# SURVEILLANCE OF INFECTIOUS DISEASES

## IN ANIMALS AND HUMANS IN SWEDEN 2022

*Chapter excerpt:*
*Antibiotic resistance in bacteria from animals and food*

SVA NATIONAL VETERINARY INSTITUTE
Jordbruksverket Swedish Board of Agriculture
Folkhälsomyndigheten PUBLIC HEALTH AGENCY OF SWEDEN
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**Cover**: A cultivation of *Salmonella* at the Public Health Agency of Sweden.
Photo: Nicklas Thegerström/DN/TT. Cover design by Rodrigo Ferrada Stoehrel.



**Reporting guidelines**: Reporting guidelines were introduced in 2018 for those chapters related to purely animal pathogens. The guidelines build on experiences from several EU projects, and have been validated by a team of international experts in animal health surveillance. The aim is to develop these guidelines further in collaboration within the global surveillance community and they have therefore been made available in the form of a wiki on the collaborative platform GitHub (https://github.com/SVA-SE/AHSURED/wiki). Feel free to contribute!

**Layout**: The production of this report continues to be accomplished using a primarily open-source toolset. The method allows the source text to be edited independently of the template for the layout which can be modified and reused for future reports. Specifically, the chapter texts, tables and captions are authored in Microsoft Word and then converted to the LaTeX typesetting language using a custom package written in the R software for statistical computing. The package uses the pandoc document conversion software with a filter written in the lua language. Most figures and maps are produced using R and the LaTeX library pgfplots. Development for 2022 has focused on generalising the R package to accommodate conversion into formats other than LaTeX and PDF, with a focus on markdown files which can be published as HTML websites using the Quarto publishing system. The report generation R package and process was designed by Thomas Rosendal, Wiktor Gustafsson and Stefan Widgren.

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# Antibiotic resistance in bacteria from animals and food

## BACKGROUND

The National Veterinary Institute (SVA) has the mission to monitor and analyse the development of antimicrobial resistance in bacteria from animals and food of animal origin. This also includes implementation of the mandatory harmonised monitoring of antibiotic resistance in bacteria from food-producing animals and food thereof, dictated by EU legislation. The monitoring activities are carried out through the Swedish Veterinary Antibiotic Resistance Monitoring Programme (Svarm), which has been running since 2000.

The objectives of Svarm are to detect changes in trends in resistance and to provide a basis for recommendations on the use of antibiotics in animals. Three types of bacteria are monitored: zoonotic bacteria, specific animal pathogens and indicator bacteria from healthy animals and meat. In addition, both intestinal content from healthy farm animals and fresh meat are screened for *E. coli* producing extended spectrum beta-lactamases (ESBL), AmpC-enzymes and carbapenemases. The rationale for monitoring indicator bacteria, i.e., commensal *Escherichia coli* and *Enterococcus* spp. from the normal intestinal flora of healthy animals, is that resistance among these bacteria reflects the selection pressure caused by the of use of antibiotics in an animal population. These commensal bacteria can also be a reservoir of mobile resistance genes that can reach humans through the food chain. Thus, the prevalence of resistance in bacteria that contaminate meat reflects the magnitude of the potential human exposure to such reservoirs in food-producing animals.

The Svarm programme conforms to directive (2003/99/EG) and subsequent decisions (2013/652/EU, from 2021 replaced by 2020/1729/EU). According to the directive, resistance in *Salmonella*, *Campylobacter jejuni* and C. *coli,* as well as indicator bacteria shall be regularly monitored in broilers, turkeys, laying hens, pigs and cattle using harmonised methodologies. Briefly, for Sweden, this implies that each year, isolates of *Salmonella* from all notified outbreaks in food-producing animals, as well as 170 isolates of *Campylobacter* from either broilers or pigs, are tested for antibiotic susceptibility. Also, 170 isolates of *E. coli* from intestinal content of healthy broilers or pigs are tested each year. In addition, each year 300 samples of intestinal content and 300 samples of fresh retail meat from either broilers and turkeys (only 150 samples) or from pigs and cattle are analysed for presence of ESBL/AmpC- and carbapenemase producing *E. coli*. Due to small production volumes, it is not mandatory for Sweden to investigate *Campylobacter* or indicator bacteria from healthy turkeys or cattle. It is not mandatory to screen for ESBL/AmpC- or carbapenemase producing *E. coli* in these animal categories either. However, sometimes such investigations are still performed, on a voluntary basis. Furthermore, meat from countries outside EU is sampled at border control posts and analysed for indicator *E. coli* and presence of ESBL/AmpC- and carbapenemase producing *E. coli* as well as *Salmonella* for poultry meat.

