World Organisation for Animal Health

# AMR in Aquaculture and One Health

## Regional Workshop on Antimicrobial Resistance in Aquaculture for English-Speaking African Countries

13 - 15 August 2025
Harare, Zimbabwe


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AMR&VPD – WOAH



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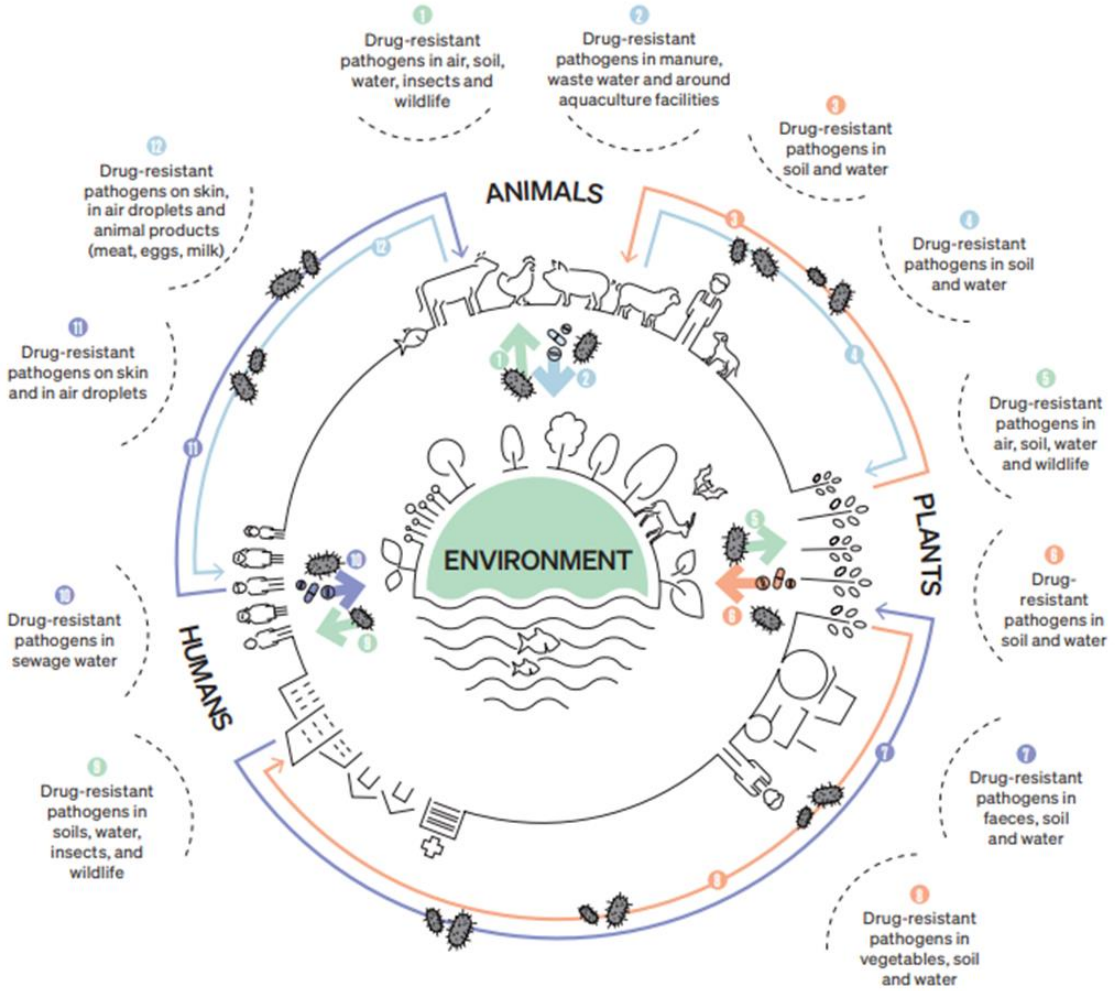
# AMR: A One Health challenge

*Misuse and overuse of antimicrobials can generate antimicrobial resistance. Drug-resistant pathogens can then spread between and within animals, humans, plants and through the environment.*







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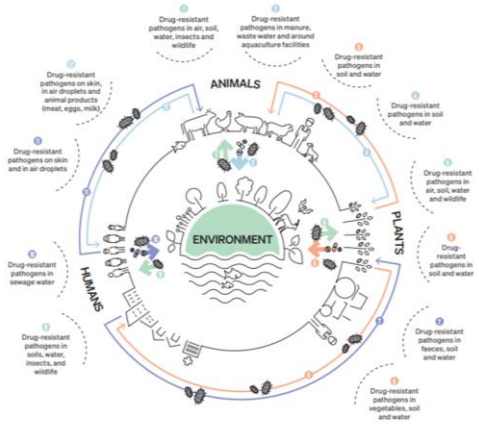
# AMR risk

