Food and Agriculture Organization of the United Nations

World Organisation for Animal Health
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Guidelines on monitoring antimicrobial use at the farm level

Regional guidelines for the monitoring and surveillance of antimicrobial resistance, use and residues in food and agriculture – Volume #5

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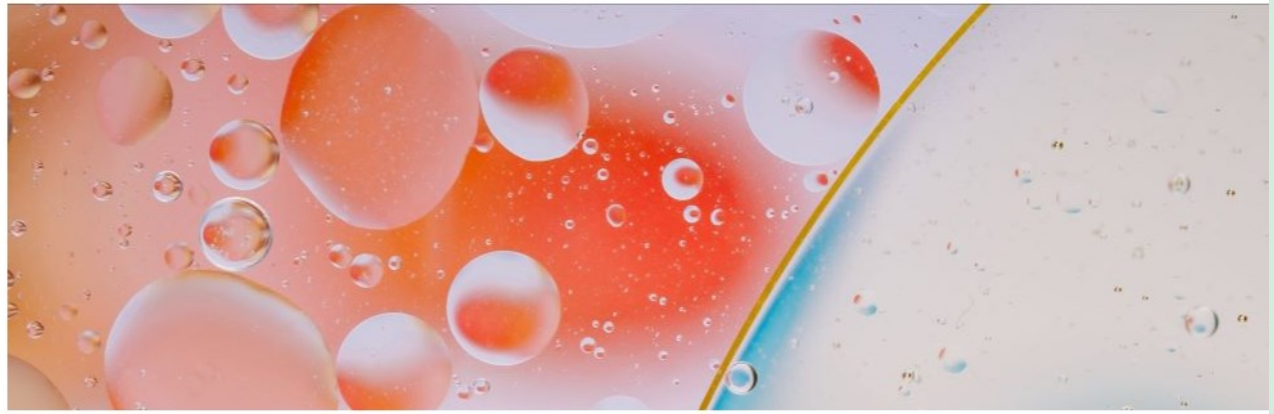
Why develop guidelines on monitoring AMU at the farm-level?

ANIMUSE

The World Organisation for Animal Health (WOAH) has been collecting data on the amounts and reasons for antimicrobial use in animals since 2015. This information is an essential asset to reduce the overuse and misuse of medication and to curb the spread of antimicrobial resistance (AMR). **ANIMUSE,** the global database on ANImal antiMicrobial USE, facilitates access to this crucial and growing set of information.



- To complement national monitoring of sales and imports of AMU
- To understand AMU in more details, for example:
  - By animal species, production type
  - Types of use: treatment, control, therapy, growth promotion
  - Identify non prudent practices
- Support the implementation of the Codex guidelines on integrated monitoring and surveillance of foodborne antimicrobial resistance

Acknowledgements

The AACTING guidelines

The AACTING-network (www.aacting.org) presents:

GUIDELINES FOR COLLECTION, ANALYSIS AND REPORTING OF FARM-LEVEL ANTIMICROBIAL USE, IN THE SCOPE OF ANTIMICROBIAL STEWARDSHIP

VERSION 1.2_2019-07-02

AACTING
Herd level antimicrobial consumption in animals
Collect | Analyze | Benchmark | Communicate

Guidelines on monitoring antimicrobial use at the farm level for Asia and the Pacific

