



SINGAPORE

COUNTRY STATUS OF AQUATIC EMERGENCY PREPAREDNESS
AND RESPONSE SYSTEMS FOR EFFECTIVE MANAGEMENT OF
AQUATIC ANIMAL DISEASE OUTBREAKS

20-22 AUGUST 2018
BANGKOK, THAILAND

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Overview



I. Legislation

II. Early Warning System

- ▣ Monitoring System on Emerging & Existing Transboundary Aquatic Animal Diseases (Import & Export control; export inspection and certification)

III. Prompt Detection System

- ▣ National Disease Surveillance
- ▣ Diagnostic Capability & Capacity
- ▣ Workflow for Disease Reporting

IV. Effective Response System

- ▣ Contingency plans and control mechanisms
- ▣ Disease Investigation Team
- ▣ Awareness building & Training Programs

V. Issues and gaps

I. Legislation

- Fisheries Act (Chapter 111)
 - Provides licensing conditions for fish culture farms
- Animals and Birds Act (Chapter 7)
 - Enables Authorised AVA officers to take measures, in Accordance with the Act, to:
 - Prevent introduction of veterinary diseases
 - Control movement of animals within and from Singapore
 - Prevent Cruelty to Animals

I. Legislation

- The Animals and Birds Act is the most relevant to manage transboundary movement of aquatic animals and disease:
 - ▣ Allows only safe, reliable sources to be imported and exported
 - ▣ ***Allows inspection and random sampling of consignments for laboratory testing by AVA***
 - ▣ ***Gives legislative power to dispose, quarantine and destroy infected animals and to disinfect premises***



II. Early Warning System

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Import & Export Control



□ Licensing

- Importers and exporters must be licensed by AVA before any ornamental fish import or export activity can be carried out

All ornamental and food fish producer farms are also licensed

□ Import permits

- Required for each individual import consignment
- Accompanying import health certificates required for importation of species susceptible to:
 - SVCV, KHV, EUS, EHNV, WSSV, *Aeromonas Salmonicida*

II. Early Warning System

Export inspection and certification



- Exporter must obtain a permit for each individual consignment exported
- Export Health Certification
 - Ornamental fish in consignments are inspected for health and absence of clinical signs of disease prior to export
 - Additional importing country requirements are also carried out and included as attestations in the health certificate
 - Dependent on inspections, surveillance and laboratory test results



III. Prompt Detection System

III. Prompt Detection System

National Disease Surveillance



- Surveillance programmes for both ornamental and marine fish farms
 - ▣ Ornamental fish surveillance to facilitate trade
 - ▣ Marine food fish surveillance to facilitate production
- All licensed farms have access to extension and diagnostic services
- Based on diagnostic results, field officers assist farms

III. Prompt Detection System

National Disease Surveillance



- Supported by the Animal Health Laboratory's test capabilities
 - ▣ Post-mortem examination (Gross and histopathology)
 - ▣ Parasitology
 - ▣ Pathogen isolation (Bacterial and viral)
 - ▣ Molecular [conventional and real-time PCR]
 - ▣ Advanced pathogen characterisation [Sequencing, NGS]

III. Prompt Detection System

National Disease Surveillance



□ Ornamental Aquatic Animal Surveillance Programs

■ Active Surveillance for significant pathogens

- Koi Herpesvirus (KHV)
- Spring Viraemia of Carp Virus (SVCV)
- White Spot Syndrome Virus (WSSV)
- *Batrachochytrium dendrobatidis* (Bd)
Covers ornamental and food frogs
- *Aeromonas Salmonicida*
- Megalocytiviruses

■ Disease investigation

- Moribund animals observed during routine inspection will be sampled for disease diagnosis
- Farmers can report suspicions of disease situation to AVA
- Laboratory diagnosis of OIE-listed, nationally notifiable, zoonotic and/or significant production diseases will be followed by on-site assessment and disease management



III. Prompt Detection System

National Disease Surveillance



- Marine Aquatic Animal Surveillance Program
 - Passive surveillance
 - Farms submit moribund fish on a voluntary basis
 - Lab results communicated through extension services
 - Disease Investigation
 - Moribund animals observed during farm visits will be sampled for disease diagnosis
 - Alternatively farmers can report suspicions of disease situation to AVA
 - Laboratory diagnosis of OIE-listed, nationally notifiable, zoonotic and/or significant production diseases will be followed by on-site assessment, and disease control and management

Isolation of premise or movement restriction may be imposed when there is detection of notifiable diseases.

