Study on Intersection of Digital Health Technologies and One Health in APEC Region

APEC Health Working Group

October 2025

Asia-Pacific Economic Cooperation

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Produced by
Dr. Chin-Shui Shih

For
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

APEC#225-HT-01.6

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I. Executive Summary

The "One Health" concept emphasizes the interconnected relationships between human health, animal health, and environmental health in all policies. It advocates for coordinated, multi-sectoral, and interdisciplinary actions. This framework addresses zoonotic diseases, emerging infectious diseases, antimicrobial resistance, food safety risks, climate change, air quality, and water quality, aiming to promote public health and well-being. One Health Initiatives have been promoted for over 15 years, and the COVID-19 pandemic has brought renewed attention to the interconnected impacts of human, animal, and environmental health, emphasizing the importance of the One Health approach once again.

Digital technology can provide significant benefits in predicting, preventing, and managing various One Health risks, and in making multi-sectoral actions faster and more effective. In 2024, the APEC Sub-Working Group on Digital Health (SWGDH) has studied and compiled the practices of economies using digital technology to address One Health challenges. This includes ongoing or planned policies, multi-sectoral governance structures, and prioritized One Health challenges, to further propose future action recommendations for APEC. This research will be SWGDH's third report.

The SWGDH was established during the HWG1 meeting in 2020 to develop and promote digital health discussions and agendas within APEC. Currently, the sub-working group has seven members: Republic of Korea; Peru; Republic of the Philippines; Chinese Taipei; Thailand; The United States; and Viet Nam, and is led by Chinese Taipei. From 2020 to 2024, the SWGDH organized five policy dialogues and published two reports: **"Summary Report of APEC Economies Digital Policy Measures to Combat Covid-19" and" Study on the Use of Telemedicine to Promote Health Equity."**

This report will focus on the actions, policies, and experiences of APEC economies including Australia; Canada; Indonesia; Republic of Korea; Singapore; Chinese Taipei; Thailand; The United States and Viet Nam; using digital technologies to address One Health challenges.

Through sharing these experiences, the report aims to help APEC economies improve cross-sectoral collaboration in facing complex health threats such as climate change, thereby building more robust, balanced, safe, sustainable, and inclusive health systems.

Keywords: digital technologies, One Health, infectious diseases, zoonotic diseases, antimicrobial resistance, climate change

II. One Health and One Digital Health：Concept and Framework

(I) One Health

1. One Health: Concept and Scope

The "Quadripartite" formed by the World Health Organization, United Nations Food and Agriculture Organization, World Organization for Animal Health, and United Nations Environment Programmed in 2022, defines "One Health" as follows:

> *One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent. The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on climate change, and contributing to sustainable development.* [1]

The "One Health" concept emphasizes the interconnected relationships between human health, animal health, and environmental health in all policies. It advocates for coordinated, multi-sectoral, and interdisciplinary actions. Therefore, this approach provides a framework for addressing zoonotic diseases, emerging infectious diseases, antimicrobial resistance, food safety risks, climate change, air quality, and water quality. The goal is to achieve optimal health outcomes.

The One Health High-Level Expert Panel (OHHLEP) outlines key **underlying** principles[2] including: Equity between

[1] WHO (2023). The One Health Definition and Principles Developed by OHHLEP. Updated on July 24, 2023. Available at: https://cdn.who.int/media/docs/default-source/one-health/ohhlep/one-health-definition-and-principles-translations.pdf?sfvrsn=d85839dd_6&download=true

[2] WHO (2023). The One Health Definition and Principles Developed by OHHLEP. Updated on July 24, 2023. Available at: https://cdn.who.int/media/docs/default-source/one-health/ohhlep/one-health-definition-and-principles-translations.pdf?sfvrsn=d85839dd_6&download=true

sectors and disciplines; socio-political and multicultural parity and inclusion and engagement of communities and marginalized voices; socio-ecological equilibrium that seeks a harmonious balance between human–animal–environment interaction and acknowledging the importance of biodiversity, access to sufficient natural space and resources, and the intrinsic value of all living things within the ecosystem; stewardship and the responsibility of humans to change behavior and adopt sustainable solutions that recognize the importance of animal welfare and the integrity of the whole ecosystem, thus securing the well-being of current and future generations; transdisciplinary and multisectoral collaboration, which includes all relevant disciplines, both modern and traditional forms of knowledge and a broad representative array of perspectives.

These key underlying principles align with the APEC Bangkok Goals on Bio-Circular-Green (BCG) Economy. In particular, in the face of climate change challenges, APEC economies should promote a sustainable agenda through cross-sectoral collaboration in a comprehensive and visionary manner to achieve strong, balanced, secure, sustainable, and inclusive development within APEC.

2. Importance of One Health Approach

As the world faces public health emergencies such as COVID-19, Mpox, Ebola, zoonotic diseases, food safety issues, antimicrobial resistance, ecosystem degradation, and climate change, there is an urgent need to build resilient health systems and accelerate global action. "One Health" is key to addressing these challenges[3].

Therefore, in the post-pandemic era, the APEC region must leverage this momentum to establish innovative, inclusive, and economically beneficial One Health strategies. These strategies

[3] https://www.who.int/news/item/27-03-2023-quadripartite-call-to-action-for-one-health-for-a-safer-world Quadripartite call to action for One Health for a safer world

should address complex challenges.

3. Achievement of multilateral governance framework

Since the establishment of the "Tripartite Organizations" (WHO, FAO, and World Organization for Animal Health) in 2010, several tools have been developed to strengthen One Health strategies globally. Following the formation of the "Quadripartite" (adding UNEP), more integrated actions have been proposed, including the One Health Joint Plan of Action and its implementation guide[4].

The One Health Joint Plan of Action outlines three main pathways and six action tracks, as illustrated in Figure 1. This framework helps adoption of the One Health approach to address related challenges, fostering a more resilient and sustainable world.

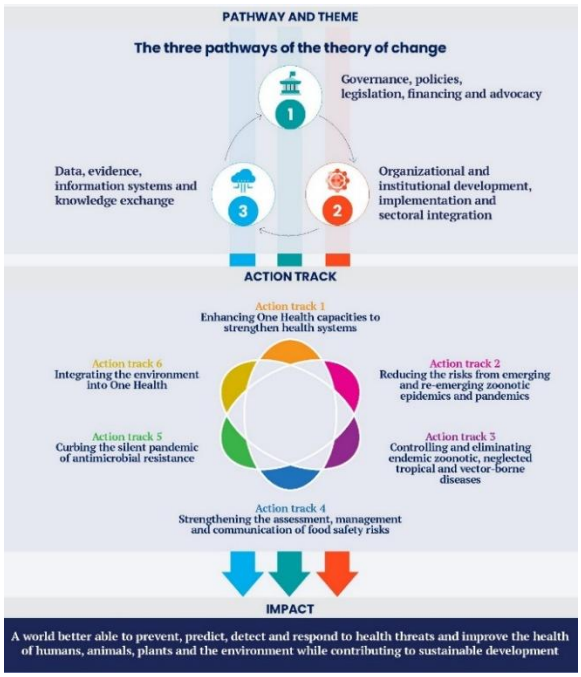

Figure 1: One Health Joint Plan of Action Framework, excerpted from "A guide to implementing the One Health Joint Plan of Action," P.6

[4] WHO, FAO, UNEP and WOAH(2023). A guide to implementing the One Health Joint Plan of Action. Licence: CC BY-NC-SA 3.0 IGO. Available at: https://www.who.int/publications/i/item/9789240082069

Additionally, in 2023, the OECD published "Embracing a One Health Framework to Fight Antimicrobial Resistance[5]." This report uses data on AMR and antibiotic usage from the OECD, EU/EEA, and G20, employing simulations and machine learning analysis. It found that unless governments implement stronger One Health policies, AMR will worsen over the next 25 years, causing thousands of deaths annually and exceeding the healthcare costs experienced during the COVID-19 pandemic.