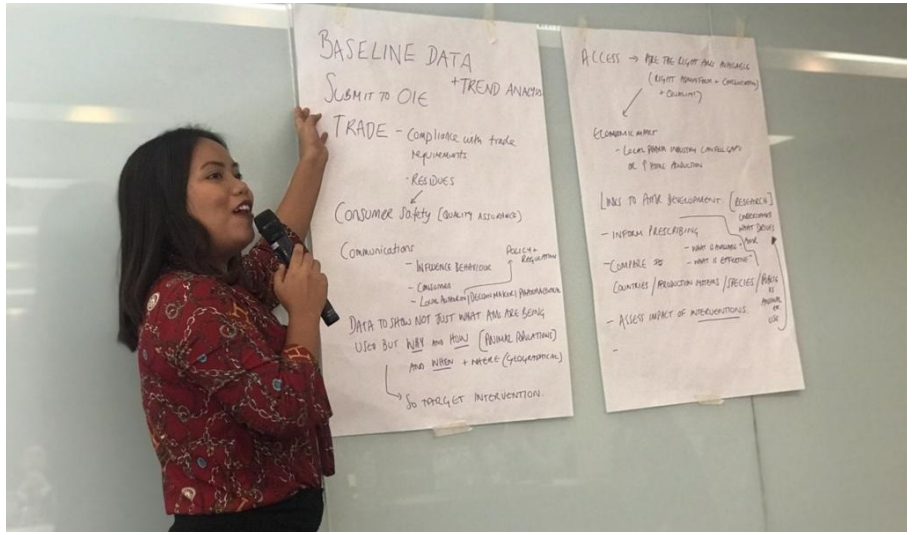
Scope of the guidelines

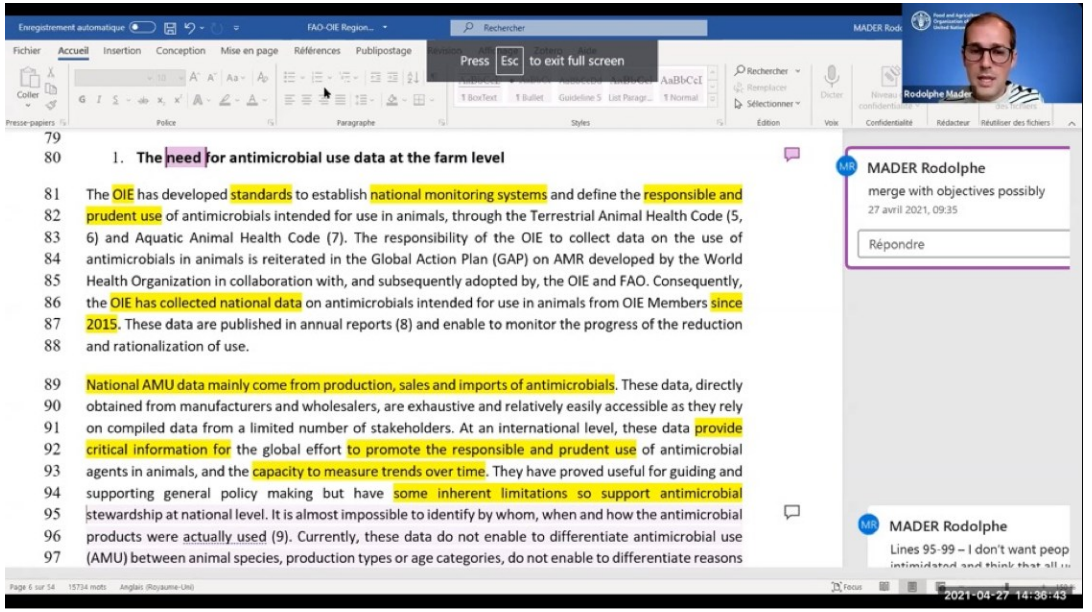
- Adapted scope to Asia and Pacific region context
- Both terrestrial and aquatic food-producing animals

Target users of the guidelines:

Countries, industries and research groups are target users : Empower users for sustainable development of monitoring projects.

A long and broad consultation of experts since 2017





A long and broad consultation of experts since 2017

1. **November 2017** - Cambodia: First Meeting of the AMR Technical Advisory Group of Southeast Asia
2. November 2018 - Thailand: First regional consultation to develop the guidelines
3. January 2019: First draft prepared by Epidemia Foundation Ltd.
4. September 2020: Second draft prepared by Dr Agnes Agunos
5. Creation of a joint technical working group with FAO RAP, WOAH RRAP and WOAH SRR-SEA and support from FAO HQ and WOAH HQ
6. April 2021 - Virtual: Second regional consultation to improve the guidelines
7. Creation of an ad hoc aquaculture expert working group
8. Guidelines review by additional experts, FAO HQ and WOAH HQ.
9. **January 2024** : Finalization!

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Technical working group members:

- WOAH – Kinzang Dukpa, Lesa Thompson, Nahoko Ieda, Tikiri Wijayathilaka, Chantanee Buranathai, Morgan Jeannin and Idrissa Savadogo
- FAO – Rodolphe Mader, Mary Joy Gordoncillo, Alejandro Dorado-Garcia

