SESSION 4: RESPONSIBLE AND PRUDENT USE OF VETERINARY ANTIMICROBIALS: PRACTICAL TOOLS AND EXPERIENCES

COUNTRY LEVEL IMPLEMENTATION: FAO EXPERIENCE IN AQUACULTURE

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Outline

• Latest aquaculture production statistics and importance as a food producing sector
• Salient features of fish farming and disease situation in aquaculture
• FAO advocacy, tools and future work in promoting prudent and responsible use of veterinary medicines
• Key messages
Latest aquaculture production statistics and importance as a food producing sector
In 2016, world aquaculture production accounted for 46.5 percent of total production (including for non-food uses) from capture fisheries and aquaculture, up from 44.7 percent in 2014, 25.8 percent in 2000, and 7.3 percent in 1980.

## Top 12 aquaculture producers

<table>
<thead>
<tr>
<th>Country</th>
<th>Quantity (million tonnes)</th>
<th>Value (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. China</td>
<td>49.2 million</td>
<td>USD 144.7 billion</td>
</tr>
<tr>
<td>2. India</td>
<td>5.7 million</td>
<td>USD 10.6 billion</td>
</tr>
<tr>
<td>3. Indonesia</td>
<td>5.0 million</td>
<td>USD 9.0 billion</td>
</tr>
<tr>
<td>4. Vietnam</td>
<td>3.6 million</td>
<td>USD 9.3 billion</td>
</tr>
<tr>
<td>5. Bangladesh</td>
<td>2.2 million</td>
<td>USD 5.6 billion</td>
</tr>
<tr>
<td>6. Egypt</td>
<td>1.4 million</td>
<td>USD 1.8 billion</td>
</tr>
<tr>
<td>7. Norway</td>
<td>1.3 million</td>
<td>USD 7.6 billion</td>
</tr>
<tr>
<td>8. Chile</td>
<td>1.0 million</td>
<td>USD 7.9 billion</td>
</tr>
<tr>
<td>9. Myanmar</td>
<td>1.0 million</td>
<td>USD 2.0 billion</td>
</tr>
<tr>
<td>10. Thailand</td>
<td>0.96 million</td>
<td>USD 2.5 billion</td>
</tr>
<tr>
<td>11. Philippines</td>
<td>0.8 million</td>
<td>USD 1.8 billion</td>
</tr>
<tr>
<td>12. Japan</td>
<td>0.7 million</td>
<td>USD 4.0 billion</td>
</tr>
</tbody>
</table>

Chapter 8: Fish and seafood: Project highlights

For production, these include issues related to transboundary issues with respect to diseases and escapes...
Salient features of fish farming and disease situation in aquaculture
Aquaculture is dynamic and complex!

About **580** species cultured:
- **362** finfishes (including hybrids)
- **104** molluscs, **62** crustaceans,
- **6** frogs and reptiles,
- **9** aquatic invertebrates, and
- **37** aquatic plants
Diseases in aquaculture: examples from largest aquaculture-related epizootics

<table>
<thead>
<tr>
<th>Disease (observation in the field)</th>
<th>Diagnosis</th>
<th>Reporting /communication (national or OIE)</th>
<th>Containment (vaccine, treatment, husbandry)</th>
<th>Management (cost-effective)</th>
<th>Disease freedom</th>
<th>National and international confidence to the sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>EUS (1970s): fungi</td>
<td>1980s</td>
<td></td>
<td>?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WSSV (1980s): virus</td>
<td>mid-1990s</td>
<td></td>
<td>?</td>
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</tr>
</tbody>
</table>

Long time lapse: years

$\text{##### losses}$: production, market = livelihoods, export earnings, food supply

$\text{##### spent}$: producers/government/academe: biosecurity (policies, prevention, diagnosis, surveillance, containment, training/education, research, trade disputes, etc); compensation; alternatives

Food and Agriculture Organization of the United Nations
Chronology of shrimp pathogen emergence in aquaculture

1970s
- BMNV: Baculoviral midgut gland necrosis virus
- MBV: Monodon baculovirus
- WSSV: White spot syndrome virus
- HPV: Hepatopancreatic parovirus
- IHHNV: Infectious hypodermal and haematopoietic necrosis virus

1980s
- NHP: Necrotizing hepatopancreatitis

1990s
- YHV: Yellow head virus
- TSV: Taura syndrome virus
- MoV: Mourilyan virus
- IMNV: Infectious myonecrosis virus
- CMNV: Covert Mortality Nodavirus
- LSNV: Laem-Singh Virus
- Vibriosis: Vibrio (harveyi, damsela, alginolyticus, vulnificus, penaeicida)

2000
- EMS/AHPND: a strain of V. parahaemolyticus
- EHP: Enterocytozoon hepatopenaei

2020?