In 2023, ASEAN introduced the "Leaders' Declaration on One Health Initiative[6]," committing to seven key actions: Establish the ASEAN One Health Network; identify priority health threats to humans, animals, plants, and the environment; promote comprehensive analysis for implementing One Health in ASEAN; develop the ASEAN One Health Joint Plan of Action; explore bilateral and multilateral One Health cooperation; encourage ASEAN member states to integrate all One Health initiatives; and request collaboration among ASEAN Health Ministers and ministers responsible for animal, agriculture, forestry, environment, and food to implement the declaration.

4. The challenges and solutions in One Health actions

One Health actions currently face several challenges, including interdisciplinary collaboration, resource allocation, and policy integration[7]. One Health actions emphasize the collaboration of experts from various fields such as medicine, veterinary science, ecology, and public health. It encourages the integration of resources across departments to avoid redundancy and ensure efficient resource use. However, existing disciplinary divides and governing structures can complicate the integration

[5] https://www.oecd-ilibrary.org/social-issues-migration-health/embracing-a-one-health-framework-to-fight-antimicrobial-resistance_ce44c755-en

[6] https://asean.org/asean-leaders-declaration-on-one-health-initiative/

[7] Danasekaran, Raja. One Health: A Holistic Approach to Tackling Global Health Issues. Indian Journal of Community Medicine 49(2):p 260-263, Mar–Apr 2024. DOI: 10.4103/ijcm.ijcm_521_2

of One Health principles into policy frameworks.

Digital tools offer advantages in data collection, integration, and analysis, potentially providing better solutions for addressing the complexities of interdisciplinary collaboration, optimizing resource allocation, and simplifying policy integration. These tools can help implement more effective and consistent health strategies across human, animal, and environmental health sectors. Sharing practical experiences, current policies, and plans among APEC economies can further enhance regional health and promote economic participation for all populations.

(II) One Digital Health

Considering the complexity, interdisciplinary, and cross-sectoral nature of the One Health field, integrating digital health technologies to address these challenges is highly promising. Scott et al. reviewed 805 articles related to "One Health and Digital," identifying the most common keywords: infectious disease management (especially SARS COV/COVID-19), antibiotic management, veterinary science, zoonotic diseases, public health, health policy, ecosystems, and multi-stakeholder collaboration[8]. These studies highlight that digital tools can be used in One Health to collect, process, and share data, information, and knowledge across multiple sectors.

Arriel Benis et al. introduced the "One Digital Health" (ODH) concept[9], which integrates information science into epidemiology research, such as disease surveillance and early warning, antimicrobial resistance monitoring and reporting, and food safety incident management. The ODH concept emphasizes viewing health and well-being from individual, population, and ecosystem perspectives. This approach requires transforming traditional health tools, disease

[8] Scott et al (2023). One Health in a Digital World: Technology, Data, Information and Knowledge. Yearb Med Inform 2023:10-8 http://dx.doi.org/10.1055/s-0043-1768718

[9] Benis A, Tamburis O, Chronaki C, Moen A. One Digital Health: A Unified Framework for Future Health Ecosystems. J Med Internet Res 2021;23(2):e22189. DOI: 10.2196/22189

surveillance models, databases, big data analysis, and health workforce training to include broader knowledge of environmental protection, veterinary care, climate change, and biodiversity, fostering an innovative and cross-sectoral coordinated action paradigm.

Data has always been a core feature of One Health, underpinning the monitoring capabilities at the human-animal-ecosystem interface, as well as the collection and analysis of relevant indicators. Currently, international organizations have implemented several monitoring systems to realize the One Health concept, including:

- World Organization for Animal Health (WOAH) Terrestrial Animal Health Code and Aquatic Animal Health Code
- WHO International Health Regulations (IHR)
- Codex Alimentarius Commission guidelines by WHO and FAO
- International Food Safety Authorities Network (INFOSAN)

These systems support the integration and application of One Health principles globally.

Currently, many One Health-related data studies provide better evidence, helping us understand how certain land uses (such as agriculture) promote disease transmission, analyze the multiple factors of disease outbreaks, and establish disease transmission models to predict epidemic trends. Increasing genomic data and data analysis enhance our understanding of animal epidemiological systems and socio-ecological systems' diversity and complexity. [10]

Moreover, experts have highlighted the potential contributions of artificial intelligence (AI) to One Health. AI can identify genotypes of animal pathogens through machine learning, control vectors (such as

[10] Ho CW-L (2022) Operationalizing “One Health” as “One Digital Health” Through a Global Framework That Emphasizes Fair and Equitable Sharing of Benefits from the Use of Artificial Intelligence and Related Digital Technologies. Front. Public Health 10:768977. doi:10.3389/fpubh.2022.76897

mosquitoes) or parasites[11], and use gene sequencing information to predict microbial antibiotic production or resistance. During the COVID-19 pandemic, digital tools played a crucial role in identifying new SARS-CoV-2 variants, aiding in tracking and monitoring the outbreak[12].

(III) Framework

To further explore how digital tools can assist APEC economies in implementing One Health actions, this study is based on the "One Health Joint Plan of Action" framework proposed by the Quadripartite, which includes three main pathways and six action tracks, and incorporates the One Digital Health concept to examine how digital tools support Pathway 3: "Data, Evidence, and Knowledge" (refer to Box 2.1).

In 2024, the Digital Health Sub-Working Group research focuses on the One Digital Health concept and the actions, policies, and experiences of APEC economies using digital technologies to address One Health challenges, such as:

1. Practices in using digital technologies to monitor, respond to, and manage One Health challenges, including zoonotic diseases, AMR, vector-borne diseases, emerging or re-emerging infectious diseases, neglected tropical diseases, food safety, and food security incidents.
2. Practices in using digital technologies to address broader issues, such as climate change and ecosystem degradation.
3. Governance structures, strategies, or capacity-building actions in addressing One Health challenges and how these elements enhance the effectiveness of digital technologies.

[11] Peters DPC, McVey DS, Elias EH, Pelzel-McCluskey AM, Derner JD, Burruss ND, et al. Big data-model integration and AI for vector-borne disease prediction. Ecosphere. (2020) 11:e03157. doi:10.1002/ecs2.3157

[12] Ezanno P, Picault S, Beaunée G, Bailly X, Munoz F, Duboz R, et al. Research perspectives on animal health in the era of artificial intelligence. Vet Res. (2021) 52:40. doi: 10.1186/s13567-021-00902-4

Through experience sharing, the study aims to assist APEC economies in enhancing cross-sectoral collaboration using digital tools to build more resilient, balanced, safe, sustainable, and inclusive health systems in the face of complex health threats such as climate change, future pandemics, and zoonotic diseases.