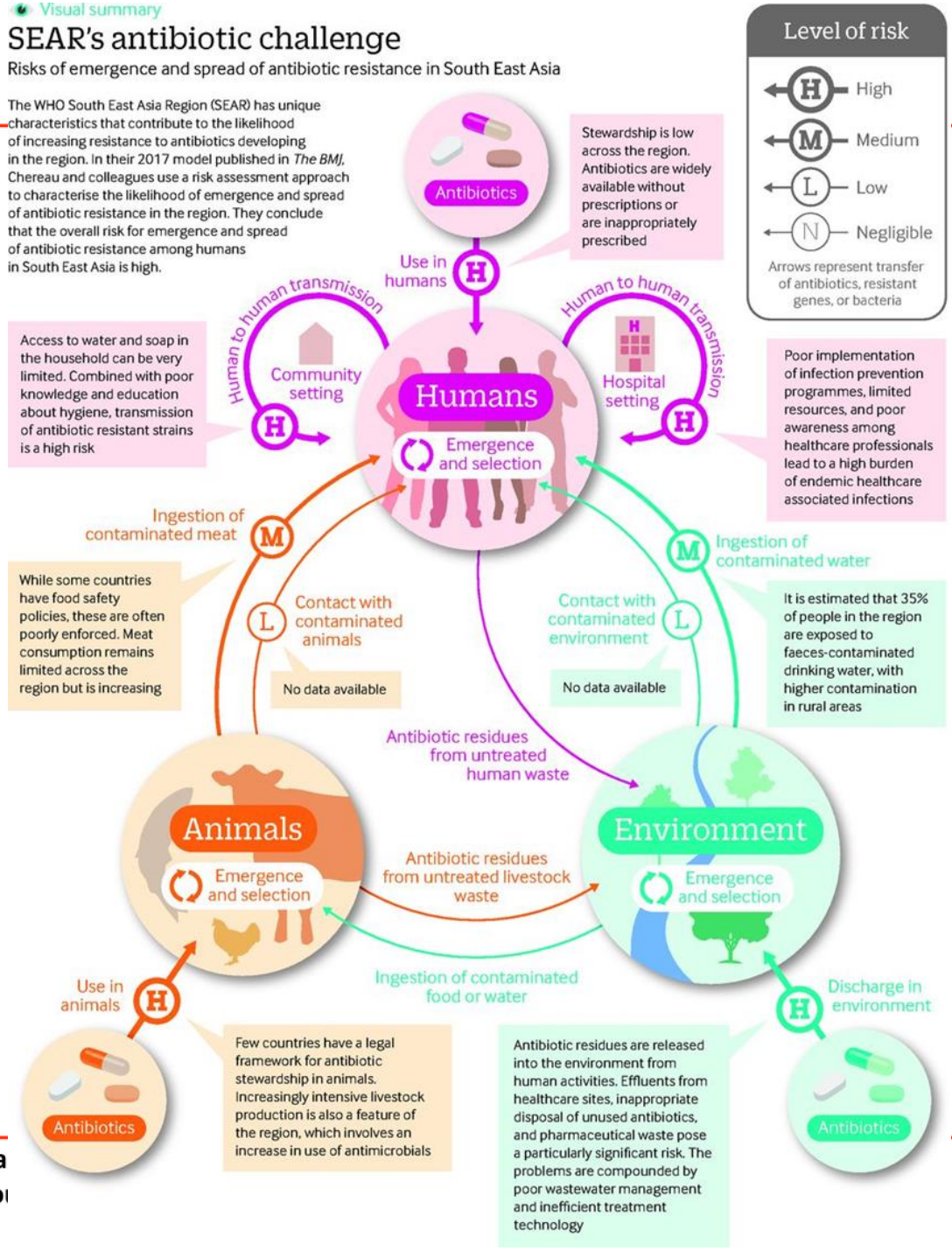



Visual summary

## SEAR's antibiotic challenge

Risks of emergence and spread of antibiotic resistance in South East Asia

The WHO South East Asia Region (SEAR) has unique characteristics that contribute to the likelihood of increasing resistance to antibiotics developing in the region. In their 2017 model published in *The BMJ*, Chereau and colleagues use a risk assessment approach to characterise the likelihood of emergence and spread of antibiotic resistance in the region. They conclude that the overall risk for emergence and spread of antibiotic resistance among humans in South East Asia is high.




Chereau et al., 2017

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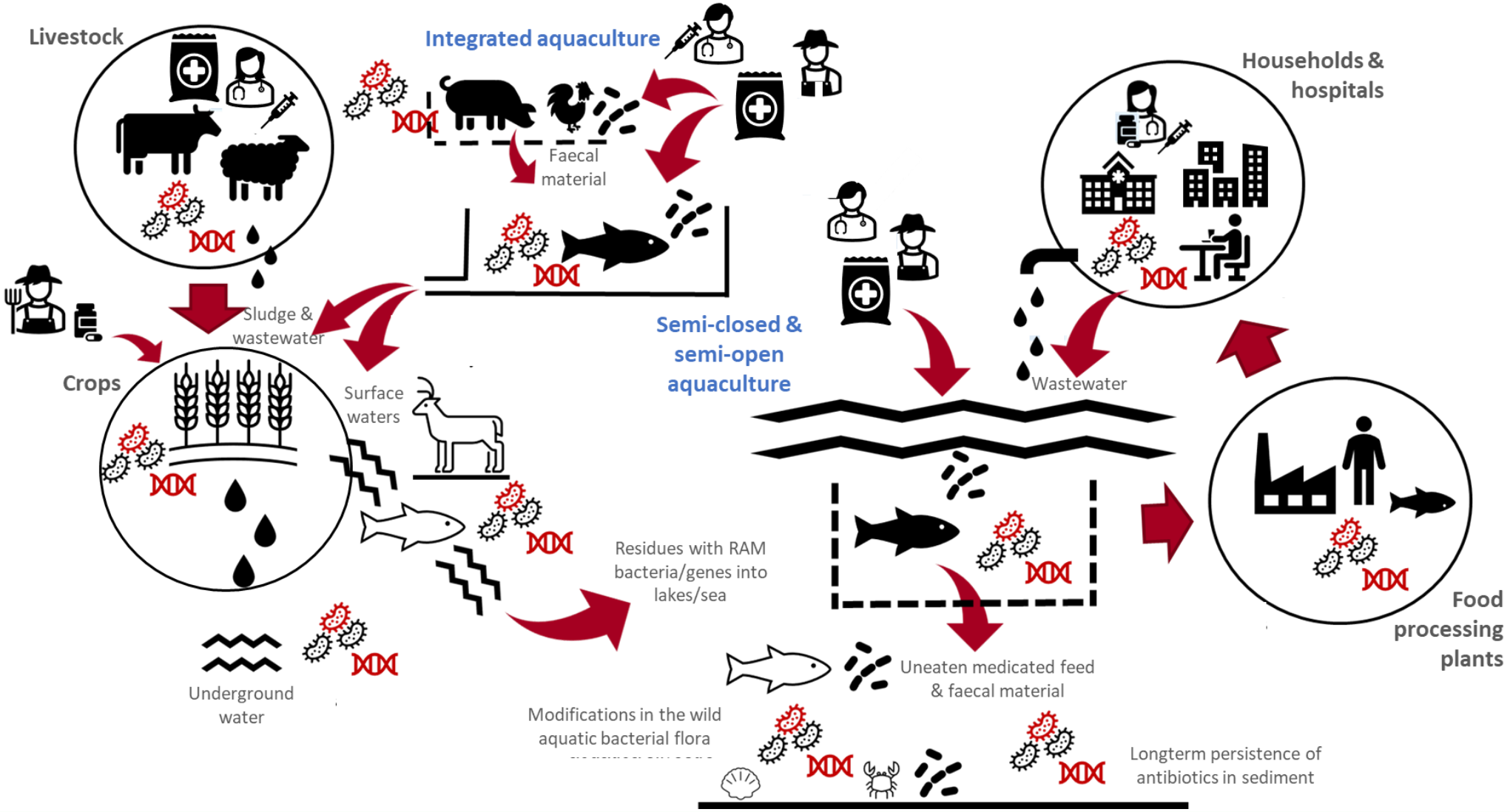
# AMR flux in aquaculture with other sectors







