TERRESTRIAL ANIMAL HEALTH STANDARDS COMMISSION

FEBRUARY 2012 REPORT

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 ~~(e.g. avian, bovine, caprine, equine, ovine, porcine)~~ 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 as core parts of national antimicrobial resistance surveillance programmes. Passive surveillance and monitoring may offer additional information (refer to Chapter 1.4.). Regional cooperation between Members conducting antimicrobial resistance surveillance should be encouraged.

~~1.~~ Surveillance and monitoring of antimicrobial resistance is necessary to:

1.~~a)~~ ~~follow trends in~~ assess and determine the trends and sources of antimicrobial resistance ~~trends~~ in bacteria;

2.~~b)~~ detect the emergence of new antimicrobial resistance mechanisms;

3.~~c)~~ provide the data necessary for conducting risk analyses ~~with~~ as relevant~~ce~~ to ~~for~~ animal ~~human~~ and human ~~animal~~ health;

4.~~d)~~ provide a basis for policy recommendations for animal and human ~~public~~ health;

5.~~e)~~ provide information ~~on~~ ~~for~~ for evaluating antimicrobial prescribing practices and~~,~~ ~~useful~~ for ~~development of~~ prudent use recommendations.

~~2. National antimicrobial resistance monitoring and surveillance programmes may include the following components:~~

~~a) scientifically based surveys (including statistically based programmes);~~

~~b) routine sampling and testing of animals on the farm, at market or at slaughter;~~

c) an organised sentinel programme, sampling animals, herds, flocks, and vectors;

d) analysis of veterinary practice and diagnostic laboratory records.

3. Countries should conduct active surveillance and monitoring. Passive surveillance and monitoring may offer additional information.

4. Targeted surveillance is conducted through an active sampling scheme designed to meet programme objectives. Passive surveillance is conducted when samples are submitted to a laboratory for testing from sources outside the programme.

Article 6.7.3.

The development of antimicrobial resistance surveillance and monitoring programmes

1. General aspects

Surveillance of antimicrobial resistance at regular ortargeted intervals or ongoing monitoring of the prevalence of resistance in prevalence changes of resistant bacteria from of animals, food, environmental and humans origin, constitutes a critical part of a animal health and food safety strategyies aimed at limiting the spread of antimicrobial resistance and optimising the choice of antimicrobial agents used in therapy.

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:

a) statistically scientifically based surveys (including statistically based programmes);

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

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

d) analysis of veterinary practice and diagnostic laboratory records.

2. Sampling strategies

a) General

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

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

iib) The following criteria are to be considered:

- sample size;
- sample source (e.g. such as food producing animal, food, animal feed);
- animal species;
- category of *animal* within species (e.g. such as age group, production type);
- stratification within category;
- health status of the *animals* (e.g. such as healthy, diseased);

- ~~random~~ sample selection ~~(e.g.~~ such as targeted, systematic random~~)~~;
- type of sample ~~specimens~~ (e.g. faecal, carcass, ~~processed~~ food product).
- sample size;

~~b)~~3) Sample size

The sample size should be~~: i)~~large enough to allow detection of existing and emerging antimicrobial ~~resistantce~~ resistance phenotypes~~;~~.

~~ii) not excessively large to avoid waste of resources.~~

Samples size estimates for prevalence of antimicrobial resistance in a large population is provided ~~Details are provided~~ in Table 1 below. ~~Sampling fall follow standard operating procedures.~~

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

	90% Level of confidence			**95% Level of confidence**		
Expected prevalence	**~~90%~~ Desired precision**			**~~95%~~ Desired precision**		
	10%	**5%**	**1%**	**10%**	**5%**	**1%**
10%	24	97	2,429	35	138	3,445
20%	43	173	4,310	61	246	6,109
30%	57	227	5,650	81	323	8,003
40%	65	260	6,451	92	369	9,135
50%	68	270	6,718	96	384	9,512
60%	65	260	6,451	92	369	9,135
70%	57	227	5,650	81	323	8,003
80%	43	173	4,310	61	246	6,109
90%	24	97	2,429	35	138	3,445