2030?

2050?
Drivers of emergent disease in aquaculture

DRIVERS OF DISEASE EMERGENCE

Trading in live animals and products

Knowledge of pathogens and their hosts

Ecosystem change

Aquatic management and health control

- The unique aquatic medium
- Slow collective awareness of new threats
- Lack of basic pathogen data (e.g. transmission)
- Lack of basic host data (e.g. immunity, genetics)
- Diagnostics focused on known/listed diseases
  - Breeding strategies not in place for many species (e.g. SPF, SPR, selective breeding)
  - Misuse of stock (e.g. SPF) in some cases
- Limited availability of vaccines and other credible control options (invertebrates)
  - Societal barriers to innovative control/surveillance strategies
  - Societal barriers to innovative genetics
FAO advocacy, tools and future work in promoting prudent and responsible use of veterinary medicines in aquaculture
Advocacy to support responsible and prudent use of antimicrobials in aquaculture and reduce AMR

Blue Growth blog


Aquaculture Biosecurity including AMR is being proposed as an Agenda during the 10th Session of COFI/SCA (August 2019, Norway)

Side Event during the FAO Committee on Fisheries (COFI) SubCommittee on Aquaculture 9th Session (October 2017, Rome)
Advocacy to support responsible and prudent use of antimicrobials in aquaculture and reduce AMR: Regional Workshops

AMR occurs when microorganisms (e.g. bacteria, fungi, viruses and parasites affecting humans, terrestrial & aquatic animals and plants) become resistant to antimicrobial agents, thus making infections or diseases caused by such microorganisms more difficult or impossible to treat. While antimicrobials play a critical role for ensuring health and productivity, their imprudent use and the associated emergence and spread of antimicrobial-resistant microorganisms place everyone at great risk.

This final workshop (12-14 December 2017) of the FAO Project FMM/RAS/298/MUL, hosted by the Agri-Pond and Veterinary Authority of Singapore, in collaboration with INFOFISH, provides an important platform to improve the scientific understanding of AMR, to share experiences in setting governance mechanisms to support national action plans on AMR (within One Health and tricopartite mechanism), to continuously enhance knowledge on food fish safety hazards, disease prevention, correct diagnostics, disease management and best practice (good fishery and good aquaculture) and future actions and capacity development needs to address AMR.

Competent Authority officials (fisheries and veterinary authorities), researchers, laboratory personnel, private sector, other service providers

Strengthening capacities, policies and national action plans on prudent and responsible use of antimicrobials in aquaculture Workshop 2 (FAO Project FMM/RAS/298)

Malaysia, Putrajaya, 7 August 2017 - 9 August 2017

Further information: Reamaso, Melba (FIIAA) (Melba.Reamaso@fao.org)

Reducing health risks from antimicrobial resistance (AMR)

11 April 2017
**Tools: responsible use guidelines**

**Issues/Findings**
- 60 different veterinary medicinal ingredients (26 are antibiotics) (Rico et al. 2013)
- Oxytetracycline (OTC) was the product most reported for treatment of diseases in all major species, e.g. shrimp, tilapia, pangasius, marine fish, trout and salmon (FAO, 2012)
- Oxytetracycline was also the most-reported antibiotic used for prevention (prophylactic) and treatment (therapeutic)
- Availability: 91.4% (n=128) of respondents indicated that OTC are freely available and 8.6% is indicated OTC based on prescription
- Information on availability of 8 other antibiotics follow the same trend as for OTC
- Antibiotics are used through all production stages
- Perceived impacts: reduced mortality; increased survival, fish/shrimp welfare
- Perceived - impacts: build up of clinical resistance in fish/shrimp; residues of food safety concern; toxicity to the environment; build up laboratory bacterial isolates resistance