In addition to the mandatory monitoring described above, Svarm is complemented with data on resistance in clinical isolates of bacteria from the routine testing of clinical submissions at SVA. Svarm is also complemented with data from research projects and specifically from the SvarmPat project focusing on resistance in animal pathogens from farm animals. SvarmPat is run in cooperation with Farm & Animal Health and is financed by the Swedish Board of Agriculture.

Sales of antibiotics for use in animals is also monitored. The primary data source is sales from pharmacies to animal owners (prescriptions dispensed) and to veterinarians (requisition for use in own practice). In Sweden, all veterinary medicinal products are sold by pharmacies and they are obliged to report all sales of medicinal and veterinary medicinal products to the eHealth Agency. Data on sales of antibiotics are calculated to kg active substance. For prescriptions, animal species is also recorded and can be included in the analyses.

Data on antibiotic resistance in bacteria from animals and food as well as data on sales of antibiotics for use in animals are presented in a yearly report together with corresponding data for human medicine compiled by the Public Health Agency of Sweden in an integrated report — Swedres-Svarm — available at www.sva.se/swedres-svarm. The different data sources compiled in this report are illustrated in Figure 73.

## LEGISLATION

As mentioned above, parts of the antibiotic resistance monitoring performed in Sweden are regulated by EU legislations (2003/99/EG and 2020/1729/EU, which from 2021 replaced 2013/652/EU). Furthermore, there is also national legislation indirectly affecting the antibiotic resistance monitoring. More precisely, findings of carbapenemase producing Enterobacterales ($ESBL_{CARBA}$) and methicillin-resistant coagulase-positive staphylococci (e.g MRSA and MRSP) in animals are notifiable in Sweden (SJVFS 2021:10 and previously SJVFS 2012:24 with amendments).

