



## Antimicrobial usage and resistance in food animals - temporal trends and relevance for Public Health

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### Key words

Antimicrobial use, antimicrobial resistance, food-producing animals, international comparison

### Aim of the study

The objectives of this project were (1) to quantify antimicrobial consumption per species in Switzerland based on sales data and compare the results with other countries; (2) to better understand antimicrobial consumption patterns and the factors influencing the use of these substances; (3) to rank combinations of bacteria species resistant to selected antimicrobial classes found in meat, based on the risk they represent for public health in Switzerland; (4) to define research priorities on the topic.

### Material and methods

Objective 1 - To explore potential methods to stratify antimicrobial sales per species three approaches were investigated using Swiss sales data (2006-2013): (1) Equal Distribution allocated antimicrobial sales evenly across all species each product was licensed for; (2) Biomass Distribution stratified antimicrobial consumption, weighting the representativeness of each species' total biomass; and (3) Longitudinal Study Extrapolation assigned antimicrobial sales per species based on a field study describing prescription patterns in Switzerland. A comparison between the antimicrobial consumption in cattle and pigs for Denmark and Switzerland (2007-2013) was established to investigate possible differences in terms of consumption patterns. For Switzerland, results from the study presented above were used; for Denmark, data from DANMAP's reports were gathered. Objective 2 - In order to better understand the factors influencing antimicrobial use, as well as the best strategies to further reduce the use of these substances, an expert opinion study was conducted with veterinarians from Denmark, Portugal and Switzerland. Moreover, the patterns and indications for use of specific substances were investigated. Participants were selected based on their experience or on peer recommendation. A questionnaire was sent to practitioners from four different production types: broilers, swine, dairy, veal/fattening calves.

Objective 3 - A risk assessment model from slaughter to consumption was developed following the *Codex Alimentarius* guidelines for risk analysis of foodborne antimicrobial resistance. Using data from the Swiss antimicrobial resistance monitoring program, 208 combinations of animal species/bacteria/antimicrobial classes were identified as relevant hazards. Exposure assessment and hazard characterization scores were developed and combined using multi-criteria decision analysis.

Objective 4 - An opinion paper was produced highlighting the main fields of research that should be prioritized to achieve a better understanding of the antimicrobial use/ antimicrobial resistance problematic.

### Results and significance

Objective 1 - Although it is not possible to validate the models, we are convinced that the Longitudinal Study Extrapolation (LSE) approach provided the best estimates. In this approach, input data for the model are derived from a longitudinal field study. The LSE model estimated a decrease in antimicrobial consumption both for cattle and pigs: the estimated consumption by cattle dropped from 81.6 mg per kg of biomass (mg/BM)

[47.1–103.3 mg/BM] in 2006 to 67.4 mg/BM [38.7–85.4 mg/BM] in 2013; for pigs, consumption estimates went down from 102.5 mg/BM [54.9–178.6 mg/BM] to 76.4 mg/BM [34.0–143.8 mg/BM] in the same time period. Consumption estimates for poultry, small ruminants (goats and sheep), horses and pets (cats and dogs) were also computed. These methods might represent a tool for other countries to quantify antimicrobial consumption per species using sales data.

Antimicrobial consumption patterns for cattle and pigs varied between Denmark and Switzerland. Both for cattle and for pigs, the largest difference was related to a higher relative consumption of penicillins in Denmark; while in Switzerland, tetracyclines and sulfonamides had a higher relative consumption. These findings stress that differences in antimicrobial consumption do not only exist in terms of amounts used, but also regarding the patterns of use; the factors behind these differences should be further investigated.

Objective 2 – Results from the expert opinion studies reveal that factors influencing antimicrobial use, as well as efficient interventions to mitigate their consumption vary between countries and productions sectors. These differences should be taken into account when developing measures to reduce antimicrobial consumption. Furthermore, clear differences existed between the countries with respect to the patterns and indications for use of specific substances. This is particularly worrying for critically important antimicrobials.

Objective 3 - Poultry-associated combinations represented the highest risk. In particular, contamination with extended-spectrum  $\beta$ -lactamase/plasmidic AmpC-producing *Escherichia coli* in poultry meat ranked high for both exposure and hazard characterization. Tetracycline- or macrolide-resistant *Enterococcus spp.*, as well as fluoroquinolone- or macrolide-resistant *Campylobacter jejuni*, ranked among combinations with the highest risk. This study provides a basis for prioritizing future activities to mitigate the risk associated with foodborne AMR in Switzerland.

Objective 4 – The paper stressed the importance of three main areas for a better understanding of the antimicrobial resistance phenomena: improving the knowledge generated from social sciences, the enhancement of monitoring system for antimicrobial use and an increased focus on the ecology of antimicrobial resistance bacteria and consequent implementation of a One Health approach to attenuate the impact of these bacteria for public health.

#### **Publications, posters and presentations**

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