ONEHealthSG

# Singapore's One Health Master Plan

Building a resilient tomorrow for people, animals, and the environment

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# Foreword

## The One Health Singapore Master Plan emerged from thoughtful collaboration across our health, environmental, and animal sectors.

Through structured workshops on strategic planning and monitoring frameworks in 2024 – 2025, alongside careful study of international best practices, teams from the Communicable Diseases Agency, National Environment Agency, National Parks Board, PUB (Singapore's National Water Agency), and Singapore Food Agency worked methodically to shape this shared vision for Singapore's health resilience.

We would like to extend our appreciation to all organisations and individuals who have contributed to the preparation of this publication and participated in the master planning process.

This roadmap acknowledges a simple truth: in today's interconnected world, protecting health requires all of us working together. The plan's development process itself demonstrated this principle, bringing diverse perspectives together to create ONEHealthSG - a framework that recognises the deep connections between human, animal, and environmental wellbeing.

Whether you're a scientific professional, researcher, industry partner, or member of the public, your role is vital in building a healthier Singapore. By sharing this knowledge and joining in our collective efforts, you can help strengthen Singapore's preparedness for future health challenges. Together, we can create a more resilient and healthier home for current and future generations.

### One Health agencies

Communicable Diseases Agency Singapore
Prepare · Prevent · Protect

National Environment Agency
Safeguard · Nurture · Cherish

National Parks
Let's make Singapore our city in nature

Animal & Veterinary Service
A cluster of NParks

PUB Singapore's National Water Agency

Singapore Food Agency

# Executive Summary

Singapore initiated its One Health framework in 2012. The One Health Coordinating Committee (OHCC) provides strategic direction and sets priorities for inter-agency coordination and collaboration. The One Health Work Group (OHWG) operates under the OHCC's direction to implement and review programmes. Key agencies involved are:

- Communicable Diseases Agency (CDA)
- Animal & Veterinary Service (AVS), a cluster of the National Parks Board (NParks)
- National Environment Agency (NEA)
- PUB, Singapore's National Water Agency
- Singapore Food Agency (SFA)

The One Health Office (OHO) was established in 2024, under the auspices of CDA, to bolster intersectoral governance, policy, and advocacy development. Its primary function is to support planning and coordination of One Health activities, while fostering stronger cooperation both within and across various entities.

The Master Plan is built on the '4Cs' core principles: Collaboration, Coordination, Communication, and Capacity Building. It outlines strategies and a unified vision for addressing complex health challenges.

This comprehensive strategy recognises how human, animal, and environmental health are interconnected. It brings together key agencies including CDA, AVS/NParks, NEA, PUB, and and SFA. The framework aligns with the One Health Joint Plan of Action published by the Quadripartite (FAO, UNEP, WHO, and WOAH).

## The Master Plan is built on these three Strategic Pillars:

### 1 Engagements via Communication, Networking, and Leadership

- Develop targeted One Health messaging for public awareness.
- Establish risk communication planning for disease outbreaks.
- Initiate and cultivate local and international partnerships, positioning Singapore as a key player in the One Health landscape.
- Participate in global and regional initiatives.
- Guide the alignment of local practices with international One Health platforms, ensuring Singapore's leadership in global health security efforts.

### 2 Sector Development via Partnerships and Education

- Foster collaboration between public, academia, and industry sectors.
- Support One Health laboratories and services.
- Enhance One Health workforce through education and training.
- Develop competencies in key areas.

### 3 Insights using Surveillance, Data, and Research

- Implement a One Health R&D Plan.
- Prioritise key One Health research areas.
- Enhance research collaboration and capacity.
- Integrate data from human, animal, and environmental health sectors.

## The framework has already yielded positive outcomes, including:

- Coordinated training for capability building.
- Coordinated efforts to combat AMR.
- Development of joint protocols for zoonotic and foodborne disease outbreaks.

## Benefits across sectors include:

- **Public**: Improved health outcomes, enhanced disease prevention, and sustainable living.
- **Academia**: Expanded research opportunities, enhanced global recognition, and cross-sector collaborations.
- **Industry**: Access to innovative research, capacity building opportunities, and collaborative projects.

The Master Plan aims to create a diverse community of frontline responders and workforce trained in One Health principles, emphasising collaboration across sectors, disciplines, and society to enhance Singapore's public health resilience. By fostering these strategies and initiatives, Singapore positions itself as a leader in One Health approaches, contributing to both local and global efforts in addressing complex health challenges in our interconnected world.

This living document serves as a roadmap for creating a resilient and healthier environment for all Singaporeans, our animal populations, and our shared environments. The plan's success relies on effective coordination among stakeholders, clear communication of One Health principles, and continuous capacity building efforts to ensure a skilled workforce capable of implementing the One Health approach. The One Health agencies will be seeking partners to drive collaborative initiatives outlined in this plan.

Photo credit: NParks

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# Introduction

Singapore views One Health as an effective and powerful approach to promote health across humans, animals, and environment. The approach generates a multiplier effect where collaborative efforts across sectors amplify individual agency actions.

- By fostering synergies between agencies, it enables comprehensive and efficient management of public health activities.
- This sustainable strategy creates a positive public health impact for Singapore and presents new opportunities for adapted methods for collaborations.

