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Trends & Foresight of Public Health Emergencies to Support Health and Economic Sustainable Growth in ASEAN

ASEAN Socio-Cultural Community
Trend Report

The ASEAN Secretariat
Jakarta

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Executive Summary

The Southeast Asia region is one of the world's highest-risk hotspots for infectious disease emergence and re-emergence, exacerbating the possibility of Public Health Emergencies of Concern - a threat to regional health security. Regional health security instability is a major concern due to its impact on sectors other than health.

Public Health Emergency interventions are critical to addressing regional health risks and must be tailored to the region's unique risk factors and challenges. These actions may include developing smart disease surveillance or epidemic awareness at national and regional levels, strengthening Public Health Emergency preparedness, improving Public Health Emergency infrastructure and health worker capacity, ensuring collaborative and intersectoral action, implementing social protection related to health emergencies, and enhancing digital transformation of health

ASEAN and its Member States can take various actions to strengthen regional health security. These recommendations include investing in various surveillance systems to improve smart surveillance, aligning Public Health Emergency initiatives to minimise redundancy, maintaining and strengthening commitment to Public Health Emergency management, and optimising Big Data and information-sharing systems at regional and national levels.

TREND REPORT

Trends & Foresight of Public Health Emergencies to Support Health and Economic Sustainable Growth in ASEAN

Resilient Development Initiative and Aly Diana

Introduction

Background, Objectives, Methodology, and Limitations

This report aims to review the trends and foresight of PHE through the presentation of the aims and progress of the ASEAN Member States (AMS) to support the health and sustainable economic growth of the region. The report will identify challenges and opportunities, both prevailing and emerging, that the AMS should overcome, explore, and capitalize on and provide an overview of regional progress vis-a-vis the ideals above.

This report was written using various methodologies: content analysis, comparative or gap analysis, and descriptive analysis for quantitative data. Each methodology was used to compare and analyze secondary data to give a perspective on phenomena in ASEAN and its Member States.

We acknowledge several limitations in writing this Trend Report, such as unequal capacity and availability, with some data being available in several, but not all AMS, with some being outdated or incomplete. Therefore, this report's internal validity should be interpreted accordingly.

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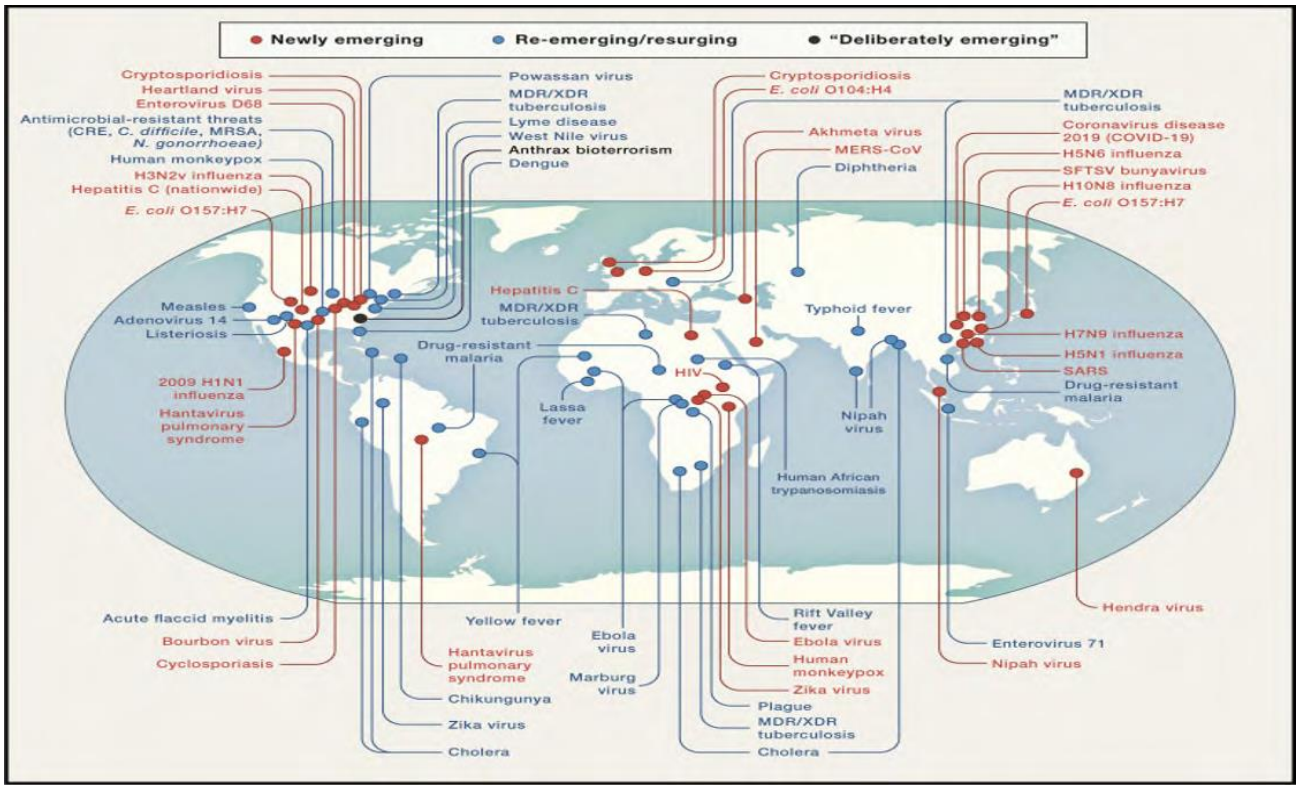
Section 1

Foresight into Public Health Emergencies of Concern

Among the variety of health threats, emerging (EID) and re-emerging (RID) infectious diseases, including deliberately emerging diseases, are the prime public health concern globally (see Figure 1.1). Hence, the foresight to emerging diseases and PHE is essential to strengthening regional health security.

pathogenic Avian Influenza A (H5N1) virus outbreak reached over 250 deaths across Cambodia, Indonesia, Lao PDR, Thailand, and Viet Nam. Moreover, the Pandemic Influenza A (H1N1) virus in 2009 impacted over 55.000 people and caused over 300 deaths in the region (Miranda et al. 2021, citing Lee 2017).

