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# Antimicrobial resistance in Aquaculture : A one health perspective



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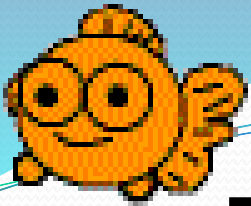
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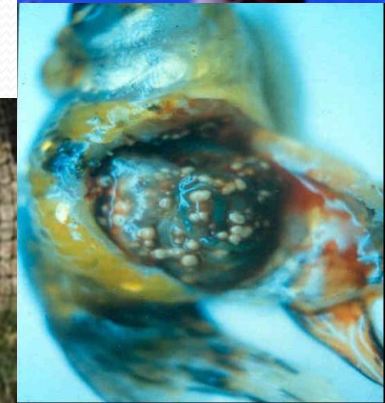
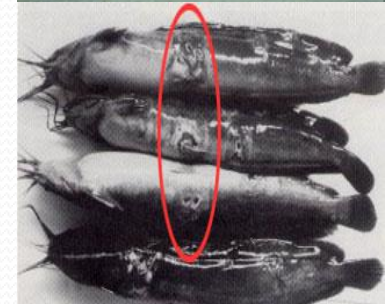
# Outline

- The risk on public health of the use of antimicrobials in aquaculture
- Transmission of AMR
- AMR often found in aquaculture
- The methods for reducing AMR in aquaculture.
- Data gaps and future research needs

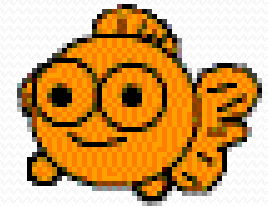


# Fish Bacterial Diseases

- Bacterial Hemorrhagic Septicemia
- Furunculosis, Ulcerative disease
- Bacterial Hemorrhagic Septicemia
- Vibriosis
- Edwardsiella septicemia
- Enteric septicemia of catfish
- Enteric red mouth
- Streptococcosis
- Columnaris disease or Saddleback disease
- Bacterial Kidney Disease (BKD)
- Tuberculosis, Mycobacteriosis
- Nocardiosis
- Piscirickettsiosis
- Franciscellosis



# List of licensed antimicrobials used in aquaculture



- Amoxicillin
- Enrofloxacin
- Sarafloxacin
- Oxolinic acid
- Oxytetracycline
- Sulfadimethoxine sodium / Ormethoprim
- Sulfadimethoxine sodium / Trimethoprim
- Sulfadiazine and Trimethoprim
- Sulfadimidine and Trimetroprim
- Sulfamonomethoxine Sodium
- Toltrazuril

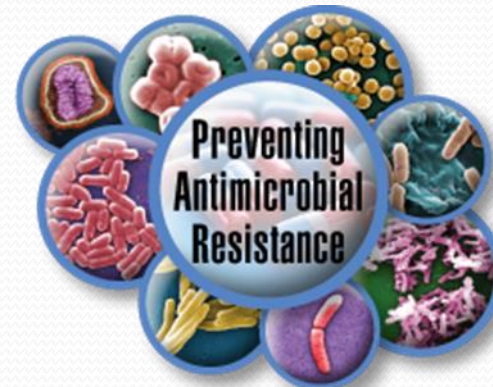


# Indications of use and formulations of antimicrobials used in Aquaculture

- treatment of Major bacterial infections : *Aeromonas* spp, *Vibrio* spp., *Streptococcus* spp.
- Licensed use in generalized conditions (septicemia), skin ulcers
- Formulations : oral (feed medication), water bath

# Antimicrobial resistance often found in Aquaculture

- Quinolone and fluoroquinolone resistance
- Chloramphenicol resistance
- Tetracycline resistance
- Betalactam resistance



# Quinolone licensed for use in fish by region of the world



- Enrofloxacin (Asia)
- Sarafloxacin (Europe)
- Flumequine (Asia)
- Oxolinic acid (Japan, Latin America)

Quinolones was no licensed in USA, Canada, Australia and South Africa

Data compiled from WHO/EMC/ZDI/98.10



# The risk on public health of the use of antimicrobials in aquaculture

## 1. Antimicrobial resistance (AMR) :

- The use of antimicrobial agents can lead to the emergence of antimicrobial resistant microorganisms and further promote the dissemination of resistant bacteria and resistance genes (OIE/FAO/WHO 2004a).
- The use of antimicrobials in aquaculture can have an impact on the resistance situation in another area, such as in human medicine, and resistance problems in one country can spread to another country.

