University of BRISTOL

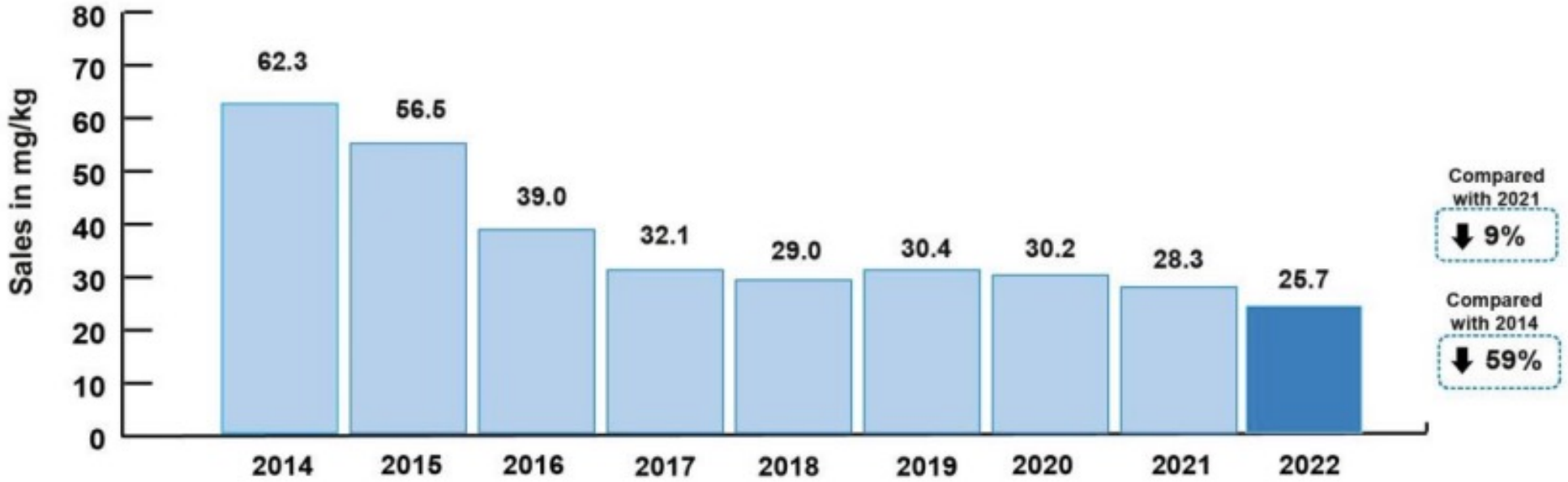
Utilising routinely collected veterinary practice data to better understand factors associated with antimicrobial use on UK dairy farms

Lucy Vass[1], Jon Massey[2], Fernando Sanchez-Vizcaino[1], Kristen Reyher[1], Andrew Dowsey[1,3]

[1]Bristol Veterinary School, University of Bristol, UK
[2]Bennett Institute for Applied Data Science, University of Oxford, UK
[3]Bristol Medical School, University of Bristol, UK

