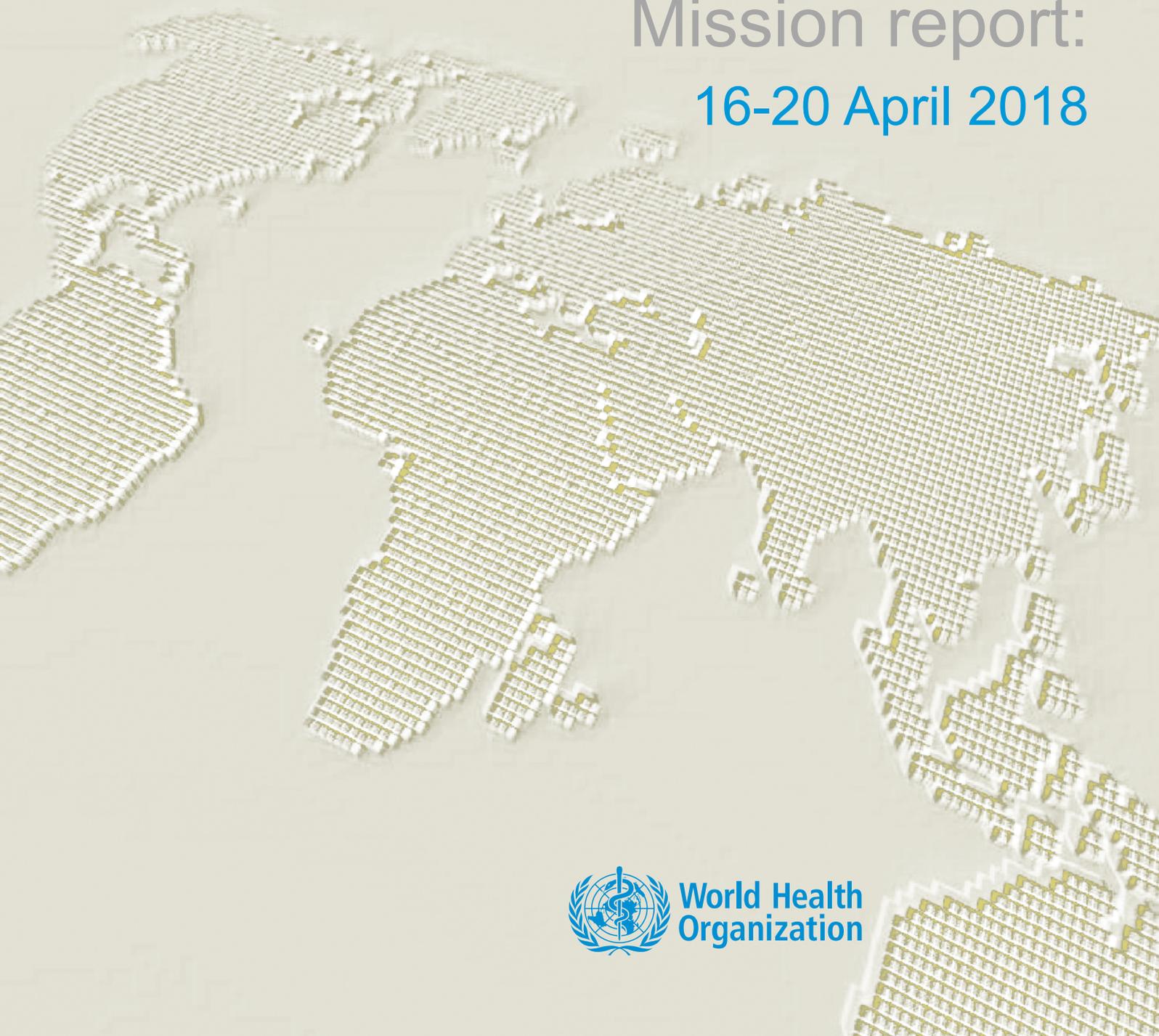# JOINT EXTERNAL EVALUATION OF IHR CORE CAPACITIES

of

SINGAPORE

Mission report:
16-20 April 2018

World Health Organization

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Contents

ACKNOWLEDGEMENTS

Acronyms and abbreviations

AMR	Antimicrobial Resistance
ASEAN	Association of Southeast Asian Nations
AVA	Agri-Food & Veterinary Authority
DORSCON	Disease Outbreak Response System Condition
EOC	Emergency operations centre
ESBL	Extended Spectrum Beta-Lactamase-producing *E.coli*
FAO	Food and Agriculture Organization of the United Nations
FETP	Field epidemiology training programme
HCAI	Health care-associated infection
HCMS	Homefront Crisis Management System
IHR	International Health Regulations
INFOSAN	International Food Safety Authority Network
JEE	Joint External Evaluation
MCI	Ministry of Communications and Information
MDR	Multi-Drug Resistant
MRSA	Methicillin Resistant *Staphylococcus Aureus*
MOH	Ministry of Health
NEA	National Environment Agency
NFP	IHR National Focal Point
OIE	World Organization for Animal Health
RPNSD	Radiation Protection and Nuclear Science Department
SAF	Singapore Armed Forces
SARS	Severe Acute Respiratory Syndrome
SCDF	Singapore Civil Defence Force
SOPs	Standard operating procedures
VRE	Vancomycin-Resistant Enterococci
WHO	World Health Organization

Executive summary

Introduction

The International Health Regulations (IHR (2005)) are the legal framework for global health security with all Member States required to develop minimum core capacities to detect, assess, report and respond to acute public health events and emergencies. In the Western Pacific Region, the Asia Pacific Strategy for Emerging Diseases has been developed as a common regional framework to guide Member States in implementing IHR (2005). More recently, the Asia Pacific Strategy for Emerging Diseases (APSED) has been upgraded to include public health emergencies and is now called the Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies (or APSED III).

The Joint External Evaluation (JEE) is one of the core components of the IHR monitoring and evaluation framework designed to assess IHR required capacities. It uses a standard tool to review national capacities across 19 technical areas related to health security. The JEE is a multisectoral process and is performed as a peer-to-peer collaboration between national and international experts.

The outbreak of Severe Acute Respiratory Syndrome (SARS) in 2003 was a major national crisis in Singapore and resulted in significant investment in strengthening systems to respond to public health emergencies. The SARS incident was also a driver for Singapore's strong leadership and robust political commitment to meet the IHR (2005) requirements for health security.

The JEE process commenced in Singapore in February 2017 with a self-evaluation overseen by the Public Health Group of the Ministry of Health (MOH). Over the next 12 months, stakeholders in Singapore compiled and assessed the information and supporting documents required to conduct a rigorous self-assessment of core capacities in preparation for the JEE.

From 16 to 20 April 2018, a multi-sectoral team of international and national experts, coordinated by WHO Western Pacific Region, jointly conducted a review of Singapore's IHR core capacities in the 19 technical areas using the JEE tool. This report summarizes the findings of the JEE in Singapore and provides recommended priority actions for each the 19 technical areas.

Findings from the Joint External Evaluation

The JEE team unanimously agreed that Singapore has demonstrated strong leadership and a highly developed capacity to detect and respond to potential public health emergencies.

Using the JEE tool, the JEE team assessed Singapore's capacity to meet IHR core functions across 48 specific indicators. Singapore demonstrated "sustainable capacity" (the highest level) for the majority of indicators (65%) and "demonstrated capacity" (31%) or "developed capacity" (4%) for the remainder.

Across the different technical areas, the JEE team was impressed with Singapore's significant achievements in IHR implementation. This included the strong national commitment for health security; the whole of government mechanism for emergency preparedness and response, scalable depending on the event; use of innovation and new technologies to strengthen detection and response systems; strong leadership and forward planning in workforce development; highly motivated staff with strong collegiality across agencies; a culture of communication and collaboration within and between response agencies; and demonstration of continuous improvement of policies and practice based on evaluation and after action reviews.

The JEE team found many strengths across the 19 technical areas, underpinned by state-of-the-art facilities and systems. The One Health framework in Singapore is a successful mechanism for integrating the surveillance and response to threats posed by zoonotic infections, antimicrobial resistance and food-borne

illness. The comprehensive risk communication system includes regular coordination within and between key agencies. Many aspects of Singapore's preparedness and response capacity are tested through multi-sectoral exercises. There is proactive reporting by the IHR National Focal Point and all Singapore residents have universal access to health care, including diagnostic testing and select key immunization services. The Singapore system is founded on robust legal, policy and financing frameworks.

The JEE team was encouraged to note that Singapore acknowledges that even the best systems can benefit from improvement. The overarching recommendations of the JEE team were to:

- Sustain and improve Singapore's well-established and functional systems for management of health security threats through implementation of IHR;

- Continue to strengthen priority areas that have already been identified, such as information systems, MOH emergency operations centre (EOC) and national capacity for infectious disease management; and

- Consider using Singapore's substantial capacity to further support other countries as well as regional and global systems for health security.

The JEE team was highly impressed by Singapore's preparation for the JEE. It was evident that a significant effort was made by Singapore to prepare a high-quality self-assessment report, presentations on the 19 technical areas, and well-planned site visits to demonstrate system functionality.

Conclusions

Health security threats will continue and can be challenging to manage, even for Member States that have demonstrated sustainable capacity for IHR (2005). During this JEE, Singapore has shown a high level of achievement in fulfilling IHR requirements. In the future, the JEE team looks forward to seeing Singapore play a leadership role in enhancing IHR (2005) capabilities at the regional and global level. The JEE team encourages Singapore to continue its commitment to enhancing health security within Singapore, regionally and globally.

In closing, the JEE team wishes to extend their deepest gratitude to Singapore for their thorough preparation, active participation and open discussion to share their extensive experience throughout this evaluation.

Singapore Scores and Priority Actions

Technical areas	Indicators	Score
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)	5
	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)	5
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	5
Antimicrobial resistance	P.3.1 Antimicrobial resistance detection	4
	P.3.2 Surveillance of infections caused by antimicrobial-resistant pathogens	4
	P.3.3 Health care-associated infection (HCAI) prevention and control programmes	5
	P.3.4 Antimicrobial stewardship activities	4
Zoonotic diseases	P.4.1 Surveillance systems in place for priority zoonotic diseases/pathogens	5
	P.4.2 Veterinary or animal health workforce	5
	P.4.3 Mechanisms for responding to infectious and potential zoonotic diseases are established and functional	5
Food safety	P.5.1 Mechanisms for multisectoral collaboration are established to ensure rapid response to food safety emergencies and outbreaks of foodborne diseases	5
Biosafety and biosecurity	P.6.1 Whole-of-government biosafety and biosecurity system is in place for human, animal and agriculture facilities	5
	P.6.2 Biosafety and biosecurity training and practices	5
Immunization	P.7.1 Vaccine coverage (measles) as part of national programme	5
	P.7.2 National vaccine access and delivery	5
National laboratory system	D.1.1 Laboratory testing for detection of priority diseases	5
	D.1.2 Specimen referral and transport system	5
	D.1.3 Effective modern point-of-care and laboratory-based diagnostics	5
	D.1.4 Laboratory quality system	5
Real-time surveillance	D.2.1 Indicator- and event-based surveillance systems	5
	D.2.2 Interoperable, interconnected, electronic real-time reporting system	4
	D.2.3 Integration and analysis of surveillance data	5
	D.2.4 Syndromic surveillance systems	4
Reporting	D.3.1 System for efficient reporting to Food and Agriculture Organization of the United Nations, World Organization for Animal Health and World Health Organization	5
	D.3.2 Reporting network and protocols in country	5
Workforce development	D.4.1 Human resources available to implement IHR core capacity requirements	5
	D.4.2 Field epidemiology training programme or other applied epidemiology training programme in place	5
	D.4.3 Workforce strategy	5

Technical areas	Indicators	Score
Preparedness	R.1.1 National multi-hazard public health emergency preparedness and response plan is developed and implemented	**5**
	R.1.2 Priority public health risks and resources are mapped and utilized	**4**
Emergency response operations	R.2.1 Capacity to activate emergency operations	**4**
	R.2.2 EOC operating procedures and plans	**4**
	R.2.3 Emergency operations programme	**5**
	R.2.4 Case management procedures implemented for IHR relevant hazards.	**4**
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	**5**
Medical countermeasures and personnel deployment	R.4.1 System in place for sending and receiving medical countermeasures during a public health emergency	**4**
	R.4.2 System in place for sending and receiving health personnel during a public health emergency	**4**
Risk communication	R.5.1 Risk communication systems (plans, mechanisms, etc.)	**5**
	R.5.2 Internal and partner communication and coordination	**4**
	R.5.3 Public communication	**5**
	R.5.4 Communication engagement with affected communities	**4**
	R.5.5 Dynamic listening and rumour management	**5**
Points of entry	PoE.1 Routine capacities established at points of entry	**5**
	PoE.2 Effective public health response at points of entry	**4**
Chemical events	CE.1 Mechanisms established and functioning for detecting and responding to chemical events or emergencies	**4**
	CE.2 Enabling environment in place for management of chemical events	**5**
Radiation emergencies	RE.1 Mechanisms established and functioning for detecting and responding to radiological and nuclear emergencies	**3**
	RE.2 Enabling environment in place for management of radiation emergencies	**3**

Scores: 1=No capacity; 2=Limited capacity; 3=Developed capacity; 4=Demonstrated capacity; 5=Sustainable capacity.

PREVENT

National legislation, policy and financing

Introduction

The International Health Regulations (IHR) (2005) provide obligations and rights for States Parties. In some States Parties, implementation of the IHR (2005) may require new or modified legislation. Even if a new or revised legislation may not be specifically required, states may still choose to revise some regulations or other instruments in order to facilitate IHR implementation and maintenance in a more effective manner. Implementing legislation could serve to institutionalize and strengthen the role of IHR (2005) and operations within the State Party. It can also facilitate coordination among the different entities involved in their implementation. See detailed guidance on IHR (2005) implementation in national legislation at http://www.who.int/ihr/legal_issues/legislation/en/index.html. In addition, policies that identify national structures and responsibilities as well as the allocation of adequate financial resources are also important.

Target

Adequate legal framework for States Parties to support and enable the implementation of all their obligations, and rights to comply with and implement the IHR (2005). New or modified legislation in some States Parties for implementation of the IHR (2005). Where new or revised legislation may not be specifically required under the State Party's legal system, States may revise some legislation, regulations or other instruments in order to facilitate their implementation and maintenance in a more efficient, effective or beneficial manner. States Parties ensure provision of adequate funding for IHR implementation through the national budget or other mechanism.

Singapore level of capabilities

The Singapore Government takes its responsibility in ensuring public health security of its people and fulfilling its obligations under the IHR (2005) seriously. A whole-of-government coordination approach is used with robust legal, policy and financing frameworks to safeguard public health security. A One Health framework exists between the Ministry of Health (MOH), National Environmental Agency (NEA), and Agri-Food & Veterinary Authority (AVA) and all have dedicated teams focused on public health.

The Infectious Diseases Act is the primary legislation for the prevention and control of infectious diseases and is jointly administered by MOH and NEA. Subsidiary legislation and regulations under the Infectious Diseases Act address more technical aspects such as the Infectious Diseases (Quarantine) Regulations which specify the regulations and processes for arriving or in-port and departing vessels.

