CHAPTER 6.7.

HARMONISATION OF NATIONAL ANTIMICROBIAL RESISTANCE SURVEILLANCE AND MONITORING PROGRAMMES

Article 6.7.1.

Objective

This chapter provides criteria for the:

1) development of national antimicrobial resistance surveillance and monitoring programmes,
2) harmonisation of existing national antimicrobial resistance surveillance and monitoring programmes,

in food producing animals and in products of animal origin intended for human consumption.

Article 6.7.2.

Purpose of surveillance and monitoring

Active (targeted) surveillance and monitoring are core parts of national antimicrobial resistance surveillance programmes. Passive surveillance and monitoring may offer additional information (refer to Chapter 1.4.). The OIE encourages cooperation between all Member Countries conducting antimicrobial resistance surveillance should be encouraged.

Surveillance and monitoring of antimicrobial resistance is necessary to:

1) assess and determine the trends and sources of antimicrobial resistance in bacteria;
2) detect the emergence of new antimicrobial resistance mechanisms;
3) provide the data necessary for conducting risk analyses as relevant to animal and human health;
4) provide a basis for policy recommendations for animal and human health;
5) provide information for evaluating antimicrobial prescribing practices and, for prudent use recommendations;
6) assess and determine effects of actions to combat antimicrobial resistance.

Article 6.7.3.

General aspects The development of antimicrobial resistance surveillance and monitoring programmes

1. General aspects
Surveillance of antimicrobial resistance and at targeted intervals or ongoing monitoring of the prevalence of resistance trends in bacteria from animals, animal feed, food, environment and humans, constitutes a critical part of animal health and food safety strategies aimed at limiting the spread of antimicrobial resistance and optimising the choice of antimicrobial agents used in therapy.

Rationale:

1) Monitoring trends in resistance is much more overarching than just prevalence and can provide stronger epidemiological information such as serotype, genotype and geographical movement of resistance types. Prevalence will rely heavily on having a very robust denominator, where the other trend information can be of value in consideration of newly emerging or low prevalence resistant bacteria types.

2) Animal feeds and environment should not be considered critical to animal health and food safety monitoring. While there may be interest in researching their role, if any, in resistance spread, making feed and environment a critical part of a surveillance system is not warranted with the current level of scientific understanding. Furthermore, resources spent monitoring these streams will take valuable resources away from monitoring animals, food and humans which are direct pathway sources for the potential spread of antimicrobial resistance. Indeed, the United States specifically notes the following:
   a. while pathogenic salmonellae in feed are rare and findings of transmission from feed to animals is even rarer, and there being an absence of the known infectious doses for the few pathogens found in feed, it would seem prudent to reconsider submitting positive feed samples for antibiotic resistance analysis—given the high cost of such determinations. This would not apply to outbreaks, where feed may be implicated.
   b. The finding of an antibiotic resistant, feed-related and pathogenic organism will be very rare and likely related to an anomalous or very unusual event.
   c. Most feed-contamination outbreaks have been related either to on-farm practices or recontamination in transport.
   d. Much feed is heat-treated and may contain antibiotics, both of which will likely inhibit growth of pathogenic organisms.
   e. Assays for pathogens in feed are very difficult, because of the wide-range of ingredients used, some of which may contain naturally-occurring bacterial inhibitor substances (e.g. acidifiers, preservatives, etc.).

3) Therefore, finding antibiotic resistant organisms in feed does not in itself mean that the feed may or will infect the animal or transfer resistance. Specific and supporting references are provided under the rationales in subsequent Articles of this chapter.

Surveillance or monitoring of bacteria from products of animal origin intended for human consumption collected at different steps of the food chain, including processing, packing and retailing, should also be considered.

National antimicrobial resistance monitoring and surveillance programmes should be scientifically based and may include the following components:

1a) statistically based surveys;

2b) sampling and testing of food producing animals on the farm, at live animal markets or at slaughter;

3c) an organised sentinel programme, for example targeted sampling of food producing animals, herds, flocks, and vectors (e.g. birds, rodents);

4d) analysis of veterinary practice, where available, and diagnostic laboratory records;

Rationale: veterinary practice records are not always readily available for routine surveillance, even though they are to be made readily available to the competent authority for regulatory issues. Diagnostic laboratories are often government entities and information is more easily
provided. In addition, the laboratories can aggregate data from a wider variety of sources than a veterinary practitioner.

