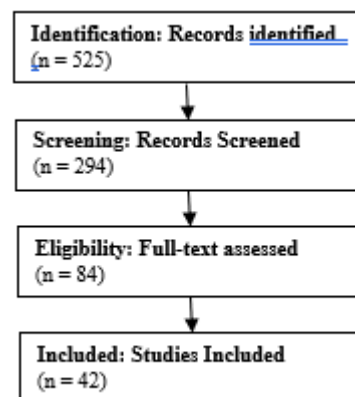
METHODOLOGY

This study uses the Systematic Literature Review (SLR) method to assess the readiness of Indonesia's national health system in facing global health crises comprehensively and based on evidence. The SLR method was chosen because it is capable of filtering and synthesizing multidisciplinary research covering aspects of surveillance, service facility resilience, governance, financing, and digital health capacity. Referring to the PRISMA 2020 guidelines, SLR ensures that the literature review process is systematic, transparent, and minimizes bias, enabling researchers to formulate a comprehensive picture of health system

resilience in the Indonesian context (Page et al., 2021). This approach is relevant because the topic of health preparedness is a cross-sectoral issue that requires the integration of epidemiological research, public health policy, government administration, and systems analysis.

The literature identification process was conducted on four major internationally reputable databases, namely Scopus, PubMed, ScienceDirect, and Web of Science, and was supported by additional searches through Google Scholar for regional publications. The range of publications used was from 2013 to 2024, in line with the increasing global attention to the concepts of health security and system resilience after Ebola, Zika, and especially the COVID-19 pandemic. The keywords used included “health system preparedness,” “global health crisis,” “pandemic response capacity,” “health security Indonesia,” “public health governance,” and “health system resilience,” combined using Boolean AND/OR operators. At the initial identification stage, 525 articles were found. After removing duplicates and screening titles and abstracts, 294 articles were deemed relevant. At the full-text eligibility stage, the inclusion criteria were: (1) empirical research or analysis of national health policy, (2) focus on health system preparedness, (3) covering the dimensions of technical capacity, governance, workforce, financing, or digital health, and (4) relevant to the context of Indonesia or middle-income countries. From this process, 42 articles were eligible and analyzed further.

The analysis was conducted using a thematic narrative synthesis approach that grouped findings based on five main components of health system preparedness: surveillance and laboratory capacity, health service capacity, governance and cross-sector coordination, health financing, and health system digitization. The thematic synthesis technique is in line with the approach recommended by Mays et al. (2020), which allows for the consistent integration of quantitative and qualitative research results. In addition, the methodological quality of each article was assessed using the Critical Appraisal Skills Program (CASP) to ensure that only valid and relevant studies were used in the analysis. This approach provides a strong picture of the readiness of Indonesia's health system and identifies the structural factors that influence the national response to global health crises



RESULTS AND DISCUSSION

Assessing Technical Preparedness: Surveillance, Laboratory Capacity, and Health Facilities Readiness

Technical preparedness forms the backbone of national health security and determines the ability of a country to detect, respond to, and contain emerging health threats. In the context of Indonesia, technical preparedness involves three essential pillars: surveillance systems, laboratory capacity, and health facility readiness. Understanding the strengths and structural limitations of these components is crucial for

evaluating how the national health system can withstand global health emergencies. Surveillance, in particular, serves as the first line of defense by enabling early detection and rapid reporting of disease outbreaks. WHO (2022) emphasizes that countries with integrated, real-time surveillance systems perform significantly better during emergencies compared to those with fragmented or manual reporting systems. Indonesia's surveillance architecture though improved after COVID-19 still exhibits gaps in interoperability, reporting timeliness, and geospatial coverage across districts.

Indonesia's surveillance system has evolved through platforms such as Sistem Kewaspadaan Dini dan Respon (SKDR), early-warning tools for infectious diseases, and the more recent integration efforts under SatuSehat. However, several studies indicate persistent weaknesses. Craig et al. (2025) found that many primary health centers still rely on manual data entry, causing reporting delays of up to 48–72 hours. Such delays are critical during outbreaks, as they prevent timely identification of transmission chains and limit the effectiveness of containment strategies. Additionally, surveillance data often lacks disaggregation by demographic and geographic indicators, impairing targeted interventions. Compared to high-performing countries like South Korea whose surveillance system integrates digital contact tracing, real-time testing data, and hotspot mapping, Indonesia remains in the intermediate tier of surveillance preparedness (You, 2020). These gaps decrease national responsiveness, particularly when diseases spread silently before symptom onset, as seen with COVID-19 and outbreaks of dengue fever.