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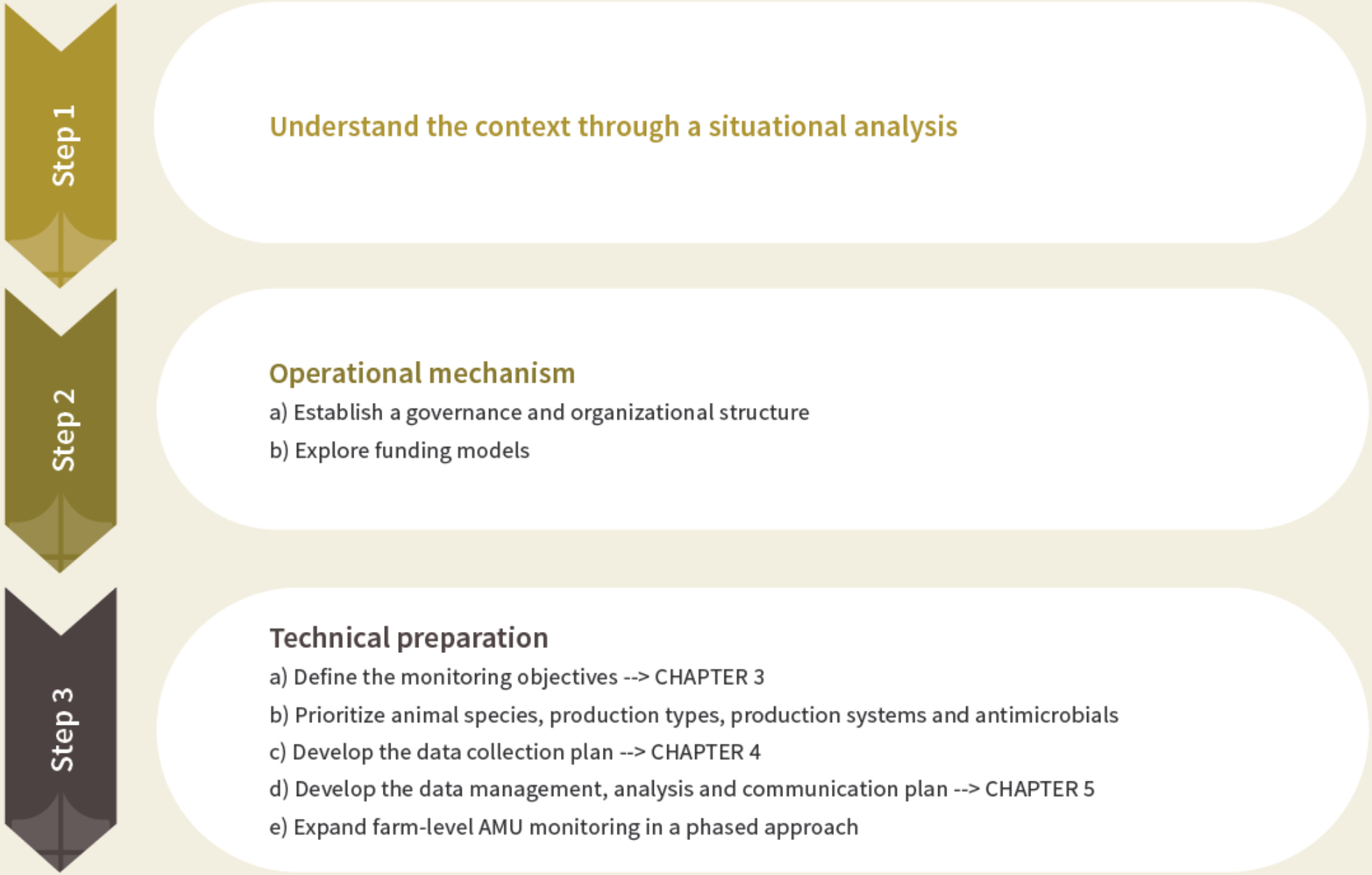
A step-by-step approach

Figure 1 Steps to be followed to initiate and operationalize a farm-level AMU monitoring system



1. Understand the context through a situational analysis

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- Essential to:
  - Understand the needs
  - Define priorities
  - Define objectives
  - Identify the relevant stakeholders
  - Find synergies with other initiatives
  - Avoid duplication of efforts

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- AMR monitoring:
  - Is there an AMR monitoring system in place in your country?
  - Does it cover zoonotic, pathogenic and commensal bacteria from animals?

- List of antimicrobials:
  - Do you have the latest versions of the WOAH list of antimicrobial agents of veterinary importance[4] and the WHO list of critically important antimicrobials?[5]

- Stakeholders:
  - Who are the key public and private players in the fight against AMR in your country?
  - Is there any existing platform or organization that gathers various actors in the fight against AMR?
  - Is there a registry of farms available at the national level? If not, is it available at the sub-national level, for instance in some districts?

- Past and ongoing AMU monitoring activities:
  - Does your country participate in the global data collection on antimicrobials intended for use in animals led by WOAH?
  - Are there any ongoing public or private initiatives in the country to document AMU?
  - Are there already completed public or private initiatives that documented AMU in your country (quantitatively or qualitatively, such as through knowledge, attitudes and practices surveys)? If yes, what were the results? Were challenges and possible solutions discussed to better document AMU?

- Governance:
  - Is there a NAP on AMR? If yes, how is the NAP governance structured (who is responsible for what)?
  - What are the main planned or ongoing interventions to tackle AMR?
  - What does the NAP request be carried out in terms of AMU monitoring in food-producing animals?
  - Is there any technical and/or financial support available to support the development of a farm-level AMU monitoring system?
  - Are there any certification programmes such as Raised Without Antibiotics or other production programmes aimed at reducing the use of antimicrobials?

- Regulations on AMU:
  - What are the current regulations in place regarding the prescription, sale and administration of antimicrobials in the food animal sector?
  - Who can access, sell or prescribe antimicrobials in the food animal sector?
  - Has the value chain of antimicrobials already been described in the food animal sector?
  - Is there a national registry of authorized veterinary medicinal products? Who is the “owner” of this registry and is it maintained and up to date? What kind of information does it contain for veterinary medicinal products containing antimicrobials?
  - Is there a system for animal drug tracing in your country, such as with a QR code?