In collaboration with Synergy Farm Health

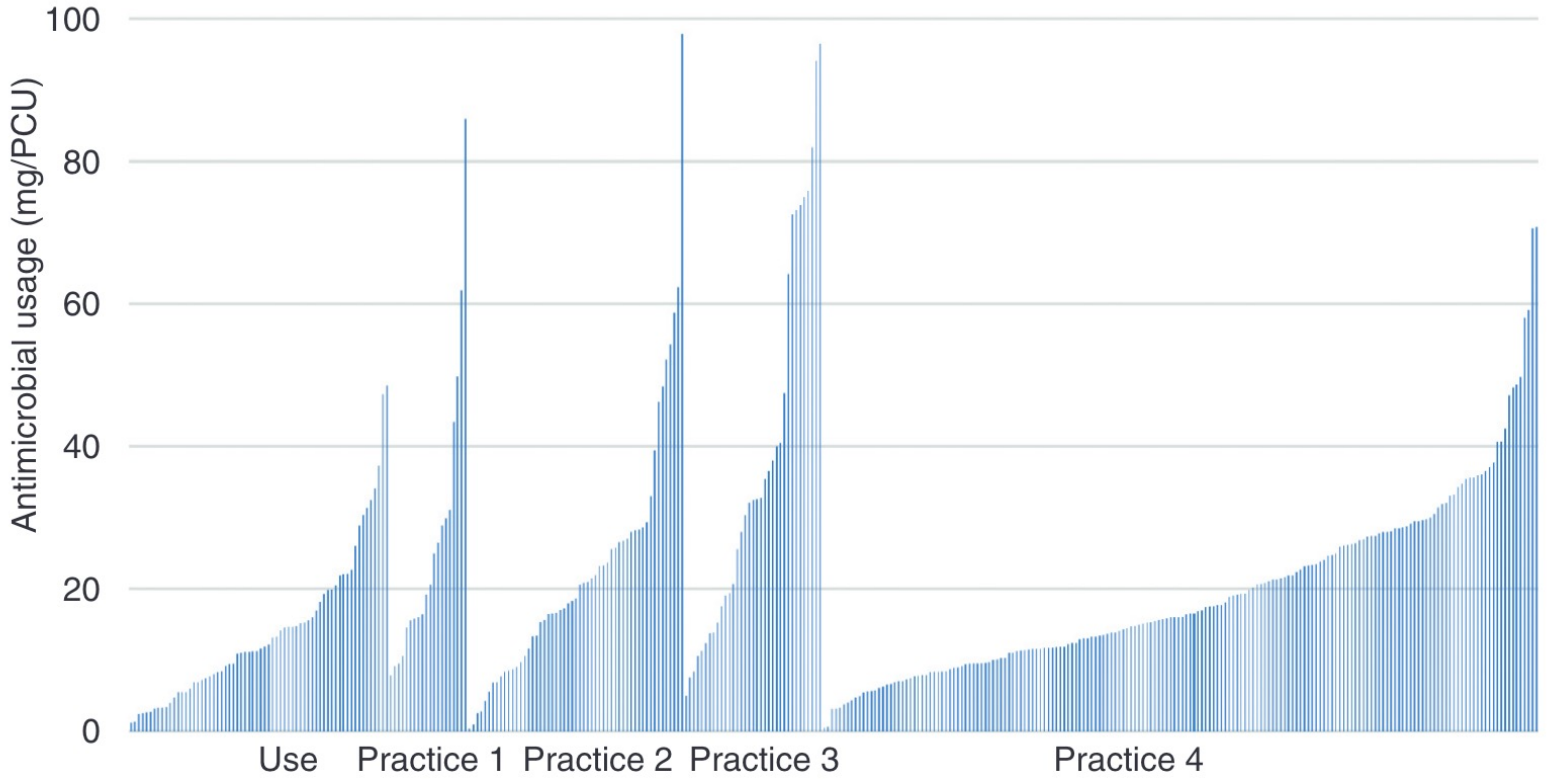
AM sales in UK food-producing animals



Sales of antimicrobials for use in food-producing animals, UK
UK-VARSS Report 2023[1]

1) UK-VARSS (2023). Veterinary Antibiotic Resistance and Sales Surveillance Report (UK-VARSS 2022). New Haw, Addlestone: Veterinary Medicines Directorate.

AM use in UK dairy



Distribution of annual AM sales to dairy farms from 4 different UK practices. Hyde 2017[1]

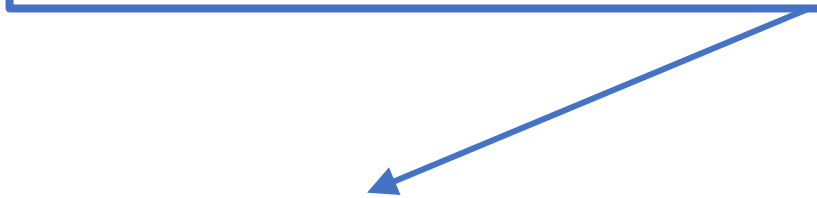
1) Hyde, R.M. et al. (2017) 'Quantitative analysis of antimicrobial use on British dairy farms', Veterinary Record, 181(25), pp. 683–683. Available at: https://doi.org/10.1136/vr.104614.

