

Changes of antimicrobial use and antimicrobial resistance (AMR) in fattening pigs in Germany between 2014 and 2021

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Background

On account of the threats associated with AMR in humans, countries are urged to reduce antimicrobial use in animal production. In Germany, antimicrobial sales for veterinarians were reduced by 65 % between 2011 and 2021. Antimicrobial use data at farm level have been recorded since summer 2014. The greatest and most consistent reduction of antimicrobial use at farm level between 2014 and 2021 was observed in pigs. It was the purpose of this study to investigate, whether the reduction in antimicrobial use did also result in a substantial reduction of antimicrobial resistance in *E. coli* that are commonly used as indicators for AMR in mammals.

Material and Methods

In Germany, antimicrobial use at farm level is evaluated using the measure of treatment frequency at the farm level. It divides the product of animal days under treatment in a six month period times the number of substances used per treatment day by the average number of animals in the considered population kept in that six month period. Use was recorded separately for weaned pigs up to 30 kg bodyweight and for older fattening pigs. Results were evaluated for every half-year period, i. e. 2014/2, 2015/1. As an example, a treatment frequency of 5 indicates that an average pig (in the age group under consideration) on the farm was treated for 5 days with one antimicrobial substance during the 6-month period. Of note, the recording was not done for the individual animal but for an average animal on the farm, which might over the respective period include several animals housed in the unit subsequently.

Antimicrobial resistance was investigated in *E. coli* isolates collected from samples of caecum content at slaughter according to Commission Implementing Decisions (EU) 2013/652 and 2020/1729. This was repeated in two-year intervals, i.e. data were available for 2015, 2017, 2019 and 2021. Likewise, selective isolation of *E. coli* that were resistant to 3rd generation cephalosporins was attempted from the samples using the method prescribed by the European Reference Laboratory for Antimicrobial Resistance (EURL-AR). The decrease in antimicrobial resistance to 14 different substances (gentamicin, chloramphenicol, ampicillin, cefotaxime, ceftazidime, meropenem, ciprofloxacin, nalidixic acid, colistin, tetracycline, tigecycline, azithromycin, trimethoprim and sulfamethoxazole) was evaluated using logistic regression models for the individual substances and for complete susceptibility.

Results

Levels of antimicrobial use as measured by the median and 3rd quartile of farm-level treatment frequencies differed substantially between age group with use being higher in younger than in older pigs. In both age groups, use decreased substantially between the second half of 2014 (14/2) and 2021 (21/2). For weaned pigs up to 30 kg, median and 3rd quartile were at 4.8 and 26.2 in 14/2 and at 1.4 and 7.4 in 21/2. For older pigs, they were at 1.2 and 9.5 in 14/2 and at 0.2 and 2.6 in 21/2. The decrease did not occur linearly over time and differed between antimicrobial substances. The decreases in median treatment

frequency at farm level correspond to reductions in average antimicrobial use by about 70% (4.8 to 1.4) in the younger pigs and by about 83% (1.2 to 0.2) in the older pigs.

Between 190 and 249 isolates were tested per annum for AMR in the four years. Highest resistance was observed to ampicillin, tetracycline, sulfamethoxazole and trimethoprim. No resistance was observed to meropenem, colistin or tigecycline. Antimicrobial resistance decreased numerically between 2015 and 2021 for most substances, but the difference was only significant for resistance to fluoroquinolones. The proportion of isolates that were susceptible to all test substances increased from 2015 (38.2%) to 2017 (49.3%), but remained constant thereafter (48.9% in 2021). Cephalosporin resistant *E. coli* were detected in approximately half of the caecal samples with only minor changes over time. It tended to increase between 2015 and 2019 (from 51.5% to 54.0%) but then dropped back to 49.0% in 2021.

Conclusions

Overall, the reduction of antimicrobial use in pigs was associated with a decrease in resistance and an increase in the proportion of isolates that were susceptible to all tested substances. However, the decrease in resistance was less pronounced than the decrease in antimicrobial use. This indicates that resistant strains of *E. coli* are probably well established in the fattening pig population and do not readily diminish with a decrease in selection pressure for resistance. As a consequence, efforts to reduce antimicrobial use in pigs have to be perpetuated and even increased to obtain a substantial reduction in antimicrobial resistance of *E. coli* in pigs at the time of slaughter.