2. Develop an operational mechanism

2. Develop an operational mechanism

- Governance and organization structure
  - Steering committee
  - Coordination unit

- Funding models
  - Good to start small
  - Look for funding sources
  - Public-private partnerships

3. Technical preparation

3. Technical preparation

a) Define the monitoring objectives

- According to identified needs, priorities, funding, capacities, available data sources
- Think how AMU data can help define and implement efficient interventions
- Define one or several objectives

CHAPTER 3

OBJECTIVES OF ANTIMICROBIAL USE MONITORING AT THE FARM LEVEL

3.1 Introduction

Farm-level AMU monitoring can have different objectives and should be defined by the farm-level AMU monitoring steering committee, according to identified needs, priorities, funding and the capacities of the coordination unit and data providers. When defining the objectives, it is important to think of how they will support the development of efficient interventions to improve antimicrobial stewardship. Focusing on just a few objectives when starting farm-level AMU monitoring is advisable.

Common objectives covered in this chapter:

- characterize AMU qualitatively and quantitatively;
- compare AMU over time, between animal species, production types and production systems;
- farm benchmarking;
- detect non-prudent and unauthorized use of antimicrobials;
- monitor and evaluate the impact of interventions aiming to reduce and rationalize AMU;
- support the interpretation of national antimicrobial distribution, sales and imports data;
- investigate associations between AMU and AMR; and
- support policymaking to tackle AMU.

How these objectives relate to each other with the aim of developing more efficient interventions, and monitoring and evaluating them is illustrated in Figure 2. Additionally, several other possible benefits of farm-level AMU monitoring are described at the end of this chapter.

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3. Technical preparation

a) Define the monitoring objectives

- According to identified needs, priorities, funding, capacities, available data sources
- Think how AMU data can help define and implement efficient interventions
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BOX 3 Case studies of farm-level data collections that detected non-prudent antimicrobial use.

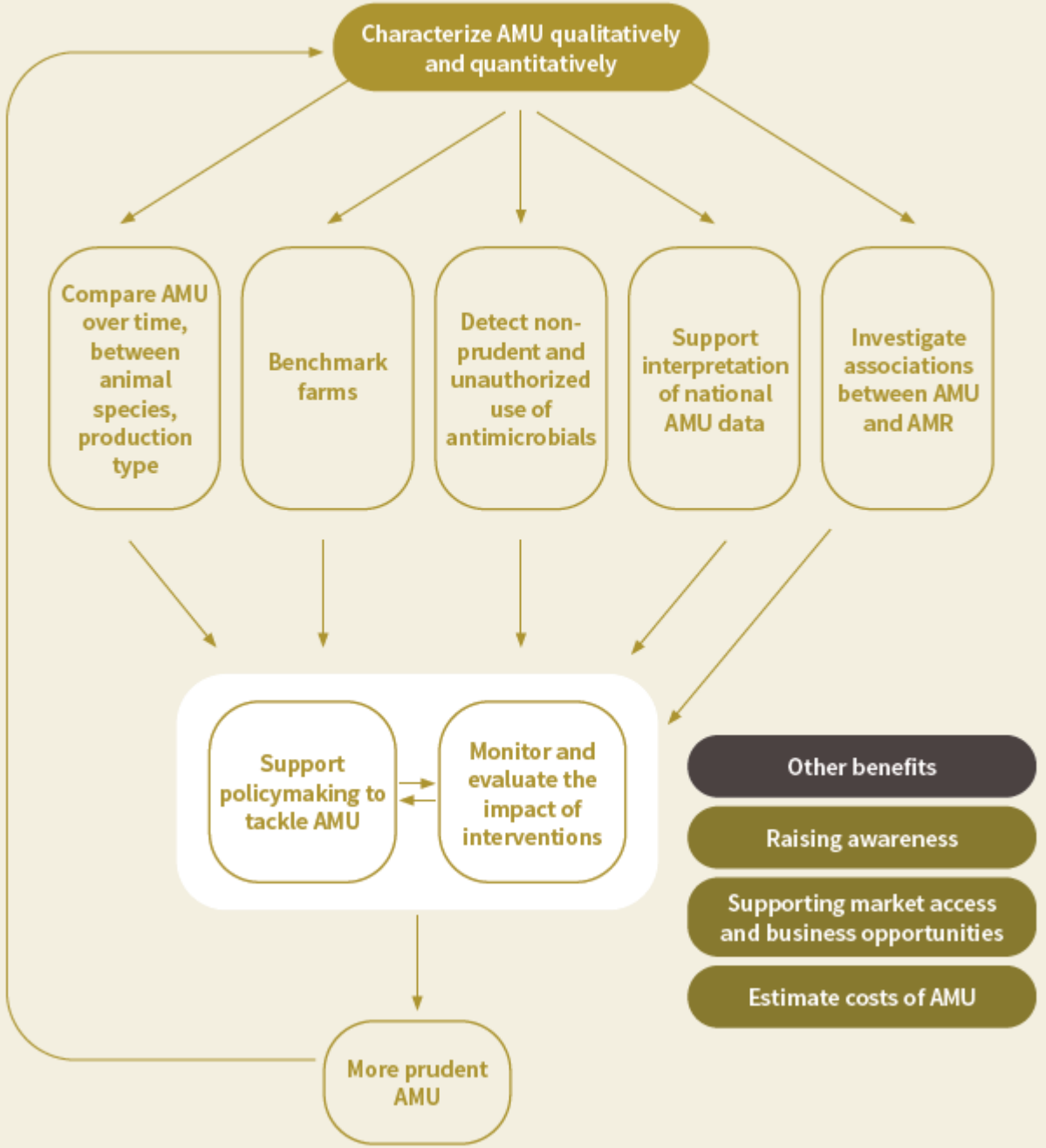
Example 1: High-resolution monitoring of antimicrobial consumption in Vietnamese small-scale chicken farms highlights discrepancies between study metrics