Singapore's Aquatic Animal Diagnostic Test Capability

[Last updated on August 2018]

| Pathogen tested or name of test | Type of test |
|---|---|
| <i>Aeromonas salmonicida</i> | Culture and PCR |
| <i>Aphanomyces invadans</i> | PCR (+ Histopathology) |
| <i>Baculovirus Penaei</i> (BP) | PCR |
| <i>Batrachochytrium dendrobatidis</i> (Bd) | PCR |
| <i>Edwardsiella</i> spp. | Culture |
| Epizootic haematopoietic necrosis virus | Virus Isolation & PCR |
| <i>Flavobacterium</i> spp. | Culture |
| <i>Franscisella</i> spp. | PCR |
| Goldfish Herpesviral Haematopoietic Necrosis Virus (GFHNV) | Real-time PCR |
| Infectious haematopoietic necrosis virus (IHNV) | Virus Isolation and PCR |
| Infectious hypodermal and haematopoietic necrosis virus (IHHNV) | Conventional and Real-time PCR |
| Infectious myonecrosis virus (IMNV) | RT-PCR and Real-time RT-PCR |
| Infectious pancreatic necrosis virus (IPNV) | Virus isolation and PCR |
| Infectious spleen and kidney necrosis virus (ISKNV) | Virus isolation and PCR |
| Koi herpesvirus | Virus isolation, conventional and Real-time PCR |
| Lates Calcarifer Herpes Virus (LCHV) [^] | Real-time PCR |
| Megalocytivirus (generic) | Real-time PCR |
| Necrotising Hepatopancreatis Bacterium (NHPB) | PCR |
| Ranavirus (generic) | PCR |

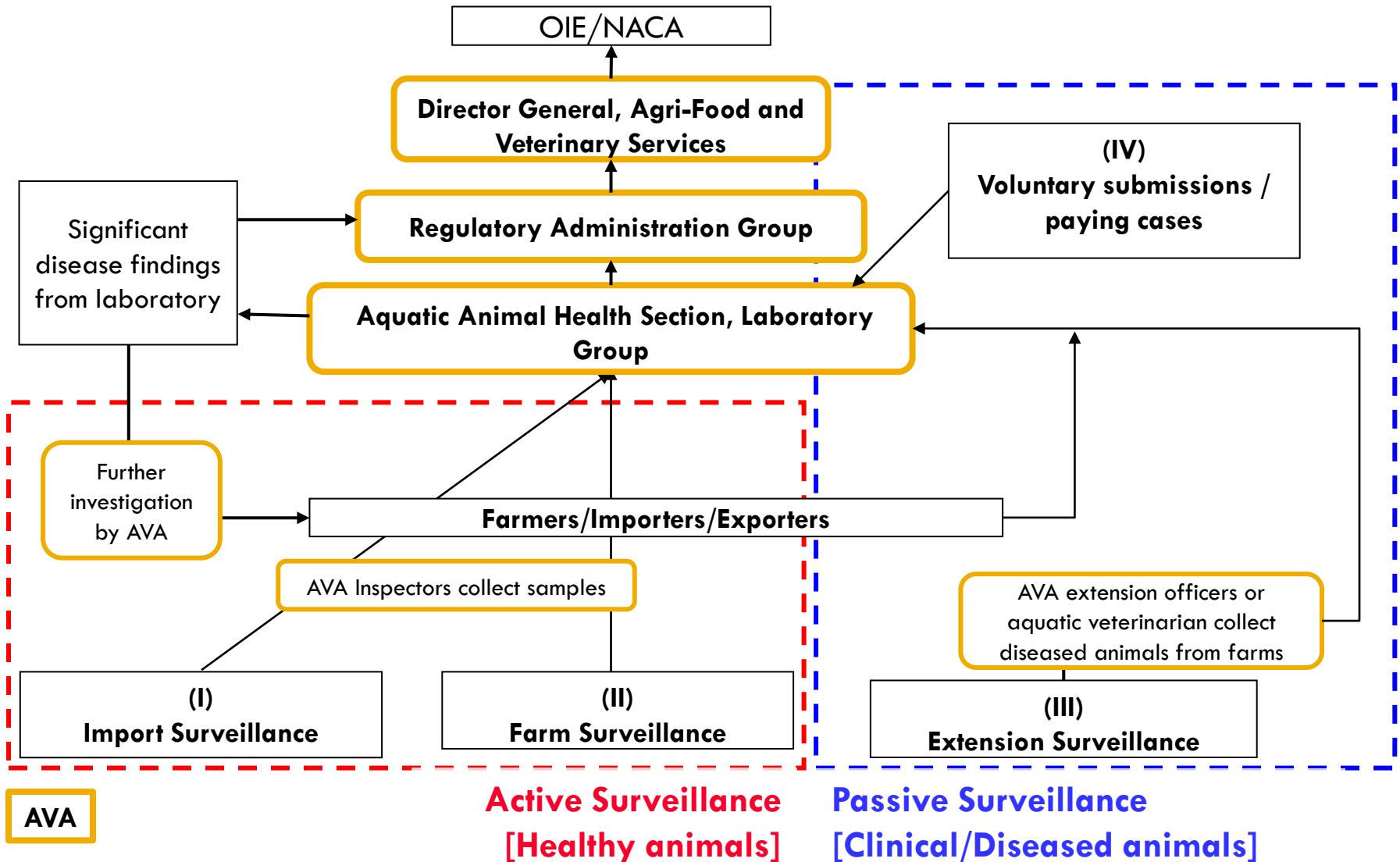
[^]WO2018/029301 - Novel Fish pathogenic Virus. For internal use only. Not offered as commercial test.