Figure 1.1. The Global Context of Emerging Infectious Diseases



Source: Morens and Fauci 2020, p.1082

1.1 Threat of Emergence (EIDs) and Re-emergence (RIDs) of Infectious Diseases

ASEAN countries are known for their susceptibility to the re-emergence of infectious diseases (EIDs and RIDs). In 2004, the highly

The infectious burden of diseases in Southeast Asia (SEA) is primarily catalyzed by respiratory and intestinal infections (Coker 2011, p.2). Malaria is still endemic in most ASEAN Member States (AMS), with endemic transmission in Cambodia, Indonesia, Lao PDR, Myanmar, the Philippines, Thailand, and Viet Nam (Yek et al. 2021, p.3). Dengue is also a leading risk

in ASEAN, with an unprecedented dengue outbreak in 2019 in Malaysia, Indonesia, the Philippines, Thailand, Viet Nam, Cambodia, and Lao PDR (WHO 2022a).

Several key factors are increasing ASEAN's vulnerability to EID and RID. If not managed appropriately, this will eventually escalate into a PHEOC and cause instability to regional health security, impacting countless non-health sectors (see Figure 1.2). The interconnectedness of risk factors, EID and RID, regional health security, and impacted non-health sectors are connected with variables of Social Determinants of Health (SDOH).

The SDOH are defined as the conditions in which people are born, grow, live, and work and are categorized into five key determinants: Education, Health and Health Care, Social and Community Context, Neighborhood and Built Environment, and Economic Stability (CDC, 2020). Several risk factors related to health (e.g., high-risk health behavior and human susceptibility to infections) and non-health (e.g., ecological condition, urbanization, and conflict and famine) have relation to SDOH. Furthermore, the non-health impact of regional health security instability (e.g., economic instability and loss of education) is also part of SDOH. It is also worth noting that these impacts on the economy, education, and inequities to vulnerable groups may also affect the non-health-related and health-related risks of EID and RID.

1.2 Key Drivers and Related Risks

The health and non-health-related risks contribute to emerging diseases in the region. The unique interaction of the epidemiological triad (i.e., infectious agents, hosts, and environments) and SDOH also affected the development of these risks.

1.2.1 Health-Related Risk

The risk highlights microbial adaptation and change and human susceptibility to infection. Microbial genetic instability allows rapid evolution to adapt to the ever-changing ecological niche, especially for influenza viruses. Hence, disease emergence is catalyzed by the genetic plasticity of infectious agents and the evolutions of diseases when encountering ecologic niches provided by hosts' interaction with the environments (Morens and Fauci 2020, p.1080).

The establishment of new infections and the likelihood of sustained transmission due to pathogen movement from animal host to human host are also risks that enforce microbial adaptability and aggravate human susceptibility to infection (ibid.). Studies also suggest that decreases in natural infections or vaccination of pathogens may facilitate the emergence of related organisms or pathogens (Llyod-smith 2013). An example is an increase in monkey-pox incidence after the cessation of smallpox vaccination (op cit.). Furthermore, growing evidence indicates that infectious disease severity and susceptibility may be related to the host's genetic variables (Morens & Taubenberge 2015). Studies have associated blood group A with COVID-19 disease severity (Morens and Fauci 2020, p.1086). Human susceptibility is compounded by high-risk health behaviors, such as lifestyle changes and irrational antimicrobial use resulting in the spread of antimicrobial resistance (AMR).