Box 2.1 The advantages of digital tools in generating One Health data, evidence, and knowledge

- Establish the foundations for One Health capacities
- Strengthen One Health surveillance, early warning and response
- Strengthen One Health approach in Economies' food controls systems and food safety coordination
- Improve food system data and analysis, scientific evidence, and risk assessment
- Foster the adoption of One Health approach in foodborne disease surveillance systems and research
- Integrate environmental knowledge, data and evidence in decision-marking
- Understand drivers of emergence, spillover and spread of zoonotic pathogens
- Identify and prioritize evidence-based upstream interventions for prevention of zoonoses
- Enable economies to implement community-centric and risk-based solutions to neglected zoonotic diseases
- Strengthen capacity and capability to control AMR
- Mainstream the health of the environment and ecosystems into the One Health approach

III. APEC's Emphasis on One Health and Digital Health

Since 2022, APEC has increasingly focused on One Health and digital health topics, reflected in leaders' declarations, high-level goals, and outcomes from health and economic high-level meetings.

1. In 2022, **Thailand** introduced the **"Bio-Circular-Green" (BCG) goals**[13], integrating climate change, environmental policies, and biodiversity into APEC's agenda.

2. In **the 2022 Leaders' Declaration**, it was emphasized that addressing climate change, food security, sustainable resource **management**, and health risks is crucial, highlighting the role of digital technology and innovation in inclusive growth.

3. **The Chair's Statement of 12th High-Level Meeting on Health and the Economy** in 2022[14] not only echoed the BCG goals but also **further** emphasized the importance of preventing emerging and re-emerging infectious diseases and promoting an open, fair digital economy to enhance pandemic preparedness.

4. **The Golden Gate Declaration** from the 2023 Leaders' Meeting **continues** to support BCG goals, address climate change challenges, and emphasized building a favorable, inclusive digital ecosystem.

[13] https://www.apec.org/meeting-papers/leaders-declarations/2022/2022-leaders-declaration/bangkok-goals-on-bio-circular-green-(bcg)-economy

[14] https://www.apec.org/meeting-papers/sectoral-ministerial-meetings/health/chair-s-statement-of-the-12th-apec-high-level-meeting-on-health-and-economy

IV. Economies Experiences in Digital Application in One Health

(I) AUSTRALIA

1. One Health Governance Structure

(1) Human Health

The interim Australian CDC is currently the primary agency in Australia for managing and monitoring infectious diseases and health risks. It adopts the One Health approach as one of its core principles.

To strengthen Australia's One Health capacity, the interim CDC focuses on three key actions[15]:

A. Cross-sector collaboration.

B. Leveraging existing experience in managing infectious diseases.

C. Promoting interdisciplinary knowledge exchange.

In the future, the interim Australian CDC plans to establish a One Health Unit (OHU) to improve whole-government policy coordination and knowledge sharing. The OHU will focus on:

A. Enhancing data utilization.

B. Monitoring emerging human health risks.

C. Building cross-sector partnerships, including collaborations with agriculture, water management, and food safety sectors, as well as with New Zealand.

(2) Animal Health

Australia addresses a wide range of biosecurity and environmental challenges, including animal and plant biosecurity, through the National Biosecurity Committee

[15] https://www.cdc.gov.au/about/what-we-do/one-health

(NBC), a ministerial-level body. The Animal Health Committee (AHC) operates under the NBC and is responsible for challenges related to animal health.

The AHC is dedicated to developing science-based, coordinated policies for animal health. It also provides guidelines on animal welfare and veterinary public health practices. [16]

(3) Cross-Sector Collaboration

The Human-Animal Spillover and Emerging Diseases Scanning Group (HASEDS) was established in 2022 as a One Health expert advisory group through collaboration and co-lead between the Australia Department of Agriculture, Fisheries and Forestry, and the Department of Health and Aged Care. HASEDS identifies, monitors, and evaluates information on emerging and re-emerging zoonotic diseases to help Australia manage associated health risks. [17]

2. One Health Action Plans and Strategies

(1) One Health Master Action Plan for Australia's National Antimicrobial Resistance Strategy – 2020 & Beyond[18]

This action plan aims to provide a One Health approach to address AMR across human, animal, and environmental health sectors in Australia. It outlines seven key objectives along with their priority areas:

Objective 1 "Clear Governance Framework for AMR Measures", the priority areas include:

A. Securing sustainable funding.

[16] https://www.agriculture.gov.au/agriculture-land/animal/health/committees/ahc
[17] https://www.agriculture.gov.au/about/news/world-zoonoses-day-2024
[18] https://www.amr.gov.au/resources/one-health-master-action-plan-australias-national-antimicrobial-resistance-strategy-2020-and-beyond

B. Developing sector-specific action plans.

C. Expanding stakeholder engagement and collaboration opportunities.

D. Monitoring and evaluating existing AMR management efforts.

Objective 2 "Prevention and control of infections and the spread of resistance", the priority areas include:

A. Adopting standardized infection control and biosecurity protocols.

B. Ensuring compliance with infection control and biosecurity practices through legislation and accreditation.

C. Reducing infections and antibiotic use through disease prevention.

D. Sharing updated AMR trends.

Objective 3 "Greater engagement in the combat against resistance", the priority areas include:

A. Developing a One Health communication strategy and framework.

B. Enhancing public awareness of AMR.

C. Promoting key AMR information.

D. Strengthening training for all relevant sectors.

Objective 4 "Appropriate usage and stewardship practices", the priority areas include:

A. Creating coordinated, evidence-based antibiotic prescription guidelines and best practices.

B. Establishing effective mechanisms to monitor antibiotic compliance.

C. Using antibiotic usage data to inform policy development.

Objective 5 "Integrated AMR and Antibiotic Usage", the priority areas include:

A. Developing a One Health surveillance system integrating AMR-related data from human, animal, food, and environmental sectors.

B. Establishing and regularly updating antibiotic lists.

C. Ensuring consistency in reporting surveillance data.

D. Using data to evaluate and guide AMR response actions.

Objective 6 "Robust Cross-Sector Research Agenda across all sectors, the priority areas include:

A. Developing an AMR research and innovation agenda.

B. Coordinating and sharing research outcomes.

C. Allocating dedicated funding for the R&D agenda of the economy.

D. Translating research findings into innovative AMR solutions.

Objective 7 "Strengthen global collaboration and partnerships", the priority areas include:

A. Participating in multilateral and bilateral AMR agendas and actions.

B. Collaborating with Southeast Asia and Pacific regions on AMR.

C. Engaging in cross-economy surveillance initiatives.

3. Case Studies: Intersection of Digital tools and one health issues

The "HOTspots pilot" [19][20] project is an ongoing monitoring and response initiative led by the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia. It aims to track AMR and related infections in healthcare facilities and community clinics. HOTspots is a digital platform that enables healthcare professionals to upload AMR testing and other clinical data. It provides real-time, visually accessible information, allowing clinicians to select appropriate treatments for specific bacteria and infections.

(II) CANADA

1. Case Studies: Intersection of Digital tools and one health issues

Canada's One Health efforts currently include surveillance of AMR. One component of these efforts is Canada's "Antimicrobial Resistance Network (AMRNet))" [21,22] which adopts a data-driven and One Health approach to monitor AMR across human and animal health sectors.

(1) Structure

AMRNet collects data from the Public Health Agency of Canada, clinical and veterinary laboratories, and public health institutions across Canada. In addition to collecting laboratory data, AMRNet consolidate data from multiple

[19] https://www.amr.gov.au/australias-response/objective-5-integrated-surveillance-and-response-resistance-and-usage/surveillance-antimicrobial-use-and-resistance-human-health#hotspots-pilot
[20] https://research.csiro.au/amr-hotspots/
[21] https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2022-48/issue-11-12-november-december-2022/antimicrobial-resistance-network-one-health-approach-antimicrobial-resistance-surveillance.html
[22] https://www.canada.ca/en/public-health/services/surveillance.html#a28

existing AMR surveillance programs, such as sentinel hospital-based infection surveillance and surveillance of antibiotic-resistant gonorrhea.