Ministries and government agencies from other sectors are also involved in ensuring IHR obligations are met, e.g. Ministry of Home Affairs, Immigration and Checkpoints Authority of Singapore, Civil Aviation Authority of Singapore, and Maritime and Port Authority of Singapore. Every government agency is supported by legislation to enable it to carry out its function effectively.

Drafting of legislation is centralized and coordinated by the Attorney-General's Chambers. The ministries and government agencies of the Singapore Government regularly evaluate and revise their respective legislation, regulations and policies, in consultation with partners and stakeholders, to ensure continued relevance and efficient coordination across sectors in public health emergency response. The IHR States Parties Annual Report is used for continual assessment on IHR implementation and review of relevant legislation.

The Singapore Government finances all necessary systems and programs without external funding support. Ministries have access to both annual block funding for routine activities (e.g., disease outbreak response, preparedness, surveillance, etc.) and emergency supplemental funding by request. There is also a dedicated funding stream in ministries and government agencies for preparedness activities.

Recommendations for priority actions

- Review and refine the Infectious Diseases Act to allow for scalable emergency responses commensurate to level of risk.
- Consider establishing cross-border agreements and protocols with neighbouring countries in regard to public health emergencies.

Indicators and scores

P.1.1 Legislation, laws, regulations, administrative requirements, policies or other government instruments in place are sufficient for implementation of IHR (2005) – Score 5

Strengths/best practices

- Effective multi-sectoral coordination using whole-of-government approach and One Health framework.
- Legislation and policies for the implementation of IHR (2005) from human, animal and environmental health (including food safety).
- In addition to block budget allocation for each ministry, reserve funds and supplementary budgets can be requested during emergencies.
- Laws and policies are regularly reviewed to address gaps. For example:
    - Infectious Diseases Act amendments in 2003, 2008, 2018/19
    - Periodic updates to Infectious Diseases Act Schedules/Gazettes
    - Policy and operations reviews in annual work plans

Areas which need strengthening/challenges

- While there are strong networks with neighbouring countries (e.g. through Field epidemiology training programme [FETP] coordination and with the Association of Southeast Asian Nations [ASEAN] Health Cluster), clearer regional escalation/alert protocols for more robust public health emergency coordination may be needed.
- Consider further development of cross-border agreements and protocols with neighbouring countries with regard to public health emergencies.

P.1.2 The State can demonstrate that it has adjusted and aligned its domestic legislation, policies and administrative arrangements to enable compliance with the IHR (2005) – Score 5

Strengths/best practices

- Strong coordination across sectors for different aspects of regulatory review process.
- Regular stakeholder engagement.
- Central coordination of legal and regulatory frameworks through the Attorney-General's Chambers.
- Laws and policies are regularly reviewed, and gaps addressed in annual work plans.
- All agencies have ensured that laws, policies and operations support are compliant with IHR, by following up on annual IHR Self-Evaluation Survey.

Areas which need strengthening/challenges

- The Infectious Disease Act may need to be enhanced to further optimise alignment of response measures to the level of risk posed by the emergency event.

IHR coordination, communication and advocacy

Introduction

The effective implementation of the IHR requires multisectoral/multidisciplinary approaches through national partnerships for efficient and alert response systems. Coordination of nationwide resources, including the designation of a national IHR focal point, which is a national centre for IHR communications, is a key requisite for IHR implementation.

Target

Multisectoral/multidisciplinary approaches through national partnerships that allow efficient, alert and responsive systems for effective implementation of the IHR (2005). Coordinate nationwide resources, including sustainable functioning of a national IHR focal point – a national centre for IHR (2005) communications which is a key requisite for IHR (2005) implementation – that is accessible at all times. States Parties provide WHO with contact details of national IHR focal points, continuously update and annually confirm them.

Singapore level of capabilities

Singapore has a well-established multi-sector coordination system and a highly advanced level of capacity for IHR coordination, communication, and advocacy. Functional whole-of-Government mechanisms are in place within the MOH and with other agencies to ensure timely reporting and effective response at various levels.

The Head of the Public Health Intelligence branch within the Epidemiology and Disease Control division of MOH is designated as the primary IHR NFP. The IHR NFP is accessible at all times and is supported by a team of duty officers to ensure sustainable coverage and efficient response.

Singapore has a well-established and robust coordination system between Ministries and Agencies to address public health emergencies of national and international concern. There are standard operating procedures (SOPs) for coordination between the IHR NFP and relevant sectors. Integration and coordination mechanisms within the MOH including the Integrated Operations Management Group during routine times and the MOH Contingency Taskforce during crises. Multisectoral mechanisms include the One Health framework and Homefront Crisis Management System (HCMS) respectively. Coordination and communication mechanisms are reviewed and updated through actual events and exercises. The National IHR NFP provides annual updates on the status of IHR implementation to all relevant stakeholders.

Examples of multi-sectoral coordination between Health and other sectors include responses to:

- Fukushima nuclear incident in Japan (2011)
- Avian influenza A(H7N9) outbreak in China (2013)
- Middle East respiratory syndrome coronavirus outbreaks in the Middle East (2013) and the Republic of Korea (2015)
- Trans boundary haze (2013)
- Ebola outbreak in West Africa (2014)
- Zika virus outbreak and associated consequences (2016)

The IHR NFP's functions are exercised annually during the World Health Organization (WHO) Western Pacific Regional Office (WPRO) annual IHR Exercise Crystal and through regular Crisis Management exercises led by the MOH Contingency Task Force such as the 2017 yellow fever exercise. After action reviews are conducted to improve future response operations. The first local cases of Zika virus infection in 2016 were notified to WHO by National IHR NFP within 24 hours of detection. The after action review concluded that the NFP was instrumental in the proactive engagement with WHO and the NFPs of other countries.

Recommendations for priority actions

- Sustain the high level of expertise in NFP functions and strengthen collaboration with WHO.
- Consider documenting and sharing Singapore's good practices in IHR coordination and communications in the region and internationally.

Indicators and scores

P.2.1 A functional mechanism established for the coordination and integration of relevant sectors in the implementation of IHR – Score 5

Strengths/best practices

- The relevant stakeholders, both national and international, are informed of public health threats in a timely manner.
- Local disease updates and plans of action are shared with WHO and IHR Member States (e.g. for Zika) through relevant IHR platforms.
- Multi-agency and multidisciplinary coordination and communication mechanisms are tested and updated regularly during responses to public health events under the HCMS framework.

Areas which need strengthening/challenges

- Sustaining a high level of expertise in the Public Health Intelligence Branch is a challenge due to limited manpower and time needed to build strong expertise.

Antimicrobial resistance

Introduction

Bacteria and other microbes evolve in response to their environment and inevitably develop mechanisms to resist being killed by antimicrobial agents. For many decades, the problem was manageable as the growth of resistance was slow and the pharmaceutical industry continued to create new antibiotics.

Over the past decade, however, this problem has become a crisis. Antimicrobial resistance is evolving at an alarming rate and is outpacing the development of new countermeasures capable of thwarting infections in humans. This situation threatens patient care, economic growth, public health, agriculture, economic security and national security.

Target

Support work coordinated by FAO, OIE and WHO to develop an integrated global package of activities to combat antimicrobial resistance, spanning human, animal, agricultural, food and environmental aspects (i.e. a One Health approach). Each country has: (i) its own national comprehensive plan to combat antimicrobial resistance; (ii) strengthened surveillance and laboratory capacity at the national and international levels following international standards developed as per the framework of the Global Action Plan; and (iii) improved conservation of existing treatments and collaboration to support the sustainable development of new antibiotics, alternative treatments, preventive measures and rapid point-of-care diagnostics, including systems to preserve new antibiotics.

Singapore level of capabilities

The National Strategic Action Plan on Antimicrobial Resistance (AMR) provides a framework to strengthen and enhance activities to combat AMR and is aligned to the WHO Global Action Plan on Antimicrobial Resistance.

Antibiotic use in humans is legislated and can only be obtained when prescribed by medical practitioners.

Under the Private Hospitals and Medical Clinics Act, all hospitals are required to have infection prevention and control policies. All public hospitals have a microbiology laboratory to conduct culture and antibiotic susceptibility testing for the eight priority AMR pathogens with selected isolates sent to the National Public Health Laboratory for further characterization. AMR surveillance for five of the eight WHO priority pathogens, plus four other AMR pathogens, and for antimicrobial prescriptions is conducted in all public acute care hospitals.

Antimicrobial Stewardship Programmes have been implemented in all seven public acute care hospitals in Singapore, which account for 80% of all hospital admissions.

In the animal sector, restrictions are placed on the types of antimicrobials used in animal feed and food-producing animals. Food products are screened for antibiotic residues by AVA. There is robust laboratory capability to detect antimicrobial resistant pathogens for all major foodborne pathogens and indicator bacteria. The laboratory conducts tests for multi-drug resistant (MDR) Salmonella spp and vancomycin-resistant enterococci (VRE), extended spectrum beta-lactamase-producing E.coli (ESBL) and methicillin resistant Staphylococcus aureus (MRSA) from imported meats and food products.

There is passive surveillance of AMR animal pathogens from testing requested by attending veterinarians for therapeutic treatment. Active surveillance is conducted for multi-drug resistant Salmonella Enteritidis and E.coli from local poultry and ruminant farms.

Antimicrobials are not allowed for growth promotion in food producing animals in Singapore and there is a high level of engagement with farmers on proper antimicrobial usage. Currently, veterinary prescription is not required for administering antibiotics to farm animals; however, AVA engages and provides guidance to farmers on antimicrobial stewardship.

Antimicrobial usage for animal establishments and veterinary clinics is monitored through sales data from wholesalers. Antibiotic usage is also monitored under the Singapore Quality Egg Scheme for participating chicken layer farms and Good Aquaculture Practices for participating food fish farms.

Waste management is addressed at the planning and design stage of facility development for pharmaceutical industries, hospitals, veterinarian clinics and farms. Environmental requirements such as proper disposal of toxic industrial waste and discharge of trade effluent are communicated.

Recommendations for priority actions

- Consider expanding animal health surveillance activities to all priority AMR organisms.
- Consider developing joint guidelines for the investigation and control of outbreaks caused by resistant bacteria of animal origin.
- Consider requiring prescriptions for antimicrobial use at farm level.
- Work with providers and the public to promote appropriate antibiotic use in the community.

Indicators and scores

P.3.1 Antimicrobial resistance detection – Score 4

Note on score: The human sector has designated laboratories for the detection and reporting of all priority AMR pathogens for more than 5 years with a system for continuous improvement (Score 5), however the animal sector laboratories detect and report selected priority AMR pathogens (Score 3) giving an average Score 4.

Strengths/best practices
- National system for laboratory testing, detection and reporting of AMR pathogens that is reviewed and updated annually.
- All seven public hospital laboratories can detect all WHO and national priority pathogens, and the National Public Health Laboratory and the Veterinary Public Health Laboratory perform national reference laboratory functions.

Areas which need strengthening/challenges
- Resources (funding, manpower) to expand surveillance to all priority AMR organisms in the animal health sector.
- Analysis, interpretation and reporting of AMR surveillance data for animal health at a national level.

P.3.2 Surveillance of infections caused by antimicrobial-resistant pathogens – Score 4

Note on score: The human sector has designated laboratories/sentinel sites that have conducted surveillance of all priority AMR pathogens for over 5 years with a system for continuous improvement (Score 5), however, the animal sector has designated laboratories/sentinel sites that have conducted surveillance of infections caused by some priority AMR pathogens (Score 3), giving an average Score 4.

Strengths/best practices

- National surveillance system for infections caused by priority AMR pathogens are reviewed and updated annually.

- All seven public acute care hospitals (which account for 80% of hospitalisation care in Singapore) and all poultry layer farms and ruminant farms are sentinel sites for surveillance.

- The One Health surveillance working group shares methods and programmes for monitoring antimicrobial use and conducting AMR surveillance.

Areas which need strengthening/challenges

- Private hospitals and primary/community care institutions are not included in national surveillance of infections caused by AMR pathogens.

- Integration of surveillance across animal, human, food and environment sectors, including identification of priority AMR pathogens across these sectors.

- AMR surveillance programmes in the Animal Sector are under review.

P.3.3 Health care-associated infection (HCAI) prevention and control programmes – Score 5

Strengths/best practices

- The national system for HCAI prevention and control is reviewed and updated every three years.

- All public and private acute healthcare facilities, as well as step-down care facilities, are legislated to have infection control programmes.

- All acute healthcare facilities, including tertiary hospitals, have designated and trained Infection, Prevention and Control physicians and nurses.

Areas which need strengthening/challenges

- Monitoring of national infection control indicators in private hospitals is voluntary and not all private hospitals participate.

P.3.4 Antimicrobial stewardship activities – Score 4

Note on score: While designated centers/facilities in the human health system have conducted all antimicrobial stewardship practices for five years with a system of continuous improvement (Score 5), the animal health sector have conducted some antimicrobial stewardship practices (Score 3), giving an average Score 4.

Strengths/best practices

- The national system for antimicrobial stewardship in public hospitals is reviewed every six months.

- AVA maintains a high level of engagement with farmers and provides guidance on antimicrobial stewardship.

Areas which need strengthening/challenges

- Antimicrobial Stewardship Programmes are not fully institutionalised in private hospitals and primary care.

- Legislation for veterinary prescription of antimicrobials at a farm level.

- Registration for drugs used for veterinary purposes.

Zoonotic diseases

Introduction

Zoonotic diseases are communicable diseases that can spread between animals and humans. These diseases are caused by viruses, bacteria, parasites and fungi carried by animals, insects or inanimate vectors that aid in its transmission. Approximately 75% of recently emerging infectious diseases affecting humans is of animal origin; and approximately 60% of all human pathogens are zoonotic.

> **Target**
> *Adopted measured behaviors, policies and/or practices that minimize the transmission of zoonotic diseases from animals into human populations.*

Singapore level of capabilities

Singapore has a strong system to detect, prevent and respond to zoonotic diseases of public health significance. There is a well-established One Health framework that applies coordinated, collaborative, multidisciplinary and cross-sectoral approaches at the animal-human-environment interface.

The One Health framework comprises the three public health agencies in Singapore – MOH, the national authority responsible for protecting human health; AVA, the national agency for animal health and food safety (until retail); and NEA, the national agency responsible for improving and sustaining a clean and green environment and food hygiene at retail food establishments. Under the framework, the One Health Coordinating Committee provides strategic direction and sets priorities for inter-agency coordination and collaboration. The One Health Working Group works under the direction of the Coordinating Committee to formulate, coordinate, implement and review programmes, initiatives and action plans. Project teams may be formed when necessary to focus on specific One Health issues or projects.

Singapore has a list of notifiable zoonotic diseases gazetted under the Animals and Birds Act which must be reported to AVA. Surveillance systems for priority zoonotic diseases/pathogens are well-established and cover Bovine Tuberculosis, Avian Influenza, Salmonella Enteritidis, Brucellosis, and E.coli O157:H7. Surveillance programmes are reviewed regularly. AVA also conducts risk assessments and may scale up surveillance when there are reports of outbreaks from neighbouring countries or countries from which Singapore imports animals and/or animal products.

Situational awareness reports or reports of potential disease outbreaks which have a zoonotic or environmental component, are timely and regularly shared through the One Health framework. Laboratory reports and specimens are also shared between public health and animal health laboratories' and these are linked.