1.2.2 Non-Health-Related Risk

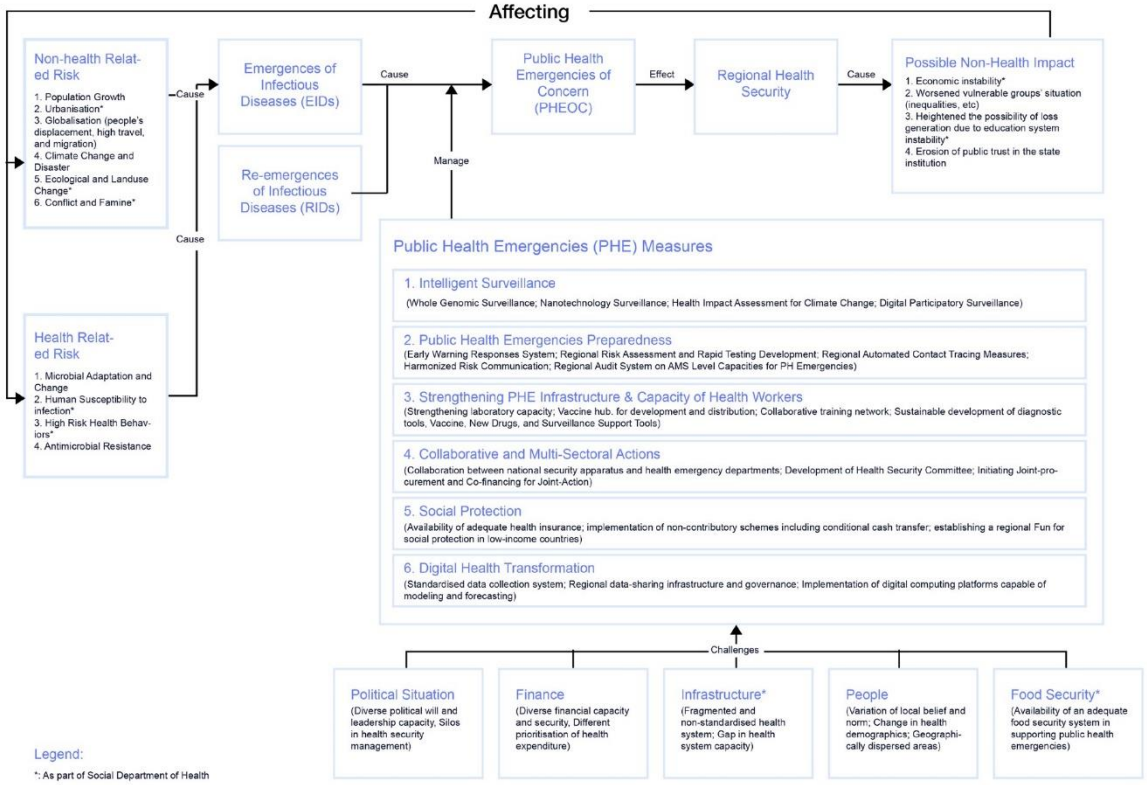
The rapidly increasing socioeconomic development in the region catalyzes its non-health-related risks. Robust population growth intensifies human-to-human contact and underpins other environmental threats such as urbanization, food system change, and land-use change. Unplanned urbanization, which causes high densities of peri-urban slums and creates conducive breeding ecosystems for infectious agents, is the driving force for vector-borne diseases. An increase in population mobility and displacement also exacerbates disease emergence, as seen through the COVID-19 pandemic cases and the diseases spread in migrant camps.

Population growth also affects food systems through agriculture and an increase in livestock production. Human-induced changes in land use for agriculture are one of the root causes of disease emergence. Reports show that agricultural drivers are associated with over 25% of EIDs and over 50% of emerging zoonotic diseases in humans (Rohr et al., 2019, p.451). Climate change can also directly affect infectious agents' survival, reproduction, and lifecycle through temperature changes and indirectly through altering their habitats and pattern of host-vector interaction.

1.3 Non-Health Sector Impacted by Regional Health Instability

EIDs and RIDs escalate the threats to ASEAN's health security, which is detrimental to non-health-related sectors (see Figure 1.2). Unstable health security causes economic instability through fiscal impacts resulting from high expenditure to manage PHE. The pandemic inflicts extreme poverty and increases population vulnerability. Asian Development Bank reported that the COVID-19 pandemic pushed 4.7 million people in the SEA region to extreme poverty in 2021. Furthermore, a report on ASEAN households indicated that the pandemic caused an income decline for 73% of sample households (Morgan and Trinh 2021, p. 12). There is also a concern for the 'lost generation' of children due to ineffective education systems. Surveys showed that 46% and 52% of children in Myanmar and the Philippines stopped attending school during the pandemic owing to inadequate internet connection and a lack of computers or tablets (ibid.).

Figure 1.2. The Framework of Public Health Emergencies of Concern Threats in the ASEAN Region



Section 2
Public Health Emergency Measures

2.1 Intelligent Surveillance

Intelligent surveillance, similar to epidemic intelligence, is the systematic collection and collation of information from various sources, which is then validated and analyzed to monitor and predict health events (ECDC 2021). It is vital to mitigate and ensure timely and evidence-based responses to PHE. The Whole Genomic Surveillance (WGS) network and Health Impact Assessment (HIA) for climate change are a few possible initiatives to support intelligent surveillance.

Genome sequencing has brought tremendous benefits for overcoming the limitations of conventional methods in therapy, disease control and prevention, and vaccine development (Chauhan et al. 2020). WHO has launched a global genomic surveillance or WGS strategy that focuses on the role of genomics as a timely and appropriate global surveillance system. It provides a deeper understanding of pathogens through genomic sequence data collected from representative populations to detect evolution and monitor trends and the spread of pathogens (WHO 2022b). WGS can track the spread of pathogens, monitor changes in the genetic code and provide information on the early emergence and spread of AMR. Its increasing affordability offers the opportunity to improve infectious disease surveillance and AMR analysis (Yam et al., 2019). Thus, WGS-based surveillance has been rapidly rolled out across the European Region, as envisaged in the European Centre for Disease Prevention and Control roadmap (ECDC 2019).

In the ASEAN region, Singapore's research groups have pioneered WGS usage on drug-resistant pathogens (Yam et al. 2019, p.4). The WGS integration to genomic analysis in the Philippine Genome Center (PGC) is also proceeding, particularly for antibiotic resistance surveillance. Malaysia also continues to advance its Whole Genome Sequences Analysis by increasing its equipped facilities. Integrated WGS emphasizing data sharing between nations is underway at the regional level. To promote this development, the ASEAN Diagnostics (Dx) Initiative generated webinar series introducing the Next Generation Sequencing for virus surveillance. The ASEAN-UK partnership further supports this through knowledge and experience sharing of WGS.

