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HEALTH SECURITY IN THE INDO-PACIFIC

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Abbreviations and acronyms

ABBREVIATION	DEFINITION
ACT	Artemisinin-based combination therapy
ADB	Asian Development Bank
AIDS	Acquired immunodeficiency syndrome
AIP-EID	Australia Indonesia Partnership for Emerging Infectious Diseases
AMR	Antimicrobial resistance
AMU	Antimicrobial use
APEC	Asia Pacific Economic Cooperation
APSED III	Third Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies
ASEAN	Association of Southeast Asian Nations
ASF	African swine fever
BSL	Biosafety level
BWC	Biological Weapons Convention
CAHW	Community Animal Health Worker
CDC	United States Centers for Disease Control
DALY	Disability-adjusted life years
DFAT	Australian Government Department of Foreign Affairs and Trade
DTP	Diphtheria-tetanus-pertussis
EMPRES	Emergency Animal Prevention System
eNHIS	electronic National Health Information System
EOC	Emergency Operations Centre
ESCAP	Economic and Social Commission for Asia and the Pacific
EWARS	Early Warning, Alert and Response System
FAO	Food and Agriculture Organisation of the United Nations
FAO-RAP	Food and Agriculture Organisation of the United Nations Regional Office for Asia and the Pacific
FETP	Field Epidemiology Training Program
FETPV	Field Epidemiology Training Program for Veterinarians
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GHSA	Global Health Security Agenda
GLASS	Global Antimicrobial Resistance Surveillance System
GMS	Greater Mekong Subregion

ABBREVIATION	DEFINITION
GOARN	Global Outbreak Alert and Response Network
HCAI	Healthcare-associated infections
HIV	Human Immunodeficiency Virus
HPAI	Highly pathogenic avian influenza
IHR	International Health Regulations
ILRI	International Livestock Research Institute
IMS	Incident Management System
IPCHS	Indo-Pacific Centre for Health Security
JEE	Joint External Evaluation
MDR-TB	Multidrug-resistant tuberculosis
MERS-CoV	Middle East Respiratory Syndrome Coronavirus
MRSA	Methicillin-resistant Staphylococcus aureus
NGO	Non-government organisation
NHSP	National Health Sector Planning
NPHL	National Public Health Laboratory
NTD	Neglected tropical disease
OECD	Organisation for Economic Cooperation and Development
ODA	Official development assistance
OIE	World Organisation for Animal Health
PDP	Product development partnership
PHEIC	Public Health Emergencies of International Concern
PHEPRP	Public Health Emergency Preparedness and Response Plan
PPHSN	Pacific Public Health Surveillance Network
PSSS	Pacific Syndromic Surveillance System
PVS	Performance of Veterinary Services
SAGE	Strategic Advisory Group of Experts
SARS	Severe acute respiratory syndrome
SDG	Sustainable Development Goals
SEARO	South-East Asia Regional Office of the World Health Organization
SMS	Short message service
SOP	Standard Operating Procedure
SPC	Secretariat of the Pacific Community
TB	Tuberculosis
TEPHINET	Training Programs in Epidemiology and Public Health Interventions Network
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
WPRO	World Health Organization Regional Office for the Western Pacific

Foreword

The Australian Government Indo-Pacific Centre for Health Security administers the Australian Government health security initiative, and supports change and innovation in health security policy and practice in the Indo-Pacific region. The Centre is working with country partners and other stakeholders, and investing in health systems research, product development, workforce and laboratory capacity building, and disease surveillance.

To support planning, coordination, and monitoring and evaluation of investments to strengthen health security in the Indo-Pacific region, this report provides an overview of health security threats in the region, and the capacity of countries to prevent, detect and respond to these threats. Evaluation of health security capacity is based largely on preparedness for health emergencies, progress towards implementing the International Health Regulations and progress towards strengthening veterinary services. This report also considers the extent of cross-sectoral and cross-disciplinary coordination.

The report focuses on countries that are recipients of official development assistance (ODA) from the Australian Government in Southeast Asia and the Pacific. Southeast Asian countries comprise Cambodia, Indonesia, Laos, Myanmar, the Philippines, Timor-Leste and Vietnam. Pacific region countries comprise Cook Islands, the Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Papua New Guinea, the Republic of Palau, the Republic of the Marshall Islands, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu.

This report is intended to provide an evidence base and reference for countries in the Indo-Pacific region, as well as partner countries and organisations taking action to strengthen health security regionally and globally. It is intended to inform the development of policies and programs, support cross-sectoral communication on health security, and maintain momentum for regional action to avoid and contain health security threats.

Executive summary

Health security is here defined as the avoidance and containment of infectious disease threats with the potential to cause social and economic harms on a national, regional or global scale (1). It is a regional and global public good that provides benefit to all members of society and is central to the achievement of many of the Sustainable Development Goals (SDGs). Health security goes beyond the domain of human public health: animal health is integral to health security, given that the majority of emerging diseases in humans are of animal origin (i.e. zoonoses), and transboundary animal diseases pose a threat to food security.

The recent emergence and spread of novel or resurgent infectious diseases raise global concerns about health security. In 2002–03, the emergence and rapid international spread of severe acute respiratory syndrome (SARS) had a global economic impact estimated at US\$40 billion (2). In 2009, the H1N1 influenza pandemic caused an estimated 18 450 deaths in 214 countries (3). Weak health systems contributed to the devastating multi-country Ebola virus disease outbreak in West Africa in 2014–15. These and other events provide stark evidence of global vulnerability to health security threats posed by infectious diseases.

The Australian Government's Health Security Initiative for the Indo-Pacific region, launched by the then Minister for Foreign Affairs in October 2017, is a 5-year initiative designed to strengthen health security in the Indo-Pacific region and support an Australian contribution to global health security. The Indo-Pacific Centre for Health Security, which administers the Initiative, commissioned this report to assess the current state of health security in the Indo-Pacific region, with a particular focus on Southeast Asia and the Pacific island countriesⁱ. Incorporating evidence from a range of sources, it highlights health system capacities and vulnerabilities and provides an evidence base to strengthen health security in the Indo-Pacific region.

The report is divided into three main parts. Part 1 provides an overview of health security in the region, including drivers of disease emergence, high-risk pathogens and the current burden of infectious diseases. Part 2 summarises the most recent published information on health security preparedness, drawing on evidence from Joint External Evaluations (JEE), Performance of Veterinary Services (PVS) evaluations, State Party annual self-assessments, reports of scoping missions commissioned by the Indo-Pacific Centre for Health Security, and other documentsⁱⁱ. Part 3 describes how health security can be improved, based on the information in Parts 1 and 2. Cross-cutting themes include gender, disability and climate change.

ⁱ The focus countries are Cambodia, Indonesia, Laos, Myanmar, the Philippines, Timor-Leste and Vietnam (Southeast Asia); and Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Papua New Guinea, Republic of Palau, Republic of Marshall Islands, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu (Pacific). All are eligible for Official Development Assistance.

ⁱⁱ Scoping missions commissioned by the Indo-Pacific Centre for Health Security involved Cambodia, Fiji, Indonesia, Laos, Myanmar, Papua New Guinea, the Philippines, Samoa, Solomon Islands and Vietnam.



Senior midwife attends to her malaria and primary health patients by motorbike. This is often the only mode of transport for the uneven roads she has to use to reach her remote communities in the Thanintharyi region, southern Myanmar. 2011.

Priority pathogens and diseases

In the Indo-Pacific region, the highest burden of disease is attributable to lower respiratory tract infections (4). Tuberculosis (TB) is the infectious disease with the second highest burden in Southeast Asiaⁱⁱⁱ, and multidrug-resistant TB is spreading throughout the region (4,5). Diarrhoeal diseases, neglected tropical diseases, HIV infection and malaria are also high-burden diseases across the Indo-Pacific region; artemisinin-resistant malaria is a particular problem in the Greater Mekong subregion^{iv} (6,7). The incidence of dengue fever is increasing, particularly in the Pacific, where a 21% increase in incidence was reported from 2013 to 2017 (4). Alarming, the incidence of measles in Southeast Asia has increased by nearly 20% in the past 5 years, related to low and declining vaccine coverage (4). Some infectious diseases – such as dengue, malaria and diarrhoeal diseases – are climate sensitive, which means that they may increase in incidence, or spread to new areas, as a result of climate change. Poor control of endemic infections may also give rise to antimicrobial resistance (AMR). Endemic zoonotic diseases accorded priority for action in the region include brucellosis, leptospirosis, rabies, anthrax, avian influenza and bovine TB.

High-risk diseases include emerging and re-emerging infectious diseases that have epidemic potential and associated high morbidity or mortality. Recent examples of high-risk diseases in the Indo-Pacific region include outbreaks of chikungunya, Nipah virus infection, SARS, highly pathogenic avian influenza and Zika virus infection. The 6-month Zika virus outbreak in French Polynesia in 2013–14 highlighted the potential of emerging diseases to spread rapidly and affect large numbers of people – the outbreak spread to the farthest archipelago only 6 weeks after it started and affected an estimated 32 000 people (11.5% of the country's population), with severe sequelae such as Guillain-Barré syndrome and microcephaly (8).

Current regional capacities

Assessments of countries' core health security capacities are carried out using the World Health Organization's JEE and State Party annual self-assessment tools – structured to assess compliance with the legally binding 2005 International Health Regulations (IHR) – and the World Organisation for Animal Health's (OIE) PVS evaluation framework. In the Indo-Pacific region, seven focus countries have completed JEEs, 10 countries have completed PVS evaluations, and five countries have completed both a JEE and a PVS evaluation^v. Only one JEE has been carried out in the Pacific to date, in the Federated States of Micronesia. Available evidence from the JEEs, PVS evaluations and State Party annual self-assessments indicate a substantial need to strengthen countries' capacity to prevent, detect and respond to health security threats. These findings are reinforced by recent scoping missions carried out for the Indo-Pacific Centre for Health Security.

ⁱⁱⁱ Using disability-adjusted life years (DALYs) as the measure of burden.

^{iv} According to the World Health Organization, artemisinin-resistant malaria has been reported from five countries in the Greater Mekong subregion: Cambodia, Laos, Myanmar, Thailand and Vietnam.

^v The seven focus countries in the Indo-Pacific region that have completed JEEs are Cambodia, Federated States of Micronesia, Indonesia, Laos, Myanmar, Timor-Leste (as yet unpublished) and Vietnam. The 10 countries in the Indo-Pacific region that have completed a PVS evaluation are Cambodia, Fiji, Indonesia, Laos, Myanmar, Papua New Guinea, the Philippines, Timor-Leste, Vanuatu and Vietnam. The five countries that have completed both a JEE and a PVS evaluation are Cambodia, Indonesia, Laos, Myanmar and Vietnam.

PREVENT

National legislation, policy and financing: In most Southeast Asian countries and some Pacific Island countries, basic legislation relevant to health security is largely in place, although legislative frameworks need updating in some countries, and compliance and enforcement need strengthening. Of the six countries in the Indo-Pacific region for which published JEE reports are available, five (83%) have evidence of national legislation, policy and financing that is sufficient for IHR implementation (9–14). Legislation for animal health is less well developed or enforced than public health law.

Antimicrobial resistance: Initiatives to reduce the risk of emergence and spread of AMR, such as the development of national guidelines for healthcare-associated infections, have been launched, but there is a clear need to strengthen AMR surveillance and antimicrobial stewardship.

Biosecurity and biosafety: Of the six countries in the Indo-Pacific region with published JEE reports, all have ‘limited capacity’ or ‘developed capacity’, indicating that this area requires strengthening to fully achieve this competency.

Immunisation: Countries in the Indo-Pacific region demonstrate strengths in immunisation capacity, but most countries have not reached or maintained high levels of vaccination coverage. Vaccination coverage is declining in some countries, and vaccine hesitancy is an emerging threat.

Points of entry: Designated points of entry to countries in Southeast Asia generally have access to trained personnel and appropriate medical services, including diagnostic facilities, for rapid assessment, care and transportation of ill travellers. However, most points of entry in the Pacific Island countries are not fully compliant with IHR requirements (15). High volumes of trade and informal animal movements across international land and sea borders pose a risk for spread of animal diseases and zoonoses.

Zoonotic diseases: Throughout the Indo-Pacific region, capacity of human health and animal health services to prevent and respond to zoonotic diseases is limited, and there is little evidence of One Health approaches being implemented. Additional capacity and coordination are also required to manage risks to food safety.

DETECT

National laboratory systems: Across the Indo-Pacific region, laboratory capacity to detect priority diseases of humans and animals is highly variable. Although there are some accredited and/or internationally recognised referral laboratories in the region, many national laboratories are not yet able to test for priority pathogens. Laboratory testing for detection of priority diseases scored as having ‘demonstrated capacity’ in four or the six JEE published reports^{vi} in the Indo-Pacific region; however, other laboratory components of the JEE did not score as highly. Financial, policy and logistical constraints often impede the collection and submission of samples for laboratory diagnosis.

Real-time surveillance: The quality of indicator and event-based surveillance in public health is generally good in Southeast Asia, and some countries are enhancing the timeliness of their surveillance systems through innovative technologies. Based on the JEE from the Federated States of Micronesia, as well as the Member State self-assessments and recent scoping missions in the Pacific, the quality of surveillance systems varies considerably in the Pacific, and generally does not meet IHR requirements. With the exception of Indonesia, animal health surveillance capacity in most countries in the region is very limited, particularly in the Pacific.

Workplace development: Field epidemiology training programs (FETPs) exist in a number of countries in the Indo-Pacific region, including Cambodia, Indonesia, Laos, Papua New Guinea, the Philippines and Vietnam. The often-cited target of at least one FETP graduate per 200,000 population^{vii} has been met in Laos and Papua New Guinea only. This means that there are still not enough trained epidemiologists in most countries, and other gaps in the health workforce remain. There are acute workforce shortages in human health and animal health at the local level, particularly in the Pacific.

^{vi} The four countries that scored a 4 (i.e. demonstrated capacity) against the IHR core capacity of ‘laboratory testing for detection of priority diseases’ were Cambodia, Federated States of Micronesia, Indonesia and Laos. Vietnam and Myanmar scored a 3 (i.e. developed capacity).

^{vii} The Global Health Security Agenda has set a target of at least one FETP graduate per 200 000 population to ensure that countries have an adequate workforce to systematically cooperate to meet IHR core competencies.

RESPOND

Preparedness: Most countries have developed preparedness and response plans for health security threats, but few of these plans constitute an effective multi-hazard plan. Of the six published JEE reports from the Indo-Pacific region, development and implementation of national multi-hazard plans scored as having no, limited or developed capacity in five countries (all in Southeast Asia).

Emergency response: Several countries have established emergency operations centres (EOCs), although further efforts are required to strengthen coordination, resourcing and information sharing across EOCs. Response capacities of many countries have not been adequately tested through drills, simulations or after-action reviews at health facilities and ports of entry.

Linking public health and security authorities: Some countries have made progress in strengthening the links between public health and security agencies, but information sharing is not standardised between agencies or between countries.

Risk communication: Across the region, there are critical gaps in risk communication that weaken the capacity of countries to effectively engage with populations at risk and the wider public in the event of health security threats, particularly in the Pacific. Many Pacific Island countries have remote, dispersed populations, with limited communication infrastructure in the outer islands.

GENDER EQUALITY AND SOCIAL INCLUSION

Sex differences and gender norms affect vulnerability and exposure to infectious diseases, access to health care (including diagnosis, treatment and ongoing care), treatment outcomes and sequelae of disease. Pregnancy is one example where women may be more susceptible to infectious diseases; in the 2009 H1N1 influenza pandemic, women in the third trimester were particularly at risk (16). Women may also be at higher risk of contracting an infectious disease as a result of labour differences (e.g. women may be more likely to keep small, backyard farms) or gendered roles (e.g. caring for the sick). High-level frameworks exist to address gender equality in the context of health security (17–19); however, application of these frameworks varies across the region and additional efforts are needed to fully implement these frameworks in programs at the national level.

One of the key challenges in the Indo-Pacific region is the limited data on how health security affects men and women differently, as well as other groups such as people with disabilities. There is further scope to include indicators for social inclusion – including gender, disability and language group (as a proxy for ethnicity) – in health security assessments, and ensure that frameworks, tools and actions to improve health security are inclusive of women and girls, people with disabilities and other marginalised groups. Collecting sex-disaggregated surveillance data, including pregnancy status for women, is an important activity for all countries to increase understanding of the impact of sex and gender on health security. In addition, inclusion of women and other marginalised groups in health security forums is an important step forward.

STRENGTHENING HEALTH SECURITY

In many countries of the region, financing arrangements for core functions relating to public health, animal health and environmental health are inadequate or unsustainable. Countries often rely heavily on financing and technical assistance from external sources for infectious disease control programs. International organisations and bilateral partners continue to play a key role in filling critical funding gaps, building sustainable capacity, and maintaining regional and global momentum toward increased IHR compliance.

However, rising per capita incomes will see some countries in the region losing access to important international funding streams that currently support major disease control programs. This will necessitate a transition to expanded domestic financing, increased use of ‘blended’ financing models that allow access to international financing for health sector investments on concessional terms, and strategic support from bilateral partners to ensure that critical health security deficits are addressed. Regional sharing of resources and institutional capacity has the potential to improve the efficiency and effectiveness of regional and national investments in health security.

Operationalisation of One Health frameworks will be critical to avoid fragmented planning and implementation of measures to address health security threats. In most countries, high-level commitments to One Health have not yet translated into routine and functional collaboration between human health and animal health authorities. There is considerable scope for coordination and joint development of resources, such as laboratories and FETPs, to efficiently improve core capacities in the human health and animal health sectors.

PART

01

Overview of health
security threats



Overview of health security

What is health security?

Health security is a national, regional and global public good. The Australian Government Indo-Pacific Centre for Health Security defines health security as the 'avoidance and containment of infectious disease threats with the potential to cause social and economic harms on a national, regional or global scale'. This definition encompasses high-burden infectious diseases with significant social or economic impact, as well emerging infectious diseases, antimicrobial resistance and outbreak-prone diseases.

The emergence and spread of new infectious diseases can threaten health security, particularly those with a high mortality rate that can be readily transmitted between people. Many common infectious diseases are becoming increasingly difficult to treat as a result of antimicrobial drug resistance. Accidental or intentional release of biological agents constitutes another health security threat. Health emergencies can also arise following natural disasters, when disruption of essential infrastructure and services can lead to outbreaks of waterborne diseases such as cholera, or vaccine-preventable diseases such as polio.

Although the concept of health security is often narrowly focused on infectious disease outbreaks and other acute public health events that transcend international boundaries (20), improving the prevention and control of endemic high-burden infectious diseases can strengthen the capacity of health systems to prevent, detect and respond to outbreaks and other health emergencies. Advancing health security and achieving universal health coverage are mutually supportive goals that contribute to building resilient health systems overall (21). For example, achieving universal coverage of key immunisation programs can prevent disease outbreaks, and preventing health security threats can ensure that healthcare workers are able to focus on providing safe and effective routine health care (21). Cost-effective infectious disease control also contributes to the overall economy of regions and countries.

A One Health approach is integral to achieving health security. One Health recognises the interconnectedness of risks to health security at the human-animal-environment interface, and the importance of multisectoral and multidisciplinary efforts to address these risks. Since the mid-20th century, 60% of emerging infectious diseases have originated in animals (zoonoses) and over 70% of all zoonotic emerging infectious diseases originated in wildlife (22). Emerging zoonoses have been responsible for some of the most severe global health crises of the past century, such as severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS), pandemic influenza, highly pathogenic avian influenza (HPAI) and Ebola virus disease. Endemic zoonotic diseases include rabies, anthrax and salmonellosis, which can cause severe disease and death in animals and people.

Why health security matters

IMPACTS OF PANDEMICS THROUGHOUT HISTORY

Pandemic infectious diseases have had a major impact on human history. The 1347–1351 pandemic of the plague, a disease caused by infection with the zoonotic bacterium *Yersinia pestis*, spread from central Asia throughout Europe, the Middle East and east Asia over 4 years along trade and travel routes. What became known in Europe as the 'Black Death' killed up to 200 million people across Eurasia.

As the global population, international travel and trade have increased, the risk of emergence and rapid international spread of infectious diseases has become a major global concern. The 1918–20 influenza pandemic, commonly known as the 'Spanish flu', infected an estimated 500 million people in all regions of the world. The pandemic had a very high impact because it had a high case fatality rate and spread between people very effectively. Up to 5% of the world's population at the time were thought to have died from Spanish flu. Another two pandemic influenzas emerged in the 20th century: the 'Asian flu' in 1957–58, which killed up to 2 million people worldwide, and the 'Hong Kong flu' in 1968–69, which may have killed as many as 4 million people. Human immunodeficiency virus (HIV) first emerged as a zoonotic disease in the early 20th century in central Africa. Starting in the 1980s, HIV emerged as a global pandemic spread primarily as a sexually transmitted infection. More than 35 million people have died from acquired immunodeficiency syndrome (AIDS) resulting from HIV infection and a similar number are living with HIV today.

DEVELOPMENT AND IMPLEMENTATION OF THE INTERNATIONAL HEALTH REGULATIONS (2005)

SARS was the first major health security event of the 21st century. SARS was caused by a novel coronavirus that is thought to have emerged from an animal reservoir in southern China in 2002. Although the total number of people infected with SARS globally (8096 cases and 774 deaths) was low compared with previous pandemics (23), SARS rapidly spread to 26 countries in 2003 and had an estimated global economic impact of US\$40 billion (2). The rapid international spread of SARS alerted the global health community to shortcomings in international capacities and frameworks to respond to novel infectious diseases with pandemic potential. Partly in response to the SARS pandemic, the World Health Organization (WHO) led a major global effort to revise the International Health Regulations that had been in place since 1969, to support the global community to more effectively prepare for a wide range of existing and emerging global health security threats.

The International Health Regulations (2005) (hereafter IHR), are an international legal instrument that are binding on 196 countries, including all WHO Member States. The IHR were adopted at the 58th World Health Assembly on the 23 May 2005 and entered into force on the 15 June 2007. The IHR provide a framework to prevent, detect and respond to health security threats of international concern. The IHR emphasise infectious diseases threats, and also address biological, chemical and radionuclear events. State Parties are required to work towards full implementation of the IHR, including developing core capacities for laboratories, surveillance, human resources, preparedness, response, risk communication and points of entry.

They are also required to develop and implement national legislation, policy and financing to achieve coordinated IHR implementation. The IHR mandate that State Parties must report to WHO any events that may constitute a public health emergency of international concern. In turn, the WHO is obliged to request verification of potential public health events of international concern. The IHR provide a mandate for WHO, through the WHO Director-General and the IHR Emergency Committee, to declare public health emergencies of international concern (PHEICs).

A PHEIC is defined as an 'extraordinary event that is determined to constitute a public health risk through the international spread of disease, and to potentially require a coordinated international response'.

The 2009 H1N1 influenza pandemic further highlighted the challenges of controlling and preventing the rapid worldwide spread of emerging infectious diseases (24). This was the first time that a PHEIC was declared under the IHR. WHO reported 18 631 laboratory-confirmed pandemic deaths worldwide due to pandemic H1N1 influenza; however, a modelling study suggested that the true death rate may have been 10 times higher (25). Although H1N1 had a lower death rate than previous influenza pandemics, it disproportionately affected pregnant women and young people (25).

The rapid international spread of Ebola virus disease in West Africa from 2014 to 2016 (Box 1) highlighted major shortcomings in the implementation of the IHR. Although all WHO Member States had agreed to develop the core capacities stipulated in the IHR by 2012, with a possible 2 year extension, no additional financing or accountability mechanisms had been established to support low- and middle-income countries to reach these goals (26).

WHO has declared a PHEIC four times since the adoption of the IHR, including for swine flu and the West Africa Ebola outbreak. A PHEIC was issued in May 2014 following resurgence of poliomyelitis cases globally, which threatened the success of the polio eradication effort. The emergence of the link between rising incidence of microcephaly and rapid spread of Zika virus in Latin America led to a PHEIC declaration in February 2016.



NIH Image Gallery from Bethesda, Maryland, USA - Ebola Virus Particle

BOX 01

THE 2014-16 EBOLA OUTBREAK IN WEST AFRICA

The 2014-16 Ebola outbreak in West Africa was a stark reminder of the world's continuing vulnerability to health security threats through the international spread of infectious disease. The Ebola outbreak originated in a rural area of southeastern Guinea, but rapidly spread to the capital Conakry. On 23 March 2014, WHO declared an outbreak of Ebola virus disease, with 49 confirmed cases and 29 deaths in Guinea at the time. Over the next few months, Ebola spread rapidly in Guinea and to the neighbouring countries Sierra Leone and Liberia. On 8 August 2014, WHO declared the West Africa Ebola outbreak a public health emergency of international concern. By the end of the outbreak, 28 616 cases and 11 310 deaths had been reported in Guinea, Liberia, and Sierra Leone. Weak health systems and governance in these fragile post-conflict states, as well as delayed detection and response by the international community, contributed to the severity of the outbreak. Hundreds of healthcare workers died, and the outbreak overwhelmed the capacity of local health systems to provide routine care, such as immunisation programs, and prevention and treatment for malaria, tuberculosis and HIV/AIDS. Limited local transmission and deaths due to Ebola virus disease also occurred in Nigeria (20 cases), Mali (8 cases) and the United States (4 cases). Additional single cases without further transmission were detected in Italy, Senegal, Spain and the United Kingdom.

Source: United States Centers for Disease Control and Prevention factsheet on the 2014-16 Ebola outbreak in West Africa. (<https://www.cdc.gov/vhf/ebola/history/2014-2016-outbreak/index.html>)

GLOBAL AND REGIONAL SUPPORT FOR HEALTH SECURITY

Several organisations and frameworks aim to assist countries in the Indo-Pacific region to improve health security. At global level, the Global Health Security Agenda (GHSA) was launched in February 2014 with a vision of a world that is safe and secure from infectious disease threats. The GHSA is a partnership of nations, international organisations and nongovernment stakeholders including WHO, the Food and Agriculture Organisation of the United Nations (FAO), the World Organisation for Animal Health (OIE), the Economic Community of West African States, the United Nations (UN) Office for Disaster Risk Reduction and the European Union. Nations in the Indo-Pacific region that have joined the GHSA are Australia, Indonesia, Japan, Laos, Malaysia, the Philippines, the Republic of Korea, Singapore, Thailand and Vietnamⁱ.

At regional level, the third Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies (APSED III) framework was released in 2017 and is a key framework for building capacity to respond to threats to health security in the Indo-Pacific region (27). The Indo-Pacific Centre for Health Security is working with country partners and other stakeholders, and investing in health systems research, product development, workforce and laboratory capacity building and disease surveillance.

Other organisations supporting Indo-Pacific health security are highlighted in Part 3 of this report.

SOCIOECONOMIC IMPACTS OF HEALTH SECURITY THREATS

Infectious disease outbreaks have a range of negative social, economic and political consequences. Economic impacts of health emergencies can be substantial. For example, the total economic impact of the West Africa Ebola outbreak was estimated at US\$600 million in Guinea, US\$1.9 billion in Sierra Leone and US\$300 million in Liberia (28). The outbreak had severe impacts on investment, production and consumption, particularly in Sierra Leone. The substantial influx of international aid money during the crisis reduced the negative economic impacts; nonetheless, the economic impacts have outlasted the end of the epidemic (28). Outbreaks also cause significant disruption to travel. In 2002–03, international travel to SARS-affected areas fell by 50–70%, and hotel occupancy dropped by more than 60% (29).

The social impacts of infectious disease outbreaks include interruption of education, reduced community functioning, stigma, discrimination, social instability, and widespread job losses and food insecurity. During the West Africa Ebola and SARS outbreaks, schools, hospitals and some borders were closed, and thousands of people were placed in quarantine. The West Africa Ebola outbreak, in particular, caused significant increases in unemployment and reduced food consumption (28). Prolonged school closures during outbreaks can disproportionately affect girls' dropout rate from school (30). Psychosocial stress can persist for months and years after the end of an outbreak. The prevalence of anxiety, depression, insomnia and other post-traumatic symptoms was much higher in SARS survivors and their families than in the general population more than one year after the end of the outbreak (29,31,32). Fear-related behaviours can exacerbate the spread of infectious diseases – for example, non-disclosure of symptoms, loss of trust in health authorities and refusal to participate in prevention programs such as vaccination. These behaviours can also increase the risk of onset of psychological disorders and exacerbate social disruptions and disadvantage during and after the outbreak (33). The stigma and discrimination directed towards survivors of infectious disease outbreaks can reduce social and economic participation, and access to healthcare long after the outbreak ends (34).

ⁱ Countries updated to 26 March 2019, see <https://www.ghsagenda.org/members> for current list.

Universal Health Care and Sustainable Development Goals

The concept of health security has been criticised for its focus on emerging infectious diseases and outbreaks at the expense of high-burden infectious diseases that have considerable negative health and socioeconomic impacts. For example, it has been estimated that the reduced health system capacity during the West Africa Ebola outbreak may have led to an additional 3.5 million untreated malaria infections and 10 900 malaria deaths (35).

The WHO emphasises that preparedness for outbreaks and health emergencies requires countries to have resilient and inclusive health systems that provide health care for all.

The Sustainable Development Goals (SDGs) comprise 17 goals to address global challenges by 2030. The SDGs were adopted by the UN General Assembly in 2015 and replaced the Millennium Development Goals. The goals relate to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice. At the core of the SDGs is a commitment to 'leave no one behind', which means ensuring that all targets should be met for all people, across all groups of society and in all nations. SDG 3 focuses on ensuring healthy lives and promotion of wellbeing for all, at all ages. A key health security-related indicator in SDG 3 is to 'strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks'.

Efforts in health security must contribute to progress towards the SDGs by specifically taking into account the ambition to 'leave no one behind'. This means, that the differential impact of health security threats on women, girls, people with disabilities and other vulnerable groups needs to be considered in order to design health security action that benefits all groups equitably. Ensuring long-term health security requires action on climate change, because climate change may increase the risk of emerging infectious diseases, contribute to the spread of existing infectious diseases, and present major risks to health and societal systems overall.