Better understanding high AM users

To further reduce AM use, we need a better understanding of the reasons driving high using herds

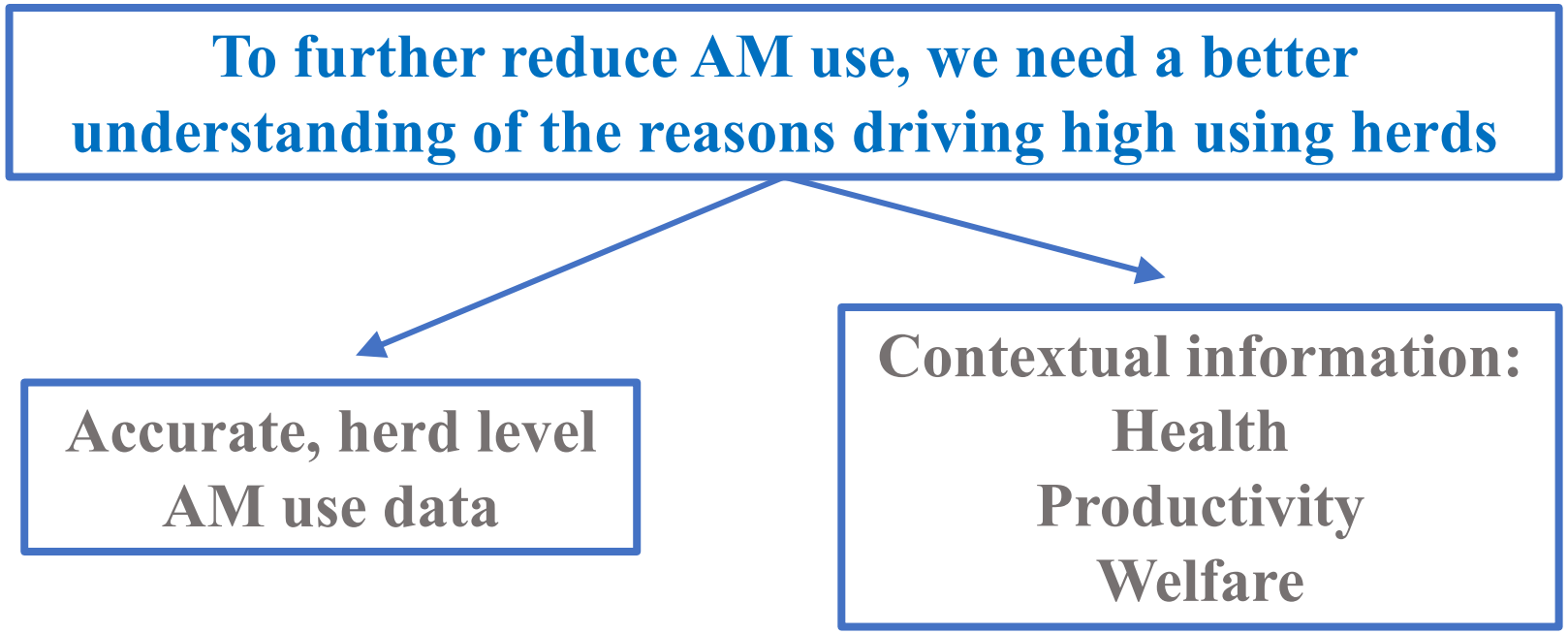
Better understanding high AM users

To further reduce AM use, we need a better understanding of the reasons driving high using herds