(2) Purpose

AMRNet provides a scalable data platform designed to meet both current and future AMR monitoring needs. It has the potential to extend beyond human and animal wastewater, environmental, and agricultural monitoring. AMRNet is designed to support AMR research in Canada

(3) Data Analysis:

AMRNet standardizes and automates data analysis, delivering results and data visualizations and quantifiable insights to stakeholders. These analyses help guide public health decisions and disease prevention strategies, enable global comparisons, and support reporting to multilateral mechanisms like WHO.

AMRNet exemplifies how digital platforms can strengthen One Health strategies by combining surveillance, research, and innovation to address AMR challenges effectively.

(III) INDONESIA

1. Case Studies: Intersection of Digital tools and one health issues

Since 2016, Indonesia has been committed to establishing a digital surveillance platform for zoonotic diseases, focusing on rabies, avian influenza, anthrax, brucellosis, and leptospirosis. This platform, known as SIZE (Sistem Informasi Zoonosis), gained significant traction in 2018 through collaborations with external partners, including the University of Oslo and the Global Fund. SIZE evolved into a One Health platform of the economy, accessible via an Android mobile application for uploading and

tracking various risks. [23]

In 2023, Indonesia launched SIZE Nasional [24] (National Zoonosis and EID Information System), an upgraded, cross-sectoral health information-sharing platform. SIZE Nasional integrates:

(1) The Early Awareness and Response System (SKDR) from the Ministry of Health.

(2) The National Integrated Animal Health Information System (ISIKHNAS) from the Ministry of Agriculture.

(3) The Wildlife Health Information System (SEHATSATLI) from the Ministry of Environment and Forestry.

With enhanced data-sharing capacity, the SIZE platform supports critical cross-sectoral functions, including: Risk assessment for zoonotic diseases, Field-level decision-making and Coordination of response actions across departments.

Indonesia aims to further improve data interoperability by integrating diverse information, including zoonotic diseases, healthcare funding, and logistics. This will enable comprehensive epidemic responses and facilitate effective intervention strategies.

(IV) REPUBLIC OF KOREA

1. One Health Governance Structure

(1) Human Health

Due to factors such as changes in habitats of vectors (e.g., mosquitoes, ticks) caused by climate change, increased global movement, and the rise in households raising companion animals, the risk of zoonotic diseases transmitted between humans and animals is increasing. Therefore, a One Health approach is necessary to respond to zoonotic diseases.

[23] https://dhis2.org/indonesia-one-health/#
[24] https://www.fao.org/indonesia/news/detail-events/en/c/1675980/

To strengthen joint preparedness and response capacities in areas requiring a One Health strategy, a One Health Council was established and has been operating within the Korea Disease Control and Prevention Agency (KDCA) since 2024. This Council consists of three divisions: the Zoonotic Diseases Division, the Waterborne and Foodborne Diseases Division, and the Antimicrobial Resistance (AMR) Control Division. In addition, KDCA is pursuing revisions to the Infectious Disease Control and Prevention Act to establish cross-ministerial governance.

In addition to the inter-council approach, inter-department councils, such as sector-specific councils established at the government level for zoonotic infectious diseases preparedness and antibiotic resistance management have also been established and are being operated. To proactively respond to emerging and re-emerging zoonotic diseases, the Zoonotic Disease Countermeasures Committee composed of related ministries (KDCA, Animal and Plant Quarantine Agency (APQA), Ministry of Environment (ME), National Institute of Wildlife Disease Control and Prevention (NIWDC), Ministry of Food and Drug Safety(MFDS), Ministry of Oceans and Fisheries (MOF), etc.) and experts in fields such as medicine, veterinary medicine, wildlife, and environment are actively working on this issue. Furthermore, the AMR Expert Committee, composed of related ministries (KDCA, Ministry of Health and Welfare (MOHW), MFDS, Ministry of Agriculture, Food and Rural Affairs (MAFRA), ME, etc.), is in operation to monitor and review the implementation of the National Action Plan on AMR, and discuss current issues regarding AMR.

(2) Animal Health

The MAFMA and the ME are focusing on various activities for the sake of the animal health. The MAFRA

oversees the prevention and control activities of livestock infectious diseases, including the establishment of disease control measures. Its affiliated agency, APQA, conducts surveillance, diagnosis, and research on the development of biological agents for livestock infectious diseases. In order to prevent harm from such diseases, the agency monitors both domestic and global outbreaks and continuously strengthens response systems. Moreover, MAFRA is expanding and improving cooperation with relevant institutions responsible for human and wildlife health to prevent and manage zoonotic diseases. The ministry is also preparing a surveillance enhancement program targeting major zoonotic diseases at the animal stage.

The ME carries out research, surveillance, diagnosis, and quarantine of diseases—including zoonotic diseases—for the management of wildlife diseases and conservation of natural ecosystem through the NIWDC. To that end, the NIWDC responds swiftly by monitoring overseas disease introduction, conducting epidemiological investigations, developing disease control techniques, performing necropsies, and developing diagnostic kits, vaccines, and treatments, by collaborating with relevant ministries. The ministry also strengthens the disease prevention and rapid response system through concentrated management of major zoonotic diseases, expansion of investigation scope for key vector species, and the development of standard diagnostic methods and control technologies. These efforts help block transmission to humans and livestock and protect the health of ecosystem.

(3) Cross-Sector Collaboration

A. Zoonotic Disease Countermeasures Committee

This committee was established in 2004 to prevent social and economic losses and protect public health by

preparing for emerging and re-emerging zoonotic diseases in advance. Since 2009, it has been jointly operated by KDCA and the APQA, with various participating ministries such as the Ministry of the Interior and Safety (MOIS), Ministry of National Defense (MND), ME (NIWDC), MFDS, and MOF, as well as private experts in medicine, veterinary medicine, wildlife, and the environment. The purpose of its operation is to strengthen cooperation and the sharing of policies, response measures, research resources, and to prepare for, prevent and control of emerging zoonotic diseases.

B. AMR Expert Committee

AMR Expert Committee has been established to assess the implementation status of AMR response strategies and discuss pressing issues related to AMR. The committee is comprised of seven director generals from key agencies, including KDCA, MOHW, the MFDS, the MAFRA, the ME, the MOF, and the Health Insurance Review & Assessment Service (HIRA), along with independent experts specialized in AMR. As of 2025, the 8th term, consisting 17 members is active and the committee meets biennially. Initially operated under the MOHW, the committee has been led by KDCA since July 2022 to improve coordination and implementation efforts.

2. One Health Action Plans and Strategies

(1) Zoonotic Disease Management Plan

To promote prevention and control policies for zoonotic diseases through a One Health-based, multi-sectoral and multi-disciplinary response system, a Zoonotic Disease Management Plan was developed. This plan was

implemented through consultations among relevant ministries, including KDCA, the APQA, and the NIWDC.

Following the First National Zoonotic Disease Management Plan (2019–2022), the Second Plan (2023–2027) is currently under implementation. The vision of the second plan is to “transform the One Health concept into action,” with four main goals:

A. Strengthening early detection and surveillance system

B. Establishing a joint preparedness and response system

C. Raising awareness and promoting global cooperation

D. Building infrastructures, including organizations, legal frameworks, and systems

Figure 2 main goals of ROK's Zoonotic Disease Management Plan, Provided by ROK team

(2) Development of the National One Health Joint Action Track

The research project is currently underway in collaboration with relevant ministries and experts, to develop Korea's One health Joint Action Plan based on the One Health Joint Plan of Action published by the Quadripartite. The goal is to align the global framework with the context of

Korea. Korea's current situation will be assessed through three pathways of change across six action tracks. Based on this, detailed short-term and mid-to-long-term implementation plans will be made for each sector.