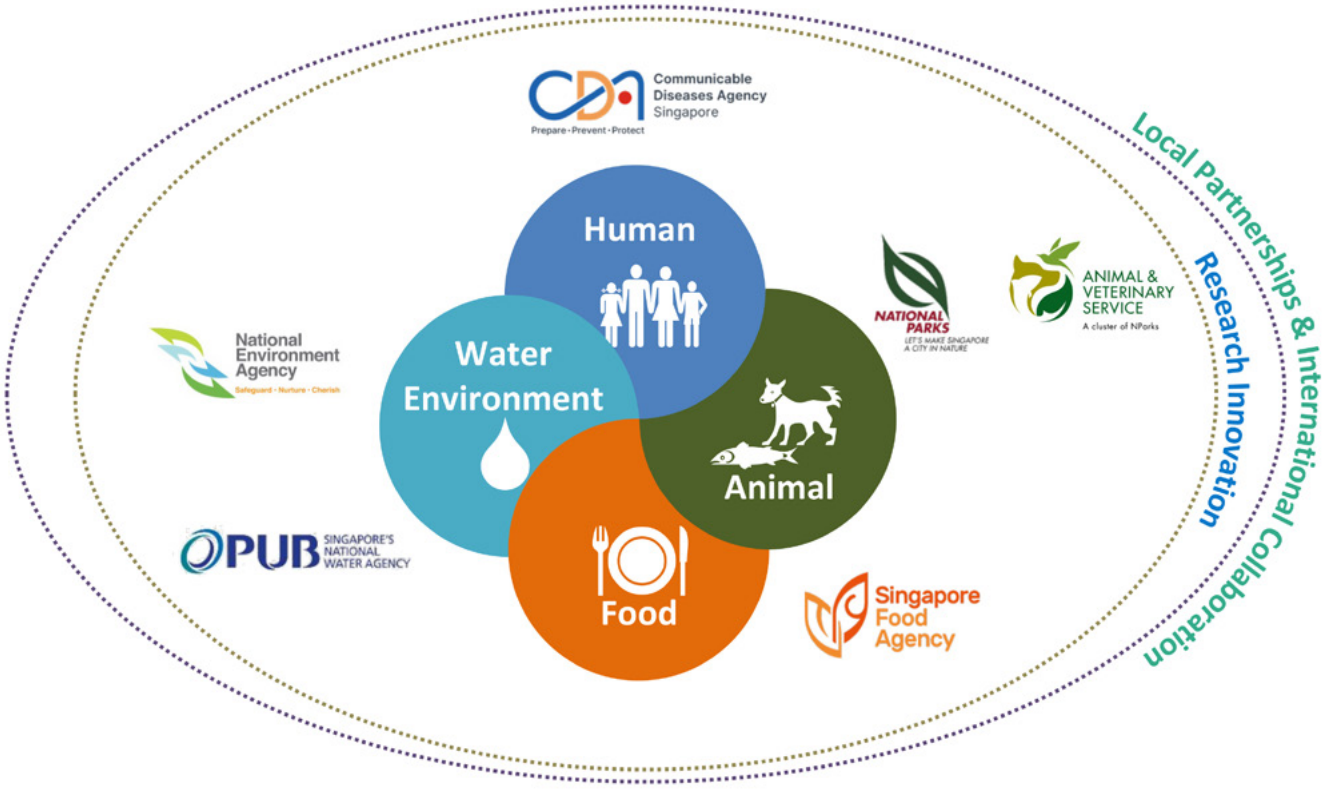


**Figure 1:**
Diagram depicting the collaborative efforts across the government agencies and different sectors that can amplify a positive public health impact, such as preventing anti-microbial resistance (AMR) [4]

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# Our Future Challenges

## Emerging and Endemic Infectious Diseases (EIDs)

Singapore faces ongoing threats from emerging and endemic infectious diseases, including foodborne pathogens, vector-borne diseases, environmental-borne pathogens, and antimicrobial resistance (AMR). These challenges are exacerbated by climate change, rapid urbanisation, deforestation in Southeast Asia, and wildlife/food trade and increased tourism.

In our interconnected world, where pathogens are 'one flight away', these multifaceted disease challenges demand an integrated response through the One Health approach, with aims to prevent and manage disease outbreaks while protecting environmental and societal needs like food security and clean resources.

## Increasingly Complex Interactions

As the health of humans, animals, plants, and ecosystems are becoming more interdependent, the risk of emerging zoonotic diseases increases, requiring the One Health approach which focuses on:

- Addressing environmental risks at their source through prevention and surveillance.
- Building cross-sector preparedness and response capabilities for health security through interdisciplinary cooperation.
- Advancing understanding of complex disease patterns while enhancing capacity to identify threats, promote sustainable development, and mitigate disease outbreak risks.

A key challenge lies in coordinating efforts to identify and prioritise shared hazards that cut across sectors, while maintaining an integrated perspective of the interlinkages between environmental, animal, and human health. To address these challenges, we strive to facilitate and enhance existing strategic coordination within and across agencies, external stakeholders, and international partners.

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# ONEHealthSG

"One Health is an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals, and ecosystems.

It recognises that the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) is closely linked and inter-dependent."

- definition by the One Health High Level Expert Panel (OHHLEP) (2021).

**Mission**

One Health for Singapore (ONEHealthSG) commits to anticipate, prevent, prepare against, respond to, and recover from shared One Health threats to build health resilience for humans, animals, and environment (Figure 2).


**Figure 2:**
Infographic depicting the '4Cs' principles to build health resilience against One Health threats across the human-animal-environment interface (adapted from the OHHLEP [5], Credit: CDA and SFA)

The cooperation will be underpinned by the One Health '4Cs' principles of Collaboration, Coordination, Communication, and Capacity Building.

### Interdisciplinary Collaboration

Foster partnerships across sectors and disciplines to address complex communication disease challenges comprehensively.

### Effective Coordination

Ensure seamless coordination and integration across efforts amongst agencies, professionals, researchers, and stakeholders at various levels.

### Open Communication

Promote transparent and timely communication to facilitate information sharing, knowledge exchange, and dissemination for prompt risk communication.

### Optimised Capacity Building

Develop practical and cross-use capacities for improved health and disease assessment and responses.

Photo credit: SFA

## What will ONEHealthSG mean to these stakeholders?

### 1. Public

The One Health approach benefits you and your community through

- **Improved health outcomes**: One Health professionals work together to prevent and respond to health risks more effectively, leading to better overall public health.
- **Enhanced disease prevention**: Early detection and intervention in zoonotic diseases reduce the risk of outbreaks, due to considerations behind the interconnections between human, animal, and environmental health.
- **Sustainable living**: Increased awareness of how human activities impact environmental and animal health promotes more sustainable lifestyle choices.

This holistic strategy offers stronger disease protection, informed health decision-making, and a healthier living environment for current and future generations.

### 2. Academia and Industry

The One Health approach brings together professionals from diverse fields to address complex health challenges that affect humans, animals, and the environment. This collaborative strategy offers distinct benefits for academia and industry, creating opportunities for innovative research and practical applications. These include:

#### For Academia

- Expanded research opportunities: Interdisciplinary collaboration opens new avenues for groundbreaking research.
- Real-world impact: Research directly translates into practical solutions for pressing health issues.

#### For Industry

- Improved risk management: Understanding the interconnections between human, animal, and environmental health helps businesses mitigate potential risks.
- Access to expertise: Collaboration and capacity building with One Health professionals provide valuable insights for workforce development and strategic planning.