## 2. Antimicrobial residues :

- Antimicrobial usage in aquaculture can result in residues of antimicrobials in the food products and environments.



# Problems of non-prudent use of antimicrobials in Aquaculture

- Antibiotic resistance
  - in animals
  - in Human
- Antibiotics residue
  - Drugs allergy
  - Carcinogenesis



## Transmission of antimicrobial resistance (direct)

Direct contact with aquatic animal and water



Contaminated in food chain and human GI tract



## Transmission of antimicrobial resistance (indirect)

### Transmission with AMR genes (horizontal genes transfer)

mobile genetic elements containing multiple resistance determinants transmissible to other bacteria.

Plasmid-mediated resistance to antimicrobials (Transferable R-plasmids) :

*Aeromonas salmonicida*, *A. hydrophila*, *Vibrio anguillarum*, *Pseudomonas fluorescens*, *Photobacterium damsella*, *Edwardsiella tarda* and *Yersinia ruckeri*

Transferability of resistance plasmids from aquatic bacterial pathogens illustrates that these bacteria can act as reservoirs of AMR genes that can be further disseminated, and ultimately reach human pathogens.

# Bacterial zoonosis from aquatic animals



A leg infected with ecthyma gangrenosum, caused by *Aeromonas hydrophila*



*Streptococcus iniae* Discitis in Singapore  
\*Singapore General Hospital, Singapore



Granuloma on human index finger caused by *Mycobacterium marinum*

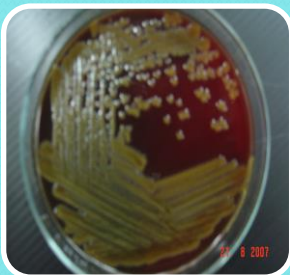
# Bacterial zoonosis from aquatic animals



food poisoning caused by *Vibrio* spp.



Diarrhea, neonatal meningitis, cellulitis in human caused by *Plesiomonas shigelloides*