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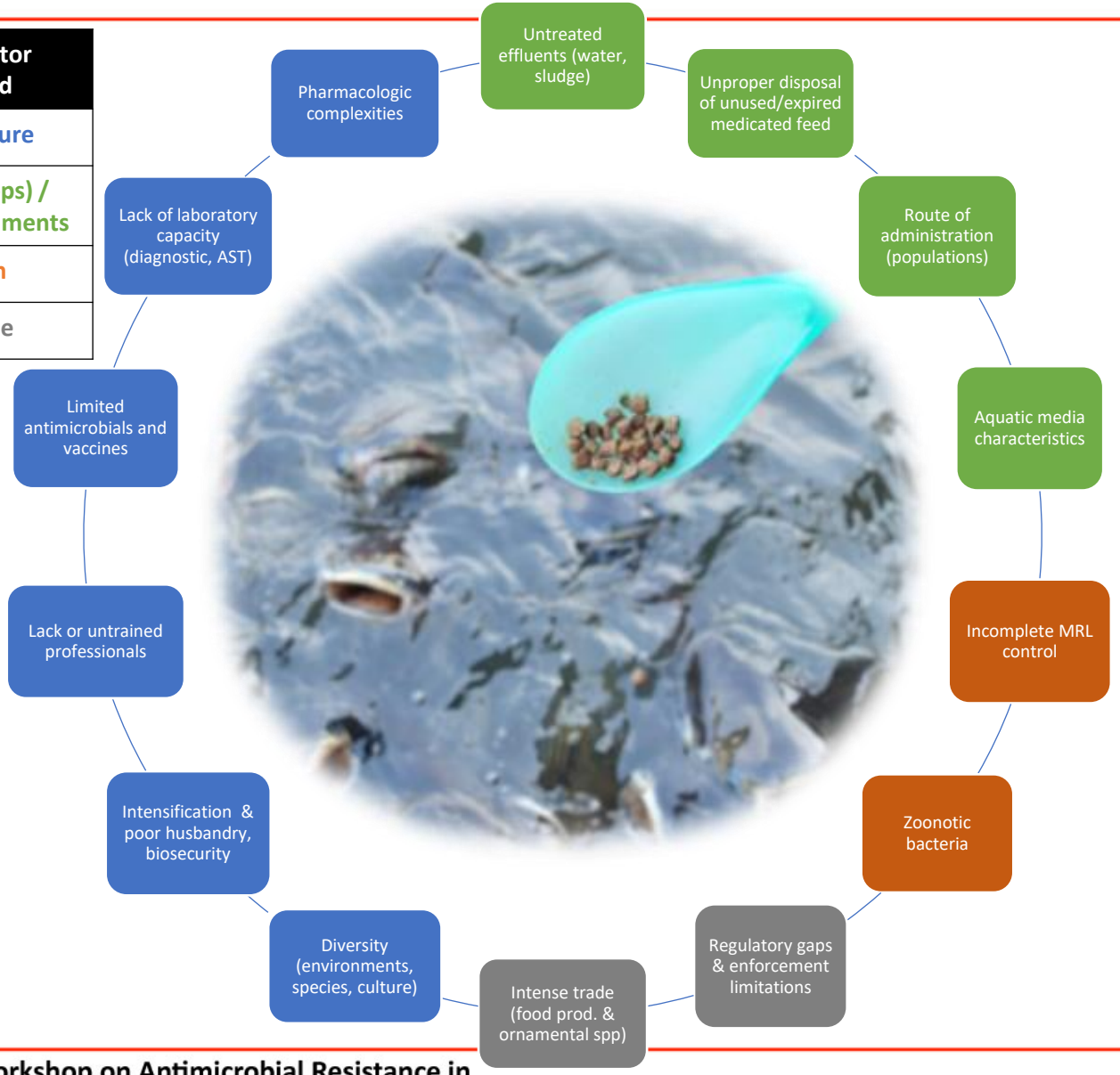
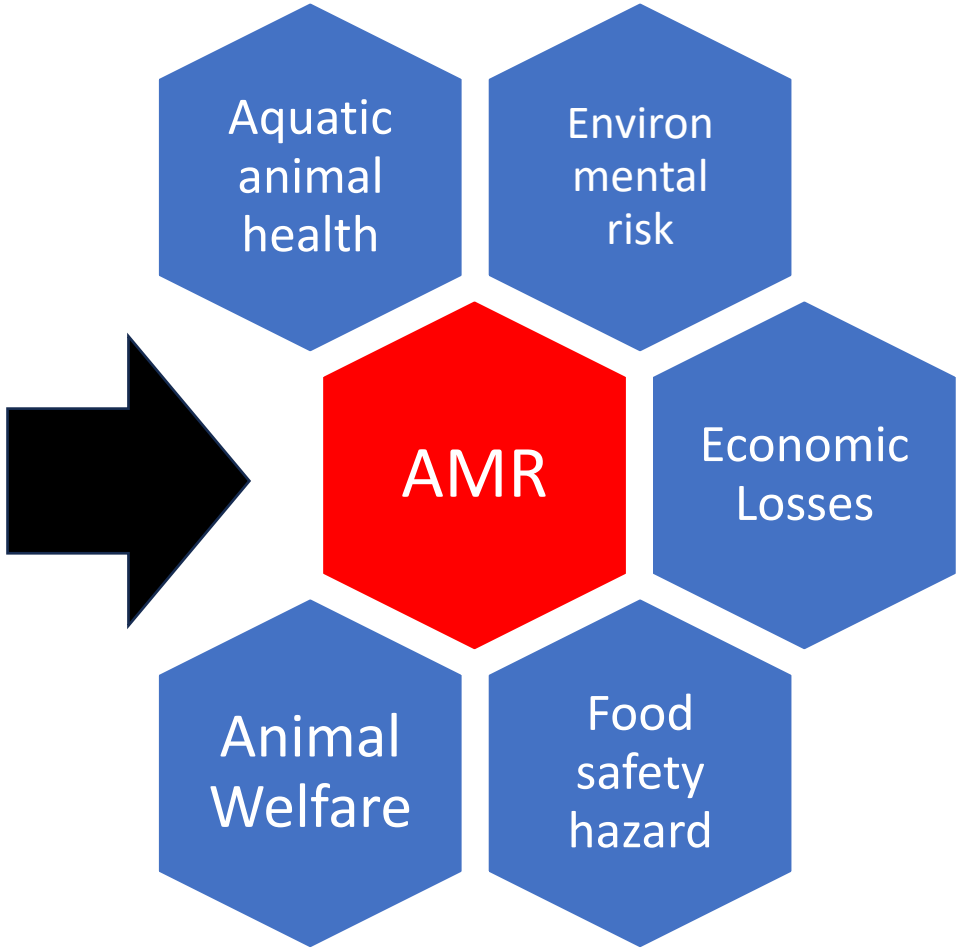
# Factors in aquaculture influencing AMR

| Main sector affected |
| --- |
| Aquaculture |
| Plants (crops) / wild environments |
| Human |
| Multiple |







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# AMR & OH approach – global efforts