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# Case Study

## From Kennel to Lab: Collaborative One Health approach in Singapore's Leptospirosis Response

In 2016, Singapore faced an unexpected outbreak of canine leptospirosis, with 17 suspected and 1 confirmed case, mostly linked to a single dog daycare centre. The situation escalated when a person whose dog had been housed at the affected centre also developed leptospirosis, suggesting possible dog-to-human transmission.

Recognising the interconnected nature of this health threat, Singapore's health officials adopted a One Health approach:

- Veterinary authorities increased surveillance and treatment of infected dogs.
- Public health officials investigated the human case and potential links to the canine outbreak.
- Environmental health teams assessed and improved sanitation practices at the daycare centre and surrounding areas.
- Public education campaigns were launched to inform dog owners and the public about leptospirosis risks and prevention measures.

**References:**
· hsuliyang. (22 July 2016). Leptospirosis in Dogs, Singapore (One Health). MIPHIDIC.

# ONEHealthSG Strategic Pillars

To realise our One Health mission and objectives, we have identified three strategic pillars that will guide our efforts (Figure 3). These pillars are interconnected and cross-functional, informing the development and implementation of all initiatives. The Master Plan's formulation draws upon insights gained from establishing the One Health Committees and leverages frameworks developed by the Quadripartite [1-3]. Through stakeholder engagement sessions and consultations, we have refined the Master Plan's scope and explored practical approaches to operationalise the One Health concept.

## Strategic Pillar 1

**Engagements**
**via Communication, Networking, and Leadership**

We will ensure Singapore remains engaged with local and overseas stakeholders and propagate conversations for One Health innovations and projects. Being a trusted leader for One Health advancement locally and globally will aid Singapore to learn and build on the One Health approach over time.

## Strategic Pillar 2

**Sector Development**
**via Partnerships and Education**

We will develop both our existing and future workforce to work in a One Health approach and develop competencies that are not bound by sectoral or discipline boundaries.

## Strategic Pillar 3

**Insights**
**using Surveillance, Data and Research**

We will apply our existing and develop future technical capabilities to generate insights and benefit One Health sectors. This includes planning joint surveillance programmes, tapping into data for analysis around practical use cases, and research into common problem statements.

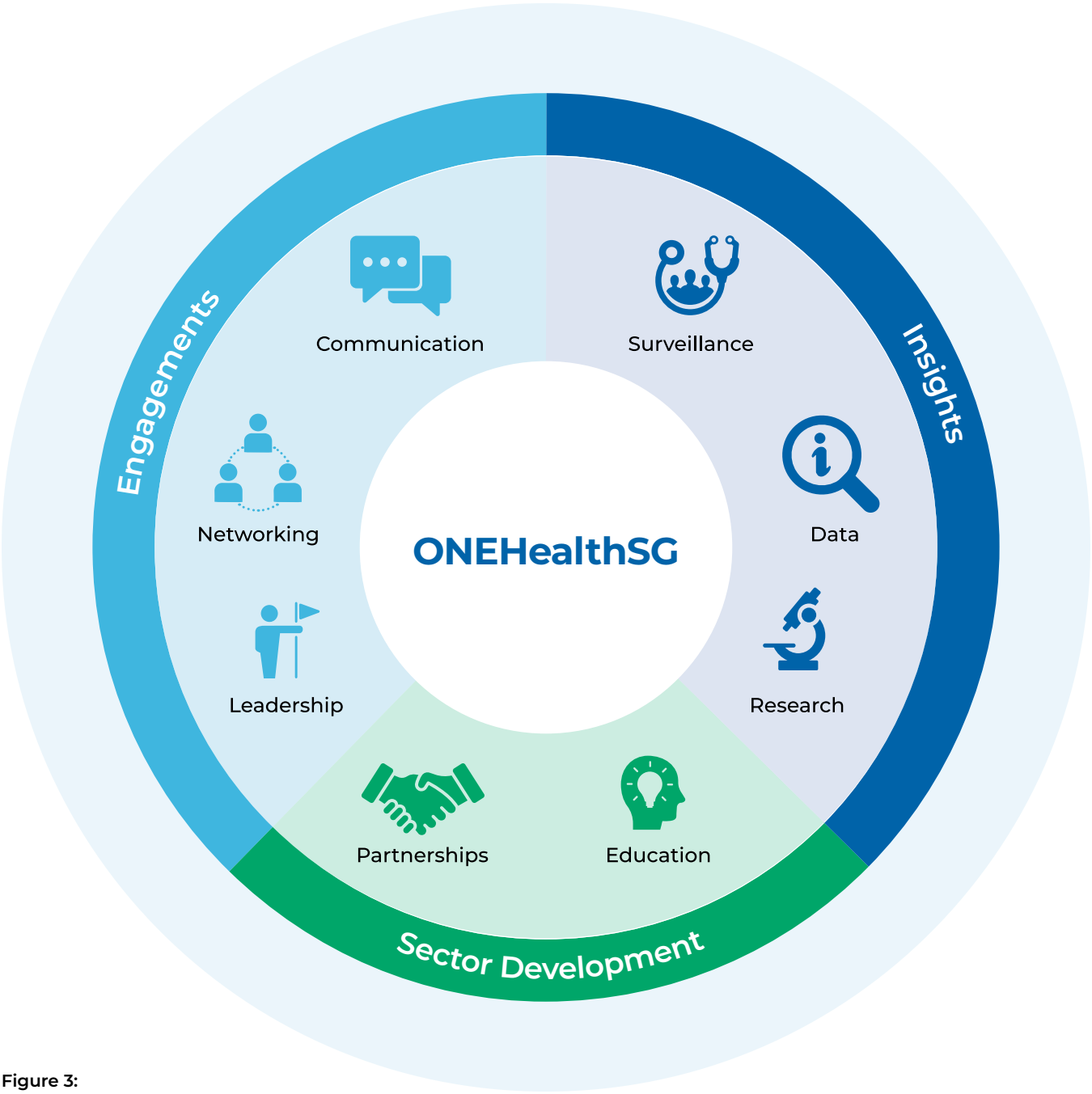


**Figure 3:**
Diagram depicting ONEHealthSG – Three Strategic Pillars

The One Health Singapore Master Plan's eight strategies, built on the '4Cs' principles and spanning communication, partnerships, education, surveillance, data, and research, form an integrated approach that brings together professionals from diverse fields to address complex challenges affecting humans, animals, and the environment.

Through coordinated implementation and stakeholder engagement across public, academic, and industry sectors, Singapore is strengthening its position as a leader in One Health initiatives while building a resilient framework that enhances both local health security and global efforts in safeguarding public health.