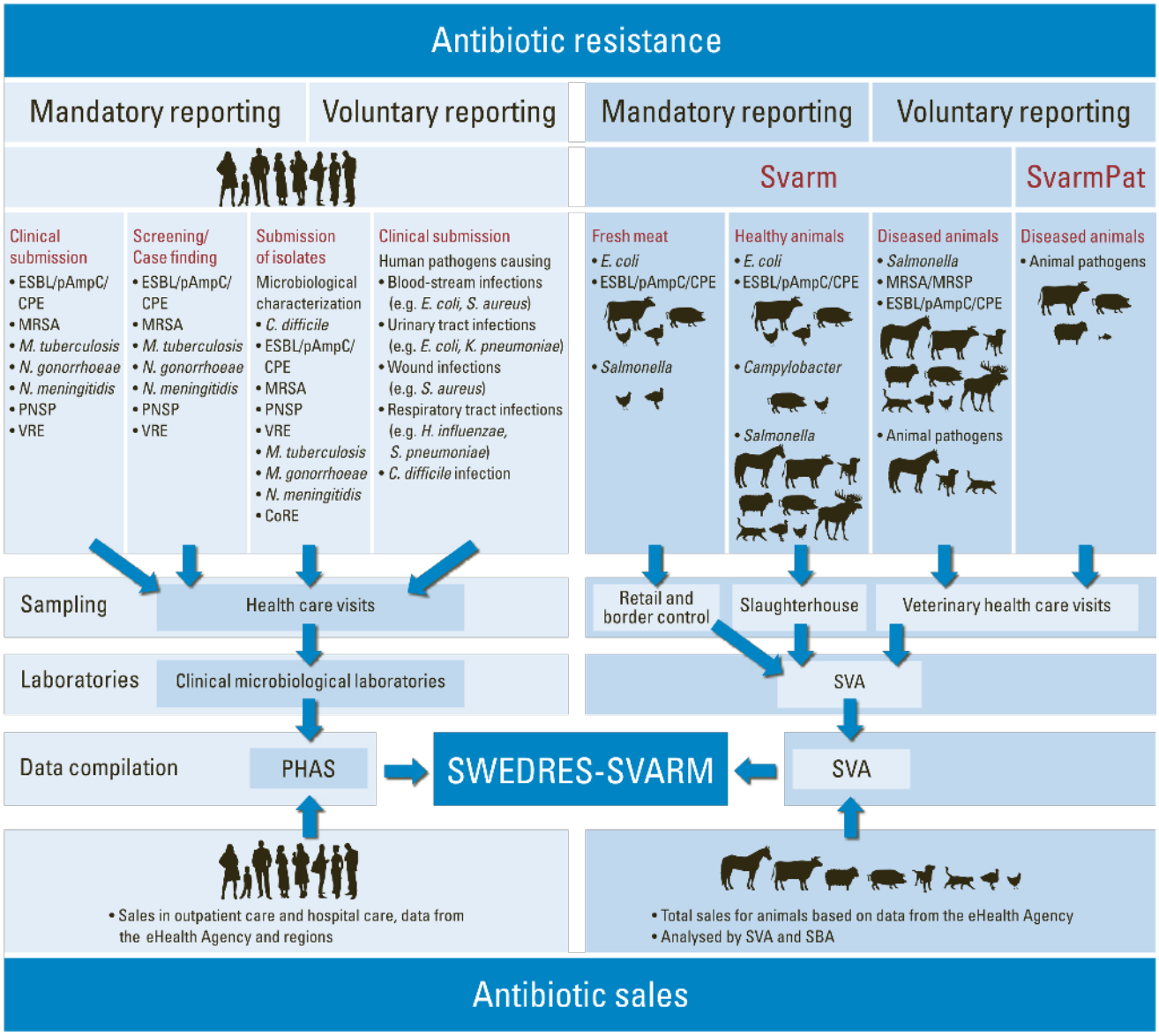


Figure 73: A schematic illustration of data included in the Swedres-Svarm report.

## SUMMARY OF MONITORING IN 2022

For a long time, Sweden has had a favourable situation compared to many other countries when it comes to antibiotic resistance in bacteria from humans. This situation remains. One of the reasons is that we have effective strategies to promote the responsible use of antibiotics and limit the spread of antibiotic resistance. In the last decades, the sales of antibiotics in Sweden have decreased for both humans and for animals. In addition, the distribution between broad- and narrow-spectrum antibiotics has changed and the proportion of narrow-spectrum antibiotics has increased. Among bacteria from animals, the occurrence of resistance has generally been stable at low or moderate levels. For some substances and in some bacteria occurrence of resistance is even declining. One example of this is the occurrence of ESBL producing *E. coli* among broilers that has declined significantly. There are however exceptions, and for example resistance to ampicillin, sulphonamides, and trimethoprim has increased in indicator *E. coli* from both broilers and pigs.

### Antibiotic sales for veterinary use

When retrieving data for 2022, a substantial decrease compared to 2021 was noted, and a lack of completeness was suspected. Investigations to resolve the issue was initiated and a number of rejected data reports from pharmacies were identified and corrected by the pharmacies. Therefore, in this report, data since 2017 has been updated. The difference between 2021 and 2022 was still inexplicably large (-12%) and a thorough search for yet undiscovered errors was undertaken but none was identified. No explanation for this sudden decrease in sale has been identified. Hence, the results should be assessed with caution. Furthermore, if at a later stage some yet unidentified error causing a lack of completeness is discovered, data will be updated and published online on the SVA web page.

In 2022, reported sales of antibiotics for animals from pharmacies in Sweden were 8865 kg, of which around 60% were narrow-spectrum penicillins. Sales of antibiotics that should be used with special restrictions (fluoroquinolones,

third generation cephalosporins and polymyxins) have decreased considerably since 2013. During the past decade, the proportion of products for the treatment of individual animals has been over 90% of the total sales.

Since the withdrawal of growth-promoting antibiotics from the Swedish market in 1986, the total sales of antibiotics corrected for population sizes over time have decreased by more than two thirds. During the 1990s, sales of veterinary products for medication of groups of animals decreased, and in the past decade there has also been a decrease in sales of products for use in individual animals. (Figure 74).

