

Project conducted in collaboration with The National Academies of Sciences, Engineering, and Medicine

COUNTERING ZOONOTIC SPILLOVER OF HIGH-CONSEQUENCE PATHOGENS IN SOUTHEAST ASIA

2024



INTRODUCTION



Introduction

Meghan Davis, Abhi Veerakumarasivam



The Guidebook, why?

To inform efforts to better understand the key factors that can contribute to zoonotic spillover in the context of the One Health approach, the INGSA-Asia Regional Chapter in partnership with the U.S. National Academies of Sciences, Engineering, and Medicine (NASEM) undertook a project to designed to help prevent and mitigate "zoonotic spillover" originating in the live animal supply chain in the Southeast Asia region.

Who wrote the Guidebook?

The guidebook project reflects the joint efforts of INGSA, NASEM, over the course of a three-year collaboration. The project incorporates data gathered during a two-year workshop series and consultation with dozens of experts. Each module is the result of a process led by volunteer module "co-leaders" and other technical subject matter experts. The names of the co-leaders are listed on the title page of each module. everyone who contributed to the project is listed in the front of the guidebook (and at the end of this handbook).

How to use this Guidebook

The guidebook is designed as an easy to use resource for those working to reduce the risk of zoonotic spillover in the region. The modules may be accessed in order or piecemeal, depending on the needs of the user. Readers who seek to gain an overall understanding of the issues and strategies for addressing them can read the guidebook in sequence from beginning to end. Readers who are facing specific challenges, such as how to address cross-border trafficking of wildlife, may prefer to access only specific modules or use this document to identify relevant reports and organizations that can provide assistance with their specific issue. Scan the QR code at the bottom of each page to read more!





GUIDEBOOK MODULES

01	Introduction	Meghan Davis, Abhi Veerakumarasivam

02	How the past informs the future: Opportunities in Southeast Asia to prevent	
	and respond to zoonotic spillover (Raina Plowright, Kelvin Lim)	
03	Efforts to prevent transboundary disease outbreaks in the Southeast Asia region (K. Yoganand, Dominic Travis)	
04	How to identify and characterize priority pathogens to guide efforts to address	
	zoonotic disease spillover (Hung Nguyen-Viet, Linda Saif, Malik Peiris)	
05	How to design and conduct risk-based surveillance for zoonotic diseases at the humar animal Interface (Meghan Davis, Samira Mubareka, Nur Firdaus Isa, Tan Cheng Siang)	
06	Strategies for engaging with diverse stakeholders across the live animal value chain to address risk (Nur Firdaus Isa, Dirk Pfeiffer)	
07	How to enhance zoonotic disease management by addressing knowledge gaps and implementation barriers (Yin Myo Aye, Wondwossen Gebreyes, Latiffah Hassan)	
08	How to use this guidance: Applying participatory methodologies to countering spillover (Elson Ian Nyl Galang, Jeff Peterson, Eri Togami)	



Raina Plowright, Kelvin Lim

This module addresses the pressing issue of zoonotic disease in the region and its overall impact on public health and other sectors. The module details how pandemic pathogens can infiltrate and proliferate within live animal supply chains (the eight steps to spillover), from reservoir hosts to wildlife trade to domesticated animals to humans. Effective interventions and real-life case studies discussed in this module help to identify and illustrate strategies to minimize pathogen persistence in live animal supply chains, especially those involving wildlife, as well as ways to reduce animal-human contact that could lead to spillover and protect individuals, particularly at risk. The goal of the module is to help the user develop semi-comprehensive strategies to address the challenges posed by zoonotic spillover events in the region in the context of the One Health approach.





Rat slaughter at a large market (left) and a rat vendor stall displaying live rats in cages in a large market (right) in Dong Thap province, October 2013. Source: Huong et al., 2020 © WCS Viet Nam.

Contents

- Global epicenter: Why Southeast Asia serves as a hotspot for emerging infectious diseases
- Biodiversity
- Wet markets, livestock farming, and food safety
- Socioeconomic factors
- Ecology
- Wildlife trade and trafficking
- Strengthening barriers: Defining zoonotic spillover and strategies for transmission control
- Pandemic prevention
- Protect humans at risk of infection
- Quick detection of spillovers upon entering human populations: monitoring & surveillance of people at risk



Conditions that cause allostatic overload, or stress, on animals.