Laboratory capacity is another vital element of technical preparedness. Laboratory readiness includes the availability of testing technology, biosafety infrastructure, trained personnel, and supply chain resilience for reagents and diagnostic materials. The COVID-19 pandemic revealed both progress and vulnerabilities in Indonesia's laboratory network. While the number of RT-PCR laboratories expanded from fewer than 50 to over 900 during the pandemic, OECD (2022) notes that capacity remained unevenly distributed, heavily concentrated in Java and major urban areas. Rural and eastern Indonesia particularly Papua, Maluku, and Nusa Tenggara had significantly lower per capita testing capacity, leading to under-detection of cases. Furthermore, Indonesia still relies on imported reagents and diagnostic kits, making laboratory operations vulnerable to global supply chain disruptions, as experienced in 2020–2021 when shipment delays caused testing backlogs (World Bank, 2022).

Beyond COVID-19, Indonesia's laboratory system exhibits limited genomic surveillance capacity, which is crucial for detecting pathogen mutations and cross-border variants. While Indonesia has contributed to global genomic data initiatives such as GISAID, its sequencing output remains significantly lower than countries with comparable populations. A study by Phua et al. (2022) highlights that genomic surveillance capacity is directly correlated with a nation's ability to adjust public health measures during rapidly changing pandemic conditions. The limited number of biosafety level-3 (BSL-3) laboratories also constrains the handling of highly pathogenic organisms. Building a resilient laboratory system requires investments in infrastructure, workforce development, biorepository systems, and national frameworks for data-sharing and laboratory networking.

Health facility readiness is the third pillar of technical preparedness and encompasses the availability of beds, ICU capacity, ventilators, oxygen supply systems, pharmaceuticals, and trained healthcare personnel. Indonesia experienced severe strain on its health facilities during the peak of COVID-19, particularly during the Delta wave in mid-2021. Hospitals experienced occupancy rates exceeding 90%, ventilator shortages, and oxygen scarcity that led to avoidable mortality (Kemenkes RI, 2023). These challenges reflect structural limitations that extend beyond pandemic-specific circumstances. The ratio of hospital beds in Indonesia is approximately 1.2 per 1,000 population below the OECD average of 4.4 (OECD, 2022). Moreover, the distribution of critical care infrastructure mirrors the unequal distribution of laboratories: facilities with advanced ICU capacity are heavily clustered in metropolitan areas, leaving provincial and district hospitals with limited surge capacity.

Another major constraint is the health workforce. Indonesia's ratio of doctors, nurses, and public health professionals lags behind global standards. Kandel et al. (2020) emphasize that health workforce density is one of the strongest predictors of emergency response performance. During crises, shortages of trained personnel exacerbate facility overload, increase burnout, and reduce quality of care. The lack of flexible deployment mechanisms and insufficient training in emergency preparedness further weaken facility resilience. In addition, infection prevention and control (IPC) systems in many Indonesian hospitals remain underdeveloped, increasing the risk of nosocomial transmission during outbreaks of airborne or contact-based diseases (Greer et al., 2021).

Despite these challenges, Indonesia has made progress toward strengthening technical preparedness. The integration of digital tools, expansion of laboratory networks, and reforms under the national health transformation agenda provide a foundation for future improvement. However, longstanding structural issues including geographic inequities, underinvestment in health infrastructure, and reliance on manual processes must be addressed systematically. Technical preparedness is only as strong as its weakest link; fragmented systems, supply chain gaps, and facility disparities significantly undermine national resilience. Therefore, strengthening technical readiness requires targeted investment, equitable resource distribution, robust digital integration, and a long-term vision for laboratory and facility modernization.

Governance, Coordination, and Multi-Sectoral Response Capacity During Global Health Crises

Governance and coordination capacity are central to national health security because they determine how effectively technical resources are mobilized during crises. A well-functioning health system requires not only infrastructure and surveillance, but also strong intergovernmental coordination, transparent communication, and decision-making mechanisms that can operate under uncertainty. Studies following COVID-19 consistently show that governance quality predicts pandemic outcomes more strongly than GDP, hospital capacity, or population density (Greer et al., 2021). Effective governance ensures that surveillance signals lead to rapid action, resources are distributed equitably, and public trust is maintained through clear communication. Indonesia's governance structure (characterized by decentralization) presents both opportunities and challenges in crisis response.