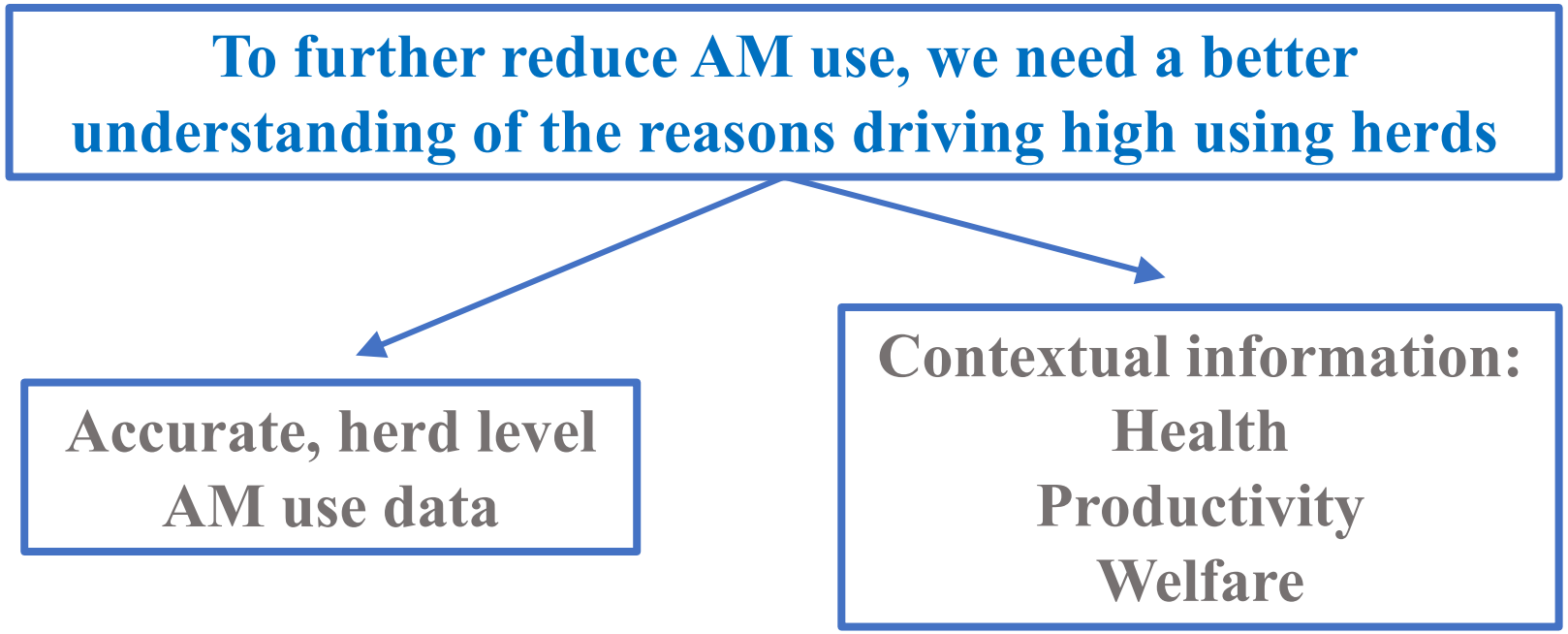


Accurate, herd level AM use data

Better understanding high AM users



Better understanding high AM users



Can we use routinely collected vet practice data?

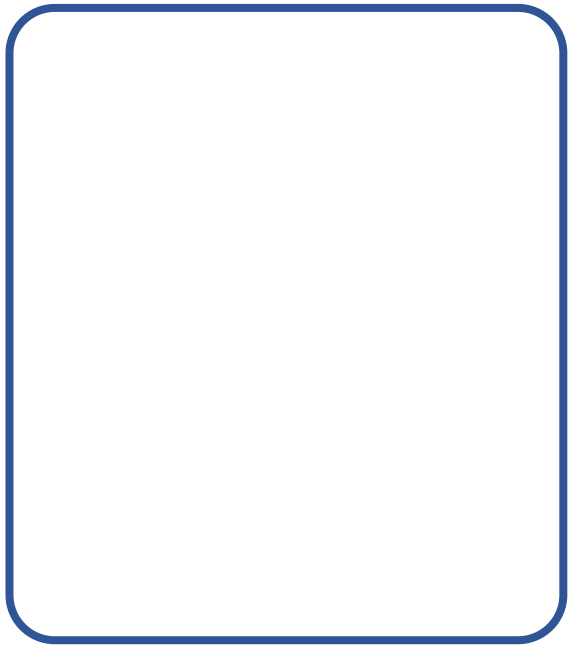
Can we use routinely collected vet practice data to better understand AM use in dairy?