There is a well-established system for responding to reports of notifiable disease and/or outbreaks, including those caused by zoonotic pathogens. AVA has a Disease Investigation Team which responds to reports of exotic diseases within 24 hours and endemic diseases within two working days. Depending on the nature of the zoonotic event, a joint investigation may be conducted through the One Health framework. There are contingency plans for diseases with serious impact to human or animal health and trade, such as rabies and avian influenza, and these include communications to stakeholders and the public.

Recommendations for priority actions

- Strengthen mechanisms for zoonotic disease reporting and further integrate animal and human surveillance systems.

- Continue developing the early warning system to predict and prevent the incursion of animal diseases.

Indicators and scores

P.4.1 Surveillance systems in place for priority zoonotic diseases/pathogens – Score 5

Strengths/best practices

- Systems are in place for prevention, surveillance, laboratory capacity and response for zoonotic diseases in humans and animals through the One Health framework.

- Surveillance programmes are reviewed regularly in accordance with World Organization for Animal Health (OIE) surveillance guidelines. Risk assessment may result in the scaling up of surveillance programmes.

- Sharing results, specimens and reports between the public health and the animal health laboratories.

- The good working relationship between AVA and their stakeholders (farms, veterinarians).

Areas which need strengthening/challenges

- Continue developing an early warning system to predict and prevent incursions of disease event and define surveillance strategies.

- Improve mechanisms for disease reporting among animal sectors and further integrate human and animal health surveillance data.

P.4.2 Veterinary or animal health workforce – Score 5

Strengths/best practices

- Animal health workforce capacity within AVA is robust, with technical expertise in different areas, including veterinarians with postgraduate qualifications in Veterinary Public Health, Epidemiology and One Health.

- Continuing education through local and overseas training courses for professional development.

Areas which need strengthening/challenges

- Continue integrating animal health professionals into specific modules of the Field Epidemiology Training Program (FETP)

P.4.3 Mechanisms for responding to infectious and potential zoonotic diseases established and functional – Score 5

Strengths/best practices

- The AVA Disease Investigation Team.

- Reporting by external stakeholders, e.g. veterinarians and farmers, is encouraged through stakeholder education and established reporting channels.

- The exchange of zoonotic disease reports through the One Health framework.

- Contingency plans are in place for diseases such as avian influenza, and these are regularly exercised to ensure operational readiness.

Areas which need strengthening/challenges

- Continue exchanging and integrating zoonosis related activities and reports following the One Health framework.

Food safety

Introduction

Food- and water-borne diarrhoeal diseases are leading causes of illness and death, particularly in less developed countries. The rapid globalization of food production and trade has increased the potential likelihood of international incidents involving contaminated food. The identification of the source of an outbreak and its containment is critical for control. Risk management capacity with regard to control throughout the food chain continuum must be developed. If epidemiological analysis identifies food as the source of an event, based on a risk assessment, suitable risk management options that ensure the prevention of human cases (or further cases) need to be put in place.

Target

Surveillance and response capacity among States Parties for food- and water-borne disease risks or events by strengthening effective communication and collaboration among the sectors responsible for food safety, and safe water and sanitation.

Singapore level of capabilities

Singapore has a robust regulatory system for food safety. AVA is the national food safety authority responsible for ensuring a resilient supply of safe food. AVA adopts a science-based risk management approach for food safety and operates an integrated "farm to fork" food safety system, reducing the risk of disease during food production, processing and distribution. This includes accreditation of countries and export establishments; import control; regulation of local farms and food establishments; and surveillance of food sampling and testing.

MOH maintains a robust notification system for surveillance of food-borne diseases and is responsible for leading the investigation and response of major food-borne outbreaks.

NEA regulates the safety of food at the retail level, specifically ensuring hygienic food handling and preparation in retail food establishments. Supported by a surveillance, research and risk assessment programme, NEA licenses and conducts regular inspections of retail food establishments. Food handlers need to be registered, complete a mandatory Basic Food Hygiene Course, and attend subsequent trainings.

A well-established multi-sectoral mechanism for information exchange and coordination for suspected foodborne disease outbreak investigations operates under the One Health framework. Food-borne illness outbreaks are jointly investigated by the three One Health agencies using the One Health Response Plan for Food-Borne Outbreaks.

The national food safety testing laboratory is the Veterinary Public Health Laboratory, which also contributes to capacity building in food safety in the areas of risk assessment, standard setting and harmonization. It is an OIE Collaborating Centre for Food Safety (Asia-Oceania region), as well as the ASEAN Reference Laboratory for analyses of Pesticide Residues and for Environmental Contaminants. Singapore is an active participant in the International Food Safety Authority Network (INFOSAN).

Recommendations for priority actions

- Enhance engagement with industry and consumers to maintain trust in food safety.

- Continue to improve food safety practices among the public.

- Consider documenting Singapore's food safety system to share regionally and internationally.

Indicators and scores

P.5.1 Mechanisms for multisectoral collaboration established to ensure rapid response to food safety emergencies and outbreaks of foodborne diseases – Score 5

Strengths/best practices

- AVA and NEA adopt a risk management approach for food safety, and together, operate an integrated food safety system that encompasses farm to fork.

- The One Health joint protocol for the investigation and response to outbreaks of foodborne illness.

- Surveillance data are shared and used to guide risk assessment activities, research, educational materials and public health operational plans.

Areas which need strengthening/challenges

- Maintaining effective engagement to educate the public about the consumer role in ensuring food safety and improving the food safety culture among local food manufacturers and retailers.

- Share best practice examples within the region.

Biosafety and biosecurity

Introduction

It is vital to work with pathogens in the laboratory to ensure that the global community possesses a robust set of tools – such as drugs, diagnostics, and vaccines – to counter the ever-evolving threat of infectious diseases.

Research with infectious agents is critical for the development and availability of public health and medical tools that are needed to detect, diagnose, recognize and respond to outbreaks of infectious diseases of both natural and deliberate origin. At the same time, the expansion of infrastructure and resources dedicated to work with infectious agents have raised concerns regarding the need to ensure proper biosafety and biosecurity to protect researchers and the community. Biosecurity is important in order to secure infectious agents against those who would deliberately misuse them to harm people, animals, plants or the environment.

Target

A whole-of-government national biosafety and biosecurity system with especially dangerous pathogens identified, held, secured and monitored in a minimal number of facilities according to best practices; biological risk management training and educational outreach conducted to promote a shared culture of responsibility, reduce dual-use risks, mitigate biological proliferation and deliberate use threats, and ensure safe transfer of biological agents; and country-specific biosafety and biosecurity legislation, laboratory licensing and pathogen control measures in place as appropriate.

Singapore level of capabilities

Singapore has a comprehensive regulatory framework for biosafety and biosecurity with a whole-of-government approach. Legislation and guidelines are periodically reviewed and updated. The import, possession, use, transfer, transport and transhipment of pathogens and toxins of human and animal origin are regulated by the Biological Agents and Toxins Act and Animals and Birds Act, respectively, while the Strategic Goods Control Act regulates their export. The Infrastructure Protection Act oversees the security of facilities that handle high security risk materials, including biological agents and toxins, and the Workplace Safety and Health Act provides for safety and health in all workplaces, including bio-laboratories.

All facilities handling dangerous human pathogens and microbial toxins (except for diagnostic purposes only) are subject to biosecurity and biosafety assessment. Facilities meeting regulatory requirements (which include an established biorisk management system) are granted approval to store and handle such pathogens or toxins and must undergo periodic certification, inspection and/or audit by MOH and/or AVA. High risk facilities are certified annually, while lower risk facilities are inspected/audited once every two to three years by MOH and annually by AVA.

Dual use research of concern is addressed by having biosafety committees in all facilities handling high-risk pathogens and microbial toxins with procedures for risk assessment and mitigation. Work involving genetic manipulation or modification is vetted by the Genetic Modification Advisory Committee and reviewed by MOH or AVA. The Biological Agents and Toxins Act prohibits the use of biological agents and toxins for non-peaceful purposes.

Within the relevant institutions there is a comprehensive multi-tier system of biosafety/biosecurity training programmes that are subsidized by the government. The Biosafety Induction Program and Biosafety

Professional Program are based on a set of standard training materials reviewed and endorsed by a panel of subject experts, such as biosafety professionals, bio-containment engineers, and security personnel. These programs include aspects of biosecurity and are conducted by trainers certified under the Advanced Certificate in Training and Assessment program.

Most institutions also run in-house biosafety and biosecurity trainings programs, either classroom-based, online or on-the-job basis.

Certified facilities possessing dangerous human and animal pathogens are also required to conduct annual joint emergency response exercises with Singapore Civil Defence Force (SCDF).

Personnel responsible for packing and shipping of dangerous pathogens and toxins must undergo specialized training and be certified.

Recommendations for priority actions

- Consider further strengthening safeguards against dual use research of concern, including a researcher's code of conduct.

Indicators and scores

P.6.1 Whole-of-government biosafety and biosecurity system in place for human, animal and agriculture facilities – Score 5

Strengths/best practices

- Mutual respect and constant communication between agencies and ministries enable a whole-of-government approach for national biosafety and biosecurity issues.

- Strong culture of biorisk assessment and biosafety and biosecurity awareness.

- Continuous review and update of biosafety and biosecurity legislation, regulations and guidelines.

- Certification and inspection scheme help to maintain good biosafety/biosecurity practices in facilities handling dangerous pathogens and microbial toxins.

- Joint inspections (by MOH, AVA and external inspectors) for dangerous pathogens of concern to human and animal health.

Areas which need strengthening/challenges

- Annual BSL-3 facility recertification process is costly (because of the involvement of third-party certifiers, mainly from overseas) and lengthy (shutdown time while preparing for recertification).

P.6.2 Biosafety and biosecurity training and practices – Score 5

Strengths/best practices

- Biosafety training programs are best practice.

- Legislative support, MOH-approved training curriculum and trainers certified under the Advanced Certificate in Training and Assessment ensure continuity, consistency and high quality of training.

- Training programmes in biosafety and biosecurity are heavily subsidized by the government in both the public and private sectors.

Areas which need strengthening/challenges

- Lack of opportunity for regular, on-the-job experience and practice for personnel without access to high containment labs.

Immunization

Introduction

Immunizations are estimated to prevent more than two million deaths a year globally. Immunization is one of the most successful global health interventions and cost-effective ways to save lives and prevent disease.

Target

A national vaccine delivery system – with nationwide reach, effective distributions, access for marginalized populations, adequate cold chain and ongoing quality control – that is able to respond to new disease threats.

Singapore level of capabilities

A comprehensive national childhood immunization programme is delivered by both public and private healthcare institutions, according to the National Childhood Immunization Schedule. Diphtheria and measles vaccinations are mandatory by law, and proof of vaccination is required for primary school registration (7 years of age) and enrolment into childcare centres (below 7 years of age) as part of administrative requirements. As diphtheria and measles vaccinations are administered together with vaccines against other diseases (such as mumps, rubella, tetanus and pertusis), the requirements ensure broad coverage for vaccinations against diseases in the National Childhood Immunisation Schedule, excluding BCG, hepatitis B, HPV and pneumococcal vaccines. A National Adult Immunization Schedule has been established to increase coverage of important vaccinations for adults. There is an efficient national vaccine delivery system with good cold chain practices.

The programme has delivered high levels of vaccination coverage amongst children, with about 95% of Singapore's two-year-old population having at least one dose of measles-containing vaccine. Vaccination coverage is nearly universal for Singapore residents. However for non-residents (who constitute about 30% of the population), documentation of immunization status may be incomplete, mostly due to difficulties with capturing vaccination records for this population.

The School Health Service (part of the Health Promotion Board) and the public healthcare system have an effective vaccine delivery system that ensures cold chain maintenance. Functional procurement and vaccine demand forecasting ensures vaccine supplies are adequate. Private healthcare providers are served by commercial service providers for vaccines and are regulated by the MOH to have the necessary equipment and system to maintain vaccine cold chain. Every child in Singapore has access to vaccination under the national schedule.

Recommendations for priority actions

- Improve awareness on vaccine benefits and promote effective strategies to address vaccine-hesitant groups.

- Augment efforts to ensure vaccination records are captured comprehensively with high vaccination coverage among non-residents.

- Consider improvements to the National Immunization Registry to include electronic data entry, automated data capture and transfer from medical clinics.

Indicators and scores

P.7.1 Vaccine coverage (measles) as part of national programme – Score 5

Strengths/best practices

- Administrative requirements (e.g. proof of vaccination for registration into childcare centres and primary schools), coupled with legislation mandating vaccinations for measles and diphtheria, support high vaccination coverage.

- Adoption of combination vaccines supports broad vaccination coverage against other diseases (e.g. mumps, rubella, pertussis) in addition to measles and diphtheria.

Areas which need strengthening/challenges

- Vaccination coverage data for non-residents is incomplete. MOH is working with other ministries and agencies to examine ways to address this.

- A small number of measles infections with delayed or missed measles/mumps/rubella vaccinations are sporadically reported.

P.7.2 National vaccine access and delivery – Score 5

Strengths/best practices

- One hundred per cent of the target population has access to vaccines under the National Childhood Immunization Schedule. Vaccines are maintained under cold chain conditions under a regulatory framework. There have been minimal disruptions to vaccine supply.

- The School Health Service conducts nation-wide school-based vaccination programs for school children.

- The Group Procurement Office conducts central bulk procurement for the public sector, ensuring a sustainable supply for the public hospitals and polyclinics.

- The National Adult Immunization Schedule is in place.

Areas which need strengthening/challenges

- HPV vaccination coverage rates in Singapore were low at below 25% in 2016. Education and other efforts to increase uptake are being considered.

- Intermittent disruptions in global vaccine supply and difficulties in sourcing for alternative supply poses a challenge in maintaining stable vaccine supply.

DETECT

National laboratory system

Introduction

Public health laboratories provide essential services including disease and outbreak detection, emergency response, environmental monitoring and disease surveillance. State and local public health laboratories can serve as a focal point for a national system, through their core functions for human, veterinary and food safety including disease prevention, control and surveillance; integrated data management; reference and specialized testing; laboratory oversight; emergency response; public health research; training and education; and partnerships and communication.

Target

Real-time biosurveillance with a national laboratory system and effective modern point-of-care and laboratory-based diagnostics.

Singapore level of capabilities

Singapore has built a comprehensive laboratory system characterized by universal access and strong capacities for diagnostic, public health surveillance and environmental monitoring services. State-of-the-art technologies and techniques, including modern point-of-care diagnostics, are used in an integrated system across human health, animal health and environmental sectors under the One Health framework.

The human health laboratory network comprises the National Public Health Laboratory (NPHL) and seven public hospital laboratories. The national reference laboratories for tuberculosis, poliovirus and HIV are in public hospital laboratories, while the NPHL hosts national reference laboratories for influenza, malaria, measles and rubella. There are two laboratories responsible for animal health and food safety testing in AVA – the Animal Health Laboratory and the Veterinary Public Health Laboratory. Transport of specimens for surveillance and outbreak investigations is contracted to private courier companies with expertise in handling biological samples. Transport of specimens known or confirmed to contain dangerous biological agents or selected microbial toxins is regulated by Biological Agents and Toxins (Transportation) Regulations.