THE SUSTAINABLE DEVELOPMENT GOALS

GOAL 3

Ensure healthy lives and promote well-being for all at all ages

GOAL 5

Achieve gender equality and empower all women and girls

GOAL 10

Reduce inequalities within and among countries

GOAL 13

Take urgent action to combat climate change and its impacts

IMPACTS OF HEALTH SECURITY THREATS IN SOCIAALLY EXCLUDED POPULATIONS

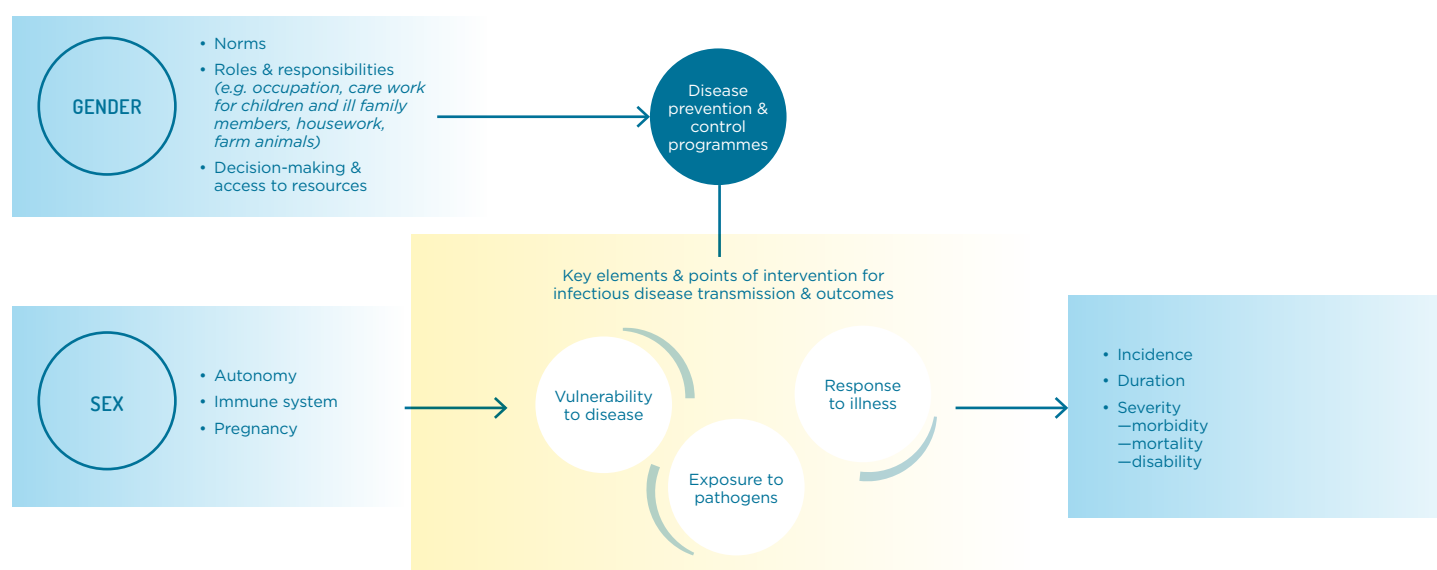


Figure 1: Framework for addressing sex and gender in emerging infectious diseases

Source: WPRO 2011 analytic framework for sex and gender in emerging infectious diseases (17)

In line with the goal to leave no one behind, it is important to understand how health security threats have differential impacts, particularly in populations that face social exclusion and disadvantage. The stark differences in vulnerability to health security threats were clearly shown in the West Africa Ebola outbreak (Box 1). While Guinea, Liberia and Sierra Leone grappled with an unprecedented outbreak in major cities, other countries in the region were able to rapidly contain local outbreaks introduced by travellers from affected regions. Although imported Ebola cases occurred in high-income countries, these countries were able to protect health workers and the general population from infection. Socioeconomic inequalities within countries also affect the risk of exposure to health security threats, as do differences between rural and urban populations, younger and older people, and ethnic groups.

Gender inequality

Health security threats can affect males and females differently, as a result of sex differences and gender inequalities. Sex refers to the biological and physiological factors that define males and females, whereas gender refers to the socially constructed roles, behaviours, activities and attributes that a given society considers appropriate for males and females. Gender differences are shaped by socio-cultural factors and differences in access to, and control over, resources. In 2016, the UN Global Health Crises Taskforce reported that (36):

‘Experience has consistently shown... that health crises have particular and important effects along gender lines that can significantly impact preparedness and response. Understanding and paying attention to the potential gendered impacts of an outbreak is critical to responding effectively’.

The benefit of integrating sex and gender into all aspects of addressing health security is that, although threats affect whole populations, they do not affect men and women equally. Each health security threat could have unique sex and gender dimensions because of differences in how infectious diseases are transmitted (and therefore prevented), clinical signs and symptoms, disease progression, and the socio-economic context in which the threat occurs. Gender-informed responses to health security threats can lead to more effective preparedness and response.

International organisations have made high-level commitments to gender mainstreaming in health security. In 2010, WHO’s Western Pacific Regional Office (WPRO) set priorities for action on mainstreaming gender into health security and emergencies (37). In 2011, WPRO released an analytic framework for taking sex and gender into account in emerging infectious disease programs (17). The FAO Regional Office for Asia and the Pacific (FAO-RAP) has released a regional gender strategy and action plan for 2017–19 (19).

The WPRO analytic framework links concepts of gender and sex differences with emerging infectious diseases (Figure 1). The framework guides the analysis of how sex differences and the sources of gender inequality affect the incidence, duration and severity of an outbreak. The effect is mediated by policies and programs that influence females’ and males’ exposure to pathogens, vulnerability to disease and response to illness.

Despite these high-level commitments to gender mainstreaming, there is limited evidence of gender mainstreaming in practice. APSED III gives no guidance on integrating sex and gender into health security planning and response (27). Neither the IHR nor the WHO JEE tool, which supports countries to evaluate their implementation of IHR core capacities, makes reference to sex or gender (38). Policies and programs for health security have rarely explicitly considered issues of sex and gender (39). Accordingly, limited data are available on how health security threats affect men and women differently.

Researchers have described the ‘conspicuous invisibility of women’ in health emergencies (40). Planners and operations managers can ignore or fail to take actions to address the consequences of emergencies for women. This is despite public health emergencies, including pandemics, most often occurring in low-income countries, usually among the poorest and most marginalised segments of the population and in the context of high levels of gender inequality. In health emergencies, women are often more vulnerable to economic hardship as a result of inequitable access to resources and may face relatively greater economic hardship. For example, curfews, cancellation of public gatherings and restriction of cross-border travel can disrupt small-volume trading and other informal occupations on which many women depend for their livelihoods in low- and middle-income countries (41).

The invisibility of women in health emergencies extends to failure to collect pregnancy status data during outbreaks, which limits research on morbidity and mortality rates including pregnancy outcomes for pregnant and lactating women (42). Furthermore, pregnant and lactating women (and often children) are frequently excluded from clinical trials of vaccines and therapeutic drugs, despite their higher risks of severe outcomes for many infectious diseases.

In practice, this has meant that many women have been denied access to potentially life-saving vaccines and medicines (43). Pregnant and lactating women were initially excluded from clinical trials of an experimental Ebola vaccine during the ongoing Ebola outbreak in the Democratic Republic of the Congo (42), a recommendation that was reversed by the WHO Strategic Advisory Group of Experts on Immunization in February 2019ⁱⁱ, 6 months after the vaccine trial commenced.

ii The SAGE Interim Recommendations on Vaccination against Ebola Virus Disease were published on February 20, 2019: http://www.who.int/immunization/interimEbolaRecommendations_feb_2019.pdf

People with disabilities

WHO estimates that 15% of the world's population is living with disabilities (44). The Convention on the Rights of Persons with Disabilities defines people with disabilities as 'those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others'.ⁱⁱⁱ

People with disabilities have the need and right to access healthcare specific to their disabilities, as well as the same need and rights as people without disabilities to access affordable, appropriate health care. Limited data are available on the specific vulnerabilities of people with disabilities in health emergencies in low- and middle-income countries. However, half of all people with disabilities worldwide cannot afford health care, and people with disabilities are 50% more likely to face catastrophic health expenditures (44), which substantially exacerbates vulnerability to severe health, social, economic outcomes related to health security threats. People with disabilities are less likely to enrol in or complete education, and have lower literacy levels and rates of participation in the work force, which reflects the effects of social exclusion for people with disabilities (45). These factors are determinants of poor health generally and susceptibility to infectious diseases specifically. They need to be taken into account when planning health messaging and access to essential health services before, during and after health emergencies.

Women with disabilities experience particularly high levels of discrimination. Women with disabilities are significantly less likely to be employed than men with disabilities in countries in the Asia-Pacific region (45). In addition, women with disabilities who do work experience poorer working conditions and lower salaries than men with disabilities. Women and girls with disabilities have substantially reduced access to reproductive health services compared with women without disabilities.

In 2012, the UN Economic and Social Commission for Asia and the Pacific (ESCAP) released the Incheon Strategy to 'make the right real' for people with disabilities in the region. The Incheon Strategy comprises 10 disability-inclusive development goals agreed by Member States, as well as 27 targets and 62 indicators to measure progress in disability-inclusive development across poverty alleviation, social and political participation, education, improving access to infrastructure and information, gender equality, disaster risk reduction, improving disability data, and enhancing regional cooperation and commitment.

Through its inclusion of goals and targets on disability data and disaster risk reduction, the Incheon Strategy provides a valuable starting point for supporting and

monitoring progress towards development of disability-inclusive frameworks for health security in the Indo-Pacific region. However, there is a need for more specific frameworks that focus on the needs and rights of people with disabilities related to health security.

The lack of inclusive frameworks for preparedness and response planning means that people with disabilities are disproportionately more likely to be marginalised and at risk of being left behind in health emergencies and disasters. Examples of how people with disabilities are affected by health security threats include the following:

- Disability can result from infectious disease. For example, the Zika virus outbreak in Latin America caused an increase in births of children with microcephaly to mothers who were infected with Zika virus during their pregnancy (46). Children with congenital Zika virus syndrome are likely to experience impairment and barriers to participation.
- People with disabilities may be more vulnerable to community-acquired infectious diseases. For example, some people with disabilities may have difficulty accessing safe drinking water and sanitation facilities, which can increase susceptibility to waterborne infectious diseases. People with disabilities may face higher risks within healthcare settings. For example, people with diabetic ulcers have increased risk of hospital-acquired AMR infections (47).
- People with disabilities may be particularly vulnerable during a health emergency or natural disaster. Mobility restrictions can hamper evacuation efforts, people may lose access to their essential medicines and devices, and carers and support people may fall sick or die.
- Attitudes and capacities of healthcare providers can exacerbate vulnerability of people with disabilities to exposure to, and poor outcomes from, health security threats. Stigmatisation and discrimination towards people with disabilities by healthcare providers, as well as general lack of knowledge and recognition of their health care needs, adversely affect people with disabilities and can lead to their exclusion from health care.
- Under-representation or exclusion of people with disabilities from programs designed to prevent, detect and respond to health security threats undermines the effectiveness of these programs overall and fails to ensure that 'no one is left behind'. There is increased risk of infectious disease spread when key population groups, including people with disabilities, are missed in efforts to prevent, detect and respond to health security threats.

ⁱⁱⁱ Convention on the Rights of Persons with Disabilities, art. 1, G.A. Res. 61/106, U.N. Doc. A/RES/61/106 (Dec. 13, 2006)

The Indo-Pacific region

The Indo-Pacific is a vast and diverse global region ranging from the eastern Indian Ocean to the western Pacific Ocean. It includes Southeast Asia, home to nearly 9% of the global population, with the second-highest population density of all global sub-regions.^{iv} Southeast Asia includes lower-middle, upper-middle- and high-income countries, such as Timor-Leste, Thailand and Singapore, respectively. The total population in the Southeast Asia region was estimated at 648.8 million in 2017, with an estimated annual population growth rate of 1.1% between 2015 and 2020. About half the population lives in urban areas.

The Pacific stretches from Pitcairn Islands in the east to Australia in the west, and from the Commonwealth of the Northern Mariana Islands in the north to New Zealand in the south. Excluding Australia and New Zealand, the total population in the Pacific was estimated at 11.5 million in 2017, with approximately 8 million people in Papua New Guinea. The overall population growth rate between 2016 and 2020 in the Pacific overall is estimated to be 8%; however, there is substantial variation in projected growth between countries. Five Pacific Island countries have projected growth rates below 1% per year, while Niue and Tonga are projected to have a negative growth rate (-6.2%, and -0.59%, respectively). The population of Papua New Guinea is expected to grow by 9% between 2016 and 2020, and Vanuatu's projected growth rate is 10% in the same period.^v

Figure 2 highlights 22 countries in the Southeast Asian and Pacific regions ODA-eligible countries that are the focus of this report. There is considerable variation in the human and animal populations throughout these 22 countries. Southeast Asian focus countries include Indonesia and the Philippines, the world's 4th and 10th most populous countries, respectively, spread over large archipelagos, as well as countries in the Greater Mekong subregion that share international land borders with China (Laos, Vietnam and Myanmar). Southeast Asia has high livestock densities, particularly of poultry (48). In contrast, most of the Pacific countries or territories are small islands or groups of islands and atolls with very small human and livestock populations. Fiji, Papua New Guinea and Vanuatu are larger islands of volcanic origin, and these have larger populations of people and livestock.



^{iv} The population density of Southeast Asia is estimated at 153 people per square kilometre, compared with 299 people per square kilometre in Southern Asia and 148 people per square kilometre in Asia overall. Source: United Nations Population Division data.

^v Source: Pacific Community, Statistics for Development Division, Population Statistics (<https://sdd.spc.int/en/stats-by-topic/population-statistics>)

Drivers of health security threats in the Indo-Pacific region

Health security threats in the Indo-Pacific region intersect with major population, economic and environmental changes in the region. In some instances, these changes can be key drivers of health security threats, while in other situations they make communities vulnerable to infectious diseases.

Population movement and change

DEMOGRAPHIC SHIFTS

Population growth is relatively low in the Indo-Pacific region; however, population ageing is a key structural factor. Rapidly declining fertility rates and steadily increasing life expectancy rates are partly driving this change (49). This presents a window of opportunity for economic growth and development during a period when a larger proportion of the population are of working age; this is often called the 'demographic dividend' (50). However, the window of time for countries to capitalise on a demographic dividend is relatively narrow, and countries in the region face challenges of ageing populations. There is also an increase in the rate of ageing^{vi}, which is occurring much more rapidly in the Indo-Pacific and at an earlier stage of development, giving countries limited time to adapt to the needs of an aged society (49). An ageing population is not a driver of health security threats, but older people may be at higher risk of severe outcomes due to infectious diseases such as influenza (51). Demographic changes such as an ageing population also threaten to stifle economic growth (52). The health needs and economic impacts of ageing populations have implications for the planning of resources that health systems require in the event of outbreaks and health emergencies.

Migration

International migration is a growing trend in the Indo-Pacific region (53). The majority of migrants move to neighbouring countries or within the same region (53). Labour is the driving force for migration movements in the region; the majority of migrants move to countries with a higher GDP per capita than their country of origin (53). Malaysia, Singapore and Thailand are key migrant hubs that receive most of their migrants from other Southeast Asian countries (54). Migrants from Indonesia, Philippines and Vietnam frequently migrate outside the region (54). There may be increased risk of pathogen spread when migrants travel to their destination countries and when returning home. Additionally, migrants themselves may be at higher risk of infectious diseases depending on their conditions of work and access to social and healthcare services in their countries of origin and destination (55).

Political factors, including conflict and instability, also drive migration in the region. Fragile and conflict-affected situations 'are characterized by political instability, weak governance and institutional capacity, economic and social insecurity, and greater vulnerability to the effects of climate change' (56). This affects countries' ability to mitigate health security threats. Myanmar is an example of a conflict-affected area in the Indo-Pacific region, affected by years of political instability, ethnic tensions and economic exclusion that leave the health system vulnerable (56).

The impending changes attributed to climate change are a key driver of migration, with some populations already moving away as an adaptation strategy, particularly in the Pacific (53,57).

^{vi} An ageing society has 7-14 per cent of their total population as older persons, while for an aged population this proportion is 14-21 per cent.

Economic development, trade and travel

Extensive trade and travel links bolstered by economic growth amplify the risk of spread of infectious diseases. Tourism has experienced uninterrupted growth over the past decades and Indo-Pacific destinations are among the most popular globally (58). Although relatively remote geographically, Papua New Guinea and the Pacific are closely connected to Asia and other parts of the world through airports and sea ports, and have increasing numbers of travellers (including workers, visitors and students) and animal movements. For example, tourist arrivals to Fiji from China, Hong Kong, India, Japan, South Korea and the rest of Asia nearly doubled from 52 313 in 2014 to 96 278 in 2018. Over half of these arrivals were from China.^{vii}

SARS highlighted the risks posed by international travel. In February 2003, a physician spent one night in Hong Kong, where he transmitted SARS to 16 hotel guests, who then seeded outbreaks in Hong Kong, Toronto, Singapore and Vietnam (59). Within weeks, more than 800 people from 26 countries and five continents had been infected (59). Model simulations of infectious disease spread via commercial air travel reveal that some countries in the region are more susceptible than others to the rapid spread of infectious diseases via international travellers (Figure 3).

Although trade of animals and animal products can be important for the health, nutrition and prosperity of Indo-Pacific countries, trade can also increase risk of zoonotic disease emergence and spread, if these risks are not managed effectively. The World Trade Organization has authorised OIE to set standards and guidelines in relation to trade in animal health, animal welfare and food safety (from farm to the point of slaughter). These include criteria for risk analysis, zoning, compartmentalisation, and safe trade in animals and animal products. WHO and the FAO are jointly responsible for Codex Alimentarius, which sets standards for food safety (from point of slaughter to consumption). Although countries can use these standards and guidelines to protect health security based on an 'appropriate level of protection', there is variation in the commitment, resourcing and capacity to apply these standards among Indo-Pacific countries. Therefore, emerging zoonotic diseases and transboundary animal diseases can move easily within and between countries through trade, and other movements of animals and animal products. Recent examples include HPAI, African swine fever (ASF), foot-and-mouth disease and a number of food safety threats.

Regulated and illegal movements of domestic animals (livestock and companion animals) and wildlife also represent a key risk. Value chains for animal products are complex and often cross international borders, including through informal and unregulated pathways. This provides potential for rapid transboundary spread of pathogen, and unregulated pathways present a problem for disease control (Box 2).

^{vii} Source: Fiji Bureau of Statistics Visitor Arrivals Statistics (www.statsfiji.gov.fj/index.php/statistics/tourism-and-migration-statistics/visitor-arrivals-statistics)



A: Potential Spread of novel influenza emerging in China after 30 days



B: Potential Spread of novel influenza emerging in China after 45 days



C: Potential Spread of novel influenza emerging in China after 60 days

Figure 3: Potential spread of a novel influenza virus emerging in China to 22 countries in the Indo-Pacific region
Source: Global Pandemic Model (<http://www.pandemic.org.au>). The model is based on commercial air travel data and a susceptible-exposed-infected-recovered (SEIR) model of infectious disease transmission. The influenza model parameters are 3000 initial cases in China (source country), $RO \approx 1.8$, and no border control or other interventions applied.



PNG village pigs

BOX 02

THE LIKELY SPREAD OF AFRICAN SWINE FEVER TO INDO-PACIFIC COUNTRIES—A STARK EXAMPLE OF THE IMPACT OF INADEQUATE CAPACITY FOR HEALTH SECURITY

Pigs are important from cultural and nutritional perspectives in many countries in the Indo-Pacific region. African swine fever (ASF) is a serious disease of pigs with high morbidity and case fatality rates. It is extremely difficult to prevent, control and eliminate because of its persistence, complex production systems, wild animal reservoirs and lack of effective vaccines.

In recent decades, ASF has progressively moved through Europe and Russia and in August 2018, ASF was found in China. It rapidly spread throughout the country as a result of delays in reporting, rapid and uncontrolled movements of pigs and pig products, poor biosecurity and large-scale swill feeding. By April 2019, China had reported 114 outbreaks in 30 provinces and approximately 1 million pigs had been culled. ASF is now widespread in Vietnam, where 556 outbreaks have been reported in 23 provinces and cities and 89 600 pigs have been culled. Cambodia's first ASF case was in April 2019 (60). The lack of preparedness of animal health authorities means that there is a very high risk of ASF spreading quickly and becoming endemic in Southeast Asia.

Further spread of ASF to the Pacific is possible, as there are significant uncontrolled movements of pig meat and pig products via air and sea trade and population movements, including direct trade and movements from China. As in much of Southeast Asia, animal health services are inadequate in many Pacific Island countries, which increases vulnerability to uncontrolled outbreaks. As ASF spreads, it will continue to have severe impacts on pig populations, as well as impacts on food security and livelihoods in affected communities.

Although non-zoonotic animal diseases are not the focus of this report, the current ASF situation provides a stark warning for communities and health services in the Indo-Pacific region of the potential impacts of severe zoonotic disease incursions.

Vulnerable health systems

HEALTH SYSTEMS CAPACITY

Health system vulnerabilities are a major concern in the face of infectious disease threats. Health emergencies present long-term challenges for health systems beyond the acute phase. For example, infectious diseases can have long-term health impacts, including disabilities in some cases. Health systems may not be sufficiently resourced to deliver long-term care to populations suffering chronic ill health after an infectious disease outbreak. Wide population dispersion makes the delivery of health services logistically challenging. Challenges in the numbers, composition, distribution and training of the healthcare workforce persist in the region, particularly in the Pacific, including (61):

- shortages of specific personnel and skill sets; and problems with recruitment, retention and an ageing workforce
- lack of effective human resource policies, management and information systems, and planning capacity
- inadequate access to education and training opportunities to meet current shortages and continuing professional development requirements
- public sector working conditions, institutional capacity and financial constraints to improvement
- implications of increasing mobility and emigration of health personnel.

A number of Pacific regional and national initiatives have been implemented to overcome these challenges, such as the Pacific Human Resources for Health Alliance, the Strengthening Specialised Clinical Services in the Pacific program and the Pacific Regional Clinical Services and Workforce Improvement Program.

Weak governance of the private and informal health sectors presents additional constraints to health security when providers in these sectors are not integrated into health security planning and activities. The size, role and quality of the private health sector vary significantly across the region. The private sector has a limited role in health in most Pacific Island countries, but is more important in Southeast Asian countries. The structure and role of the private sector vary – from a parallel private sector that exists alongside the public sector in Cambodia, to heavily privatised health care in the Philippines. Integrating health security with universal health coverage presents an opportunity to capitalise on ongoing research and activities that focus on ensuring that health policies and programs achieve desired outcomes across the entire health sector (62).

GROWING BURDEN OF NON-COMMUNICABLE DISEASE

The epidemiological transition and its associated demographic transition are typified by a declining burden of infectious diseases, childhood deaths, and fertility rates, but increasing rates of chronic or noncommunicable diseases (NCDs), in the context of an ageing population. Diseases such as cardiovascular disease, cancer, chronic respiratory disease and diabetes mellitus are responsible for an increasing proportion of morbidity in countries in the Indo-Pacific region. At the same time, many countries are continuing to grapple with endemic infectious diseases, emerging infectious diseases and outbreaks (63).

This 'double disease burden' raises challenges for further strengthening of health systems, as countries face challenges with allocation of scarce resources, and developing appropriate strategies for prevention, control and treatment of infectious diseases and NCDs. The double disease burden constrains population health gains and economic development in the many lower income countries of the region (63).

People with NCDs are frequently more susceptible to severe outcomes of infectious diseases. Non-communicable diseases may be driving a proportion of the infectious disease burden in the region; examples include the association between diabetes mellitus and TB, which is thought to be responsible for 15% of the global burden of TB (64) and up to 40% of the TB burden in selected Pacific Island countries (65). Outbreaks of multidrug-resistant *Staphylococcus aureus* have also been associated with diabetes in the Pacific context (15), while diabetes is considered a risk factor for MERS (66) and influenza (67). Estimates by the International Diabetes Federation for countries of its Western Pacific Region, which includes China, suggest there are currently 170 million cases of diabetes and projects prevalence will increase to 208 million by 2045 (68). This double disease burden has the potential to overwhelm health systems that already face a number of constraints, highlighting the importance of a joint approach to improving health security alongside strengthening health systems and achieving universal health coverage.

Food systems

Food systems have several important links with health security. Food systems, at global, regional and local levels, are often complex and encompass all stages of the production, processing, supply, preparation and consumption of food. At various points in the food system, there is potential for infectious pathogens to give rise to cases of zoonotic disease or threaten food security. There is also the potential for poor nutrition to increase susceptibility to infectious disease.

AGRICULTURAL INTENSIFICATION

In the Indo-Pacific region, as in other parts of the world, changes in agriculture and food systems are creating situations that favour the emergence and spread of infectious diseases (69). In part, these changes are driven by population growth, economic development and the consequent increase in demand for food. Intensification of animal production, changes in agricultural practices, deforestation and encroachment on wildlife habitats all contribute to changes in disease ecology and an increasing potential for pathogens to emerge and spread.

Intensified food systems may give rise to several types of health security threats (69). Emergence of zoonotic diseases, such as Nipah virus, have been closely linked to livestock intensification and associated environmental change (69). Bacterial foodborne diseases (for example, *Salmonella*, *Campylobacter* and *Escherichia coli*) that are endemic in farm animals, may increase in incidence or evolve towards higher virulence with intensification and industrialisation of food production (69). There is growing global concern about the threat of antimicrobial resistance, which may be linked to widespread use of antibiotics in livestock production (70). Finally, neglected zoonoses prevalent in livestock (such as brucellosis, bovine tuberculosis, leptospirosis, Q fever and cysticercosis) constitute an ongoing health security threat, especially in resource-poor settings (71).

NUTRITION

Food systems are linked to health security through the effect of poor nutrition on susceptibility to infectious diseases. Poor nutrition can lead to stunting, micronutrient deficiencies and obesity, which increase susceptibility to infectious diseases and the risk of noncommunicable diseases such as diabetes. Conversely, some infectious diseases, particularly enteric infections (many of which are zoonoses), increase the risk of stunting and malnutrition in infants and children. Transboundary animal diseases such as HPAI and ASF have the potential to threaten food

security, with consequent impacts on nutrition and human health. The rural population in poorer countries tends to be most affected by serious animal diseases through the combined impacts of food scarcity and poverty (72).

INFRASTRUCTURE

In many parts of Southeast Asia, major infrastructure projects such as roads and dams are changing food systems and ecosystems. For example, hydroelectric dams on the Mekong River and its major tributaries threaten freshwater fisheries and food security in the Mekong River Basin (73,74), while road development and the increasing food demands of urban populations are driving greater movements of animals and other agricultural products across international boundaries (75). Although such infrastructure developments may bring various benefits, their effects on ecosystems and food systems present new pathways for infectious diseases to emerge and spread.

Climate change

Climate change is likely to have substantial and far-reaching impacts on human and animal health in the Indo-Pacific region. Countries in the Indo-Pacific region are among the worst affected by climate change to date and are projected to suffer severe adverse impacts throughout the 21st century (76). The Pacific Island countries are vulnerable to the effects of sea level rise and extreme weather events that threaten the very existence of these low-lying island nations (77).

Mitigating and adapting to climate change is critical to long-term human wellbeing and survival. Although uncertainties exist about the exact nature of climate change impacts, direct and indirect effects of climate change on infectious diseases are likely to increase the risk of health security threats (78). Climate change has primary direct effects on population health – for example, through the adverse health effects and deaths associated with extreme weather events such as heat waves and cyclones. Climate change also has secondary, indirect effects on health through influencing the distribution and density of pathogens or their vectors that spread disease (79). Climate change is projected to have wide-ranging impacts on species' range and diversity, which means that new species interactions may occur, increasing the risk of emergence of zoonoses. Climate change is also projected to have tertiary, whole-of-society effects with severe implications for health (80). For example, economic losses related to the impacts of extreme climate events reduce resources available for health systems overall. Severe climate change-related events such as prolonged drought or increased cyclone frequency can cause major disruptions to food supplies, which can have follow-on

impacts on national and international governance, including capacity to address health security threats. Climate change may also directly affect health infrastructure. In low-lying Pacific islands in particular, hospitals, laboratories and other healthcare facilities are vulnerable to sea level rise. Several hospitals have been severely damaged during cyclones and flash floods, which highlights the vulnerability of the Pacific region as the frequency of extreme weather events is expected to increase (77).

CLIMATE-SENSITIVE INFECTIOUS DISEASES

Pathogens whose life cycle includes a life stage exposed to ambient weather conditions (including time within vectors or hosts) can be considered to be 'climate-sensitive' infectious diseases. Climate change due to human activities is predicted to alter the patterns of many climate-sensitive infectious diseases, by affecting the growth, lifespan and reproductive rate of climate-sensitive pathogens (81). Vector-borne and zoonotic diseases are likely to be particularly climate sensitive. This is because vectors, such as mosquitoes, and wildlife species that host pathogens are also affected by changing temperature, rainfall and other climate factors. Climate-sensitive infectious diseases in the Indo-Pacific region include malaria, dengue and chikungunya (Table 1).

Climate change is likely to have varying impacts on infectious disease patterns in different parts of the Indo-Pacific region, as a result of regional differences in the extent of warming, and in the interaction between climate and other factors that affect infectious diseases. Climate change is co-occurring with significant land-use change due to agricultural intensification and encroachment on wildlife habitats, which substantially increases the risk of zoonotic disease emergence.

Many of the potential effects of climate change on health are likely to have different consequences for men and women (85). For example, malaria is a climate-sensitive disease for which pregnant women are particularly at risk of poor outcomes. Although the incidence of malaria in the Indo-Pacific region has declined overall, in line with substantial investments in malaria control and elimination programs, global progress towards malaria elimination is stalling (86), and the Indo-Pacific region remains at risk of malaria resurgence in an increasingly warmer world. Moreover, there are differences between women and men in roles, behaviours and attitudes regarding adaptation to climate change. For example, droughts in developing countries bring health hazards through reduced availability of water for drinking, cooking and hygiene, and through food insecurity. Women and children disproportionately suffer health consequences of nutritional deficiencies and the burdens associated with travelling further to collect clean drinking water (85).

CLIMATE CHANGE ACTION IN THE INDO-PACIFIC REGION

Following the 2008 World Health Assembly resolution on Climate Change and Health, in 2009, the South-East Asia Regional Committee on Climate Change and Human Health was approved. In 2012, WHO Regional Office for South-East Asia (SEARO) published its regional strategy for protecting health from climate change (87). The strategy has the overall objective of assisting Member States' health sectors to assess the health vulnerability of both their populations and the sector itself. In 2017, SEARO Member States endorsed the Male' Declaration with commitments to build resilient health systems that are able to anticipate, respond to, cope with, recover from and adapt to climate-related shocks and stresses.^{viii}

In August 2017, the 12th Pacific Health Ministers Meeting noted that, although many ministers of health actively voice their concerns regarding the health risks of climate change, projects to build resilience of health systems to climate change could not be pursued because of a lack of funding. This was due to the complexity and uncertainty of navigating the processes to access international and bilateral funds. In November 2017, at the 23rd Conference of the Parties (COP23) to the UN Framework Convention on Climate Change (UNFCCC), WHO launched a Special Initiative on Climate Change and Health in Small Island Developing States, in collaboration with UNFCCC and the Fijian Presidency of COP23. The initiative recognises that small-island developing states are on the front line of climate change, facing a range of acute and long-term risks, including extreme floods, storms, droughts and sea level rise; and increased risks of waterborne, vector-borne and foodborne diseases.

Regional initiatives to address climate change are important, but lack of coordinated global action on climate change represents one of the biggest threats to health security in the region and globally. The year 2020 has been identified as a global tipping point for climate change action, but global progress to address climate change through action in the agriculture, energy, finance, heavy industry, infrastructure and transport sectors is insufficient, or in the wrong direction entirely in several domains (88).

^{viii} The Male' declaration was signed by the 11 SEARO Member States at the 70th Regional Committee Meeting of SEARO on 25 August 2017 in the Maldives (SEA/RC70/3 Rev.1).

High-burden, high-risk & epidemic-prone infectious diseases

There are several ways in which infectious diseases can present a threat to national and regional health security:

- Some high-burden infectious diseases have significant social or economic impact. Burden of disease can be measured in terms of disability-adjusted life years and incidence, and social and economic effects can be estimated from impact assessments and modelling studies.
- High-risk infectious diseases include emerging and re-emerging infectious diseases that have high morbidity or mortality.
- Epidemic-prone infectious diseases include some high-burden and high-risk infectious diseases that cause outbreaks in one or more countries, frequently requiring a coordinated international response.