Method: Longitudinal study conducted from October 2016 to May 2018 in 102 small-scale farms

Key findings: "A total of 180 products (76.2%) contained antimicrobials of critical importance according to the WHO. Of those, 132 products (55.9%) contained antimicrobial active ingredients of critical importance ('highest priority') and 91 products (38.5%) contained critically important ('high priority') antimicrobials. The most common antimicrobial active ingredients used were colistin (25.8% of products, 83.7% of flocks), followed by oxytetracycline (15.7%; 76.4%), tylosin (13.6%; 36.9%), doxycycline (11%; 30%), and amoxicillin (10.2%; 24.6%)." In terms of treatment incidence, chickens in this study consumed three times more than the global average levels (estimated in 138.0 doses per 1 000 chicken-days).

Source: Cuong *et al.*, 2019.

Figure 2 Farm-level monitoring objectives and how they relate to achieving more prudent antimicrobial use



3. Technical preparation

b) Prioritize the animal species, production types, production systems

Table 1 Suggested criteria and resources to guide the selection of animal species, production types, stages and systems to cover in a farm-level AMU monitoring system

Selection criteria	Possible resources
Economic significance of the animal production	National animal production statistics FAO statistics (https://data.apps.fao.org/) FAO's Fisheries and Aquaculture statistics (https://www.fao.org/fishery/en/statistics/software/fishstatj/en) World Animal Health Information System (WAHIS) data (https://wahis.woah.org/#/home)
Relative contribution to national production	National animal production statistics National aquaculture production statistics
Per capita consumption	National agriculture statistics, total diet studies
National priorities or internal priorities within an industry	Administrative orders National action plans Business development plans
Available information on AMU and AMR and their potential impacts on animal and human health	Previous studies Literature reviews Farm records Interviews Stakeholder consultations Export rejections due to antimicrobial residues

3. Technical preparation

c) Develop the data collection plan

CHAPTER

4 DEVELOPMENT OF A DATA COLLECTION PLAN

4.1 Introduction

The data collection plan should be developed by the coordination unit. The plan should then be approved by the steering committee. It should be designed to meet the agreed-upon objectives while also considering existing capacities. Developing a simple and pragmatic data collection plan when initiating a farm-level AMU monitoring system is advisable. The plan may then be refined over time as capacities improve and experience is generated. In this chapter, we recommend following three steps: (i) identify suitable data sources and providers, (ii) define the data collection template and (iii) choose the most suitable data collection method among repeated surveys, sentinel and population-wide continuous approaches.

4.2 Identify suitable data sources and providers

a. Data sources

Farm-level AMU data can be retrieved from various sources:

- farm treatment records either available at the farm or at a higher level within the food production company in integrated systems;
- antimicrobial products or feed packages present in farm;
- purchase orders;
- inventory reports;
- prescription records; and
- other records used for quality assurance or accreditation programmes.

Review the availability and quality of data sources to decide which sources are most suitable. When possible, collect data on

3. Technical preparation

c) Develop the data collection plan

- Identify suitable data sources and providers

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3. Technical preparation

c) Develop the data collection plan

- Identify suitable data sources and providers

FAO/Hlaing Hlaing Myint

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3. Technical preparation

c) Develop the data collection plan

- Identify suitable data sources and providers


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Table 2 **Advantages and limitations of different data providers for AMU monitoring at the farm level**

	Advantages	Limitations	References
Farmers/farm workers	• They are usually those who give the antimicrobials to their animals, so they are usually the only data providers who can submit real-use data.	• AMU information may not be properly recorded or recorded by different people/farm workers • Recall bias (if interviews are done) • Antimicrobial packages often not kept after use • Unclear (ambiguous) labelling of products found in farms (Carrique-Mas et al., 2019) • Difficult to maintain interest/ commitment over time • Limited knowledge and understanding of antimicrobials • Unclear labelling on antimicrobial product and feed packages. • Frequent illiteracy	Coyne *et al.*, 2019; Cuong *et al.*, 2019; Cuong *et al.*, 2021.
Veterinarians and pharmacists selling veterinary products/ aquatic animal health professionals	• Stronger understanding on antimicrobial use • Records tend to be accurate and reliable	• Information on purpose of AMU often unknown (for pharmacists selling veterinary products) • Not relevant data providers in geographic areas where veterinary services are limited or for backyard production. • May be reluctant to participate if they benefit from the sales of antimicrobials.	Phu *et al.*, 2019; Lekagul *et al.*, 2020; Singer *et al.*, 2020a; Singer *et al.*, 2020b; Ha *et al.*, 2021.
Veterinary paraprofessionals (paravets, animal health workers)	• Appropriate for backyard/ small scale farms. • Very good reach on the ground with farmers (could play an intermediate role, e.g. to collect AMU data from farms), even in areas with no veterinarian.	• Limited knowledge on antimicrobials and AMU.	Barroga *et al.*, 2020.
Technical/sales representatives from food production industries, feed providers or pharmaceutical companies/suppliers	• Good knowledge on antimicrobials. May have access to good quality data at farm level. • May be able to collect farm-level AMU data for many farms at the same time (more efficient than collecting data from each farm).	• Likely to be reluctant to share data on AMU in order not to breach confidentiality	Apley *et al.*, 2012; Lekagul *et al.*, 2020; Van Cuong *et al.*, 2016; Singer *et al.*, 2020a.

