

Understanding AMU in aquaculture

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Regional Workshop for WOAHA Focal Points for Aquatic Animals

Name of the speaker (add)

7 – 9 July 2026 | Tokyo, Japan

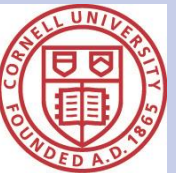
Position of speaker (add)



Jockey Club College of Veterinary
Medicine and Life Sciences

香港城市大學
City University of Hong Kong

in collaboration with Cornell University



World Organisation
for Animal Health



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Use of Antibiotics in Aquaculture

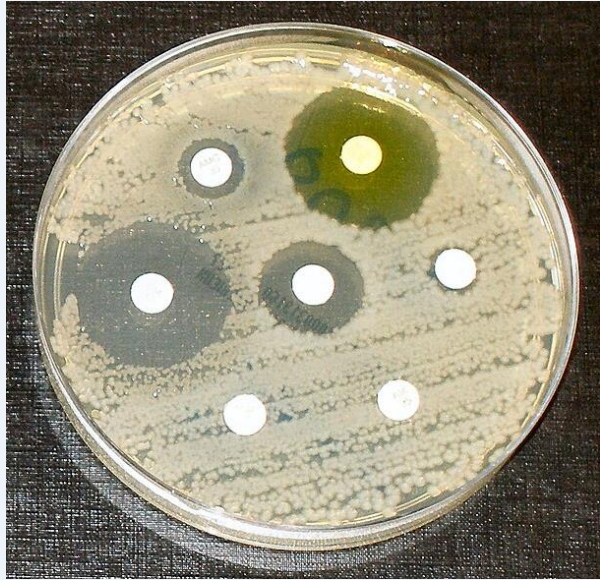


- Used to stop mortality from bacterial infections
 - Work relatively well
 - Not expensive
 - Easy to obtain
- Issue:
 - Overuse
 - Lots of bacterial diseases and used instead of disease prevention
 - Growth promotion (illegal in most countries)
 - Misuse
 - Used for non bacterial diseases (lack of diagnostics)
 - Improper dosing (exposed bacteria to sublethal levels of antibiotics)