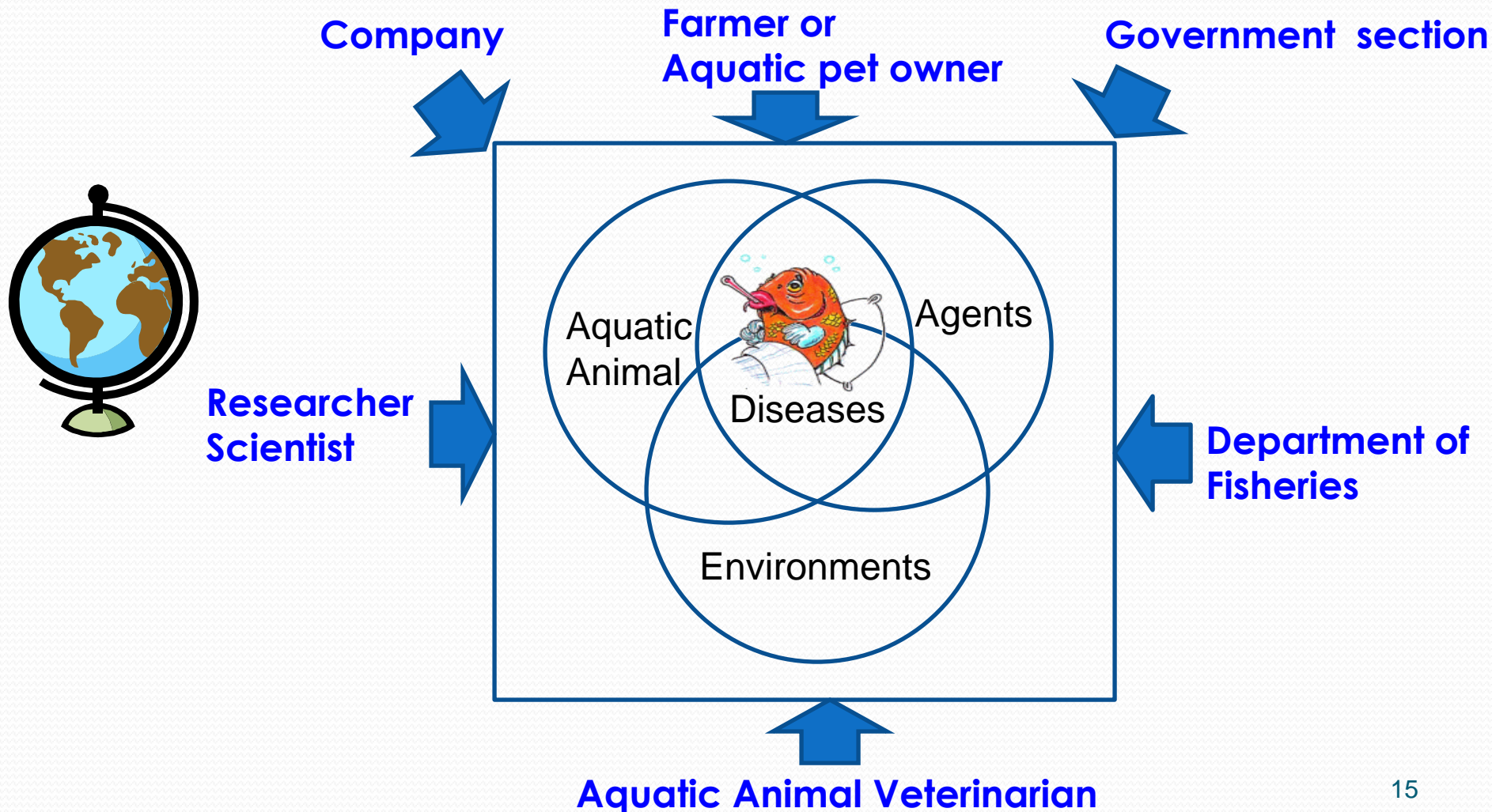


Nosocomial infection caused by *Chryseobacterium indologenes*

# The methods for reducing AMR in aquaculture

- Prudent use of antimicrobials
- Non antibiotic approaches
  - Vaccines
  - Immunostimulants
  - Phytobiotics
  - Probiotics
  - Bacteriophage therapy
  - Ozone nanobubble
  - etc.

# Cooperation for Prevention of AMR in Aquaculture



# Data gaps and future research needs (1)

- more national and regional data on prevalence of AMR in various bacteria and different production types
- more data on the conditions in the aquaculture environment including sediments for selection of resistance to antimicrobials
- better national and regional data on AMU in aquaculture
- more national and regional data on the occurrence of residues of various antimicrobials in aquaculture products from different production types
- more knowledge on spread of resistance genes from aquatic bacteria to human pathogens



# Data gaps and future research needs (2)

- more knowledge on consumption of aquaculture products and consumption habits in various regions
- World standardization on antimicrobials susceptibility tests and the breakpoint for aquatic bacteria
- more research in pharmacological aspects of antimicrobials used in aquaculture in order to provide a more exact approach to develop MRL values

# Summary (1)

- rapid increase in therapeutic and prophylactic usage of antimicrobials in aquaculture including those important in human therapeutics such as quinolone and fluoroquinolone.
- bacteria whose resistance arises from mutations or from mobile genetic elements containing multiple resistance determinants can be transmitted to other bacteria.

# Summary (2)

- AMR can be transmitted between human pathogens and animal pathogen.
- Several recently found genetic elements and resistance determinants are shared between aquatic animal pathogens and human pathogens.
- Massive use of antimicrobials in aquaculture can thus potentially negatively impact animal and human health as well as the aquatic environment and should have prevention and control.

**Thank you for your attention**

**Antimicrobial  
resistance : No  
action today, No  
cure tomorrow**



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