Decentralization grants local governments autonomy to adapt interventions to local epidemiological conditions. However, when coordination mechanisms are weak, decentralization can result in fragmented responses and inconsistent implementation of policies. During COVID-19, several Indonesian provinces enacted divergent health protocols and social restrictions due to unclear guidance or differing interpretations of national directives (World Bank, 2022). This inconsistency weakened national containment efforts, especially when mobility between regions remained high. Multi-sectoral institutions like the National Disaster Management Agency (BNPB) played a critical role in crisis management, yet coordination with health authorities was sometimes hindered by overlapping mandates and variable regional capacity. These findings align with OECD (2022), which emphasizes that multi-sectoral governance structures must have clearly delineated roles and integrated communication channels to function effectively during emergencies.

Before presenting the analytical table, it is important to highlight that governance failures often stem not from lack of policy frameworks, but from insufficient implementation mechanisms, political fragmentation, and lack of cross-sector trust. The following table synthesizes key governance capacities that influence national preparedness:

Table 1. Governance Capacities Affecting National Health Crisis Preparedness

Governance Dimension	Key Elements	Impact on Crisis Response
Intergovernmental Coordination	Clear mandates, unified protocols, cross-level communication	Faster and more coherent implementation of health measures

Risk Communication & Public Trust	Transparent updates, consistent messaging, evidence-based policies	Higher compliance, lower misinformation spread
Multi-Sectoral Integration	Collaboration among health, finance, logistics, security sectors	Efficient resource allocation and cross-sector mobilization

The table highlights that governance-related barriers can undermine even strong technical capacity. For example, insufficient risk communication can lead to public confusion, panic buying, or rejection of health measures. Indonesia faced this challenge when early messaging regarding masking and mobility restrictions shifted frequently, weakening public trust. Research by Phua et al. (2022) found that countries with consistent communication had significantly lower mortality during COVID-19 due to higher adherence to public health guidelines.

Multi-sectoral integration is equally crucial. Health crises require coordinated action involving transportation, law enforcement, social protection, logistics, and finance. In Indonesia, slow coordination in vaccine distribution and oxygen supply during the 2021 surge illustrated the need for improved inter-sector mechanisms. Countries like Singapore and South Korea demonstrate that strong multi-sectoral structures enable rapid mobilization of resources, efficient contact tracing, and seamless public communication (You, 2020). Indonesia's experience indicates that improving governance capacity requires not only new regulations but also structural reforms in bureaucratic agility, emergency leadership, and information-sharing.

Finally, governance resilience must include mechanisms for accountability and learning. Crisis responses improve only when governments systematically review past actions, openly acknowledge gaps, and institutionalize reforms. OECD (2022) stresses that iterative improvement is a defining trait of resilient health systems. Indonesia has initiated several reforms, including the establishment of the Indonesia One Health University Network and enhancements in digital health governance; however, many reforms remain unevenly implemented across provinces. Strengthening accountability mechanisms, building local government capacity, and ensuring nationwide adoption of digital health standards are crucial steps toward improved national preparedness.

Strengthening Financing, Human Resources, and Digital Health Systems for National Preparedness

Strengthening health financing, human resources, and digital health infrastructure is a fundamental component of national preparedness that determines whether a country can sustain long-term resilience in the face of global health emergencies. Health financing shapes the capacity of a system to expand services, mobilize emergency resources, and ensure continuity of essential care during crises. Indonesia's health expenditure remains relatively low at around 3.1 percent of GDP, which is significantly below the global average of 6.3 percent (World Bank, 2022). This limitation has direct implications for preparedness because insufficient investment reduces the ability to maintain strategic stockpiles, support surge capacity, and strengthen laboratory and surveillance networks. According to Gadsden et al. (2022), countries that allocate consistent and targeted health financing to emergency preparedness experience shorter outbreak durations and reduced mortality. In Indonesia, budget fragmentation between national and subnational governments often leads to inconsistent implementation of preparedness programs. Regions with limited fiscal capacity struggle to upgrade facilities or maintain adequate workforce levels, creating disparities in resilience across provinces.

A resilient health system also depends heavily on a robust and well-distributed health workforce. Indonesia faces a persistent shortage of healthcare workers, including physicians, nurses, epidemiologists, and laboratory technicians. The ratio of physicians remains at 0.46 per 1,000 population, well below WHO's recommended minimum (Kemenkes RI, 2023). Workforce density is uneven across the archipelago. Java has the highest concentration of health workers while eastern regions experience chronic shortages. Such disparities weaken national preparedness because emergencies require rapid workforce mobilization.