All laboratories have the required equipment to perform core laboratory tests and have equipment maintenance contracts. Preventive maintenance is conducted regularly based on manufacturers' and/or institutional recommendations. Procurement of necessary media and reagents is managed by material management teams in individual institutions who liaise with commercial vendors directly. MOH makes arrangements with the suppliers for reagent stockpiling. During major outbreaks, MOH provides support in securing reagents as necessary.

Quality of laboratory testing is ensured through mandatory licensing according to minimum standards prescribed under the Private Hospitals and Medical Clinics Act. Laboratory accreditation is voluntary and includes accreditation schemes administered by the College of American Pathologists and the Singapore Accreditation Council Laboratory Accreditation Scheme. All major laboratories fulfilling public health functions are accredited to international standards (ISO 15189, College of American Pathologists or ISO 17025).

DETECT

Mechanisms and arrangements (including links with laboratories outside Singapore) ensure rapid deployment of surge capacity. Both NPHL and Animal Health Laboratories have collaborative projects with Ministry of Home Affairs and Ministry of Defence laboratories whose primary function is detection of biothreat agents. The Veterinary Public Health Laboratory closely collaborates with the Environmental Health Institute.

The Private Hospitals and Medical Clinics Act and individual accreditation bodies require that laboratories participate in external quality assessment (EQA) programs for every test conducted. Domestic EQA programs include HIV, tuberculosis, and malaria administered by the respective national reference laboratories designated by MOH. EQA schemes for other tests are obtained from overseas commercial providers. AVA laboratories operate under a quality assurance system accredited to ISO 17025 and subscribe to international proficiency testing schemes annually.

Licensing of laboratories that import and/or use animal pathogens is overseen by AVA and regulated under the Animal and Birds Act. Laboratories are inspected prior to licensing to assess their operational biosafety and biosecurity procedures.

Medical devices, including in-vitro diagnostic devices and their accessories, are regulated by Health Sciences Authority in Singapore under the Health Products Act. Product registration, unless exempted, is required for medical devices before they may be supplied. Registered products are placed on the publicly-accessible Singapore Medical Device Register.

Recommendations for priority actions

- Consider further strengthening the regulatory regime to ensure compliance of all laboratories with national and international quality standards.

- Review and strengthen existing regulation and training programs for the use of Point-of-Care testing in non-laboratory environments.

- Identify and train a national pool of qualified assessors for human and animal health laboratories.

- Consider expanding the functions of NPHL to provide training and technical assistance at the regional level.

Indicators and scores

D.1.1 Laboratory testing for detection of priority diseases – Score 5

Strengths/best practices

- A wide range of testing methods are used across the human and animal health laboratory network for timely clinical management, public health surveillance, detection and response. High complexity testing is supervised by qualified scientific and technical staff, and medical microbiology specialists.

- Effective mechanisms to ensure accurate, responsive and accessible laboratory testing and referral to specialized laboratories.

- Partnerships with research and academic institutes; assistance and collaborations for the detection of exotic and emerging zoonotic pathogens.

Areas which need strengthening/challenges

- Linkages with OIE reference laboratories may be strengthened.

D.1.2 Specimen referral and transport system – Score 5

Strengths/best practices

- Designated couriers and trained infectious substances shippers are used to transport specimens.

- The possession and transfer of dangerous pathogens listed in the Biological Agents and Toxins Act schedule are regulated.

Areas which need strengthening/challenges

- Structured training in safe packaging and transport of infectious substances could be expanded to all laboratory staff and couriers as part of biosafety training, not only those regulated under Biological Agents and Toxins Act.

D.1.3 Effective modern point-of-care and laboratory-based diagnostics – Score 5

Strengths/best practices

- Universal access to affordable laboratory testing with timely reporting of results.

- The guidelines and oversight by MOH for point-of-care tests, e.g. GP-based HIV screening using rapid test kits, to ensure quality is maintained and positive results are followed up with confirmatory tests.

- Licensing of healthcare facilities and device registration regulate the import and use of diagnostic tests and devices.

- Continued engagement with global networks, such as the ASEAN networks and WHO's Global Influenza Surveillance and Response System.

Areas which need strengthening/challenges

- The global problem of ensuring that point-of-care tests provide accurate results and are not misinterpreted. A supportive regulatory regime to ensure that only accurate test kits are used by trained personnel, which is flexible and can be adapted as more accurate tests become available.

- Lack of proficiency testing programmes for many diseases and lack of reference materials and limited interactions with OIE reference laboratories (e.g. for consultation, access to reference materials).

D.1.4 Laboratory quality system – Score 5

Strengths/best practices

- Licensing is mandatory for all laboratories providing clinical testing. Voluntary accreditation by the Singapore Accreditation Council and College of American Pathologists is also adopted by many laboratories. Overseas EQAs are widely used by laboratories for most tests.

- AVA laboratories operate under a quality assurance system accredited to ISO17025 and participate annually in external quality assurance programmes.

Areas which need strengthening/challenges

- The adoption of the standards framework administered by the Singapore Accreditation Council so that clinical laboratories are accredited to international standard for medical testing (ISO 15189).

- Lack of proficiency testing programmes for many priority diseases in Animal Health.

- Lack of reference materials for assay validation and in-run controls.

- Shortage of suitable technical assessors for conducting audits based on the requirements of international standards.

Real-time surveillance

Introduction

The purpose of real-time surveillance is to advance the safety, security and resilience of the nation by leading an integrated biosurveillance effort that facilitates early warning and situational awareness of biological events.

Target

Strengthened foundational indicator- and event-based surveillance systems that are able to detect events of significance for public health, animal health and health security; improved communication and collaboration across sectors and between sub-national, national and international levels of authority regarding surveillance of events of public health significance; improved country and intermediate level regional capacity to analyse and link data from and between strengthened, real-time surveillance systems, including interoperable, interconnected electronic reporting systems. This would include epidemiologic, clinical, laboratory, environmental testing, product safety and quality and bioinformatics data; and advancement in fulfilling the core capacity requirements for surveillance in accordance with the IHR and OIE standards.

Singapore level of capabilities

Singapore has a very robust capacity for indicator and event-based surveillance with mandatory reporting for a comprehensive list of potential pathogens in both human and animal health.

Human Health

As part of indicator based surveillance, medical practitioners, laboratories and educational institutions notify diseases and clusters through an innovative online platform developed by MOH (CD-LENS). The system is linked to medical record systems in public hospitals, enables auto-population of standardized notification templates and triggers providers to report via the on-line system. The system also provides doctors with guidance on notifiable diseases and information on disease trends and outbreaks to relevant stakeholders.

Syndromic surveillance systems include five core syndromes – severe acute respiratory syndrome, acute flaccid paralysis, acute haemorrhagic fever, acute watery diarrhoea, and jaundice with fever. The Severe Infectious Diseases of Possible Infectious Cause (SIDPIC) program identifies serious illness (deaths or ICU admissions) of unknown cause among persons 1-49 years of age. All hospitals and laboratories monitor absenteeism and investigate clusters of severe acute respiratory illness among staff. Real-time electronic syndromic surveillance (e.g. respiratory and diarrheal disease) is conducted at emergency departments of all public hospitals, selected private primary care clinics and all polyclinics located island wide.

Horizon scanning is also conducted daily to detect potentially important public health threats from a wide variety of open source information which is collated and circulated to relevant stakeholders. Risk assessments are conducted to determine the risk of pathogen importation into Singapore.

DETECT

Animal Heath

AVA manages event-based and indicator-based surveillance systems for animal health and food safety. Under the Animals and Birds Act, veterinarians and farmers that suspect or diagnose a notifiable disease in animals are required to report the disease to AVA via phone call or using the notifiable disease reporting form available on AVA's website. Singapore imposes penalties for not reporting notifiable diseases. AVA has border control checkpoints where imported livestock (mostly poultry and swine imported for direct slaughter) are subject to surveillance. AVA officers regularly inspect farms for any clinical illness, increases in animal mortality, and presence of other syndromes compatible with important transboundary animal diseases; if any abnormalities are observed, samples are collected for testing and restrictions are implemented. Surveillance efforts also address diseases in wildlife and fish, with passive surveillance implemented for wild boar and bats. Reports of dead wildlife made to National Parks and/or Wildlife Reserves Singapore are shared with AVA and MOH as part of the One Health framework.

Vector Control and Food Safety

The NEA conducts environmental surveillance of vectors and vector-borne pathogens. Variations in the population of the Aedes mosquito in the urban environment are monitored using large-scale deployment of traps (i.e. 50000). Regular surveys for the Anopheles mosquito are also conducted in rural and forested areas. Mosquitoes in high risk areas and blood samples of patients suspected of vector-borne diseases are screened for arbovirus and malaria. The vector population and pathogen data is analysed and collectively interpreted to inform risk-based response operations.

NEA and AVA conduct surveillance of food-borne pathogens. Imported and locally produced food items and ready-to-eat food at retail food establishments undergo routine laboratory testing. Pathogens detected undergo genetic analysis for molecular epidemiology, and these data are used to identify potential risks. Food establishments are subject to routine inspection to ensure food safety.

Analysis and integration of disease surveillance

Experienced epidemiologists, supported by statisticians, analyse and interpret data across the three agencies. Although the surveillance systems operated by the MOH, AVA and NEA are currently independent, data are regularly shared through the One Health framework on a daily or weekly basis. When relevant, data are also shared with other partner agencies (e.g. the Ministry of Education and Ministry of Manpower).

Recommendations for priority actions

- Continue to enhance disease surveillance and outbreak response capacity through the development of a comprehensive, integrated, data management system.
- Strengthen mechanisms for disease reporting among animals and further integrate zoonotic and human surveillance systems.
- Actively seek opportunities to share Singapore's innovative approaches and expertise in conducting real-time disease surveillance to support reporting systems in other countries.

Indicators and scores

D.2.1 Indicator- and event-based surveillance systems – Score 5

Strengths/best practices

- Singapore has well-established indicator and event-based surveillance systems which enable rapid detection of health threats to humans and animals.
- The MOH online disease reporting platform uses prompts and automated data captured from electronic medical records and represents a state-of-the-art application of technology to enhance disease detection.

- Institutionalized use of the One Health framework to ensure timely and comprehensive communication among public health stakeholders is exemplary.

Areas which need strengthening/challenges

- Disease surveillance and outbreak management processes could be enhanced by further integration of animal, environmental and human health reporting systems.

D.2.2 Interoperable, interconnected, electronic real-time reporting system – Score 4

Strengths/best practices

- Medical practitioners and relevant stakeholders can view weekly trends, disease updates and guidelines for notifiable infectious diseases through the online reporting system.

- Results from the Animal Health Laboratory are accessible electronically to AVA inspectors and other stakeholders.

Areas which need strengthening/challenges

- An electronic platform for reporting animal illness and death accessible by farmers, veterinarians, wildlife experts and other stakeholders could augment existing reporting mechanisms.

- Public health and veterinary surveillance systems are not yet inter-operable or inter-connected.

D.2.3 Analysis of surveillance data – Score 5

Strengths/best practices

- Regular epidemiological analysis of human and animal disease surveillance data.

- Systematic risk assessments of potential international threats through 'horizon scanning' practices on a daily basis.

- Surveillance information are shared and integrated across sectors through a well-established One Health framework.

Areas which need strengthening/challenges

- Integration of various disease reporting mechanisms in a centralised system would strengthen the capacity for comprehensive surveillance data analyses and outbreak management.

D.2.4 Syndromic surveillance systems – Score 4

Strengths/best practices

- Syndromic surveillance systems detect five core syndromes indicative of public health emergencies.

- Structured, operational surveillance of severe illness of unknown cause which triggers additional laboratory investigation represents best practice for identifying serious emerging disease.

- Syndromic surveillance data are compiled and shared with MOH management, medical practitioners, veterinary and environmental health agencies and other stakeholders on a weekly basis.

- Programs monitoring staff absenteeism and investigating clusters of illness among hospital and laboratory workers are laudable.

Areas which need strengthening/challenges

- Programs that monitor staff absenteeism and illness could be extended to the animal health sector.

- Greater efforts could be made to share Singapore's expertise in supporting other countries in their efforts to develop robust surveillance systems.

DETECT

Reporting

Introduction

Health threats at the human–animal–ecosystem interface have increased over the past decades, as pathogens continue to evolve and adapt to new hosts and environments, imposing a burden on human and animal health systems. Collaborative multidisciplinary reporting on the health of humans, animals and ecosystems reduces the risk of diseases at the interfaces between them.

Target
Timely and accurate disease reporting according to WHO requirements and consistent coordination with FAO and OIE.

Singapore level of capabilities

Singapore has a well-established multi-sectoral system for efficient reporting of potential public health emergencies of international concern to WHO, FAO and OIE as required IHR (2005), supported by legislation.

The Head of the Public Health Intelligence Branch within the Epidemiology and Disease Control division of MOH is designated as the primary IHR NFP, with the staff of the Branch working together to perform its functions as IHR reporting officers. The IHR NFP is accessible at all times via email, telephone and fax and communicates to WHO via email. IHR reporting officers receive didactic and on the job training on conducting risk-assessments and are familiarized with the Terms of Reference for the IHR NFP.

The capacity for timely reporting under IHR has been practiced through real events – in 2016 the Singapore IHR NFP notified WHO of the first case of autochthonous Zika virus infection within 24 hours of laboratory confirmation, in accordance with Article 6 of the IHR. Subsequent situation updates were also provided. The Singapore IHR NFP also participates in web-based IHR Annex 2 tutorials, the annual IHR Exercise Crystal conducted by WHO Western Pacific Region and annual meetings on the Asia Pacific Strategy for Emerging Diseases to gain experience in IHR event assessment and notification. IHR-related risk assessments conducted have been published in the Western Pacific Surveillance and Response journal.

AVA can notify OIE promptly about animal diseases through the World Animal Information System or by fax or email. AVA submits six monthly and annual reports to OIE as required, as well as immediate notification of the first occurrence or re-occurrence of OIE-listed diseases. With the adoption of the One Health framework, a multi-sectoral process is in place for assessing potential environmental and zoonotic threats or events which may require reporting to WHO/ OIE.

Staff of the AVA perform the function of Emergency Contact Points for INFOSAN in Singapore and the NEA serves as INFOSAN's focal point.

As Singapore is a compact city state, surveillance and reporting to WHO/FAO/OIE are conducted at a national level, minimizing the potential for reporting delays or coordination issues. There are incident management structures for decision making and reporting on public health events and mass casualty incidents.

Recommendations for priority actions

- Explore opportunities to support regional level capacity and exercises for IHR reporting.
- Consider more frequent exercising of capability to report chemical and radiological/nuclear incidents.

Indicators and scores

D.3.1 System for efficient reporting to FAO, OIE and WHO – Score 5

Strengths/best practices

- MOH staff are effective IHR NFP duty officers and ensure efficient reporting through relevant channels.

- IHR NFP officers are contactable via mobile and email 24 hours a day 7 days a week.

- IHR-related risk assessments have been published in a peer reviewed journal.

Areas which need strengthening/challenges

- Maintaining the capacity to report promptly to FAO, OIE and WHO requires ongoing effort.

- The timeliness of communication among the One Health agencies (MOH, NEA, and AVA) can improve.