Exposure to antibiotics

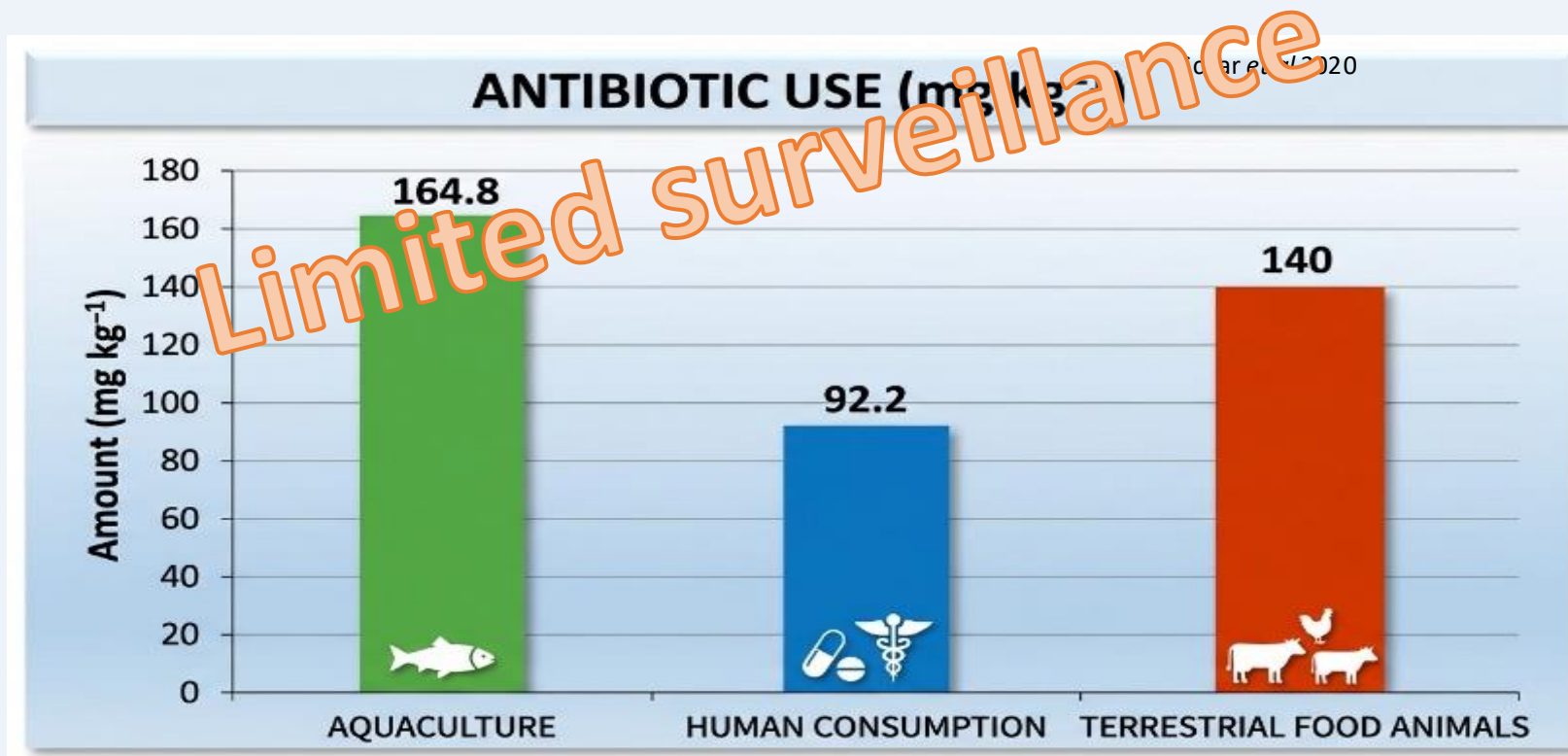


- Acts as a selection pressure for
 - Bacteria with specific resistant genes
 - Bacteria that can express intrinsic genes involved in antibiotic uptake and excretion
 - Efflux pump and outer membrane protein genes
 - Sub-lethal exposure to antibiotics “trains” bacteria to upregulate genes



How much
antibiotics are
used in
Aquaculture ?

- Schar *et al* 2020 estimated....
 - 2017: 10.3 tons of antibiotics
 - 2030: projected at 13.6 tons





How do we monitor AMU in Aquaculture ?



Important to understand how drugs are delivered and what data can be collected



How are antibiotics delivered?



- In feed medications (most common)
 - Based on kg of fish
 - i.e. OTC 100mg/kg of fish per day for 10 days
 - Can be described as kg AI per tonne of feed but still based on feed rate to deliver specific dose
 - Hand mixed
 - Small farmers
 - Many countries in SE Asia
 - Manufactured at a mill
- In water (should not be done!)
- Injectables (minimal use)



Most common drugs delivered in feeds in aquaculture (labels exist in different countries)



- Common antibiotics with fish labels
 - Florfenicol
 - Oxytetracycline
 - Quinolones
 - Enrofloxacin
 - Oxolinic Acid
 - Sulfadimethoxine with ormetoprim potentiator (Romet 30)
- Sold as feed premix so not 100% active



Information needed at the farm level to use in feed antibiotics

- Biomass of population treated
 - Average weight of fish
 - Number of fish
- Dose
- Active ingredient in premix
- Duration of treatment





Example

In-feed antibiotic calculation example:

- **Oxytetracycline 14 day treatment at a dose of 100mg/kg/day using the product Oxysol 44 (44% AI)**
 - Basic info : 100,000 fish @ 1kg
 - Biomass : $100,000 * 1 = 100,000\text{kg}$
 - Daily dose : $100,000\text{kg} * 100\text{mg/kg} = 10\text{kg}$
 - 14 day dose
 - $10\text{kg} * 14 = 140\text{ kg OTC}$
 - The product Oxysol 44 is only 44% active oxytetracycline therefore you will need
 - $140 / 0.44 = \mathbf{318.14\text{ kg Premix}}$



- **Calculating the amount of feed this product needs to be mixed into:**
- If feeding at a 1% biomass then
- Daily amount of feed required
 - $1\% * 100,000 \text{ kg (biomass)} = 1000 \text{ kg or } 1 \text{ ton}$
- For a 14 day treatment
 - $14 * 1 \text{ ton} = 14 \text{ tons or } \mathbf{14,000 \text{ kg}}$ of feed
- Instructions: mix 318 kg of Oxysol into 14,000 kg of feed or **22.7 kg of oxysol 1000 kg of feed**. Feed this medicated feed at a rate of 1% body weight for 14 days to achieve the desired dose. Script will require 14,000 kg of medicated feed.



Medicate
feed based
on feed rates

Active drug	Active drug in premix	Dose per kg of fish	Duration	Feed rate (%)	Active conc. in kg per T of feed (or g/kg)	Premix conc. kg per T of feed (or g/kg)
Oxytetracycline	440g/kg or (44%)	100 mg/kg	10 to 21 days	0.5	20	45.45
				1	10	22.73
				2	5	11.36
				5	2	4.55
Florfenicol	500g/kg (50%)	15 mg/kg	10-14 days	0.5	3	6.00
				1	1.5	3.00
				2	0.75	1.50
				5	0.3	0.60



Issues that can arise with drug calculations and delivery of AB

- Poor biomass estimations
 - Errors in inventory
 - Wide variation in weights or unknown weights
- Mixed species within a system feeding at different rates
- Leaching
- Poor quality drugs
- Fish not eating



Farm Data on AMU

- Varies greatly
 - Industries are very different
 - Different species and life cycles
 - Different systems
 - Small vs Large companies
 - No international standards applicable to all
 - Limited enforcement of regulations





Type of data

- Qualitative data
 - Types of drugs used on farms
- Quantitative data
 - Amount of drug used over a specified time
 - Records /prescriptions
 - Receipts
 - Active ingredient (kg)
 - Amount of medicated feed used
 - Need to know the dose and feed rate
 - Number of fish treated
 - Dynamic population!





Stats



- Absolute amount of different types of antibiotics used on (types of) farms
- Standardization by quantity of production (PCU)

$$\frac{\text{amount active ingredient of antibiotic(s) used in year X (mg)}}{\text{biomass of aquaculture species at risk of being treated in year X (kg)}}$$

- Numerator
 - Need to have reporting of antibiotic use
 - Sales and or farm level
- Denominator
 - Population that could be treated
 - More difficult to establish



Example in Salmon Industry

Trends in Antibiotic Use and Aquaculture Production (2007–2023)





AMU Indicators

- Good enforcement of regulations for monitoring usage
 - pharmaceutical sales and farm level
 - Different drugs have different dosages
 - If pooling and providing a total active ingredient can be misleading
 - Florfenicol vs Oxytetracycline
- Harvest data for denominator
 - Includes only 1 or 2 species with similar life cycle
 - Tracked at industry level because fish processed and large export market
 - Issues remain: Production cycles span more than one year
 - Fish harvested not always those treated
 - Fish treated not always harvested in the same year of drug use
 - Some medication was used on animals that have died
- For countries with multiple types of aquaculture industries monitoring AMU is very complicated.
 - Small vs large farms; live markets; different species