**Type** | **Most frequently used antibiotics in aquaculture: generic name**
---|---
Tetracyclines | Oxytetracycline, doxycycline
Quinolones | Oxolinic acid, flumequine, enrofloxacin (and other fluoroquinolone)
Phenicols | Florfenicol, chloramphenicol, thiamphenicol
Anti-folates | Trimethoprim/sulfamethoxazole, trimethoprim, sulfonamides
β-lactams | Amoxicillin
Macrolides | Erythromycin, josamycin, neomycin (for G+ve bacteria)
Nitrofurans | Nitrofurantoin
Tool: Guidance in developing the aquaculture component of the NAP on AMR

- Review and collection of relevant information:
  - most important cultured species based on production
  - most important bacterial diseases affecting the most important cultured species based on agreed criteria; include those not in the FAO list, if any, using criteria review baseline data and diagnostic method used
  - Codex Alimentarius MRLs;
  - actions to deal bacterial diseases (prevention, good aquaculture/biosecurity practices, treatment with antibiotics, alternative treatment)

- Develop guidance in the mechanism for collection of information on antimicrobial usage (AMU)

- Develop guidance in the mechanism for collection of information on AMR surveillance Requirements for AMU and AMR surveillance (personnel, field/lab procedures, skills, facilities, policies/legislation, reporting/record keeping, monitoring, etc.)

- Review member state actions and Tripartite (WHO, OIE, FAO) actions

- Aquaculture component to be integrated in the country NAP on AMR under the One Health framework
Tool: Responsible management of bacterial diseases in aquaculture

Background: Review of important bacterial diseases in aquaculture

- Not much attention to bacterial diseases even though they significantly affect aquaculture production
- Only 2 bacterial pathogens included in the OIE list of aquatic diseases: NHP and AHPND both of shrimp
- An essential first step is to understand what diseases are affecting the sector and how they are being dealt with, e.g. prevention? treatment? management?
- If antibiotics are used - what are these, how are they used? prophylactic or therapeutic? how are they administered? by whom? are they effective or failure?
- If not, what alternatives to antibiotics are being used
- No focus in AMU and AMR in previous books
- Need for information on biosecurity and management of bacterial disease, which could have steps specific to a pathogen
- Need for a book providing guidance on diagnostic methods and antimicrobial susceptibility testing

A prerequisite to the work on AMR in aquaculture
Responsible Management of Bacterial Diseases in Aquaculture: Experts and write-shops

<table>
<thead>
<tr>
<th>Experts: A group of microbiologists, aquatic veterinarians and aquatic animal health specialists</th>
<th>Write-shops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Olga Haenen (Netherlands); Dr Larry Hanson (USA); Dr Indrani Karunasagar (India); Dr Iddya Karunasagar (India); Dr Celia Lavilla-Pitogo (Philippines); Dr Mark Lawrence (USA); Dr Rohana Subasinghe (Sri Lanka); Dr Sjnezana Zrncic (Croatia); Dr Melba Reantaso (FAO)</td>
<td>First: Frascati, Italy (December 2016)</td>
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<td></td>
<td>Second: Mangalore, India (April 2017)</td>
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<td></td>
<td>Third: Putrajaya, Malaysia (August 2017)</td>
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<td>Fourth: Singapore (December 2017)</td>
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</table>
### Review of important bacterial diseases in aquaculture

<table>
<thead>
<tr>
<th>Gram-negative bacteria</th>
<th>Gram-positive bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vibriosis</strong> <em>(V. anguillarum, V. harveyi clade, V. parahaemolyticus, Aliivibrio salmonicida (V. salmonicida), V. vulnificus, Photobacterium damselae)</em></td>
<td><strong>Mycobacteriosis</strong> <em>(Mycobacterium fortuitum, M. marinum, Nocardia asteroides, N. crassostreae (ostreae), N. seriolae)</em></td>
</tr>
<tr>
<td><strong>Aeromonas</strong> <em>(Motile Aeromonas spp.: Aeromonas caviae, A. hydropla, A. sobria, A. veronii, A. jandaei; A. salmonicida)</em></td>
<td><strong>Streptococcosis</strong> <em>(Streptococcus agalactiae, S. iniae, Lactococcus garvieae, Aerococcus viridans)</em></td>
</tr>
<tr>
<td><strong>Edwardsiellosis</strong> <em>(Edwardsiella anguillarum, E. ictaluri, E. piscicida, E. tarda, Yersinia ruckeri)</em></td>
<td><strong>Renibacteriosis</strong> <em>(Renibacterium salmoninarum)</em></td>
</tr>
<tr>
<td><strong>Pseudomonas</strong> <em>(Pseudomonas anguilliseptica, P. fluorescens)</em></td>
<td><strong>Infection with Anaerobic Bacteria</strong> <em>(Clostridium botulinum, Enterobacterium catenabacterium)</em></td>
</tr>
<tr>
<td><strong>Flavobacteriosis</strong> <em>(Flavobacterium branchiophilum, F. columnare, F. psychrophilum, Tenacibaculum maritinum)</em></td>
<td></td>
</tr>
<tr>
<td><strong>Infection with Intracellular Bacteria</strong> <em>(Piscirickettsia salmonis, Hepatobacter penaei, Francisella noatunensis, Chlamydia spp.)</em></td>
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</table>