Ways to prevent and mitigate zoonotic spillover

- Reduce persistence and amplification of a pathogen once it enters the wildlife trade.
- Control the pathogen contaminating the environment.
- Interspecies interactions: ways to reduce animal and human behaviours that increase exposure throughout the supply chain.
- Implementing regulations and enforcement measures to restrict wild animal sales in live animal markets.
- Improve hygiene standards and sanitation in live traditional markets to reduce the risk of zoonotic disease transmission.
- Market infrastructure and layout that increase disease transmission: High population-dense structures, stacked cages, and mixing of different animal species.
- Reduce probability of animals in allostatic overload throughout .



This module provides insights into the transformative potential of transboundary approaches to counter zoonotic spillover of high-consequence pathogens in the region. Recognizing that the implementation of control points cannot be achieved by a single discipline, ministry, or agency, this module emphasizes the need for collaborative efforts across the entire wild and domestic animal supply chain. Many global agreements and processes have been created to support domestic animal trade and minimize disease risk, while very few exist for wildlife. Wildlife trade often creates favourable conditions for the emergence and transmission of zoonotic diseases, leading to increased risks of epidemics at both regional and global levels. The module details solutions to address the interconnected goals of reducing biodiversity loss and sustaining public health.



Contents



Replica of illegal wildlife parts and products including rhino horns and tiger skulls on display at the Vientiane International Airport to educate travellers about the illegality of buying and carrying these products.

- Examination of the concept of 'transboundary' and its application to spillover risk reduction.
- Description of existing cases of transboundary collaboration to prevent spillover.
- Conceptualization of the wildlife trade as a transboundary system in the region and an examination of attempts to understand and regulate the system.
- Advocates for a transboundary approach to wildlife trade in Southeast Asia.



Rodents are commonly sold in local fresh markets along with fish, frogs, various insects, and vegetables in Lao PDR, such as at this organic market in Vientiane city.

Ways to improve transboundary collaboration

- Continue harmonizing language and methods across disciplines, countries, and regions to increase collaboration efforts on prevention and response.
- Continue connecting communities to national and regional strategies and networks to foster more participatory wildlife monitoring and health surveillance.
- Focus on fostering development and implementation of both high-level standards for and communitybased examples of bio-social models of wildlife trade risk assessment and management.

PATHOGENS

How to Identify and Characterize Priority Pathogens to Guide Efforts to Address Zoonotic Disease Spillover

Hung Nguyen-Viet, Linda Saif, Malik Peiris

The emergence and re-emergence of zoonotic diseases has been accelerating in the past 25 years. A majority of the agents responsible are RNA viruses from wildlife reservoirs spilling over directly or through intermediate animal hosts. The highlights of this module are the review and development of guidelines and important tools to identify and prioritize zoonotic pathogens in the region, especially those with pandemic potential, and their animal reservoirs, and the populations at highest risk. It presents case studies of potential new coronaviruses (CoV) that could emerge as WHO's 'Disease X', guidelines for biosafety and biosecurity measures, information related to high-impact zoonotic pathogens and a discussion of possible target animals to monitor for CoV zoonoses based on historic and case studies of spillback and secondary spillover of SARS-CoV-2.





SARS-CoV-2 in animals: new host reservoirs for secondary spillovers to human

Contents

- Background, introduction and historical context for emergence and re-emergence of zoonotic pathogens
- Prioritization of high-impact zoonotic pathogens with pandemic potential
- Common characteristics of pathogens with pandemic potential
- WHO 'Disease X' and pandemic preparedness
- Host reservoirs and intermediate hosts for emerging/reemerging human and porcine coronaviruses
- Spillovers, spillbacks, and secondary spillovers of SARS-CoV-2: analytical and in vitro predictors
- Case studies of spillback and secondary spillover of SARS-CoV-2
- Case examples of targeted animal reservoirs and intermediate or bridging host species to monitor for surveillance of zoonotic coronaviruses.
- Host reservoirs, spillover, and spillback for influenza A virus
- Surveillance, laboratory biosafety infrastructure and capacity, and national biosafety guidelines and regulations



Timeline of the emergence of CoVs in people or swine over the past millennium. (Keusch et al., 2022). Note: 'X' denotes future unknown 'Disease X'.