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# Strategic Pillar 1 Engagements

**Fostering collaboration and awareness in One Health**

This section outlines our strategies for fostering collaboration, raising awareness, and exercising leadership in the One Health domain.

**We focus on three Objectives:**

- **Communications**: Develop targeted messaging to promote understanding and action.
- **Networking**: Build collaborative relationships across disciplines and borders.
- **Leadership**: Champion One Health approaches on the global stage.

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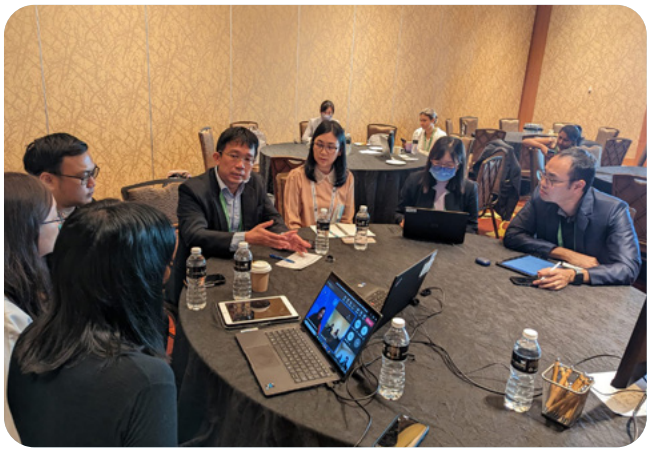
## Strategic Pillar 1: Engagements

# Communications

### One Health Communication Strategy: Promoting Awareness and Action

Drawing reference from World Health Organization's Joint External Evaluation, our One Health communication strategy aims to highlight the crucial links between human, animal, and environmental health through:

- Building robust risk communication systems.
- Fostering partnerships across sectors.
- Delivering clear public messaging.
- Engaging directly with communities.
- Addressing perceptions, risky behaviours, and misinformation.



Meeting between officers in One Health agencies with international counterparts to share lessons on multisectoral partnerships (Photo credit: One Health agencies).

**Here is how different groups will benefit:**

#### For the Public

- Learn practical ways to protect yourself, your pets, and our environment from diseases.
- Understand how your daily actions can contribute to a healthier Singapore.
- Access clear, reliable information to make informed health decisions.

#### For Academia

- Engage in innovative research that bridges multiple disciplines.
- Collaborate with diverse experts to solve complex health challenges.
- Contribute to evidence-based policies that improve public health.

#### For Industry

- Build capacity and capability for preparedness that addresses One Health challenges.
- Enhance corporate social responsibility for food safety, environmental health, animal health, and/or public health through One Health initiatives.

## We aim to enhance One Health communications in the following ways:

### Multi-sectoral Public Awareness Messaging

Develop and disseminate targeted One Health messages addressing contemporary issues to educate both the public and industry players. For example, messages highlighting the benefits of connection to nature with zoonotic disease risk awareness and prevention measures.

### Risk Communication Planning

Establish messaging guides and standard operating procedures (SOPs) for risk communications for emerging and endemic disease outbreaks as part of preparedness programmes. These can be quickly leveraged and adapted to engage the public with accurate, timely, and evolving information, and respond to concerns or misinformation.


One Health workshop on Monitoring and Evaluation (Photo credit: One Health Agencies).

## Strategic Pillar 1: Engagements

# Networking

### One Health Networking: Building Collaborative Engagements

In commitment to create a robust collaborative ecosystem, we are actively fostering One Health stakeholder networking, bringing together experts, organisations, and stakeholders from across various sectors to:

- Facilitate the exchange of expertise across disciplines.
- Address transboundary health issues comprehensively.
- Catalyse the development of innovative health solutions.
- Mobilise collective efforts to safeguard the interconnected health of humans, animals, and the environment.
- Enhance responsiveness to emerging health threats.
- Optimise knowledge and resource sharing.

Networking between academia and government at disease prioritisation workshop (Photo credit: One Health agencies).

### We aim to enhance One Health networks in the following ways:

#### Grow local and international networks and partnerships

Establish and build relationships with key local and international organisations through technical cooperation, allowing Singapore to learn, build multilateral cooperation, and expand capability and awareness.

#### Participate in global and regional Initiatives

We will actively profile Singapore's One Health initiatives through policy, scientific, academic, and public conferences and symposiums, and leverage them to demonstrate Singapore's position as a driving force in One Health.

#### Pursue alignment with key local and international platforms

Singapore will support and actively participate in the development of multi-stakeholder and multidisciplinary initiatives to achieve practical outcomes for One Health locally, regionally, and globally through engagement of public, academia, and industry partners.

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## Strategic Pillar 1: Engagements

# Leadership

Singapore is committed to fostering international collaborations in the One Health approach, recognising the interconnected nature of global health challenges across human, animal, and environmental sectors.

The 'Quadripartite' alliance, formed in 2022 at the 28th Tripartite Executive Annual Meeting, exemplifies high-level international cooperation in addressing One Health challenges. This partnership comprises:

### World Health Organization (WHO)

The WHO plays a key role in promoting One Health approaches at the international level, particularly in addressing global health challenges, coordinating responses to pandemics and emerging diseases, and advocating for collaborative efforts across human, animal, and environmental health sectors.

### Food and Agriculture Organization (FAO) of the United Nations

The FAO leads efforts to address food security, nutrition, and agricultural sustainability from a One Health perspective, recognising the interconnectedness of human health, animal health, and the environment in the context of food production and consumption.

### World Organisation for Animal Health (WOAH) previously known as Office International des Epizooties - OIE

The WOAH provides international leadership in animal health, promoting standards and guidelines that support the prevention and control of animal diseases, including zoonoses, and advocating for a One Health approach to veterinary public health.

### United Nations Environment Programme (UNEP)

The UNEP leads efforts to address environmental challenges from a One Health perspective, recognising the interconnectedness of human health, animal health, and the environment in the context of environmental conservation and sustainability.

It is relevant for Singapore to exercise leadership and stay engaged internationally to collaborate with partners towards common One Health projects and initiatives, facilitating the development of One Health capabilities and capacities in the region. Singapore can play a vital role in exercising thought leadership in regional organisations such as ASEAN, particularly in fields such as food safety.

