



# Investigation of the relationship between animal health indicators, antimicrobial usage and antimicrobial resistance on Swiss dairy farms

Adrian Minnig<sup>1</sup>, Véronique Bernier Gosselin<sup>2</sup>, Silja Griss<sup>1</sup>, Gertraud Schüpbach-Regula<sup>1</sup>, Mireille Meylan<sup>2</sup>, Guy-Alain Schnidrig<sup>1,3</sup>, Beat Thomann<sup>1\*</sup>

<sup>1</sup>Veterinary Public Health Institute, Vetsuisse Faculty, University of Bern, 3012 Bern, Switzerland

<sup>2</sup>Clinic for Ruminants, Vetsuisse Faculty, University of Bern, 3012 Bern, Switzerland

<sup>3</sup>Federal Food Safety and Veterinary Office, FSVO, 3003 Bern, Switzerland

## Key words

Dairy cow; Health and welfare indicators; Antimicrobial usage; Animal Treatment Index, Antimicrobial resistance; Management practices

## Aim of the study

The aim of this study was to (i) investigate the relationship of health and welfare indicators (HWI) to farm-level antimicrobial usage (AMU), (ii) capture the current situation of antimicrobial resistance (AMR) in dairy cows and calves on the study farms, and (iii) identify associations between AMR occurrence, AMU, and management practices in Swiss dairy cow farms.

## Material and methods

Dairy cow farms were categorized as farms with high vs. low AMU based on the data from the Swiss antimicrobial reporting system (IS ABV) to recruit 22 high AMU farms and 28 low AMU farms for this study. A set of 25 HWI covering the four categories of (1) health; (2) husbandry and nutrition; (3) appropriate behavior; and (4) freedom from pain, suffering, harm and anxiety was used to assess health and welfare in dairy cows on all 50 study farms. Of these 25 HWI, 13 were assessed during farm visits and 12 were calculated using a combination of regularly collected data from public government databases and breeding associations. Results from these indicator assessments were used to build partial- (per category) and total farm-level health and welfare scores (pHWS and HWS, both 0-100%). To assess the occurrence of AMR, pooled fecal samples were taken rectally from dairy cows and pre-weaning calves on study farms and afterwards inoculated in selective *E. coli*-medium. Extracted isolates were tested for their susceptibility against 15 antimicrobial agents and classified as susceptible vs. resistant according to EUCAST guidelines. At the end of each farm visit, a questionnaire on management practices which may influence AMU was filled out together with the farm owner. Data on farm-level AMU of dairy cows for the years 2021-2023 was obtained from IS ABV. Besides the grouping into high vs. low AMU farms, AMU was also quantified using the "Tierbehandlungsindex", a Switzerland specific antimicrobial animal treatment index (ATI). For the investigation of potential relationships, the farm-level ATI for dairy cows for the year 2023 was used, as HWI- and AMR-data were collected during this time period.

## Results and significance

The average HWS of all study farms was 67% (range: 50-84%) with an average pHWS for health, husbandry and nutrition, appropriate behavior, and freedom from pain, suffering, harm and anxiety of 66% (range: 27-91%), 73% (range: 50-100%), 80% (range: 33-100%), and 53% (range 12-88%), respectively. Single HWI results below an indicator-specific threshold value (alarm value) suggested a need for action to improve health and welfare regarding this indicator. HWI with the largest number of farms below the alarm values were "cleanliness of udder and teats" (20/50 farms), "proportion of cows with calving interval over 430 days" (17/50 farms), "productive lifespan of culled cows" (14/50 farms), and the "proportion of uneasy cows during qualitative behavior assessment (QBA)" (14/50 farms).

Farm level mean ATI of dairy cows for all 50 study farms during the years 2021, 2022 and 2023 were 3.42, 2.77 and 3.97, respectively. High and low AMU farms had a three-year average ATI of 6.62 and 0.85, respectively. Within this three-year period, 13 farms in the low AMU group had at least one year without any antimicrobial treatment prescription (ATI = 0).