<table>
<thead>
<tr>
<th>cold</th>
<th>temperate</th>
<th>tropical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appr. 0-15°C</td>
<td>5-25°C</td>
<td>20-37°C</td>
</tr>
</tbody>
</table>

In red: considered important for tropical regions

**Criteria used** for making the draft list of most important bacterial pathogens in aquaculture:
1. Economic importance of affected species
2. Socio-economic impact
3. Zoonotic potential
Responsible Management of Bacterial Diseases in Aquaculture (available by 2019): **will assist in prioritizing bacterial diseases** using the same criteria of: (i) economic importance of affected species; (ii) socio-economic impact; and (iii) zoonotic potential

<table>
<thead>
<tr>
<th>Chapter 1</th>
<th><strong>INTRODUCTION</strong>: Background, Objectives and Scope, Importance of Aquaculture, Health of Aquatic Animals, Guide for Users, Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 2</td>
<td><strong>BACTERIAL DISEASES in AQUACULTURE: GENERAL CONSIDERATIONS</strong>: Introduction, Bacterial Classification, Major Bacterial Diseases in Aquaculture, Pathogenesis of Bacterial Infection, Role of Diagnostics, Risk Factors, Reference</td>
</tr>
<tr>
<td>Chapter 3</td>
<td><strong>BACTERIAL DISEASES in AQUACULTURE: PATHOGEN-SPECIFIC CONSIDERATIONS</strong>: Gram-negative bacterial pathogens (n=6); Gram-positive bacterial pathogen (n=4): Each pathogen section contains Background information, causative agent, host, ecological factors, geographical distribution, clinical aspects, diagnostics, transmission, prevention, management (prevention), zoonotic potential, references</td>
</tr>
<tr>
<td>Chapter 4</td>
<td><strong>PREVENTION AND MANAGEMENT</strong>: Prevention (GAP, biosecurity, prebiotic, probiotic, immunostimulants, green water technology, vaccination); Management (treatment, alternatives to antimicrobials), reference</td>
</tr>
<tr>
<td>Chapter 5</td>
<td><strong>PRUDENT USE</strong>: (i) Correct diagnosis, etc.; administration; prophylactic, therapeutic, metaphylactic; medicated feeds (ii) AMU; (iii) AMR, (iv) reference</td>
</tr>
</tbody>
</table>
1. **Vibriosis**

- **Vibrio harveyi**: Luminescent vibriosis
  - **Host range**: in culture of shrimp larvae, grouper, snapper, Asian seabass
  - **Geographic distribution**: warm regions, ubiquitous in seawater
  - **Diagnostics**: TCBS agar a.o., luminescent; diagnosis is easy
  - **Management**: Eggs are colonized by *V. harveyi* before hatch: remove spawners and rinse eggs
  - **Zoonotic potential**: no

2. **Aeromoniasis**

- **Aeromonas spp.:** *A. caviae, A. hydrophila, A. sobria, A. veroni, A. jandaei*
  - **Host range**: various freshwater and brackish water fish species, like catfish, tilapia, *Puntius and rohu in India (Dr. Sahoo)*
  - **Geographic distribution**: global, opportunistic
  - **Diagnostics**: standard
  - **Management**: avoid other causes of disease
  - **Zoonotic potential**: low

3. **Edwardsiellosis**

- **E. tarda, E. piscicida, and E. anguillarum**
  - **Host range**: various freshwater and marine fish, tilapia, *Pangasius hypophthalmus, eel*
  - **Geographic distribution**: global
  - **Diagnostics**: standard
  - **Management**: standard. Vaccines available.
  - **Zoonotic potential**: yes: *E. tarda*
3. **Pseudomoniasis**
- **Yersinia ruckeri**: Enteric Red Mouth (ERM)
  - **Host range**: rainbow trout and other salmonids
  - **Geographic distribution**: global
  - **Diagnostics**: standard, yellow faeces
  - **Management**: standard. Vaccines available.
  - **Zoonotic potential**: no.