50) sampling and testing of products of animal origin intended for human consumption.

51) sampling and testing of feed ingredients or feed.

**Rationale:** the lack of an association between pathogens found in animal feeds and those found in animal populations make testing of feed and feed ingredients of questionable value to a surveillance program. Furthermore, pathogen distribution within feeds is not homogeneous within contaminated batches (<10% of samples tested from a contaminated batch), and contamination of feed and feed ingredients occur at low prevalence.


These problems, along with a less than perfect sensitivity of available testing methods make testing inefficient (requiring too many samples be tested to identify contamination) and unreliable.


Additionally, many feed ingredients are produced on farm and would not be subject to monitoring. Finally, this monitoring is not practical for developing countries without access to sophisticated testing laboratories.

**Article 6.7.4.**

**Sampling**

12. **Sampling strategies**

   a) Sampling should be conducted on a statistical basis. The sampling strategy should ensure:

      - the sample is representative of the population of interest;
      - the robustness of the sampling method.

   b) The following criteria are to be considered:

      - sample source such as food producing animal, food, animal feed;

**Rationale:** see rationale provided under Article 6.7.3

      - animal species;
23. **Sample size**

The sample size should be large enough to allow detection or determine prevalence and/or trends of existing and emerging antimicrobial resistance phenotypes.

**Rationale:** see rationale provided under Article 6.7.3

The sample should avoid bias and provide a representative sample of the animal population, process, product or other unit of interest whilst taking into account the expected prevalence of the resistance phenotype and the desired level of precision and confidence.

**Rationale:** edited for improved grammar and clarity

The sample size calculation in Table 1 is based on independent samples. If there is any clustering at the establishment or animal level, the sample size should be adjusted accordingly.

Sample size estimates for prevalence of antimicrobial resistance in a large population are provided in Table 1 below.

<table>
<thead>
<tr>
<th>Expected prevalence</th>
<th>90% Level of confidence</th>
<th>95% Level of confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Desired precision</td>
<td>Desired precision</td>
</tr>
<tr>
<td></td>
<td>10% 5% 1%</td>
<td>10% 5% 1%</td>
</tr>
<tr>
<td>10%</td>
<td>24 97 2,429</td>
<td>35 138 3,445</td>
</tr>
<tr>
<td>20%</td>
<td>43 173 4,310</td>
<td>61 246 6,109</td>
</tr>
<tr>
<td>30%</td>
<td>57 227 5,650</td>
<td>81 323 8,003</td>
</tr>
<tr>
<td>40%</td>
<td>65 260 6,451</td>
<td>92 369 9,135</td>
</tr>
<tr>
<td>50%</td>
<td>68 270 6,718</td>
<td>96 384 9,512</td>
</tr>
<tr>
<td>60%</td>
<td>65 260 6,451</td>
<td>92 369 9,135</td>
</tr>
<tr>
<td>70%</td>
<td>57 227 5,650</td>
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</tr>
<tr>
<td>90%</td>
<td>24 97 2,429</td>
<td>35 138 3,445</td>
</tr>
</tbody>
</table>

24. **Sample sources** (Table 2)

Member Countries should examine their livestock production systems on the basis of available information and assess which sources are likely to contribute most to a potential risk to animal and human health.

a) **Animal feed**

Member Countries should consider including animal feed in surveillance and monitoring programmes if resources are sufficient after implementing surveillance of food producing animal populations and of food.
of animal origin intended for human consumption, as they may become contaminated with antimicrobial resistant bacteria, e.g. *Salmonella*.

**Rationale:** as noted in the rationale provided under Article 6.7.3, there is a lack of an association between pathogens found in animal feeds and those found in animal populations make testing of feed and feed ingredients of questionable value to a surveillance program. Indeed, feed samples provide the lowest value sample, and thus, yield little usable information.

b) Food producing animals

Categories of food producing animals considered for sampling should be relevant to the country’s production system. **Resource allocation should be guided by production volume and the prevalence of resistant bacteria.**

c) Food

Member Countries should consider including products of animal origin intended for human consumption, produced locally or imported, in surveillance and monitoring programmes, as foodborne transmission is considered to be an important route for the transfer of antimicrobial resistance.

4b. Type of sample to be collected (Table 2)

While it is difficult to collect feed samples representative of the batch, should be collected in sufficient amounts sufficient for isolation of resistant bacteria of concern (at least 25 g) should be collected, and should be linked to pathogen surveillance programmes.