The majority of the *E.coli* isolates examined were pan-susceptible. Among the resistant isolates, most were resistant against tetracycline, followed by ampicillin and sulfamethoxazole. The proportion of resistant isolates was significantly higher in calves than in cows. Multiclass resistant ( $\geq 3$  antimicrobial classes) isolates were found in 30% of all calf isolates and in 1.3% of all cow isolates. Isolates resistant against highest priority critically important antimicrobials were found in 8% of all calf isolates and 1.3% of all cow isolates. This distribution of resistant isolates per antimicrobial class and the large difference between pre-weaning calves and dairy cows are consistent with findings in literature from Switzerland and other countries.

Regarding the relationship between dairy cow health and welfare and farm-level AMU, no significant difference in total HWS or any of the category pHWS was found between the two groups of high vs. low AMU farms. On the level of single HWI, high AMU farms had a significantly higher proportion of “uneasy” cows (within the qualitative behavior assessment, QBA;  $p=0.03$ ) and a trend for high AMU farms to have a higher bulk tank milk somatic cell count ( $p=0.07$ ) was found. When AMU was quantified using ATI, total HWS and pHWS for health were negatively correlated with ATI (for both  $p=0.01$ ). Multiple single HWI (e.g. productive lifespan) also negatively correlated with the ATI. The occurrence of at least one resistant isolate from any antimicrobial class per farm did not significantly differ between high vs. low AMU farms and no association to farm specific ATI was found. Comparisons of the occurrence of resistance and ATI per antimicrobial class showed no significant correlations. Milk sample pathogen detection before treatment and in-herd proportion of antimicrobial dry off therapy were management practices associated with higher ATI.

Outcomes from this study demonstrate that the applied HWI and HWS are suitable assessment tools to evaluate, monitor and benchmark the health and welfare status of dairy farms. While some findings suggest partially reduced health and welfare in farms with higher AMU, further analyses with a large number of farms are required to better understand the relationship between HWI and AMU. The antimicrobial resistance patterns observed could not be generally linked to farm-specific AMU, highlighting this complex relationship in which management practices such as udder health management play an important role.

#### **Publication:**

Minnig, A., Bernier Gosselin V., Griss, S., Schüpbach-Regula, G., Meylan, M., Schnidrig, G.A., Thomann, B., (in preparation). Investigation of relationship between animal health indicators, antimicrobial usage, and antimicrobial resistance on Swiss dairy farms

#### **Posters and presentations**

Minnig et al., (2023). Investigation of relationship between animal health indicators, antimicrobial usage, and antimicrobial resistance on Swiss dairy farms. Oral presentation VPH Annual Conference, Bern, Switzerland, December 2023

Minnig et al., (2024). Investigation of relationship between animal health indicators, antimicrobial usage, and antimicrobial resistance on Swiss dairy farms. Poster presentation AACTING Conference, Vienna, Austria, February 2024

Thomann et al., (2024) Smart Animal Health – Gesundheitsindikatoren für Nutztiere. Netzwerk Rindergesundheit, Mai 2024

Minnig et al., (2024). Zusammenhang zwischen Tiergesundheitsindikatoren, Antibiotikaverbrauch und Antibiotikaresistenzen bei Schweizer Milchviehbetrieben. Vortrag DACH-Epidemiologie-Tagung, Salzburg, Österreich, September 2024

Minnig et al., (2024). Investigation of relationship between animal health indicators, antimicrobial usage, and antimicrobial resistance on Swiss dairy farms. Poster presentation ISVEE17, Sydney, Australia, November 2024

Minnig et al., (2024). Investigation of relationship between animal health indicators, antimicrobial usage, and antimicrobial resistance on Swiss dairy farms. Oral presentation VPH Annual Conference, Zurich, Switzerland, December 2024

**Project:** 1.22.02

**Project duration:** October 2022 – January 2025