**We will:**

- **Build Singapore's networks** with international organisations and other stakeholder groups, enabling us to share and learn from thought leaders on multi-sectoral One Health initiatives.
- **Contribute Singapore's experience to international One Health projects and technical cooperations**, establishing common ground with like-minded stakeholders and bringing various parties together for multilateral cooperation.

Photo credits: NParks

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# Case Study

## Wildlife health and its importance within One Health

The conservation of biodiversity and natural ecosystems is integral to the protection of wildlife health, and by extension, One Health. However, these are threatened by illegal wildlife trade across country borders and regulated and unregulated wildlife trade domestically. These activities increase the risk of disease transmission within the intersecting spheres of society, animal, wildlife, and environment, while also threatening natural ecosystems and biodiversity.

As part of Singapore's commitment to combat illegal wildlife trade and safeguard wildlife health, the Centre for Wildlife Forensics (CWF) – a National Parks Board (NParks) laboratory facility – has been designated as a WOAH Collaborating Centre for Wildlife Trade and Wildlife Health as of 29 May 2025. The Centre specialises in managing regional wildlife health threats such as those arising from both legal and illegal wildlife trade, through its wildlife forensics capabilities and expertise in wildlife trade supply chain. It works with WOAH and regional experts to promote a healthy human-wildlife-ecosystem interface by upholding biodiversity conservation and One Health principles.

**References:**
- Centre for Wildlife Forensics. (n.d.). National Parks Board.

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# Strategic Pillar 2 Sector Development

**Cultivating Partnerships and Education for One Health**

This section outlines our strategies for fostering sector development through two Objectives:

- **Partnerships:** Mobilise local and international partnerships with industry, professional, and community sectors to operationalise One Health principles and programmes.
- **Education:** Raise competencies through interdisciplinary training, delineating competencies, and identifying specific learning requirements for various roles and activities.

## Strategic Pillar 2: Sector Development

# Partnerships

### Industry engagement in One Health: Opportunities for Collaboration and Innovation

One Health activities offer significant benefits to various sectors, including the public, academia, and industry.

#### For the Public:

- Improved health outcomes through early detection of diseases.
- Better-informed decision-making about personal and community health.
- Increased awareness of the interconnections between human, animal, and environmental health.

#### For Academia:

- Expanded research opportunities in interdisciplinary fields.
- Enhanced potential for impactful publications and grant funding.
- Opportunities to translate research into practical applications.

#### For Industry:

- Improved risk management and biosecurity practices through capability-building efforts across sectors.
- Enhanced corporate social responsibility and public image.
- Access to new research and expertise.

### Two key areas of focus for partnerships across sectors are:

#### One Health Laboratories and Services

Industry can play a vital role in translating One Health surveillance and laboratory services into practical, real-world applications. There are significant opportunities for developing new technologies that enhance early disease detection capabilities. Furthermore, the creation of integrated laboratory networks across different sectors can greatly improve our ability to identify and respond to health threats quickly and effectively.

#### Partnerships with Professional and Industry Associations

Professional groups and industry partnerships are vital to advancing the One Health approach through information sharing, policy development, and standard-setting. These collaborations enable wider public outreach of reliable health information while leveraging unique perspectives and expertise for risk assessments and industry best practices.

Examples include:

- Waste management - Developing effective methods for waste disposal to minimise environmental contamination and disease transmission.
- Water quality monitoring - Ensuring clean water sources to prevent waterborne diseases affecting both humans and animals.
- Monitoring programmes - Farms and other animal-holding facilities monitor animal health for early detection of potential zoonotic diseases.

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## Strategic Pillar 2: Sector Development

# Education

### Developing the One Health Workforce: Education and Interdisciplinary Collaboration

The One Health workforce refers to a multidisciplinary and collaborative network of professionals from various fields working together to address health issues at the interface of humans, animals, and the environment. The workforce encompasses professionals in their fields: physicians, veterinarians, epidemiologists, ecologists, public health experts, environmental scientists, microbiologists, and policy makers, among others.

Education equips One Health workforce professionals with interdisciplinary skills and understanding of human-animal-environmental health connections, enabling collaboration across traditional disciplinary boundaries and innovative solutions to emerging health threats. Through public-industry-academia collaboration, we aim to:

- Foster rapid crisis response capabilities.
- Develop innovative solutions to complex challenges.
- Position Singapore as a One Health leader.
- Promote sustainable practices across domains.
- Empower individuals and organisations to contribute to safeguarding health across all interconnected life forms.

### A diverse community of frontline responders and workforce trained in One Health will be better prepared for outbreaks.

To achieve this, various sectors can contribute:

#### Public Engagement

- Participate in community workshops and seminars on One Health topics.
- Access online resources and courses designed for public understanding of One Health concepts.

#### Academic Contributions

- Develop interdisciplinary curricula integrating One Health concepts across various fields.
- Adapt the Competencies for One Health Field Epidemiology (COHFE) Framework (Figure 4) to enhance cross-sector collaboration in addressing health threats.
- Provide expert consultation to government and industry on One Health issues.

#### Industry Involvement

- Collaborate with Institutes of Higher Learning (IHLs) and government bodies to develop industry-specific One Health training programmes such as best farming practices in animal husbandry.
- Participate in One Health conferences and workshops to gain insights and share perspectives.
- Implement in-house training programmes on relevant One Health principles.
- Engage in joint research projects with academic partners.