PCR refers to conventional PCR unless otherwise specified.

| Pathogen tested or name of test | Type of test |
|--|--|
| Red seabream iridovirus (RSIV) | Virus isolation and PCR |
| Scale Drop Disease Virus (SDDV)* | Real-time PCR |
| Spring viraemia of Carp virus (SVCV) | Virus isolation, conventional and Real-time PCR |
| <i>Streptococcus agalactiae</i> | Culture and PCR |
| <i>Streptococcus iniae</i> | Culture and PCR |
| Taura Syndrome Virus (TSV) | Real-time RT-PCR |
| Tilapia Lake Virus (TiLV) | PCR |
| <i>Vibrio alginolyticus</i> | Culture |
| <i>Vibrio cholerae</i> | Culture |
| <i>Vibrio parahaemolyticus</i> | Culture |
| <i>Vibrio</i> spp. | Culture |
| <i>Vibrio vulnificus</i> | Culture |
| Viral haemorrhagic septicaemia virus (VHSV) | Virus isolation and PCR |
| Viral nervous necrosis (VNNV) | Virus isolation, conventional and Real-time RT-PCR |
| White spot syndrome virus (WSSV) | Nested and real-time PCR |
| Yellow head virus (YHV) | RT-PCR and Real-time RT-PCR |
| Multiplex PCR for Freshwater Fish pathogens (Generic <i>Streptococcus agalactiae</i> , <i>Streptococcus iniae</i> , Infectious spleen and kidney necrosis virus) | Multiplex PCR |
| Multiplex PCR for Marine Fish pathogens (Big Belly, <i>Streptococcus iniae</i> , Infectious spleen and kidney necrosis virus) | Multiplex PCR |
| Multiplex PCR for <i>Streptococcus agalactiae</i> (Generic, serotypes Ia, Ib and III) | Multiplex PCR |

*WO2014/191445 - Scale Drop Disease (SDD) Causative Virus and Derivatives thereof. For internal use only. Not offered as commercial test. PCR refers to conventional PCR unless otherwise specified.

III. Prompt Detection System Workflow for Disease Reporting



III. Prompt Detection System

Reporting of Disease Detection



- Internal
 - Regulatory Administration Group
 - Central database of all notifiable animal disease outbreaks in Singapore
- External
 - Positive detections of OIE-listed diseases are reported to OIE via WAHIS
 - Quarterly Aquatic Animal Disease Report (OIE & NACA)



IV. Effective Response System

IV. Response System

Legislation



- The Animals and Birds Act provides a response mechanism to manage transboundary aquatic animal disease situations:
 - ▣ Allows only safe, reliable sources to be imported and exported
 - ▣ ***Allows inspection and random sampling of consignments for laboratory testing by AVA***
 - ▣ ***Gives legislative power to dispose, quarantine and destroy infected animals and to disinfect premises***