# NAPs-AMR & aquaculture

## Guidance levels to include aquaculture in NAPs-AMR

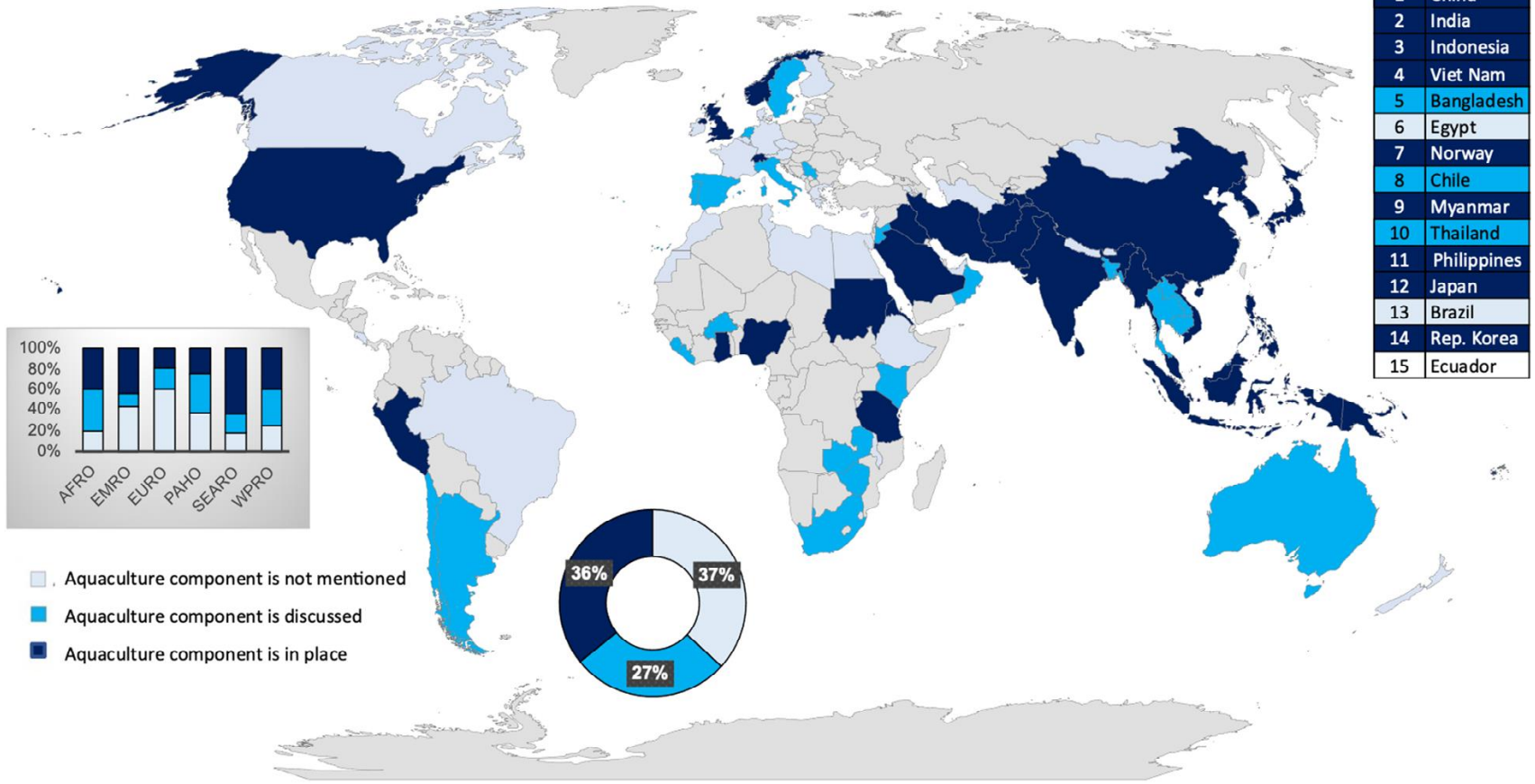
(Reantaso et al., 2020)

I. Generic: Aligned with GAP (WHO) and international strategies (WOAH, FAO)

II. Specific: According to characteristics of country's aquaculture and their relatedness to potential emergence of AMR

1. Identify most important cultured species and their pathogens
2. Review MRL (Codex Alimentarius)
3. Review methods to address bacterial diseases (prevention/biosecurity, management, treatment, ATAs)
4. Guidance and requirement on AMU and AMR surveillance

## Global analysis – NAPs-AMR & aquaculture (Caputo et al., 2022)




| Rank | Country |
|---|---|
| 1 | China |
| 2 | India |
| 3 | Indonesia |
| 4 | Viet Nam |
| 5 | Bangladesh |
| 6 | Egypt |
| 7 | Norway |
| 8 | Chile |
| 9 | Myanmar |
| 10 | Thailand |
| 11 | Philippines |
| 12 | Japan |
| 13 | Brazil |
| 14 | Rep. Korea |
| 15 | Ecuador |



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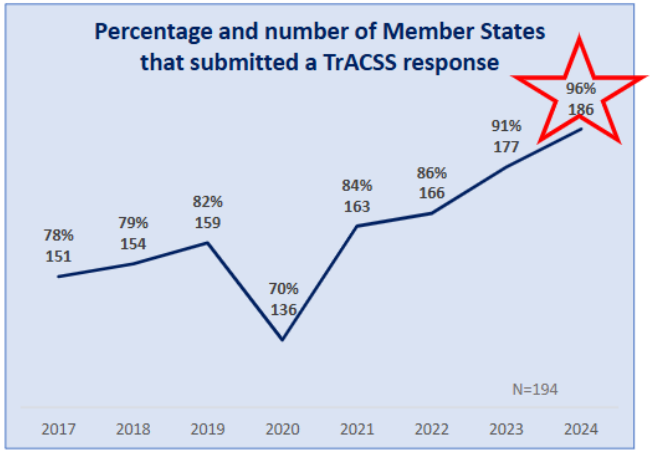
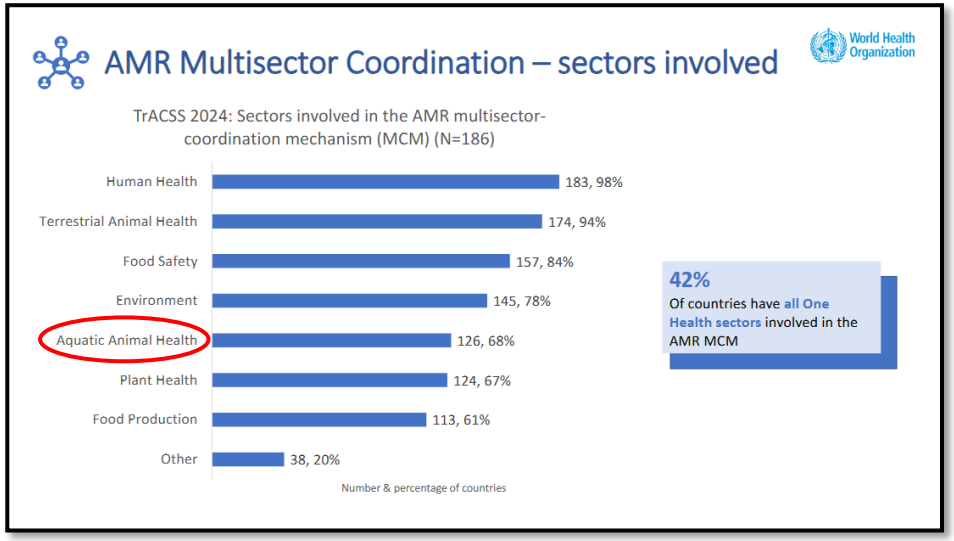
# TrACSS: AAH sector - 2024

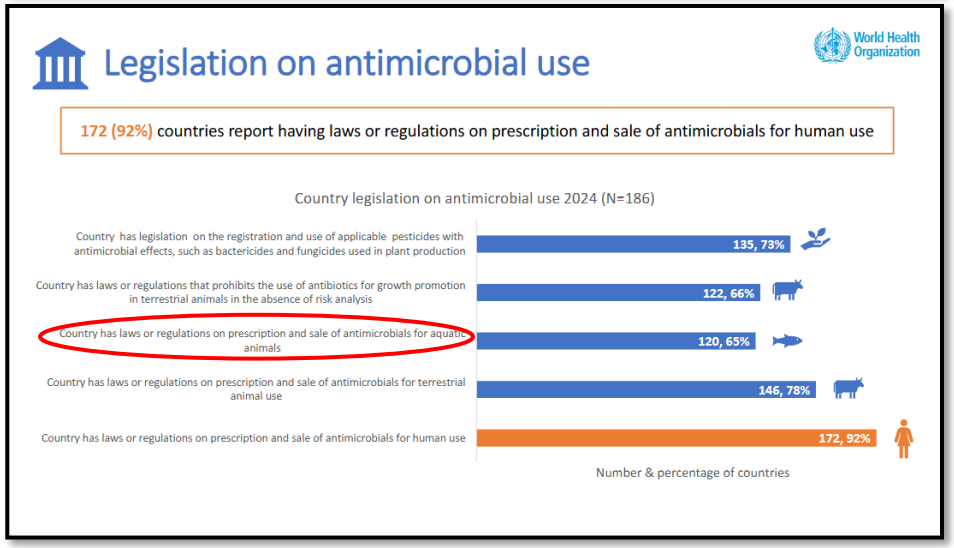
## Tracking AMR Country Self-Assessment Survey (TrACSS)