D.3.2 Reporting network and protocols in country – Score 5

Strengths/best practices

- A well-established One Health framework ensures prompt and effective information sharing between the human, animal and environmental sectors and coordinated reporting to WHO, FAO or OIE.

Areas which need strengthening/challenges

- The capacity to report chemical and radiological/nuclear incidents under IHR has not been evaluated as often as that for communicable disease threats.

DETECT

Workforce development

Introduction

Workforce development is important in order to develop a sustainable public health system over time by developing and maintaining a highly qualified public health workforce with appropriate technical training, scientific skills and subject-matter expertise.

Target

States Parties with skilled and competent health personnel for sustainable and functional public health surveillance and response at all levels of the health system and the effective implementation of the IHR (2005).

Singapore level of capabilities

Singapore has a well-established multidisciplinary human resource capacity for IHR implementation.

MOH, AVA and NEA have adequate multidisciplinary public and animal health workforce of field epidemiologists, public health physicians, veterinarians, engineers, laboratory technologists, information specialists and biostatisticians. The One Health framework is used to coordinate public health work among MOH, AVA and NEA. All three agencies have workforce strategies to ensure adequate workforce capabilities into the future.

Workforce training programs include the MOH two-year Singapore Field Epidemiology Training Programme (S-FETP), AVA's professional development framework and the Specialist Diploma in One Health course for NEA and AVA. Ninety-percent of S-FETP graduates continue to work at the MOH, emphasising the role of S-FETP in strengthening the MOH public health workforce.

There are comprehensive and robust strategies for human resource attraction, development, rotation and retention in all three agencies. Essential competencies have been mapped to guide continuous professional development of staff and award frameworks provide opportunities for further staff development and career growth. HR strategies and frameworks are periodically reviewed to ensure their relevance to changing workforce needs.

Due to the compact size of Singapore, the existing multidisciplinary human resource capacity is adequate and readily deployable across the country.

Recommendations for priority actions

- Review the current S-FETP and develop a plan for a sustainable S-FETP beyond 2018 to meet changing needs of public health workforce.

- Consider sharing Singapore's experiences in sustainable workforce development, including the strong system and culture for staff learning and development, innovative solutions to address anticipated HR, and appropriate use of new technology.

- Continue to contribute to the global health emergency workforce (such as by sending and receiving multidisciplinary personnel internationally, staff secondment and other possible new means of regional and international collaboration in workforce development).

Indicators and scores

D.4.1 Human resources available to implement IHR core capacity requirements – Score 5

Strengths/best practices

- S-FETP graduates have provided MOH with a pool of trained epidemiologists. FETP fellows are also continuously encouraged to develop expertise in infection control and outbreak response management.

- The One Health framework facilitates coordination of multi-agency teams that can work on cross-cutting projects.

Areas which need strengthening/challenges

- Although there is multidisciplinary human resource capacity across the three agencies, the adoption of innovative solutions in specific areas such as outbreak management, epidemiology, infection control and data management, may redirect human resources towards more high-level functioning.

D.4.2 FETP or other applied epidemiology training programme in place – Score 5

Strengths/best practices

- The S-FETP has sustainable national funding and uses novel training methods to maintain interest level and engage millennials on subject matter.

- AVA has a transdisciplinary disease investigation team comprising veterinarians and animal health personnel identified for in-house training, which includes epidemiological concepts.

Areas which need strengthening/challenges

- Expanding the S-FETP to include public health officers from AVA and NEA.

D.4.3 Workforce strategy – Score 5

Strengths/best practices

- All three public health agencies (MOH, NEA, AVA) have comprehensive workforce strategies that provide continuous education and promote retention of a qualified national public health workforce.

- There is a high retention rate of staff in the MOH, especially for Public Health personnel.

- Strong culture of encouraging professional growth and development in technical fields by providing opportunities for staff development, e.g. funding and time for training programmes.

Areas which need strengthening/challenges

- The re-design of human resources, as innovations in technology are introduced.

DETECT

RESPOND

Preparedness

Introduction

Preparedness includes the development and maintenance of national, intermediate and community/primary response level public health emergency response plans for relevant biological, chemical, radiological and nuclear hazards. Other components of preparedness include mapping of potential hazards, the identification and maintenances of available resources, including national stockpiles and the capacity to support operations at the intermediate and community/primary response levels during a public health emergency.

Target

Development and maintenance of national, intermediate (district) and local/primary level public health emergency response plans for relevant biological, chemical, radiological and nuclear hazards. This covers mapping of potential hazards, identification and maintenance of available resources, including national stockpiles and the capacity to support operations at the intermediate and local/primary levels during a public health emergency.

Singapore level of capabilities

There is strong political support and dedicated funding for preparedness activities in Singapore. The Homefront Crisis Management System (HCMS) is the national framework for coordinating whole-of-government planning and response to national crises (e.g. civil emergency, terrorist attack, severe disease outbreak) and is coordinated by the Ministry of Home Affairs. There are three arms of the HCMS:(i) the Homefront Crisis Ministerial Committee provides high-level strategic and political guidance; (ii) the Homefront Crisis Executive Group comprises high-level representatives from ministries and government agencies to provide policy guidance, strategic decisions and resolves cross-ministry issues; and, (iii) inter-agency Crisis Management Groups which oversee contingency planning and crisis management within specific domains. MOH is the lead agency for Crisis Management Group (Health), which manages all public health related incidents.

Within the MOH Crisis Management System, the Minister Crisis Committee, chaired by the Minister for Health, provides high-level strategic and policy guidance and the Contingency Task Force, chaired by the Permanent Secretary for Health, is the main executive body that provides the overall operational oversight during crisis. Contingency Task Force workgroups provide support. The MOH EOC is where staff monitor the crisis situation and coordinate the operations and implementation of responses.

The MOH Disease Outbreak Response System is the generic preparedness and response plan against disease outbreaks. The Disease Outbreak Response System Condition (DORSCON) framework is a colour-coded alert, response and risk communications system for assessing potential public health risk and impact. There are also disease specific plans for influenza and other respiratory disease pandemics, MERS, Ebola and for major smoke haze. Responses at points of entry (PoE) are included in these plans. MOH has a national-level outbreak response team to augment existing capabilities for outbreak response. Preparedness for mass casualty incidents occurs through a four-year readiness cycle for all public hospitals, with MOH conducting an average of two mass casualty deployment exercises per year. Preparedness against chemical events and radiation emergencies are described under the respective Technical Areas.

MOH manages emergency response stockpiles for therapeutics (e.g. antivirals, antidotes), vaccines, non-pharmaceuticals, medical consumables including personal protective equipment, surge equipment (e.g. ventilators) and screening/detection equipment.

There is continuous improvement for preparedness and response at the whole of government level and within individual agencies. After action reviews are conducted after real-life events and exercises with plans updated as necessary. Exercises include multi-agency mass vaccination exercises at polyclinics and vaccination centres, and mass casualty exercises at public hospitals.

The National Risk Register process identified four key public health crisis scenarios – outbreak of severe disease with unknown cause, avian influenza pandemic, bioterrorism and outbreaks of unknown disease on board a cruise liner. Reviews and updates to the risk mapping process are conducted as required.

Singapore contributes to global and regional preparedness, specifically with their ASEAN and WHO partners.

Recommendations for priority actions

- Consider developing an integrated/all hazard plan for public health emergency preparedness and response.
- Upgrade information management systems within and between MOH and healthcare institutions.

Indicators and scores

R.1.1 National multi-hazard public health emergency preparedness and response plan developed and implemented – Score 5

Strengths/best practices

- The whole-of-government approach used for Singapore's preparedness and response to public health events have been tested by actual disease outbreaks (H1N1 in 2009, Zika in 2016), outbreaks anticipated from international events (Ebola in 2015) and many exercises.
- All events and exercises are evaluated though after-action reviews to improve the system.
- Preparedness plans for different hazards, including chemical, radiological, disease outbreak and deliberate acts.
- Although Singapore has not had any recent serious mass casualty incident, MOH exercises each public hospital for medical emergency operations readiness.

Areas which need strengthening / challenges

- Automation of the information collection and management system between MOH and healthcare institutions, and within MOH.

R.1.2 Priority public health risks and resources mapped and utilized – Score 4

Strengths/best practices

- Continuous surveillance and monitoring of international and local disease outbreaks and identification of lessons learned from after action reviews feed into risk mapping and preparedness.
- MOH continually updates their national risk assessments for disease outbreaks.
- Dedicated funding for preparedness activities.

Areas which need strengthening/challenges

- Risk assessment of public health events resulting from bioterrorism.

RESPOND

Emergency response operations

Introduction

A public health emergency operations centre is a central location for coordinating operational information and resources for strategic management of public health emergencies and emergency exercises. Emergency operations centres provide communication and information tools and services, and a management system during a response to an emergency or emergency exercise. They also provide other essential functions to support decision-making and implementation, coordination and collaboration.

Target

Country with public health emergency operations centre (EOC) functioning according to minimum common standards; maintaining trained, functioning, multisectoral rapid response teams and "real-time" biosurveillance laboratory networks and information systems; as well as trained EOC staff capable of activating a coordinated emergency response within 120 minutes of the identification of a public health emergency.

Singapore level of capabilities

The HCMS has been described under the technical area for Preparedness. In an emergency, the Ministry of Home Affairs coordinates the whole of government response and activates the relevant government agencies. A Crisis Management Group specific to the emergency may lead the response. In a health-related emergency (e.g. major disease outbreak), the MOH will lead the Crisis Management Group for Health to coordinate inter-agency operations.

Within MOH, the Contingency Task Force is activated during a crisis and consists of a central decision-making committee chaired by the Permanent Secretary of Health. The Contingency Task Force is the main executive body and provides the overall operational oversight for the public health and healthcare sector during a crisis.

The response to public health incidents is coordinated from the MOH EOC using an all hazards approach. The MOH EOC is staffed by duty officers who perform initial information gathering, risk assessment, classification of the incident, appropriate escalation and options for response.

The EOC operates an on-call duty officer system for responding to all diseases of unknown origin and other public health emergencies. This EOC has limited space, although other rooms can be commandeered to accommodate surge staff. A new EOC is currently being developed and should be operational by October 2018. Permanent and surge staff for the EOC are provided a continuum of training to ensure familiarity and competence in the EOC. The EOC SOPs are updated annually.

The MOH EOC demonstrated its capacity during the Zika virus outbreak in 2016 and in support of various mass gathering events including the 2015 8th ASEAN Para Games and the 2015 South East Asian Games. The EOC capability was also tested through a table top exercise in September 2017 and a command post exercise in October 2017.

There are SOPs for the management and transport of potentially infectious patients in the community and at PoE where these have been exercised. A portable medical isolation unit is available to transport a patient with a dangerous infectious disease if required. MOH provides guidance on case management to healthcare practitioners and institutions whenever there is a new major public health threat and this guidance is updated with new information as it arises.

Recommendations for priority actions

- Consider exercising the MOH EOC more frequently.
- Continue exercises for the special transport ambulance service for potentially infectious patients.

Indicators and scores

R.2.1 Capacity to activate emergency operations – Score 4

Strengths/best practices

- A core team of EOC staff are involved in incident management on a daily basis.
- In addition to full-time EOC staff, surge staff are pre-identified and have been trained accordingly.

Areas which need strengthening/challenges

- The physical layout of the EOC can be improved once the enhanced MOH EOC is completed.
- The information collection and management system could be better integrated amongst relevant agencies.

R.2.2 EOC operating procedures and plans – Score 4

Strengths/best practices

- EOC plans have been exercised.

Areas which need strengthening/challenges

- EOC members need to continually familiarize themselves with the SOP.

R.2.3 Emergency operations programme – Score 5

Strengths/best practices

- Regular activations and exercises are conducted that test emergency operations.

Areas which need strengthening/challenges

- Repository of plans and change of personnel would require a system of in-house training for new staff.

R.2.4 Case management procedures implemented for IHR relevant hazards – Score 4

Strengths/best practices

- Case management guidance to medical practitioners and healthcare institutions is available routinely and is updated whenever there is a new public health threat.
- Case management and transport of potentially infectious patients from PoE to the designated hospital have been exercised.

Areas which need strengthening/challenges

- The special ambulance transport service for potentially infectious patients has been outsourced to a service provider. This is not a dedicated service and the staff require regular training to maintain competency in infection control.

Linking public health and security authorities

Introduction

Public health emergencies pose special challenges for law enforcement, whether the threat is manmade (e.g. the anthrax terrorist attacks) or naturally occurring (e.g. flu pandemics). In a public health emergency, law enforcement will need to quickly coordinate its response with public health and medical officials.

Target

Country conducts a rapid, multisectoral response in case of a biological event of suspected or confirmed deliberate origin, including the capacity to link public health and law enforcement, and to provide and/or request effective and timely international assistance, such as to investigate alleged use events.

Singapore level of capabilities

Under the whole-of-government approach and the HCMS, MOH works closely with all security agencies, such as the Singapore Police Force, SCDF and Immigration & Checkpoints Authority. SOPs or agreements exist for the coordination of joint risk assessment and response to public health and other emergencies at PoEs where both public health and security authorities have operational safety and health security responsibilities.

Bioterrorism is identified as a priority public health risk in the National Security Risk Register. The Singapore Police Force maintains a joint response plan for deliberate biological events, known as the National Emergency Response Team for Biological Incidents. MOH has developed and operationalized response plans to address the deliberate release of anthrax and smallpox and these pathogens are included in the Singapore Police Force operational plan. The concept of chain of custody is recognized in the public health, medical and civil defense sectors.

Public health and security agencies have conducted joint training on information sharing and joint investigations and responses. Overall coordination between public health and security authorities are practiced and reviewed in annual mass casualty exercises. For a biological scenario, an anthrax decontamination scenario was tested in 2017.

Public health and security authorities routinely share information such as the MOH Risk Assessment Report on Communicable Diseases and the Homefront Daily Situation Report. Other sensitive security information may be shared as needed through the National Security Coordination Center.

Recommendations for priority actions

- Enhance the existing capacity of joint threat assessment for deliberate biological events.
- Consider implementing a sustainable cycle of testing and refinement of the response plans and SOPs for deliberate biological events.
- Explore opportunities to create an interface between public health and security sectors at regional and international levels.

RESPOND

Indicators and scores

R.3.1 Public health and security authorities (e.g. law enforcement, border control, customs) linked during a suspect or confirmed biological event – Score 5

Strengths/best practices

- Links between MOH and security agencies through the whole-of-government approach.

- Deliberate biological events are included in the National Security Risk Register.

- The Singapore Police Force, together with other Homefront agencies including MOH, has jointly developed a whole-of-government response plan for deliberate biological events.

- Public health and security sectors regularly exchange their own risk assessment reports.

Areas which need strengthening/challenges

- MOH risk assessment for disease outbreaks resulting from bioterrorism.

- Regular update of the SOPs and coordination with relevant agencies as the number of scenarios and response plans increases.

Medical countermeasures and personnel deployment

Introduction

Medical countermeasures are vital to national security and protect nations from potentially catastrophic infectious disease threats. Investments in medical countermeasures create opportunities to improve overall public health. In addition, it is important to have trained personnel who can be deployed in case of a public health emergency for response.

Target

National framework for transferring (sending and receiving) medical countermeasures, and public health and medical personnel from international partners during public health emergencies.

