Why is antimicrobial resistance in faecal *E. coli* greater in cows than sheep?

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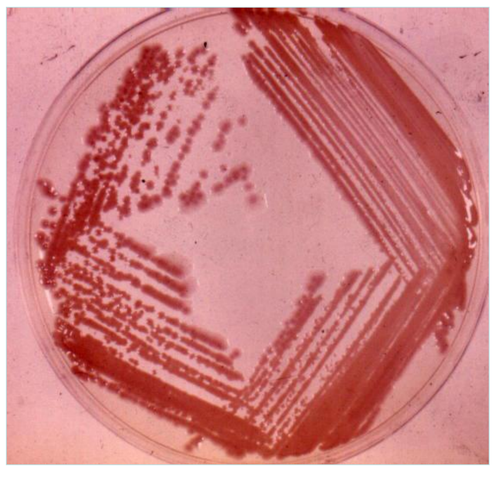
Introduction

- Although unquantified, the link between antimicrobial resistance in production animals and humans is demonstrated by case studies(1).
- It is useful to have knowledge of the level of antimicrobial resistance within production animals.
- We ran two surveys: one of calves and adult cattle and the other of sheep measuring sample-level prevalence of resistance in faecal *E. coli*.
- Prevalence was highest in calves, then adult cattle and lowest in sheep.



Methods

- 100 beef cattle farms and 104 sheep farms - randomly sampled in the Scottish Highlands.
- Target number of animals per farm to be sampled was 5 calves, 5 finishing cattle or 5 cows and 10 sheep. Faecal samples were taken directly from the animal and tested by smearing on *E. coli*-selective media plate impregnated with antibiotic (Ampicillin, Apramycin, Nalidixic Acid and a control plate). A scoring system gave a simplified quantification of the density of bacteria able to grow on the media(2).
- At the time of sampling a questionnaire was completed with the farmer to estimate what antimicrobials had been used within the past 12 months on the farm.
- A betabinomial GLM accounted for underdispersion where necessary.
- We tested for the effect of antibiotic type, the amount of growth on the control plate, the type of animal and the level of antimicrobial usage on the farm.

Results

- Antibiotic type was the most important factor determining resistance with low levels of measured resistance for apramycin and nalidixic acid (Table 1).
- Most of the remaining variation in resistance was accounted for, by animal type with calves showing highest resistance and sheep lowest.
- The simplified measure of density of *E. coli* did not account for as much of the variation as did animal type.
- A comparison of non-nested models with AIC suggested greater support for type of animal as an explanatory variable than our measure of density of *E. coli*.
- The level of antimicrobial usage appeared both low (especially in sheep) and was not associated with the level of resistance

Table 1. Prevalence estimates for each antibiotic*animal class combination calculated assuming a betabinomial distribution. Confidence intervals (in brackets) were calculated from the estimated standard error for each prevalence estimate.

Probability (95% CI)	Ampicillin	Apramycin	Nalidixic Acid
Calves	87.8% (82.8, 91.5)	15.2% (9.9, 22.8)	7.38% (4.1, 13.0)
Adult cattle	47.0% (41.5, 52.5)	3.36% (1.85, 6.00)	1.94% (0.74, 4.97)
Sheep	20.6% (16.8, 25.0)	4.55% (2.7, 7.5)	0.785% (0.3, 1.9)

Conclusions

- Sample-level resistance is higher amongst calves than adult cattle, with sheep showing the lowest prevalence.
- A possible explanation for this gradient is that calves have higher densities of E. coli than adult cows(3) and possibly sheep. However, the statistical modelling suggested that this can not be the full explanation for the differences in prevalence between the different animal types. Therefore we are left believing that there are other explanations and a simple one is to hypothesise that cattle are reared more intensively.
- Whilst antibiotic usage in cattle was generally higher than in sheep the statistical modelling did not support the inclusion of antibiotic usage and therefore this explanation isn't supported by our data either.
- In summary, we can be reasonably confident that sample level prevalence was higher in calves than adult cattle and in turn higher than sheep and that this is in part may be for by the density of *E. coli* in each category but that there appear to be other drivers at work.

References

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Acknowledgements

We thank the farmers of the Highlands of Scotland who voluntarily participated in these surveys, Mrs Siobhan MacDonald who collected the bovine samples and the Scottish Government who funded these studies.