A. Pathways of Change

- Policy, legislation, advocacy, and financing
- Organization development, implementation and sectoral integration
- Data, evidence and knowledge

B. Action Tracks

- Enhancing One Health capacities to strengthen health systems
- Reducing the risk from emerging and re-emerging zoonotic epidemics and pandemics
- Controlling and eliminating endemic zoonotic, neglected tropical and vector-borne diseases
- Strengthening the assessment, management and communication of food safety risks
- Curbing the silent pandemic of AMR
- Integrating the environment into One Health

(3) National Action Plan on AMR

To strengthen AMR control across human, animal, and environmental sectors and ensure sustainable public health, Korea has established an inter-ministerial collaboration system involving MOHW, Ministry of Agriculture, Food and Rural Affairs (MAFRA), MOF, ME, MFDS, and KDCA. The second National Action Track on AMR (2021-2025) aims to reduce antimicrobial resistance through the appropriate use of antimicrobials, enhance surveillance systems, and

implement proactive infection control measures to curb the spread of AMR.

3. Case Studies : Intersection of Digital Tools and One Health Issus

(1) One Health AMR Portal

The One Health AMR Portal was established to share multisectoral AMR research materials for the multi-sectoral joint project on the One Health approach against AMR. The project is coordinated by seven ministries: KDCA, MAFRA, MOF, ME, MFDS, the Rural Development Administration (RDA), and the Ministry of Science and ICT (MSIT). In addition, the portal exhibits AMR and antimicrobial use (AMU)/ antimicrobial consumption (AMC) data from surveillance system of Korea for both sectors of human and animal. It also provides research resources, such as WGS, to the public for R&D initiatives to combat against AMR.

(2) Integrated Information System for Infectious Disease

The system that has been made and operated integrates and connects all response stages of disease control using Information and Communication Technology (ICT). It ensures data consistency through the linkage with external public information and supports policy-making by providing refined information to the both internal and external stakeholders via an infectious disease big data platform. Integrated information sharing with relevant ministries strengthens both the usability of information and the effectiveness of the response system.

(3) Inter-ministerial Collaboration on the Integrated Information System for Infectious Disease

A. Ministry of Interior and Safety (MOIS): Real-time verification of personal information for domestic

patients and the support for assigning local public health centers based on registered addresses: Issuance of hospitalization and isolation notices via mobile devices

B. Ministry of Justice (MOJ): Real-time verification of personal information when foreign patients are reported

C. National Institute of Wildlife Disease Control and Prevention (NIWDC, under the Ministry of Environment): Provision of wildlife infectious disease outbreak data, especially for monitoring AI, additional data on SFTS will be included

D. Animal and Plant Quarantine Agency (APQA, under the Ministry of Agriculture, Food and Rural Affairs): Receives data on livestock infectious disease outbreaks (including farm information) through the National Livestock Disease Control Information System

E. Ministry of Food and Drug Safety (MFDS): Receives school meal menus by provincial education offices and foodborne illness outbreak reports by facility (number of patients and confirmed cases)

(V) SINGAPORE

1. One Health Governance Structure

In 2012, Singapore established the One Health Coordinating Committee (OHCC) [25] to address interdisciplinary public health threats through a coordinated, multi-sectoral approach. The OHCC comprises experts from five key agencies: Ministry of

[25] https://www.moh.gov.sg/docs/librariesprovider5/joint-one-health-report/joint-oh-quarterly-report_nov-2022.pdf

Health, National Environment Agency, National Parks Board, Singapore Food Agency and National Water Agency.

The OHCC has delivered significant outcomes across several key areas, including: Codes of practice for priority diseases, Training and capacity building, Risk communication and Surveillance programs. It has played a critical role in managing vector- and food-borne diseases, such as Zika virus outbreaks and Group B Streptococcus infections linked to raw fish consumption.

Now in its second decade, the OHCC focuses on four priority strategies:

(1) Early scanning and surveillance.

(2) Host and vector management.

(3) Cross-agency information integration.

(4) Science and technology development.

The OHCC also produces regular assessments of One Health risks affecting Singapore.

2. One Health Action Plans and Strategies

In 2017, the One Health AMR Taskforce, under the OHCC, launched the National Strategic Action Plan on Antimicrobial Resistance (AMR) [26]. This plan outlined a vision and strategy through 2022 to enhance Singapore's capacity to address AMR challenges, close existing gaps, and guide future actions.

The plan integrates measures across human, animal, environmental, and food sectors using a One Health approach. It highlights five key "core strategies":

(1) Education: Raising awareness about AMR.

[26] https://www.ncid.sg/About-NCID/OurDepartments/Antimicrobial-Resistance-Coordinating-Office/Documents/National%20Strategic%20Action%20Plan%20on%20Antimicrobial%20Resistance.pdf

(2) Surveillance and Risk Assessment: Monitoring resistance trends.

(3) Research: Advancing understanding and solutions.

(4) Prevention and Control of Infection: Reducing infection rates.

(5) Optimizing Antimicrobial Use: Ensuring prudent antibiotic practices.

3. Case Studies: Intersection of Digital tools and one health issues

The Biosurveillance Framework [27], implemented by Singapore's One Health Coordinating Committee (OHCC), is a systematic approach to collecting, analyzing, interpreting, and sharing data on emerging diseases, their animal hosts, and vectors. It supports early detection, response, and management of health risks.

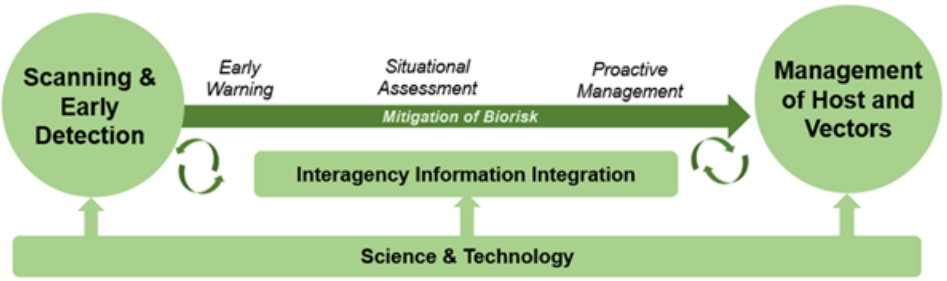

Figure 3 Biosurveillance Framework of Singapore
Source: The Centre for Urban Greenery and Ecology, National Parks Board (NParks) of Singapore.

As part of OHCC, the National Parks Board is leading a biosurveillance research project focusing on zoonotic diseases. The project aims to enhance existing knowledge on biosurveillance, such as understanding how urban development

[27] https://www.nparks.gov.sg/Cuge/Programmes-Schemes/Research%20Programmes/Biosurveillance%20Research%20Programme

and animal migration impact zoonotic disease transmission, and managing associated risks. The ultimate goal is to establish more effective monitoring systems, implement land-use planning, and design habitat restoration strategies to equip communities with practical zoonotic disease prevention measures.

This research project focuses on two key areas:

(1) Genomics and Genetics

Developing new molecular detection methods, sensors, diagnostic platforms, and analytical tools.