Singapore level of capabilities

Singapore is a high-income economy and has sufficient resources for responding to public health and animal health emergencies. Although Singapore does not manufacture medical countermeasures, MOH has established a Memorandum of Understanding with a global manufacturer based in Singapore for procurement of medical countermeasures and has established an Advance Purchase Agreement for the supply of vaccine during crises. Singapore has stockpiled sufficient medical countermeasures assessed as difficult to procure during crisis for pandemic influenza, chemical, biological, radiological and nuclear incidents and civil emergency for the whole population. In addition, the Health Sciences Authority can provide regulatory clearance or exemptions on an urgent basis for importing unlicensed products into Singapore.

Singapore also has a demonstrated capacity for sending medical countermeasures overseas. For international public health emergencies, the Singapore Armed Forces (SAF) has stockpiles of medical supplies with plans for distribution. The most recent SAF international relief operation was the delivery of medical and relief supplies in response to the Rohingya refugee crisis to Bangladesh in 2017. Singapore, in collaboration with the Asia-Europe Foundation, houses antiviral drugs and personal protective equipment for ASEAN countries in preparation for an influenza pandemic.

For animal health outbreaks, there are animal health contingency plans to mobilize countermeasures. AVA has contracts with vaccine and logistics providers for the rapid deployment of supplies and conducts table-top and field simulation exercises to ensure readiness. Singapore donated 37,000 doses of rabies vaccines to Malaysia for their rabies control efforts in 2017 in response to a rabies outbreak.

Singapore has a demonstrated capacity for sending and receiving health care personnel during a public health emergency. The Singapore MOH coordinates with public healthcare institutions and if necessary, with the SAF to send healthcare personnel to respond to international public health emergencies when needed. The SAF plays a key role in operational and logistics support when necessary. MOH is also actively engaged in international public health emergency response through WHO mechanisms, such as the Global Outbreak Alert and Response Network. There is no arrangement for cross border deployment and receipt of personnel during animal health emergencies.

MOH can receive medical experts during major crises as necessary. The Singapore Medical Council can provide temporary professional registration to allow foreign medical experts to practice in Singapore if required. However, there has been no exercise or actual deployment in the past year.

Recommendations for priority actions

- Strengthen preparedness for international deployment of medical countermeasures and personnel.

- Consider pre-identifying trained personnel for potential deployment.

- Conduct exercises to test the existing mechanism to receive medical countermeasures and health personnel.

Indicators and scores

R.4.1 System in place for sending and receiving medical countermeasures during a public health emergency – Score 4

Strengths/best practices

- MOH can coordinate with SAF to provide medical and relief countermeasures to international public health emergencies.

- MOH has stockpiled enough medical countermeasures for immediate distribution in-country for the whole population.

Areas which need strengthening/challenges

- There are no formal agreements for deployment of veterinary countermeasures or personnel in animal health emergencies.

R.4.2 System in place for sending and receiving health personnel during a public health emergency – Score 4

Strengths/best practices

- MOH can coordinate with SAF to deploy healthcare personnel in international public health emergencies.

- Singapore is actively engaged in international public health emergency response through WHO mechanisms.

Areas which need strengthening/challenges

- Singapore has a limited number of public health and healthcare personnel available for international deployment due to the size of the population.

Risk communication

Introduction

Risk communications should be a multilevel and multifaceted process which aims at helping stakeholders define risks, identify hazards, assess vulnerabilities and promote community resilience, thereby promoting the capacity to cope with an unfolding public health emergency. An essential part of risk communication is the dissemination of information to the public about health risks and events, such as disease outbreaks. For any communication about risk caused by a specific event to be effective, the social, religious, cultural, political and economic aspects associated with the event should be taken into account, including the voice of the affected population.

Communications of this kind promote the establishment of appropriate prevention and control action through community-based interventions at individual, family and community levels. Disseminating the information through appropriate channels is essential. Communication partners and stakeholders in the country need to be identified, and functional coordination and communication mechanisms should be established. In addition, the timely release of information and transparency in decision-making are essential for building trust between authorities, populations and partners. Emergency communications plans should be tested and updated as needed.

Target

State Parties use multilevel and multifaceted risk communication capacity. Real-time exchange of information, advice and opinions between experts and officials or people who face a threat or hazard (health or economic or social wellbeing) to their survival, so that informed decisions can be made to mitigate the effects of the threat or hazard and protective and preventive action can be taken. This includes a mix of communication and engagement strategies, such as media and social media communications, mass awareness campaigns, health promotion, social mobilization, stakeholder engagement and community engagement.

Singapore level of capabilities

Singapore has a fully operational whole of government system for risk communication. The MOH has a dedicated Communications and Engagement Group, with officers seconded from the Ministry of Communications and Information (MCI) who are skilled in managing corporate communications, media relations, online communications, public engagement and strategic communications. During crises and national emergencies, surge staff are available from MCI.

Protocols and SOPs for crises communication guide response to real-world events. These are regularly tested in emergencies with at least three large scale exercises per year. In addition, officers in the Communications and Engagement Group are exposed to smaller scale crises, such as hospital outbreaks. After actions reviews are conducted to further refine processes and close identified gaps.

MOH maintains close coordination with public healthcare institutions and other government agencies such as the Singapore Tourism Board for internal communication. In non-crisis periods, public healthcare institutions coordinate their messaging and media statements with MOH to ensure alignment of overarching messages. During national crises, there are established and well-practised protocols for communication, including clearance procedures. MOH works with MCI and the People's Association (a statutory board under the Ministry of Culture, Community and Youth) to communicate with the public through grassroots networks. Several exercises to test communication and coordination with partner organizations are conducted annually and was most recently tested in response to the Zika outbreak in 2016.

MOH has many platforms to disseminate information to the public, including statements to mainstream media, the MOH website and Facebook page, online platforms of healthcare institutions, having stakeholders deliver public communications and public education campaigns. MOH maintains good relations with media representatives, with whom they have frequent interactions and engagements for the purposes of communicating announcements and facilitating responses to media queries. MOH can quickly produce communication products by accessing whole-of -government resources. The MOH research team can conduct surveys for public reaction to key messages.

MOH engages the entire population during public health emergencies. Targeted messages are developed according to the needs of at-risk communities and key messages are tested during the creative concept development process. However, communication with stakeholder during emergencies are predominantly top-down and driven by the government as risk communications is regarded as a government responsibility by the community. More ground-up engagement may enhance community participation and ownership.

Singapore has a robust system to conduct real-time listening using nationwide media surveillance from both traditional and social media. Issues, such as "fake news", are quickly identified and immediately addressed. While communication is assessed through after-action reports, a systematic evaluation of listening and rumour management may improve future communication interventions.

Recommendations for priority actions

- Enhance stakeholder engagement and community ownership of risk communication through joint planning and sharing of resources.

- Consider evaluating risk communication and community engagement interventions to document lessons learnt, inform future planning and assess impact on behavior change.

- Sustain the current human resources capacity for risk communication, with sufficient opportunity for staff development, including international deployment.

Indicators and scores

R.5.1 Risk communication systems (plans, mechanisms, etc.) – Score 5

Strengths/best practices
- MOH has a fully operational system for risk communication integrated into the whole-of-government crisis structure.

- Communication protocols are regularly tested in exercises and used in real-world events.

- A team of highly trained and experienced communications professionals manage communication during peacetime and emergencies.

- The MOH Communications and Engagement Group has sufficient human resources and funding and can access surge capacity from MCI.

- Innovative approaches and new technologies are constantly developed and used to communicate with the public. Lessons learnt are incorporated to further strengthen the risk communication system.

Areas which need strengthening/challenges
- Regular evaluation and documentation of the effectiveness of risk communication interventions may enhance planning for future events and be shared externally.

R.5.2 Internal and partner communication and coordination – Score 4

Strengths/best practices

- There is a robust risk communication structure at all levels of Government to promptly respond to health emergencies.

- Processes and protocols with clearly-defined communication roles and responsibilities are regularly tested and applied in emergencies.

- MOH has a close working relationship with the communications teams in other government agencies and public healthcare institutions.

Areas which need strengthening/challenges

- Joint planning to increase participation of internal partners and stakeholders in risk communication.

- The varying degrees of competency among communications teams of public healthcare institutions.

R.5.3 Public communication – Score 5

Strengths/best practices

- A highly professional communications team manages all aspects of public communications and engagement.

- The variety of communication platforms adopted can reach a wide audience to address public concern and rumours.

- MOH has well-established links with community organizations for rapid information dissemination.

- The positive relationship with the media based on mutual trust helps during emergencies.

Areas which need strengthening/challenges

- There is a need to ensure that communications are targeted to different groups, with consideration for language, cultural norms and practices.

- Using mobile phones for communication to reach a wider audience.

R.5.4 Communication engagement with affected communities – Score 4

Strengths/best practices

- The national response plan includes social mobilization and community engagement.

- During emergencies, more robust and intensive community engagement measures are administered, including deployment of Grassroots Leaders and trained Dengue Prevention Volunteers to engage at-risk communities.

- Targeted messages are developed according to the needs of at-risk communities.

- Messages are tested during the creative concept development process.

Areas which need strengthening/challenges

- Communication with stakeholder during emergencies is predominantly top-down and driven by government.

- Risk communications is regarded as a government responsibility by the community, and there is room to further encourage the community to be mobilized into action.

- Systematic documentation of best practices for regional sharing, including evaluating the impact of risk communication interventions on behaviour change.

R.5.5 Dynamic listening and rumour management – Score 5

Strengths/best practices

- The MOH research team conduct media surveillance and can rapidly respond to fake news and rumours, in conjunction with MOH decision makers.
- The whole-of-government commination network allows agencies to dispel misinformation on a variety of platforms.
- Established SOPs provide strategic guidance to public healthcare institution responses to rumours and fake news.

Areas which need strengthening/challenges

- Developing a robust strategy to systematically collect and address rumours and misinformation in new media applications such as chat rooms and mobile phone applications.
- Systematic evaluation of rumour management to further improve future interventions.

RESPOND

OTHER IHR-RELATED HAZARDS AND POINTS OF ENTRY

Points of entry

Introduction

All core capacities and potential hazards apply to "points of entry" and thus enable the effective application of health measures to prevent international spread of diseases. States Parties are required to maintain core capacities at designated international airports and ports (and where justified for public health reasons, a State Party may designate ground crossings), which will implement specific public health measures required to manage a variety of public health risks.

Target

States Parties designate and maintain core capacities at international airports and ports (and where justified for public health reasons, a State Party may designate ground crossings) that implement specific public health measures required to manage a variety of public health risks.

Singapore level of capabilities

Singapore has two designated PoE under the IHR: Changi Airport, regulated by the Civil Aviation Authority of Singapore, and the Singapore Cruise Centre, regulated by the Maritime and Port Authority of Singapore. MOH operates as the competent authority for PoE, working closely with NEA, to ensure the implementation and application of health measures under the IHR.

Raffles Medical Group is the medical provider at Changi Airport providing 24/7 medical coverage for all passengers, visitors and staff, temperature screening and are the first responder to an infectious disease incident. There are eight clinics throughout the airport providing general practitioner consultation, emergency services, x-ray services, health screening, travel medicine (including vaccinations), dental services and minor surgery.

Temperature screening is conducted via thermal scanners for all travellers disembarking from flights originating from the Middle East to detect possible cases of MERS. Febrile travellers are then assessed by an on-site healthcare team and travellers with suspected pneumonia are referred to designated hospitals via dedicated special ambulance service.

At the Singapore Cruise Centre, the Port Health Office is staffed by NEA and provides oversight and management of maritime declarations of health, administrative control of ill travelers and verification of routine capacities. Ill travelers onboard a ship are initially examined by either the onboard medical doctor or a doctor engaged by the ship's agent. If further assessment and treatment are required, the ill traveler will be transferred to hospital via ambulance service. Parkway Shenton medical group provides temperature screening and onward management of ill travelers at the Singapore Cruise Centre. Singapore is designated by WHO to issue Ship Sanitation Certificates with an average of 7000 issued per year in the past three years. Ship inspectors are well-trained and equipped to inspect ships and issue Ship Sanitation Certificates in accordance to the IHR (2005) requirements.

Infectious disease SOPs incorporate clear processes and agency involvement for responding to potentially infectious passengers at designated PoEs. Crisis Management Group meetings are convened during an emergency for coordination and dissemination of information across agencies. During non-crisis periods, the National Border Health Committee meets to review and endorse progress and effectiveness of border health control measures and action plans.

A variety of exercises which demonstrate the effectiveness of public health response have been conducted at the two designated PoEs: Crisis Management Group activation, infectious disease emergency response, portable medical isolation unit response, and medical screening.

Response to other hazards (e.g. chemical or radiological) are conducted by the emergency services at each PoE and if required, the SCDF can provide further support. This process has been well exercised by these agencies. Both Changi Airport and Singapore Cruise Centre have inspection programs to ensure they meet the routine capacities to provide a safe environment. Areas inspected include water supply, food establishments, public washrooms, general cleanliness and solid waste management, and vector control.

Recommendations for priority actions

- Develop an all hazard Public Health Emergency Contingency Plan for each PoE.
- Consider exercising a wider array of health threats at PoEs, such as chemical and radiological hazards.
- Continue to publish on the effectiveness of responding to public health events at PoE.

Indicators and scores

PoE.1 Routine capacities established at points of entry – Score 5

Strengths/best practices
- Routine capacities at PoE are well managed through in-house expertise and contracted service providers.
- Singapore is designated by WHO to issue Ship Sanitation Certificates.

Areas which need strengthening/challenges
- Singapore's extensive global connections increase the risk of imported cases of infectious diseases.

PoE.2 Effective public health response at points of entry – Score 4

Strengths/best practices
- There are well-established processes for suspected infectious disease cases at PoEs, overseen by a multi-agency National Border Health Committee.
- The whole of government approach that covers all relevant sectors and services at the PoEs.
- Regular exercises conducted with multiple government agencies and stakeholders at the PoEs.

Areas which need strengthening/challenges
- Including public health in responses to all hazards at the PoEs, not only infectious diseases.
- Evaluation of the effectiveness of responses to public health events at the PoEs.

OTHER

Chemical events

Introduction

Timely detection and effective response of potential chemical risks and/or events require collaboration with other sectors responsible for chemical safety, industries, transportation and safe disposal. This would entail that State Parties need to have surveillance and response capacity to manage chemical risk or events and effective communication and collaboration among the sectors responsible for safety.

Target

States Parties with surveillance and response capacity for chemical risks or events. This requires effective communication and collaboration among the sectors responsible for chemical safety, industries, transportation and safe disposal.

Singapore level of capabilities

There is an established legislative and regulatory framework and arrangements for environmental surveillance, assessment and management of chemical risks and events. The NEA, Ministry of Manpower, SCDF, Singapore Police Force and Singapore Customs collaborate under the whole-of-government framework to manage chemical risks and events.

NEA maintains the regulatory control programme for hazardous substances under the Environmental Protection and Management Act to prevent pollution and safeguard the environment and public health and safety. This programme covers hazardous substance licensing, control, transport and storage, and the surveillance, assessment and management of chemical spills or leaks and fires at chemical plants, under the whole-of-government framework. Information on hazardous substances and guidelines on safe handling are incorporated into emergency response plans. The surveillance programme for chemical incidents comprises air and water monitoring for key toxic substances and when these are identified and traced, corrective actions are taken, and a post-incident investigation report generated.