The HIA for climate change is advocated as a vital tool needed to systematically identify and quantify the effects of climate change on public health and to evaluate the impact of disease-specific adaptation and mitigation measures (Ammann et al., 2021, p.1). HIA is a combination of procedures, methods, and tools by which a policy, program, and project may be judged regarding its potential effects on the population's health. In 2010, Thailand was assigned to build HIA's capacity in AMS as a lead country. The first phase of HIA implementation in ASEAN involved building awareness and establishing the HIA framework. The second phase emphasizes the enforcement of regional initiatives and the need to understand the gaps in workforce capacity for HIA implementation.

Digital participatory surveillance is another tool to support a real-time intelligent surveillance system. It empowers citizens to participate in surveillance through online reporting —reconfirmed and recorded by big-data networks. Currently, no formal initiative is directly related to digital participatory surveillance at the regional level. However, ASEAN's initiatives (e.g.,

Emergency Operations Center Network) align with digital participatory surveillance system. At the national level, Thailand implemented digital surveillance through the Participatory One Health Digital Disease Detection (PODD) in Chiang Mai, using applications to report unusual diseases in backyards, wild animals, and humans. PODD mobile app successfully recorded thousands of abnormal events reported by volunteers (Ending Pandemics 2022). Optimizing diverse types of surveillance will support regional intelligent surveillance systems.

2.2 Public Health Emergencies Preparedness

Continuous preparedness, planning, capacity building, and testing mechanisms at national and regional levels are crucial to ensure an efficient response to PHE. ASEAN must implement measures to mitigate PHE risks to respond efficiently to health emergencies. Building a system within the AMS and the region is essential to strengthen PHE preparedness. ASEAN has developed the ASEAN Strategic Framework for Public Health Emergency as a strategic map guiding health security programs development in AMS and efficiently preparing for and mitigating PHE and biosafety risks.

Early warning systems (EWS) for PHE have become crucial, especially during an outbreak. EWS provides advanced detection of infectious disease outbreaks, widening the range of response options to contain the outbreak (National Research Council (US) Committee on Climate, Ecosystems, Infectious Diseases, and Human Health 2001, p.86). EWS platforms in AMS are managed mainly by the National Disaster Management Organization, some by the Ministry of Health (GFDRR and The World Bank 2020, p.16). Some EWS is also integrated into their EWS platforms for multi-hazard, while others are standalone platforms (ibid.). Furthermore, supporting data reporting for EWS, innovative technologies for contact tracing have been adopted in AMS to identify possible contacts with infected individuals. Although AMS have adopted country-level contact tracing, regional contact-tracing methods have not been developed. Data gaps for the EWS data reporting and timeliness of disease surveillance updates are still apparent in the AMS due to wide-area coverage in some countries and insufficient infrastructure, particularly in hard-to-reach areas. The use of contact tracing also emerges as a challenge and has implications for human rights, particularly the right to data privacy and protection.

On the country level, AMS have developed mechanisms to ensure risk assessment and communication. The National Focal Point or International Health Regulation focal points utilize existing national structure and regional mechanisms. It may conduct a risk assessment soon after receiving a health-related incident report to predict the current health situation and help determine the proper disease eradication strategy. Risk assessment and communication are accommodated in the ASEAN Strategic Framework for Public Health Emergency 2020.

The Declaration of the 7th ASEAN Health Ministers Meeting and Joint Statement of the Special ASEAN Plus Three Summit on Coronavirus Disease 2019 (COVID-19) emphasized methods for strengthening PHE preparedness. ASEAN has established the ASEAN Emergency Operations Center (EOC) Network for Public Health as a platform to

share information promptly through various communication mechanisms. The ASEAN BioDiaspora has also been developed to build regional capacity in big data predictive analytics. The platform provides updated reports on national risk assessments, readiness, and response planning efforts. Furthermore, ASEAN Risk Assessment and Risk Communication Center, platforms for risk assessment and communication, are established to help disseminate preventive and control measures, including combating false news and misinformation.

2.3 Strengthening PHE Infrastructure & Capacity of Health Workers

COVID-19 has exposed the inequities and capacities of health infrastructures to manage PHE in ASEAN. Most health systems have been underprepared and overwhelmed. Therefore, strengthening PHE infrastructures (e.g., infrastructure for surveillance systems, emergency facilities, and laboratories) is imperative. These emphasize sustainable development of vaccines, therapeutics, and diagnostics (VTD) tools, laboratory capacity enhancement, and the health workforce's capability improvement to manage the infrastructures.

Most AMS have insufficient systems to access or develop VTD tools. A study revealed that the region heavily depends on imported diagnostics (The Academy of Medical Science 2019, p.6). To improve these, the Joint Statement in the 9th ASEAN Plus Three Health Ministers Meeting in 2022 showed the member states' commitment to building a regional supply chain and self-reliance for VTD tools.

ASEAN founded the ASEAN Network for Drugs, Diagnostics, Vaccines, and Traditional Medicines Innovation to promote ASEAN-led health product innovation. Later, the ASEAN Dx Initiative was established to commercialize and make locally-developed diagnostic products available, with The Biotek-M Dengue Aqua Kit and ASEAN Sero-surveillance study as its projects. ASEAN also harmonizes regulations for diagnostic tools, supports local manufacturers, and develops and adopts several diagnostic tools. However, challenges persist, including the limited number of local manufacturers and access to samples, particularly for neglected diseases.

