A Register-based Study of Antibiotic Use in Danish Veal Farms

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Which farm characteristics affect antibiotic use?

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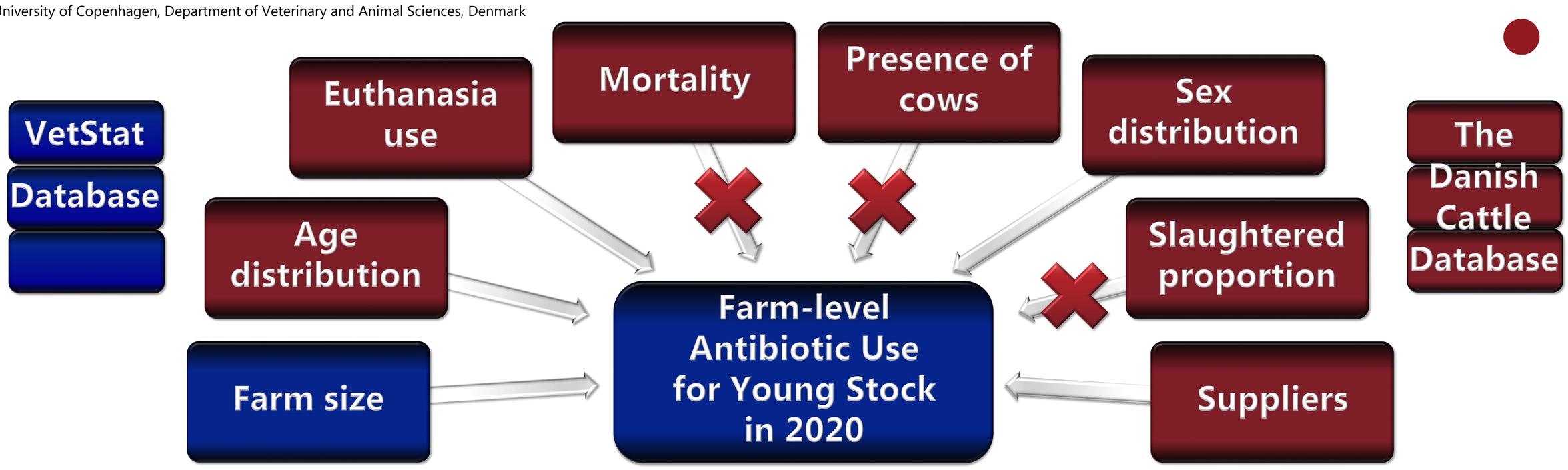

Figure 1: The model depicted with the eight explanatory variables tested for association with the outcome Farm-level antibiotic use in 2020. The databases VetStat and the Danish Cattle Database are depicted and data extracted from each is colored accordingly

Results: Increasing farm size based on young stock population, proportion of males, number of suppliers, proportion of young stock under 6 months of age, and the use of euthanasia resulted in higher odds of having a "High" AMU. Presence of cows, mortality and proportion of slaughtered animals were not found to have an effect in the final model.

Odds Ratios with 95% confidence intervals for the final model

Variable	Level	Odds Ratio	Confidence Interval		p-value
			Lower 2.5%	Upper 97.5%	
Age distribution	>= 0.5	3.97	1.91	8.25	0.00022
Euthanasia use	Euthanizes	2.22	1.11	4.45	0.024
Farm size	300 to 600	8.40	3.60	19.59	< 0.0001
	>= 600	13.33	5.17	34.40	< 0.0001
Sex distribution	>= 0.9	3.69	1.76	7.73	0.00053
Suppliers	10 to 20	3.29	1.38	7.82	0.0071
	>= 20	6.41	2.50	16.44	0.00011

Materials and methods:

Model: A multivariable logistic analysis model testing eight qualitative variables' association with a dichotomous outcome. Backwards elimination was applied using Akaike's Information Criterion.