The SCDF regulates the storage and transportation of petroleum and flammable materials and oversees mandatory licensing of companies that store and transport these materials. The licensees are required to have Company Emergency Response Teams to provide initial on-site response. These teams are audited by SCDF to ensure their operational readiness and emergency response during incidents.

Regular exercises are also conducted to test the coordination and response of various agencies in responding to large-scale incidents or emergencies, e.g. a major chemical leak/spill. All exercises and responses undergo an After-Action Review to identify potential areas of improvement. Areas identified for improvement are tracked within the Homefront Crisis Management System or within the individual responding agency.

Singapore is party to the Chemical Multi-Environmental Agreements and participates in the UN HazMat Assessment Unit and UN Strategic Advisory Group for Environmental Emergencies. For technical information on chemicals, NEA refers to chemical databases such as the European Chemical Agency and SCDF refers to the Palmtop Emergency Action for Chemicals.

For chemical events, SCDF are the first responders and lead agency for the response. SOPs have been developed to aid responders in attending to incidents involving toxic chemicals. If a chemical event involving a highly toxic chemical with potential to cause mass casualties is reported or detected, a higher

level of response involving multiple agencies (e.g. Ministry of Manpower, SCDF, Singapore Police Force) is activated and coordinated under the HCMS. All stakeholders, including industry, have emergency response plans which are regularly exercised.

Drug Information Services are available in the major public health sector hospitals for poison related enquires from healthcare professionals. After office hours, a pharmacist is on call on an ad-hoc basis. There is no dedicated national poisons centre.

Recommendations for priority actions

- Evaluate the 24/7 availability of existing drug information services for medical practitioners and assess the need for establishing a dedicated clinical toxicology information system (poison centre).

Indicators and scores

CE.1 Mechanisms established and functioning for detecting and responding to chemical events or emergencies – Score 4

Strengths/best practices

- Whole-of-government framework for the coordination of multiple agencies during a major chemical event.
- All stakeholders have well-defined roles in the national response plan and these are regularly exercised.

Areas which need strengthening/challenges

- Establishing a national poisons centre.

CE.2 Enabling environment in place for management of chemical events – Score 5

Strengths/best practices

- NEA's regulatory control framework is reviewed periodically for new chemicals.
- Regular exercises are conducted to test the coordination and response of various agencies in responding to a large-scale chemical incident or emergency.
- Licensees of hazardous substance, petroleum and/or flammable materials conduct exercises to test their emergency response plans.

Areas which need strengthening/challenges

- Challenges in engaging with small and medium sized companies on chemical management. Efforts are being made to involve industry associations in developing guidelines and sharing good practices on chemical management with these companies.

Radiation emergencies

Introduction

To counter radiological and nuclear emergencies, timely detection and an effective response towards potential radiological and nuclear hazards/events/emergencies are required in collaboration with sectors responsible for radiation emergency management.

Target

States Parties with surveillance and response capacity for radiological and nuclear hazards/events/ emergencies. This requires effective communication and collaboration among the sectors responsible for radiological and nuclear emergency management.

Singapore level of capabilities

The Radiation Protection and Nuclear Science Department (RPNSD) of NEA is the regulatory authority for radiation protection and administers the Radiation Protection Act and Regulations. The Act and Regulations are reviewed and updated to align with latest international safety standards on radiation protection. Under the whole-of-government approach, relevant agencies collaborate to monitor radiation exposure in various settings (NEA, AVA, SCDF, the National Water Agency, Health Sciences Authority, Maritime and Port Authority and Ministry of Home Affairs).

Radiation incidents are monitored by SCDF and NEA with small-scale radiation emergencies managed by licensees. All incidents are to be immediately notified to the RPNSD, with a follow-up report used by RPNSD to recommend further actions. National crises are managed under the HCMS framework. The inter-agency plan for radiological incidents covers risk assessment, surveillance, reporting, event confirmation, decontamination, and radioactive contaminated waste management. Hospitals are equipped to handle contaminated and/or over-exposed patients. The response plan also addresses contaminated foodstuffs and drinking water, mitigating psychological impact, risk communication, worried-well, and follow-up of over-exposed persons. A National Radiological Dispersion Device Response Plan has been established.

Multi-agency exercises for various radiological emergency scenarios are regularly conducted. All exercises/ responses undergo after-action review to identify areas for improvement. Follow-up actions are tracked within the HCMS and by lead agencies.

The Government is expanding the capability under the Nuclear Safety, Research and Education Programme, with the Singapore Nuclear Research and Safety Initiative further targeting radiobiology and radiochemistry to support radiation safety work. The operational budget for radiation safety work by governmental agencies is in the national budget.

Singapore is an International Atomic Energy Agency member state and as a party to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (1986), Singapore can access regional and international assistance. In addition, a focal point for WHO Radiation Emergency Medical Preparedness and Response Network established at the MOH, enables access to technical expertise abroad and fosters collaboration.

Recommendations for priority actions

- Strengthen surge capacity for national dose assessment biodosimetry and bioassay networks.

- Establish dose assessment capability for rapid assessment and prognosis to justify implementation of emergency protective actions.

- Formalize arrangements for systematic information exchange between relevant agencies on actual or potential radiation events.

Indicators and scores

RE.1 Mechanisms established and functioning for detecting and responding to radiological and nuclear emergencies – Score 3

Strengths/best practices

- The national emergency response framework covers small to large-scale radiation incidents.

- Coordination and collaboration at whole-of-government level for response to large scale radiological emergencies under the HCMS framework.

- Strong capacity in civil defense sector to respond to emergencies involving hazardous substances.

Areas which need strengthening/challenges

- Strengthening of dose assessment capacities, including developing national capacities for health physics, cytogenetic biodosimetry and bioassays as well as joining regional and global networks, to support decision making during a response to radiological emergency.

- Coordination between radiological emergency response, incident investigation, and site recovery efforts.

RE.2 Enabling environment in place for management of radiation emergencies – Score 3

Strengths/best practices

- Firm national framework established to regulate sources of radiation exposure and occupational safety.

- Regular exercises to assess readiness and identify improvements.

- Hospitals equipped and resourced, with national stockpiles to manage contaminated and over-exposed persons.

- Health professionals trained in case management for providing care for over-exposed persons.

Areas which need strengthening/challenges

- Further development of national emergency response plans for incidents involving marine transportation of nuclear material.

- Radioactive waste management and its incorporation into national contingency plans to minimize volume of waste generated that is necessary for storage.

Appendix 1: JEE background

Mission place and dates

Singapore; 15 to 20 April, 2018

Mission team members:

- Professor Paul Effler, Australia, Department of Health Western Australia (Team Lead)
- Dr Li Ailan, WHO Regional Office for the Western Pacific
- Ms Joy Rivaca Caminade, Independent Consultant
- Dr Zhanat Carr, WHO Headquarters
- Ms Suzanne Halligan, New Zealand, New Zealand Ministry of Health
- Dr Silvia Kreindel, Food and Agriculture Organization of the United Nations
- Dr Karen Nahapetyan, WHO Regional Office of Eastern Mediterranean
- Dr Tomoya Saito, Japan, National Institute of Public Health
- Dr Anne Yu, United States of America, US Department of Health and Human Services
- Dr Yusma Jeffrin Md Yusof, Brunei Darussalam, Ministry of Health (Observer)

Objective

To assess Singapore's capacities and capabilities relevant to the 19 technical areas of the JEE tool for providing baseline data to support Singapore's efforts to reform and improve their public health security.

The JEE process

The JEE process is a peer-to-peer review. The entire external evaluation, including discussions around the scores, the strengths, the areas that need strengthening, best practices, challenges and the priority actions should be collaborative, with JEE team members and host country experts seeking full agreement on all aspects of the final report findings and recommendations.

Should there be significant and irreconcilable disagreement between the external team members and the host country experts, or among the external, or among the host country experts, the JEE team lead will decide the outcome; this will be noted in the final report along with the justification for each party's position.

Preparation and implementation of the mission

On 13 February 2017, Singapore voluntarily requested a JEE as part of their commitment to the monitoring and evaluation of core capacities under the IHR (2005). The Ministry of Health established the JEE Secretariat to provide oversight, coordination and logistical arrangements for the JEE. After compiling the self-evaluation technical survey, the first of a series of workshops and discussions with representatives from relevant ministries were conducted in October 2017. The compilation of the self-evaluation report covering 19 technical areas took approximately 12 months. Around 10 Singapore Government agencies were involved in the preparation process.

Prior to the JEE mission, videoconferences were held between the JEE Planning and Coordination team in Singapore and the WHO Regional Office of the Western Pacific. The purpose of these meetings was to

discuss expectations, clarify the process and share updates on preparation for the JEE mission. The self-evaluation report and supporting documentation were shared with the JEE team approximately five weeks prior to the mission.

The mission began on 15 April 2018 with a briefing between Singapore MOH and international experts of the JEE team. Between 16 April and 20 April 2018, national and international experts jointly reviewed national capacities in the 19 technical areas of the JEE tool. Field visits were also conducted on 17 April 2018 and provided an opportunity for more in-depth discussions and verification of capacities. Field sites included National Centre for Infectious Diseases, Tan Tock Seng Hospital, National Public Health Laboratory, Animal Health Laboratory, Changi Airport and Singapore Cruise Center.

The mission concluded on 20 April 2018 with a joint review and consensus on JEE scores and priority actions. The results of the assessment and observations of Singapore's preparedness and response capacities were presented to the Director of Medical Services, MOH, Associate Professor Benjamin Ong.

Limitations and assumptions

- The evaluation was limited to one week, which limited the amount and depth of information that could be managed.

- It is assumed that the results of this evaluation will be publically available.

- The evaluation is not an audit. Information provided by Singapore will not be independently verified but will be discussed and the evaluation rating mutually agreed to by the host country and the evaluation team. This is a peer-to-peer review.

Key host country participants and institutions

Singapore lead representatives

- Adj A/Prof Jeffery Cutter, Senior Consultant, Public Health Group, Ministry of Health, Singapore (Team Lead)

- Ms Chan Wei Ling, Director, Corporate Human Resource Division, Ministry of Health

- Dr Charlene Fernandez, Director (Animal Health Laboratory), Laboratories Group, Agri-Food & Veterinary Authority of Singapore

- Dr Charmaine Chng, Deputy Director (Regulatory Programmes), Regulatory Administration Group, Agri-Food & Veterinary Authority of Singapore

- Mr Ethan Goh, Deputy Director (Policy & Control), Communicable Diseases Division, Ministry of Health

- Mdm Helen Phang, Director (Veterinary Public Health Laboratory Chemistry Department), Laboratories Group, Agri-Food & Veterinary Authority of Singapore

- Dr Jeannie Tey, Deputy Director (Public Health Intelligence/Non-communicable Diseases), Epidemiology & Disease Control Division, Ministry of Health

- Dr Kelvin Lim, Director (Surveillance & Inspection), Agri-Establishment Regulation Group, Agri-Food & Veterinary Authority of Singapore

- Ms Lee Hwee San, Deputy Director (Supply Chain Management), Resource Management Division, Ministry of Health

- Mr Leow Poh Chuan, Head (Nuclear Science & Technology Section), Radiation Protection and Nuclear Science Department, National Environment Agency

- Ms Lim Siok Peng, Director, Corporate Communications Division, Ministry of Health
- Mr Lim Weng Kee, Deputy Director (Operations Planning & Development), Emergency Preparedness and Response Division, Ministry of Health
- Mr Philip Tan, Deputy Director (Operations Readiness & Control), Emergency Preparedness and Response Division, Ministry of Health
- A/Prof Raymond Lin, Head, National Public Health Laboratory, Ministry of Health
- LTC Ryan Ong, Senior Assistant Director (Plans & Policies), HazMat Department, Singapore Civil Defence Force
- Mr S Mohan, Senior Manager (Port & Airport Health), Central Regional Office, Environmental Public Health Operations Department, National Environment Agency
- Adj A/Prof Steven Ooi, Deputy Director (Surveillance & Response), Communicable Diseases Division, Ministry of Health
- Ms Suzanna Yap, Chief Engineer (Chemical Control), Pollution Control Department, National Environment Agency
- Dr Su Yun Se Thoe, Deputy Director (Biosafety), Public Health Group, Ministry of Health
- Mr Teh Chun Siong, Deputy Director (Control of Ops Branch 1), Environmental Public Health Operations Department, National Environment Agency
- A/Prof Vernon Lee, Director, Communicable Diseases Division, Ministry of Health

Participating institutions

Ministry of Health
- Communicable Diseases Division
- Corporate Human Resource Division
- Emergency Preparedness and Response Division
- Epidemiology & Disease Control Division
- National Public Health Laboratory
- Public Health Group
- Resource Management Division

Agri-Food & Veterinary Authority of Singapore
- Agri-Establishment Regulation Group
- Laboratories Group
- Regulatory Administration Group
- Veterinary Public Health Laboratory

National Environment Agency
- Environmental Protection Division
- Environmental Public Health Division
- Environmental Public Health Operations Department

- Pollution Control Department
- Radiation Protection and Nuclear Science Department
- Environmental Health Institute

Other Ministries and agencies
- Singapore Civil Defence Force
- Singapore Police Force
- Singapore Customs
- Singapore Armed Forces
- Civil Aviation Authority of Singapore
- Changi Airport Group
- Immigration & Checkpoints Authority
- Ministry of Home Affairs
- Ministry of Manpower
- Maritime Port Authority

Supporting documentation provided by host country

Materials provided to the external JEE team prior to the mission
- Joint External Evaluation Singapore: Self-Evaluation Report. April 2018.
- Joint External Evaluation of Singapore: Self-Evaluation Technical Questions. April 2018.

Presentations to the JEE team during the mission
- Overview of Singapore's Healthcare System. A/Prof Vernon Lee, Director, Communicable Diseases Division, Ministry of Health. Powerpoint presentation, 16 April 2018, Singapore.
- EOC in MOH; Singapore Crisis Management Framework and Crisis Response. Mr Lim Weng Kee, Deputy Director (Operations Planning & Development), Emergency Preparedness and Response Division, Ministry of Health. Powerpoint presentation, 17 April 2018, Singapore.
- EOC in MOH; Horizon scanning and risk assessment. Dr Olivia Oh, Public Health Intelligence, Ministry of Health. Powerpoint presentation, 17 April 2018, Singapore.
- JEE IHR Technical areas 1-19. Individual PowerPoint Presentations. 15 to 20 April 2018, Singapore.