4. **Pseudomoniasis**: *Pseudomonas anguilliseptica*, "Sekiten-byo" in Japanese eel, 'Red spot disease' in elvers *Anguilla* spp, "winter disease" in sea bream *Sparus aurata*; and *Pseudomonas fluorescens*
  - **Host range**: *Pseud. ang.*. Many susceptible fish species, like eel, tilapia (Egypt), cod; *Ps. fluoro.*: tilapia, tench, silver carp, bighead carp, rainbow trout
  - **Geographic distribution**: *Pseud. ang.*: Japan, since 1981 in Europe, N-Africa, SE-Asia; *Ps. fluoro.*: global
  - **Diagnostics**: standard
  - **Management**: management can be carried out by increasing the water temp to 27°C for 2 weeks, without antibiotics
  - **Zoonotic potential**: no.

5. **Mycobacteriosis**: *Mycobacterium marinum* and *M. fortuitum*
- **Fish tuberculosis**
  - **Host range**: freshwater, brackish and marine fish species, like tilapia, catfish, cormorants, snakehead, striped bass
  - **Geographic distribution**: global
  - **Diagnostics**: special media, slow grower, ZN-stain
  - **Management**: Cannot be cured with antibiotics
  - **Zoonotic potential**: yes

6. **Streptococcus**: *Streptococcus agalactiae/inae*
- **Host range**: various freshwater and marine fish species, tilapia (*Oreochromis niloticus*), channel catfish (Ictalurus punctatus), rainbow trout (*Oncorhynchus mykiss*)
- **Geography**: in Asia, USA, Australia, Brazil, Peru, China, Taiwan, Thailand, Australia, New Zealand, Argentina, Europe
- **Diagnostics**: standard
- **Management**: There is a vaccine for S. inae.
- **Zoonotic potential**: yes
Zoonotical (contact) fish pathogenic bacteria from warm water systems

Streptococcus agalactiae (tilapia)
Streptococcus iniae (tilapia)
Edwardsiella tarda (eel, cichlids, ornamental fish)
Vibrio vulnificus (eel)

Photobact. damselae damselae (marine fish)
Mycobacterium marinum (various warmwater fish, incl. tilapia)
Mycobacterium fortuitum (warmwater ornamental fish)
Tool: Guidance steps on AMU survey and AMR surveillance

1. Understanding and knowledge of AMU/AMR in aquaculture (3 regional workshops)

2. Development of guidance
   - Review of priority diseases in tropical aquaculture (part of aquaculture component of NAP on AMR)
   - Review of important bacterial diseases in aquaculture (part of aquaculture component of NAP on AMR)
   - Prioritise the most important diseases of economically important cultured species (part of aquaculture component of NAP on AMR)
   - AMU/AMR survey guidance: review and assess country level applicability

Guidance on Surveillance: developed during Mangalore AMR in aquaculture workshop (together with OIE – Delphy)
<table>
<thead>
<tr>
<th>Context</th>
<th>Guidance</th>
</tr>
</thead>
</table>
| Target microorganism | • Consider bacteria that are native to the aquatic environment in the ecosystem (freshwater, marine, brackish water);  
                       • Consider bacterial pathogen relevant to the aquacultured species in the culture system in the country;  
                       • Consider indicators of contamination coming from humans and animal farms;  
                       • Consider human pathogens like *Salmonella*, if there has been an established link between the aquaculture system and outbreaks of fish poisoning;  
                       • Make decision on number of isolates of each type to be tested based on frequency of isolation of the target microorganism and expected level of prevalence of resistance in the bacterial population. |

<table>
<thead>
<tr>
<th>Data collection</th>
<th>Sampling design</th>
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<tbody>
<tr>
<td>Logistics and operational aspects</td>
<td>Target microorganism</td>
</tr>
<tr>
<td>Stakeholders</td>
<td>Laboratory methodology</td>
</tr>
<tr>
<td>Surveillance objectives</td>
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</table>