Local vaccine availability is key to vaccine self-reliance. Most AMS has conducted related research and development (R&D) with 13 manufacturers in Indonesia, Myanmar, Singapore, Thailand, and Viet Nam (ASEAN 2021, p.17). The ASEAN Vaccine Baseline Survey (AVBS) divided AMS into vaccine-producing (Indonesia, Myanmar, Singapore, Thailand, and Viet Nam) and non-vaccine-producing (Brunei Darussalam, Cambodia, Lao PDR, Malaysia, and the Philippines) countries. Based on the AVBS, Thailand and Viet Nam have a high capacity for vaccine R&D. In contrast, Indonesia has only limited facilities, with one vaccine candidate developed despite PT Bio Farma presence, one of the largest pharmaceutical companies in SEA.

The Regional Strategic and Action Plan for ASEAN Vaccine Security and Self-Reliance provides the platform for collaborative actions. It may support the regional vaccine hub establishment to deploy and develop vaccines in the region. Collaboration of AMS and pharmaceutical companies in vaccine

manufacturing can facilitate technology and knowledge transfer (Yean 2022, p.4). However, limited access to samples, capacity and resource disparities, imported ingredients usage (OECD 2021, p.7), and the low trust in homemade vaccines (Seah et al. 2022, p.14) hamper the growing achievements.

Adequate laboratory capacities are vital in strengthening PHE measures. There are laboratory capacities disparity among AMS. Cambodia, Lao PDR, and Myanmar struggle with essential laboratory services. In contrast, Indonesia, Malaysia, Singapore, and Thailand have advanced research capacity (Miranda et al. 2021, p.1142). The ASEAN Strategic Framework for Public Health Emergency stated the region's endeavors to improve AMS' laboratory capacity and network through the Regional Public Health Laboratories Network.

ASEAN must also invest in equipping health workers to manage PHE infrastructure. In the region, the underwhelming amount of public-emergencies-trained health workers has been a dominant theme throughout the pandemic. Although various training programs continue to be developed, health workers trained in emergencies are poorly distributed and have diverse skill standards. The ASEAN Comprehensive Recovery Framework listed several initiatives to manage these issues, including training for pandemic handling and providing scholarships for AMS students.

2.4 Collaborative and Multi-Sectoral Actions

One Health is an approach to promoting a holistic multidisciplinary approach at the animal-human-ecosystem interfaces (Gongal, 2013, p.114). One Health recognizes the need to promote a culture of working together in a sustainable way to address health risks at the human-animal interface, particularly in resource-constrained countries (ibid.). One Health approach in the ASEAN region supports multi-sectoral actions and ensures the sustainability of the ASEAN Center for Public Health Emergencies and Emerging Diseases (ACPHEED). It is essential to address shared health threats by recognizing the interconnection between people, animals, infectious agents, and the environment. The One Health approach has also been affirmed by AMS through the 15th ASEAN Health Ministers Meeting Joint Statement and integrated into diverse initiatives, including its adoption to tackle AMR.

Integrating the One Health approach requires collaboration between the national security apparatus, travel and logistic sectors, agriculture and food supply chain actors, and health departments to respond to health hazards. Information and intelligence sharing about the pathogen and exposure will be necessary to support the public health response (Cicero et al. 2019, p.7). This collaboration expands the perspective needed to anticipate the broad range of impacts posed by biological threats (ibid.). It also supports the recovery action plans in the region, including collaboration to develop a regional checkpoint system at countries' entry points connected to the regional surveillance system, as seen in the European Union Healthy Gateways.

The ASEAN Health Ministers' Meetings have implemented mechanisms for health cooperation. Additionally, by establishing the Regional Action Plan on Healthy Lifestyle 2020, ASEAN calls for intersectoral links

between ASEAN's departments, suggesting that solutions to health threats must be solved in parallel to other areas of attention (Lamy and Phua 2012, p.7). Initiations for sustainable joint procurement and a co-financing for joint action have been done through the COVID-19 response fund to support AMS in managing COVID-19 transmission and safety protection.

Health security committee development is essential to trigger regional response and enhanced coordination of risk communication. ACPHEED serves as a center of excellence and a regional hub to prevent, detect, and respond to PHE. The ACPHEED's roles include facilitating the development of joint regional surveillance and laboratory response, receiving initial public emergency reports, coordinating with relevant bodies to facilitate intersectoral coordination, serving as the repository of information regarding PHEOC, and coordinating research and development for PHE (Miranda et al. 2021, p.1142). However, future development of the ACPHEED needs to address diverse health protocols and risk tolerance between AMS and the limited funding mobilization for ACPHEED, especially those provided by regional funding.

2.5 Social Protection in Health

Health financing strategies vary across AMSs. They range from tax-funded national health systems in Brunei Darussalam, Malaysia and Thailand, to contributory social health insurance schemes (SHI) in Cambodia, Indonesia, the Philippines, Singapore, Thailand and Viet Nam, to community-based health insurance in Myanmar. Higher-income countries have higher levels of health care and service delivery due to a multi-layered health financing system. Systems include tax-financed subsidies, basic social health insurance levels, mandatory individual savings accounts managed by the government, and a government-established endowment fund that provides a safety net for health expenditures (ILO 2015).

