

Risk factors for antibiotic resistance in *Campylobacter* spp. from finishing pigs.

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Antibiotic resistance has been a growing concern over the last decades. The safety of food from animal origin cannot only be compromised by drug residues, but also by antibiotic resistance of food-borne pathogens. In severe cases of human infection with these pathogens, antimicrobial treatment may be complicated or even made impossible. Therefore, a reduction of the use of antimicrobials in meat production is an important contribution to minimizing the risk for humans to be infected by resistant bacteria from animal origin. As quality assurance has to be implemented “from stable to table”, monitoring and research on resistance has to be done not only on consumers’ level in meat, but on farm level in living animals as well. As *Campylobacter* is the most frequent zoonotic pathogen in Switzerland (Swiss Federal Office of Public Health 2003) and is frequently isolated from pigs, it is used as model agent in this study.

The objective of this study was to identify farm-level risk factors for antibiotic resistance in *Campylobacter* species isolated from finishing pigs.

Material and Methods

From May 2001 to November 2001, a cross-sectional study was performed on 88 finishing pig farms with either traditional indoor housing in slatted floor pens (41 farms) or ‘animal-friendly’ production with straw bedding and outdoor access (47 farms). Housing system and farm management were assessed by structured interview. The prevalence of clinical disease was recorded on four occasions on each farm. Two different groups of fattening pigs were examined two weeks after entering the fattening unit (30 kg weight), and before slaughter (100 kg weight). From each farm, twenty faecal samples from market-weight finishing pigs were collected and combined into four pooled samples (Stege et al. 2000). Pooled faecal samples were cultured for *Campylobacter* species. Isolated *Campylobacter* strains were further characterized by phenotypic or biochemical traits. For resistance testing, the disc diffusion method was performed as recommended by the National Committee for Clinical Laboratory Standards (NCCLS 1997,1998). Tested antimicrobials included fluoroquinolones (ciprofloxacin and nalidixic acid), erythromycin, tetracycline, kanamycin, polymyxin, chloramphenicol, gentamicin, and streptomycin. Data were analysed by multivariable logistic regression, correcting for farm effect by Generalized Estimation Equation. For each antimicrobial, a separate regression model was performed. In addition, risk factors for resistance against at least three antimicrobials were analysed in a separate model.

Results

Ninety-two percent of pooled faecal samples were positive for *Campylobacter* species. In 95% of the positive pools, *Campylobacter coli* was isolated. In *Campylobacter*-strains, the prevalence of resistance was 25% for fluoroquinolones, 20% for erythromycin, 9% for tetracycline, 79% for streptomycin, and less than 2% for kanamycin and polymyxin. All isolates were susceptible to chloramphenicol and gentamicin. In univariable analysis, pigs raised in 'animal-friendly' farms had lower odds for being carriers of *Campylobacter* species with resistance to three or more of the tested antimicrobials than pigs from traditional production. In addition, significantly fewer isolates were resistant to fluoroquinolones and streptomycin in 'animal-friendly' farms. In multivariate analysis, type of housing was no longer a significant risk factor for antibiotic resistance. 'Animal-friendly' farms differed from traditional farms in a lower prevalence of tail biting, a lower prevalence of skin lesions, and a smaller average herd size. All of these factors significantly decreased the risk for antibiotic resistance in multivariate analysis.

Significant risk factors for fluoroquinolone resistance were clinical evidence of tail biting in 100 kg pigs, and feed that did not contain whey. In contrast, lameness in 100 kg pigs and skin lesions at the coronary band in 30 kg pigs were associated with a decreased risk for fluoroquinolone resistance. Erythromycin resistance was positively associated with the health problems lameness and skin lesions at the ears in 30 kg pigs, ad libitum feeding, and housing of pigs in an old building. Tetracycline resistance was more frequent in farms where 30 kg pigs showed respiratory signs, lameness and recumbency. No routine worming, and larger herd size were also significant risk factors for tetracycline resistance. Streptomycin resistance was positively associated with presence of tail biting in 30 kg pigs. Multiple-resistance *Campylobacter* strains were found more frequently in farms which did not restock with an all-in all-out system, and when lameness, ill-thrift, and skin lesions at the shoulder were observed in 30 kg pigs.

Discussion

Predominantly, health problems observed in 30 kg pigs showed a strong positive association with the presence of antibiotic resistance in *Campylobacter* species. This is consistent with data on prescription of medicated feed in Switzerland, where the majority of prescriptions affected pigs < 30 kg (Arnold et al. 2003). Because of low data quality of treatment records, it was not possible to show a direct association between the frequency of antimicrobial treatment on farms and resistance in isolated *Campylobacter* strains. However, it is likely that fewer injuries and an optimised management resulted in a reduced use of antimicrobials, and thus reduced development of resistance in isolated bacteria. Risk factors related to the feeding practice were not previously identified in relation to antimicrobial resistance and need further investigation in order to exclude potential confounding.

In summary, it was shown that good management and a good herd health status were associated with a reduction of the prevalence of resistance in *Campylobacter* species from finishing pigs. The causal pathway of these associations will be further

investigated. Improving pig welfare and health may not only be of economical and ethical interest, but may also contribute to human health.

References

¹ Swiss Federal Office of Public Health. "Meldungen Infektionskrankheiten". Bulletin, 2003, 33: 570.

² Stege H, Jensen TK, Moller K, Baekbo P, Jorsal SE. "Prevalence of intestinal pathogens in Danish finishing pig herds". Preventive Veterinary Medicine, 2000, 46, 279-292.

³National Committee for Clinical Laboratory Standards. "Performance Standards for Antimicrobial Disc Susceptibility Tests". 6th edn. Approved standard M2-A6. Wayne, NCCLS, 1997, 1-17.

⁴National Committee for Clinical Laboratory Standards. "Performance Standards for Antimicrobial Susceptibility Testing". 8th informational supplement M100-S8. Wayne, NCCLS, 1998, 14-15.

⁵ Arnold S, Gassner B, Giger T, Zwahlen R. "Banning antimicrobial growth promoters in feedstuffs does not result in increased therapeutic use of antibiotics in medicated feed in Swiss pig farming". Pharmacoepidemiology & Drug Safety, 2003 (in press).