~~Calculations based on v6.04b to c Upgrade, October 1997, Centers for Disease Control (public domain software available at hpp://www.cdc.gov/epo/epi/epiinfo.htm)Epi Info version 3.5.1., November 2010, Centers for Disease Control and Prevention (public domain software available at http://www.cdc.gov/). Further information on sample size calculation can also be found in Annex 1 of the EFSA Journal (2007), 96, 1-46, "Report including a proposal for a harmonized monitoring scheme of antimicrobial resistance in *Salmonella* in fowl (*Gallus gallus*), turkeys, and pigs and *Campylobacter jejuni* and *C. coli* in broilers.~~

~~3~~4. Sample sources

Members should examine their livestock production systems on basis of available information and assess which sources are likely to contribute most to a potential risk to ~~and decide, after *risk analysis*, the relative importance of antimicrobial resistance and its impact on~~ animal and human health.

a) Animal feed

Members should consider including animal feeds in surveillance and monitoring programmes as they may become contaminated with antimicrobial resistant bacteria, e.g. *Salmonella.*

b~~a~~) Food producing animals

~~Each OIE Member should examine its livestock production systems and decide, after *risk analysis*, the relative importance of antimicrobial resistance and its impact on animal and human health.~~

Categories of food producing animals ~~livestock that should be considered for sampling include cattle and calves, slaughter pigs, broiler chickens, layer hens and/or other poultry and farmed fish~~ considered for sampling should be relevant to the country's production system ~~livestock and include~~.

~~b~~c) Food ~~and animal feed~~

Members should consider including relevant food products originating from food producing animals in surveillance and monitoring programmes as foodborne transmission ~~Contaminated food~~ is ~~commonly~~ considered to be an important ~~the principal~~ route for the transfer of antimicrobial resistance. ~~from animals to humans. Plants and vegetables of different types may be exposed to manure or sewage from livestock and may thereby become contaminated with resistant bacteria of animal origin. Animal feed, including imported feed, may also be considered in surveillance and monitoring programmes.~~

~~Table 1. Sample size estimates for prevalence of antimicrobial resistance in a large population~~

~~Level of confidence~~						
~~Expected prevalence~~	**~~90% Desired precision~~**			**~~95% Desired precision~~**		
	~~10%~~	**~~5%~~**	**~~1%~~**	**~~10%~~**	**~~5%~~**	**~~1%~~**
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~~Calculations based on Epi Info v6.04b to c Upgrade, October 1997, Centers for Disease Control (public domain software available at hpp://www.cdc.gov/epo/epi/epiinfo.htm)~~

4~~5~~. Type of ~~S~~sample ~~specimens~~ to be collected

Feed samples should be collected in amounts sufficient for isolation of resistant bacteria of concern (at least 25 g) and should be linked to pathogen surveillance programmes.

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) ~~all sfrom livestock, and whole caeca should be collected from poultry. In cattle and pigs, a faecal sample size at least of 5 g provides a sufficient sample for isolation of the bacteria of concern.~~

Sampling of ~~the~~ carcasses at the *abattoir* provides information on *slaughter* practices, *slaughter* hygiene and the level of microbiological ~~faecal~~ contamination and cross-contamination of *meat*. ~~during the slaughter process~~. Further sampling of the product at retail sales level ~~from the retail chain~~ may provide~~s~~ additional information on the overall microbiological contamination from *slaughter* to the consumer. ~~prevalence changes before the food reaches the consumer~~.

Existing food processing microbiological monitoring, ~~and~~ 'hazard analysis and critical control points' (HACCP) 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 2. ***Examples of sampling sources, sample types and monitoring outcomes*** ~~***of monitoring***~~

Source	**Sample type**	**Outcome**	**Additional information required~~/~~ or additional stratification**
Herd ~~/~~ or flock of origin	Faecal or bulk milk	Prevalence of resistant~~ce in~~ bacteria originating from animal populations (of different production types) Relationship resistance – antimicrobial ~~biotic~~ use	~~Per a~~Age categories, production types, etc. Antimicrobial~~biotic~~ use over time
Abattoir	Faecal	Prevalence of resistant~~ce in~~ bacterial ~~populations~~ originating from animals at slaughter ~~age~~	
	Caeca~~/~~ **or** ~~I~~intestine	As above	
	Carcass	Hygiene, contamination during slaughter	
Processing, packing	~~Meat~~ Food products	Hygiene, contamination during processing and handling	
Point of sales (Retail)	~~Meat~~ Food products	Prevalence of resistant~~ce in~~ bacteria originating from food, exposure data for consumers	
	~~Vegetables~~	~~Prevalence of resistantce in bacteria originating from vegetables, exposure data for consumers~~	
Various origins	Animal feed	Prevalence of resistant~~ce in~~ bacteria originating from animal feed, exposure data for animals	