**Rationale:** Again, as mentioned above, pathogen distribution within feeds is not homogeneous within contaminated batches, (<10% of samples tested from a contaminated batch) and contamination of feed and feed ingredients occur at low prevalence.


These inherent problems, along with less than perfect sensitivity of available testing methods make testing inefficient (requiring too many samples be tested to identify contamination) and unreliable.


Faecal samples should be collected in amounts sufficient for isolation of the resistant bacteria of concern (at least 5 g from bovine and porcine and whole caeca from *poultry*).

**Sampling of carcasses at the slaughterhouse/abattoir provides information on slaughter practices, slaughter hygiene, and the level of microbiological contamination and cross-contamination of meat. Further sampling of the product at retail sales level may provide additional information on the overall microbiological contamination from slaughter to the consumer.**

Existing food processing microbiological monitoring, risk-based management and other food safety programmes may provide useful samples for surveillance and monitoring of resistance in the food chain after slaughter.

**Table 2 provides examples of sampling sources, sample types and monitoring outcomes**.
<table>
<thead>
<tr>
<th>Source</th>
<th>Type</th>
<th>Output</th>
<th>Additional information required or additional stratification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd or flock of origin</td>
<td>Faeces or bulk milk</td>
<td>Prevalence of resistant bacteria originating from animal populations (of different production types)</td>
<td>Age categories, production types, etc. Antimicrobial use over time</td>
</tr>
<tr>
<td>Abattoir</td>
<td>Faeces</td>
<td>Prevalence of resistant bacteria originating from animals at slaughter</td>
<td>As above</td>
</tr>
<tr>
<td></td>
<td>Caeca or intestines</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carcass</td>
<td>Hygiene, contamination during slaughter</td>
<td></td>
</tr>
<tr>
<td>Processing, packing</td>
<td>Food products</td>
<td>Hygiene, contamination during processing and handling</td>
<td></td>
</tr>
<tr>
<td>Point of sale (Retail)</td>
<td>Food products</td>
<td>Prevalence of resistant bacteria originating from food, exposure data for consumers</td>
<td></td>
</tr>
<tr>
<td>Various origins</td>
<td>Animal feed</td>
<td>Prevalence of resistant bacteria originating from animal feed, exposure data for animals</td>
<td></td>
</tr>
</tbody>
</table>

### Bacteria subjected to surveillance and monitoring

#### Article 6.7.5.

**Bacterial isolates**

The following categories of bacteria could **may** be included in surveillance and monitoring programmes monitored:

**1a** Animal bacterial pathogens relevant to the countries’ priorities

- **Surveillance and monitoring of antimicrobial resistance in animal bacterial pathogens** is important, both to:
  - detect emerging resistance that may pose a concern for animal and human health;
  - detect changes in susceptibility patterns;
  - provide information for risk analysis;
  - provide data guide for veterinarians in to inform their prescribing treatment decisions.

**2b** Information on the occurrence of antimicrobial resistance in animal bacterial pathogens is in general either derived from routine clinical material sent to veterinary diagnostic laboratories or from an active monitoring programme. These samples, often derived from severe or recurrent clinical cases including therapy failure, may provide biased information. Although antimicrobial resistance information provided by diagnostic laboratories is primarily for treatment purposes, it is also useful for identification of novel resistance patterns and can possibly assist in identifying emerging resistance. However, in order to estimate accurately the prevalence of antimicrobial resistance in the bacterial pathogen, in a larger population of animals, an active sampling programme should be implemented.

**3b** To promote a harmonised global approach to the selection of animal bacterial pathogens for inclusion in national surveillance and monitoring programmes, bacteria should be selected using the following criteria:

- impact on animal health and welfare;
  - implication of antimicrobial resistance in the bacterial pathogen on therapeutic options in veterinary practice;
  - impact on food security and on production (economic importance of associated diseases);
bacterial diseases responsible for the majority of veterinary antimicrobial usage (stratified by usage of different classes or their importance);
existence of validated susceptibility testing methodologies for the bacterial pathogen;
existence of quality assurance programmes or other pathogen reduction options that are non-antimicrobial, such as [vaccines and Good Agricultural Practices].

The table below, derived using the above criteria, lists suggested animal bacterial pathogens for inclusion in a surveillance or monitoring programme of food-producing animals. This list is not exhaustive and should be adapted according to the situation in the country.