- Annual multisector survey jointly administered by the Quadripartite agencies.
- It monitors the implementation of AMR NAPs across 194 WHO Member States and the key indicators of the Global Action Plan on AMR since 2016.
- The survey has five sections – multisector, human health, animal health, agriculture and environment.
- Some of the indicators being tracked include: *AMR governance, awareness and education, AMR surveillance, Monitoring consumption and use of antimicrobials, IPC, etc.*
- Indicators are assessed on an A-E scale of increasing capacity. *Level C (or D) serves as threshold for 'nationwide' implementation*




**www.amrcountryprogress.org**







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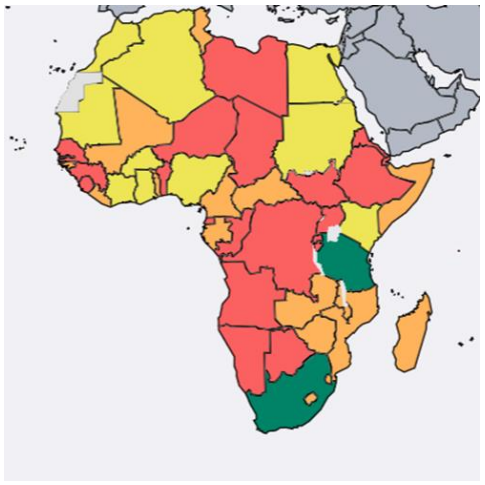
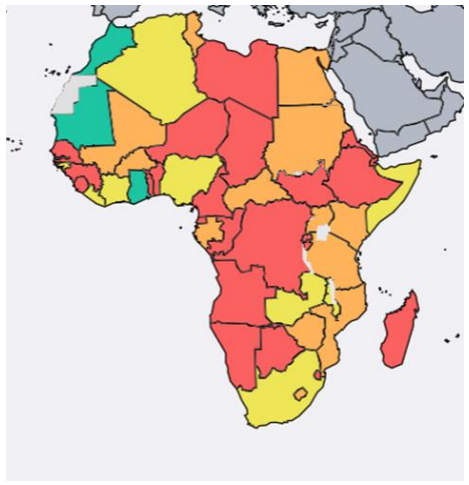
# TrACSS: AAH sector – Africa 2024



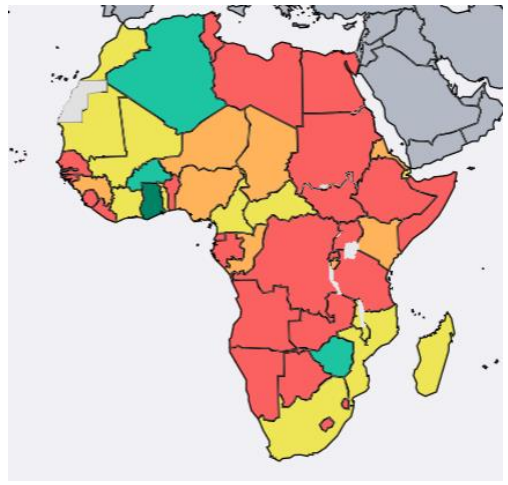
4.2 **Training and professional education on the aquatic health sector**

**A**: No training on AMR
**B**: Courses available
**C**: AMR in some AAHP curricula
**D**: Training available nationwide
**E**: AMR required in AAHP training



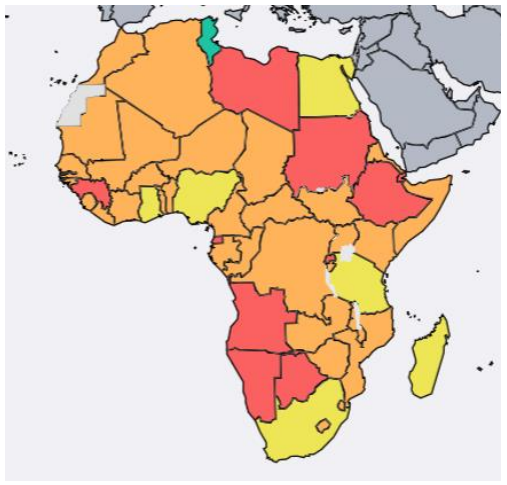
4.4 **Progress with strengthening aquatic animal health services**

**A**: No systematic approach
**B**: AAHS assessed (PVS aquatic)
**C**: Implementation underway
**D**: Regular monitoring
**E**: Strong capacity (WOAH Standards)



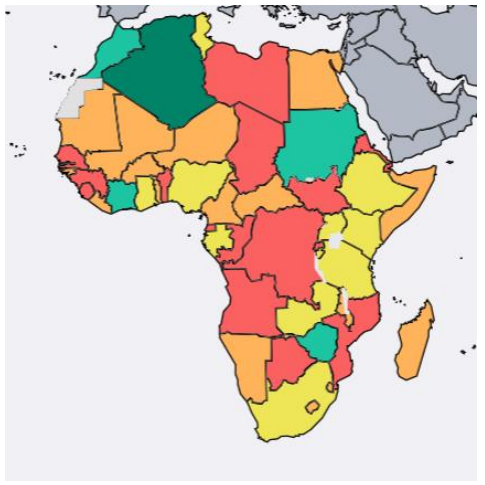
4.8 **National surveillance system for AMR in live aquatic animals**

**A**: No strategies or plans
**B**: National plan but no capacity
**C**: Some data collected
**D**: Data systematically collected
**E**: National system established



4.10 **Biosecurity and good animal husbandry practices to reduce AMU and minimize development and transmission of AMR in aquatic animal production**

**A**: No systematic efforts
**B**: Some activities in place
**C**: National plan agreed
**D**: Nationwide implementation
**E**: Implementation monitored



4.12 **Optimizing AMU in aquatic animals**

**A**: No national policy for AM
**B**: Partial legislation on AM
**C**: Full national legislation on AM
**D**: International standards incorporated
**E**: Enforcement implemented



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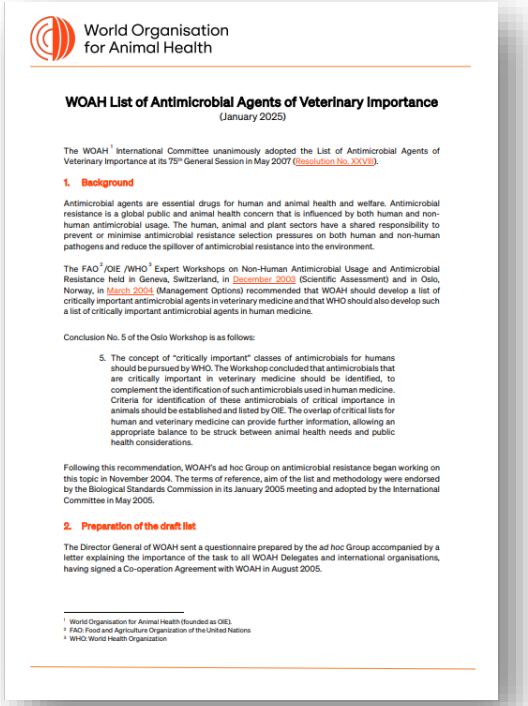
# Lists of antimicrobial agents



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**WOAH List of Antimicrobial Agents of Veterinary Importance**
(January 2025)

The WOAH [1] International Committee unanimously adopted the List of Antimicrobial Agents of Veterinary Importance at its 75th General Session in May 2007 (Resolution No. XXVIII).