In this report, classification of infectious diseases relevant to health security as 'high-burden', 'high-risk' or 'epidemic-prone' is based on measures of burden and incidence, national and regional strategic plans or priority disease lists, a rapid literature review and expert consultations (Appendix A).

High-burden infectious diseases relevant to health security

High-burden diseases that are particularly relevant to health security are those that have significant social or economic impact. This could be due to health system impacts of a high disease burden. Endemic high burden diseases with outbreak potential, such as dengue, are particularly important to health security because of the risk of social and economic harm during an outbreak. Countries in the Indo-Pacific region have prioritised several endemic diseases in their national strategic plans and WHO country cooperation strategies, which provides another measure of the importance of high-burden diseases to each country's overall health security (see Table A1 in Appendix A). High-burden climate-sensitive infectious diseases may have an increased range or higher transmission intensity under climate change scenarios. Climate sensitivity should also be considered when evaluating the potential risks to health security posed by endemic infectious diseases.

METRICS FOR ASSESSING BURDEN

Different approaches can be used to decide whether an infectious disease or disease group is 'high-burden'. The Global Burden of Disease (GBD) consortium, coordinated by the Institute for Health Metrics and Evaluation, provides annually updated estimates of the global, regional and national burden of diseases, injuries and risk factors for most countries and territories in the Indo-Pacific region (89).

Disability-adjusted life years (DALYs) are a common metric for assessing burden of disease because this measure estimates the number of years of 'healthy' life lost as a result of a particular condition across the population. DALYs combine the number of years lost as a result of ill health (disability) or early death (premature mortality). DALYs can provide a useful estimate of the overall impact of an infectious disease or disease type on population health. For example, a disease that has low incidence but causes a very high number of years of healthy life lost would have relatively high impact at population level. Infectious diseases that cause infant and child mortality tend to have high DALYs for this reason, as do chronic infectious diseases that cause long-term ill health.

Incidence is another important measure of burden. Incidence refers to the number of new infections in a population over a defined period of time. However, incidence alone does not give a measure of the severity or lasting impacts of disease. Incidence is particularly useful for understanding disease trends. Infectious diseases that have been increasing in incidence may become higher burden in the future – a risk that may be exacerbated for climate-sensitive diseases.

HEALTH, SOCIAL AND ECONOMIC IMPACTS OF HIGH- BURDEN INFECTIOUS DISEASES IN THE INDO-PACIFIC REGION

DALYs and incidence of infectious diseases in the 22 focus countries in Southeast Asia and the Pacific region were extracted from the GBD database for 2017.

TB is the second-highest-burden infectious disease by DALYs in Southeast Asia, and one of the major contributors to morbidity and mortality due to lower respiratory infections in general (Table 2). The incidence of TB in the Pacific increased by 8% between 2013 and 2017 (Table 3). A study in Indonesia estimated that the economic burden related to treated and untreated TB cases was approximately US\$6.9 billion per year. Loss of productivity due to premature death was by far the largest component, representing 87% of the total estimated economic impact (90).

Dengue is one of the highest-burden infectious diseases when measured by incidence. The incidence of dengue is increasing, particularly in the Pacific region, where a 21% increase was reported from 2013 to 2017 (Table 3). The economic impacts of dengue are substantial. For example, the estimated economic impact of dengue in the Philippines was US\$345 million in 2012 (91). Recent scoping missions conducted in Solomon Islands, Samoa and Fiji reported regular dengue outbreaks in 2018 (Fiji), 2017 (Samoa) and 2013 and 2016 (Solomon Islands) with deaths from dengue shock syndrome and haemorrhagic fever (92–94). In Samoa, two-thirds of cases were reported in children aged 1–14 years (94).

Diarrheal diseases are a climate-sensitive disease group with very high and increasing incidence throughout the Indo-Pacific region. The incidence of neglected tropical diseases is declining overall, but they still account for a considerable disease burden by both DALYs and incidence. The incidence of neglected tropical diseases in general is higher in Southeast Asia than in the Pacific, but the incidence of malaria declined by only 9% in the Pacific compared with more than 50% in Southeast Asia between 2013 and 2017. *Plasmodium vivax* malaria is more widespread than *P. falciparum* malaria, with 2.9 billion people at risk of infection, of whom 90% live in the wider Asia-Pacific region (95,96).

Alarmingly, the incidence of measles has increased by nearly 20% in the past five years in the Southeast Asian region (Table 2), which is related to low and declining vaccine coverage in some regions (see 'Immunisation' in Part 2).

Apart from these high-burden diseases, several other endemic diseases have been identified in national strategic plans as priority endemic diseases (see Table A1 in Appendix A). Endemic zoonotic diseases that have been prioritised for action in countries in the Indo-Pacific region include brucellosis, leptospirosis, rabies, anthrax and bovine TB. The Pacific islands are free from rabies, but it occurs at varying incidence in Southeast Asian countries (estimated at 0.1 cases per 100 000 people in 2016 overall in the GBD database) (89). Myanmar has one of the highest human rabies incidence rates in the world; rabies now kills more people than malaria, but the true burden of rabies is unknown because of significant surveillance limitations (97).

Regional data are unavailable for brucellosis, leptospirosis, anthrax, avian influenza and bovine TB, as these diseases

are not reported separately in the GBD database. Anthrax is present in livestock populations in Southeast Asia, and small, sporadic outbreaks of anthrax have occurred in people (99). Reviews of the global burden of brucellosis have reported that no data on brucellosis incidence are available in countries in the Indo-Pacific region (100,101). Similarly, no data on the incidence of bovine TB are available for Southeast Asian or Pacific countries, despite Southeast Asian countries being major cattle producers (102).

Overall, most high-burden infectious diseases were reported to have similar incidence in men and women. Of note, TB is significantly more common in men (161.3 cases per 100 000) than in women (130.8 cases per 100 000) in Southeast Asia, but more common in women (148.4 cases per 100 000) than in men (111.1 cases per 100 000) in the Pacific. The incidence of HIV/AIDS is twice as high in men (19.0 cases per 100 000) in Southeast Asia as in women (9.0 cases per 100 000), but there is little difference in the Pacific. Dengue is somewhat more common in women than in men overall in Southeast Asia and the Pacific, but the differences are not significant.

DISEASE	DALYS PER 100,000 PEOPLE ^A	INCIDENCE PER 100,000 PEOPLE ^B	% CHANGE IN INCIDENCE ^C	CLIMATE-SENSITIVE ^D
Lower respiratory infections	1 136.7	9 988.1	-2.6	Yes
Tuberculosis	788.1	146.0	2.0	No
Diarrheal diseases	585.4	69 101.9	3.3	Yes
HIV/AIDS	418.8	14.01	-13.4	No
Neglected tropical diseases and malaria	404.4	6 495.7	-2.2	Yes
Dengue	157.2	2 940.6	1.0	Yes
Meningitis	147.0	23.9	-12.0	No
Typhoid and paratyphoid	132.8	214.2	-14.6	Yes
Syphilis	127.9	106.0	-1.9	No
Malaria	93.9	256.0	-52.5	Yes
Upper respiratory infections	83.4	238 199.3	-1.5	No
Measles	77.5	423.2	19.5	No
Whooping cough	47.4	221.5	-10.0	Unclear

Table 2: High-burden infectious diseases in Southeast Asia in 2017

Source: Global Burden of Disease data for Southeast Asia, including Cambodia, Indonesia, Laos, Malaysia, Maldives, Mauritius, Myanmar, Philippines, Seychelles, Sri Lanka, Thailand, Timor-Leste and Vietnam

a Disability adjusted life years (DALYs) per 100 000 people in 2017

b Incidence per 100 000 people in 2017

c Percentage change in incidence over a 5-year period from 2013-17

d Climate-sensitive is defined as diseases caused by pathogens whose life cycle includes a life stage exposed to ambient weather conditions, including time within vectors or hosts

DISEASE	DALYS PER 100,000 PEOPLE ^A	INCIDENCE PER 100,000 PEOPLE ^B	% CHANGE IN INCIDENCE ^C	CLIMATE-SENSITIVE ^D
Lower respiratory infections	2 750.2	11 751.1	1.7 ↑	Yes
Diarrheal diseases	1 845.4	147 148.4	7.3 ↑	Yes
Syphilis	836.0	490.5	-12.3 ↑	No
Neglected tropical diseases and malaria	682.4	11 869.3	-8.1	Yes
HIV/AIDS	673.2	28.0	5.1	No
Meningitis	566.8	154.1	2.3	No
Tuberculosis	557.9	129.2	8.1	No
Malaria	321.9	11 105.0	-8.7	Yes
Whooping cough	302.6	5 16.4	13.4	No
Measles	216.9	574.7	-12.9	No
Lymphatic filariasis	148.6	0.0	0.0	Yes
Typhoid and paratyphoid	129.6	162.7	-13.9	Yes
Acute hepatitis	103.8	6 573.3	1.8	Unclear
Upper respiratory infections	78.2	227 102.8	-0.3	Yes
Dengue	11.1	759.8	20.5	Yes

Table 3: High-burden infectious diseases in the Pacific in 2017

Source: Global Burden of Disease data for Oceania, including Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu.

a Disability adjusted life years (DALYs) per 100 000 people in 2017

b Incidence per 100 000 people in 2017

c Percentage change in incidence over a 5-year period from 2013-17

d Climate-sensitive is defined as diseases caused by pathogens whose life cycle includes a life stage exposed to ambient weather conditions, including time within vectors or hosts

High-risk infectious diseases

High-risk infectious diseases include emerging and re-emerging infectious diseases that have high morbidity or mortality, and potentially pose a national or regional health security threat. The concept of 'high-risk' infectious diseases in the context of health security has two elements: the likelihood of an event occurring (that is, the probability of emergence and spread of an infectious disease) and the consequences should that event occur. It is challenging to estimate likelihood because knowledge about risk factors for emerging infectious diseases is usually incomplete, and it is difficult to predict rare but potentially high-impact events. Apart from acute health impacts and mortality in people, the consequences of high-risk infectious diseases include a broad range of effects on human health, animal health, economies, communities and environments.

EMERGING AND RE-EMERGING INFECTIOUS DISEASES

Southeast Asia is considered to be a global 'hotspot' for disease emergence, particularly zoonoses, as a result of the coexistence of many of the factors that facilitate the interspecies transmission, maintenance and spread of pathogens (99). There is a high risk of emergence of zoonoses at the human-livestock-wildlife interface, as exemplified by the repeated emergence and spread of zoonotic influenza viruses in the region (Box 3).

In general, there are fewer drivers of zoonotic disease emergence in the Pacific than in Southeast Asia because of the relative underdevelopment of animal production, the lower opportunity for interspecies contact at aggregation points (such as wet markets) and the less complex local food systems (106). For example, Pacific Island countries are considered to be at low risk for HPAI, because they are not on major flyways for migratory waterfowl. However, recent outbreaks of leptospirosis in the Pacific demonstrate the potential for zoonotic disease transmission in the region (107), and the Pacific islands are vulnerable to the introduction of emerging diseases through travel and trade.

In many countries in the Indo-Pacific region, the risk of zoonotic disease emergence and spread is exacerbated by inadequate veterinary services, a lack of farm-level economic incentives to control zoonotic diseases in animals, underreporting of human cases, and lack of collaboration across sectors and disciplines (108).



Ducks, Cambodia 2005. Photo: Lorrie Graham / AusAID



BOX 03

ZOONOTIC AVIAN INFLUENZA IN THE INDO-PACIFIC REGION

Zoonotic influenza viruses circulate in poultry and wildlife in the Indo-Pacific region.

Highly pathogenic H5N1 influenza viruses emerged as a zoonotic threat in Asia in 1997, with the animal and human cases in Southeast Asia in 2004. H5N1 viruses have spread by migratory waterfowl to many parts of the world, causing outbreaks and deaths in domestic poultry and people. While vaccines have been used to control H5N1 influenzas in poultry in some places, their impact has been limited due to incomplete coverage, limited clinical expression in wild and domestic waterfowl and the ability of influenza viruses to evolve (103).

Starting in 2010, several related viruses, including H5N2, H5N6, H5N8 (H5Nx viruses) emerged in China, and started spreading internationally from 2014 (104). While H5N2 and H5N8 viruses are restricted to wild and domestic poultry, H5N6 viruses have affected people in China and several neighbouring countries.

H5N1 and H5Nx influenza viruses are now present in several South East Asian countries, such as Vietnam, Cambodia, Laos, Myanmar and Indonesia, due to their close proximity and movements of birds and people from infected areas (104). In some of these cases, there are significant differences in capacity to prevent, detect and control AI viruses among human, animal and wildlife health sectors. This is demonstrated where HPAI has been detected in humans long before its detection in bird populations, leading to the suggestion that humans are being used as 'sentinels'.

Low pathogenic H7N9 avian influenza viruses emerged in March 2013 and since then, there have been 1568 cases and 615 deaths in humans in China.ⁱ H7N9 was initially a low pathogenic virus in poultry that caused serious disease in humans. However, H7N9 that are highly pathogenic in poultry and in humans have now emerged. In China, compulsory vaccination program for poultry commenced in September 2017 and since then there has been a significant reduction in human cases (105). No human cases have yet occurred outside of China, except in travellers to affected regions in China.¹

Though zoonotic influenza viruses can cause severe disease and death in people, the pandemic potential of these viruses is considered relatively low, due to limited human-to-human transmission. However, close proximity of people, domestic poultry and wild waterfowl increases the risk of re-assortment of avian and human influenza genes, which could result in the emergence of a highly pathogenic influenza virus with capacity for significant human-to-human transmission.

ⁱ As reported in the FAO Emergency Prevention System for Animal Health H7N9 monthly situation update on 8 May 2019

ANTIMICROBIAL RESISTANCE

The Indo-Pacific region is a site of growing rates of TB and malaria drug resistance, as well as alarmingly high levels of antibiotic resistance in community-acquired and healthcare-acquired bacterial infections in several settings (15,109).

The first-line protocol for the management of *P. falciparum* infections using artemisinin-based combination therapy is under threat, as a result of widespread resistance to artemisinin and its derivatives in Cambodia, Myanmar, Thailand and Vietnam (Box 4).



Pumping in dry season Cambodia
Photo: Chris Graham/AusAID

BOX 04

ARTEMISININ-RESISTANT MALARIA IN THE GREATER MEKONG SUBREGION

The Greater Mekong Subregion (GMS) is the global epicentre of emerging antimalarial drug resistance (110). Chloroquine resistance was first reported in western Cambodia in the 1970s, followed by resistance to other anti-malarial drugs, including artemisinin (111,112). All countries in the GMS have now reported artemisinin resistance in *P. falciparum* malaria infections. This is of substantial international concern because artemisinin-based combination therapies (ACT) are the first-line treatments for *P. falciparum* infections around the world (113–115). In western Cambodia, multidrug-

resistant *P. falciparum* malaria was confirmed in 2015, with reports of complete treatment failure in *P. falciparum* cases treated with the first-line therapy (dihydroartemisinin-piperaquine) used in Cambodia at the time (7). Cambodia has now reported resistance to four ACTs (116,117). There is also evidence of ACT-resistance in Vietnam, and mefloquine resistance continues to be a concern in Thailand, where artesunate-mefloquine is used as first line treatment (111). ACT resistance in the GMS is likely to threaten the efforts to eliminate malaria in the Asia Pacific region by 2030 (118).

Outbreaks of drug-resistant bacterial infections such as TB can overwhelm healthcare services in the Pacific islands (Box 5). In 2010 at the Pacific Islands National TB Programme Managers meeting in Fiji, managers from national TB programs across the Pacific declared that even a single case of multidrug-resistant (MDR) TB in a Pacific island should constitute a public health emergency. Since this time, approximately 1570 cases of MDR TB have been reported from 17 Pacific islands. Of these, 1506 cases have been reported from Papua New Guinea, where extensively drug-resistant TB^{ix} is also present – a more serious and deadly form of MDR TB.

In addition, recent scoping missions carried out in Fiji, Samoa and Solomon Islands have identified the challenges posed by AMR in Pacific Island countries. In Fiji, AMR was identified as an emerging threat with at least 10 outbreaks due to multi-drug resistant organisms reported since 2006 (92). Factors associated with AMR in the Pacific include over-prescribing of antibiotics in clinical settings, poor patient compliance with treatment regimens, and poor infection prevention and control practises exacerbated by ageing hospital infrastructure and a comparatively high prevalence of diabetes in patients accessing health care (94). In Samoa and Fiji, AMR has been associated with immune-compromised patients, including those being treated for diabetic foot sepsis (92,94). The risk of importation of AMR is difficult to quantify without strong laboratory and surveillance systems in place to detect AMR for a range of pathogens. However, the outbreak of multi-drug resistant TB in the Federated States of Micronesia (Box 5) illustrates the potential for importation of AMR organisms as Pacific Islanders seek opportunities in neighbouring countries.

^{ix} Extensively drug-resistant TB is defined by WHO as TB that has 'resistance to any fluoroquinolone and to at least one of three second-line injectable drugs (capreomycin, kanamycin and amikacin), in addition to multidrug resistance'.

BOX 05

AN OUTBREAK OF MULTI-DRUG RESISTANT TUBERCULOSIS IN THE FEDERATED STATES OF MICRONESIA

In 2008, a two-strain outbreak of multidrug-resistant tuberculosisⁱ (MDR TB) was reported from the remote island of Weno, in Chuuk State, Federated States of Micronesia. An initial case was reported in a Chuukese man who had probably been infected with multidrug-resistant TB while living in another Pacific island, but who had never been treated for TB (119).

The Chuuk State Department of Health Services did not have the capacity to deal with such an event (120). Second-line TB drugs were not available locally, and attempts to procure the necessary drugs proved complex and time-consuming (121,122). A one-year delay in accessing treatment sustained local transmission. Without access to treatment, four of the first five patients died, including a mother and her 2-year-old child.

As the magnitude and severity of the outbreak became clear, the Government of the Federated States of Micronesia requested external assistance to manage the outbreak. In response, a multi-agency investigation was initiated, led by the United States Centers for Disease Control and Prevention, in collaboration with staff from partner technical organisations, including the World Health Organization.ⁱⁱ

The response was complex, lengthy and comprehensive. It included refurbishment of the hospital's TB ward, the provision of second-line TB drugs, social support for patients to complete treatment, recruitment and upskilling of additional local staff, support from experienced TB clinicians to design treatment regimens, and one of the world's first observational studies on preventive therapy among multidrug-resistant TB contacts. The outbreak response lasted 5 years and cost more than US\$1 million. A total of 42 cases were reported, seven died and 104 were given preventive therapy (122).

ⁱ MDR TB is defined by WHO as TB that is resistant 'to at least both isoniazid and rifampicin', two of the most powerful first-line TB medicines that are currently available.

ⁱⁱ A number of organisations participated in the response, including the Government of the Federated States of Micronesia, the United States Centers for Disease Control and Prevention, the United States Department of the Interior, WHO, the United States Department of Defense, the Secretariat of the Pacific

Epidemic-prone diseases

Some infectious diseases have potential to cause epidemics that spread internationally, necessitating a response from WHO and the global community. The WHO maintains a global priority list of pandemic and epidemic-prone diseases^x, which currently includes:

- Chikungunya
- Cholera
- Crimean-Congo haemorrhagic fever
- Ebola virus disease
- Hendra virus infection
- Influenza (pandemic, seasonal, zoonotic)
- Lassa fever
- Marburg virus disease
- Meningitis
- MERS
- Monkeypox
- Nipah virus infection
- Plague
- Rift Valley fever
- SARS
- Smallpox
- Tularaemia
- Yellow fever
- Zika virus disease

The Indo-Pacific region continues to be at high risk of epidemic-prone diseases, as outbreaks of zoonotic influenza and SARS described elsewhere in this report have shown. Countries in Southeast Asia and the Pacific have experienced outbreaks of several other WHO-prioritised pandemic- and epidemic-prone diseases.

Outbreaks of chikungunya in Southeast Asia were first reported in Thailand (1960s), Vietnam (1975), Myanmar (1975) and Indonesia (1982). After more than 20 years without an outbreak, chikungunya re-emerged in 2006 in India, followed by outbreaks throughout Southeast Asia (including Cambodia, Indonesia, Myanmar, the Philippines and Thailand) and a widespread outbreak in the Pacific in 2012–14, which affected American Samoa, the Federated States of Micronesia, Papua New Guinea, Samoa, Tokelau and Tonga (123). The largest Pacific outbreak was in Papua New Guinea, with many tens of thousands of chikungunya cases caused by the East Central South African lineage of the virus (123), highlighting the vulnerability of Pacific Island countries to the spread of infectious diseases originating in any part of the world.

Cholera is less common in the Indo-Pacific region than in other areas of the world, but outbreaks necessitating an international response have occurred. For example, the Global Outbreak Alert and Response Network (GOARN) supported national ministries of health in the response to outbreaks of cholera in Papua New Guinea in 2009 and

the Philippines in 2012 (124). Cholera outbreaks also occur in Myanmar, including an outbreak of 1 617 suspected cases in 2015 (125).

In the western Pacific region, the first laboratory-confirmed cases of infection with what became pandemic influenza A (H1N1) were reported on 28 April 2009. By 11 June 2009, the day the pandemic was declared by WHO, nine countries and areas in the WHO Western Pacific region had reported laboratory-confirmed H1N1 (126). From April 2009 to July 2010, more than 250 000 cases of H1N1 were reported from 34 countries and areas in the Western Pacific region.

Zoonotic influenza outbreaks in poultry and humans have occurred in several Southeast Asian countries. Since 2003, Cambodia has reported 56 cases laboratory-confirmed and 37 deaths due to H5N1 avian influenza in humans. Similarly, Indonesia has reported 200 cases and 168 deaths, and Vietnam has reported 127 cases and 65 deaths. Other countries including Laos and Myanmar have reported a small number of H5N1 cases (127). An ongoing outbreak of H7N9 in poultry and humans is occurring in China, but transmission has not yet occurred in animals or humans in other countries.^{xi}

The incidence of meningitis in the Indo-Pacific region is thought to be relatively low (Tables 2 and 3), but high-quality data on the incidence of meningitis are scarce in the region (128). Weak surveillance systems, inconsistent case definitions, and lack of awareness among clinicians and public health officials contribute to underreporting (129). The Philippines reports about 100 meningitis cases annually and experienced an outbreak of 78 cases and 30 deaths in two regions from October 2004 to January 2005, with the response effort supported by GOARN (124). An outbreak of 85 cases of meningococcal C in Fiji between March and September 2018 led to a mass vaccination program as part of the response.^{xii}

Three cases of MERS coronavirus (MERS-CoV) were confirmed in the Philippines in 2014–15, and cases have also been reported in Thailand and Malaysia. The 2014–15 outbreak of MERS-CoV in the Republic of Korea, a high-income country, suggests that the Indo-Pacific region would be highly vulnerable to outbreaks of MERS-CoV and other novel infections. The outbreak of 186 MERS-CoV cases (including 36 deaths) in the Republic of Korea followed a single patient exposure in a returned traveller to the Middle East who presented to the emergency room at a tertiary care hospital in Seoul (130).

^x The WHO Emergencies program listed 19 pandemic and epidemic-prone infectious diseases at the time of writing this report (www.who.int/emergencies/diseases).

^{xi} As reported in the FAO Emergency Prevention System for Animal Health H7N9 monthly situation update on 8 May 2019.

^{xii} As reported in the Fiji Meningococcal C Outbreak Situation Report Volume 14, 23 September 2018.

Almost 17 000 individuals who had contact with a suspected or confirmed MERS-CoV case were quarantined, and the outbreak had considerable psychosocial and economic impacts throughout the country (131).

Nipah virus is a salient example of the risk of zoonotic disease emergence in the Indo-Pacific region. Nipah virus was first identified during an outbreak of acute febrile illness among pig farmers in Malaysia in 1998 (132). Since then, it has been reported in a number of countries in the wider region, including the Philippines (2014), Bangladesh (2001) and India (2001, 2007 and 2018) (132). In some of these outbreaks, exposure to Nipah virus was linked to consuming date palm sap that had been contaminated by the urine or saliva of fruit bats. Fruit bats (family Pteropodidae) are the natural hosts of Nipah virus. The first cases of human-to-human Nipah transmission were reported in Bangladesh and India, including in healthcare settings (132) and amongst people in close proximity (including touching, feeding and nursing) to patients (133). The case fatality rate has ranged from is 40–75% in different outbreaks (132).

The first recorded outbreak of Zika virus disease in the Pacific was reported from Yap State, Federated States of Micronesia. Reported in 2007, a total of 49 confirmed and 59 probable cases of Zika were identified (134). The outbreak was relatively mild, with no hospitalisations, haemorrhagic manifestations, cases of microcephaly or deaths reported (134). In 2013–14, French Polynesia reported a large outbreak of Zika virus, with almost 28 000 people affected, representing approximately 12% of the total population (135). At the time, this was the largest reported outbreak outside the Americas. Eight cases of microcephaly were reported; seven of these coincided with exposure to Zika in the first trimester of pregnancy (135). Several other countries in the Indo-Pacific region have reported Zika virus, including Cambodia, the Philippines, Samoa, Solomon Islands and Thailand (136). Recent scoping mission reports carried out in the Pacific in 2018 identified Zika virus disease as a particular concern, with Zika virus circulation reported in Solomon Islands (2016) (94) and Fiji (2015–17) (92).

Major outbreaks of other infectious diseases have also occurred in the region, at times necessitating an international response. For example, GOARN has supported national ministries of health in the response to outbreaks of dengue (Timor-Leste in 2005) and leptospirosis (Philippines in 2009 and Fiji in 2016) (124).

LIMITATIONS IN EVALUATING BURDEN AND RISK

It is difficult to accurately assess and classify high-burden, high-risk and outbreak-prone infectious diseases in terms of their current and potential burden of disease, as well as their current or potential social and economic impacts across the Indo-Pacific region.

GBD data do not include separate estimates for all infectious diseases of interest in this region. For example, data are not available for leptospirosis, recently emerging infectious diseases such as Zika, AMR pathogens such as artemisinin-resistant malaria and methicillin-resistant *Staphylococcus aureus*, or low-burden outbreak-prone infectious diseases such as novel influenza A viruses, coronaviruses, Nipah virus and polio. Estimates for the current or potential burden and impact of these diseases are presented in individual studies, but it is difficult to extrapolate these findings to the Southeast Asian and Pacific regions as a whole.

GBD data are unavailable for several Pacific countries, including Cook Islands, Nauru, Niue, Republic of Palau, Tokelau and Tuvalu. The availability and quality of data reported from other Pacific countries varies. In many cases, GBD estimates are based on modelling rather than reported data in the Pacific.

Even for diseases for which GBD data are available, there are several limitations to data collection, reporting and interpretation. The quality of GBD data is reduced by time lags in available data; absence of data from specific regions, age groups or time periods; and other sources of unreliability. Data are unavailable at the subnational level for many countries, which impedes assessment of the heterogeneity of disease burdens at the local level.

In the absence of sufficient data, disease burden is estimated using other variables, such as regional trends or demographic and socioeconomic indicators. These modelling exercises attempt to counteract systematic biases or inaccurate reporting in country-collected data. Nonetheless, given the limitations outlined above, the GBD estimates should be interpreted with caution, and may not present the most reliable picture of infectious disease burden in the region. This applies in particular to the Pacific, where small population sizes mean that there are wide ranges in estimates for many infectious diseases.

PART

02

Preparedness



Regional progress

Countries are required under the International Health Regulations (2005), and encouraged under the OIE Terrestrial animal health code and Aquatic animal health code, to assess their capacity to prevent, detect and respond to human and animal health threats. Assessments are carried out using Joint External Evaluations (JEEs) and State Party self-assessments, and Performance of Veterinary Services (PVS) evaluations.

JEE is a voluntary process involving external evaluation and country input to assess progress towards full IHR implementation (38). Countries can request a JEE mission to help them identify their most urgent health systems needs to improve preparedness for health security threats. Each of these sections reports on a number of technical areas, with one or more indicators for the full implementation of IHR core capacities. As part of the evaluation process, a score between 0 and 5 is assigned to each of 48 indicators (Box 6), and qualitative comments are made about strengths and areas for improvement (38). Once completed, JEE country reports are publicly available through WHO. It is intended that each country undergo a baseline JEE to assess current capacity and capabilities, followed by evaluations approximately every five years. Cambodia, the Federated States of Micronesia, Indonesia, Laos, Myanmar and Vietnam have completed JEEs and their scores are summarised in Appendix B. Timor-Leste completed a JEE mission in 2018, but it was not published at the time of preparing this report.

The JEE process is supported by National Action Plans for Health Security in some countries. This is a multiyear country-led planning process to accelerate implementation

of IHR core capacities and adopts a One Health-oriented, whole-of-government approach. Cambodia, Indonesia, Myanmar, Papua New Guinea and Vietnam have completed (or are developing) National Action Plans for Health Security. Processes are in place to bring together public and animal health stakeholders through IHR-PVS National Bridging Workshops that are facilitated by WHO and the OIE. At the time of writing this report, Indonesia had completed a National Bridging Workshop.

Although the JEE process is voluntary, all WHO Member States must conduct annual self-assessments of their progress towards establishing IHR core capacities. Since 2010, the national IHR focal point in each Member State has been asked to complete a detailed State Party Self-Assessment Report. Countries provide scores from 0 to 100 for their progress towards 24 indicators of 13 IHR core capacities.

Self-assessment reports are a useful source of information about progress towards implementation of the IHR. However, as each country completes a self-assessment report without an external evaluator, the reliability of the data for comparisons between countries and between years is limited. In some cases, there are discrepancies between the self-assessed scores and JEE scores where both are available. Between 2015 and 2018, WHO conducted a series of global consultations to revise the self-assessment tool. Since June 2018, a revised State Party Self-Assessment Annual Reporting (SPAR) tool has been available to support countries to report on the status of their national core capacities to the World Health Assembly (137). SPAR data for 2018 is used as part of the assessment of health security capacity in the Indo-

BOX 06

EXPLANATION OF JOINT EXTERNAL EVALUATION SCORES

- 1 **No capacity** Attributes of a capacity are not in place.
- 2 **Limited capacity** Attributes of a capacity are in development stage.
- 3 **Developed capacity** Attributes of a capacity are in place; however, there are issues concerning sustainability and funding.
- 4 **Demonstrated capacity** Attributes are in place and considered to be sustainable for a few more years.
- 5 **Sustainable capacity** Attributes are functional and sustainable, and the country is supporting other countries in their implementation

Source: WHO Joint External Evaluation tool (38).

Pacific region in this report. SPAR 2018 data was available for Cambodia, Cook Islands, Fiji, Indonesia, Kiribati, Laos, Marshall Islands, Myanmar, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, Vanuatu and Vietnam.ⁱ Country average SPAR scores for 11 indicators related to capacity to address infectious disease threats are shown in Appendix C.

PVS is the OIE tool for assessing the capacity of national veterinary services to meet international standards. The PVS process follows a pathway that involves evaluations, followed by gap analysis and follow-up missions, as well as specific tools for evaluating legislation, public-private partnerships, veterinary legislation and laboratories. Unlike JEEs, Member States can choose whether to make their PVS report publicly available. Ten countries in the region have completed at least one step in the PVS Pathway, but only the PVS evaluation report for Vietnam is publicly available. Although many countries choose not to publish their PVS reports, many make them available to a limited number of stakeholders such as partner governments and agencies. In the Pacific region, only Fiji, Papua New Guinea and Vanuatu have individual OIE membership, and only these countries have completed or commenced OIE PVS and gap analyses. Other Pacific Island countries are represented at OIE by the Pacific Community.