~~5~~6. Bacterial isolates

The following categories of bacteria could be monitored:

a) Animal bacterial pathogens relevant to the countries' priorities

Monitoring of antimicrobial resistance in animal pathogens is important, both to:

i) detect emerging resistance that may pose a concern for animal ~~human~~ and human ~~animal~~ health;

ii) guide *veterinarians* in their prescribing decisions.

Information on the occurrence of antimicrobial resistance in animal pathogens is in general derived from routine clinical material sent to veterinary diagnostic *laboratories*. These samples, often derived from severe or recurrent clinical cases including therapy failure, may provide biased information.

b) Zoonotic bacteria

i) *Salmonella*

Salmonella should be sampled from animal feed, food producing animals~~, cattle, pigs, broilers and other poultry~~, and animal derived food products. For the purpose of consistency and harmonisation, samples should be preferably taken at the *abattoir*~~. facilitating sampling and reducing the concurrent costs, samples should preferably be taken at the *abattoir*~~.

Surveillance and monitoring programmes may also ~~use~~ include bacterial isolates obtained from designated national *laboratories* originating from other sources.

Isolation and identification of bacteria and bacterial strains should follow nationally or internationally standardised ~~accepted~~ procedures.

Serovars of public health ~~epidemiological~~ importance such as *S.* Typhimurium and *S.* Enteritidis should be included. The inclusion ~~selection~~ 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.

~~Validated antimicrobial susceptibility testing methods should be used.~~

ii) *Campylobacter*

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

~~Validated antimicrobial susceptibility testing methods should be used.~~

~~Agar or broth micro-dilution methods are recommended for *Campylobacter* susceptibility testing. Internal and external quality control programmes should be strictly adhered to.~~

~~Validated methods with appropriate reference strains are expected to become available in the near future.~~

iii) Other emerging bacterial pathogens ~~Enterohaemorrhagic *Escherichia coli*~~

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

~~Enterohaemorrhagic *Escherichia coli* (EHEC), such as the serotype O157, which is pathogenic to humans but not to *animals*, may be included in resistance surveillance and monitoring programmes.~~

~~Validated antimicrobial susceptibility testing methods should be used.~~

c) Commensal bacteria

E.~~scherichia~~ coli and *enterococci* (*Enterococcus faecium* and *E. faecalis*) may be sampled from animal feed, food producing animals and animal-derived food products. ~~are common commensal bacteria.~~

These bacteria are commonly used in surveillance and monitoring programmes as indicators, providing information on the potential reservoir ~~considered to constitute a reservoir~~ of antimicrobial resistance genes, which may be transferred to pathogenic bacteria. ~~causing *disease* in *animals* or humans.~~ It is considered that these bacteria should be isolated from healthy *animals*, preferably at the *abattoir*, and be monitored for antimicrobial resistance.

~~Validated antimicrobial susceptibility testing methods should be used.~~

~~*Table 2. **Examples of sampling sources, sample types and outcome of monitoring***~~

~~**Source**~~	~~**Sample type**~~	~~**Outcome**~~	~~**Additional information required/additional stratification**~~
~~Herd of origin~~		~~Prevalence of resistance in bacteria originating from animal populations (of different production types)~~ ~~Relationship resistance - antibiotic use~~	~~Per age categories, production types, etc.~~ ~~Antibiotic use over time~~
~~Abattoir~~	~~Faecal~~	~~Prevalence of resistance in bacterial populations originating from animals at slaughter age~~	
	~~Intestine~~	~~As above~~	
	~~Carcass~~	~~Hygiene, contamination during slaughter~~	
~~Processing, packing~~	~~Meat products~~	~~Hygiene, contamination during processing and handling~~	
~~Retail~~	~~Meat products~~	~~Prevalence of resistance in bacteria originating from food, exposure data for consumers~~	
	~~Vegetables~~	~~Prevalence of resistance in bacteria originating from vegetables, exposure data for consumers~~	
~~Various origin~~	~~Animal feed~~	~~Prevalence of resistance in bacteria originating from animal feed, exposure data for animals~~	

~~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.