3. Technical preparation

c) Develop the data collection plan

- Identify suitable data sources and providers
- Define the data collection template

Table 3 **General farm and animal information collected as part of a farm-level AMU monitoring system**

	Minimum variables	Additional possible variables
General farm information	Unique farm identifier[a]	• **Name and contact of farm manager/owner** • **Location of the farm** (e.g. region, village administrative unit, coordinates) • **Name of data collector** • **Date of data collection** • **Additional descriptors:** level of education of farmers, number of years of experience of farmers, biosecurity, vaccine use, nutrition, etc.
Animal information	Animal species	• **Production system**[b] (e.g. backyard or commercial for livestock; backyard, semi-intensive or intensive in aquaculture) • **Production type** (e.g. broilers or laying hens for chickens; aquatic animals cultured as broodstock for hatchery production or cultured for sale and consumption) • **Production stage** (e.g. weaning, fattening, brooding) • **Animal age** • **Production period** (all year long / on specific periods of the year) • **Breed** • **Animal identifier** (if AMU data provided per animal)

Table 4 **Antimicrobial treatment information collected as part of a farm-level AMU monitoring system**

	Minimum variables	Additional possible variables
Antimicrobial treatment information	**Antimicrobial active ingredient** (or commercial name if there is a database that can be used to retrieve the antimicrobial active ingredient from the commercial name)	• **Route of administration** (injection, oral through drinking water/medicated feed, bath/tank treatment, pond treatment) • **Indication** (e.g. veterinary medical vs non veterinary medical use: treatment, control, prevention, growth promotion) • **Animal health status/clinical presentation** (e.g. respiratory disease, digestive disease); • **Person responsible for administration** (e.g. farmer, veterinarian, veterinary paraprofessional)
		For the calculation of count-based indicators: • **Number of animals treated**[c] (per production type, stage etc., if this information is recorded) • **Number of animals present** at the AMU date or during the study period[c] (per production type, stage etc., if this information is recorded). • **Treatment duration and/or treatment dates** For the calculation of weight-based or dose-based indicators:[d] *To calculate the weight of antimicrobial agent:* • If antimicrobials are administered in feed (see Annex 4): o **Pre-mix strength** o **Weight of premix used** o **Mixing rate** (volume of premix per volume of feed) o **Weight of feed delivered or consumed** o **Estimated feed consumed/day/animal**[e] • If antimicrobials are administered through water (see Annex 5): o **Strength of the product** (e.g. in mg of active ingredient/mL of product) o **Volume of product used** o **Mixing rate** (volume of product per volume of drinking water) o **Volume of water drank by the animals** o **Estimated water consumed/day/animal** • If antimicrobials are administered by injection: o **Strength of the product** (in g of active substance/L of product, mg/g, mg/mL, g/kg, IU/g, etc.); see WOAH Considerations on converting content of antimicrobial active ingredients in veterinary medicines into kilograms) o **Weight or volume of product administered** • If antimicrobials are administered in bath (in fish hatcheries)[f]: o **Strength of the product** o **Volume of product used** o **Volume of fish tank** *To calculate the animal biomass:*[f] • **Number of animals present**[g] at the AMU date or during the study period (per production type, stage etc. if this information is recorded). • **Animal weight** (e.g. measured at the time of treatment, average weight at the production stage, pre-slaughter weight).

3. Technical preparation

c) Develop the data collection plan

- Identify suitable data sources and providers
- Define the data collection template
- Select the data collection method
  - **Repeated surveys**
  - **Sentinel**
  - **Population-wide continuous**

Table 6 **Suitability of repeated surveys, sentinel and population-wide continuous approaches to achieve each of the common farm-level AMU monitoring objectives**

Objective	Repeated surveys	Sentinel	Population-wide continuous
Characterize AMU qualitatively and quantitatively	●●	●●	●●●
Compare AMU over time, between animal species, production types	●●	●●●	●●●
Farm benchmarking	●	●●	●●●
Detect non-prudent and/or unauthorised use of antimicrobials	●●	●	●●●
Support the interpretation of national antimicrobial use data based on antimicrobial distribution, sales and import data	●●	●●	●●●
Investigate associations between AMU and AMR	●	●●●	●●●
Monitor and evaluate the impact of interventions to reduce and rationalize AMU	●	●●	●●●
Support policy-making to tackle AMU	●●	●●	●●●

Legend: ● somewhat suitable; ●● suitable; ●●● particularly suitable.