IV. Response System

Aquatic Animal Contingency Plans



- Detection of ***notifiable*** aquatic diseases
- Issue quarantine order
- Quarantine and movement restrictions
 - Prohibit movement and release of live and dead susceptible species
 - Biosecurity
- Site investigation
 - Movement and production records
 - Fish health
- Collection of samples for confirmation
- Affected and in-contact fish culled
- Disinfection of premises
- Re-inspection to ensure compliance

IV. Response System

Control mechanisms for major pathogens



| Major pathogens | Control Measures |
|---|--|
| Megalocytivirus - Infectious Spleen and Kidney Necrosis Virus (ISKNV) | Stock vaccinated fish only. Recommend to cull diseased & potentially infected fish. Activation of heat shock proteins as part of disease management. |
| Megalocytivirus – Red Sea Bream Iridovirus (RSIV) (notifiable) | Stock vaccinated fish only. Cull diseased fish & vaccinate clinically healthy fish. |
| Singapore Grouper Iridovirus (SGIV) | Exclusion of virus via screening of incoming stock. Recommend to cull diseased and potentially infected fish. |
| Viral Nervous Necrosis Virus (VNNV) | Stock vaccinated fish or exclusion of virus via screening of incoming stock. Recommend to cull diseased & infected fish |
| Koi Herpesvirus (KHV) (notifiable) | Cull diseased & infected fish |
| White Spot Syndrome Virus (WSSV) (notifiable) | Stock clean, disease free crustaceans. Production in closed systems with high biosecurity In event of detection, cull all diseased & infected shrimp |

IV. Response System

Control Mechanisms for major pathogens



| Major pathogens | Control Measures |
|-------------------------------------|--|
| Scale Drop Disease Virus | Exclusion of virus via screening of incoming stock. |
| Lates Calcarifer Herpesvirus (LCHV) | Exclusion of virus via screening of incoming stock. |
| Big Belly Bacterial Disease | Pathogen exclusion. Raise early life stages of susceptible fish species, in low salinity RAS. Antibiotic treatment ineffective over several batches. |
| Streptococcosis | Stock vaccinated fish only, OR Treatment with a suitable oral, in-feed antibiotic. Monitor for development of antibiotic resistance. |
| Vibriosis | Stock vaccinated fish only, OR Treatment with a suitable oral, in-feed antibiotic. Monitor for development of antibiotic resistance. |

IV. Response System

Disease Investigation Personnel



- Formation of the Disease Investigation Team (DIT)
 - Formed in 2017
 - Comprises veterinary and field officers involved in different operational capacities
 - Activated by Director-General
 - Mount swift and coordinated response to local disease outbreak situations

IV. Response System

Awareness building & Training Programs



- Fish Farmers' Workshops and Newsletters
 - ▣ Industry and regulatory developments
 - ▣ Educational content
 - Infectious disease
 - Biosecurity
 - Aquaculture systems technology
 - Laboratory testing
- Practical training sessions
 - ▣ Necropsy and wet mount parasitology examination

V. Issues and Gaps

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Need to build greater Awareness and Education

- Development of better biosecurity and management practices
 - ▣ Crafting of templates and guidelines for adherence by farms
 - ▣ Basic disease management
- Import quality assurance
 - ▣ Screening of imported stock
 - ▣ Purchase from accredited sources
- More prudent antimicrobial use
 - ▣ Prevent development of antimicrobial resistance

V. Issues and Gaps

Lack of commercial vaccines



- Low level of vaccine development for tropical food finfish
 - Potentiates non-specific use of antimicrobials
 - Due to long developmental periods (6-7 years)
 - Autogenous vaccines an alternative
 - New regulations warranted
- Necessitates better industry education
 - Increase uptake of existing vaccines
 - Improve husbandry

V. Issues and Gaps

Transparent Reporting of Disease Status



- Allows timely notification of pathogen detections
 - ▣ Basis for implementation of mitigation measures
 - ▣ Critical for ASEAN countries
- Existing mechanisms
 - ▣ OIE WAHIS
 - ▣ NACA Quarterly Aquatic Animal Disease (QAAD) Reports

V. Issues and Gaps

Emergence of New Pathogens



- Pathogen emergence in recent years presents potential for new disease situations to arise
 - ▣ Modification of existing trade requirements
- Necessitates pre-emptive mechanisms
 - ▣ Horizon scanning
 - ▣ Transparent notification (WAHIS and QAAD)
 - ▣ Enhancement of laboratory diagnostic capabilities and surveillance
 - ▣ Partnerships with academia



Thank you!