Studies in BMJ Global Health show that workforce surge capacity is one of the strongest indicators of successful emergency response (Kandel et al., 2020). Furthermore, Indonesia faces challenges related to insufficient training in emergency protocols, limited continuing education opportunities, and the absence of structured national deployment mechanisms for disaster situations. Building long-term resilience requires investments in pre-service education, continuous professional development, and a centralized emergency personnel registry that allows rapid mobilization.

Digital health is increasingly recognized as a major determinant of preparedness in modern health systems. Digital transformation enables real-time surveillance, integrated patient records, predictive modelling, and telemedicine services that reduce pressure on facilities during crises. Countries with strong digital health ecosystems responded more effectively to COVID-19 because digital tools improved case detection, contact tracing, and resource allocation (Greer et al., 2021). Indonesia has made progress through initiatives such as PeduliLindungi and the SatuSehat platform, which aim to unify health data across facilities. However, fragmentation remains a critical problem. Many health facilities still use standalone information systems that are not interoperable, reducing the efficiency of national-level analysis. OECD (2022) highlights that interoperability is essential for rapid crisis decision-making. In Indonesia, inconsistent internet infrastructure in remote regions and variable digital literacy among health workers pose further barriers to nationwide implementation of digital systems.

Before presenting the analytical table, it is important to note that financing, workforce capacity, and digital systems interact in ways that shape overall resilience. The following table synthesizes the major readiness components that influence national preparedness.

Table 2. Key Readiness Components in Health Financing, Workforce, and Digital Systems

Readiness Component	Core Elements	Impact on National Preparedness
Health Financing	Budget adequacy, emergency funds, flexible allocation	Ensures surge capacity and resource mobilization
Health Workforce	Workforce density, training, deployment mechanisms	Improves speed and quality of emergency response
Digital Health Systems	Interoperability, surveillance integration, digital literacy	Enhances data-driven decision-making and early detection

The table highlights that readiness does not depend solely on one domain. Health financing strengthens both workforce and digital capacity. Workforce competence determines how effectively digital tools and emergency protocols are implemented. Digital systems improve transparency and coordination, which in turn supports more efficient allocation of financial and workforce resources. Indonesia's experience during COVID-19 illustrates these interdependencies. Delays in data consolidation hindered rapid decision-making. Workforce shortages limited the scale of testing and contact tracing. Budget constraints affected the procurement of essential supplies. Strengthening each component is therefore essential for achieving a resilient and responsive national health system.

Indonesia has begun implementing structural reforms through the national health transformation agenda. These reforms include digital health integration, improved referral systems, and reinforcement of primary care. However, achieving genuine preparedness requires long-term political commitment, consistent investment, and institutional coordination between central and local governments. Without these foundations, Indonesia may continue to face systemic vulnerabilities in future global health crises.

Strengthening resilience therefore involves not only addressing technical gaps, but also building a governance ecosystem that is capable of sustaining continuous improvement and adaptation.

CONCLUSIONS

The readiness of the national health system in facing a global health crisis is greatly influenced by technical capacity, governance, financing, health worker resilience, and digitization. Analysis through a Systematic Literature Review approach shows that Indonesia has made progress in several aspects, such as laboratory expansion, the use of digital technology, and improved coordination mechanisms. However, a number of fundamental challenges still limit the effectiveness of the national response. These challenges include regional infrastructure disparities, low health worker density, fragmented information systems, limited health funding, and suboptimal cross-sectoral governance in emergency situations. This shows that national preparedness is determined not only by technical capacity, but also by the system's ability to adapt and effectively integrate various components.

On the other hand, the experience of the COVID-19 pandemic provides an important lesson that a global health crisis cannot be addressed by improving only one aspect of the health system. A comprehensive strengthening is needed, including the improvement of real-time surveillance, the equal distribution of health facility capacity, the improvement of health worker competence, and the digitization of integrated information from the central to regional levels. In addition, transparent, coordinated, and evidence-based crisis management plays an important role in ensuring a rapid and consistent response across Indonesia. Improving fiscal capacity and emergency funding mechanisms is also key to maintaining essential health services when there is a spike in cases.

Through the integration of sustainable financing, the strengthening of health human resources, and consistent digital reform, Indonesia has the opportunity to build a more resilient health system in the face of future global threats. The resilience of the national health system will be achieved if all stakeholders move within a coordinated collaborative framework. With a long-term strategy oriented towards equity and modernization, Indonesia can improve national preparedness and reduce the impact of global health crises on public health and socioeconomic stability.

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