- **124** dairy farms
- 9 years (2010-18)
- Approx. 3% of the total UK dairy herd
- Larger, high yielding herds than UK average

Lucy Vass, Bristol Veterinary School

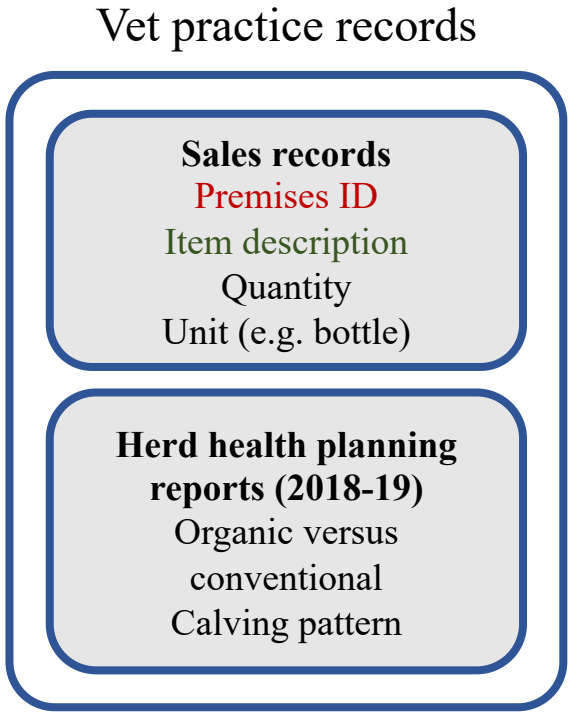
Linking AM sales and farm contextual information