However, nations with a significant informal sector struggle to attain universal coverage through contributory programs. Vulnerable households have a low rate of healthcare usage due to the high out-of-pocket (OOP) costs and inaccessible treatments. Households in Malaysia, for example, face substantial OOP expenses, with OOP expenditure being the second highest source of health financing after the Ministry of Health in 2019, placing households at risk of poverty (Ministry of Health Malaysia 2021, p.20; Mohd Hassan et al. 2022). In 2015, out-of-pocket spending in Cambodia, Myanmar, and the Philippines exceeded 50%., The Philippines has a sizeable OOP expenditure and fiscal deficit (ADB 2022, p.8).

Meanwhile, Thailand has excellent health coverage, service quality, and financial protection. Shifting from solely contributory schemes to a combination of revenue and social insurance funding has allowed social protection expansion. However, there is still a significant service gap due to a shortage of healthcare workers.

Regarding healthcare access deficiencies, Indonesia and Viet Nam score about average (ILO 2015). Indonesia and Viet Nam provide subsidized optional or mandatory coverage for self-employed employees (ILO 2019). For example, Indonesia has the BPJS Health program, the health sector's social protection program organizer, which is one of five National Social Security Systems (BPJS Health 2018).

Lower-income nations, such as Lao PDR and Myanmar, provide modest health care through various local schemes. In Lao PDR, social health protection is provided by the health insurance branch, voluntary health insurance for self-employed workers, and the Maternal and Child Health program for new mothers and children under the age of five. In Myanmar, the primary plan is the Social Security Board's Medical Care Scheme, covering private-sector workers. Both Lao PDR and Myanmar are working on merging current projects and creating a national social health insurance system. In addition, although Cambodia has made progress on social health protection schemes, health coverage is still inadequate in several ways, including population coverage, service availability, and quality.

Regionally, ASEAN has long been committed to ensuring social protection for all. The region adopted the ASEAN Declaration on Strengthening Social Protection in 2013 and the Regional Framework and Action Plan in 2015 for an integrated and cross-sectoral approach to social protection delivery and to address developing concerns and difficulties. It is also incorporated into the ASCC strategic measures, emphasizing improving access to and sustainability of social services.

The ASEAN Senior Officials Meeting on Social Welfare and Development promotes the well-being and quality of life of the elderly, children, and other vulnerable populations. The goals are achieved through social protection as cross-cutting issues require a coordinated and holistic strategy engaging multi-sectoral stakeholders (ASEAN 2020). Furthermore, the ASEAN Plus Three Health Ministers Meeting (APTHMM) reiterated their commitment to achieving SDGs, including financial risk protection, access to high-quality critical healthcare services, and affordable access to vital medications and immunizations. The 8th APTHMM also pushes ASEAN and three senior health officials with accelerating progress toward universal health coverage (UHC) in all nations.

2.6 Digital Health Transformation

Data services include data standardization, regional data-sharing infrastructure, and digital computing platforms capable of modeling and simulation. The COVID-19 pandemic underscored the importance of integrated and standardized real-time data for decision-making. These data, however, are left scattered and unstandardized. Therefore, standardization must unlock the potential features of untapped data sources, increase interoperability, and allow portability (Soucie 2012).

Data-sharing is one of the prerequisites of informed decision-making. However, concerns about data breaches, misuse, and theft have been running rampant due to data-sharing intensification. As a result, there emerges a need to have a data-sharing infrastructure that ensures data quality while also not jeopardizing the citizens' privacy. Consequently, building proper institutional arrangements for decisions over data is equally important (Micheli et al. 2020).

In the past, ASEAN introduced the ASEAN BioDiaspora and the ASEAN BioDiaspora Virtual Center (ABVC) to predict, anticipate, and respond to (emerging) public health concerns via Big Data predictive analytics and visualization. The BioDiaspora program links multiple datasets and empowers AMS's public health capacities through real-time web-based

risk assessment tools (the explorer and insight tools). During the COVID-19 pandemic, the ABVC generated risk assessment reports for AMS decision-makers and the public. This report encompasses the dissemination timeline, public health outlook, risk of importation, air travel volume, fatality cases, and travel advisories among AMS in response to COVID-19.

The ABVC and the BioDiaspora tools are initiatives for regional data governance and risk assessment in ASEAN. A data governance model must have several elements; data integration, policy-making, innovation, and tackling societal issues (Micheli et al. 2020). Subsequently, trust between the governing entity and the community or public is pivotal and implied within the framework of this model. In carrying out data-sharing and analytical activities, the entities may collaborate with various institutions, including companies, data intermediaries, research institutions, start-ups, and even small and medium-sized enterprises (ibid.).

ABVC lacks several crucial components for a data governance model: trust and rapport-building, such as accountability, transparency, and community involvement. Apart from relying on government data and information, the ABVC draws data from partner's databases and news articles–using news articles as data allows the ABVC to bypass some of the issues hindering data analytics (e.g., data standardization and privacy). In doing so, it did not provide citizens with adequate transparency and engagement. For instance, information or documents explaining the details of data retrieval, data-sharing mechanisms, methods of modeling on public information explaining the details of data retrieval, data-sharing instruments, and existing modeling methods are severely lacking. The framework also does not outline ASEAN citizens' role (e.g., providing or utilizing the data) within the initiative.

The infrastructure of ABVC can store sensitive information in its local storage and distributes results of data analysis (Wirth 2021). It draws anonymous data from government-issued reports and news articles and receives submissions of government-issued publications from the AMS. The data is then assessed through meta-analysis, resulting in ASEAN's summarized information. The process described previously embodies the elements of safe data, setting, and outputs possessed by data infrastructures known as data enclaves and distributed data analysis. Moreover, the ABVC is prone to collecting duplicate data from the same individuals and is not flexible enough to provide summarization based on needs (Wirth 2021).