Part 2 of this report follows a similar structure to a JEE, with additional assessment of competencies in animal health and extent of cross-sectoral collaboration.

Although most PVS mission reports were not available, an assessment of preparedness for African Swine Fever based on PVS pathway mission reports of Cambodia, Laos, Myanmar and Vietnam was available (60). As

three of these countries have chosen to not make their PVS evaluations public, countries are not named when reporting specific findings from this report. Additional information sources include donor-funded scoping mission reports and academic literature.

The JEE and PVS instruments notably omit any guidance on integrating sex and gender into health security planning and response, despite the conclusions made by the UN Global Health Crises Task Force (36). The needs and rights of people with disabilities and other populations, such as ethnic minorities, are not addressed. The tendency for health planning to be dominated by technical experts frequently leads to failure to take into account social, cultural and economic determinants of health, including inequalities (138). Underrepresentation of women and people with disabilities on national and international planning bodies is likely to further contribute to this oversight. Accordingly, there is limited data available to assess regional capacity to prevent, detect and respond to health security threats that adversely affect socially excluded populations. Where possible, examples drawn from the academic and grey literature have been included to illustrate the types of risks that some population groups face.

7

COUNTRIES IN THE REGION HAVE COMPLETED JEEs

Cambodia, the Federated States of Micronesia,
Indonesia, Laos, Myanmar, Timor-Leste, Vietnam

10

COUNTRIES HAVE COMPLETED OR COMMENCED PVS

Cambodia, Fiji, Indonesia, Laos, Myanmar,
Papua New Guinea, the Philippines, Timor-Leste,
Vanuatu, Vietnam

6

COUNTRIES HAVE COMPLETED OR COMMENCED JEEs & PVS

Cambodia, Indonesia, Laos, Myanmar,
Timor-Leste, Vietnam

ⁱ IHR SPAR data are available here: <https://www.who.int/gho/ihr/en/>

Prevent

Capacity to prevent the emergence, importation and spread of infectious diseases at national and international levels requires implementation of wide-ranging core competencies. These include developing legislation and safeguarding financing, ensuring best practice in laboratories handling high-risk infectious agents and protecting national health security at points of entry. Key programs and health system capabilities need to be in place to identify and reduce the risk of emergence of novel pathogens (especially zoonoses), and prevent the emergence, re-emergence and spread of vaccine-preventable, foodborne and zoonotic diseases, and AMR.

National legislation, policy and financing

Countries in the Indo-Pacific region are progressing towards their obligations for strengthening their capacity to achieve core capacities in public health and animal health.

Southeast Asian countries addressed in this report self-assessed at 47–87% for implementation of legislation and financing for IHR core capacities in 2018. The five Southeast Asian countries that have published a JEE scored between two and four for the core competencies relating to legislation, policy and financing; most scored 3, representing ‘developed capacity’. Cambodia, Laos and Myanmar have developed national health security plans, drawing on the lessons learned through the JEE process.

In the Pacific, Fiji and Samoa self-assessed at 100% overall, and Cook Islands and Tuvalu self-assessed at 80%, indicating implemented capacities meet IHR requirements. However, five Pacific Island countries reported that they limited or very limited legislative, policy and financing capacity, with Nauru, Palau, Papua New Guinea, Solomon Islands and Vanuatu self-assessing at less than 50% across these indicators. A recent scoping mission in the Pacific region also found that many countries have outdated legal frameworks and legislation in the sectors that are relevant to health security and implementation of the International Health Regulations (15).

Of four Southeast Asian countries that were evaluated for their capacity to prevent incursion and spread of African Swine Fever, three countries have completed veterinary legislation missions through the PVS pathways (60). Most countries have legislation for animal health security

in place, and in some cases, this is comprehensive, or revisions are underway. However, in many cases, there are gaps in coverage and a lack of enabling regulations. One country was assessed as having no authority or capability, and lacked legislation in most fields of veterinary services activity; some countries had some capability but had not assessed the technical, social and economic applicability of their legislation.

One country achieved a higher level of advancement with good standards of legislation, but lacked legislation and regulations covering the whole veterinary sector. In general, compliance with legislation is challenged by the limited ability to raise public awareness and conduct enforcement activities. Important gaps include lack of definition of competent authorities, chains of command, lists of notifiable diseases, obligation to report, preparation of contingency plans, declaration of an emergency and systems for animal identification, border control and payment of compensation.

Financing for health, in general, varies considerably throughout the region (Figure 4). Global attention in the region is currently focused on accelerating progress towards universal health coverage, in the context of the Sustainable Development Goals (139). Keeping this objective in mind, the Lancet Commission on Investing in Health found that countries that increase their public health expenditure to more than 3% of gross domestic product make faster progress in reducing disparities in health outcomes and providing a basic package of care (140).

Availability and effectiveness of emergency funding for health emergencies or other natural disasters varies throughout the region (9–14). No Pacific Island countries have specific budgetary provisions available for health emergencies, but mechanisms are in place for countries to access national and international funding on a case-by-case basis as health emergencies arise (15,92–94). Specific financing arrangements for animal health emergencies across the region are non-existent in many countries, although some Southeast Asian countries have made access to limited funding directly available. Compensation schemes for loss of livestock during animal health emergencies also vary; some Southeast Asian countries have provided compensation payments following HPAI outbreaks, although with varying accessibility and effectiveness, but no country has a fully-developed compensation scheme in place for animal health emergencies (60).

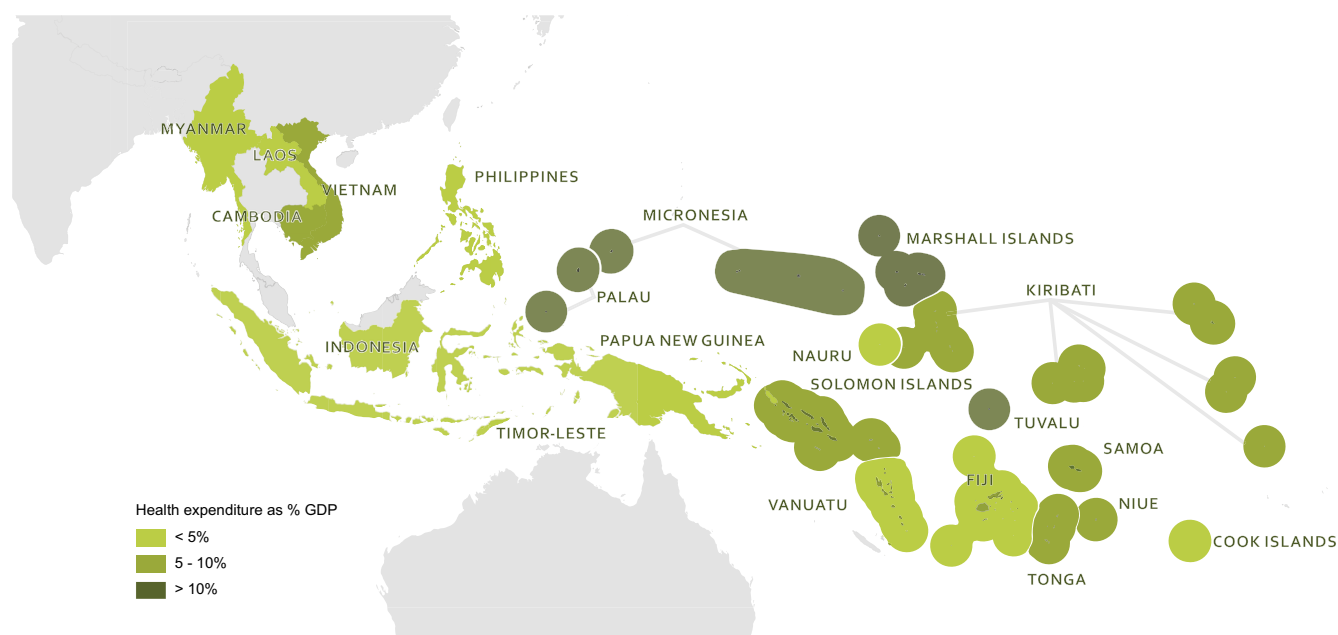


Figure 4: Health expenditure as percentage of GDP in the 22 focus countries in the Indo-Pacific region
Source: World Health Organization Global Health Expenditure database (2018)

Coordination, communication and advocacy

Implementation of core capacities in human and animal health relevant to addressing health security threats requires multisectoral, multidisciplinary national partnerships that support efficient, alert and responsive systems. This includes designation and functioning of a national IHR focal point for national and international coordination, reporting and response.

In 2018, Fiji self-assessed at 100% overall for IHR coordination and national IHR focal point functions. Several other countries self-assessed at 70–80% (Niue, Papua New Guinea, Samoa in the Pacific, and Myanmar, Timor-Leste and Vietnam in Southeast Asia), with other countries scoring lower. For the Southeast Asian countries that have completed JEEs, common strengths include evidence of coordination between ministries, and functional mechanisms for cross-sectoral collaboration are

in place. Examples of this functional collaboration include increasingly systematic information exchange between animal and human health surveillance units (9), and sharing of information about IHR capacities with other sectors and the media (14). The Pacific Health Security Coordination Plan 2017–2022 was developed to support regional work in improving coordination of efforts to achieve effective access to IHR core capacities (141). Nonetheless, countries should continue to strengthen multisectoral, multidisciplinary collaboration and communication mechanisms, including sharing lessons learned.

Antimicrobial resistance

Global initiatives have been launched to reduce the risk of emergence and spread of AMR, limit excessive antimicrobial usage (AMU), and promote prudent and responsible AMU in humans and animals. Action on AMR is a cornerstone of the tripartite collaboration between WHO, the FAO and the OIE through which these organisations work together to address health risks at the interface of human and animal ecosystems (142). WHO released a Global Action Plan on Antimicrobial Resistance in 2015 that recognises surveillance and monitoring of AMU in humans and animals as one of the prime strategies for responding to AMR (143), along with improving the capacity of laboratories and surveillance systems to detect AMR. As of December 2018, Cambodia, Laos, Myanmar and the Philippines had enrolled in the WHO Global Antimicrobial Resistance Surveillance System (GLASS).

There are several coordinated activities under the tripartite agreement to address AMR in the Indo-Pacific region. For example, FAO-RAP is facilitating the development of a series of regional guidelines for AMR in food production and agriculture. The guidelines will address AMR surveillance in foodborne bacteria from healthy animals intended for food consumption, AMR surveillance in animal pathogens recovered from clinically or subclinically diseased food-producing animals, AMR monitoring in animal settings and in the environment, and monitoring of AMU in food-producing animals. The Fleming Fund is also supporting a range of national and regional initiatives to address AMR in humans and animals throughout the Indo-Pacific region.

In Southeast Asian countries, AMR surveillance programs have been implemented to varying degrees (scores ranging from 2 to 4 for countries that have completed JEEs), and findings are shared with relevant stakeholders, including clinicians and policy makers, through annual reports, antimicrobial treatment guidelines and surveillance reports (109). National HCAI guidelines and standard operating procedures have been developed in all countries that have completed JEEs. Nonetheless, there is only partial implementation and limited monitoring of HCAI guidelines, and infrastructure and human resources for HCAI personnel are not adequate in many settings (109).

In the Pacific region, AMR is increasingly recognised as a public health priority. Fiji was the first country in the Pacific region to develop a national AMR action plan in 2015; many other countries have not developed national AMR action plans or taskforces (15). Accordingly, many countries do not have effective infection prevention

and control systems in place, and there is very limited collection, collation and analysis of AMR data. As of December 2018, no Pacific island countries had enrolled in GLASS. Nonetheless, there is growing evidence that AMR is a public health threat in the Pacific region, with widespread multidrug-resistant TB (144) and evidence of AMR in hospital settings (15).

Across the region, a common weakness is the lack of designated national AMR laboratories, and lack of human resources and laboratory infrastructure for AMR activities. This hampers AMR surveillance efforts in humans, animals and the environment (15,109).

Antimicrobial stewardship varies between countries. In some countries, antimicrobial stewardship policies in public health are being developed, whereas, in other countries such as Vietnam, stewardship policies have already been implemented in health settings (10). Efforts are underway to develop antimicrobial stewardship policies in animal health, and Indonesia and Vietnam banned the addition of antimicrobial growth promoters to animal feed at the start of 2018. Design and monitoring of stewardship policies is hampered by limited data on AMU in food-producing animals and the complexity of antimicrobial supply chains in the veterinary sector (Figure 5). Modelling studies suggest that Southeast Asia has one of the fastest growing rates of antibiotic consumption in food animal production in the world, due to an increased demand for low-cost animal protein and shifts towards intensive production systems, as well as continuing ease of access to antimicrobials (70). The projected rate of growth of antibiotic use in livestock production in Myanmar, Indonesia and Vietnam (205%, 202% and 157% by 2030 respectively) is amongst the highest in the world (70), but restricted access to antimicrobials is in general poorly regulated and enforced throughout the region.

AMU and AMR are complex issues that require collaboration across sectors at both the policy and operational levels. Overall, action on AMU and AMR is more advanced in the public health sector than in the animal health sector, and there is poor collaboration among actors in the public health, animal health, pharmaceutical and food sectors. Collaboration between the public and private health sectors in most countries requires considerable strengthening. Limited information is available in all countries on whether antimicrobial stewardship guidelines (if in place) are being implemented in the private sector, including private pharmacies, private practitioners and private clinics, or in the veterinary sector.

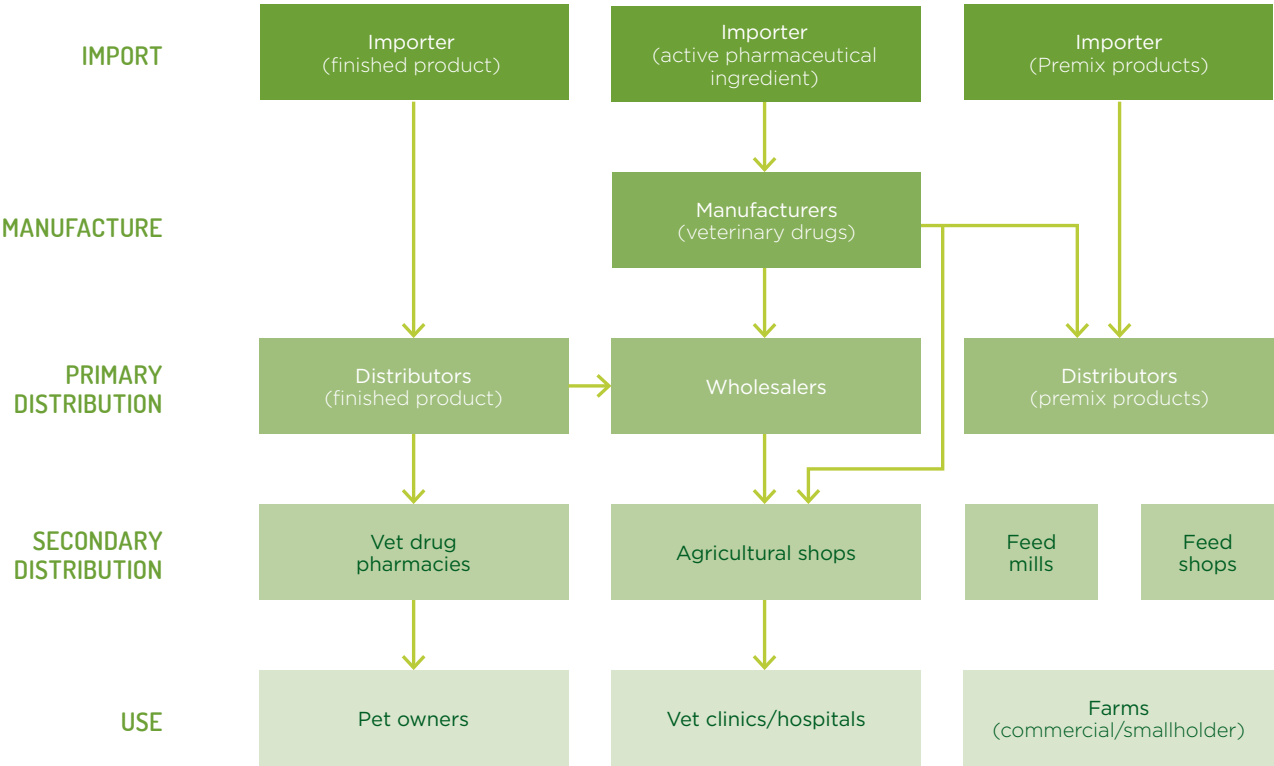


Figure 5: Antimicrobial supply chain in the veterinary sector
Source: adapted from a figure presented by OIE at a FAO-RAP consultation meeting on developing regionally harmonised guidelines for monitoring of antimicrobial use in food-producing animals, November 2018, Bangkok, Thailand.

Zoonotic diseases

Recent epidemics of SARS, Nipah virus and avian influenza demonstrated the vulnerability of Southeast Asian countries to zoonotic disease threats and highlighted the role of weak animal health capacity in regional health security (145). However, capacity to prevent zoonotic disease events remains poor in the region; across the 22 focus countries, the majority self-reported their capacity at only 20% in 2018. Of the countries that have completed JEEs in the Southeast Asian region, most scored 2 or 3 for indicators relating to prevention of zoonotic disease emergence. Vietnam showed demonstrated capacity to adequately prevent zoonotic disease events (10).

The Pacific is vulnerable to zoonotic disease outbreaks, as demonstrated by the large leptospirosis outbreak in Fiji in 2012 following successive severe flood events (Box 7). Fiji subsequently developed a national leptospirosis control program through a One Health strategy and collaboration (146). However, in general, animal health issues are perceived to be of lower importance in the Pacific region, in part because it has not experienced major outbreaks of emerging zoonotic diseases that have occurred elsewhere in the world.

There is limited evidence that gender considerations are included in programs that aim to prevent zoonotic disease transmission in the Indo-Pacific region. The recent evaluation of the FAO Emergency Animal Prevention System (EMPRES) found that although FAO is committed to gender mainstreaming as a core principle of its work to build resilience to food safety emergencies and transboundary animal diseases, there were no consistent strategies in place to ensure gender analysis of implemented programs, and few data available on the impacts and outcomes of EMPRES programs disaggregated by gender (152). Emergency responses were particularly less likely to incorporate gender dimensions. Some areas of work under EMPRES did integrate gender perspectives. For example, the Emergency Centre for Transboundary Animal Diseases of FAO-RAP used participative and medical anthropological approaches to investigate gender and diversity issues for transboundary animal diseases. This approach was used to identify deficiencies in risk communication by international organisations working to address transboundary animal diseases in Cambodia (152).

Gender norms, gendered division of labour and access to resources can lead to different outcomes for women and men who are exposed to zoonotic diseases (17). Men tend to be responsible for larger herd animals, work on commercial farms, and have exposure to wild animals due to such activities as mining and logging. Women's exposure arises from caring for animals in small household farms that often include poultry (17). Worldwide, there have been more cases of H5N1 avian influenza in women

(53%) than men (47%), but more men have contracted H7N9 avian influenza (55%) than women (45%) (153). Understanding gendered roles and behaviours are critical to understanding how infectious disease exposure and outcomes vary by gender. There are a number of gender dimensions that should be taken into account when planning prevention and response strategies for zoonotic diseases such as HPAI (Figure 6).

BOX 07

LEPTOSPIROSIS IN THE PACIFIC ISLAND COUNTRIES

Leptospirosis is one of the most widespread zoonotic diseases worldwide, with particularly high incidence and high fatality rate in the Pacific. Flooding and heavy rainfall have been associated with numerous outbreaks of leptospirosis around the world. An increased frequency of extreme weather events such as cyclones and floods due to climate change are likely to lead to result in an upsurge in the frequency and magnitude of leptospirosis outbreaks (147). Outbreaks of leptospirosis have been reported in Fiji in 2019 (148) and 2012 (149), and in 2008 in New Caledonia (150), and smaller seasonal outbreaks occur throughout the Pacific (151). The 2012 outbreak in Fiji following successive severe flood events was one of the largest reported in the South Pacific. A total of 1 217 suspected cases occurred, 83% within 6 weeks of the first flood events (149). Most cases occurred in males (61%) and indigenous Fijians (59%). The median age of cases was 30 years. The outbreak investigation found that multiple animal reservoirs may have been involved (149). Rodents, cattle, pigs and dogs are all likely to be important carriers for leptospirosis. As observed in Fiji, the involvement of multiple animal reservoirs in a single outbreak highlights the need for integrated human, animal, and environmental health strategies for leptospirosis control in the region. Increasing frequency of extreme weather events in the Pacific also calls for strengthened surveillance and emergency response capacities.

HIGHLY PATHOGENIC AVIAN INFLUENZA AND GENDER

Outbreaks of highly pathogenic avian influenza (HPAI) have different impacts on men and women.

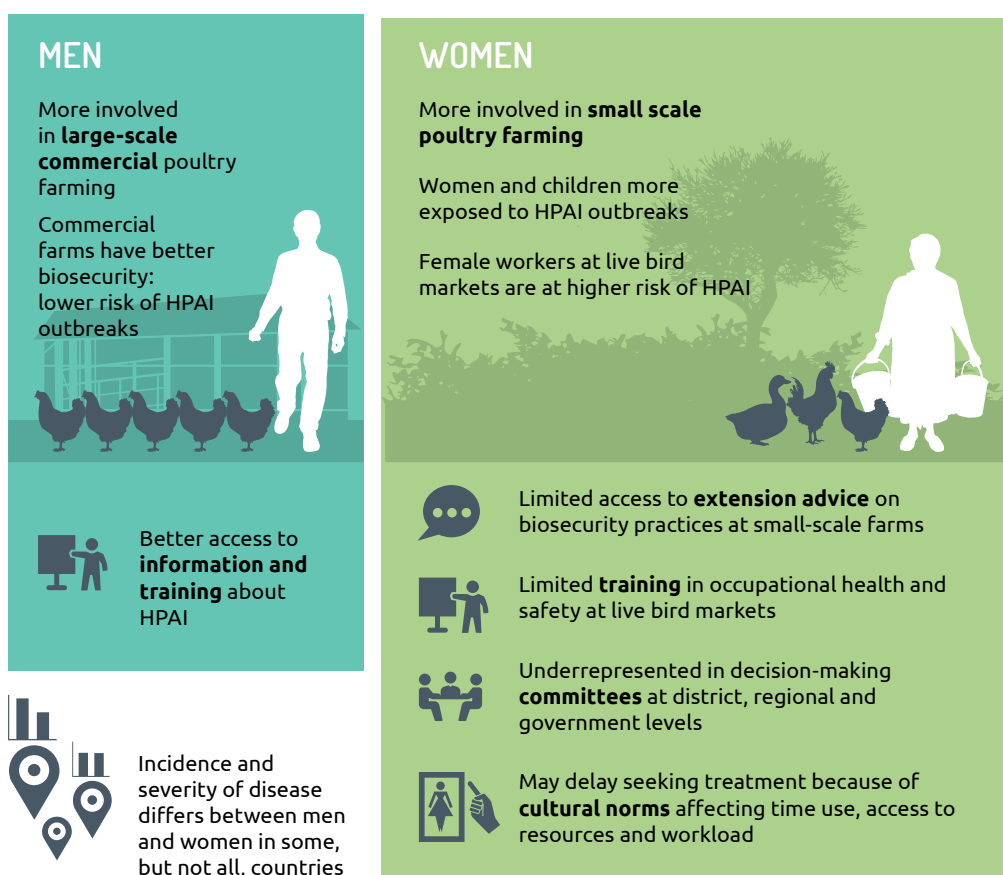


Figure 6: Highly pathogenic avian influenza and gender

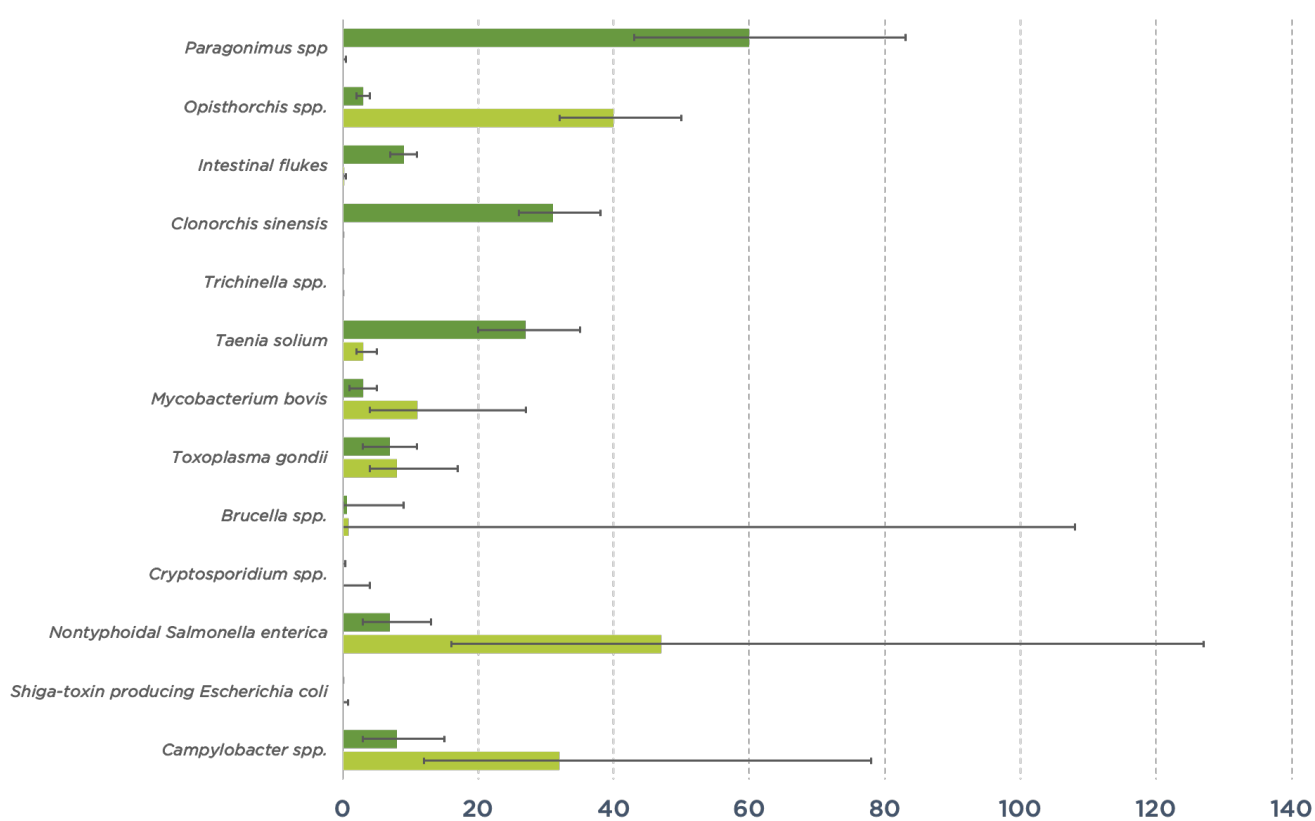


Figure 7: Disability-adjusted life years per 100,000 population due to consumption of animal-source foods harbouring food-borne pathogens, 2010

Source: Unpublished data provided by Min Li and Professor Arie Havelaar.

Food safety

WHO estimates that 1 in 10 people fall ill every year from eating contaminated food, and 420 000 die as a result (154). Foodborne diseases are interlinked with food safety threats that have been found to be most severe in low- and middle-income countries. These diseases are related to a complex mix of factors, ranging from poor water quality and hygiene to lower levels of education and insufficient food safety legislation or implementation of such legislation. The total burden of infectious foodborne disease for specific pathogens throughout the world has recently been estimated. Figure 7 presents the total DALYs for important foodborne pathogens in the region.

Data for Southeast Asia refers to WHO SEAR B region, which includes Indonesia, Sri Lanka, Thailand and Timor-Leste. Data for Western Pacific refers to WHO WPR B region, which includes Cambodia, China, Cook Islands, Fiji, Kiribati, Laos, Malaysia, the Republic of the Marshall Islands, the Federated States of Micronesia, Mongolia, Nauru, Niue, Palau, Papua New Guinea, the Philippines, the Republic of Korea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu, and Vietnam.

Capacity to prevent food safety events is generally poor to moderate. Food safety laws and regulations are in place in most countries, but, as six countries that completed JEEs scored between 2 and 3 for this indicator, there is considerable work to be done to strengthen capacity to address food safety threats in the region. Training of food inspectors has been conducted in some countries, and a multi-ministerial approach combining food, public health and animal production sectors is evident in some countries. For example, Vietnam has established a National Inter-Ministerial Standing Committee on Food Safety, led by the Deputy Prime Minister (10).

Effective food safety processes require an integrated One Health approach (155), and better integration between food laboratories, veterinarians involved in livestock processing, and agencies involved in public health surveillance and outbreak response. In the region, only Samoa has self-assessed at 100% for implementation of a multisectoral collaboration mechanism for food safety events, with most countries reporting their capacity to be at 20–60%. There is a shortage of trained food safety personnel, including food safety officers and food laboratory analysts, and those who are employed in these roles require continuing education and training. Food safety surveillance and monitoring data are rarely used for action, and outbreak investigations are not appropriately documented, including lessons learned and recommendations for preventing future outbreaks.

Laboratory biosafety and biosecurity

Core capacities in biosafety and biosecurity specifically relate to having facilities in place to safely conduct research on high-risk pathogens, especially to support development of drugs, diagnostics and vaccines for these pathogens.

Biosafety level 3 (BSL3) laboratories in public and animal health sectors are available in some Southeast Asian countries, which have developed manuals addressing general biosafety and biosecurity issues in laboratories. There are ongoing 'train the trainers' programs in biosafety and biosecurity. Highlights include Myanmar's national health laboratory, which has been designated as a WHO-accredited laboratory (14), and that Indonesia has incorporated biosafety and biosecurity into university curricula (9). Countries that have completed JEEs have not yet fully implemented a whole-of-government biosafety and biosecurity system, or biosafety and biosecurity training and practices.

There are no BSL3 laboratories in the Pacific, and no storage or processing of high-risk pathogens or toxins (15). Accordingly, many Pacific countries do not have whole-of-government biosafety and biosecurity systems in place to the extent required by the IHR, and many countries do not have mechanisms for licensing laboratories in general (15).

Overall, considerable strengthening is needed to address biosafety and biosecurity in the Indo-Pacific region. In general, there is a lack of adequate biosecurity legislation, regulations and guidelines; infrastructure and human resources; and awareness and commitment among some stakeholders. It is critical that laboratory workers who could potentially be exposed to high-risk pathogens are protected. Further comprehensive and continuing training of staff working in biosafety and biosecurity should be a priority, and vaccination policy for laboratory staff should be introduced in many settings.

Immunisation

Immunisation is one of the most successful public health interventions in history, but high vaccine coverage rates must be achieved and maintained to ensure that populations are protected from vaccine-preventable diseases. Low vaccine coverage is a product of ineffective distribution channels, cold chain disruptions, other quality control issues and, increasingly, vaccine hesitancy – that is, reluctance or refusal to vaccinate despite the availability of vaccines. WHO considers vaccine hesitancy as one of the top 10 threats to global health in 2019.ⁱ

Overall, countries in the Indo-Pacific region demonstrate important strengths in immunisation capacity. The WHO Expanded Program on Immunisation is well established throughout the region, with long-term, national-level immunisation plans in place and strong political commitment towards the program. In general, cold chains are in place for vaccine delivery and storage, and vaccine stockouts are rare.