Table 3. Examples of target animal species and animal bacterial pathogens that may be included in resistance surveillance and monitoring programmes

<table>
<thead>
<tr>
<th>Target animals</th>
<th>Respiratory pathogens</th>
<th>Enteric pathogens</th>
<th>Udder pathogens</th>
<th>Other pathogens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>Pasteurella multocida</td>
<td>Escherichia coli</td>
<td>Staphylococcus aureus</td>
<td></td>
</tr>
<tr>
<td>Mannheimia haemolytica</td>
<td>Salmonella spp.</td>
<td>Streptococcus spp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigs</td>
<td>Actinobacillus pleuropneumoniae</td>
<td>Escherichia coli</td>
<td>Salmonella spp.</td>
<td>Streptococcus suis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poultry</td>
<td>Salmonella spp. Campylobacter jejuni</td>
<td></td>
<td>Escherichia coli</td>
<td></td>
</tr>
</tbody>
</table>

Rationale: Poultry meat is known to be an important source of foodborne *Salmonella* and *Campylobacter* infections.

2b) Zoonotic bacteria

Salmonella

*Salmonella* should be sampled from animal feed, food producing animals and animal-derived food products. In countries with a low prevalence of *Salmonella*, there may be a benefit in sampling animal feeds. For the purpose of consistency and harmonisation, feed samples should preferably be taken at the feed mill and animal samples should preferably be taken at the slaughterhouse/abattoir.

Rationale: To be consistent with the newly approved Chapter 6.Y (*Salmonella* control in pigs), rather than be recommended for all Member countries, the sampling of animal feeds in countries with low prevalence should be suggested.

It is not uniformly accepted that feed and feed ingredients are the major source of infection for animals, or the source of greatest public health risk. Exposure doses of $10^3$ organisms given intranasally or orally are not sufficient to establish infections in pigs, and oral doses of $10^8$ cfu have been required to consistently produce experimental infections.

Thus, feed would need to be contaminated with greater than $10^4$ Salmonella per gram to deliver an infective dose to a market hog within two months of harvest.


While there is a paucity of published longitudinal studies sampling both pigs and feed, one such study demonstrated an insignificant role of feed contamination.


Additionally, there is a consistent disparity between serotypes isolated in animal feeds and those isolated from pigs.


Moreover, many *Salmonella* serotypes occurring in animal feed are not considered epidemiologically important for human foodborne disease and would be outside the scope of this document, while the most important serotypes such as *Salmonella typhimurium* and *enteriditis* are seldom reported in feed.

- Stege H. 2000. Subclinical *Salmonella enterica* infection in Danish finishing pig herds – prevalence and risk factors. Doctoral dissertation. Royal Veterinary and Agricultural University, Copenhagen, DK;

Surveillance and monitoring programmes may also include bacterial isolates originating from other sources obtained from designated national laboratories originating from other sources.
Isolation and identification of bacteria and bacterial strains should follow nationally or internationally standardised procedures.

Serovars of public health importance such as S. Typhimurium and S. Enteritidis should be included. The inclusion of other relevant serovars will depend on the epidemiological situation in each country.

All Salmonella isolates should be serotyped and, where appropriate, phage-typed according to standard methods used at the nationally designated laboratories. For those countries that have the capabilities, Salmonella could be genotyped using genetic finger-printing methods.

**(b) Campylobacter**

Campylobacter jejuni and C. coli should be isolated from food producing animals and associated food products (primarily from poultry). Isolation and identification of these bacteria should follow nationally or internationally standardised procedures. Campylobacter isolates should be identified to the species level.

**(c ii) Other bacteria that are pathogenic for humans emerging bacterial pathogens**

Other emerging bacterial that are pathogens pathogenic for humans such as methicillin-resistant Staphylococcus aureus (MRSA), and Listeria monocytogenes or others which are pathogenic to humans, may be included in resistance surveillance and monitoring programmes.

**(3a) Commensal bacteria**

*E. coli* and *enterococci* (*Enterococcus faecium* and *E. faecalis*) may be sampled from animal feed, food producing animals and products of animal origin intended for human consumption.

These bacteria are commonly used in surveillance and monitoring programmes as indicators, providing information on the potential reservoir of antimicrobial resistance genes, which may be transferred to pathogenic bacteria. It is considered that these bacteria should be isolated from healthy animals, preferably at the slaughterhouse/abattoir, for the purpose of consistency and harmonisation and be monitored for antimicrobial resistance.