Documents provided to the JEE team

National legislation, policy and financing
- The Infectious Diseases Act
- Private Hospitals and Medical Clinics Act
- Health Products Act (HPA)
- Environmental Public Health Act
- Control of Vectors and Pesticides Act
- Environment Protection and Management Act

- Radiation Protection Act

- Animals and Birds Act

- Control of Plants Act

- Sale of Food Act

- Wholesome Meat and Fish Act

- Disease Outbreak Response System Condition (DORSCON) Framework

- Terms of Reference (TOR) and Composition of the One Health Coordinating Committee (OHCC)

- Pandemic Preparedness

- Zika Circulars

IHR coordination, communication and advocacy

- Procedures for handling the first case of MERS

- Public Health Intelligence - 101 Guide

- Questionnaire for Monitoring Progress in the Implementation of IHR Core Capacities in States Parties

- Infectious Diseases Act

- OIE Reports

- Public Health Intelligence – 101 Guide

- Procedures for Handling the First Case of MERS-COV

Antimicrobial resistance

- Infectious Diseases Act

- Private Hospitals and Medical Clinic Act Regulations

- National Infection Control Guidelines

- National Infection Control Indicators – Technical Manual

- Recommendations on immunization of healthcare workers

- NARCC Annual Report (2015)

- Animals and Birds Act (Licensing of Farms)

- Sample letter to farms on drugs prohibited for food animals

- Sale of Food Act (Food Regulations)

- Application Information – License to Manufacture, Process and Sale of Animal Feed

- Directives for Drug Usage – Aquaculture (Letter sent by Email and Registered Post)

- Directives for Drug Usage – Poultry (Letter sent by Email and Registered Post)

- Directives for Drug Usage –Ruminants (Letter sent by Email and Registered Post)

- National Antimicrobial Resistance Control Committee (NARCC) report on 2015 Data

Zoonotic diseases

- Animals and Birds (Disease) Notification.

- Animals and Birds Act

- OIE Annual Animal Health Report

- Public Health and Animal Disease Surveillance – An Overview of Activities within AVA

Food safety

- Sale of Food Act

- Food Regulations

- Wholesome Meat and Fish Act

- Environmental Public Health Act

- Environmental Public Health (Food Hygiene) Regulations

- Infectious Diseases Act

Biosafety and biosecurity

- Biological Agents and Toxins Act (Chapter 24A), 31st December 2006

- Animals and Birds Act (Chapter 7), 31 December 2002

- Strategic Goods (Control) Act (Chapter 300), 31st July 2003

- Infrastructure Protection Act 2017 (No. 41 of 2017), 3rd November 2017

- Workplace Safety and Health Act (Chapter 354A)

- Singapore Biosafety Guidelines for Research on Genetically Modified Organisms (GMOs), GMAC Singapore, January 2013

- National competency standard for the course Follow Good Biosafety Practices, Competency Code PI-PRO-310C-1, Singapore Workforce Skills Qualifications

- MOH BSL-3 Facility Certification Checklist

- Biological Agents and Toxins (Transportation) Regulations, Rg 1, G.N. No S 875/2005, 15th May 2007

- Biological Agents and Toxins (Exemption) Regulations 2009

- Biological Agents and Toxins (Proficiency Testing) Regulations 2008

- Laboratory Biosafety Manual (Third Edition)

Immunization

- National Childhood Immunization Schedule

- National Adult Immunization Schedule

- Infectious Diseases Act (Chapter 137), 31 July 2003

- Ministry of Health. Communicable Disease Surveillance in Singapore: Annual Report 2016, Chapter 7 – Childhood Immunization, pp. 121-133, available at https://www.moh.gov.sg/content/dam/moh_web/Publications/Reports/2017/Full%20Version.pdf   (accessed on 12 April 2018)

- Infectious Diseases (Diphtheria and Measles Vaccination) Regulations, Rg 3, G.N. No. S 466/1989, 25 March 1992

- Infectious Diseases (Certificates of Vaccination or Other Prophylaxis) Regulations, 2008

- Prevalence of Antibodies against Measles, Mumps and Rubella in the Childhood Population in Singapore, 2008-2010

- MOH Establishes National Adult Immunization Schedule; Extends use of Medisave for Vaccines under the Schedule (accessed on 12 March 2018)

- National Paediatric Seroprevalence Survey

- Guidelines on How to Maintain the Vaccine Cold Chain

National laboratory system

- Private Hospital and Medical Clinics Act (Chapter 248), 30 December 1999

- Private Hospital and Medical Clinics Regulations, Rg 1, 2002 Ed

- Private Hospitals and Medical Clinics (MedAlert System) Regulations 2008

- Health Products Act (Chapter 122D), 31st December 2008

- Infectious Diseases (Notification of Infectious Diseases) Regulations 2008

- Guidelines for Private Hospitals, Medical Clinics and Clinical Laboratories (under the Private Hospitals and Medical Clinics Act (1980) and Private Hospitals and Medical Clinics Regulations (1991))

- Guidelines for Approval of Laboratory for AFB (Smear) Testing

- Guidelines for Laboratory Performing HIV Testing

- National Guidelines for Retention Periods of Medical Records, MOH Circular 05/2015

- Guidelines for Approval of Laboratory for Malaria Parasite Testing

- List of Approved Agencies to Endorse and/or Provide External Quality Assessment Schemes (EQAS)

- List of Approved Laboratory Accreditation Bodies

- Licensing Terms and Conditions on Blood and Blood Product Collection, Processing, Storage and Distribution

- Licensing Terms and Conditions on Blood Transfusion

- Licensing Terms and Conditions on Maintaining a Supply of Personal Protective Equipment for Use during Public health Emergencies, MOH 2011

- Biological Agents and Toxins (Transportation) Regulations, Rg 1, G.N. No. S 875/2005, 15 May 2007)

- Specific Licensing Terms and Conditions (LTCs) on Medical Records for Healthcare Institutions, MOH 2015.

- National Proficiency Testing Scheme for ABO Group and Rhesus (D) Type Testing

- Update on Management and Testing of Suspect Cases of Middle East Respiratory Syndrome (MERS), MOH 2016

- Update on Avian Influenza A/H7N9, Middle East Respiratory Syndrome Coronavirus (MERS-CoV) and Dengue Fever (DF), MOH Circular 33/2013

- Inter-Laboratory QA Programme

- Central Tuberculosis Laboratory List of External Quality Assessment Programmes

- Inter-Laboratory Proficiency Testing

- National Proficiency Testing (NPT) Scheme for AFB (Smear) Testing

- Bacteriology Survey Report

- QCMD 2017 Dengue Virus (RNA) Programme

- Report for National HIV Screening Proficiency Programme Panel A – 2018

- QCMD 2017 Influenza Virus A and B RNA EQA Programme- Influenza Virus A May 2017

- QCMD 2017 Influenza Virus A and B RNA EQA Programme- Influenza Virus A October 2017

- QCMD 2017 Influenza Virus A and B RNA EQA Programme- Influenza Virus A For In house Method May 2017

- QCMD 2017 Influenza Virus A and B RNA EQA Programme- Influenza Virus A For In house Method October 2017

- QCMD 2017 Influenza Haemagglutinin Typing EQA Programme

- Certificate of Completion – National Public Health Laboratory

- WHO External Quality Assessment Programme for the Detection of Influenza Viruses by RT-PCR

- Malaria Parasite Proficiency Test

- QCMD 2017 Measles and Mumps EQA Programme – Measles Virus

- 2017 WHO Measles/ Rubella ELISA EQA

- 2017 Feedback Form: Measles Molecular Proficiency Panel

- QCMD 2017 MERS Coronavirus EQA Programme

- Polio Global Eradication Initiative

- Salmonella Serotyping WHO EQAS 2017

- Biological Agents and Toxins Act (Chapter 24A)

- Infectious Diseases Act (Chapter 137)

- Certificate of Accreditation – National Public Health Laboratory

- Application for Approval to Provide ABO Group and Rhesus (D) Type Testing as a Specialised Test and Service Under the Fifth Schedule of the Private Hospitals and Medical Clinics Regulations

- Application for Approval to Provide Acid Fast Bacilli Testing as a Specialised Test and Service Under the Fifth Schedule of the Private Hospitals and Medical Clinics Regulations

- Application for Approval to Provide Human Immunodeficiency Virus Testing as a Specialised Test and Service Under the Fifth Schedule of the Private Hospitals and Medical Clinics Regulations

- Application for Approval to Provide Malarial Parasite Test as a Specialised Test and Service Under the Fifth Schedule of the Private Hospitals and Medical Clinics Regulations

Real time surveillance

- List of notifiable diseases under the Infectious Diseases Act

- List of notifiable diseases under the Animals and Birds Act

- Weekly Infectious Diseases Bulletin

- Epidemiological News Bulletin

- Communicable Diseases Surveillance annual reports

- Vector-borne diseases surveillance reports (www.nea.gov.sg/public-health/vector-control/overview)

- Communicable Diseases Live and Enhanced Surveillance

- Dengue Cases

- Dengue Clusters

- Dengue Surveillance Data (October-December 2017)

- Guidelines on the Notification of Infectious Diseases in Singapore for Hospitals

- Establishment of the One Health Framework for Singapore (For Information)

- List of Infectious Diseases Legally Notifiable under the Infectious Disease Act

- OIE Six-Monthly Report on the Notification of the Presence of OIE-Listed Diseases (Aquatic)

- OIE Six-Monthly Report on the Notification of the Presence of OIE-Listed Diseases (Terrestrial)

- Annual Animal Health Report (Jan-Dec 2015)

- Report on Public Health Situation and Operations – 21 March 2017

- Taskforce on Strengthening Outbreak Detection and Response Completes Its Review

Reporting

- Infectious Diseases Act

- Animals and Birds Act

- Questionnaire for Monitoring Progress in the Implementation of IHR Core Capacities in States Parties

- OIE Six-Monthly Report on the Notification of the Presence of OIE-Listed Diseases (Aquatic)

- OIE Six-Monthly Report on the Notification of the Presence of OIE-Listed Diseases (Terrestrial)

- Annual Animal Health Report (Jan-Dec 2015)

Workforce development

- NEA Organisation Chart

- MOH: People Strategy, Capability Development Framework, Staff Competency Framework and Scholarship & Scholarship Framework

- Singapore FETP Curriculum

Preparedness

- MOH HQ Crisis Management SOP

- Anthrax Response Plan

- Smallpox Public Health Preparedness and Response Plan

- Interim Pandemic Plan

- Integrated Operations Hub and Emergency Operations Centre SOP

- OPS Civil Emergency Plan

- OPS Civil Emergency Radiation Device MOH Casualty Management Plan

- Training Plans

- DORSCON Framework

Emergency Response Operations

- MOH HQ Crisis Management Standard Operating Procedure
- Anthrax Response Plan
- Epidemiological News Bulletin (Vol 44 No. 1, January 2018)
- MOH Pandemic Readiness and Response Plan for Influenza and Other Acute Respiratory Diseases (Revised April 2014)
- Integrated Operations Hub and Emergency Operations Centres Standard Operating Procedure
- Anthrax Outbreak Response Plan (version 4.0)
- Operations Civil Emergency Plan (5th Edition)
- OPS Civil Emergency Radiation Disperson Device (Dirty Bomb) MOH Casualty Management Plan
- Public Hospital Mass Casualty Exercise Plan (led by MOH & co-led by the Public Hospital)
- Small Pox: Public Health Preparedness and Response Plan
- Training Plan for Emergency Operations Staff (for EPR Division only)

Linking Public Health and Security Authorities

- Risk Assessment Report (26/3/17 – 1/01/17)

Risk Communication

- Communications Structure for Public Health Emergencies
- Ministry of Health HQ Organisation Chart
- Communications and Engagement Group
- Contingency Task Force Organisation Structure
- Media Response Plans
- Daily Analytical Report Summary (25 April 2017)
- Message Clearance Plan for Media Statement
- National Response Plan (Guiding Principles for Communications)
- Report on Zika Response (29 August 2016)
- Joint External Evaluation of Singapore News Stories during Zika
- After Action Review of the Ministry of Health's Response to the Zika Virus Situation
- Dynamic Listening and Rumour Management
- Daily Analytical Report Summary (2-4 September 2016)
- Handling Rumours (Arresting Online Rumours Promptly)
- Examples of NEA Vox Posts on Dengue/Zika as of 20 June 2017
- Zika Flyer
- FAQ from NEA's Contact Centre

- Management of 3P Outreach for Notified Zika Case (2016)
- Mozzie Wipeout Movement Against Zika (2016)
- AAR from Zika Outbreak 2016 – Communications
- Additional Supporting Documents
- FAQ Data From Public Health Hotline

Points of Entry

- Border Health Temperature Screening Exercise, Singapore Cruise Centre
- Changi Airport Vector Surveillance Programme
- Mosquito Control Regime at Changi Airport Buffer Areas
- Local Situation and Operation – Sample Report
- Maritime Declaration of Health
- Maritime and Port Authority of Singapore – Port Marine Circular No 07 of 2009
- Maritime and Port Authority of Singapore – Port Marine Circular No 07 of 2010
- MOH Portable Medical Isolation Unit (PMIU) Exercise 2014
- PMIU EX 2014 Exercise Sequence
- Procedures for Handling Suspect Infectious Diseases Case/s at Air Checkpoints
- Locations of RMG Clinics and Pharmacies
- Passengers who Require Medical Treatment at Changi Airport
- Environmental Public Health (Quality of Piped Drinking Water) Regulations 2008
- Water Report (February 2017)
- Our Drinking Water Quality
- LOA for General Cleaning and Sanitary Services
- Operations Specifications (Harbour Front Passenger Terminal)
- LOA for General Cleaning and Sanitary Service
- LOA for Pest Control
- Scope of Work for Pest Control
- Service Report for Pest Control
- Border Checkpoints Screening Operations Manual
- Border Health Checkpoints Screening – Land Checkpoints
- Border Health Checkpoints Screening – Sea Checkpoints
- Report on Temp Screening (Sample Email)
- Ship Sanitation Control Exemption Certificate
- Ship Sanitation Control Certificate

Chemical Event

- Environmental Protection and Management (Air Impurities) Regulations

- Environmental Protections and Management (Hazardous Substances) Regulations
- Environmental Protections and Management (Trade Effluent) Regulations
- Environmental Protections and Management Act (Chapter 94A)
- Environmental Protections and Management Act (Chapter 95)
- Fire Safety (Emergency Response Plan) Regulations
- Fire Safety (Petroleum and Flammable Materials) Regulations
- Fire Safety Act (109A)
- Globally Harmonised System of Classification and Labelling of Chemicals (GHS)
- Management of Poisoning
- Socio-psychiatric Aspects of Poisons Management (Annex C)
- MOH Clinical Practice Guidelines December 2011, Management of Poisoning
- Safety Case Assessment Guide
- Safety Case Technical Guide
- Singapore Standard Code of Practice for the Storage of Flammable Liquids
- Specification for Hazard Communication for Hazardous Chemicals and Dangerous Goods
- Singapore Standard Code of Practice for Hazardous Waste Management
- Workplace Safety and Health (General Provisions) Regulations
- Workplace Safety and Health (Major Hazard Installations) Regulations 2017
- Workplace Safety and Health (Medical Examinations) Regulations 2011
- Workplace Safety and Health (Risk Management) Regulations
- Workplace Safety and Health (Safety and Health Management System and Auditing) Regulations 2009
- Workplace Safety and Health Act
- Workplace Safety and Health Guidelines
- Guidelines on Flammable Materials
- Workplace Safety and Health Guidelines on Laboratories Handling Chemicals

Radiation Event

- Radiation Protection Act (Chapter 262)
- Radiation Protection (Ionising Radiation) Regulations
- Radiation Protection (Transport of Radioactive Materials) Regulations
- Radiation Protection (Exemption for Transit, Transhipment and Carriage of Conveyance Equipment) Regulations