<table>
<thead>
<tr>
<th>Context</th>
<th>Guidance</th>
</tr>
</thead>
</table>
| Laboratory methodology   | • Use internationally valid method for isolation and identification of target bacterial species (e.g. ISO, AOAC, APHA)  
                       • If such methods are not available, consider “fit for purpose” method based on performance characteristics of the method (e.g. FAO/WHO Guidance on human pathogenic *Vibrio* spp.).  
                       • Perform disc diffusion and MIC assays as per CLSI or other internationally validated guidelines.  
                       • Ensure laboratory quality control systems are in place. Preferably, laboratory should have accreditation e.g. ISO 17025.  
                       • Conclusions on sensitivity/resistance should be based on epidemiological cutoff values. If these values do not exist, try to establish by analyzing MIC values of required number of wild type isolates  
                       • Report results providing data on resistance, MIC and zone diameter values |
Tool: Guidance document on Performance of antimicrobial susceptibility testing programmes relevant to aquaculture and aquaculture products (available by early 2019):

• **principle**: the absolute need for the use of **internationally agreed standardised test protocols and the adherence to the quality control requirement** of those protocols; & the importance of the use of consensus, internationally harmonised, criteria in the interpretation of the meanings that can be given to *in-vitro* susceptibility data

• **current status of the standard protocols** that can be recommended for use in **bacteria isolated from aquatic animals**; currently available standardised protocols are **adequate** for the determination of the antimicrobial susceptibility of 37 (64%) of 44 species of bacteria representing those most frequently isolated from aquatic animals.

• **design of programmes aimed at monitoring or surveillance of AMR associated with the use of antimicrobial agents in aquaculture**, e.g. investigations of:
  • **susceptibility of pathogens of aquatic animals**.
  • **public heath implications of**:
    • the presence in *aquacultural products* of **bacteria with reduced susceptibility to antimicrobial agents**.
    • **antimicrobial agent use in aquaculture mediated through aquacultural products**.
    • **antimicrobial agent use in aquaculture mediated through the environmental resistome**.
<table>
<thead>
<tr>
<th>Bacterial species group</th>
<th>Gram-positive/ Gram-negative</th>
<th>Affected species</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibriosis <em>(V. anguillarum, V. harveyi clade, V. parahaemolyticus, V. vulnificus, Photobacterium damselae)</em></td>
<td>Gram-negative</td>
<td>Shrimp, mussel, clam: <em>V. parahaemolyticus</em></td>
<td>Malaysia</td>
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<tr>
<td></td>
<td></td>
<td>Milkfish and shrimp: <em>V. parahaemolyticus</em></td>
<td>Philippines</td>
</tr>
<tr>
<td>Streptococcosis <em>(Streptococcus agalactiae, S. iniae, Lactococcus garvieae, Aerococcus viridans)</em></td>
<td>Gram-positive</td>
<td>Tilapia, milkfish: <em>Streptococcus agalactiae, S. iniae</em></td>
<td>Philippines</td>
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<td></td>
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<td>Tilapia and traditional fish: <em>Streptococcus sp.</em></td>
<td>Vietnam</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>Gram-negative</td>
<td>Catfish, tilapia, green mussel, clam</td>
<td>Malaysia</td>
</tr>
</tbody>
</table>
AMU survey and AMR surveillance: Malaysia, Philippines, Viet Nam

Results are being analysed.

Process contributed to development of aquaculture component of country NAP on AMR.
# Tools: Best practice guidance (Pillar no. 4)

## Best practice guidance for carp, tilapia and shrimp

<table>
<thead>
<tr>
<th>Best practice guidance for carp, tilapia and shrimp</th>
</tr>
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<tbody>
<tr>
<td>Know your fish</td>
</tr>
<tr>
<td>Know your pathogens</td>
</tr>
<tr>
<td>Know your systems</td>
</tr>
<tr>
<td>Know your contamination pathways</td>
</tr>
<tr>
<td>Source healthy seeds</td>
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</tbody>
</table>

![Fish images]
## Tool: Documentation products: AMR in Aquaculture: enhance our understanding