# COHFE Framework

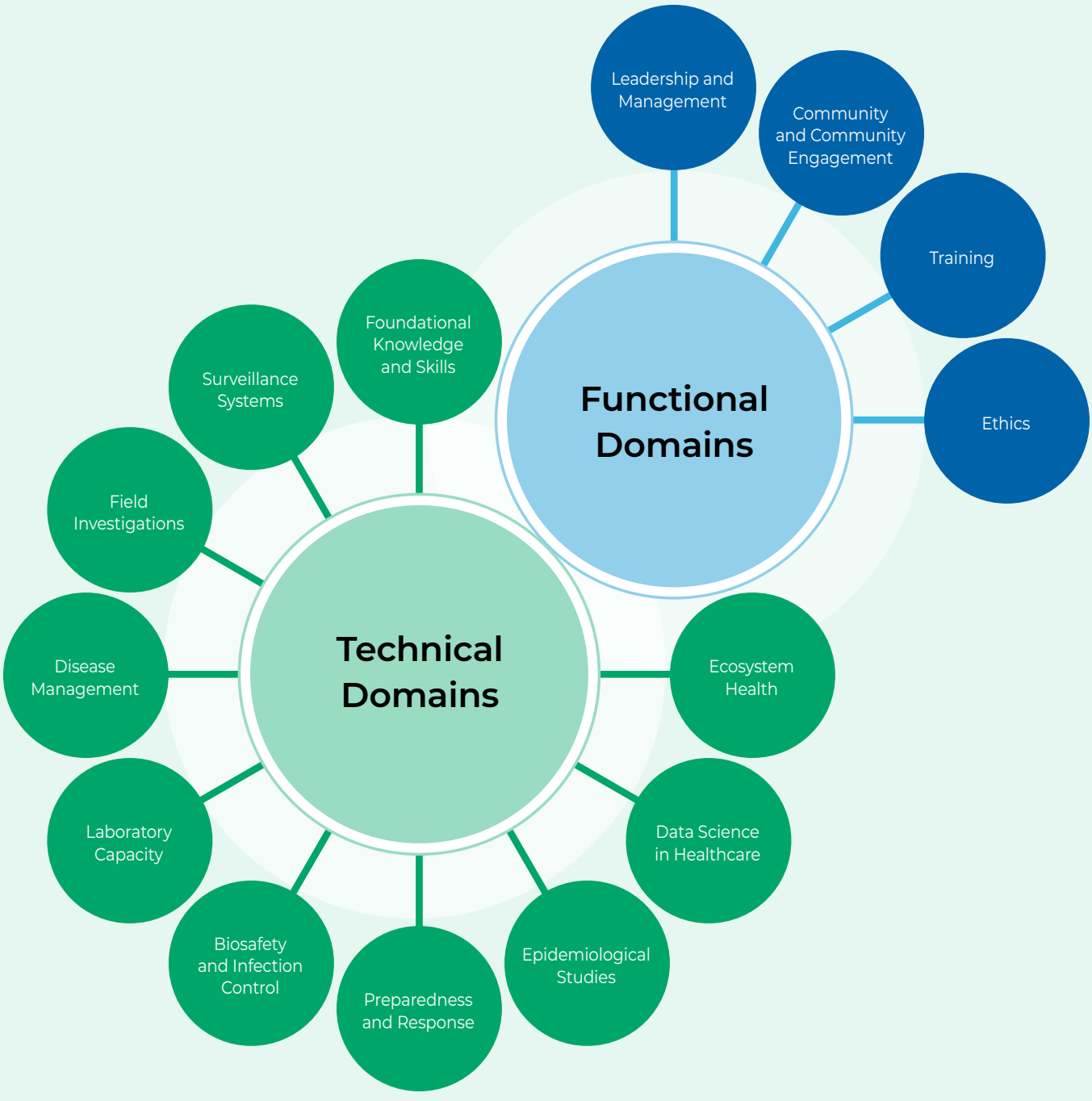


**Figure 4:**
Infographic depicting COHFE's framework listing competencies relevant for One Health in two domains

## One Health competencies include the following knowledge areas [6-8]:

### 1 Field epidemiology:

Skills in investigating disease outbreaks, conducting surveillance, and analysing health data in real-world settings across human, animal, and environmental domains.

It is a crucial competency that underpins many aspects of One Health work, providing the methodological foundation for investigating and responding to health issues at the human-animal-environment interface. It complements and enhances the other competencies by providing practical skills in data collection, analysis, and interpretation in real-world settings.

### 2 Systems thinking:

Understanding complex interactions between human, animal, and environmental health systems.

### 3 Cross-sectoral collaboration:

Ability to work effectively with professionals from diverse disciplines and sectors.

### 4 Communication and stakeholder engagement:

Ability to effectively communicate One Health concepts and engage diverse stakeholders.

### 5 Data management and informatics:

Skills in collecting, analysing, and interpreting data from multiple sources to inform One Health decision-making.

### 6 Risk assessment and management:

Ability to identify, evaluate, and mitigate risks at the human-animal-environment interface.

### 7 One Health policy and governance:

Knowledge of regulatory frameworks and policy-making processes relevant to One Health issues.

### 8 Zoonotic disease management:

Knowledge of diseases that can spread between animals and humans, and strategies to prevent and control them.

### 9 Environmental health assessment:

Skills in evaluating environmental factors that impact health across species, including urban/built environments.

### 10 Biosecurity and biosafety:
Understanding risks and implementing measures to prevent the spread of infectious agents.

### 13 Antimicrobial resistance:
Understanding the mechanisms, impacts, and strategies to address antimicrobial resistance across different sectors.

### 11 Wildlife health and conservation:
Understanding the role of wildlife in ecosystem health and disease transmission.

### 14 Climate change and health:
Recognising and addressing the health impacts of climate change on humans, animals, food production, and ecosystems.

### 12 Food safety and security:
Knowledge of food production systems and the interlinkages between the environment, agriculture and food production, and food safety and public health.


### 15 Contingency planning:
Ability to plan for, and respond to, contingencies related to priority zoonotic diseases and other health threats from a One Health perspective.

This comprehensive approach ensures that frontline responders and professionals across disciplines are well-prepared to address complex health challenges at the intersection of human, animal, and environmental systems.

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# Strategic Pillar 3 Insights

**Harnessing Research, Information, and Surveillance for One Health**

The Strategic Pillar on Insights leverages research, information, and surveillance to generate evidence-based strategies for safeguarding health in Singapore and beyond. This section outlines our approach to developing and utilising insights across three Objectives:

- **Research:** Prioritise and conduct multidisciplinary studies to address knowledge gaps and translate findings into actionable policies.
- **Data:** Share data across sectors to enhance decision-making and risk assessment capabilities.
- **Surveillance:** Improve monitoring and evaluation systems that span human, animal, and environmental health sectors for early detection and response to health threats.

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## Strategic Pillar 3: Insights

# Research

### Singapore's One Health research

The complexity of today's health challenges demands multidisciplinary research at the intersections of human, animal, and environmental health. Knowledge gaps can hinder effective interventions, and by prioritising One Health research, additional shared benefits include:

- Addressing knowledge gaps and optimising risk mitigation measures.
- Creating a robust research ecosystem contributing to science and technology competencies.
- Applying research findings to address local and regional public health risks.
- Positioning Singapore as a leading centre for One Health research and development.
- Contributing to international efforts in tackling global health challenges.
- Translating research into actionable policies and interventions, benefiting all sectors.