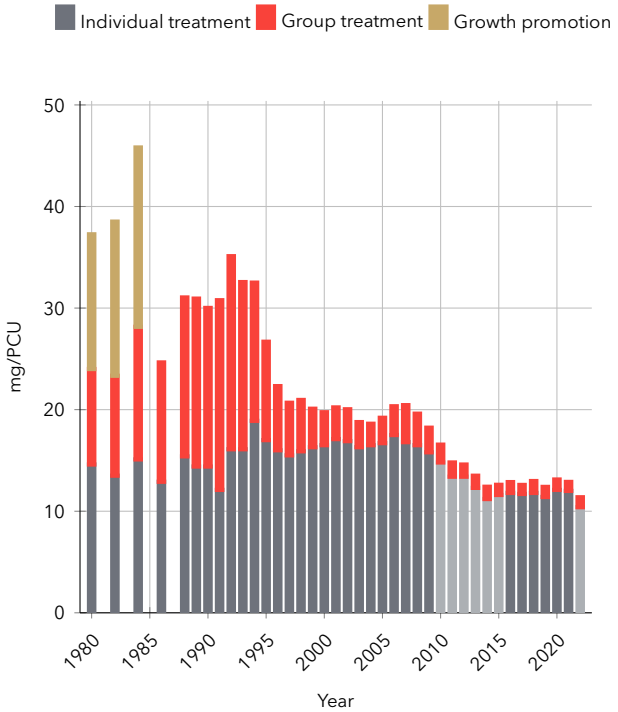


Figure 74: Yearly sales of veterinary medicines with antibiotics expressed as milligrams per population correction unit (mg/PCU). Data for 2022 may be subject to change. Individual treatment data for 2010–2015 are uncertain because of a lack of completeness mainly affecting injectable products. Data for 2022 are also uncertain as a full explanation is lacking. Uncertain individual treatment data are indicated by a lighter grey colour. In the present figure, all products (including tablets) are included, while in data presented in the European surveillance of veterinary antimicrobial consumption tablets are excluded when calculating mg/PCU.

## Extended spectrum beta-lactamase (ESBL) producing Enterobacterales

ESBL-producing Enterobacterales are generally rare among animals in Sweden. Previously, the occurrence in intestinal samples from broilers was high but it has decreased in recent years (Figure 75).

In 2022, the occurrence of ESBL-producing *E. coli* in intestinal samples from broilers, fattening turkeys and laying hens, as well as samples of broiler and turkey meat was investigated with selective methods. Such bacteria were isolated from 2% of the intestinal samples from broilers and laying hens, respectively but not in any intestinal samples from fattening turkeys. Furthermore, such bacteria were not isolated from any of samples of turkey meat or broiler meat of Swedish origin. However, 25% of broiler meat samples of non-Swedish origin were positive for ESBL-producing *E. coli*, although the number of samples are limited and hence the results should be assessed with caution.

Bacteria that produce $ESBL_{CARBA}$ have not been confirmed in domestic animals in Sweden.