3. Technical preparation

c) Develop the data collection plan

- Identify suitable data sources and providers
- Define the data collection template
- Select the data collection method
  - **Repeated surveys**
  - **Sentinel**
  - **Population-wide continuous**

1. *Sampling frame determination*
2. *Sampling strategy*
   - Simple random sampling
   - Multistage random sampling
   - Stratified random sampling
   - Convenience sampling
3. *Data collection time frame*
4. *Sample size requirements*
5. *Data collection tools*

3. Technical preparation

c) Develop the data collection plan

- Identify suitable data sources and providers
- Define the data collection template
- Select the data collection method
  - **Repeated surveys**
  - **Sentinel**
  - **Population-wide continuous**

TIP 3. "Point prevalence surveys" as part of a stepwise approach to establish AMU monitoring

Point prevalence surveys consist of collecting AMU data at a defined time point, such as on a defined day (WHO, 2018). Although widely used in human hospitals, the production cyclicity and the seasonality effect make this design less relevant for the animal sector. However, this methodology may be used as a preliminary approach for training purposes on field data collection and to provide basic information on:

- AMU (a rough assessment of AMU could be useful for proper sample size calculation.);
- possible difficulties to reach farmers (do they allow you to come and ask questions?);
- capacity of farmers to understand questions on AMU;
- availability and quality of data sources such as farm treatment records;
- capacity to record information on number and weight of animals; and
- unsuspected field challenges.

Table 5 **Description of four sampling strategies to monitor AMU at the farm level**

Sampling method	Description	Example	Advantages/Disadvantages
Simple random sampling	• Farms are randomly selected from the sampling frame.	• 10 % of all broiler farms in a country are randomly selected.	• Simple methodology. • Strong representativeness of the target population. • Logistical issues if the sampling frame covers a large territory (e.g. a country). • Challenge in accessing a complete, accurate and up-to-date sample frame
Multistage random sampling	• The first stage of random sampling is made on a higher-level unit known as the *primary sampling unit*, and then one or more lower-level sampling units are defined until the lowest-level sampling unit (the farm), from where data will be collected.	• A *primary sampling unit* is the district, a secondary sampling unit is the village within the selected district, and then the *tertiary sampling unit* is the farm within the selected village.	• Lower representativeness of the target population. • Fewer logistical issues, as efforts are concentrated in smaller geographic areas.
Stratified random sampling	• The sampling frame is divided into subgroups and random samples are taken from each subgroup with sample sizes proportional to the size of the subgroup.	• If the sampling frame consists of all swine farms in a country, subgroups may consist of breeders, multipliers, farrow-to-feeder, farrow-to-finish and feeder-to-finish farms. Subgroups may be defined according to a characteristic that is deemed to have an influence on the amount or patterns of AMU.	• Higher statistical precision compared to simple random sampling and thus requires a smaller sample size, which can save time, money and efforts.
Convenience sampling	• No random component. • Farms are selected according to available budget and human resources to conduct the monitoring, farm accessibility, motivation of the data providers etc. • May also be defined in a multistage approach.	• In a study from Pakistan (Umair *et al.*, 2021), farms were selected from Punjab and Khyber Pakhtunkhwa provinces, which contain most poultry farms of the country. Within these two provinces, commercial broiler chicken farms rearing more than 2000 birds and willing to participate were selected for AMU data collection.	• Easiest method to implement. • May be used as a starting point to pilot AMU monitoring and providing preliminary data. • Various sampling biases.

3. Technical preparation

d) Develop the data management, analysis and communication plans

- Data management

CHAPTER

5

DEVELOPMENT OF DATA MANAGEMENT, ANALYSIS AND COMMUNICATION PLANS

5.1 Data management

The data management plan, including database construction, is essential to the success of the monitoring. Having a convenient data management system is key. It makes it easy for data providers to report AMU data so that they continue to participate in the project. Facilitating the work of the data managers and epidemiologists on the database is also essential. Therefore, this step should be carefully considered and preferably pilot-tested before actual data collection.

a. Database design

As a starting point, simple spreadsheets such as Microsoft® Excel (Microsoft 365) files, Google® Sheets or LibreOffice Calc files may be used. They are affordable or even free, are easy to use and share, and make it possible to perform the most frequent data analyses. However, they are sub-optimal for data quality checks, programming automated analyses and outputs, and do not typically provide the required level of confidentiality and security. Initiatives such as the WOAH Global Data Collection on AMU or the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) initially collected data with Excel spreadsheets. Later on, to increase the security and data quality of the database, a more advanced database management system could be used but may require advanced skills and dedicated resources.