- To improve and promote biosafety and biosecurity of various agencies (ASEAN, CDC, WHO, etc) have described criteria, tools, and approaches to prioritize the high-impact zoonotic pathogens specific to each country in the region .
- Certain animal species can be used to monitor for zoonotic pathogen spillover at the human-animalenvironmental interface based on their susceptibility to the priority pathogens and the associated risk assessments (discussed in Module 5).
- Preparation for pandemics of unknown emerging zoonotic diseases (WHO disease X) can use agnostic detection methods (NGS, etc) as well as development or sourcing of broadly reactive pan-virus family vaccines and antiviral therapeutics.

SURVEILLANCE

How to Design and Conduct Risk-Based Surveillance at the Human-Animal Interface

Meghan Davis, Samira Mubareka, Nur Firdaus Isa, Tan Cheng Siang

The "Tripartite" collaboration between WHO, FAO, and WOAH has emphasized the imperative for coordinated surveillance systems to combat infectious diseases at the human-animal-environment interface. While traditional risk-based approaches are valuable, the incorporation of One Health principles enhances the effectiveness of surveillance and intervention strategies. This module promotes the combination of traditional surveillance methods with the engagement of communities in participatory surveillance approaches to foster improved reporting, accelerated detection, and enhanced response. This module also describes innovative initiatives such as mobile phone and community-led surveillance networks that demonstrate the potential for more local-level involvement in disease surveillance.



Contents

- One Health surveillance at the human-animal interface
- Syndromic surveillance
- Laboratory surveillance
- Seroepidemiological studies
- Environmental surveillance
- Event-based surveillance
- Risk-based approaches



This figure details how interactions among partner groups and iterative activities, risk assessment and decisionmaking using participatory approaches can improve disease surveillance. Within surveillance systems, disease reporting and laboratory networks may rely on established mandatory reporting requirements at multiple levels of governance or institutional structure, whereas syndromic surveillance may use emerging technologies, such as text data mining and artificial intelligence (AI)-based systems. Sampling programs may be part of established initiatives, such as occupational health surveillance, or may rely on clinical populations and research initiatives for some or all of the data.

- Methods developed for risk-based approaches can help prioritize resources and target high a priority areas and populations.
- Coordination of surveillance activities using human health, animal health, and environmental health bolsters pandemic preparedness.
- Re-purposing and/or maintaining existing diagnostic capacity and broad virologic assays can be employed to detect emerging zoonotic threats.
- Engagement of experienced stakeholders can identify how people are in direct or indirect contact with animals and animal products.
- Interoperability of One Health data will be essential to increase preparedness.

STAKEHOLDERS

Strategies to Engaging Diverse Stakeholders Across the Live Animal Value Chain to Address Risk

Nur Firdaus Isa, Dirk Pfeiffer

This module elaborates on the process of identifying and engaging a wide range of stakeholders, from individuals and local communities to broader populations, who play pivotal roles in creating, assessing, and managing risks across both domestic and wild live animal value chains. The module highlights critical points of contact facilitating transmission of zoonotic diseases and explores various stages of the animal and animal products value chain, offering a set of culturally tailored, collaborative, and interdisciplinary solutions and recommendations to combat zoonotic disease spillover. The approach advocated within this module offers a holistic, collaborative, and inclusive perspective on zoonotic disease management, that could benefit populations throughout the region and beyond.





The figure shows the sequence of processes along a value chain from input to consumer associated with livestock-derived commodities

Contents

- The animal and animal products value chain within Southeast Asia: Structure and Components
- General stakeholder mapping activities and engagement best practices
- Establishing trusted networks in a fragmented system
- Critical points of contact between humans and animals in the value chain in Southeast Asia and associated complex risk factors
- Small-scale agrarian socio-economy and zoonotic disease risks in Southeast Asia



Example of an Animal Value Chain for the Poultry Food System

- Recognizing and understanding the multifaceted local contexts and their impact on pandemic risks is the foundational step towards crafting effective risk mitigation strategies.
- The engagement of a wide set of stakeholders is imperative to foster co-production of knowledge that empowers them to take ownership of the interventions.
- The dynamic nature of socio-ecological systems can be used to design creative solutions to the prevention of zoonotic spillover.