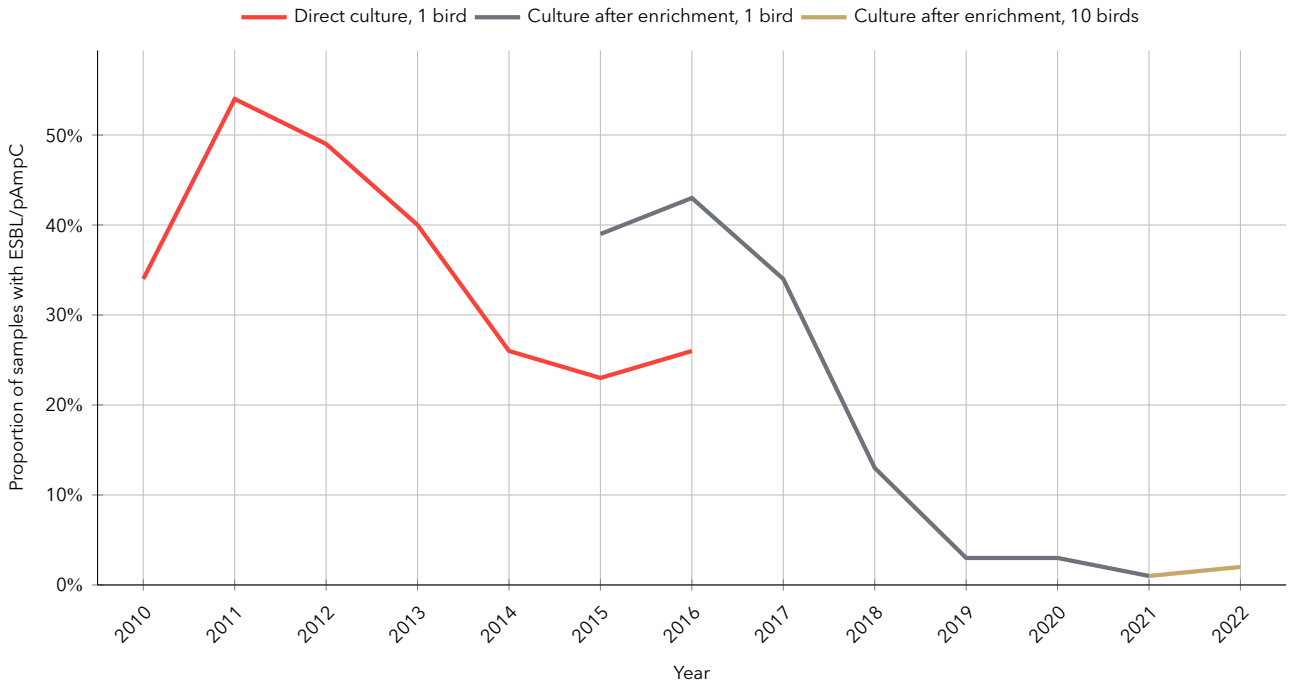


Figure 75: Proportion (%) of samples from broilers positive for *Escherichia coli* with ESBL/pAmpC from 2010 to 2022.

### Methicillin-resistant *Staphylococcus aureus* (MRSA)

The occurrence of MRSA in animals in Sweden is still low, which limits the spread from animals to humans. MRSA was found sporadically in horses, dogs, cats and one parrot. The increase of MRSA cases, compared to previous years, seen in horses in 2020 (n=27) and 2021 (n=23) was partly explained by outbreaks in equine hospitals. Consequently, in 2022 the figures dropped to 13 cases, as there were no outbreaks. In companion animals, the same types of MRSA as in humans dominate, indicating a human source of MRSA in these animals.

### Methicillin-resistant *Staphylococcus pseudintermedius* (MRSP)

In 2022, the number of reported cases of methicillin-resistant *Staphylococcus pseudintermedius* (MRSP) in animals was around the same level as in previous years. In total 54 cases of MRSP were notified to the Swedish Board of Agriculture, including 52 from dogs, one from a cat and one from a orangutan. All isolates were available for further investigations. When MRSP first occurred among animals in Sweden, the sequence type ST71 dominated. However, for several years the isolates of MRSP have been more diverse with several sequence types occurring.

### Resistance in zoonotic pathogens

*Salmonella* is rare in animals in Sweden. Furthermore, only a few of the notified cases involve antibiotic-resistant strains. Resistance to fluoroquinolones is rare. Among 115 isolates from domestic animals in 2022 only 3 were resistant to one antibiotic each and none was resistant against fluoroquinolones. Isolates from human invasive infections with *Salmonella* are markedly more resistant, probably due to the large proportion of cases acquired abroad.

*Campylobacter* from animals in Sweden are generally susceptible to relevant antibiotics, and resistance to erythromycin, for example, is most uncommon.

Infections, either in humans or in animals, caused by *Salmonella* and *Campylobacter* are usually not treated with antibiotics.

### Resistance in animal clinical isolates

Bacteria causing clinical disease in animals are mostly susceptible to antibiotics relevant for treatment. Respiratory pathogens from farm animals and horses are generally susceptible to benzylpenicillin, but resistance occurs, for example in *Pasteurella multocida* from calves. Penicillin resistance is common in *Staphylococcus pseudintermedius* from dogs, *Staphylococcus hyicus* from pigs, and occurs in *S. aureus* from horses and *S. felis* from cats. However, in *S. schleiferi* from dogs penicillin resistance is uncommon. Resistance to commonly used antibiotics in *E. coli* occurs in all animals but is most prominent in enteric isolates from young calves and pigs. Susceptibility testing for guidance in antibiotic therapy is warranted, especially for staphylococci, *E. coli,* and *Brachyspira* spp.

### Resistance in indicator bacteria from healthy animals

Antibiotic resistance in *E. coli* from the intestinal flora of healthy animals serves as an indicator for the presence of resistance in an animal population. The prevalence of acquired resistance in such commensal bacteria also indirectly indicates the magnitude of the selective pressure from the use of antibiotics in an animal population. The prevalence of resistance in indicator bacteria from animals in Sweden is low, and the situation is favourable in an international perspective. As an example, in the latest investigations of indicator *E. coli* from broilers and pigs, 69% and 64% respectively, were susceptible to all tested substances (Table 40).

Table 40: Proportion of randomly selected indicator *Escherichia coli* from broilers and pigs that are susceptible to all investigated antibiotics.

| | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Species | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
| Pigs | - | 68 | - | 71 | - | 71 | - | 64 | - |
| Broilers | 75 | - | 71 | - | 69 | - | 72 | - | 69 |