### One Health R&D

#### Research Priority Setting

We will identify and prioritise key One Health areas, aligning resources with pathways for translating findings into policies and actions. This approach emphasises a deeper understanding of interdependencies between human, animal, plant, and environmental health through a multi-disciplinary and collaborative approach between experts in all these fields. We will foster a tripartite solution between the government, academia, and industry to:

- Conduct research advancing understanding of human-animal-environment health interactions.
- Collaborate with industry and public health agencies to translate research into practical applications.
- Engage in joint research projects with academic partners to address One Health challenges in their field.

#### Research Collaboration

We will build upon existing centres of excellence in their respective domains to enhance research capacity and advance research collaborations in One Health areas aligned with our research priorities.

#### Mainstreaming One Health in research

We will establish and embed One Health, multidisciplinary research agendas within complementary research workstreams setting practical targets. Upon completion of research, translate results into actionable outcomes and disseminate findings to relevant stakeholders. Actively engage with agencies in pertinent One Health research projects and partnerships.

Photo credit: SFA

03

# Case Study

## Biosurveillance: Singapore's Cutting-Edge Defence Against Zoonotic Threats

Singapore's National Parks Board (NParks) is leading a S$15 million Biosurveillance Research Programme, part of Singapore's RIE2025 plan, to advance understanding of zoonotic diseases and develop evidence-based mitigation strategies.

This initiative exemplifies the integration of One Health principles in national research priorities. It brings together a diverse community of scientists from fields such as genomics, ecology, microbiology, and vector biology to address zoonotic disease threats. They are employing cutting-edge technologies like environmental DNA sampling and field-deployable sensors to monitor potential threats in real-time.

The research explores the interactions between urban development, animal behaviour, and disease transmission. As climate change and global travel heighten zoonotic disease risks, Singapore's biosurveillance programme underscores the significance of One Health collaboration in safeguarding human and ecological health in our interconnected world.

**References**:
• Biosurveillance Research Programme. (2025). Nparks.gov.sg.

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## Strategic Pillar 3: Insights

# Data

### One Health Shared Information

A comprehensive information strategy integrates data and insights across human, animal, and environmental health sectors through enhanced data inter-operability and collaboration, fostering a shared understanding and coordinated response to complex health challenges. This enables:

- Joint risk assessment and coordinated responses.
- Advanced analytics and modelling tools for risk mapping.
- Early warning systems for potential disease outbreaks.
- Fresh insights through collaborative interpretation.
- Data sense-making and prediction using existing IT structures.
- Holistic joint-risk assessments through effective data sharing.
- Joint interpretation of results and coordinated action planning.

### One Health Data Sharing and Integration

#### Joint Risk Assessment

We will establish and refine frameworks for risk assessments by conducting regular joint risk assessment exercises to evaluate emerging disease threats. Once completed, these assessments would be used to update preparedness and readiness measures for health security actions.

#### Information Integration

We will integrate epidemiological data for enhanced intelligence gathering and develop predictive models. This approach improves sense-making capabilities, enabling appropriate and timely responses to public health threats.

Photo credits: NEA

04

# Case Study

## Singapore's Zika Outbreak Management in 2023-2024

Singapore's management of Zika outbreaks in 2023-2024 highlighted the effectiveness of integrated surveillance and coordinated One Health response by sharing data across sectors.

The implementation of wastewater and mosquito testing, alongside case-based surveillance, enabled identification of areas with active transmission and informed targeted response measures.

In May 2023, following a cluster of infections in northeastern Singapore, the National Environment Agency (NEA) promptly deployed Zika virus (ZIKV) wastewater and mosquito surveillance in the affected area, complemented by nationwide wastewater monitoring for situational assessment. Positive ZIKV signals from wastewater and mosquito samples were detected only at the affected area and coincided with the peak in reported cases. In response, vector control measures were intensified locally, while alerts were issued to primary healthcare providers and the community to promote timely case-identification, personal protection, and prevention. The subsequent waning of signals suggested effectiveness of control measures.

In early 2024, persistent ZIKV signals in wastewater and mosquito samples were similarly observed following a reported Zika case. Targeted vector control measures were implemented, accompanied by a public advisory of the area of possible transmission.

Singapore's comprehensive strategy for managing Zika transmission demonstrates the effectiveness of integrating mosquito, wastewater, and clinical surveillance data through cross-sectoral sharing to inform targeted public health interventions. The approach exemplifies the adoption of a One Health framework in managing vector-borne diseases.

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## Strategic Pillar 3: Insights

# Surveillance

### One Health Surveillance

One Health surveillance integrates data from human, animal, and environmental health sectors through systematic collection, analysis, interpretation, and dissemination of health-related data and information from the various sectors. This coordinated approach enables:

- Early detection and response to complex health threats.
- Improved insights through aligned surveillance systems.
- Comprehensive understanding of upstream risks.
- Greater reassurance on zoonotic diseases and health hazards.
- Risk-based strategies for diseases emerging from unique specific animal hosts, microbial agents, and environmental changes.
- Targeted surveillance strategies for specific areas and ecosystems.
- Complementary data collection and analysis through cross-agency coordination.
- Efficient resource allocation and seamless information flow between all relevant stakeholders.

### We aim to enhance One Health surveillance systems in the following ways:

#### Surveillance and Laboratory Technologies

We will identify and develop One Health surveillance and laboratory systems with the capabilities for cross-sectoral use cases. Examples include regular sharing of novel laboratory techniques and methodologies for deployment across multiple purposes and disease investigations.

#### Collaborative Surveillance

We will enable multi-source and multi-sectoral surveillance systems to expand surveillance capacity, e.g., the deployment of wastewater surveillance technology for infectious disease detection and investigation (e.g. SARS-CoV-2, Zika, Mpox and AMR). Update disease investigation protocols and strengthen capacities for surveillance with an aim to increase sensitivity of disease surveillance systems.

#### Contingency Planning

Contingency plans for priority zoonotic diseases and other health threats can be updated and refreshed based on data captured via collaborative, cross-agency surveillance efforts.

Photo credit: SFA

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# Case Study

## Cross-Sectoral Surveillance and One Health Response to the GBS ST283 Investigation in Singapore

The 2015 Group B Streptococcus (GBS) ST283 outbreak investigation in Singapore exemplifies effective One Health surveillance through integrated laboratory systems and cross-sectoral collaboration. Clinical microbiologists at a tertiary hospital first recognised an unusual surge in severe GBS infections and initiated investigations with Singapore's public health authorities.