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3. Technical preparation

d) Develop the data management, analysis and communication plans

- Data management
- Data analysis
  - **Qualitative**

BOX 10 Examples of qualitative data analyses, extracted from a broiler AMU survey report in Indonesia

Broiler AMU survey report in Indonesia (FAO): cross-sectional survey conducted in 2017 and 2018

Example of table describing the purpose of antimicrobial use (% of farms):

	Growth promotor	Prophylactic	Therapeutic	N/A	Total farms
Central Java	0%	95%	17%	2%	144%
East Java	1%	93%	19%	0%	91%
Lampung	0%	76%	32%	9%	34%
South Sulawesi	0%	94%	17%	0%	115%
West Java	0%	78%	58%	0%	120%
West Kalimantan	1%	64%	48%	2%	248%
All provinces	0%	81%	35%	1%	752%

N/A: Not applicable (i.e. purpose not known)

3. Technical preparation

d) Develop the data management, analysis and communication plans

- Data management
- Data analysis
  - **Qualitative**
  - **Quantitative**

$$\frac{numerator}{denominator} = AMU\ indicator$$

Count-based indicators

- **Number of days of treatment per animal**

$$\sum_{antimicrobial\ product\ administration} \frac{(Number\ of\ animals\ treated \times Number\ of\ AAS\ per\ product \times Number\ of\ treatment\ days)}{Number\ of\ animals\ in\ the\ population\ at\ treatment\ time}$$

Dose-based indicators

Example: Number of DDDAs / 1000 animal-days

Weight-based indicators

$$\sum_{antimicrobial\ product\ administration} \frac{Weight\ of\ AAS\ (in\ mg)}{Animal\ biomass\ (kg)}$$

3. Technical preparation

d) Develop the data management, analysis and communication plans

- Data management
- Data analysis
  - **Qualitative**
  - **Quantitative**

BOX 11 Calculation of count-based AMU indicators based on an example

Scenario: Over the 30-day study period, the farmer has treated 10 out of 100 pigs for five days with a veterinary product containing a combination of penicillin G and streptomycin by injection. Then, he sold 20 pigs and treated 50 of his remaining 80 pigs for three days with a veterinary product containing tylosin in the feed.

- Number of treatments per animal

$$\frac{10 \times 2}{100} + \frac{50 \times 1}{80} = 0.2 + 0.625 = 0.825 \text{ treatments per animal}$$

- Number of days of treatment per animal

$$\frac{10 \times 2 \times 5}{100} + \frac{50 \times 1 \times 3}{80} = 1 + 1.875 = 2.875 \text{ days of treatments per animal}$$

- Proportion of medicated rations

$$\frac{3 \text{ medicated ration}}{30 \text{ rations}} = 10\% \text{ of the rations were medicated}$$

- Proportion of days with treatment

$$\frac{5 + 3}{30} = 27\% \text{ of days with treatment}$$

3. Technical preparation

d) Develop the data management, analysis and communication plans

- Data management
- Data analysis
  - **Qualitative**
  - **Quantitative**

Table 8 **Advantages, limitations and examples of count-based, weight-based and dose-base indicators for AMU monitoring at the farm level**

	Advantages	Limitations	Examples
Count-based indicators	• Easier to calculate than other indicators. • Useful to describe AMU in a simple manner to non-experts such as farmers or policy makers. • No need to record the weight or volume of AAS used. • No need to calculate the animal biomass.	• Do not account for variations in dosing regimens between farms (variations can be important, especially when there is no recommended dosing regimen, which happens in aquaculture).	• Number of days of treatment/animal • Proportion of animals treated
Weight-based indicators	• Make it possible to compare with AMU data based on national and international sales, import and distribution. • Tools exist to support the calculation of AAS weights.	• Require the collection of data on quantities of AAS used, which can be • All AAS do not have the same dosing regimens, so AMU data comparisons are hindered by the diversity of AAS used. • Require the calculation of the animal biomass, which can be complex, especially in aquaculture. • Aquaculture: o Comparing weight-based indicators between oral antimicrobial administration and by immersion may not be relevant (more antimicrobial weight is needed by immersion to reach the right concentration in a large volume). o Some water parameters (e.g. pH) can lead to antimicrobial instability or binding to calcium, which requires the use of higher amounts of antimicrobials than in other water conditions. This can impact comparability between farms.	• mg of AAS/kg of animal biomass (based on production) • mg of AAS/kg of animal biomass (at time of treatment) • mg of antimicrobials/ tonnes of culture water (used in aquaculture)
Dose-based indicators	• Make it possible to correct for differences in dosing regimens between AAS and formulations • Make it possible to measure trends over time, despite changes in which AAS are used (AACTING Network, 2018).	• Require the collection of data on quantities of AAS used, which can be complex. • Require the preliminary definition of DDDAs or DCDAs relevant to the country of interest (which is complex) or the collection of data on used doses to calculate UDDAs or UCDAs (which can be difficult to collect). • Not suitable when antimicrobials are used as growth promoters.	• Number of DDDAs per 100 animal-days or per 1 000 animal-days • Number of UCDAs/kg of animal biomass

3. Technical preparation

d) Develop the data management, analysis and communication plans

- Data management
- Data analysis
- Data communication

3. Technical preparation

e) **Expand farm-level AMU monitoring in a phase approach**

- Scope
- Objectives
- Data collection
- Data analysis
- Communication

Is it still too complex?

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Drawings: FAO/Chiara Caproni

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Thanks for your attention!