2.7 Challenges in Implementing Public Health Emergency Measures

1. Political

Diverse political will and the possible redundancy of efforts in health security management pose potential challenges in ASEAN. AMS's distinct conditions push for various political will on different PHE measures, as seen in the varied take and initiatives implemented in the first phase of the COVID-19 pandemic. Regarding redundancy, the COVID-19 pandemic has catalyzed various initiatives development in ASEAN, including the ACPHEED, the ASEAN EOC Network, and the Regional Public Health Laboratories Network. Although these show

ASEAN's commitment to enforcing regional health security, these may heighten the possibility of silos and program redundancy among each initiative.

2. Financial

The AMS's financial capacity disparities challenge PHE measures. The SEA region has the lowest level of health spending globally. On average, less than 5% of GDP is spent on health, less than the recommended spending needed to achieve UHC (WHO 2021). Limited resources also indicate different health expenditure prioritization and are linked with possible insufficient public investment in health, especially during emergencies.

3. Infrastructure

The gap in financial capacity will widen the gap in health system capacity and infrastructure availability. In ASEAN, the first Biosafety level-4 (BSL-4)[1] laboratories will open by 2025 in Singapore. In contrast, several AMS are still struggling to own the BSL-3 labs. Furthermore, with the smallest area in the ASEAN region, Singapore has 8 BSL-3 labs, while other more prominent and overpopulated countries like Indonesia have fewer. These gaps eventually lead to insufficient health diagnostic procedures and virus characterization.

4. People and Behavioral Factors

SEA's richness in cultural customs poses challenges in controlling infectious diseases. Behaviors and norms may become barriers to health-seeking behavior or induce risky health behavior, hampering PHE measures. Food taboos (e.g., throwing away colostrum and imposing taboos on protein for pregnant women in Lao PDR) are risk factors for undernutrition (World Bank 2022). Preferential to seeking traditional folk healers, linked with spiritual beliefs in the Philippines and Orang Asli of Malaysia, influences the concept of disease causations and worsens an individual's condition (Chew et al. 2022; Abad et al. 2014). Another example is beliefs in the Philippines and Indonesia that caused COVID-19 vaccine rejection for fear that it will replace immunity from God or contain prohibited-animal-derived products (Amit et al. 2022; Agustarika et al. 2022).

5. Food security

Adequate food security implies accessible nutritionally dense foods and appropriate food regulation to maintain a healthy society, especially during emergencies. Inadequate food security and safety are detrimental to the population's health. The SEA region also has the second-highest burden of food-borne diseases, which can worsen the health emergency. Therefore, AMS must ensure a secure and adequate food security system that considers the prevention of food-borne diseases.

1 The four biosafety levels (BSL) are used to identify laboratories' protective measures, with BSL-4 having the highest level of containment required to study infectious agents or toxins that pose a high risk of aerosol-transmitted laboratory infections and life-threatening diseases for which no vaccine or therapy is available (The Science, Safety, Security Project 2015)

Section 3
Results and Recommendations

3.1. Policy Gap Analysis Results & Recommendations

ASEAN must invest in PHE measures to address future health hazards. Regional challenges hamper the achievement and widen the gap between AMS. Table 3.1 illustrates regional-related policy gaps and the possible action to manage them. Based on those, a few recommendations to address the issues may include the following:

1. Investing in Varied Surveillance Systems to Enhance Intelligent Surveillance

Intelligent surveillance monitors health threats by gathering and tracking information from various public health events or sources. The surveillance will identify threats in real-time and generate predictions in a specific time range. Establishing a WGS network and executing regular HIA on climate change impacts can enhance ASEAN's intelligent surveillance system. Considering AMS's varying capacity, assessment of WGS implementation capability and related initiatives in AMS; promotion of public-private partnership; and development of ethical policy regarding data can support regional WGS network development and standardize HIA execution.

2. Aligning ASEAN's Initiatives and Programs Related to Public Health Emergencies to Minimize Redundancy of Efforts

The COVID-19 pandemic accelerated the implementation of initiatives relating to PHE measures in the ASEAN region. Although these indicate ASEAN and its member states' dedication to strengthening regional health security, establishing diverse health initiatives can create redundancy of efforts if not arranged strategically. Therefore, a centralized institution that can list, align, and coordinate the regional and national initiatives relating to health emergencies is crucial to achieving a healthy ASEAN community. The recently established ACPHEED can strategically fulfill this role.

3. Maintaining and Increasing Commitment to Public Health Emergency Preparedness and Measures even After the Recovery Phase of the COVID-19

As the world enters the recovery phase of the COVID-19 pandemic, the commitment to PHE measures becomes highly important. This commitment is vital to maintain the momentum of the development and implementation of PHE measures. Strengthening PHE infrastructure by endorsing local VTD, enhancing health workers' ability, and developing social protection accommodating sudden PHE are a few recommended actions to ensure long-term PHE measures. ASEAN can also promote market involvement for infrastructure and social protection development, strengthen AMS laboratories and social protection networks, expand access to community-based health insurance through primary healthcare facilities, and develop PHE management training.

4. Building and Optimizing Big Data and Information-Sharing System

Data sharing is vital to align regional actions in preventing and controlling PHE. A few recommended efforts to advance data sharing in ASEAN include: (i) conducting a feasibility assessment and landscape analysis to depict the possibility of regional big data network development and the capacity of AMS in

developing and running the system; (ii) promoting guidelines to ensure standardized data gathering; and (iii) enhancing cybersecurity in the system and enforcing regional data privacy law to gain public's trust in the data governance system.