However, considerable challenges remain. Although an increasing number of Pacific countries are reaching a minimum of 90% measles-containing vaccine coverage target (Figure 8), most countries in the region have not yet reached this level, and even fewer are reaching or maintaining 95% coverage, which is the level required to ensure herd immunity for measles.⁽¹⁵⁶⁾ Measles-containing vaccine coverage remains alarmingly low in several countries, leaving these countries at risk of measles outbreaks (Figure 9). Coverage with diphtheria-tetanus-pertussis (DTP)-containing vaccine is generally better than measles-containing vaccine coverage, but still falls short of the 90% DTP coverage target set by WHO (Figure 9). Pneumococcal vaccination programs have been introduced in some countries in the Indo-Pacific region, with highly variable coverage: less than 20% in Myanmar and Papua New Guinea to more than 95% in several Pacific island countries (Figure 9).

The Indo-Pacific region has experienced several outbreaks of vaccine-preventable diseases in recent years. A 2018 outbreak of vaccine-derived polio in Papua New Guinea, 18 years after this country achieved polio-free status, revealed the continuing vulnerability of populations to vaccine-derived poliovirus in the face of declining vaccine coverage. A measles outbreak is ongoing in five regions of the Philippines since early 2019, with 25 956 confirmed cases and 381 deaths from 1 January to 30 March 2019 (156). Vaccine hesitancy is a possible factor contributing to the decline in measles-containing vaccine coverage during the past decade in the Philippines, where a dengue vaccine controversy led to dramatic declines in public confidence in vaccine safety overall (157).

Across the region, there are challenges in reaching remote populations, including ethnic minorities and populations in conflict-affected areas (9,11-14). In some settings, there is inadequate operational support for routine immunisation and outreach services, and an urgent need to update cold chain systems to ensure that vaccine coverage targets can be reached. Limited data are available on immunisation coverage for people with disabilities in the Indo-Pacific region. Although relative vaccination coverage among people with and without disabilities is generally similar in low- and middle-income countries, discrepancies exist between countries, across sociodemographic groups, and for different types of disabilities and vaccine programs (158). Although limited evidence is available, several studies report that people with developmental and intellectual disabilities are more likely to miss out on vaccines (159-161). In a study in Thailand, seasonal influenza vaccination coverage was reported to be higher and increasing over time among people with chronic conditions, compared with lower and decreasing over time among people with intellectual disabilities (162). This is particularly concerning because people with disabilities are at higher risk of adverse outcomes of influenza (Figure 10).

ⁱ Ten threats to global health in 2019 (<https://www.who.int/emergencies/ten-threats-to-global-health-in-2019>)

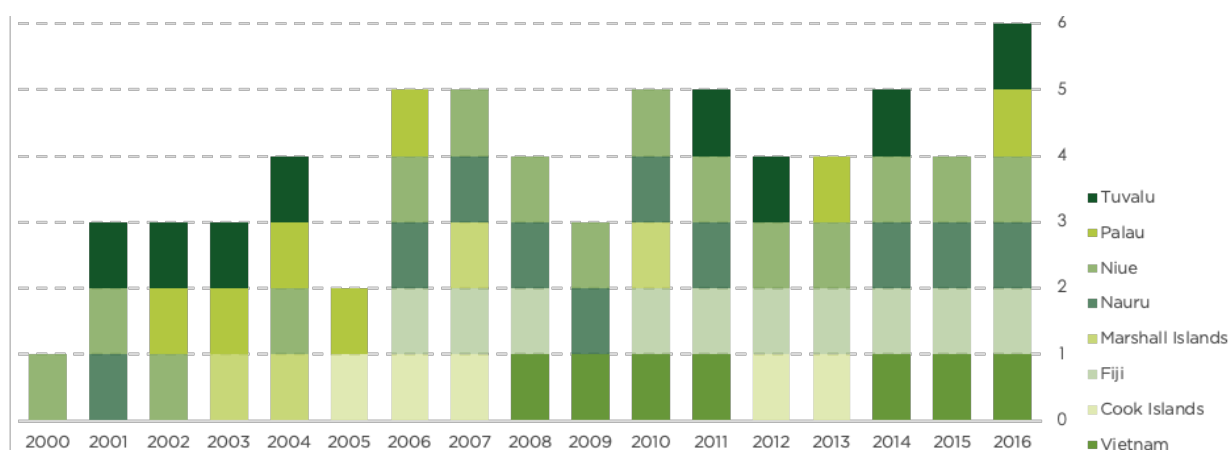


Figure 8: Countries reaching at least 90% coverage with the measles-containing vaccine since 2000

Source: ESCAP Online Statistical Database based on data from the SDG Global Database (WHO), 25 July 2018 (http://data.unescap.org/escap_stat). Data for each country represents proportion of the target population covered by the first dose of measles-containing vaccine in their national program.

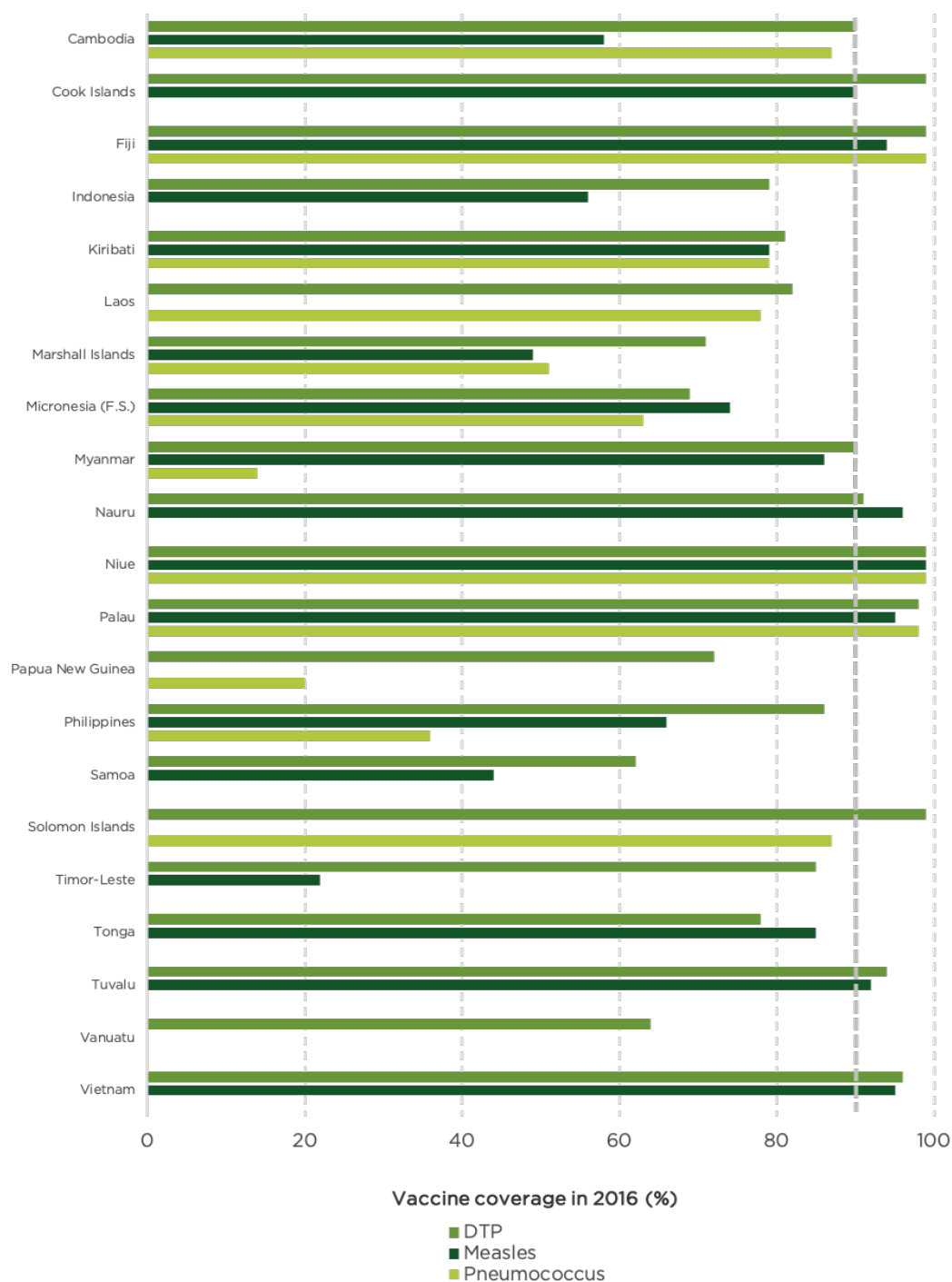


Figure 9: Vaccine coverage in the Indo-Pacific region in 2016

Source: ESCAP Online Statistical Database based on data from the SDG Global Database (WHO), 25 July 2018 (http://data.unescap.org/escap_stat). Data for each country represents proportion of the target population covered by vaccines included in their national programme (SDG indicator 3.B.1); for measles, this is defined as first dose of measles-containing vaccine in their national program; for DTP, this is three-dose diphtheria-tetanus-pertussis vaccine; for pneumococcus, this is three-dose pneumococcal conjugate vaccine for countries where this vaccine is included in their national schedule.

NO ONE LEFT BEHIND

Breaking down the barriers to influenza vaccination for people with disability

Seasonal influenza vaccination reduces the risk of illness and death, especially for vulnerable populations at high risk of complications, including pregnant women, young children, people over 65 years of age, healthcare personnel and people with disability.









PEOPLE WITH DISABILITY	
<ul style="list-style-type: none"> • Less likely to have influenza vaccine in many settings • More likely to have complications from seasonal influenza 	
BARRIERS TO VACCINATION FOR PEOPLE WITH DISABILITY	POTENTIAL SOLUTIONS
 <p>Accessing information about vaccine programs</p>	 <p>Use multiple health and risk communication strategies and modes (e.g. to ensure access for people with auditory or visual disability)</p>
 <p>Travelling and accessing a health facility</p>	 <p>Ensure that health facilities have accessible entries Consider mobile clinics to reach people who have difficulty travelling to health facilities</p>
 <p>Negative attitudes by healthcare providers towards people with disability</p>	 <p>Implement training programs and policies for health workforce and society to reduce stigma and discrimination experienced by people with disability</p>
 <p>Paying for health services, including vaccines</p>	 <p>Offer free or subsidised influenza vaccines for at-risk groups, including people with disability</p>

Figure 10: Breaking down barriers to influenza vaccination for people with disability

Points of entry

Points of entry represent key points for implementation of measures to prevent the international spread of infectious diseases. Points of entry include airports, sea ports and land border crossings. Countries throughout the region vary in their level of implementation of routine capacities at IHR-designated points of entry (self-assessed scores of 20–80%, averaging 56% overall). These include quarantine and inspection services for animals, animal products, food, food ingredients, medical products, vectors, hazardous materials and agents and human remains. The effectiveness of public health responses at points of entry is generally weaker (self-assessment scores averaging 47% overall).

According to JEEs, designated points of entry in Southeast Asia generally have access to trained personnel and appropriate medical services, including diagnostic facilities, for rapid assessment, care and transportation of ill travellers. Staff at points of entry have been trained in inspection procedures to ensure a safe environment at facilities. Simulation exercises for responding to mass casualty events have been conducted. Indonesia has a publicly accessible system in place for real-time recording and reporting of monitoring and inspection at designated points of entry.ⁱⁱ However, standard operating procedures (SOPs) across all points of entry are not in place throughout the region, and human resources and infrastructure are inadequate for full implementation of screening, isolation and quarantine procedures. There is weak cross-border collaboration and information sharing with neighbouring countries, despite shared land borders and close proximity by air travel.

Self-assessments demonstrate that points of entry in the Pacific region are generally not compliant with IHR requirements (15). Airports do not have protocols in place for responding to incoming passengers with suspected infectious diseases. Airports generally have medical rooms available, but lack key facilities, including decontamination areas and appropriate personal protective equipment. Tuvalu has a new airport with a decontamination area and segregated medical assessment room, which is consistent with IHR requirements but has not been formally assessed through a JEE (15).

Sea ports throughout the Pacific region do not have sufficient facilities or protocols in place to manage health security threats (15). This is particularly concerning given relatively high volumes of tourists, workers and animal entry via sea ports. Fiji, Samoa and Solomon Islands have increased connectivity, particularly through additional air links, to Asia and other Pacific island countries. While some screening facilities exist, there is limited inter-sectoral dialogue between health and other agencies and requires further strengthening for health security response and preparedness activities (92–94).

Considerable unmanaged illegal and informal trade of animals and animal products occurs in the region, particularly via land borders in Southeast Asia. The PVS evaluation follow-up missions in four Southeast Asian countries determined that all four countries had very limited capability or capacity to control their borders, including the control of live animals, meat and other animal products (60). Although countries have formal controls in place at major land border crossings, these are focused on documentation and not on inspection of animals or animal products. Most countries have legislation to support application of quarantine and border security procedures, but legislation is not always compliant with international standards or based on comprehensive risk analysis. An additional concern is the lack of authority to control animal feed safety at points of entry. Swill feeding (feeding food scraps to pigs) is widespread in the region (60). This represents a major risk for incursion and spread of pig diseases such as ASF, and could plausibly increase the risk for entry of emerging zoonoses transmitted from pigs or pig products.

ⁱⁱ See www.kespe.depkes.go.id

Detect

Capacity to detect infectious disease cases and events is an essential function of health systems. Early detection of outbreaks is necessary if these are to be controlled before substantial spread, and comprehensive, accurate identification of cases is necessary to provide treatment, understand the burden and epidemiology of infectious diseases, and allocate resources effectively. Capacity for detection includes surveillance, health information systems, laboratory diagnostic capability, and epidemiological expertise to transform surveillance data into useful, actionable intelligence to support decisions and policies. Capacity for detection must extend to the animal health sector, to enable early identification of emerging or spreading zoonoses, before major impacts on human health occur.

National laboratory systems

Across the Indo-Pacific region, laboratory capacity to detect priority diseases in humans and animals is highly variable. Specimen referral and transport capacities are generally well implemented, with many countries self-assessing at 100% for this indicator. Although there are some accredited and/or internationally recognised referral laboratories in the region, many national laboratories are not yet able to test for priority pathogens (11,12,14,15). Even where laboratory diagnostic capability is relatively well established in national reference laboratories, access to laboratory diagnostic capacity at regional and local levels remains limited in many countries. Point-of-care tests are available in some areas for some important diseases (such as HIV/AIDS and malaria), but coverage is far from complete (9,14,10–13). This means that there are substantial delays in diagnosis and initiation of treatment in many settings. There is also a risk of overreliance on point-of-care tests in the absence of adequate technical training and laboratory verification; this may result in false positive or false negative diagnoses, with adverse consequences for the individuals involved and population-level surveillance (9–14).

There are 52 OIE reference laboratories, covering 37 diseases or topics, in eight countries in the wider Asia-Pacific region, although most of these laboratories are not located in the 22 focus countries of this report. Nonetheless, their presence supports regional laboratory capacity, because reference laboratories frequently receive and test samples sent from countries in the region without these

facilities. Reference laboratories participate in 'twinning' programs with candidate laboratories to exchange knowledge and skills over a defined project period.

For example, the Australian Animal Health Laboratory is currently twinning with the Regional Animal Health Office No. 6 Ho Chi Minh City (RAHO-6 HCMC) in Vietnam, to exchange knowledge on emerging infectious diseases of swine.

Southeast Asian countries that have completed JEEs scored 3 or 4 with respect to national laboratory systems, indicating developed capacity overall. Most states in Southeast Asia have a national animal health laboratory. Indonesia has a well-developed network of national and regional reference laboratories for human and animal health. The public health reference laboratories can detect most infectious diseases listed in the country's National Early Warning Alert and Response System. The veterinary reference laboratories can detect 25 different infectious diseases and are integrated with regional networks, including the Australian Animal Health Laboratory. Other countries in the region make use of regional and international laboratory networks (such as WHO and FAO networks) to strengthen their capacity. For example, Laos has developed a specimen transport and referral system to ship specimens overseas when tests cannot be performed in-country. Some countries have additional support through access to nongovernment research laboratories, such as the Institut Pasteur in Cambodia. Several countries in Southeast Asia participate in external quality assurance programs for selected pathogens provided by WHO. Animal laboratory evaluations are generally confidential; therefore, more thorough analysis of regional animal laboratory capacity in Southeast Asia is not possible.

Several Pacific Island countries self-reported their laboratory capacities at 80% or higher overall in 2018, including Cook Islands, Fiji, Kiribati, Nauru, Niue, Samoa and Tonga. However, recent scoping mission reports identified laboratory capacity as an area that requires significant additional investment if regional health security is to be improved (15). Critical activities to strengthen laboratories include further training and capacity development, twinning of laboratories in the Pacific with laboratories external to the Pacific, structured developmental pathways for laboratory staff, appointments for resident pathologists and improved systems for sample referral. The scoping missions also found that most countries in the Pacific lack diagnostic capacity for several endemic and emerging infectious

diseases of public health importance, do not have external quality assurance mechanisms in place, and experience regular stockouts of essential reagents and supplies.

In contrast to national laboratory facilities, subnational public and animal health laboratory capacity remains poorly developed or absent in much of the Pacific region (15).

Pacific countries rely heavily on regional laboratory networks to send samples for diagnosis to Fiji, as well as further afield to Australia, New Zealand and the United States (15). Substantial efficiencies could be gained through further strengthening of Pacific regional research networks, and focusing on coordinating improvements to laboratory capacity across the human and animal health sectors, and between countries. For example, Fiji is currently making substantial improvements to its laboratory capacity across multiple sectors, but there is limited national strategic multisectoral coordination of these efforts (92). A substantial upgrade of the Fiji National Public Health Laboratory (NPHL) is under way that will enable the NPHL to serve as a regional dengue, Zika and chikungunya reference laboratory. At the same time, upgrades and construction of three veterinary laboratories are planned. Both the Ministry of Agriculture laboratory and the Biosecurity Authority of Fiji are upgrading their veterinary laboratories to biosafety level 2 facilities, and the Fiji National University is also constructing a veterinary hospital with state-of-the-art veterinary laboratories (92).

Surveillance

The quality of indicator-based and event-based surveillance is fair to good in Southeast Asian countries (JEE scores ranged from 3 to 4, and self-assessment scores from 60–80%). Countries have established early warning and response systems for detection of national priority diseases, with weekly reporting from frontline and district-level health facilities well established. Timely and complete indicator-based surveillance has been largely achieved in some countries and is improving in others. The quality and comprehensiveness of surveillance data collection remains a common area for strengthening throughout the region (109).

The quality of indicator- and event-based surveillance varies considerably in the Pacific, and generally does not meet IHR requirements. The Federated States of Micronesia has achieved capacity in indicator- and event-based surveillance (13). Fiji implemented a digital event-

based early warning and response system for outbreak-prone diseases following Tropical Cyclone Winston in 2016, but the national surveillance system requires urgent upgrading (92). Other Pacific countries have limited surveillance capacity that is restricted to a few diseases or syndromes, and very limited capacity for timely detection of unusual events and outbreak-prone diseases (15). The Pacific Public Health Surveillance Network (PPHSN) integrates voluntarily reported surveillance data from several Pacific island countries and territories, and focuses on improving surveillance of outbreak-prone diseases in the region. The PPHSN includes the EpiNet response network of IHR focal points and other key country representatives. However, the effective functioning of the PPHSN is challenged by insufficient human resources and lack of integration of animal health information for priority zoonoses (15).

Secure, integrated surveillance information systems are lacking in most countries, although numerous (but often fragmented) electronic systems with a narrower scope exist. Ad hoc tools (including Excel spreadsheets)

BOX 08 ELECTRONIC HEALTH INFORMATION SYSTEM IN PAPUA NEW GUINEA

Since 2015, Papua New Guinea has been expanding its nationwide, state-of-the-art, mobile tablet-based electronic National Health Information System (eNHIS). Jointly funded by the Asian Development Bank and the Australian Government Department of Foreign Affairs and Trade, the eNHIS became the national health information system at provincial level across 22 provinces in 2018, replacing the legacy system. Near-real-time outpatient data and geolocated inpatient discharge data are now available to health authorities for analysis in dashboards and mapping, using simple in-built point-and-click visualisation tools.

The eNHIS enables secure, reliable, real-time data for authorities to monitor health security issues in Papua New Guinea, and has the potential to revolutionise the health sector.

are used commonly, and paper-based systems for data collection are relatively widespread. Most surveillance systems comprise multiple separate components, and there is limited integration of indicator- and event-based surveillance, electronic health records and laboratory surveillance; this limits the utility of data for analysis and decision making (9–14). Strengths in the use of electronic surveillance system components in the region include Papua New Guinea's new electronic National Health Information System (see Box 8), Indonesia's animal health information system (see Box 9), a national toll-free hotline for rapid reporting of unusual events in Laos, and a toll-free hotline for rapid response team members in Cambodia that supports voice recognition and automatic entry of data received via the hotline into an online database.

With the exception of Indonesia (see Box 9), animal health surveillance capacity in most countries in the region is poor, particularly in the Pacific.ⁱⁱⁱ However, this also reflects the fact that the Pacific region is free from many major transboundary and zoonotic animal diseases; accordingly, animal health is a relatively low priority.

Because of the limited animal health capacity, public health authorities effectively have near-exclusive responsibility for surveillance of zoonotic diseases in people in many Pacific countries. Priority zoonoses such as brucellosis, leptospirosis, zoonotic TB and influenza are not notifiable

diseases for humans (163), which means that very limited surveillance information is available.

Some countries in the Indo-Pacific region have conducted joint training of human and animal health workers, but routine integration of surveillance activities across human and animal health does not occur. Wildlife health surveillance is particularly weak, and this is a major gap in the region's capacity to detect novel zoonoses (9–11,14,12).

In most countries, passive detection of suspected infectious disease cases in people or animals relies heavily on nurses, community health workers and community animal health workers, many of whom are volunteers. These workers act as a frontline team in identifying and treating cases, tracing contacts, implementing disease control activities and communicating with local populations.

In this context, it is vital that health workers are able to reach all members of the community. This is most effectively achieved through representation of men and women, as well as migrant populations, and ethnic and religious minorities, as appropriate.

For example, the National Malaria Control Program in Cambodia selects two village malaria workers per village, preferably one woman and one man. In many settings, community animal health volunteers are mostly men, which may limit the reach of community-level surveillance and response.

ⁱⁱⁱ Information about animal health surveillance in the Pacific region was attained through expert consultation.

BOX 09

INDONESIA'S NATIONAL INTEGRATED ANIMAL HEALTH INFORMATION SYSTEM

iSIKHNAS is Indonesia's integrated animal health information system. The system is based on principles of people-centred design that provide immediate benefit to providers and users of health data at the local level. It uses existing technological infrastructure and allows flexible integration of data from a variety of sources (including SMS, spreadsheets and local data systems) to create a single, cloud-based database. Automated and customisable analyses and reports are available to users at all levels (local to national).

A modular design allows the system to expand and adapt according to user needs. It currently comprises more than 30 integrated modules, including disease case reports, treatments (with details of drug, amount, and person administering the treatment linked to the case), laboratory test results, vaccinations, disease control activities, individual animal movements

and husbandry activities such as artificial insemination. iSIKHNAS is used throughout the Indonesian archipelago and currently has more than 5 million registered users, including veterinarians, animal health workers and farmers; the database receives more than 50 000 SMS and instant messenger reports per day. Although developed as an animal health information system, the principles and technology are equally applicable to public health, and the integration of public health and animal health data.

iSIKHNAS was developed under the Animal Health Program of the Australia Indonesia Partnership for Emerging Infectious Diseases (2010–15) and is now supported almost entirely by the Government of Indonesia. Weather events in the Pacific also calls for strengthened surveillance and emergency response capacities.

Reporting

Countries are required to ensure timely and accurate reporting of health security-related events under their obligations to WHO and the OIE. Ideally, countries should be capable of reporting potential health events of international concern within 24 hours, consistent with their international obligations. Reporting capacity is not included as a SPAR indicator, therefore only information from JEEs has been used to inform assessment of reporting in the region.

Of the six countries with JEE assessments, most scored three for systems for efficient reporting, and two for the quality of reporting networks and protocols. Several countries have participated in simulation exercises such as the WHO IHR Exercise Crystal, as well as real reports of potential public and animal health emergencies such as Zika, circulating vaccine-derived poliovirus, avian influenza and suspected Ebola virus disease. The Federated States of Micronesia was the first country in the region to report an event of potential international public health concern under the IHR, with notification of a Zika outbreak in 2007, shortly after the IHR came into force (13). However, gaps have been identified which highlight challenges for the capacity of Pacific Island countries for timely reporting within countries and to the international community (15).

For both human and animal diseases, in some cases, timely reporting of potential health emergencies may be hampered by political and economic (including trade) concerns. For example, campaigns to 'stamp out' animal diseases through culling of livestock in some countries have created mistrust and fear among smallholder farmers (164). This can act as a disincentive to report animal diseases to local animal health workers and authorities. Routine information sharing across human and animal health sectors (especially wildlife) is limited in most settings, which further limits timely reporting of zoonotic disease events.

Human resources

Developing and maintaining a highly qualified public and animal health workforce with appropriate technical training and subject-matter expertise is vital for ensuring that countries have the human resources available to implement IHR core capacities. Applied epidemiology training programs are an important part of workforce development for health security. Field epidemiologists respond to outbreaks and reports of unusual events, among other public health concerns. TEPHINET is a global organisation that supports and coordinates field epidemiology training programs (FETPs), including setting standard competencies for advanced, intermediate and frontline FETPs. FETP and field epidemiology training program for veterinarians (FETPV) programs aim to contribute to health security by providing a highly trained public health (including veterinary public health) workforce, who contribute to public health capacity in their countries from the start of the program.

The Indo-Pacific Centre for Health Security has partnered with the Australian National University to deliver the ASEAN Health Security Fellows program. This program supports field epidemiologists in ASEAN countries to undertake the two-year Master of Philosophy in Applied Epidemiology, which is a TEPHINET-accredited advanced FETP course. Fellows complete their on-the-job training in their own countries and travel to Australia for intensive course blocks. The aim of this program is to increase the number of FETP advanced graduates who can then act as trainers and public health leaders in the region.

Despite these promising initiatives, there are gaps in public health workforce capacity throughout the region. Adequate capacity and skill are lacking at the local level in many settings. There are issues with recruitment and retention of qualified public health staff throughout the region, particularly in the Pacific, which has very high rates of emigration of qualified personnel to high-income countries, especially New Zealand, the United States

FIELD EPIDEMIOLOGY TRAINING PROGRAMS

The Global Health Security Agenda has set a target for at least 1 FETP graduate per 200,000 people

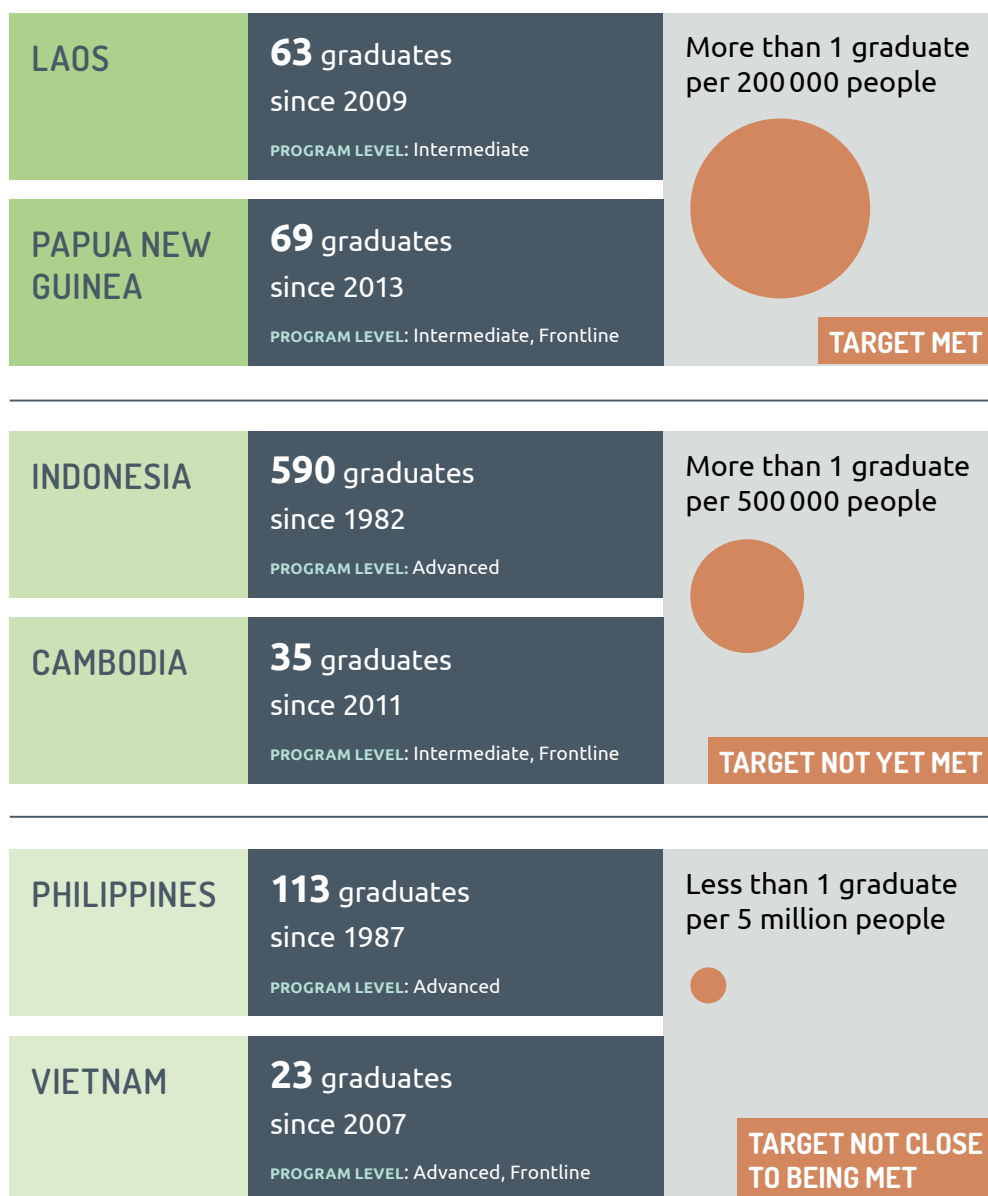


Figure 11: Field epidemiology training programs in the Indo-Pacific region

and Australia (15). Access to medical doctors varies substantially across the region. Some small Pacific island countries are relatively well served by medical doctors, but shortages are particularly acute in Cambodia, Indonesia, Laos and Papua New Guinea (Figure 12).

Gender disparities persist in health workforces (165). Nurses tend to be responsible for infection control in health care facilities, and community health workers represent the front-line of the health system. Multiple studies have demonstrated that female healthcare workers lack the status and power to influence decision-making and practices, which increases the risk of HCAI (17).

Initiatives are in place to improve the animal health workforce in countries in Southeast Asia. FETPVs are becoming increasingly common as part of efforts to improve regional health security. The Southeast Asia regional FETPV was established in 2009 has trained 94 veterinarians throughout the region, though this is far from reaching GHSA targets. Some countries (including Thailand) are integrating their FETP and FETPV programs to promote One Health coordination on infectious disease threats. Building on the success of the China FETPV, the FAO supported the development of national FETPVs in Indonesia and Vietnam in 2017, in addition to continued

support for the regional FETPV. Southeast Asian countries have also implemented community animal health worker (CAHW) programs, partly in response to the threat faced by the region with the emergence of HPAI H5N1 influenza in poultry. There could be an opportunity to strengthen links between FETPV graduates and CAHWs to enhance and broaden surveillance networks.