**1. Background**

Antimicrobial agents are essential drugs for human and animal health and welfare. Antimicrobial resistance is a global public and animal health concern that is influenced by both human and non-human antimicrobial usage. The human, animal and plant sectors have a shared responsibility to prevent or minimise antimicrobial resistance selection pressures on both human and non-human pathogens and reduce the spillover of antimicrobial resistance into the environment.

The FAO [2]/OIE /WHO [3] Expert Workshops on Non-Human Antimicrobial Usage and Antimicrobial Resistance held in Geneva, Switzerland, in December 2003 (Scientific Assessment) and in Oslo, Norway, in March 2004 (Management Options) recommended that WOAH should develop a list of critically important antimicrobial agents in veterinary medicine and that WHO should also develop such a list of critically important antimicrobial agents in human medicine.

Conclusion No. 5 of the Oslo Workshop is as follows:

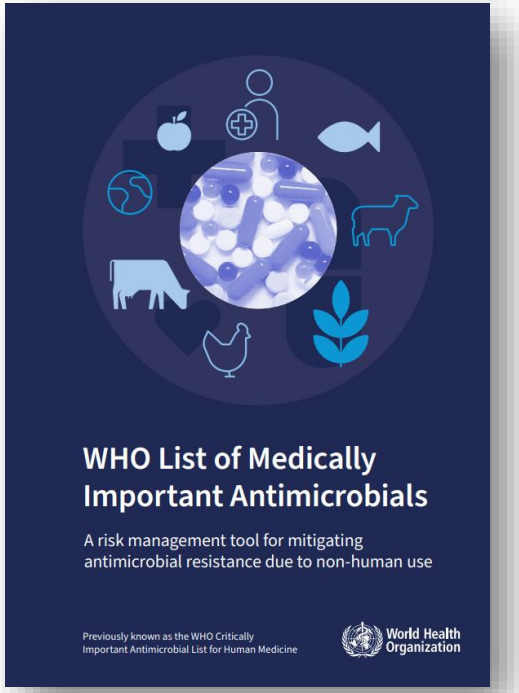
> 5. The concept of "critically important" classes of antimicrobials for humans should be pursued by WHO. The Workshop concluded that antimicrobials that are critically important in veterinary medicine should be identified, to complement the identification of such antimicrobials used in human medicine. Criteria for identification of these antimicrobials of critical importance in animals should be established and listed by OIE. The overlap of critical lists for human and veterinary medicine can provide further information, allowing an appropriate balance to be struck between animal health needs and public health considerations.

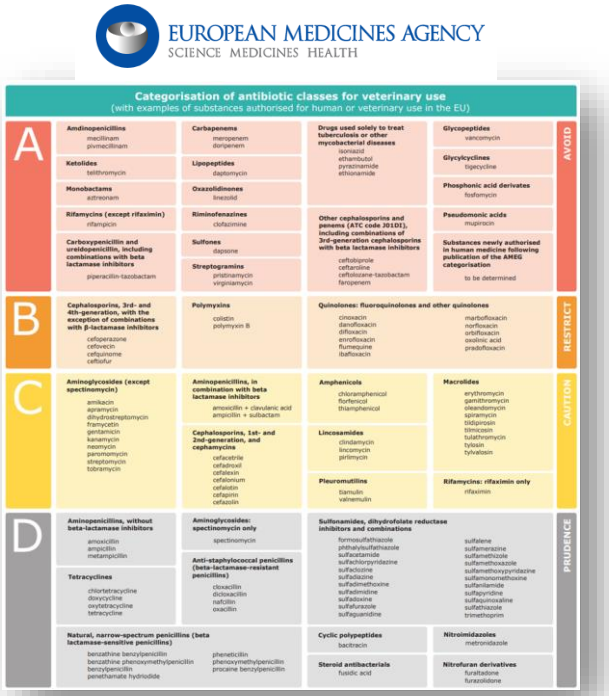
Following this recommendation, WOAH's ad hoc Group on antimicrobial resistance began working on this topic in November 2004. The terms of reference, aim of the list and methodology were endorsed by the Biological Standards Commission in its January 2005 meeting and adopted by the International Committee in May 2005.

**2. Preparation of the draft list**

The Director General of WOAH sent a questionnaire prepared by the *ad hoc* Group accompanied by a letter explaining the importance of the task to all WOAH Delegates and international organisations, having signed a Co-operation Agreement with WOAH in August 2005.

[1] World Organisation for Animal Health (founded as OIE).
[2] FAO: Food and Agriculture Organization of the United Nations
[3] WHO: World Health Organization







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# Lists of antimicrobial agents - categories

| CLASS/SUB-CLASS | Molecules used in aquaculture | WOAH 2025 | WHO 2024 | EMA |
|---|---|---|---|---|
| AMINOGLYCOSIDES | Neomycin | VHIA | CIA | Caution |
| AMPHENICOLS | Florfenicol, Thiamphenicol | **VCIA** | HIA | Caution |
| LINCOSAMIDES | Lincomycin | VHIA | HIA | Caution |
| MACROLIDES | Erythromycin, Kitasamycin, Tilmicosin | **VCIA** | CIA | Caution |
| (AMINO)PENICILLINS | Amoxicillin, Ampicillin | **VCIA** | HIA | Prudence |
| PHOSPHONIC ACID DERIVATIVES | Fosfomycin | VHIA | HPCIA | Avoid |
| PLEUROMUTILINS | Tiamulin | VHIA | IA | Caution |
| QUINOLONES | Flumequine, Oxalinic acid | VHIA | HPCIA | Restrict |
| FLUOROQUINOLONES | Ciprofloxacin, enrofloxacin | **VCIA** | HPCIA | Restrict |
| SULFONAMIDES | Sulfadiazine, Sulfadimethoxine, Sulfamerazine, Sulfamonothenoxine, Sulfisozole sodium, Ormethropim + sulfonamide | **VCIA** | HIA | Prudence |
| TETRACYCLINES | Chlortetracycline, Doxycycline, Oxytetracycline, Tetracycline | **VCIA** | HIA | Prudence |



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# WOAH List & Tech Ref Doc Aquatics

World Organisation for Animal Health

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### Recommendations

Any use of antimicrobial agents in animals should be in accordance with the WOAH Standards on the responsible and prudent use laid down in Chapter 6.10 of the *Terrestrial Animal Health Code* and in the Chapter 6.2. of the *Aquatic Animal Health Code*.