Sampling animal host environments and analyzing their diversity to monitor pathogen mutations and transmission dynamics.

(2) Interactions between Environmental Ecology and Epidemiology

Investigating how zoonotic pathogens and vectors emerge and spread through human-environment interactions, including economic activities.

This initiative aims to advance Singapore's biosurveillance capacity and inform strategies for mitigating zoonotic disease risks.

(VI) CHINESE TAIPEI

1. One Health Governance Structure

(1) Human Health

The Ministry of Health and Welfare's Centers for Disease Control (CDC) is responsible for human health issues within the One Health framework. The CDC addresses antimicrobial resistance, gene sequencing for cross-species infections (such as influenza and Salmonella), and prevention of zoonotic and vector-borne diseases.

(2) Animal Health

The Ministry of Agriculture monitors major zoonotic diseases entering border, researches cross-species transmission of avian influenza, and develops diagnostic methods for bovine tuberculosis.

(3) Cross-Sector Collaboration

A. The CDC, Bureau of Animal and Plant Health Inspection and Quarantine, and Veterinary Research Institute jointly established the **"Interagency Zoonotic Disease Risk Assessment Team"** in 2022. This team integrates animal and human disease expertise to assess risks, promote early warnings, and provide evidence-based risk management practices.

B. In various actions, the **Ministry of Science and Technology** is also involved in developing vaccine platform technologies to enable the rapid and integrated production of health tools during an outbreak.

2. One Health Action Plans and Strategies

Chinese Taipei's "Action Plan in Antimicrobial Resistance 2021-2025" serves as the high-level strategy for addressing AMR issues, jointly developed by the Ministry of Health and Welfare and the Ministry of Agriculture. The plan includes six major goals:

(1) Enhancing AMR Awareness and Training

Public awareness campaigns, guidelines for antibiotic use, and professional training for veterinarians, plant doctors, livestock industry, and animal drug manufacturers.

(2) Strengthening Surveillance and Investigation

Establishing an integrated monitoring system across

humans, animals, plants, and the environment, incorporating resistance gene analysis; monitoring antibiotic usage and prescriptions in animals; establishing reference laboratories with guidance and courses, and introducing new surveillance technologies such as whole-genome sequencing.

(3) **Preventing and Controlling Animal Infections:** Improving biosecurity measures in farms, fishponds, and slaughterhouses, and promoting vaccination.

(4) **Promoting Responsible Antibiotic Use:** Implementing risk management policies for antibiotics, reducing medicated feed, and developing clinical guidelines for animal medication.

(5) **Innovative Technology Development and Cross-Sector Research:** Promoting whole-genome sequencing research and establishing a gene database for resistant microbes; developing innovative therapies and vaccines against AMR and facilitating the commercialization of research results.

(6) **Incorporating Global and Regional Guidelines and Standards:** Continuously exchanging with other economies and regions to update Chinese Taipei 's AMR action strategies.

3. Case Studies: Intersection of Digital tools and one health issues

(1) Developing New Generation Information Systems and Adopting Smart Technologies in Communicable Disease Control and Prevention

This project aims to enhance epidemic prevention and control information technology and response framework through three main initiatives:

A. **Strengthening Information Governance in**

Disease Control:

- Digitizing school flu vaccination records
- Improving interdepartmental epidemic data exchange
- Establishing offsite data backups
- Enhancing cybersecurity at the CDC
- Upgrading laboratory information systems and automating infectious disease test results
- Revamping the epidemic reporting system and encouraging hospital participation
- Modernizing material warehousing systems
- Establishing a project office for coordination

B. **Digital Response Framework for Public Health:**

- Utilizing AI and big data to optimize epidemic response
- Real-time cross-departmental information and resource linkage during outbreaks
- Historical data integration for case tracing and predictive analytics to provide automated alerts

C. Community and Public AI-Based Epidemic Prevention Spaces:

- Implementing Ultraviolet Germicidal Irradiation (UNGI) in building ventilation and CO2 sensors
- Establishing "smart epidemic prevention and control space demonstration sites" in community healthcare facilities and indigenous communities.

(2) 2020-2024 Global Health Security – Antimicrobial Resistance (AMR) Management Action Plan

This human health sector AMR action plan incorporates One Health and digital technologies through:

A. Enhancing AMR Management:

- Establishing hospital management systems
- Expanding antibiotic use and resistant bacteria monitoring systems
- Promoting cross-sector AMR management capabilities and innovative research

B. Strengthening Infection Control in Healthcare Facilities:

- Creating a AMR prevention and cross-department collaboration platform of the economy
- Establishing public-private partnerships
- Enhancing IPC capabilities of healthcare institutions and workers

C. Improving Infection Control in Long-Term Care Facilities:

- Promoting hand hygiene and cleanliness
- Implementing training and certification for infection control capabilities
- Conducting infection control inspections

D. Enhancing Biosafety in AMR-related Laboratories:

- Implementing and strengthening lab risk management systems

- Inspecting pathogen and toxin storage facilities
- Expanding laboratory biosafety information systems
- Providing biosafety training and digital courses.

(VII) THAILAND

1. One Health Governance Structure

Thailand's Coordinating Unit for One Health (CUOH) [28] was established in 2014 as a collaborative platform for One Health-related activities. Since its inception, CUOH has undertaken four main activities:

(1) Organizing dialogue and coordination meetings.

(2) Providing guidance and knowledge sharing.

(3) Allocating funding.

(4) Assisting the government in managing health resources.

2. One Health Action Plans and Strategies

(1) One Health Initiative[29]

In 2016, seven Thai ministries—including the Ministry of Agriculture and Cooperatives, Ministry of Natural Resources and Environment, Ministry of Social Development and Human Security, Ministry of Interior, Ministry of Labor, Ministry of Education, and Ministry of Public Health—signed a memorandum of understanding for the One Health Initiative for National Health Security. This framework established cross-sectoral collaboration with the following action areas:

A. Inter-agency collaboration and information sharing.

[28] https://www.sciencedirect.com/science/article/pii/S2352771424000545

[29] https://doc.woah.org/dyn/portal/digidoc.xhtml?statelessToken=nT6TRodznPD8oU4fPEfG-Bqg-bNtDcqgDqJzmKyvPLo=&actionMethod=dyn%2Fportal%2Fdigidoc.xhtml%3AdownloadAttachment.openStateless

B. Strengthening integrated governance capacity.

C. Building workforce capacity in One Health fields.

D. Raising public awareness of One Health issues.

(2) Thailand National Strategic Plan for Emerging Infectious Diseases[30]

Under the One Health Initiative, Thailand launched the National Strategic Plan for Emerging Infectious Diseases in 2017. This plan aims to develop a comprehensive system capable of minimizing the risks of infection, illness, death, and other adverse impacts of emerging infectious diseases. It includes six key strategies:

A. Public health emergency preparedness.

B. EIDs surveillance, prevention, and control with one health approach.

C. Enhance public information, risk communication and education on EIDs

D. Regional and Global Collaboration

E. Multi-sectoral, private sectors, provincial and community participations

F. Research, development and knowledge management.

3. Case Studies: Intersection of Digital tools and one health issues

Since 2014, the city of Chiang Mai has implemented the Participatory One Health Digital Disease Detection (PODD) [31], a participatory digital health surveillance initiative for monitoring emerging animal and environmental health threats.