Animal health services in Pacific Island countries are characterised by very small numbers of veterinarians and a high level of turnover of veterinary staff. The vast majority of animal health workforce capacity is concentrated in Fiji and Vanuatu. Several countries in the region have no, or very few, veterinarians to provide routine animal health services. There is a high level of reliance on para-veterinarians, who have basic field training in animal health, but training standards are variable. The Fiji National University has recently introduced a veterinary sciences faculty, which aims to train around 20 graduates each year from Fiji and other Pacific Island countries once fully operational. Fiji National University also teaches a three-year Bachelor of Animal Husbandry and graduate diploma courses. Many graduates work as biosecurity officers in surveillance, point-of-entry inspections and emergency response.^{iv}

iv Information about the animal health workforce in the Pacific region was attained through expert consultation.

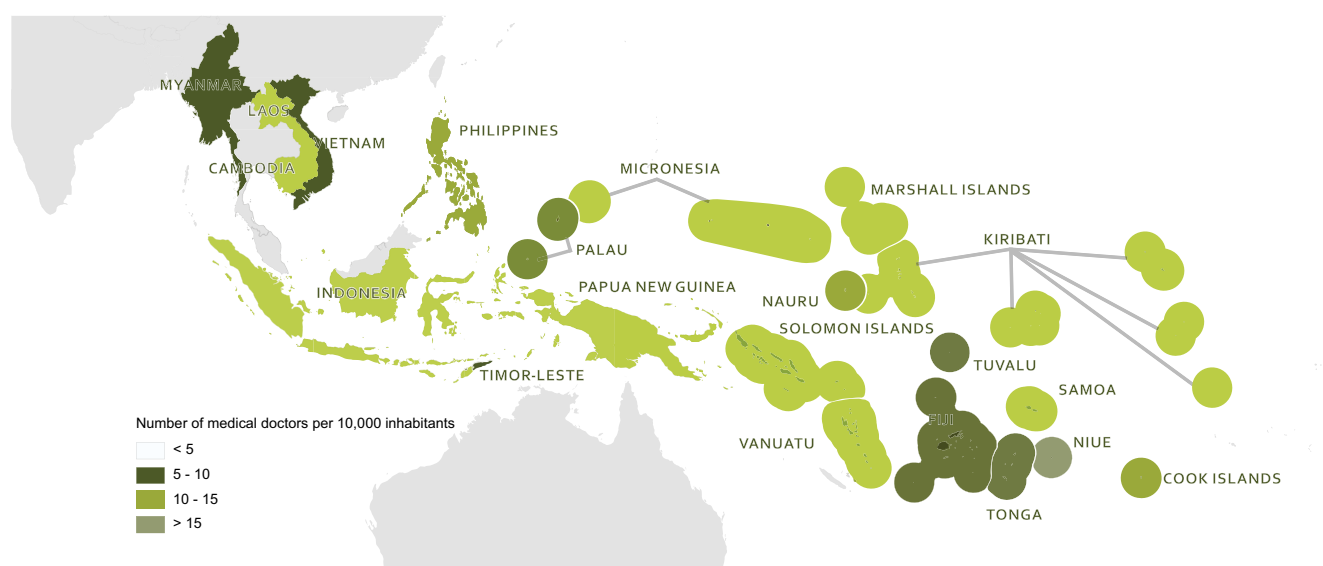


Figure 12: Number of medical doctors per 10,000 people in the Indo-Pacific region

Source: ESCAP Online Statistical Database based on data from the SDG Global Database (WHO), 25 July 2018 (http://data.unescap.org/escap_stat). Data based on number of medical doctors, including generalists and specialist medical practitioners, per 10 000 population in the given national and/or subnational area (SDG indicator 3.c.i).



Australian volunteer Yasmin Lisson (right) visits a health centre on an outbreak investigation in Cambodia. Supplied: Yasmin Lisson

Respond

Achieving core capacities to respond to health security threats is crucial to minimise health, social and economic losses for individuals and communities. Adequate response capacity requires development and testing of emergency plans through simulation exercises and real events, an adequately resourced and trained workforce, collaboration with security and law enforcement sectors, and effective risk communication to all communities and population subgroups.

Preparedness

Preparedness is a key component of the emergency response cycle. It includes the development and maintenance of national, intermediate and community-level public health systems that can respond to an infectious disease threat in a timely and efficient manner. Key indicators for country preparedness include the development and implementation of a multi-hazard national public health emergency preparedness and response plan (PHEPRP), and mapping of priority health risks and resource utilisation.

Across the Indo-Pacific region, there are significant weaknesses in planning, prioritisation and assessment of health security risks. Most countries self-reported capacities related to their national emergency preparedness as scoring 20–60%, which in general was the weakest indicator across their national health emergency frameworks (which also include response operations and resource mobilisation).

There is considerable variation in preparedness in Southeast Asia. In Indonesia, a multi-hazard national PHEPRP has been developed and implemented, but further development is needed in staff for response activities, surge capacity and resource mobilisation tools (9). Similarly, Vietnam has a multi-hazard national PHEPRP for infectious diseases, but this is not yet integrated across sectors (such as natural disasters and defence) and so does not yet constitute a full multi-hazard approach (11). Cambodia has made significant progress through planning and discussion activities with relevant sectors on the development of public health emergency response plans across different stakeholders, including an inter-ministerial and intersectoral operations-level working group. However, there is an urgent need to develop multisectoral all-hazards plans to identify priority threats (11). Myanmar has

developed a national disaster management framework with a focus on natural disasters and infectious disease threats, but there is no overarching PHEPRP that embodies a multi-hazard approach (14). In Laos, disease-specific plans for addressing IHR-related outbreaks and other threats have been designed. An emergency risk management plan and all-hazards response plan have been drafted but are yet to be fully implemented, and will require expansion to include streamlined response of emergency operation centres, as well as staff training and drills (12).

In the Pacific, the Federated States of Micronesia has demonstrated high capacity with the development and implementation of its national and state disaster response plans, which include annual training and drill exercises (13). No country in the Pacific has developed a truly all-hazards PHEPRP, though an all-hazards plan is currently being drafted for Nauru (15). Throughout the Pacific, existing multi-hazards plans face similar shortcomings to those reported for Southeast Asia, including weak intersectoral coordination; unclear ownership of plans; and lack of drills, simulations or after-action reviews at health facilities and ports of entry (15).

The development of effective preparedness strategies for public health emergencies requires the balanced and active participation of women, people with disabilities, ethnic minorities and other disadvantaged groups. Full and equal participation is critical in planning, decision making and identifying appropriate preparedness activities. For example, a review of the Ebola outbreak in Liberia concluded that full participation and a visible leadership role for women are important for effective planning of community-level preparedness (41).

Emergency response operations

Public health emergency response is typically coordinated from a central location known as the emergency operations centre (EOC), which coordinates operational information and resources for strategic management of public health emergencies and emergency exercises. Development and implementation of emergency response procedures and EOCs vary throughout the Indo-Pacific region. In countries that have completed JEEs, EOCs were not routinely used for activities such as surveillance and coordinating public health action. Refined and implementable EOC and Incident Management System (IMS) plans are not widely in place, and training modules and drills using simple and efficient information technology systems with response teams have not been fully utilised.

The Indonesian national EOC is amongst the most well developed in the region, with established guidelines and SOPs for emergency response, trained public health staff, information technology systems and a register for surge capacity during crises (9). In Laos, EOCs have been established since 2014, with a reliable communication structure. However, clear guidelines and training modules, staff surge capacity and IMS structures have not been prioritised and implemented, and are likely to experience challenges at the time of activation. Disease-specific case management guidelines exist but do not adopt an all-hazards approach, and are not well integrated into the IMS structure (12). In light of these findings, the Bill & Melinda Gates Foundation is supporting the planning, design and strengthening of a dual-function EOC to support malaria elimination activities, with the aim of building core capacities to effectively respond to other health security threats (166).

Myanmar has a similar state of play, with a developed EOC that can be activated and operationalised, but with no permanent staff with clear roles and responsibilities assigned for the EOC within an IMS structure (14). After-action review was conducted following Cyclone Roanu, which identified strengths and challenges in emergency response processes. Myanmar is currently developing an emergency response plan with support from Public Health England, which aims to strengthen its EOC functions and adopt a comprehensive all-hazards

plan. Similar challenges for activation and coordination of EOCs, are evident in Vietnam, relating to public health personnel, information management and sharing, collaboration and coordination, and integration of IMS structures (10).

The Federated States of Micronesia is the only Pacific island country to have undergone formal evaluation of its emergency response capacity. High capacity to activate and operate the EOC was evident. However, identification of assigned staff for emergency response was a challenge, and local trainers need to conduct regular drills. In general, training needs across all indicators were highlighted in the Federated States of Micronesia (13). Other Pacific Island countries have self-assessed their emergency response capabilities as ranging between 20% (Papua New Guinea and Solomon Islands) to 100% (Marshall Islands), with most self-assessing at 60–80% for indicators related to emergency response.

Across all countries, further efforts are required to strengthen coordination, collaborative leadership and information sharing across EOCs. For example, in Cambodia, no clear frameworks or processes were available to activate the EOCs. Similarly, there were no clear guidelines for training of staff on IMS principles or establishing pre-identified roles and responsibilities during the EOC activation phase. The value of multisectoral coordination in emergency response operations was highlighted during the first outbreak of avian influenza in poultry in the Philippines in April 2017. Rapid response teams were dispatched, and samples were immediately sent to an FAO reference laboratory (167). When H5N6 was confirmed, a quarantine and control area was established around the affected farms, with strict surveillance and movement controls, as well as culling on infected properties (167). Intensive surveillance was initiated at hospital and community levels, along with community awareness activities (167). No human cases were detected, and the outbreak was resolved by September 2017 (167).

Risk communication

Recent health security threats have highlighted the need for strong risk communication strategies, with the goal of real-time exchange of information between experts and officials, people who face a threat or hazard, and the community at risk. This includes a mix of media and social media communications, mass awareness campaigns, health promotion, social mobilisation, stakeholder engagement and community engagement. For example, the 2009 influenza pandemic revealed considerable shortcomings in risk communication in the context of a global health security threat (168). Needs were identified at all levels of engagement, including communication among stakeholders within organisations, and guidance for effectively sharing important public health information while negotiating the political and cultural complexities of outbreaks (168).

Across the Indo-Pacific region, there are critical gaps in risk communication that weaken the capacity of countries to effectively communicate with populations in the event of health security threats. There are six countries in Southeast Asia and the Pacific that self-assessed at 20% for their risk assessment capacity, and no country has reached 100% implementation of risk communication core capacities. Rumour management and response, public communication and community engagement require considerable strengthening throughout the region. Vietnam has made substantial progress during the past 5 years, through the active design and implementation of strategies to improve risk communication activities, although gaps in reaching geographically isolated areas remain (10). In the Federated States of Micronesia, a strong informal network for dynamic listening to, and reporting of, rumours exists, but there is no system for rumour verification and response (13). The Fiji Red Cross Society has comprehensive risk communication strategies in place, based on International Federation of Red Cross and Red Crescent Societies (IFRC) guidelines and protocols, but critical gaps remain in their capacity to fully support risk management and communication in Fiji and other Pacific Island countries (92).

Although countries are developing cross-sectoral early risk communication plans, standardised protocols and training modules are needed to effectively communicate and share information during emergencies and routine

conditions. For example, in Myanmar, three government ministries share responsibility for, and take part in, risk communication functions for emergencies, and coordinate with other government agencies and departments (14).

Within the Myanmar Ministry of Health and Sports, the Disaster and Public Health Emergency Response Unit and the Health Literacy Unit coordinate to develop messages relating to public health emergencies, which the Ministry of Information is responsible for disseminating information to the public. However, there are no specialised risk communication staff within the Ministry of Health and Sports, and no formalised training is available (14).

Effective risk communication is crucial in the animal health sector, particularly as smallholders are sometimes reluctant to report disease outbreaks for fear of consequences that can include culling of their animals. In many places in the region, smallholders are also unaware of the risk posed by zoonoses, have frequent close contact with their livestock, and will salvage sick and dying animals for home consumption (145,169).

There are multiple gender dimensions to effective risk communication before, during and after a disease outbreak. An effective risk communication response would integrate these dimensions, including standing protocols on principles for gendered communication. Gender norms shaping risk perception and risk tolerance at individual and societal level may be a barrier to effective messaging. For example, risk communication during the 2015–16 Zika outbreak in Latin America included unrealistic advice to women to avoid pregnancy without providing the means to do so, or addressing uncertainty about the length of time that women were at risk of a Zika-affected pregnancy after they or their sexual partners had been infected (170). There may also be dynamic gender patterns in infectious disease outbreaks that need to be addressed through responsive risk communication. For example, although TB is generally more prevalent amongst men, most cases during the MDR-TB outbreak in the Federated States of Micronesia in 2008 (Box 5) were women (67%) and children (48%) (171). In this outbreak, women and older children may have had higher rates of TB (despite their lower prevalence of general risk factors) because of their role as primary carers.

Linking public health and security authorities

Health security threats can pose special challenges for law enforcement, including in the context of naturally occurring outbreaks, but also bioterrorism events. Defence policy, planning and operations can play an important role in ensuring health security in the Indo-Pacific region. Agencies for animal health, human health, customs, quarantine, defence and law enforcement have common areas of work related to legal and illegal movements of people, livestock and animal products. These arrangements need to be built into policy, legislation, planning, operational procedures and training.

There is evidence of progress towards improving linkages between health and security agencies. Indonesia and Laos demonstrated significant progress in strengthening links between public health and law enforcement, particularly in relation to conducting training and drills across agencies involved in combating terrorism using chemicals, biological agents, radioactive agents, nuclear materials and explosives; and also ministries with responsibility for livestock, agriculture and the environment (9,12). Cambodia, the Federated States of Micronesia, Myanmar and Vietnam limited capacity for coordination between public health and security authorities (10,11,13,14). Although frameworks to interact with defence agencies and cross-sectoral communications exist to some degree, there are few formal agreements, documentation or memorandums of understanding between agencies for information sharing in case of an emergency.

Emergency preparedness for biological health threats is a key area for coordination between health and security agencies. Most Indo-Pacific countries are included among the 182 State Parties covered under the Biological Weapons Convention. Three countries have neither signed nor ratified the Biological Weapons Convention (Kiribati, Micronesia and Tuvalu). The United States Centers for Disease Control and Prevention has published a categorised list of bioterrorism agents and diseases to guide planning for emergency preparedness and control. High-priority agents include organisms in three categories based on the level of risk to national security. Considerations include potential for transmissibility, morbidity and mortality, and social disruption; ease of manufacture; and need for special action. However, the identified threats are not widely applicable across all global regions. In 2016, Australia reported the results of a review of biological agents of security concern (172). After a comprehensive process of consultation and study of work by other countries, the review adopted a list of 22 threats that were of security concern for Australia. It also recommended approaches to reduce the risk of these threats; to ensure strict controls over the elimination of these agents, where possible; and to ensure secure storage, and limitations on the use, of any stocks that remain. Similar systematic processes could be carried out at the national or regional level to identify and prepare for the most relevant biological health threats in the Indo-Pacific region.



Medical team carrying patient on stretcher for treatment. Yogyakarta, Indonesia. Photo by Melbourne the Photographer.



Environmental Health Officer, Flying Officer Evie Sharman, 3 Expeditionary Health Squadron, testing a young Pakistani patient for malaria inside the Australian Defence Force health centre in Kot Addu. Photo by Petty Officer Damian Pawlenko

Integrating health security and disaster response

There are key areas of overlap between health response and disaster response in core capacities to address health security threats. Countries in the Indo-Pacific region are at disproportionately higher risk of experiencing natural disasters, particularly with climate change (173). Countries such as the Solomon Islands are located in an area of the Pacific known for frequent tropical cyclones. Due to their location within the active seismic area known as the Pacific 'Ring of Fire', many Indo-Pacific countries are affected by earthquakes and tsunamis.

Damage to public health infrastructure and large-scale displacement of populations increase the risk of infectious disease outbreaks and can weaken health systems. Availability of safe water and sanitation facilities, the degree of crowding, the underlying health status of the population, and access to health care interact with the local disease ecology to influence the risk of spread of infectious diseases (174). Outbreak-prone infectious diseases in disaster settings include measles, cholera, acute gastroenteritis, leptospirosis and acute respiratory infections such as influenza. Natural disasters may disrupt routine infectious disease surveillance through damage to infrastructure, or loss or diversion of health personnel. Disaster responses may require rapid deployment or expansion of surveillance systems.

Key health security frameworks are aligned to frameworks for planning and responding to natural disasters. Common areas across APSED III and the Western Pacific Regional Framework for Action for Disaster Risk Management for Health include the role of PHEPRPs, multisectoral risk assessments and risk communication. The APSED III framework was designed to integrate with the Sendai Framework for Disaster Risk Reduction 2015–2030, which supports countries to develop multisectoral responses to health emergencies.

There is some evidence that integration between health security and disaster planning is being achieved in the Indo-Pacific region. For example, EOCs in some countries have dual uses in responses to public health emergencies (including infectious disease outbreaks) and natural disasters. This dual use function has been particularly well implemented in Indonesia (9). In the Pacific region, the Pacific Syndromic Surveillance System (PSSS), coordinated by the PPHSN, has demonstrated capacity to expand to other emergency surveillance systems, such as EWARS in a box ^v following Cyclone Winston in Fiji 2016 and the 2018 earthquake in Papua New Guinea (175–177). Training of civil society and volunteers has not always been prioritised in PHEPRPs, but has in some cases been conducted by organisations such as the Red Cross (15).

^v *EWARS in a box is a set of resources developed by the WHO to support detection of disease outbreaks in settings without reliable internet or electricity, such as disaster settings. The box includes solar-powered mobile phones, laptops and a local server to collect, manage and report data.*

PART

03

Strengthening
health security





Regional health systems strengthening

Part 2 of this report provided a baseline assessment of health security based on national capacity assessments, such as JEEs, PVS evaluations, self-assessment reports and country scoping missions. However, health security challenges require regional approaches; in particular strong regional leadership and governance (178). Existing frameworks such as APSED III sets targets for strategic action to improve health security across the areas assessed in Part 2 of this report. The eight focus areas of APSED III include:

1. Public health emergency preparedness
2. Surveillance, risk assessment and response
3. Laboratories
4. Zoonoses
5. Prevention through health care
6. Risk communication
7. Regional preparedness, alert and response
8. Monitoring and evaluation

Part 3 of this report focuses on opportunities for strengthening regional health security that have not been comprehensively addressed in existing frameworks. For example, ASPED III gives very limited attention to gender and disability inclusiveness. The relevance of One Health is acknowledged, and strategic actions are outlined for improving coordination between animal and public health authorities to prevent, detect and respond to zoonotic diseases. However, there is no regional assessment of the state of One Health initiatives in health security. The importance of integrated real-time surveillance and information systems is acknowledged, but limited detailed information is available to support countries to design and implement information systems that integrate data from public and animal health laboratories, field-level event-based surveillance, monitoring of AMU and AMR, and other key domains.

This report has highlighted high-burden and high-risk infectious diseases in the Indo-Pacific region, but several information gaps preclude a more comprehensive assessment. In particular, limited information was available for outbreak-prone infectious diseases such as leptospirosis, which is prioritised in the national health sector plans of several countries but is not included in global frameworks for pandemic and epidemic-prone diseases. A regionally harmonised list of priority infectious diseases that pose health security threats could improve regional capacity in several ways. For example, it could support targeted improvements to laboratory capacity to detect priority infectious diseases throughout the region, improve comparability of surveillance information across countries, and allow targeted research and product development, such as for vaccines and diagnostics. Finally, achieving health security requires regional financing and coordination. Therefore, an assessment of the current state of regional funding and coordination for health security is provided.

Intersections between these areas are shown in Figure 13.

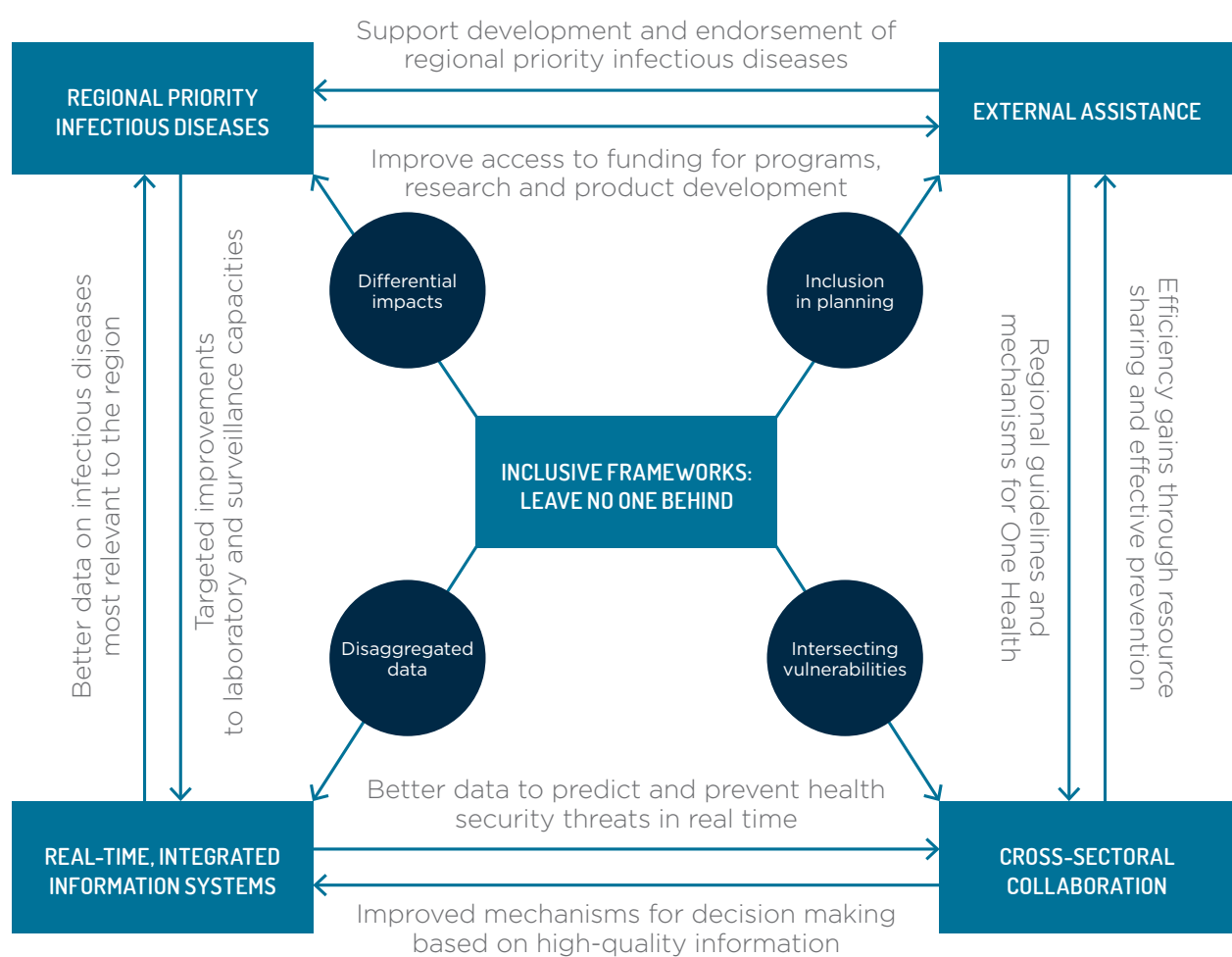


Figure 13: Intersections between domains for health security strengthening

Inclusive frameworks

Universal Health Coverage and leaving no one behind

In the 2030 Agenda for Sustainable Development, the concept of ‘leaving no one behind’ emerged as a cross-cutting theme that affects the attainment of all 17 Sustainable Development Goals. With the adoption of the 2030 Agenda, 193 UN Member States pledged that ‘no one will be left behind’ and that there would be efforts to ‘reach the furthest behind first’ (179).

In practice, leaving no one behind means that countries, and other actors and stakeholders will take explicit and deliberate actions to end extreme poverty, and reduce inequalities and discrimination, with a special focus on fast-tracking progress for those who are furthest behind (180). The United Nations Development Programme provides a framework for determining who is left behind that considers five key factors: discrimination, geography, governance, socioeconomic status, and shocks and fragility. Evidence on these factors can only be assembled when high-quality disaggregated data are available for parameters such as sex, gender, age, ethnicity, income and disability status. This highlights the role of strong information systems (including health information systems) to determine who is left behind and monitor progress. The imperative for high-quality disaggregated data is reflected in the UN Statistical Commission’s statement that the ‘Sustainable Development Goal indicators should be disaggregated, where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics, in accordance with the Fundamental Principles of Official Statistics’ (181).

The Indo-Pacific region includes vulnerable and socially excluded population groups such as refugee and displaced persons, indigenous populations and ethnic minorities, mobile and migrant populations, and people with disabilities. These population groups may be at particularly high risk of exposure to infection, as well as adverse outcomes, in the context of health security threats. However, there are limited data available to determine the size and vulnerability of these groups to health security threats.

For example, though WHO estimates the global prevalence of disability to be around 15%, the average prevalence of disability in the region is estimated at only 5% based on national data collections, and as low as 1–2% in some countries, which is considered a substantial underestimate (182). Reliable data on disability prevalence in the Indo-Pacific region are difficult to obtain, as each country uses different definitions and data sources to estimate disability prevalence (45). Stigma, shame and social exclusion due to cultural norms and attitudes contribute to people choosing not to disclose disabilities (including those of family members) during surveys or census data collections.

Although the direct links between health security and leaving no one behind may not always be articulated, it is clear that actions taken to strengthen health systems to move towards universal health coverage and leave no one behind aim to promote health-secure and resilient societies. In turn, countries cannot determine who is left behind without strong health information systems and high-quality disaggregated health data.

Intersections between universal health coverage and national health security include the following (183):

- A reduction in the financial barriers to accessing healthcare may stimulate demand for health care services, in turn facilitating early detection of infectious diseases.
- Protecting people from catastrophic health expenditures reduces the risk of falling into poverty, an important social determinant of vulnerability to health security threats.
- Improved access to high-quality health care services reduces the need to cross international borders to seek health care, which may reduce the risk of international spread of infectious diseases.
- Improving health coverage may improve trust in health authorities, which supports effective cooperation between the public and authorities for state-led interventions during health emergencies.
- Improved individual health security through better access to high quality health care contributes to global health security at the community, national and global levels.

Gender and disability inclusiveness

The assessment of the current state of regional health security (Part 2) was limited by the lack of gender- and disability-disaggregated data in most health security indicators. APSED III, the JEE tool and the PVS instruments make minimal reference to gender or disability.

WPRO recommends that countries ensure that surveillance systems collect, report and analyse data disaggregated by sex, and incorporate gender analysis in health security risk assessments (17). Additional opportunities include:

- increasing opportunities for women to gain leadership positions in laboratories and improving the accessibility of laboratory services
- addressing women's and men's different exposures, knowledge, resources and vulnerability to health security threats, including for zoonotic diseases
- tailoring clinical guidelines to address symptoms and disease progression that vary between females and males, and in women who are pregnant or lactating
- supporting women's role in infection control and prevention at home and in the community
- reporting gender representation and reducing gender inequality in the workforce, including FETPs.

There was insufficient data available to assess the impact of health security-related events for people with disabilities. Through the Incheon Strategy, efforts are underway throughout the region to improve disability statistics, increase ratification of the Convention on the Rights of Persons with Disabilities, and improve harmonisation of the convention with domestic laws. The focus countries of this report that have ratified the Convention on the Rights of Persons with Disabilities are Cambodia, Cook Islands, Indonesia, Kiribati, Laos, Myanmar, Nauru, Palau, Papua New Guinea, the Philippines, the Republic of the Marshall Islands, Tuvalu, Vanuatu and Vietnam.

There are many entry points for strengthening national and regional capacity for health security through disability-inclusive frameworks – for example:

- addressing the immediate risks of increased exposure to health security threats for people with disabilities, as well as risks associated with poor access to water, lower education levels and reduced economic participation that leave people with disabilities more vulnerable to health security threats
- improving access to information and resources for people with disabilities, particularly for people with intellectual, developmental and cognitive disabilities, and their families and caregivers
- improving data collection and reporting on coverage of key health programs, such as immunisation, for people with disabilities, and addressing low vaccine coverage where it occurs.
- There are several areas where gender- and disability-inclusiveness could be addressed together, such as:
- developing protocols for risk communication with diverse audiences, taking into account preferences in media, existing knowledge and resources, and gender-based roles
- incorporating gender and disability issues in learning opportunities, including reviews of compliance with the IHR, simulation exercises, and basic and implementation research
- introducing indicators for gender and disability inclusiveness in health security assessments, such as the collection, analysis and use of gender- and disability-disaggregated data; and training and performance of public and animal health workers to provide appropriate prevention, detection and response services to women people with disabilities and other marginalised groups
- ensuring greater participation of women and people with disabilities in national and regional bodies that plan and review health security threats, including a role for representative bodies to hold technical specialists to account for their performance regarding gender and disability inclusiveness.

Operationalising One Health approaches

One Health frameworks

Human health is fundamentally linked to animal and environmental health, and zoonoses are a major threat to international health security (145,184). This is particularly relevant in the Indo-Pacific region because of agricultural practices that involve humans and animals being in close proximity, suitable climatic conditions and wildlife species richness (22). Consequently, One Health approaches are key to ensuring optimal health outcomes for people, animals and environments in the Indo-Pacific region.

One Health approaches to health security aim 'to improve health and well-being through the prevention of risks and the mitigation of effects of crises that originate at the interface between humans, animals and their various environments' (185). It is a multisectoral approach based on sustainable collaboration between all relevant sectors and disciplines responsible for human, animal and environment health. Implementing a One Health approach may bring benefits that include (142):

- timely and effective response to zoonotic disease emergence and outbreaks
- improved sharing of information across sectors to ensure that decision making is based on accurate and shared assessments of the health security threat
- improved acceptability and accountability for development and implementation of legislation, policies and programs across sectors
- equitable and effective distribution of technical, human and financial resources
- recognition and addressing of gaps in infrastructure, capacity and information.

Good governance, coordination and communication, as well as adequate resources, are key elements to ensure the sustainability of One Health. In particular, a coordination mechanism with decision-making authority should be defined at a high level to provide leadership and advocacy, and commit the necessary resources. Health security-related activities that may benefit from a One Health approach include (142):

- strategic planning and emergency preparedness, including frameworks that adequately engage with how gender norms, gendered division of labour and access to resources intersect with risks posed by disease outbreaks
- integrated surveillance and prevention programs for zoonotic diseases and antimicrobial resistance
- joint risk assessment, outbreak investigations and response for zoonotic disease threats, including consideration of key differences in exposure, vulnerability and behavioural responses by gender and for people with disabilities
- risk communication and community engagement, taking into account principles of social inclusion to ensure that no one is left behind
- joint training and development of public and animal health workforces.