Population: 553 Danish veal farms

Period: 2020

Data sources: Two Danish registers

- VetStat
- The Danish Cattle Database

Model input definitions

Outcome

"High" or "Low" farm antibiotic use: Number of antibiotic Animal Daily Doses[1] for cattle young stock relative to number of animal days per farm in 2020 i.e. % Treated Animals/Day. Dichotomized using cut 1.2%[2]

Explanatory variables

Farm size: Average number of cattle young stock animals in 2020. Three groups with cuts 300 and 600

Age distribution: Proportion young stock above and below six months of age dichotomized using the 75% quantile

Euthanasia use: Proportion of young stock animals euthanized. Dichotomized (present/absent)

Mortality: Proportion of young stock animals dead grouped by 33% and 66% quantiles

Presence of cows: Proportion of cows relative to overall farm size. Dichotomized (present/absent)

Sex distribution: Proportion of male young stock dichotomized using the median

Slaughtered: Proportion of young stock and bulls slaughtered relative to farm size grouped using 40% and 80% quantiles

Number of suppliers: Number of unique suppliers. Three groups with cuts 10 and 20

Discussion: The model performed well in identifying farms with AMU below the threshold but were less consistent in identifying farms above the threshold of 1.2% treated animals per day correctly. Challenges with the model performance may be caused by a very heterogeneous study population. The results and reported odds ratios should therefore be interpreted with caution.

Observed outcome vs model prediction

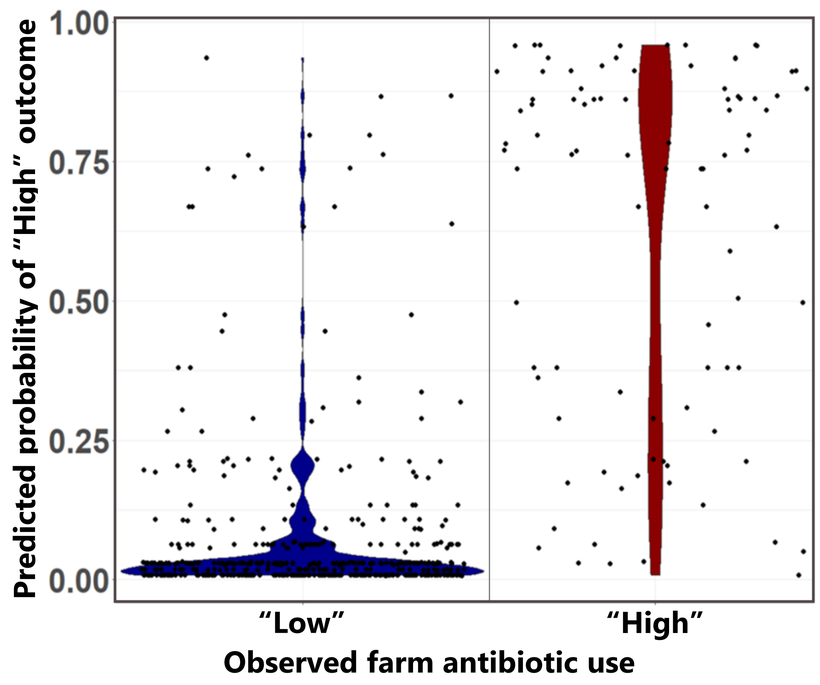

Figure 3: Violin plot with overlaying scatterplot visualising model performance per study farm with the observed outcome classified as below ("Low") and equal to or above ("High") 1.2% treated animals per day versus the models predicted probability of a "High" outcome

ROC curve

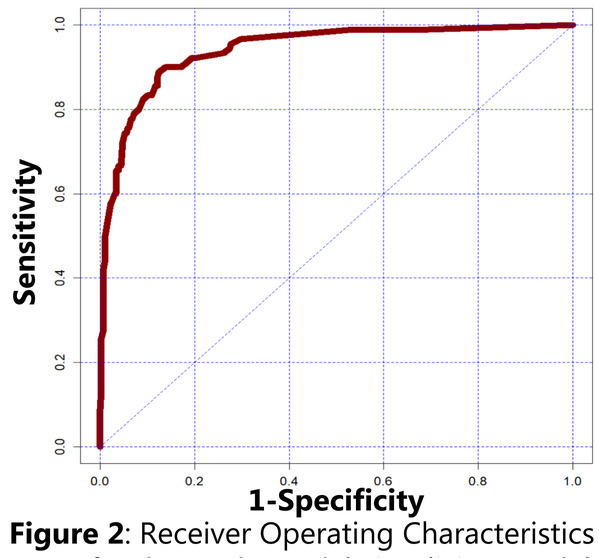

Figure 2: Receiver Operating Characteristics curve for the study model visualizing model performance in distinguishing between farms with an antibiotic use below and above 1.2% treated animals per day on average the resulting Area Under the Curve was 0.94.

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[1] Animal Daily Dose is defined per product and species by the Danish Veterinary and Food Administration based on Summary of Product Characteristics provided by the medical company [2] The Danish national "yellow card" threshold for cattle young stock