PODD is implemented by a multidisciplinary team of

[30] https://ddc.moph.go.th/uploads/ckeditor2/eidnationplan20172022_en_270660.pdf
[31] https://endingpandemics.org/projects/participatory-one-health-digital-disease-detection-podd/

veterinarians, public health officials, animal health officers, community workers, and experts in GIS, economics, and information science. Through a mobile application and website, frontline workers report abnormal health risks and diseases in humans and wildlife. These reports assist local health officials and experts in making decisions and responding to threats. Collected community data, including pathogen samples, is used to guide intervention measures, such as vaccination campaigns.

(VIII) THE UNITED STATES

1. One Health Governance Structure

(1) Human Health

Centers for Disease Control One Health Office works within The United States and with other economies and regions to build strong partnerships and takes a strategic, targeted approach to control and prevent zoonotic and emerging infectious diseases and other One Health issues. The office works with partners in other economies and across federal, state, tribal, local, and territorial governments; industry; professional organizations; academic partners; and nongovernmental organizations to:

A. Coordinate partners to address One Health challenges

B. Prepare for and respond to outbreaks and public health emergencies, such as Ebola, Zika, and COVID-19

C. Build One Health capacity and strengthen global health security through training and tool development

D. Strengthen surveillance and information sharing across public health, agriculture, wildlife, and other sectors

E. Educate people on ways to prevent diseases they can get from pets, wildlife, and farm animals

F. Develop guidance for veterinarians, public health officials, wildlife professionals, animal health officials, and many others[32]

(2) Animal Health

The Animal and Plant Health Inspection Service (APHIS)[33] under the U.S. Department of Agriculture focuses on safeguarding animal and plant health. Through programs addressing animal welfare, biotechnology, wildlife damage management, and global trade, APHIS ensures a secure and affordable food supply, protects aviation from wildlife-related incidents, safeguards pets during disasters, and preserves forests and community trees. Its work spans several critical areas:

A. Animal Care and Welfare

- Ensures humane treatment of animals.
- Protects animal welfare during emergencies.

B. Global Services

Ensures safe trade of agricultural products, animals, and plants.

C. Veterinary Services

- Maintains the health and quality of animals, animal products, and veterinary biologics.
- Trains and certifies veterinary professionals.

D. Biotechnology Regulation

- Oversees genetically engineered organisms and

[32] https://www.cdc.gov/one-health/php/about/index.html
[33] https://www.aphis.usda.gov/mission

ensures compliance for users.

E. Plant Protection and Quarantine

- Provides quarantine and certification for plants and plant products.
- Protects U.S. agriculture from pests and diseases.

F. Wildlife Management

- Manages damage caused by wildlife and promotes research to mitigate risks.

G. Tribal Cooperation

- Collaborates with Native American tribes to protect their natural resources.
- Provides capacity building and emergency health response plans for plants and animals.

H. One Health Approach

Addresses zoonotic diseases and health risks, including rabies, SARS-CoV-2, avian influenza, invasive pests, and AMR

APHIS's comprehensive scope underscores its commitment to safeguarding human, animal, and plant health, fostering a holistic approach to biosecurity and public health.

(3) Cross-Sector Collaboration

One Health Federal Interagency Network (OH-FIN) and One Health Federal Interagency Coordination Committee (OH-FICC) are the primary mechanisms for cross-agency coordination at the federal level to address One Health challenges. [34]

[34] https://www.cdc.gov/one-health/php/about/federal-one-health-coordination-1.html

A. OH-FIN:

Established in 2017, OH-FIN focuses on eight priority zoonotic diseases, including influenza, salmonellosis, West Nile virus, plague, novel coronaviruses, rabies, brucellosis, and Lyme disease.

B. OH-FICC:

In response to the COVID-19 pandemic, the U.S. government launched OH-FICC in 2019, led by the CDC. It expanded OH-FIN by incorporating over 20 federal agencies and experts to address emerging health risks like COVID-19. OH-FICC develops health guidelines addressing human-animal-environment interfaces, covering companion animals, wildlife, livestock, environmental health, and animal diagnostics.

C. Role of CDC:

As the leading agency, the CDC coordinates efforts across federal, state, tribal, and non-governmental partners to foster information sharing and response strategies for One Health challenges.

2. One Health Action Plans and Strategies

(1) National One Health Framework To Address Zoonotic Diseases and Advance Public Health Preparedness in The United States: A Framework for One Health Coordination and Collaboration Across Federal Agencies[35]

In 2023, Congress directed the CDC, in collaboration with the Department of Agriculture and other federal agencies, to establish a unified One Health coordination mechanism.

[35] https://www.federalregister.gov/documents/2023/09/20/2023-20338/national-one-health-framework-to-address-zoonotic-diseases-and-advance-public-health-preparedness-in

This framework aims to enhance prevention, surveillance, control, and response capacities for zoonotic diseases and One Health challenges across the U.S.

The CDC is working with federal agencies, civil society, academia, and the private sector to define the framework's objectives, governance elements, existing gaps, action plans, milestones, and guiding principles. These principles will promote health equity, sustainability, and cross-sectoral actions.

3. Case Studies: Intersection of Digital tools and one health issues

Federal One Health partners in the OH-FICC also investigated spread of SARS-CoV-2 between people and animals, through the development and implementation of a standardized One Health epidemiological investigation toolkit and surveillance system that has been adopted across the economy. Combining surveillance data with genomic information from both human and animal samples through One Health investigations of SARS-CoV-2 infections in people and animals have helped improve our understanding of how COVID-19 affects different animal species, virus transmission, the potential for variant emergence in people and animals, and the potential role of animals in spreading the virus.

CDC One Health experts have conducted or assisted in investigations of SARS-CoV-2 cases in people and companion animals, farmed mink, wild animals, and captive animals in zoos, along with our state and local public health and animal health partners, as well as federal partners such as USDA and DOI.[36]

[36] https://www.cdc.gov/one-health/php/about/federal-one-health-coordination-1.html

(IX) VIET NAM

1. One Health Governance Structure

Viet Nam's Master Plan for the One Health Partnership Framework for Zoonoses (2021–2025) [37] is the primary governance framework of the economy for addressing One Health risks. Jointly led by the Ministry of Agriculture and Rural Development, the Ministry of Natural Resources and Environment, and the Ministry of Health, the plan establishes key mechanisms, including a Steering Committee, a Secretariat and a Multi-sectoral technical coordination committees.

2. One Health Action Plans and Strategies

The Master Plan outlines six key objectives and outcomes:

(1) Strengthening institutional capacity and cross-sector collaboration:

A. Establish multi-sectoral dialogue and cooperation frameworks.

B. Minimize spillover risks at the human-animal-environment interface.

C. Manage zoonoses using a One Health approach.

(2) Reducing the emergence and transmission risks of zoonotic pathogens:

A. Address risks arising from biological, environmental, and human behavioral factors.

(3) Enhancing food safety and AMR management:

A. Govern and monitor antibiotic use.

B. Promote best practices across sectors to reduce

[37] https://leap.unep.org/en/countries/vn/national-legislation/master-plan-one-health-partnership-framework-zoonoses-2021-2025

antimicrobial resistance.

(4) Mitigating the impact of specific zoonotic diseases:

A. Reduce the health impacts of diseases such as H5N1 influenza, rabies, anthrax, leptospirosis, and Streptococcus suis infections.

B. Address other re-emerging diseases.

(5) Strengthening resource mobilization and preparedness:

A. Improve response capacity and recovery efforts for emerging and re-emerging infectious diseases.

B. Enhance the speed and effectiveness of zoonotic disease management.

(6) Managing human activities that affect natural ecosystems and zoonotic disease risks:

A. Implement measures to control behaviors impacting the environment and zoonotic risks.

3. Case Studies: Intersection of Digital tools and one health issues

Viet Nam plans to leverage digital systems under the Master Plan to monitor and mitigate zoonotic disease risks associated with animal trade. These initiatives include:

(1) Wildlife conservation and combating illegal wildlife trade.