SUSTAINABLE ONE HEALTH

SUPPORT AND ADVOCACY

NATIONAL GOVERNANCE

ONGOING TRAINING

Implementation

There are several high-level commitments to One Health in the Indo-Pacific region. Regional-level tripartite efforts supported creation of the One Health Secretariat at the FAO Regional Office for Asia and the Pacific. ASEAN has also committed to the establishment of an ASEAN Coordinating Centre for Animal Health and Zoonoses. The OIE and WHO jointly facilitate National Bridging Workshops that bring together human and animal health professionals at a country level. National Action Plans for Health Security also include zoonotic disease components. At a subregional level, the Mekong Basin Disease Surveillance Network was established by Cambodia, China, Laos, Myanmar, Thailand and Vietnam in 2001 (186).

At the national level, the wide impact of zoonotic diseases such as HPAI led to the development of several One Health initiatives, such as the National Zoonosis Committee in Indonesia (27,187), the Communicable Disease Control Department in Cambodia (188) and H1N1-related activities in Vietnam (189). The Philippine Inter-agency Committee on Zoonoses was created in 2011 by a presidential decree that defined its powers, functions and responsibilities, and provided funding for its activities (190). It provides a formal collaborative platform to three sectors: Department of Health, Department of Agriculture, and Department of Environment and Natural Resources. Although these examples demonstrate some high-level support for One Health in Southeast Asia, effective and routine establishment of One Health at an operational level is rare.

In contrast to high-level initiatives, there is less evidence that One Health approaches are fully embedded at operational level. Operationalisation of One Health is hampered by weaknesses in coordination, information exchange, perceptions of benefit and human resources – this includes weaknesses in training and experience in applying One Health approaches to the prevention, detection and response to health security threats. Sustainable One Health approaches require an adequate legislative framework to provide high-level support and advocacy, a dedicated national-level governance structure

and ongoing training to develop the skills required for multisectoral collaboration (191,192). For example, in Fiji, efforts to improve the control of leptospirosis have been pursued since 2011 using a multisectoral approach. Intensive consultations with experts and key stakeholders led to the development of a National Action Plan for Leptospirosis (193). However, three main issues were identified as hindering multisectoral collaboration between animal and public health authorities (194). First, leptospirosis was mainly perceived as a human health problem, and very little animal health data were available. This limited the sustained involvement of staff from sectors outside public health. Second, management and communication relating to leptospirosis occurred mainly during outbreaks, and there was little awareness of leptospirosis when no outbreak was occurring, hampering the sustainability and continuity of the control activities. Third, legislation was insufficient to effectively support a multisectoral approach. However, revisions of important instruments such as the Public Health Act are anticipated to better support the implementation of the National Action Plan.

Real-time, integrated surveillance systems

Timely analysis and reporting of health security threats ultimately depends on the effectiveness of local surveillance and rapid flow of information between local, regional and national level. Parts 1 and 2 of this report highlighted several information gaps on the incidence, burden and risks associated with infectious diseases that could potentially cause health security threats, which hinders effective preparedness. The quality of surveillance systems varies in the region, but a common weakness is the lack of integrated, interoperable surveillance systems that support real-time data collection, analysis and reporting. The JEE evaluation tool identifies this as a key target for countries to meet in order to achieve IHR core capacities (38).

Information systems can be designed with the capacity to readily incorporate different surveillance data collection approaches, as more types of monitoring and surveillance information become available. For example, integrated surveillance and information systems could:

- enable multiportal (e.g. SMS, smart phone application or email-based) electronic data capture at the data source, or as close as possible to the source (to minimise paper-based records; and minimise the burden of, and delays to, data entry)
- support field-level users to perform their roles more easily, and reduce the burden and disincentives typically associated with reporting
- include automated systems for data validation and quality control to minimise the presence of invalid data
- support flexible, multipurpose integration across hospital, laboratory, community practice, animal health and biosecurity sectors
- allow automated routine data analysis and reporting, customised to monitoring and surveillance objectives, and stakeholder needs
- have inbuilt capacity to integrate other data sources and programs, including monitoring and surveillance in animals and humans – this can be achieved either by having a single central system, or by ensuring consistency and close interoperability with other monitoring and surveillance systems
- have the capacity to support flexible ad hoc analysis (for changing priorities)
- have a high level of data security that complies with best practice.

The Tupaia project in the Pacific region illustrates the potential for integration of surveillance data to improve availability of data for health security decision making at national and subnational level. Tupaia is a multi-country program to map health systems, strengthen services and help governments fairly distribute resources in the Pacific region. The Tupaia program of work includes the development of a dashboard of progress towards achievement of IHR core capacities as indicators of health system preparedness in Solomon Islands. This approach is unique: unlike the usual application of the IHR self-assessment at a national level, Tupaia has been assessing the ability of the tool to aid provincial-level assessment, planning and monitoring. This approach is highly suited to Pacific island countries, which are geographically dispersed, have decentralised health systems, and use regional approaches to support the achievement of some IHR core capacities. The dashboard will allow easy, consolidated access to indicators and visualisations for monitoring IHR core capacities. This project is being piloted in Solomon Islands, with the aim of demonstrating the feasibility and utility of filtering relevant health system indicators into a single accessible online dashboard for use by the Solomon Islands Public Health Emergency & Surveillance Unit (Figure 14). It is anticipated that the dashboard will be used to visualise, inform and prioritise provincial-level health system strengthening (and emerging infectious diseases preparedness).

Integration of surveillance data into accessible platforms is only one aspect of real-time integrated surveillance and information systems. One area that is frequently overlooked when designing and evaluating surveillance and information systems is understanding and addressing the factors that influence willingness and ability to report health data.

User-focused surveillance systems such as iSIKHNAS in Indonesia (Box 9) achieve high coverage and reporting rates because they are designed to provide immediate benefit to providers and users of health data at the local level. EWARS in a box implemented in Fiji following Cyclone Winston used simple mobile technology to enable system users to enter data and access epidemiological data in a simple and acceptable manner.

There are several other opportunities for integration of surveillance information to strengthen health security in the Indo-Pacific region. For example, AMR is recognised as an emerging health security threat, but existing surveillance systems have limited capacity and weak integration across sectors for surveillance of AMR and AMU, and for monitoring the effectiveness of antimicrobial stewardship activities.

There is potential for substantial gains through integrating AMU and AMR into real-time surveillance systems. Granular data on AMU that include indications for treatment, patient or animal characteristics, and prescribing or dispensing history of providers present significant opportunities for implementing targeted antimicrobial stewardship programs. Integrating AMU and AMR data across human and animal health would provide an invaluable resource for understanding and predicting the risk of AMR emergence.

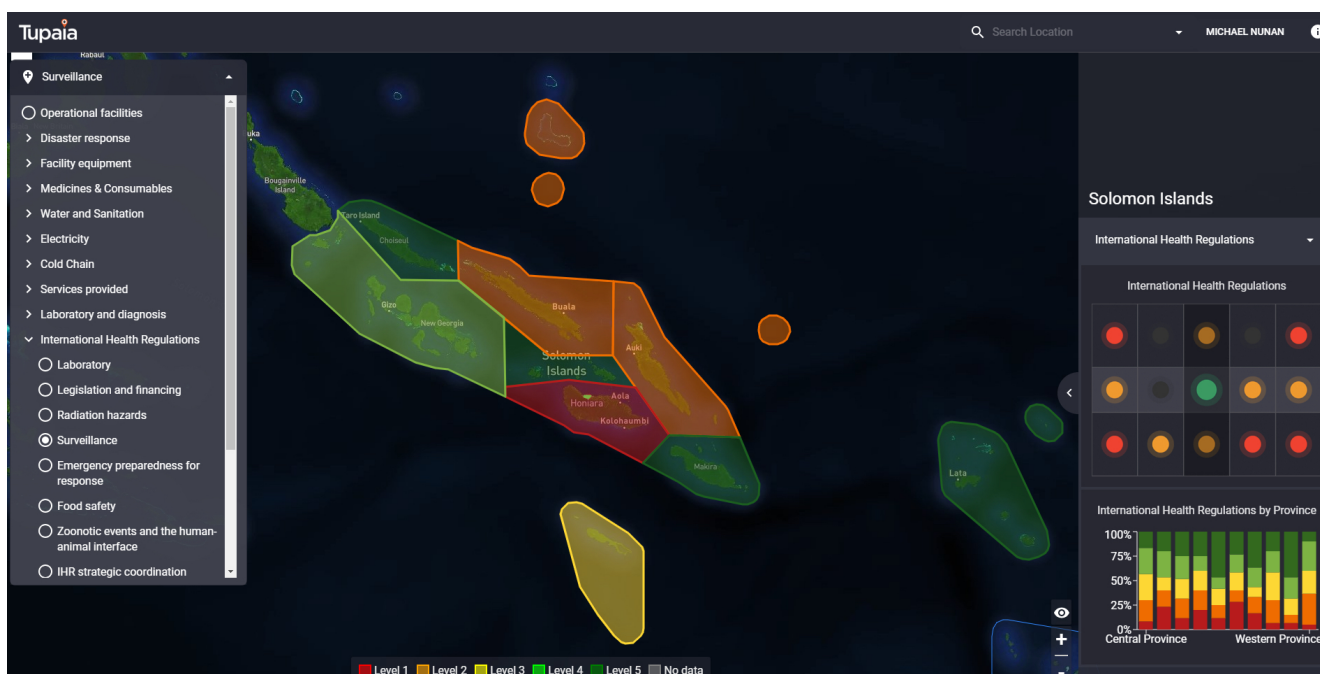


Figure 14: Example of province-level core capacities in surveillance in the Solomon Islands visualised using the Tupaia project dashboard tool. Visualisation from dummy data. Demonstration data for illustration purposes only.

Credit: Beyond Essential Systems

Regional priority lists for high-risk and epidemic-prone infectious diseases

WHO has identified pandemic and epidemic-prone infectious diseases (Part 1). Although many of these diseases are important in the Indo-Pacific region, several diseases do not occur in the region, and diseases important in the region (such as leptospirosis) are not included. In Part 1 of this report, it was identified that data on several infectious diseases that pose health security threats is missing or of poor quality. A regional list of priority infectious diseases for health security could support improved data collection and analysis of regional threats, and attract funding to support prevention, detection and response activities.

In the Indo-Pacific region, diseases are prioritised in national and regional health strategic plans, and the WHO Country Cooperation Strategies. Diseases prioritised for regional and national surveillance in the Pacific Outbreak Manual are acute flaccid paralysis/polio, cholera, ciguatera fish poisoning, chikungunya, dengue, epidemic hepatitis, leptospirosis, malaria, measles, meningococcal disease, pertussis, rubella, SARS, TB, typhoid fever and Zika (195). The Pacific Outbreak Manual also highlights the importance of vigilance for emerging infectious diseases such as MERS-CoV, Ebola and Nipah virus (195). In 2011, a formal disease prioritisation exercise was carried out in Vietnam to prioritise zoonotic diseases of public health significance, which identified avian influenza, rabies, *Streptococcus suis* infection, pandemic influenza and foodborne bacterial diseases as the 5 most important zoonoses (196). Other zoonotic diseases identified as being important were anthrax, foodborne parasitic diseases, leptospirosis and plague (196).

Although national and subregional disease prioritisation exercises have occurred, developing and endorsing a region-wide list of priority high-risk and epidemic-prone infectious diseases could further support regional efforts to strengthen health security. An endorsed list of priority diseases may raise the international profile of these diseases and attract funding to ensure that research, product development and program activities are adequately supported.

Funding, action and research for neglected tropical diseases (NTDs) illustrates the benefits of priority-setting activities. In 2012, WHO published a roadmap for accelerating action to reduce the global impact of NTDs (197). Multiple stakeholder groups, including donors, endemic countries, NGOs and pharmaceutical companies, then signed the London Declaration on Neglected Tropical Diseases to control, eliminate or eradicate 10 NTDs by 2020. In 2013, WHO adopted two resolutions i that prioritised 17 NTDs for which effective control and elimination may be feasible. Additional NTDs have since been added to the list ii at meetings of the Strategic and Technical Advisory Group for Neglected Tropical Diseases. These initiatives have generated funding and sustained momentum through bilateral partnerships, donors and international organisations (198).

There are some important caveats to priority disease lists as a basis for resource allocation. Firstly, countries need to be prepared for novel infectious diseases, not only established threats. Secondly, it is important that investments to manage regional threats also provide benefits in accordance with local and national needs. Nonetheless, a regional list of high-risk pandemic and epidemic-prone infectious diseases could assist in the optimisation of resources, and maximise multisectoral collaboration to prevent, detect and respond to infectious and emerging diseases.

i WHA66/20, 15 March 2013 and WHA66/12, 27 May 2013
 ii See current list at https://www.who.int/neglected_diseases/diseases/en/

External assistance for regional health security

Bilateral and multilateral assistance

Recognising that health security is a national, regional and global public good, national governments, regional organisations, international bodies and other partnerships currently invest in programs to prevent, detect and control infectious diseases in the Indo-Pacific region.

Throughout the Indo-Pacific region, health security primarily falls within the responsibility of the health sector, which is predominantly funded by national governments. With the assistance of WHO and other technical advisors, several countries in the region are developing and resourcing National Action Plans for Health Security. For example, Myanmar estimates that its five-year plan to address 19 key technical areas relevant to health security will cost some US\$160 million (199). Many countries in the region receive development assistance for health programming, often in the form of bilateral assistance. Health security programmes and projects also receive funding through multi-lateral organisations. Examples include large investments in tuberculosis (TB), HIV and malaria from the Global Fund to Fight AIDS, Tuberculosis and Malaria (the Global Fund), and investments in vaccines and immunisation services from GAVI, the Vaccine Alliance.

The total amount of official donor funding to support the health sector in the 22 ODA-eligible Indo-Pacific countries in 2017 was approximately US\$1.1 billion. ⁱⁱⁱ Of this, approximately US\$237 million was directed towards infectious disease control and prevention, of which half was allocated specifically to malaria and TB control. The majority of funding for infectious disease control came from multilateral organisations (-US\$137 million), but most of this funding (US\$123.5 million) was provided by the Global Fund, and to two main countries (Cambodia and Myanmar). ^{iv} Of the -US\$100 million provided by OECD Development Assistance Committee (DAC) countries, -US\$81 million came from the United States.

ⁱⁱⁱ Estimate based on official donor aid flows at activity level in 22 focus countries of the Indo-Pacific region, as reported to OECD. Aid to health includes general and basic health, and population policies/programmes and reproductive health. OECD Health Statistics are available via the online OECD statistics database (<http://stats.oecd.org>)

^{iv} Aid flows from multilateral organisations are not fully represented by these statistics, because GAVI and other organisations are not included in activity-level flows in OECD DAC statistics. The distribution of funding between DAC countries and multilateral organisations is not always unambiguously defined; for example, as most ADB expenditure is sourced from multi-donor trust funds, most ADB flows are attributed to the contributing bilateral donors.

In line with a trend of declining health sector financing since 2013, aid flows for infectious disease control in the Indo-Pacific region in 2017 were lower than in 2016 (~US\$244 million). This is in contrast to the increased investment in health security between 2009–13. During this period, bilateral and multilateral funding for the health sector averaged US\$1.5–1.6 billion per annum. Several initiatives launched during this period, such as the ADB Second Greater Mekong Subregion Regional Communicable Diseases Control Project, have now come to completion.

Regional organisations have made considerable progress in strengthening regional health security over the past few years. For example, ASEAN began to institutionalise regional frameworks for health security after SARS (2000). Since 2003, the ADB has provided funding of US\$324.9 million to projects throughout the Asia-Pacific that have a health security component (201). This included a US\$42 million grant towards prevention and control of avian influenza in affected countries. The ASEAN Risk Communication Resource Centre has worked since 2010 to establish a central capacity within ASEAN to provide leading edge training and research on risk communication for emerging infectious diseases. In the Pacific region, the PPHSN implemented a field epidemiology training program known as the Pacific Data for Decision-making Programme (DDM), which was designed to respond to the unique health challenges and foster appropriate responses in the Pacific region (202).

The regional health security financing landscape for the next few years is mixed. There are some major new investments and programs underway, but critical gaps remain. Some countries in the region are transitioning towards middle-income economies, and their access to aid has changed or may change in the near future. This has prompted reassessment of national funding for infectious disease control programmes in several countries.

The ADB has committed to increasing health investments to up to 5% of its portfolio and is financing the US\$125 million Greater Mekong Subregion Health Security Project 2017–2022. Its Operational Plan for Regional Cooperation and Integration 2016–2020 emphasises investment in regional public health, climate change and disaster risk mitigation, and strengthening multisectoral collaborations. In line with these commitments, the ADB is providing US\$40 million in total to systems strengthening for effective vaccine coverage programs in Samoa, Tonga, Tuvalu and Vanuatu (201).

The Fleming Fund, a United Kingdom aid programme established in 2015 to address the global AMR threat, has committed £265 million from 2016–21 for improving laboratory AMR diagnostic capacity and AMR surveillance networks in low- and middle-income countries worldwide. Several Fleming Fund country and regional grants have already been released in the Indo-Pacific region. The Fleming Fund also funds professional fellowships for individuals engaged in AMR and AMU surveillance in key national institutions, who are trained and mentored to lead efforts to address AMR in their countries. The World Bank Group through the International Development Association (IDA) is supporting 25 IDA countries to strengthen their pandemic preparedness, a prerequisite for accessing the Pandemic Emergency Financing Facility resources in the event of a major outbreak. Work has commenced in Cambodia, Myanmar and Vietnam in the Indo-Pacific region. The Australian Government Indo-Pacific Centre for Health Security has committed AU\$300 million from 2017–22 to support the development of new vaccines, therapeutics and diagnostics and related national regulatory capacities, undertake applied health systems research, strengthen national capacities to prevent, detect and respond to infectious diseases, and increase Australia's contribution to multilateral action on regional and global health security.

Several donors and organisations continue to provide assistance to countries through targeted programs across various domains of health security. For example, the APEC Healthy Asia-Pacific 2020 initiative outlines measures for APEC members to take to boost their health systems, including health emergency preparedness, surveillance, response and recovery systems. The WHO Health Emergencies Programme is currently supporting Myanmar and other countries in the SEARO and WPRO regions to prepare for, prevent, respond to and recover from all hazards. Several countries in the region are anticipated to undergo JEE processes and develop National Action Plans for Health Security in the next few years, supported by WHO and other technical advisors. TEPHINET and SAFETYNET continue to support the expansion of FETPs in the region, and FAO supports expansion of FETPVs. Aid flows to the health sector overall increased in 2014–16 relative to 2011–13 in several countries, particularly in Fiji and Laos.

However, financing for health security remains a fraction of total donor flows. Though total development aid is increasing overall, many donors are reducing their aid flows for the health sector, particularly for middle-income countries. Health sector aid flows declined in 2014–16 relative to 2011–13 in several countries, including Myanmar, Palau, Papua New Guinea, Timor-Leste, Tonga, Vietnam and Vanuatu. ^v Existing donor funding is heavily skewed towards malaria and tuberculosis control, and most funding is provided by only few countries, increasing the exposure of health security financing to shifts in political priorities concerning aid and development. Many countries are undergoing or have completed transition away from GAVI support for national immunisation programs (15), but as shown in Part 2, most countries have not yet reached high levels of vaccine coverage.

In line with the transboundary nature of health security threats, sustainable and cost-effective models for health security financing need to be developed at national and regional level. There are key roles for regional organisations to play to address critical gaps, build sustainable capacity, and maintain regional and global momentum to maximise commitments of national governments to health security. The ADB has identified regional governance, increased cross-sectoral collaboration, health systems strengthening, building surge capacity and digital tools for surveillance as priority areas for future investment (201). Further work required includes proactive mainstreaming of climate change-related issues into the regional agenda and using regional resources to strengthen the public health systems of the ASEAN countries requiring the most support (200). Regional organisations can work to encourage sharing of resources, capacity and reference centres to optimise the efficiency of regional and national investments in health security. Existing ASEAN frameworks also provide a useful basis for improving information and data-sharing arrangements, a critical element of improving regional health security overall (200). Collaboration between multilateral organisations and international banks such as ADB further strengthen health security in the region. In 2017, the Global Fund and ADB signed a ‘memorandum of understanding to support the financing, design and implementation of country-led programs to fight HIV, tuberculosis and malaria, and build resilient health systems in ADB member countries eligible for Global Fund financing’ (203).

Lack of inclusion of the private health sector can undermine the effectiveness of health security programs; conversely, there is considerable opportunity for the private sector to contribute to health security strengthening through funding and improved coordination, as well as through product development.

^v Estimate based on official donor health sector aid flows in 22 focus countries of the Indo-Pacific region, as reported to OECD.

Product development partnerships

Product development partnerships (PDPs) bring together funding agencies, private industry and scientists to develop new drugs, diagnostics and other tools for use in low resource settings. PDPs have successfully engaged (or re-engaged) pharmaceutical companies to commit to research and development for infectious diseases most common in low-income settings. The overall pipeline for priority NTDs has more than doubled over the past 10 years. ^{vi} PDPs have also been critical in establishing access plans to ensure that public health needs are taken into account following market authorisation. For example, Coartem® Dispersible is the first ACT developed specifically to treat malaria in children. Coartem Dispersible was developed through a PDP between Medicines for Malaria Venture and Novartis, in response to a specific call for development of child-friendly essential medicines. Through access agreements, Coartem Dispersible has been registered in 35 malaria-endemic countries since launching in 2009 and is made available to countries through a not-for-profit pricing scheme.

PDPs have supported several other malaria drugs and tools from development to launch. For example, in June 2018, WHO provided prequalification for rectal artesunate suppositories to Cipla and Shasun, which is also intended to increase the availability of malaria medicines suitable for use in young children. Of particular relevance to the Indo-Pacific region, a PDP between GlaxoSmithKline and Medicines for Malaria Venture supported clinical trials and authorisation in Australia and the United States of America of single-dose tafenoquine as a radical cure for *P. vivax* malaria (Box 10).

A collaboration between Syngenta and the Innovative Vector Control Consortium (IVCC) delivered a new, non-pyrethroid insecticide formulation (Actellic® 300CS), which comes at a critical time when many countries are reporting insecticide resistance in *Anopheles* mosquitoes that transmit malaria. WHO Pesticide Evaluation Scheme approved the formulation in 2013, which was the first time a commercial product exited the IVCC pipeline.

PDPs support several other product pipelines that could lead to drugs, diagnostics, vaccines and other tools that make a substantial difference to health security. For example, the Indo-Pacific Centre for Health Security awarded AU\$18.75 since 2018 to IVCC to support the development of new tools to prevent the spread of vector-borne diseases. The Centre also invests in the TB Alliance, a PDP that works with pharmaceutical companies, research institutes, NGOs, academia and donors to support the development of new TB drugs for underserved markets. The TB Alliance has advanced new first-line TB drugs for children to market, and has several drugs in Phase 1, 2 and 3 clinical trials.

^{vi} This observation further supports the idea of developing a regional priority list for infectious diseases that have the potential to cause health security threats, as a means to attract and consolidate funding and resources.



Photo: Anna Wang/MMV

BOX 10

TAFENOQUINE FOR RADICAL CURE OF PLASMODIUM VIVAX MALARIA

Tafenoquine is a new anti-malarial drug that has been developed for radical cure (prevents relapse) of *Plasmodium vivax* malaria. Like primaquine, the existing first-line treatment for radical cure of *P. vivax* malaria, tafenoquine achieves radical cure by targeting the hypnozoite (liver) phase of *P. vivax* infection. However, tafenoquine has a longer half-life of approximately two weeks, compared to a half-life of about 6 hours for primaquine. Radical cure of *P. vivax* malaria is therefore possible with a single dose of tafenoquine, compared to the 14-day regimen required for radical cure with primaquine (204).

Tafenoquine was discovered by the US Army in 1978. The regional malaria elimination agenda

has led to increased funding and support for antimalarial drug development (205), and a PDP to support the development of tafenoquine was established between GSK, the Bill and Melinda Gates Foundation and Medicines for Malaria Venture. In 2018, the United States Food and Drug Administration, shortly followed by the Australian Government Therapeutic Goods Administration, approved tafenoquine for malaria prophylaxis in adults (Arakoda™, 60 Degrees Pharmaceutical, 100 mg tablets) and for radical cure of *P. vivax* malaria in persons aged 16 years and older (Krintafel™, GSK, 150 mg tablets) (206).

Conclusions

The Indo-Pacific region faces a number of health security challenges across its heterogeneous human and animal populations and geographical regions. Health security threats in the Indo-Pacific region intersect with major population, economic and environmental changes. Increasing movement of people and animals via burgeoning trade and travel routes is increasing the connectivity of the region and opening up areas of the Pacific to new health security threats.

The burden of infectious diseases such as TB and dengue is high, and the region is vulnerable to the emergence and spread of new infectious diseases. Southeast Asia is a global hotspot for zoonotic diseases, a result of complex interactions at the human-animal-environment interface that facilitate the emergence and spread of pathogens from animals to people. Agricultural intensification and climate change can act as drivers or risk amplifiers of health security threats. The risk of disease emergence and spread is compounded by vulnerable public health and animal health systems in many places in the Indo-Pacific region. AMR is a growing threat, with MDR malaria, MDR TB and MDR bacterial infections spreading in the region.

Overall, the capacity for health systems across the Indo-Pacific region to prevent, detect and respond to health security threats is highly variable.

WHAT HAS BEEN ACHIEVED

- Health security is a priority for many countries and the focus of numerous bilateral and international initiatives.
- Several countries have completed external evaluations of their public and animal health sector capacities to address health security threats, including IHR implementation. To date, 7 countries have completed JEEs, 10 countries have completed PVS assessments and 6 countries have completed both.
- All countries that have completed JEEs have reached demonstrated capacity for at least one indicator, and Indonesia, the Federated States of Micronesia and Laos have reached demonstrated capacity for one or more indicators in each of the prevent, detect and response capacity domains.
- As further evidence of increasing commitments to, and accountability for, health security, several countries are developing or have completed National Action Plans for Health Security, and Indonesia has completed a national bridging workshop to improve links between the public and animal health sectors.

WHAT IS PROGRESSING

- Legislation to support basic health security capacities is in place in many countries, but consistent enforcement and compliance is not yet demonstrated. Legislative frameworks require updating in many Pacific island countries.
- Regional financing for health security is increasing, but funding available at national level is not yet sufficient to meet all health security needs, especially for animal health.
- Preparedness and emergency response capacities are developing, but standard operating procedures are not fully developed, capacities have not been adequately tested through drills, simulations or after-action reviews, and regular refresher trainings are not conducted in many settings.
- More opportunities are becoming available for field epidemiology training for public and animal health professionals, but most countries do not yet have sufficient human resources across multiple sectors relevant to health security, including laboratories, primary health care and emergency response personnel.
- Countries are progressing towards implementation of electronic real-time surveillance and information systems, but integration and sharing of surveillance information across human and animal health sectors is rudimentary in most settings.
- National reference laboratories can detect priority pathogens, but subnational and veterinary laboratory capacity is inadequate in many places.



Farmers old and new house Cambodia
Photo: Chris Graham/AusAID

WHAT IS NOT YET ACHIEVED

- High-quality health data is not available in countries with a high burden of infectious diseases and vulnerable to health security threats; lack of access to relevant information is a major impediment to measuring disease burden, detecting outbreaks, monitoring trends, analysing risks, evaluating intervention, catalysing multi-sector collaboration and providing an evidence base for health policy.
- Animal health in the Pacific faces critical resource and funding shortages that severely limit capacity to prevent the incursion and spread of zoonotic diseases.
- Lack of attention to gender and disability inclusiveness means that some population groups are likely to be left behind in health security programs.
- Management of biosecurity risks arising from the legal and illegal movements of people, animals and animal products need substantial strengthening.
- Declining immunisation coverage in some countries leaves populations exposed to vaccine-preventable diseases such as measles.
- The projected rate of growth of antibiotic use in livestock production in Southeast Asia is amongst the highest in the world, but antimicrobial stewardship policies and practices are not widely implemented in the livestock and sector, which poses considerable risks for AMR emergence.
- The Indo-Pacific region is highly vulnerable to climate change, which may increase the risk of emergence and spread of infectious diseases, threaten health facilities in the Pacific through sea-level rise, and strain health system capacity through increased frequency of severe weather events that have adverse health impacts.

OPPORTUNITIES TO STRENGTHEN

There are several opportunities for strengthening health security across Indo-Pacific region. These include improving capacity to detect and respond to zoonotic disease, increasing activities related to antimicrobial stewardship, improving laboratory capacity, sustaining immunisation coverage, and initiatives to maintain a highly skilled workforce that can be deployed during emergencies.

There is scope for improving health security through design and implementation of real-time, surveillance and information management systems that are integrated across sectors and countries.

The effectiveness and reach of health security programs throughout the Indo-Pacific region could be improved by ensuring gender- and disability-inclusiveness are considered and addressed in health security frameworks.

Regional organisations and donor bodies should sustain momentum for health security action at national and regional levels. A regional list of high-risk pandemic and epidemic-prone infectious diseases could assist in the optimisation of resources, and maximise multisectoral collaboration to prevent, detect and respond to infectious and emerging diseases. There are also opportunities for coordination and joint development of resources such as laboratories to achieve cost-effective improvements in core capacities across the human and animal health sectors. Integration with disaster response and security agencies at national and regional levels can deliver integrated, effective, efficient systems for health security.

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Appendix A:

Priority infectious diseases in the Indo-Pacific region

Summary of methodology for reviewing high-burden and high-risk infectious diseases

REVIEW OF NATIONAL STRATEGIC PLANS

We reviewed the National Health Strategic Plans from 21 of the 22 focus countries.ⁱ We identified priority infectious diseases (including zoonotic diseases) outlined in the plans and summarised these in a table. In addition, we extracted information on national preparedness from the national health strategic plans as this was a common feature of all plans.

REVIEW OF WHO COUNTRY COORDINATION STRATEGIES

We reviewed the WHO Member State Country Cooperation Strategies for all 22 countries. In addition, we reviewed the Pacific Islands Countries and Areas WHO Cooperation Strategy 2018–22. We identified priority infectious diseases (including zoonotic diseases) listed in these Strategies and included these in a summary table, which also included information from the National Health Strategic Plans.

REVIEW OF REGIONAL STRATEGIES

We also reviewed regional strategies, documents and reports; information on infectious and zoonotic diseases was extracted from these documents. These documents included, but were not limited to, APSED III, The Pacific Health Security Co-ordination Plan 2017–22, and meeting reports from relevant regional meetings such as the Third Regional Workshop on Multi-Sectoral Collaboration on Zoonoses Prevention and Control held in Bali in 2012, and the Global Framework for Progressive Control of Transboundary Animal Diseases meeting held in 2013. We consulted with regional and national experts to identify relevant documents for review.

ⁱ The national health strategic plan from the Federated States of Micronesia was not available at the time of review.

REVIEW OF EXISTING PRIORITISATION EXERCISES

As part of our literature we identified papers that described disease prioritisation exercises in other settings. We reviewed the methodology of these exercises (including the expert consultation and ranking components) and the priority diseases identified as a result. We compared this to the diseases that we had already identified as being a priority.

EXTRACTION OF GLOBAL BURDEN OF DISEASE DATA

We extracted Global Burden of Disease (GBD) data from the Institute of Health Metrics and Evaluation website (99) for 2017. We analysed these data to compile a list of high-burden infectious diseases for the region. We summarised the top 20 high-burden infectious diseases based on disability-adjusted life years as the measure of burden, and presented this in a summary table along with the priority diseases identified in the National Health Strategic Plans and the WHO Country Cooperation Strategies (Table A1).