Figure 3.1. Policy Gap Analysis and Recommendations

Health Clusters	Health Issues	Possible Actions	Evidence Analysis	Recommendation	Stakeholder
Intelligent Surveillance	Diverse capacity to develop WGS network	1. Conduct an assessment of WGS implementation capability 2. Develop regional genomic surveillance networks that put countries with advanced laboratories as focal points	The network for Genomic Surveillance in South Africa	• Assess AMS' WGS capacity and pathogen threats • Increase research funds through collaboration with relevant bodies and public-private partnership • Establish centralized sequencing facilities (center of excellence) • Utilize modern sequencing technologies such as MinION by Oxford Nanopore Technologies that minimize the infrastructure requirements	- ASEAN - Policy Makers - Scholars - HCP - Private Sectors
PHE Preparedness	Data gaps and timeliness for the EWS data reporting	1. Improving infrastructure and human resources 2. Reducing the digital division	Effective EWS is when the data is timely and correctly collected, and communities are aware of EWS and receive timely and actionable information (IndiKit n.d.)	• Infrastructure improvement • Increase coordination between the district health office, public health center, and ministry of health • Provide training for staff • Access to digital literacy training	- Policy Makers - Private sectors - NGOs
Strengthening PHE Infrastructure	The disparity in the capacity to develop local VTD tools	1. Strengthen public-private partnerships and market involvement in VTD tools development 2. Develop a digital or physical regional biobank of sample	1. The Academy of Medical Science recommendation for improving laboratory development capacity in Southeast Asia 2. The significant impact of regional biobanks in Europe and Norway on the development of research and personalized medicines	• Conducts assessment to determine regional needs in VTD tools and capacity in developing VTD • Develop mapping of potential public-private partnerships to innovate VTD tools and implement a program to unite market access and provide incentives to promote private sector interest in VTD tools development • Develop ethical guidelines for clinical research biobank • Build a minimum viable product of digital biobank that compiled AMS' data as the preliminary step in regional biobank • Build a minimum viable product of digital biobank that compiled AMS' data as the preliminary step in regional biobank	- ASEAN - Policy Makers - Scholars - HCP - Private Sectors
	Diverse laboratory capacity	1. Implement a laboratory mentorship program 2. Strengthen laboratories networks and regional laboratories' referral by implementing a regional laboratory task force	1. Dedicated technical mentorship program in Southeast Europe 2. Best practice from European Regional Laboratory Task Force	• Develop a laboratory mentorship system between AMS within a specific time range to increase the transfer of knowledge and technical experiences • Utilise AVBS survey results by developing preliminary recommendations and guidelines to improve AMS' capacity based on the survey • Develop a special task force to increase AMS' laboratory preparedness for infectious disease surveillance	

Continued ▼

Multi-Sectoral Actions	The need for collaborative actions for PHE	1. Accelerate ACPHEED establishment through a sustainable funding plan and development of overarching PHEOC plans	WHO recommendation for PHEOC establishment	• Conduct financial and partnership landscape analysis to fund the ACPHEED • Establish a regional funding mechanism to ensure sustainable funding from all AMS for ACPHEED • Develop an emergency operation plan (EOP); a series of hazard-specific responses; and a prevention and mitigation plan	- ASEAN - Policy Makers - Scholars - Private sectors - Community
Social Protection	Countries with a sizeable informal sector struggle to achieve universal coverage	1. Expand access to social and community-based health insurance 2. Establish a guaranteed minimum level of protection.	Developing-country initiatives to increase health coverage follow a consistent enrollment and finance pattern, beginning with formal-sector employees and progressing to a government-subsidized enrolment of the poor (Bitran 2014).	**1. For AMS with SHI:** • Broaden SHI coverage, particularly for hard-to-reach populations such as the near-poor and the informal sector. • Offer financial incentives to encourage family coverage for formal sector workers rather than just employee coverage (as is currently the case). • Increase general revenue subsidies significantly to pay for increased coverage for informal sector employees and their families. **2. For AMS without SHI:** • Specific subsidizing programs should be established for households caring for the elderly and lower socioeconomic groups. • Government should incentivize the private sector also to deliver health services suited to the requirement of the public as a whole to minimize the financial expenditure of private healthcare services • Conduct a study to establish or evaluate existing strategic purchasing system to accommodate current and future health threats and reduce OOP	- ASEAN - Policy Makers - Scholars - Private sectors - Community
Digital Health Transformation	The lack of data standardization, trust,and governance	1. Improve the availability and usage of data sources 2. Ensure citizen's trust in the digital system through robust cybersecurity and data safety and privacy policies	1. Epidemic intelligence platforms in the WHO Regional Office for Africa utilize Facebook and Twitter 2. ASEAN Digital Masterplan includes enforcement of data privacy policies and cybersecurity enforcement to gain the public's trust for digital health transformation	• Develop trust-building and educational campaigns on the ABVC or other national and regional big data system • Make use of other sources of data to enrich the ABVC (e.g., incorporating data from social media and connecting ABVC with AMS' national data for specific diseases) • Support the development of regional and national data privacy laws or the implementation of global data privacy laws in the region • Develop regional cybersecurity standards through collaboration with third-party agencies or other relevant and experienced partners	- ASEAN - Policy Makers - NGOs - Private Sectors - Community

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