The responsible and prudent use of antimicrobial agents does not include the use of antimicrobial agents for growth promotion in the absence of risk analysis.

According to the criteria detailed above, antimicrobial agents in the WOAH List are classified according to three categories, Veterinary Critically Important Antimicrobial Agents (VCIA), Veterinary Highly Important Antimicrobial Agents (VHIA) and Veterinary Important Antimicrobial Agents (VIA).

However, a specific antimicrobial/class or subclass may be considered as critically important for the treatment of a specific disease in a specific species (See specific comments in the following table of categorisation of veterinary important antimicrobial agents for food-producing animals).



For a number of antimicrobial agents, there are no or few alternatives for the treatment of specific disease(s) in identified target species as it is indicated in the related comments in the WOAH List. In this context, particular attention should be paid to the use of VCIA and of specific VHIA.

In the WOAH List, some antimicrobial classes, subclasses and specific antimicrobial agents are considered to be Highest Priority Critically Important (HPCIA) by WHO; this is currently the case for Fluoroquinolones, third and fourth generation Cephalosporins, Colistin (Polymyxin E) and Phosphonic acid derivatives (e.g., Fosfomycin). Therefore, HPCIAs should be used according to the following recommendations:

- Not to be used for prevention in an individual or group of animals at risk of acquiring a specific infection or in a specific situation where infectious disease is likely to occur if the drug is not administered.
- Not to be used as a first line treatment unless justified, when used as a second line treatment, it should ideally be based on the results of bacteriological tests; and
- Extra-label/off-label use should be limited and reserved for instances where no alternatives are available and in agreement with the national legislation in force; and
- Urgently prohibit their use as growth promoters.

The classes in the WHO category of HPCIAs should be the highest priorities for countries in phasing out use of antimicrobial agents as growth promoters.

The WOAH List of antimicrobial agents of veterinary importance is based on expert scientific opinion and will be regularly updated when new information becomes available.

Antimicrobial classes / sub classes used only in human medicine (e.g., carbapenems) are not included in the WOAH List. Recognising the need to preserve the effectiveness of these antimicrobial agents in human medicine, careful consideration based on risk assessment and existing evidence should be given regarding their potential use (including extra-label/off-label use) or authorisation for use in animals or both.

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## Technical Reference Document Listing Antimicrobial Agents of Veterinary Importance for Aquatic Species

**An appendix to the List of Antimicrobial Agents of Veterinary Importance**

**Scope**

The objective of this Technical Reference Document Listing Anti
Species (hereafter referred as Aquatic Technical Reference Doc
information to the List of Antimicrobial Agents of Veterinary Im
aquatic species, it aims to contribute to the development and updat
and best practice management, risk management, and risk prioriti
(AMR). This document is not intended to serve as a treatment guid

This document is focused on antibiotics used in food producing aq
and crustaceans. Although the use of antibiotics in the mollu
recognized, these applications are not within the scope of this doc

Only those antimicrobial agents in authorized products labelled
crustaceans are considered. It is acknowledged that extra-label(
those countries where there are few antimicrobial alternatives. In sc
to implement, there are antimicrobial products being marketed, in
are commonly used in aquaculture establishments. Antimicrobials
of on-label use in any country), or in unauthorized/not well-estab
Technical Reference Document.

Use of antimicrobials in fish species are represented by the abbre
fish and crustacean aquaculture of this document, following th

**ANTIMICROBIAL AGENTS OF VETERINARY IMPORTANCE AUTHORISED FOR USE IN FISH AND CRUSTACEAN IN AQUACULTURE**

| Antimicrobial Agents (Class, Sub-class and Substance by International Nonproprietary Name (INN)) | Categorisation | | | Molecules | Species | Authorised for use in fish/ crustacean | Specific comments per class |
|---|---|---|---|---|---|---|---|
| | VCIA | VHIA | VIA | | | | |
| AMINOCOUMARIN | | | x | Novobiocin (vet only) | AVI, CAP, OVI | No | This class is currently only used in animals. |
| AMINOCYCLITOL | x | | | Spectinomycin | AVI, BOV, CAN, CAP, EQU, FEL, LEP, OVI, SUI | No | |
| AMINOGLYCOSIDES | x | | | Dihydrostreptomycin | AVI, BOV, CAN, CAP, EQU, FEL, LEP, OVI, SUI | No | The aminoglycoside + 2 deoxystreptamine neomycin is used to treat infections caused by *Aeromonas*, *Edwardsiella* and *Vibrio* in fish and crustaceans. |
| | | | | Streptomycin | AVI, AVI, BOV, CAP, EQU, LEP, OVI, SUI | No | |
| AMINOGLYCOSIDES + 2 DEOXYSTREPTAMINE | x | | | Amikacin (synonym: amikacillin, amikacin) | BOV, CAN, EQU, FEL | No | |
| | | | | Apramycin (vet only) | AVI, BOV, LEP, OVI, SUI | No | |
| | | | | Astromycin (synonym: fortimycin) | LEP, OVI | No | |
| | | | | Framycetin | CAN, CAP, FEL, OVI | No | |
| | | | | Gentamicin | AVI, BOV, CAM, CAN, CAP, EQU, FEL, LEP, OVI, SUI | No | |
| | | | | Kanamycin | AVI, BOV, CAN, EQU, FEL, SUI | No | |
| | | | | Neomycin | API, AVI, BOV, CAN, CAP, **CELI**, EQU, FEL, LEP, OVI, **PIS**, SUI | Yes | |
| | | | | Paromomycin | AVI, BOV, CAN, CAP, FEL, OVI, LEP, SUI | No | |
| | | | | Tobramycin (synonym: tobramicin) | CAN, EQU, FEL | No | |