(2) Rapid response to zoonotic disease outbreaks.

(3) Managing animal vaccines and antibiotics.

(4) Ensuring food safety and animal welfare.

(5) Strengthening certification capabilities.

(6) Raising awareness within livestock and agricultural

communities.

The Master Plan also recommends integrating digital outbreak management systems into Viet Nam's National Digital Transformation Program through 2025 (with Orientations Toward 2030). Building on Viet Nam's success in combating COVID-19, this integration aims to develop a robust system to address health threats more effectively.

V. Future Research Directions and Questionnaire

(I) Report Development and Process

This report has incorporated contributions from members of the APEC Sub-Working Group on Digital Health (SWGDH) and insights from discussions during the 2024 HWG1 and HWG2 meetings. It also includes discussions from the APEC Digital Health Policy Dialogue held on November 7, 2024, titled "Intersection of Digital Health Technologies and One Health."

This study serves as a reference for governance structures, action plans, collaborative frameworks, and practical experiences for addressing One Health challenges through digital health technologies, fostering a more resilient health security system in the APEC region.

(II) Key Findings

1. Cross-Sectoral Governance Mechanisms for One Health

The study highlights governance structures established by APEC economies to address One Health challenges, including:

(1) Human Animal Spillover and Emerging Diseases Scanning Group (Australia).

(2) One Health Council, Zoonotic Disease Countermeasures Committee and AMR Expert Committee (Republic of Korea)

(3) One Health Coordinating Committee (Singapore).

(4) Interagency Zoonotic Disease Risk Assessment Team (Chinese Taipei).

(5) Thai Coordinating Unit for One Health (Thailand).

(6) One Health Federal Interagency Coordination Committee (The United States).

(7) Master Plan Framework Collaboration (Viet Nam).

These mechanisms vary in positioning within governance systems. Economies like ROK; Singapore; Thailand; the U.S.; and Viet Nam adopt ministerial-level coordination frameworks that enable broader mandates such as funding, action coordination, and policy guidance. Others, like Australia and Chinese Taipei, operate through working groups focusing on technical and specific issues such as zoonotic disease risk monitoring and assessment.

Challenges remain, including Insufficient high-level cross-sector collaboration mechanisms, Lack of economy-level One Health strategies and Limited funding for One Health initiatives.

2. Focus Areas in One Health Action Plans

Economies' One Health action plans primarily focus on two domains:

(1) Antimicrobial Resistance (AMR): Prioritized by economies like Australia; Canada; ROK; Singapore; and Chinese Taipei.

(2) Zoonotic Diseases: Prioritized by economies like Indonesia; ROK; Singapore; Chinese Taipei; Thailand; the U.S.; and Viet Nam.

Broader One Health issues, such as climate change and environmental health, remain underexplored due to their complexity and limited operational experience within the health sector.

3. Economies are leveraging digital technologies based on existing disease surveillance practices for Risk Monitoring and Analysis

Digital health tools are actively used for AMR and zoonotic disease surveillance, reporting, tracking, and decision-making. For example, Indonesia has developed an interoperable digital platform integrating multiple databases.

(III) Recommendations for Future Actions

1. Expand Existing Efforts to Address Broader One Health Challenges

While economies have made significant progress in addressing AMR and zoonotic diseases, future efforts should explore extending these approaches to broader challenges such as climate change adaptation, ensuring food safety and mitigating foodborne illnesses, and promoting environmental health.

2. Data Interoperability and Workforce Development as Key Governance Elements

Building on successful practices, economies should prioritize:

(1) Developing cross-sectoral data monitoring and integration systems.

(2) Investing in digital health infrastructure and workforce training to ensure digital literacy.

(3) Standardizing data collection and ensuring data interoperability to enhance responses to One Health risks.

These actions will strengthen health system resilience, promote universal health coverage (UHC), and enhance public participation in economic activities.

3. Foster Knowledge Exchange and Stakeholder Engagement

One Health challenges require multi-sectoral cooperation and active participation from stakeholders, including digital solution providers, practitioners in hospitals, food industries, and livestock sectors, and communities and the public.

Different economies, facing unique challenges, resources,

and existing governance structures, have adopted various One Health governance frameworks. Understanding each other's policy considerations can provide valuable insights for economies still exploring or developing their One Health strategies, enabling them to create actions tailored to their specific needs.

Therefore, APEC health-related meetings, as well as workshops on infectious diseases, food safety, and animal health, should continue to include sessions where economies and stakeholders present their cross-sectoral governance frameworks and showcase their digital applications. This exchange of knowledge and experiences will foster mutual understanding and prompt action among economies. A more resilient, capable, and resource-equipped health system for addressing One Health challenges will ultimately ensure the health and well-being of the APEC region and support its economic prosperity.

Annex: Digital Technologies for One Health Challenges: Questionnaire

I. Contact Information

(I). Economy：

(II). Contact Person (and Title)：

(III). Contact Information (Email and Phone)：

II. Priority Areas in One Health (Select all that apply)

□Zoonotic Diseases

□Vector-borne Diseases

□Neglected Tropical Diseases

□Antimicrobial Resistance

□Food Safety and Food Security

□Environmental Pollution

□Climate Change Challenges

□Strengthening Governance and Capacity

□Other (Please specify)：

III. One Health Governance Structure

(I). Which department/agency/authority are responsible for One Health-related issues in your economy? (provide department names or websites)

1. Department Name：

   (1) Website (if available)：

   (2) One Health-related Responsibilities(Please specify)：

(II). Does your economy have a **cross-departmental/cross-sector One Health task force?** Please specify the involved departments and their respective responsibilities.

IV. One Health Action Plans and Strategies

(I). What are your economy's One Health action plans and strategies? (Please provide name of the document)

(II). Website (if available)：

(III). Key Issues Addressed (Brief answer)：

(IV). Project Summary (Brief answer)：

V. Digital Utilization: Case Studies

Please share up to two case studies where digital technologies were used to address One Health challenges, including but not limited to disease surveillance, pandemic logistics management, data governance, online courses, and innovative technology use. Provide related outcomes, charts, or photos.

※When sharing case studies, experiences not only from the Health Department (or human health sector) but also from other sectors such as: **Environment Department** (forest protection, natural resource use, water and air purification, climate change, and other environmental health issues), **Agriculture Department** (animal health issues in livestock and fisheries), **Economy Department** (impact of One Health on the economy) are welcomed. Please include relevant outcomes, charts, or photos to illustrate these experiences.

VI. Expectations for APEC Discussions

The Digital Health Sub-Working Group plans to promote conferences and activities on using digital technologies to address One Health challenges in the near future. What topics do you expect the activities to cover, and what concrete outcomes would you like to see as future APEC actions?

□Zoonotic Diseases

□Vector-borne Diseases

□Neglected Tropical Diseases

□Antimicrobial Resistance

□Food Safety and Food Security

□Environmental Pollution

□Climate Change Challenges

□ Governance Issues: How to conduct cross-departmental collaboration, how to translate discussion outcomes into practical policies

□Utilization of Digital Technologies: Disease surveillance, prediction, and prevention

□Utilization of Digital Technologies: Capacity building and training

□ Utilization of Digital Technologies: Introduction of innovative technologies

□Other (Please specify)