ACADEMIC REVIEW

We undertook a rapid scoping review of the published scientific literature and the grey literature focusing on priority infectious diseases identified as being high burden diseases, and diseases identified as priorities in other literature sources highlighted above. Our search process was iterative; additional literature was sourced for selected infectious diseases. We searched by disease, by grouping of disease and by country. Our literature review of the published scientific literature was carried out by experienced public health scientists who searched PubMed and Google Scholar databases. WHO websites were also searched for relevant grey literature. Based on our rapid literature review, we compiled the country lists and supplemented this with several emerging zoonoses that have been frequently described as emerging zoonotic disease threats in the academic literature in the past few years.

EXPERTS CONSULTED

We consulted with a range of multi-disciplinary experts in human and animal infectious diseases and zoonotic diseases, including all members of the Indo-Pacific Centre for Health Security Technical Reference Group, members of the project's Advisory Panel, academics with expertise in infectious diseases and with direct experience in the listed countries, and regional representatives from WHO, the SPC, FAO and OIE.

TABLE A1: SOURCES OF INFORMATION ON PRIORITY INFECTIOUS DISEASES IN NATIONAL AND REGIONAL STRATEGIC PLANS AND WORKSHOPS

DISEASE	INCLUDED IN THE NATIONAL HEALTH STRATEGIC PLAN	INCLUDED IN THE WHO COUNTRY COORDINATION STRATEGY	INCLUDED IN NATIONAL OR REGIONAL ZOOTIC PRIORITY ZOOTIC DISEASE LISTS
Malaria	Cambodia, Indonesia, Philippines, Timor-Leste, Vietnam, Niue, Papua New Guinea, Solomon Islands	Cambodia, Indonesia, Laos, Myanmar, Philippines, Laos, Timor-Leste, Niue, Papua New Guinea, Solomon Islands, Vanuatu	
Tuberculosis	Cambodia, Philippines, Timor-Leste, Vietnam, Cook Islands, Kiribati, Marshall Islands, Nauru, Niue, Papua New Guinea, Solomon Islands	Cambodia, Indonesia, Laos, Myanmar, Philippines, Timor-Leste, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu	
HIV/AIDS	Philippines, Timor-Leste, Vietnam, Cook Islands, Kiribati, Marshall Islands, Niue, Papua New Guinea	Cambodia, Indonesia, Myanmar, Philippines, Timor-Leste, Cook Islands, Fiji, Nauru, Niue, Papua New Guinea, Samoa, Vanuatu	
Avian influenza		Cambodia	OIE/FAO/WHO regional workshop on zoonoses prevention and control in Southeast Asia 2012, SPC/FAO/OIE regional workshop on transboundary animal diseases in the Pacific 2013
Ebola virus	Philippines	Cambodia	
MERS-CoV		Cambodia	
Zika	Philippines	Cambodia, Philippines	
Polio		Laos, Fiji	
Measles		Laos, Fiji, Nauru, Papua New Guinea	
Rubella		Laos, Fiji, Nauru	
Tetanus		Laos, Philippines	

DISEASE	INCLUDED IN THE NATIONAL HEALTH STRATEGIC PLAN	INCLUDED IN THE WHO COUNTRY COORDINATION STRATEGY	INCLUDED IN NATIONAL OR REGIONAL ZOOONOTIC PRIORITY ZOOONOTIC DISEASE LISTS
Pertussis		Laos	
Schistosomiasis		Laos	
Dengue	Philippines, Timor-Leste	Philippines, Timor-Leste, Federated States of Micronesia, Marshall Islands, Vanuatu	
Leptospirosis	Philippines		SPC/FAO/OIE regional workshop on transboundary animal diseases in the Pacific 2013
Hepatitis B		Philippines, Fiji, Kiribati	
Hepatitis C		Philippines	
Chikungunya		Philippines, Papua New Guinea	
Japanese encephalitis		Philippines	
Leprosy	Timor-Leste, Kiribati, Marshall Islands, Nauru	Timor-Leste, Federated States of Micronesia, Kiribati, Marshall Islands	
Lymphatic filariasis	Timor-Leste, Kiribati	Timor-Leste, Federated States of Micronesia, Kiribati, Samoa	
Yaws	Timor-Leste	Timor-Leste	
Trachoma	Nauru		
Syphilis	Nauru		
Cholera		Papua New Guinea	
Rabies			OIE/FAO/WHO regional workshop on zoonoses prevention and control in Southeast Asia 2012, SPC/FAO/OIE regional workshop on transboundary animal diseases in the Pacific 2013

Appendix B:

Summary of JEE scores

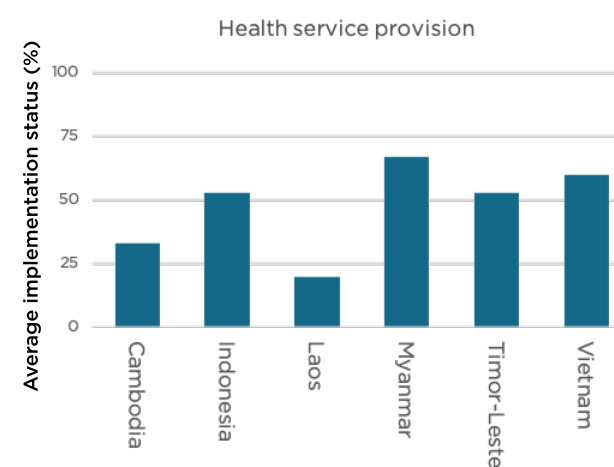
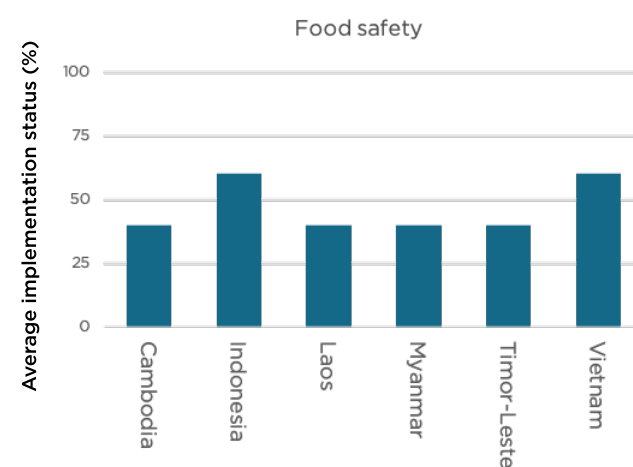
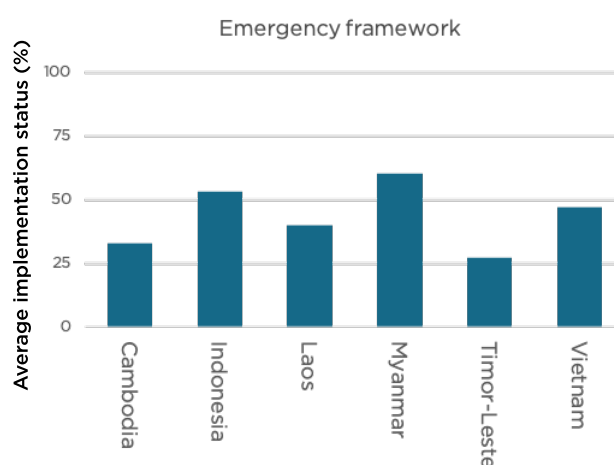
TECHNICAL AREA	INDICATORS	CAMBODIA	INDONESIA	MICRONESIA	LAOS	VIETNAM	MYANMAR
Prevent							
National legislation, policy and financing	P.1.1 Legislation, laws, regulations, administrative requirements, policies or other government instruments in place are sufficient for implementation of IHR (2005)	3	3	3	3	3	2
	P.1.2 The State can demonstrate that it has adjusted and aligned its domestic legislation, policies and administrative arrangements to enable compliance with IHR (2005)	3	3	3	4	3	2
IHR coordination, communication and advocacy	P.2.1 A functional mechanism is established for the coordination and integration of relevant sectors in the implementation of IHR	4	3	3	4	4	2
Antimicrobial resistance	P.3.1 Antimicrobial resistance detection	3	2	4	2	2	3
	P.3.2 Surveillance of infections caused by antimicrobial-resistant pathogens	2	2	4	1	2	3
	P.3.3 Health care-associated infection (HCAI) prevention and control programs	2	3	1	3	3	1
	P.3.4 Antimicrobial stewardship activities	2	3	1	1	2	1
Zoonotic diseases	P.4.1 Surveillance systems in place for priority zoonotic diseases/pathogens	2	3	2	3	4	3
	P.4.2 Veterinary or animal health workforce	3	3	2	3	4	3
	P.4.3 Mechanisms for responding to infectious and potential zoonotic diseases are established and functional	3	2	3	3	3	2

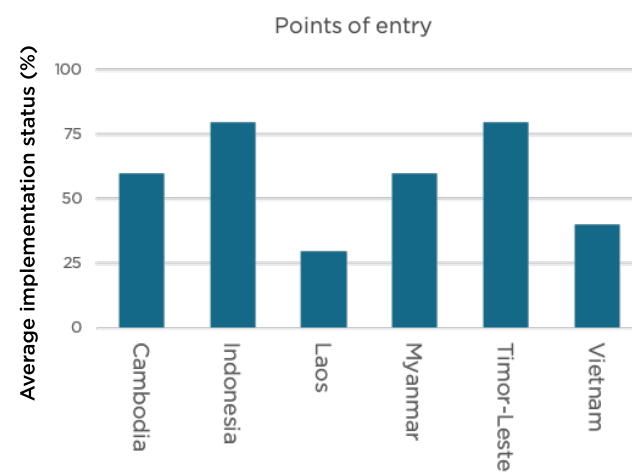
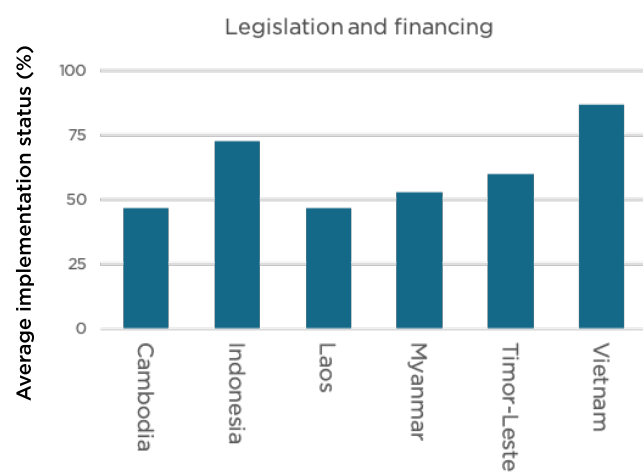
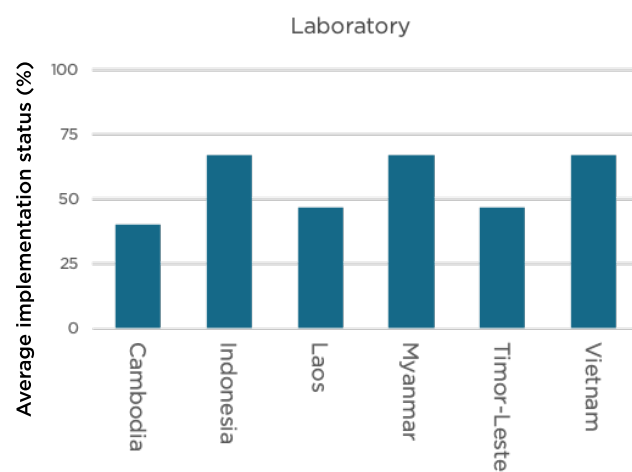
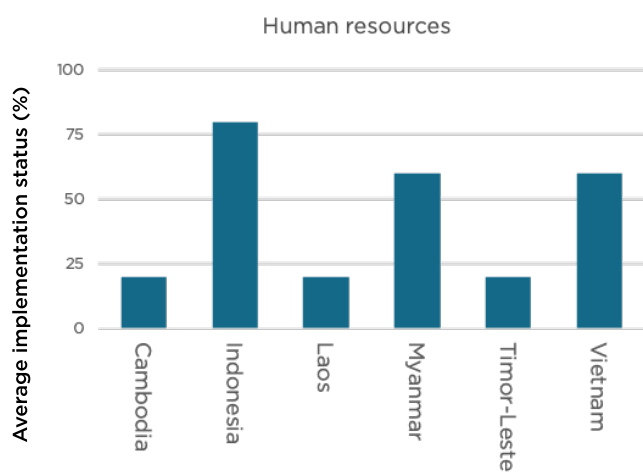
TECHNICAL AREA	INDICATORS	CAMBODIA	INDONESIA	MICRONESIA	LAOS	VIETNAM	MYANMAR
Food Safety	P.5.1 Mechanisms for multisectoral collaboration are established to ensure rapid response to food safety emergencies and outbreaks of foodborne diseases	2	3	2	2	3	2
	P.6.1 Whole-of-government biosafety and biosecurity system is in place for human, animal and agriculture facilities	2	3	2	2	3	2
Biosafety and biosecurity	P.6.2 Biosafety and biosecurity training and practices	2	3	3	2	3	1
	P.7.1 Vaccine coverage (measles) as part of national programmed	4	4	3	3	4	3
	P.7.2 National vaccine access and delivery	4	4	4	4	4	4
Immunisation							
Detect							
National laboratory system	D.1.1 Laboratory testing for detection of priority diseases	4	4	4	4	3	3
	D.1.2 Specimen referral and transport system	2	4	4	3	3	3
	D.1.3 Effective modern point-of-care and laboratory-based diagnostics	2	3	3	3	3	2
	D.1.4 Laboratory quality system	2	3	2	2	3	3
Real-time surveillance	D.2.1 Indicator- and event-based surveillance systems	4	3	4	4	4	4
	D.2.2 Interoperable, interconnected, electronic real-time reporting system	3	3	2	3	3	2
	D.2.3 Integration and analysis of surveillance data	3	2	4	4	3	3
	D.2.4 Syndromic surveillance systems	4	4	4	4	4	3
Reporting	D.3.1 System for efficient reporting to FAO, OIE and WHO	3	3	3	4	3	3
	D.3.2 System for efficient reporting to FAO, OIE and WHO	2	3	2	4	2	2

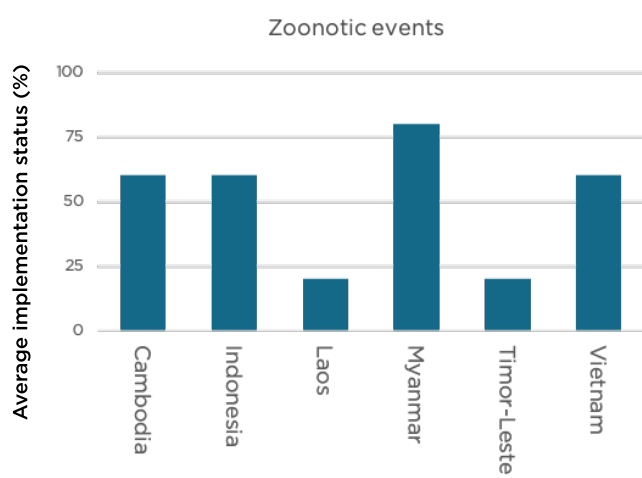
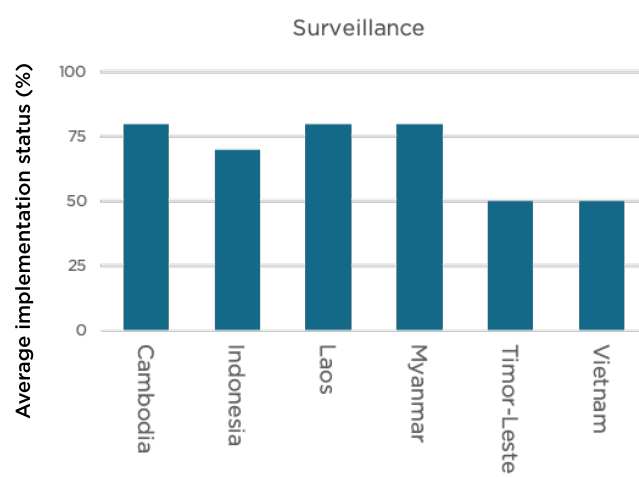
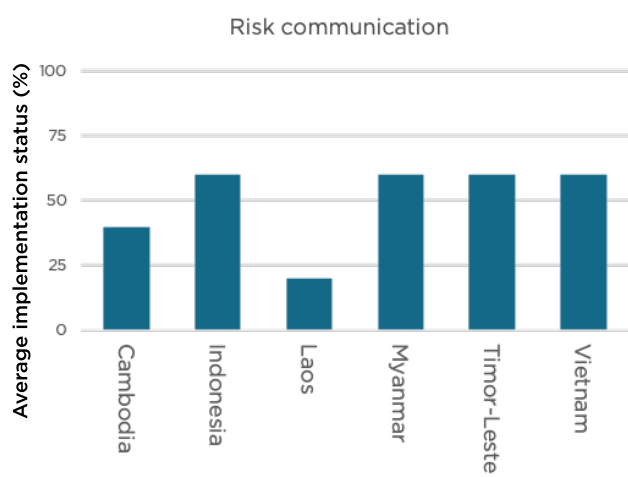
TECHNICAL AREA	INDICATORS	CAMBODIA	INDONESIA	MICRONESIA	LAOS	VIETNAM	MYANMAR
Workplace development	D.4.1 Human resources available to implement IHR core capacity requirements	2	3	3	3	3	3
	D.4.2 FETP or other applied epidemiology training programme in place	3	4	3	3	4	3
	D.4.3 Workforce strategy	2	3	2	2	3	3
Respond							
Preparedness	R.1.1 National multi-hazard public health emergency preparedness and response plan is developed and implemented	1	3	5	2	2	1
	R.1.2 Priority public health risks and resources are mapped and utilized	1	2	2	2	2	1
	R.2.1 Capacity to activate emergency operations	2	3	4	2	2	2
Emergency Response Operations	R.2.2 EOC operating procedures and plans	1	2	4	1	3	1
	R.2.3 Emergency operations programme	1	3	4	3	3	2
	R.2.4 Case management procedures implemented for IHR relevant hazards	1	3	2	2	3	2
Linking public health and security authorities	R.3.1 Public health and security authorities (e.g. law enforcement, border control, customs) are linked during a suspect or confirmed biological event	2	4	2	4	2	2
Linking public health and security authorities	R.4.1 System in place for sending and receiving medical countermeasures during a public health emergency	2	4	5	2	2	1
	Medical countermeasures and personnel deployment	2	4	4	2	2	2
	R.5.1 Risk communication systems (plans, mechanisms)	2	3	2	2	3	1
Medical countermeasures and personnel deployment	Risk communication	3	3	2	3	3	3
	R.5.3 Public communication	3	4	3	3	3	3
	R.5.4 Communication engagement with affected communities	3	4	3	3	2	2
Risk communication	R.5.5 Dynamic listening and rumour management	3	4	3	2	3	2
	PoE.1 Routine capacities established at points of entry	3	4	3	3	3	2
	PoE.2 Effective public health response at points of entry	2	4	2	2	2	2

Appendix C: Summary of State Party Self Assessment scores

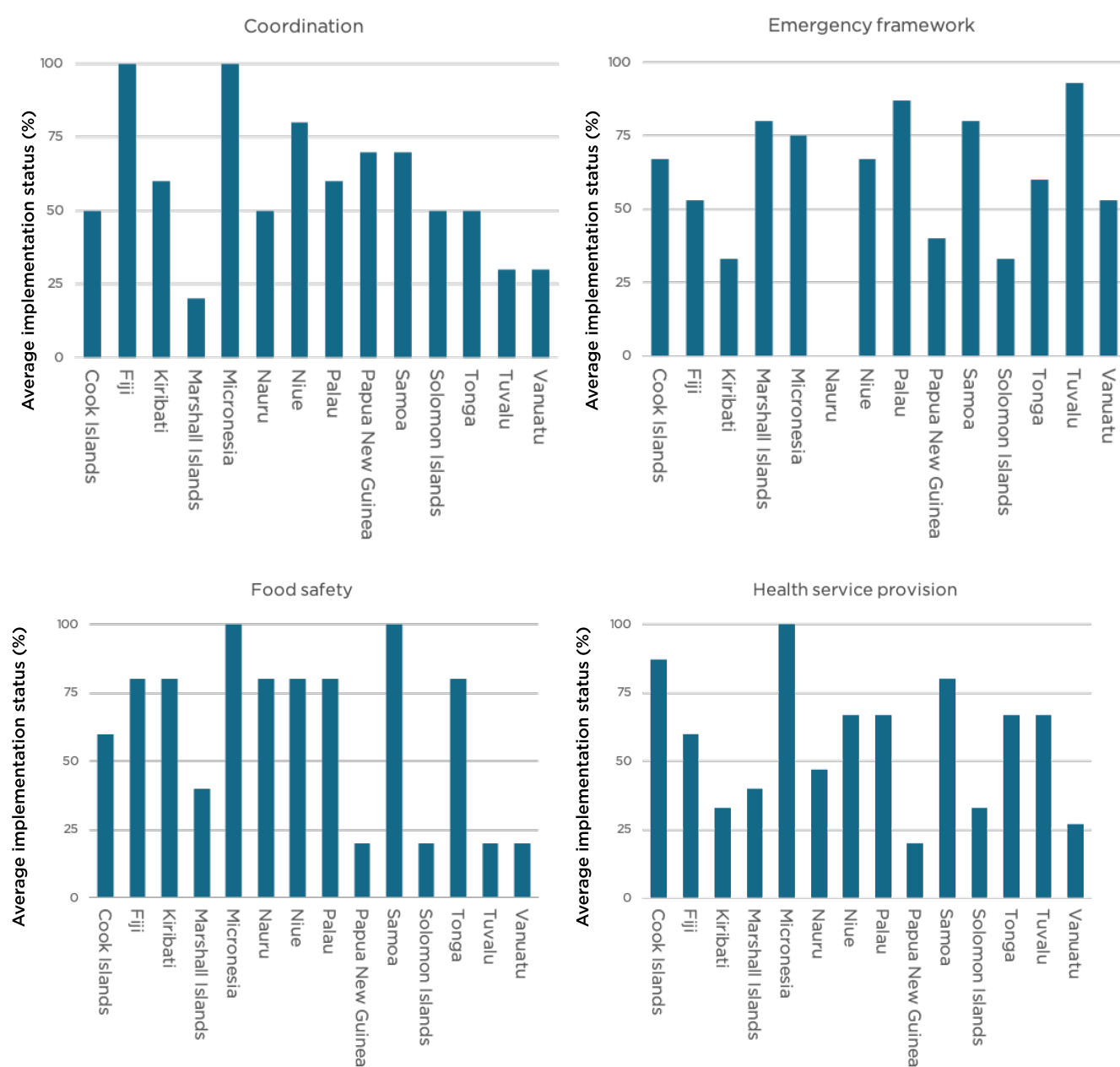
Southeast Asia

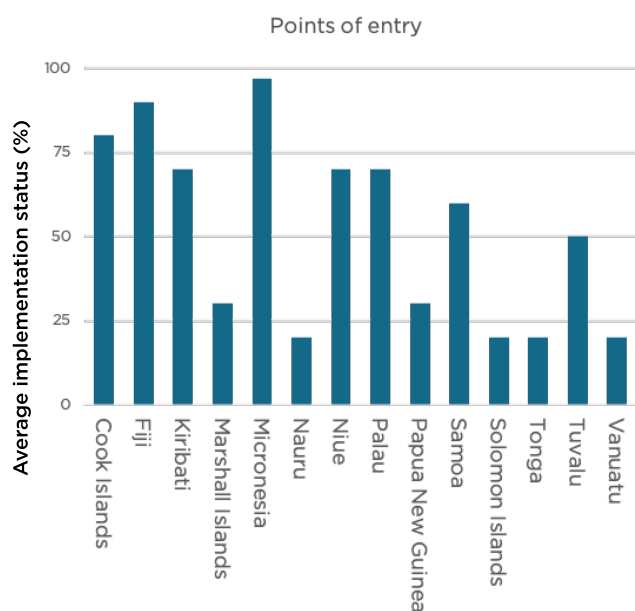
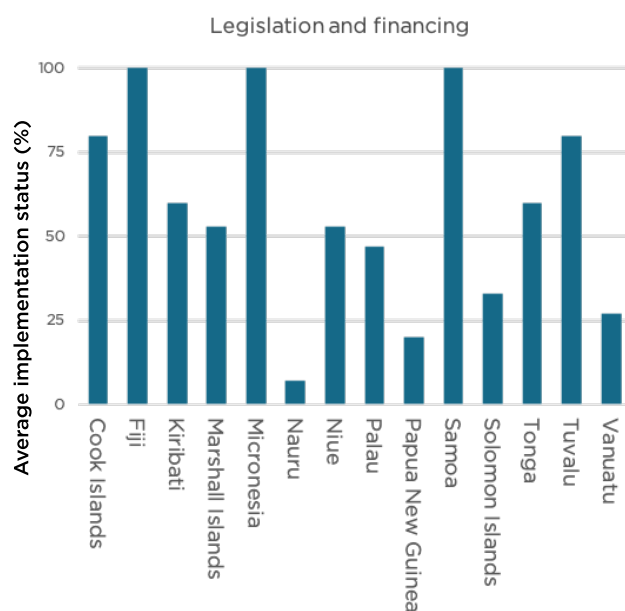
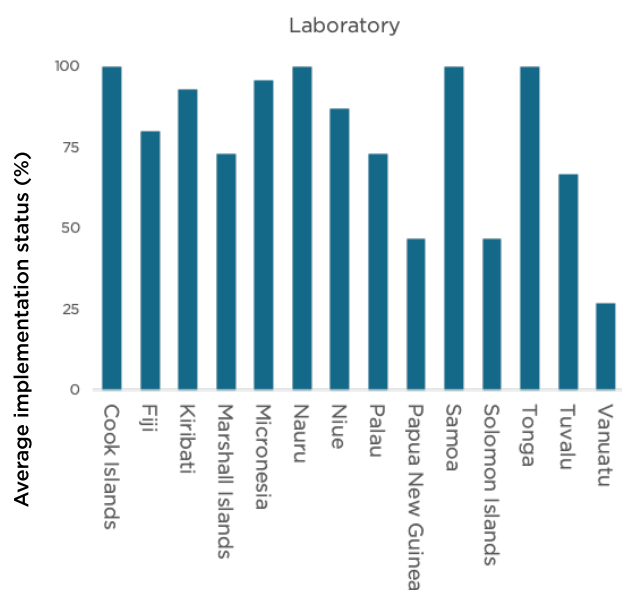
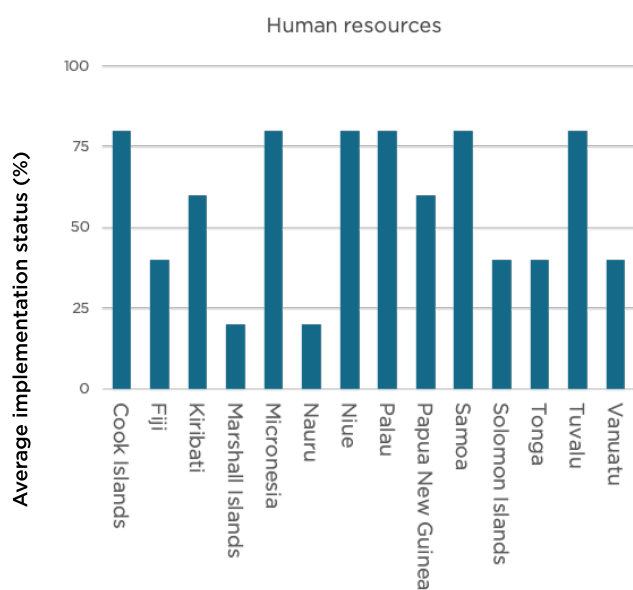


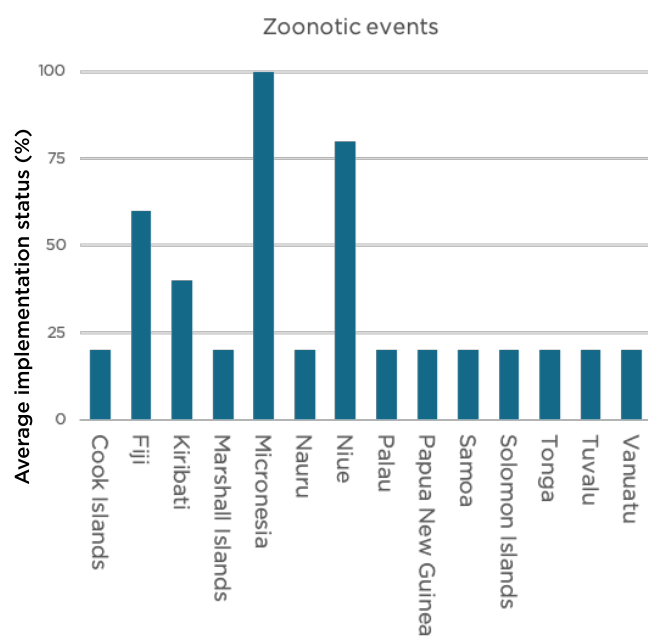
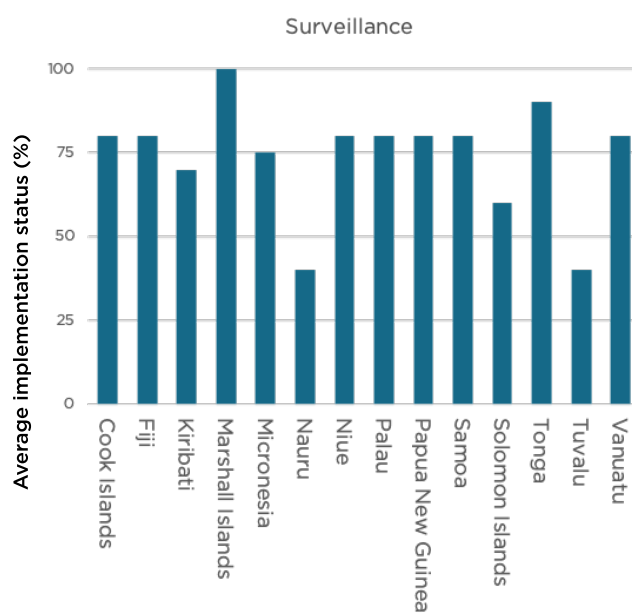
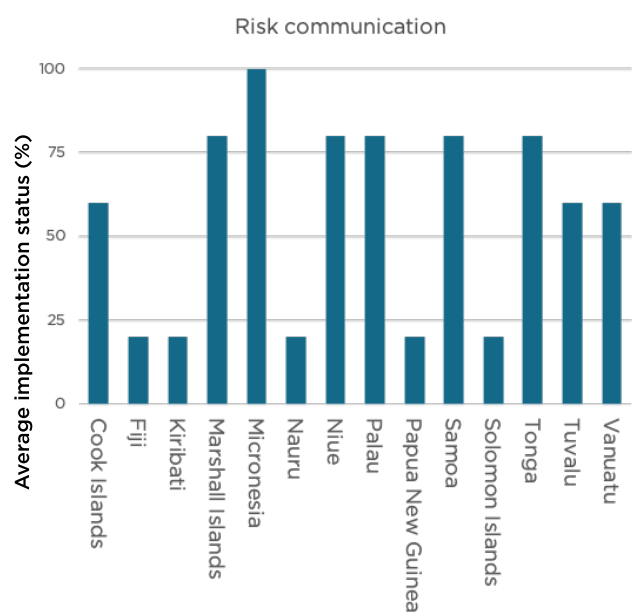




Pacific







Notes

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Notes

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Notes

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