Appendix 2

**LIST OF MAJOR BACTERIAL PATHOGENS AND DISEASES AFFECTING AQUATIC SPECIES**

| Pathogens[1] | Examples of diseases | Examples of susceptible host species |
|---|---|---|
| **Fish** | | |
| *Aeromonas* spp. (*A. caviae*, *A. hydrophila*, *A. veronii*) | Motile *Aeromonas* septicaemia | Cyprinids (carps), Salmonids (salmon Siluriformes (catfish) |
| *Aeromonas salmonicida* | Furunculosis | Cichlids (tilapia), marine fish (various species), Salmonids (salmon, trout) |
| *Chlamydia* spp. | Epitheliocystis | Cichlids (tilapia), Siluriformes (catfish |
| *Edwardsiella ictaluri* | Enteric septicaemia of catfish | Siluriformes (catfish) |
| *Edwardsiella piscicida* (formerly *E. tarda*) | Edwardsiellosis | Anguilliformes (eel), Cichlids (tilapia) fish (various species), Pleocglossidiu Salmonids (trout), Siluriformes (catfi |
| *Flavobacterium branchiophilum* | Bacterial gill disease | Salmonids (salmon, trout) |
| *Flavobacterium columnare* (formerly *Flexibacter columnaris*) | Columnaris disease | Cichlids (tilapia), Cyprinids (carp), Sa (salmon, trout), Siluriformes (catfish) |
| *Flavobacterium psychrophilum* | Bacterial cold water disease, rainbow trout fry syndrome | Pleocglossidis (ayu), Salmonids (salm trout) |
| *Francisella* spp. | Francisellosis | Cichlids (tilapia), marine fish (various species), Siluriformes (catfish) |
| *Lactococcus garvieae*, *L. petauri* | Piscine Lactococcosis | Cichlids (tilapia), marine fish (various species), Salmonids (trout) |
| *Nocardia* spp. | Nocardiosis | Cichlids (tilapia), marine fish (various species) |
| *Photobacterium damselae* subsp. *piscicida* (formerly *Pasteurella piscicida*), *P. damselae* subsp. *damselae* | Pseudotuberculosis, pasteurellosis, photobacteriosis | Cichlids (tilapia), marine fish (various species), Salmonids (salmon, trout), |
| *Piscirickettsia salmonis* | Piscirickettsiosis | Salmonids (salmon, trout) |
| *Pseudomonas* spp. | Pseudomoniasis, *Pseudomonas anguilliseptica* | Siluriformes (catfish) |
| *Pseudomonas anguilliseptica* | Red spot disease, Pseudomoniasis | Anguilliformes (eel) |
| *Renibacterium salmoninarum* | Bacterial kidney disease | Salmonids (salmon, trout) |
| *Streptococcus* spp. (*S. iniae*, *S. agalactiae*) | Streptococcosis | Cichlids (tilapia), marine fish (various species), Salmonids (salmon, trout), Siluriformes (catfish) |
| *Tenacibaculum dicentrarchi* | Tenacibaculosis | Salmonids (salmon, trout) |
| *Tenacibaculum maritimum* (formerly *Flexibacter maritimus*) | Marine flexibacteriosis, tenacibaculosis | Marine fish (various species), Salmo (salmon, trout) |
| *Vibrio anguillarum* (formerly *Listonella anguillarum*) | Classical vibriosis | Cichlids (tilapia), Pleocglossidis (ayu) fish (various species), Salmonids (sa trout), Siluriformes (catfish) |
| *Vibrio* spp. (*V. harveyi*, *V. ordalii*) | Atypical vibriosis | Marine fish (various species), Salmo (salmon) |
| *Aliivibrio salmonicida* (formerly *Vibrio salmonicida*) | Cold water vibriosis | Pleocglossidis (ayu), Salmonids (salm trout) |
| *Yersinia ruckeri* | Enteric redmouth disease, yersiniosis | Salmonids (salmon, trout) |
| **Crustaceans** | | |
| *Aeromonas* spp. | *Aeromonas* spp. – Aeromoniasis | Penaeid shrimp/prawn |
| *Aerococcus viridans* | Gaffkemia, red tail | American lobster |
| "*Candidatus hepatobacter penaei*" | Necrotising hepatopancreatitis | Penaeid shrimp/prawn |
| *Rickettsia* spp. | Rickettsiosis | Penaeid shrimp/prawn |
| *Vibrio* spp. (*V. harveyi*, *V. alginolyticus*) | Vibriosis | Penaeid shrimp/prawn |

[1] In parenthesis are examples of common pathogenic species.

**LIST OF MAJOR BACTERIAL PATHOGENS AND DISEASES AFFECTING AQUATIC SPECIES**

| FINFISH | *Aeromonas* spp. (*A. caviae*, *A. hydrophila*, *A. veronii*) | *Aeromonas salmonicida* – *Furunculosis* | *Chlamydia* spp. – Epitheliocystis | *Edwardsiella ictaluri* – Enteric septicaemia of catfish | *Edwardsiella piscicida* – Edwardsiellosis | *Flavobacterium branchiophilum* – Bacterial gill disease | *Flavobacterium columnare* – Columnaris disease | *Flavobacterium psychrophilum* – Cold water disease, rainbow trout fry syndrome | *Francisella* spp. – Francisellosis | *Lactococcus garvieae*, *L. petauri* – Lactococcosis | *Nocardia* spp. – Nocardiosis | *Photobacterium damselae piscicida* (formerly *Pasteurella piscicida*), *P. damselae damselae* – Pasteurellosis, photobacteriosis | *Piscirickettsia salmonis* – Piscirickettsiosis | *Pseudomonas* spp. – Pseudomoniasis, *Pseudomonas anguilliseptica* – Red spot disease, Pseudomoniasis | *Renibacterium salmoninarum* – Bacterial kidney disease | *Streptococcus* spp. (*S. agalactiae*, *S. iniae*) – Streptococcosis | *Tenacibaculum dicentrarchi* – Tenacibaculosis | *Tenacibaculum maritimum* (formerly *Flexibacter maritimus*) – Marine flexibacteriosis, tenacibaculosis | *Vibrio anguillarum* – Vibriosis | *Vibrio* spp. (*V. harveyi*, *V. ordalii*) – Atypical vibriosis | *Vibrio* spp. (*V. harveyi*, *V. campbellii*) – Vibriosis | *Aliivibrio salmonicida* – Cold water vibriosis | *Yersinia ruckeri* – Enteric redmouth disease |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMINOGLYCOSIDES + 2 DEOXYSTREPTAMINE | x | x | | | x | x | | | | | | | | | | | | | | | | | |
| AMPHENICOLS | x | x | | | x | x | x | x | x | x | | x | x | | | x | x | | x | x | x | x | x |
| LINCOSAMIDES | | | | | | | | | | x | | | | | | | x | | | | | | |
| MACROLIDES | | | | x | | | x | x | | x | x | | | | | x | x | | | | | | |
| PENICILLINS | x | x | | | | | | | | | | x | | | | | x | | | | | | |
| PHOSPHONIC ACID DERIVATIVES | | | | | x | | | | | | | x | | | | | x | | | | | | |
| PLEUROMUTILINS | | | | | | | | | | | | | | | | | | x | | | | | |
| QUINOLONES 1st GENERATION | x | x | | | | x | | | | | | x | x | x | | | | | x | x | x | | x |
| QUINOLONES 2nd GENERATION (FLUOROQUINOLONES) | x | x | | | x | | x | x | | x | | x | | x | | x | x | | x | x | | x | x |
| SULFONAMIDES | x | x | | | | x | | | | x | x | | | | | | x | | | x | x | x | |
| SULFONAMIDES + DIAMINOPYRIMIDINES | x | x | | x | x | x | | | | | | x | x | | | | x | | | x | x | | x |
| TETRACYCLINES | x | x | x | | x | x | x | x | x | x | x | x | x | | x | x | x | | | x | x | x | x | x |

| CRUSTACEANS | *Aeromonas* spp. – Aeromoniasis | *Aerococcus viridans* – Gaffkemia, red tail | "*Candidatus Hepatobacter vanamei*" – Necrotising hepatopancreatitis | *Rickettsia* spp. – Rickettsiosis | *Vibrio* spp. – Vibriosis |
|---|---|---|---|---|---|
| AMINOGLYCOSIDES + 2 DEOXYSTREPTAMINE | X | | | | X |
| AMPHENICOLS | | | X | | X |
| QUINOLONES 2nd GENERATION (FLUOROQUINOLONES) | X | | | X | X |
| TETRACYCLINES | X | X | X | X | X |



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# Thank you !

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