BARRIERS

How to Enhance Zoonotic Disease Management by Addressing Knowledge Gaps and Implementation Barriers

Yin Myo Aye, Wondwossen Gebreyes, Latiffah Hassan

This module discusses practical actions to address technical, coordinated, collaborative, and institutional challenges that hinder the effective implementation of One Health integrative public health strategies. It is structured around nine key barriers and actionable plans to address these barriers within the summarized framework for enhancing resilience against zoonotic disease threats in the region. Several case studies are included to illustrate how individuals and organizations have overcome barriers and improved outcomes. The cases span local, national, and regional interactions, emphasizing an integrated approach for preventing and mitigating zoonotic spillover.





This figure shows the nine key barriers and gaps to fill to prevent zoonotic spillover.

Contents

- Resource constraints
- Operationalizing One Health
- Communication, collaboration, and coordination
- Data management, sharing, and security
- Transboundary disease surveillance
- Human behavior and consumption
- Workforce and human capacity development
- Laboratory capacity and biosafety
- Engagement of commercial entities



One Health operational framework. Source: NASEM spillover Workshop, Singapore, 2023

- Harmonizing activities across diverse sectors and agencies responsible for human health, domestic and wild animal health, and environmental health can lead to coordinated action and improved outcomes.
- Efficient resource allocation is essential to overcome inadequacies and variation, such as weak and varied surveillance systems, services, research-conducting transboundary, cross-country comparisons as well as substantial underreporting of diseases.
- Expertise pooling can be accomplished by sustaining a reservoir of skilled professionals adept at addressing the interface of human, animal, and environmental health in the region.

PARTICIPATORY-

Applying Participatory Methodologies to Countering Zoonotic Spillover

Elson Ian Nyl Galang, Jeff Peterson, Eri Togami

The cultural, social, economic, environmental, and political contexts of the country, region, or organization must be carefully accounted for when seeking to develop useful and effective guidelines. This is particularly essential for the richly diverse Southeast Asia region. Modules 2-6 discuss strategies to improve current and future practices and policies related to One Health and zoonotic spillover. Essential to any improvement is a change in human behaviour. This module details 'participatory approaches' to engage diverse actors across all points of the live animal value chain. Such approaches to implementation not only ensure a more holistic and contextualized process but can pave the way to better ownership, salience, and legitimacy of the outcomes of implementation. The module outlines the key components of the participatory approach implementation process, including how to take into account cultural, social, economic, political, and environmental contexts, and how to recognize and respect the characteristics of the people involved. (The development of this quidebook used several of the participatory approaches that are described).

Finally it illustrates the necessity of a blend of methodologies, including implementation science, participatory research, and other social sciences to improve the uptake of the spillover prevention methods and outcomes.





Different levels of human organizational structures.

Contents

- Context from multiple levels
- Characteristics of the people engaged
- A participatory approach to implementation
- Practical ideas on how to foster genuine engagement
- Characteristics of best policies and practices
- Best strategies for implementing zoonotic prevention measures
- The vision of a participatory approach to implementation



Characteristics of a successfully implemented guideline

Strategies for Implementing Zoonotic Prevention Measures

- Keep messages simple
- Focus on compatibility across sectors
- If it works, make sure the results are plain to see
- Develop guidelines that include practices and policies that are going to be perceived as 'better' than what is currently in place.
- Ensure 'low risk' by allowing for the possibility that practices and policies are flexible according to circumstances and that adopters can "back out" of their commitments

Countering Zoonotic Spillover of High-Consequence Pathogens (HCP): Workshop Series Organizing Committee Members

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NASEM and INGSA Data Gathering Workshops

Workshop #1 (Virtual, over VTC) May 2022

Workshop #2 (Virtual, over VTC) July 2022

Workshop #3 (In person, Bangkok) September 9-11, 2022

Workshop #4 (In-person, Singapore) November 11-13, 2022

Workshop #5 (In-person, Kuala Lumpur) June 1-3, 2023

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