<table>
<thead>
<tr>
<th>Focus Area: Awareness, Evidence</th>
<th>Focus Area: Awareness, Governance</th>
<th>Focus Area: Awareness, Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FATP</strong>: AMR in aquaculture</td>
<td><strong>FAO Book</strong>: Responsible management of bacterial diseases in aquaculture</td>
<td><strong>FATP</strong>: Understanding antibiotic treatment failures in salmon aquaculture</td>
</tr>
<tr>
<td><strong>FATP</strong>: Case for a model AMR surveillance programme for aquaculture</td>
<td><strong>FAO Code of Conduct for Responsible Fisheries on Prudent and Responsible Use of Antimicrobials in Aquaculture</strong></td>
<td><strong>FATP</strong>: Potential transfer of antimicrobial resistance and zoonotic bacteria through global ornamental fish trade</td>
</tr>
<tr>
<td><strong>FATP</strong>: Complexities involved in source attribution of AMR genes found in aquaculture products</td>
<td><strong>FATP</strong>: Guidance in the development of NAP on AMR: aquaculture component</td>
<td><strong>FATP</strong>: Aquaculture practices to minimise antimicrobial use and antimicrobial resistance – shrimp farming</td>
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**FATP**: FAO Fisheries and Aquaculture Technical Paper
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<tr>
<th>Focus Area: Awareness, Evidence</th>
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<td><strong>FATP</strong>: Survey on AMU and AMR in aquaculture in China</td>
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<td><strong>FAO non-serial publication</strong>: Performance of antimicrobial susceptibility testing programmes relevant to aquaculture and aquaculture products</td>
<td><strong>FATP</strong>: Review of good aquaculture and biosecurity practices and other existing technical guidelines that will be relevant to support AMU/AMR work</td>
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<td><strong>FATP</strong>: Fish Waste Management: Turning fish waste into healthy feed</td>
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<td><strong>FATP</strong>: Integrated fish/livestock farming in Malaysia, the Philippines and Vietnam Review of alternatives to antimicrobials in aquaculture (vaccines, phage therapy, quorum sensing, prebiotics, probiotics, plant therapy)</td>
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Key messages
Key message 1: Food fish has a wealth of health benefits (don’t forget aquatics!)

Aquaculture has huge potential to contributing to food and nutrition security: challenged with biosecurity issues; good farming and biosecurity practices; special attention because we are aquatics (you can’t see us; contributing and/or recipient).
Key message 2: Putting farmers in the equation (esp. small-scale producers)

Disease costs are too high for small-scale sector to survive

Understanding their needs and expectations

Important role of farmers

Getting them involved and utilise their indigenous knowledge

Making them aware of the risks and helping them manage the risks at farm level

How do you deal with thousands of small-scale aquaculture producers?

Effective technologies and strategies which are accessible and affordable to the resource-poor small-scale sector

Provide feedback and updates

Not only in the acknowledgement (for scientific presentations and papers!)
Key message 3: Better understanding, coordinated and integrated actions

- AMR is a complex problem & is driven by many interconnected factors.
- Single, isolated interventions have limited impact.
- Greater innovation and investment are required in research and development of new antimicrobials, vaccines, and diagnostic tools.
- Aquaculture producing countries need to develop the aquaculture component of country NAP on AMR
- We need better understanding of AMR in aquaculture before integration into One Health

Risk assessment of AMR in aquaculture 26-29 November 2018, Palermo, Italy
Guidance in the development of Aquaculture Component of the National Action Plan on AMR: Malaysia, Philippines, Vietnam

CCRF Technical Guidelines on Prudent and Responsible Use of Antimicrobials in Aquaculture

Responsible management of bacterial diseases in aquaculture

Best practice guidelines on carp, tilapia and shrimp

Technical Paper on Responsible Use of Antibiotics in Aquaculture

Guidance on Surveillance of AMU and AMR

Guidance on Antibiotic Susceptibility Testing for Aquaculture and Aquaculture Products

http://www.fao.org/3/a-i5996e.pdf
ACKNOWLEDGEMENTS
Juan Lubroth (CVO) and FI Management

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<tr>
<th>Country Team</th>
<th>Expert Team</th>
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<tr>
<td>Philippines: SIMEONA E. REGIDOR; SONIA SOMGA; JOSE O. PACLIBARE</td>
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<td>Vietnam: THI LAN HUONG NGUYEN; THI LUA DANG</td>
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<td>China: LI AIHUA</td>
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**Partners:** Member states; EU; NACA; NORAD/NVI; OIE; FAO Centers on Aquatic Biosecurity (including AMR)
- Chinese Academy of Fisheries Science: Pearl River Fisheries Research Institute and Yellow Sea Fisheries Research Institute (China)
- Nitte University (India)
- Centre for Environment, Fisheries and Aquaculture Science (CEFAS, U.K.)
- Mississippi State University (USA)
Thank you very much for your kind attention