~~7~~8. Antimicrobial~~s to be used in~~ susceptibility testing

Clinically important antimicrobial agents~~/~~ or classes used in human and veterinary medicine should be included in antimicrobial resistance surveillance programmes ~~monitored~~. Member Countries should refer to ~~Chapter 1.1.6. of the *Terrestrial Manual* and~~ the OIE list of antimicrobials of veterinary importance for monitoring purposes. However, the number of tested antimicrobial agents may have to be limited according to financial resources.

~~8~~9. ~~Type of data to be recorded and stored~~

~~Data on Aantimicrobial susceptibility data should be reported quantitatively (minimum inhibitory concentrations [MICs] or inhibition zone diameters), rather than qualitatively.~~

Appropriately validated antimicrobial susceptibility testing methods should be used in accordance with Chapter 1.1.6. of the *Terrestrial Manual*, concerning laboratory methodologies for bacterial antimicrobial susceptibility testing. Antimicrobial susceptibility data should be reported quantitatively (minimum inhibitory concentrations [MICs] or inhibition zone diameters), rather than qualitatively.

~~910~~9. Recording, storage and interpretation of data ~~results~~

a) 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.

b) The storage of raw (primary, non-interpreted) data is essential to allow the evaluation ~~of the data~~ in response to various kinds of questions, including those arising in the future.

c) 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 monitoring programmes) is envisaged. Results should be collected in a suitable national database. They should ~~shall~~ be recorded quantitatively:

   i) as distributions of ~~minimum inhibitory concentrations (~~MICs~~)~~ in milligrams per litre;

   ii) or inhibition zone diameters in millimetres.

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

   i) sampling programme;

   ii) sampling date;

   iii) animal species~~/ or livestock category~~ type;

   iv) type of sample;

   v) purpose of sampling;

   vi) type of antimicrobial susceptibility testing method used;

   vii) geographical origin (geographical information system data where available) of *herd*, *flock* or *animal*;

viii) ~~age of~~ A~~a~~*animal* factors (e.g. age, condition, health status, identification, sex).

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

i) identity of *laboratory*,

ii) isolation date,

iii) reporting date,

iv) bacterial species,

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

v) sero~~var~~type~~/~~ or serovar,

vi) phage~~-~~ type,

vii) antimicrobial susceptibility result ~~/~~or resistance phenotype~~,~~

viii) ~~molecular~~ genotype.

f) The proportion of isolates regarded as resistant should be reported, including the defined interpretive criteria ~~breakpoints~~ used.

g) In the clinical setting, breakpoints are used to categorise bacterial strains as susceptible, intermediate ~~susceptible~~ or resistant. These clinical breakpoints~~, often referred to as clinical or pharmacological breakpoints,~~ may be ~~are~~ elaborated on a national basis and may vary between Members.

h) ~~The system of reference used should be recorded.~~ The antimicrobial susceptibility testing standards and guidelines used should be recorded.

i) For surveillance 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.

j) Ideally ~~If available~~, data should be collected at the individual isolate level, allowing antimicrobial resistance patterns to be recorded ~~the phenotype of the isolates (resistance pattern) should be recorded~~.

11~~0~~. Reference laboratory and annual reports

a) Members should designate a national reference centre that assumes the responsibility to:

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

ii) coordinate and collect information from participating surveillance laboratories ~~at a central location~~ within the country;

iii) produce an annual report on the antimicrobial resistance situation ~~of~~ in the country.

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

i) raw data;

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

iii) inter-laboratory proficiency testing results;

iv) information on the structure of the monitoring system;

v) information on the chosen laboratory methods.

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

Target animals	**Respiratory pathogens**	**Enteric pathogens**	**Udder pathogens**	**Other pathogens**
Cattle	*Pasteurella* spp.	*Escherichia coli*	*Staphylococcus aureus*	
	Haemophilus somnus	*Salmonella* spp.	*Streptococcus* spp.	
Pigs	*Actinobacillus pleuropneumoniae*	*Escherichia coli*		*Streptococcus suis*
		Brachyspira spp.		
		Salmonella spp.		
Poultry				*Escherichia coli*
Fish				*Vibrio* spp.
				Aeromonas spp.