Vet practice records

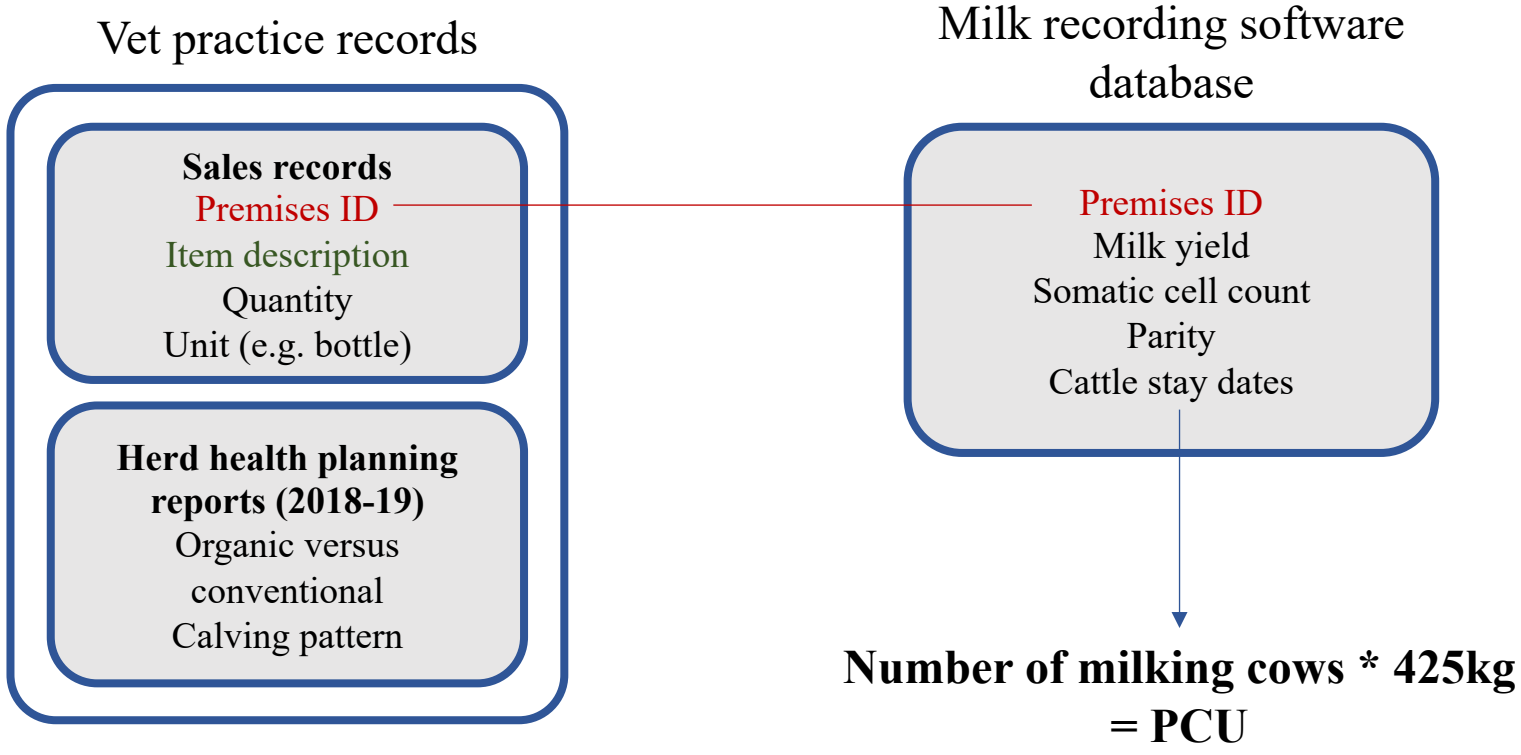


Linking AM sales and farm contextual information

Linking AM sales and farm contextual information



Linking AM sales and farm contextual information



Linking AM sales and farm contextual information

Internal medicines database

Veterinary Medicines Directorate

Product name
Active ingredient
Concentration

Vet practice records

Sales records
Premises ID
Item description
Quantity
Unit (e.g. bottle)

Herd health planning reports (2018-19)
Organic versus conventional
Calving pattern