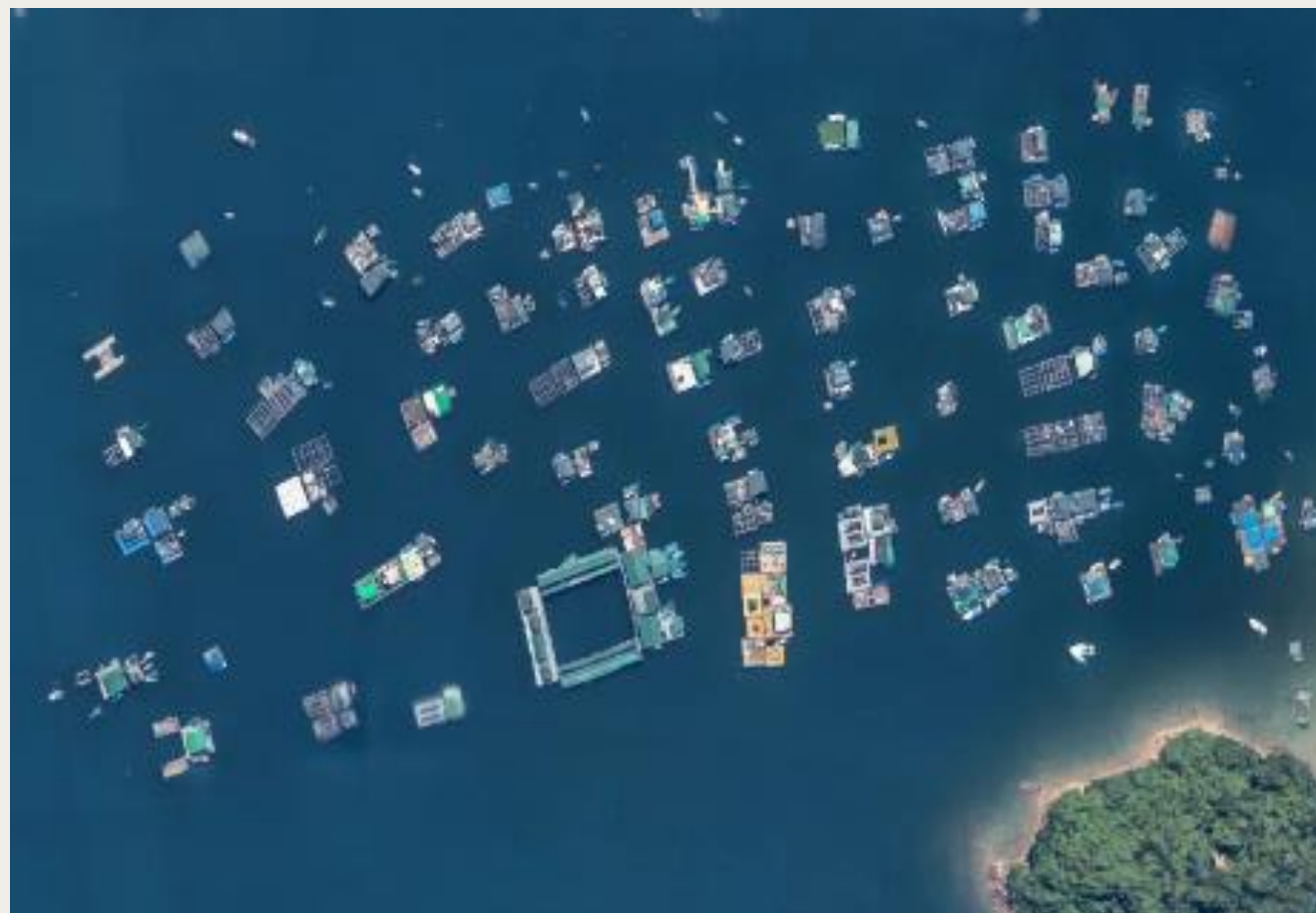


WOAH Guidelines for measuring AMU in aquaculture (in press)



Thank you

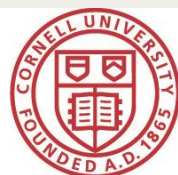
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