Singapore's response showcased seamless coordination between agencies through multi-disciplinary collaboration. By considering interconnections between human health (patient cases), animal health (fish sources), and environmental factors (food supply chains), authorities quickly identified ready-to-eat raw freshwater fish dishes as the infection source through data sharing and joint analysis.

The investigation demonstrated sophisticated cross-sectoral laboratory capabilities and partnerships, employing consistent molecular typing methods across human clinical, food, and environmental samples. Whole genome sequencing (WGS) enabled precise tracking of the GBS ST283 strain through the entire supply chain. This research approach revealed fish and water strains were nearly identical to clinical strains (0-2 SNPs difference), providing crucial transmission pathway evidence.

Through coordinated risk assessment and communication, authorities instituted regulations and educated the public to mitigate food safety risks associated with raw freshwater fish dishes, and instituted regulations to safeguard public health. The resulting regulatory changes significantly reduced cases, showing how One Health strategies create lasting community protection.

Singapore's leadership extended beyond initial response, expanding research to Southeast Asia through regional partnerships and networking. Singapore subsequently engaged with the Food and Agriculture Organisation to establish a global expert review, demonstrating how local clinical expertise drives international collaboration and creates enduring systemic improvements through education and knowledge transfer.

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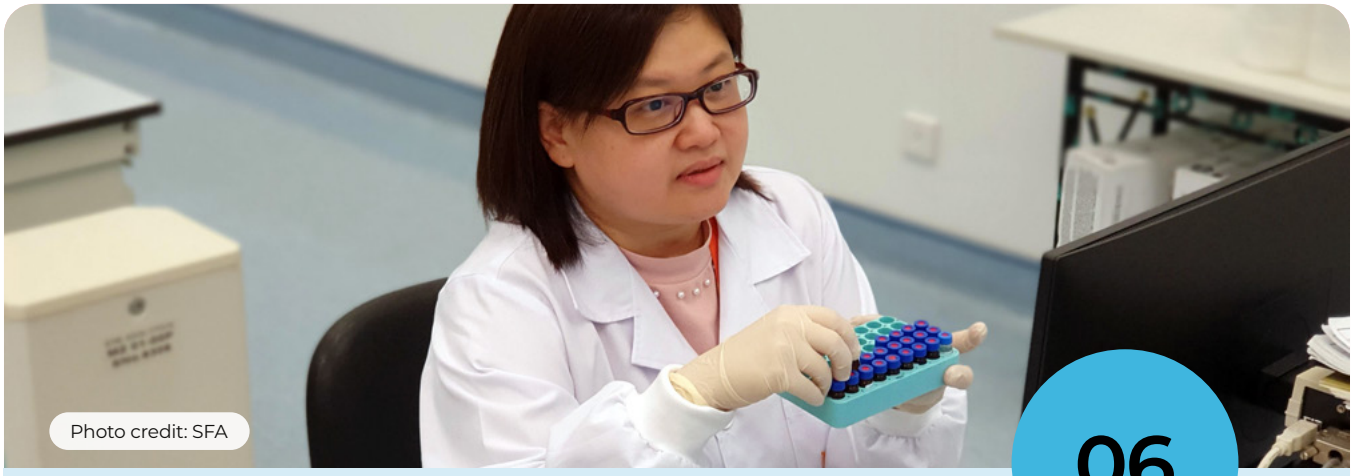

Photo credit: SFA

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# Case Study

## Multi-sectoral AMR surveillance capabilities

As Singapore's national animal health laboratory, the Centre for Animal & Veterinary Sciences (CAVS) plays a pivotal role in AMR surveillance and research. CAVS leads efforts to monitor AMR trends, detect multi-drug-resistant strains, and conduct risk analyses across the animal sector, including companion animals, wildlife, and farmed species. Through its established technical expertise and partnerships, CAVS has contributed to regional and international initiatives, such as the development of FAO AMR surveillance guidelines and research collaborations with global experts.

As Singapore's environmental public health laboratory, the Environmental Health Institute (EHI) conducts surveillance and risk assessment to understand the prevalence of AMR in both natural and built environments, across different environmental matrices such as air, surfaces, and water (such as wastewater and coastal waters), to determine levels and risks to public health. EHI has contributed to knowledge and capacity development through the provision of regional trainings and workshops.

As Singapore's national reference laboratory for food science, the Singapore Food Agency's National Centre for Food Science (NCFS) provides scientific evidence through laboratory testing, research, data science and exposure analysis, and risk assessment to ensure food safety. The NCFS monitors the AMR profile of common foodborne pathogens in food producing animal farms and in food products. The information gathered provides valuable insights into the development of AMR locally and helps SFA take appropriate precautionary measures.

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# A Whole-of-Society Endeavour

One Health is an approach that requires collaboration and partnerships across sectors, disciplines, and subsequently together with society as a whole. Singapore's One Health Master Plan is developed to guide our nation on its strategies to demonstrate our commitment to One Health locally and on the global stage.

Effective One Health initiatives will enhance Singapore's public health resilience and safeguard the health of Singapore collectively including animals and the environment. It identifies the various areas for stakeholders to contribute to this agenda and work together for the betterment of Singapore, our home.

Singapore is ready. We welcome all who share our vision of a One Health approach in creating a healthier future, for the generations of Singaporeans to come.

# Glossary

| Terms | Definitions |
|---|---|
| Emerging Infectious Disease | An infectious disease that is newly recognised in a population or geographic area but is rapidly increasing in incidence or geographic range. |
| Field Epidemiology | Application of epidemiological knowledge, skills, and competencies in surveillance of, and response to, urgent health challenges. |
| Health Resilience | Capacity to effectively prevent, prepare for, detect, adapt to, respond to, and recover from public health threats e.g., epidemics and pandemics |
| One Health | One Health is an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals, and ecosystems. It recognises that the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and interdependent (as defined by OHHLEP).<br><br>While the current focus of One Health threats is on infectious diseases, Singapore's framework can be leveraged to address other health threats at the interconnection between people, animals, and ecosystems. |
| One Health Network | An engagement (formal or informal) between two or more discrete organisations or entities, with representation from One Health sectors. This also can have co-benefits related to mitigating environmental or chronic disease risks, urban planning for health. |
| One Health Workforce | Responders who play a role in detecting, investigating, and responding to disease outbreaks, thus protecting health across all sectors using a One Health approach |
| Zoonotic Disease | An infectious disease that is transmitted between animals and people. |

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# References and Resources


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