**Article 6.7.6.**

**7. Storage of bacterial strains**

If possible, isolates should be preserved at least until reporting is completed. Preferably, appropriate isolates should be permanently stored. Bacterial strain collections, established by storage of all isolates from certain years, will provide the possibility of conducting retrospective studies.

**Article 6.7.7.**

**8. Antimicrobial susceptibility testing**

Clinically important antimicrobial agents or classes used in human and veterinary medicine should be included in antimicrobial resistance surveillance programmes. Member Countries should refer to the OIE list of antimicrobials of veterinary importance for surveillance and monitoring purposes. However, recognising that the number of tested antimicrobial agents may have to be limited according to financial resources.

 Appropriately validated antimicrobial susceptibility testing methods should be used in accordance with Guideline Chapter 3.1. of the Terrestrial Manual, concerning laboratory methodologies for bacterial antimicrobial susceptibility testing. Antimicrobial susceptibility data should be reported not only qualitatively (susceptible or resistant), but also quantitatively (minimum inhibitory concentrations [MICs] or inhibition zone diameters), rather than qualitatively.

**Article 6.7.8.**

**9. Recording, storage and interpretation of data**

**(1a) Because of the volume and complexity of the information to be stored and the need to keep these data available for an undetermined period of time, careful consideration should be given to database design.**
2b) The storage of raw (primary, non-interpreted) data is essential to allow the evaluation in response to various kinds of questions, including those arising in the future.

3c) Consideration should be given to the technical requirements of computer systems when an exchange of data between different systems (comparability or compatibility of automatic recording of laboratory data and transfer of these data between and within resistance surveillance and monitoring programmes) is envisaged. Results should be collected in a suitable national database. They should be recorded quantitatively:

   a) as distributions of MICs in micrograms per millilitre;
   b) or inhibition zone diameters in millimetres.

4d) The information to be recorded should include, where possible, the following aspects:

   a) sampling programme;
   b) sampling date;
   c) animal species and production type;
   d) type of sample;
   e) purpose of sampling;
   f) type of antimicrobial susceptibility testing method used;
   g) geographical origin (geographical information system data where available) of herd, flock or animal;
   h) animal factors (e.g. such as age, condition, health status, identification, sex);
   i) exposure of animals to antimicrobial agents;
   j) bacterial recovery isolation rate.

5e) The reporting of laboratory data should include the following information:

   a) identity of laboratory,
   b) isolation date,
   c) reporting date,
   d) bacterial species,
   e) bacterial recovery isolation rate,

   and, where relevant, other typing characteristics, such as:

   a) serotype or serovar,
   b) phage type,
   c) antimicrobial susceptibility result or resistance phenotype,
   d) genotype.

6f) The proportion of isolates regarded as resistant should be reported. The number of isolates regarded as resistant should be reported as a proportion of the number of isolates tested, including the defined interpretive criteria used.

7g) In the clinical setting, breakpoints are used to categorise bacterial strains as susceptible, intermediate or resistant. These clinical breakpoints may be elaborated on a national basis and may vary between Member Countries.
8h) The bacterial isolation methods, antimicrobial susceptibility testing methods, standards and guidelines used should be recorded.

9) For surveillance and monitoring purposes, use of the microbiological breakpoint (also referred to as epidemiological cut-off point), which is based on the distribution of MICs or inhibition zone diameters of the specific bacterial species tested, is preferred. When using microbiological breakpoints, only the bacterial population with acquired resistance that clearly deviates from the distribution of the normal susceptible population will be designated as resistant.

10i) Ideally, data should be collected at the individual isolate level, allowing antimicrobial resistance patterns over time to be recorded, along with relevant data on usage and management practices when available.

10. Reference laboratory and annual reports

1a) Member Countries should designate a national reference centre that assumes the responsibility to:

a) coordinate the activities related to the antimicrobial resistance surveillance and monitoring programmes;

b) coordinate and collect information from participating surveillance laboratories within the country;

c) produce an annual report on the antimicrobial resistance situation in the country.

2b) The national reference centre should have access to the:

a) raw data;

b) complete results of quality assurance and inter-laboratory calibration activities;

b) inter-laboratory proficiency testing results;

c) information on the structure of the surveillance or monitoring system;

c) information on the chosen laboratory methods.

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— Text deleted.