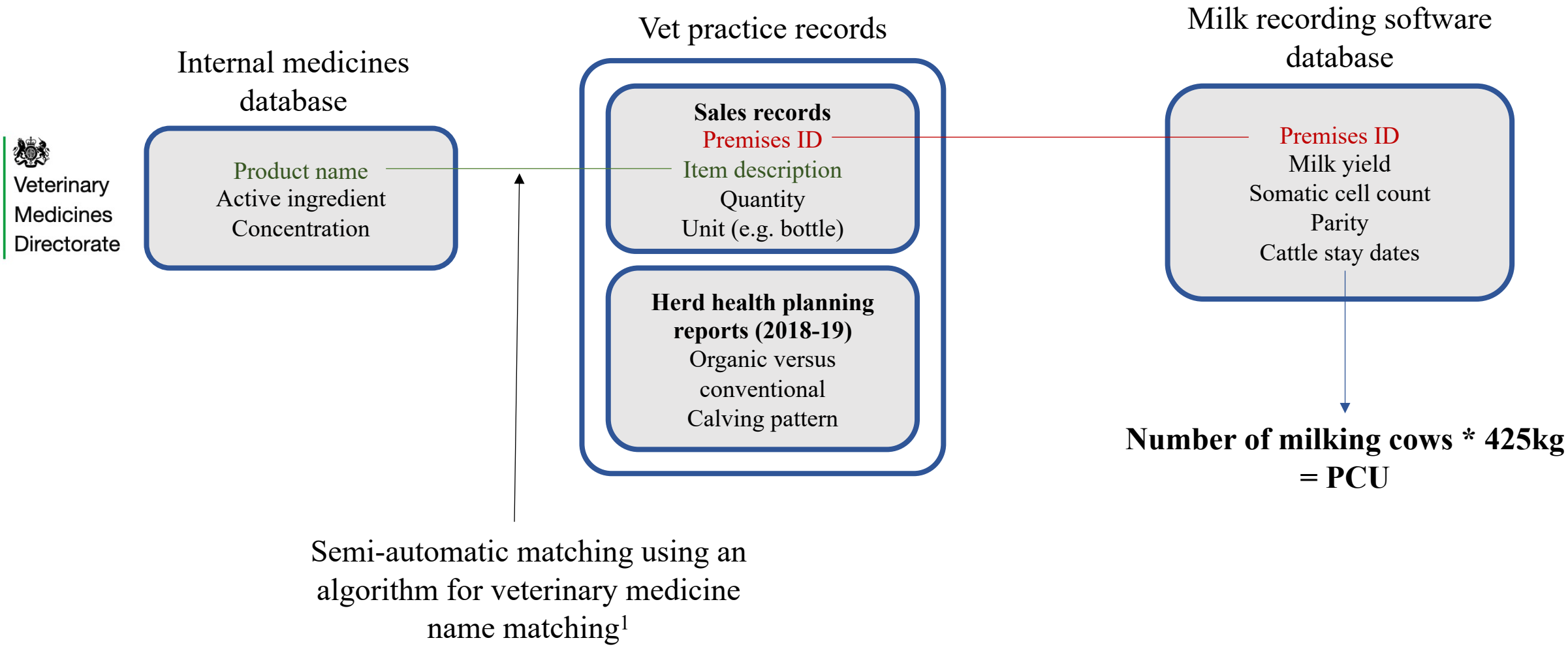
Milk recording software database

Premises ID
Milk yield
Somatic cell count
Parity
Cattle stay dates

Number of milking cows * 425kg = PCU

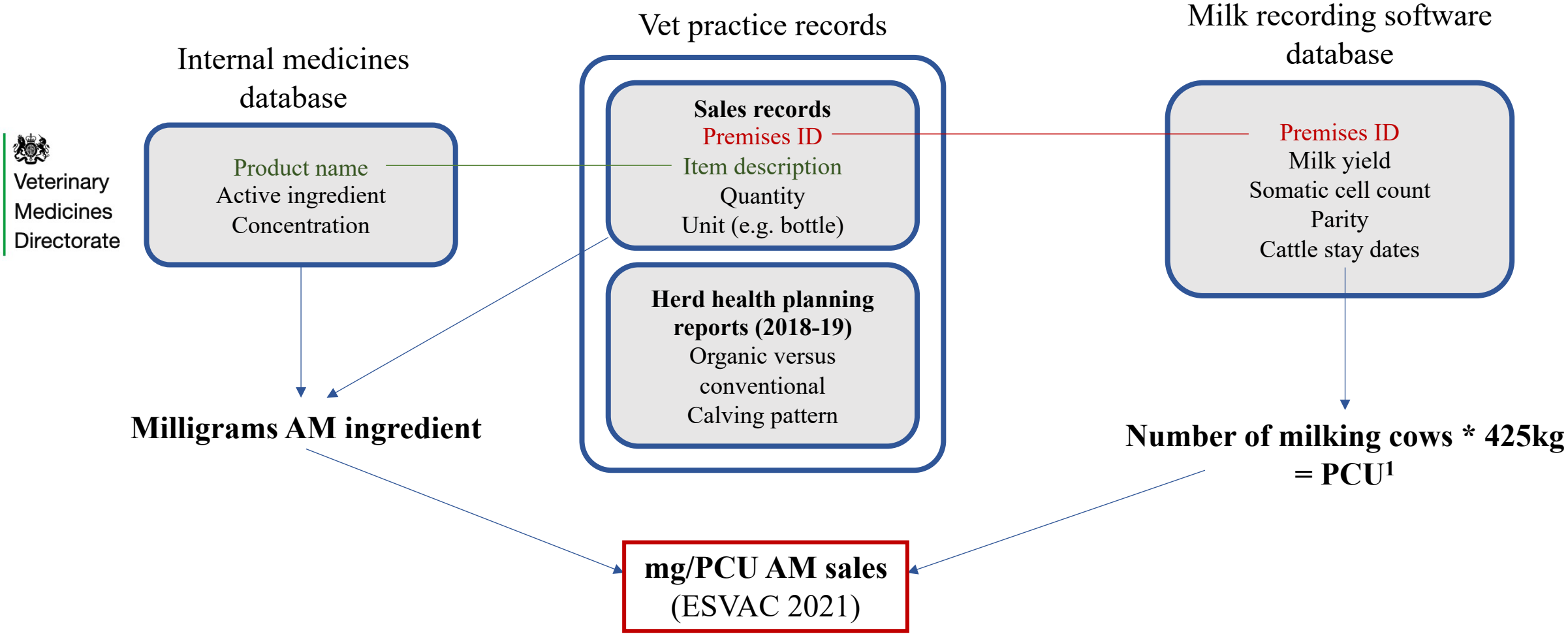
Lucy Vass, Bristol Veterinary School

Linking AM sales and farm contextual information



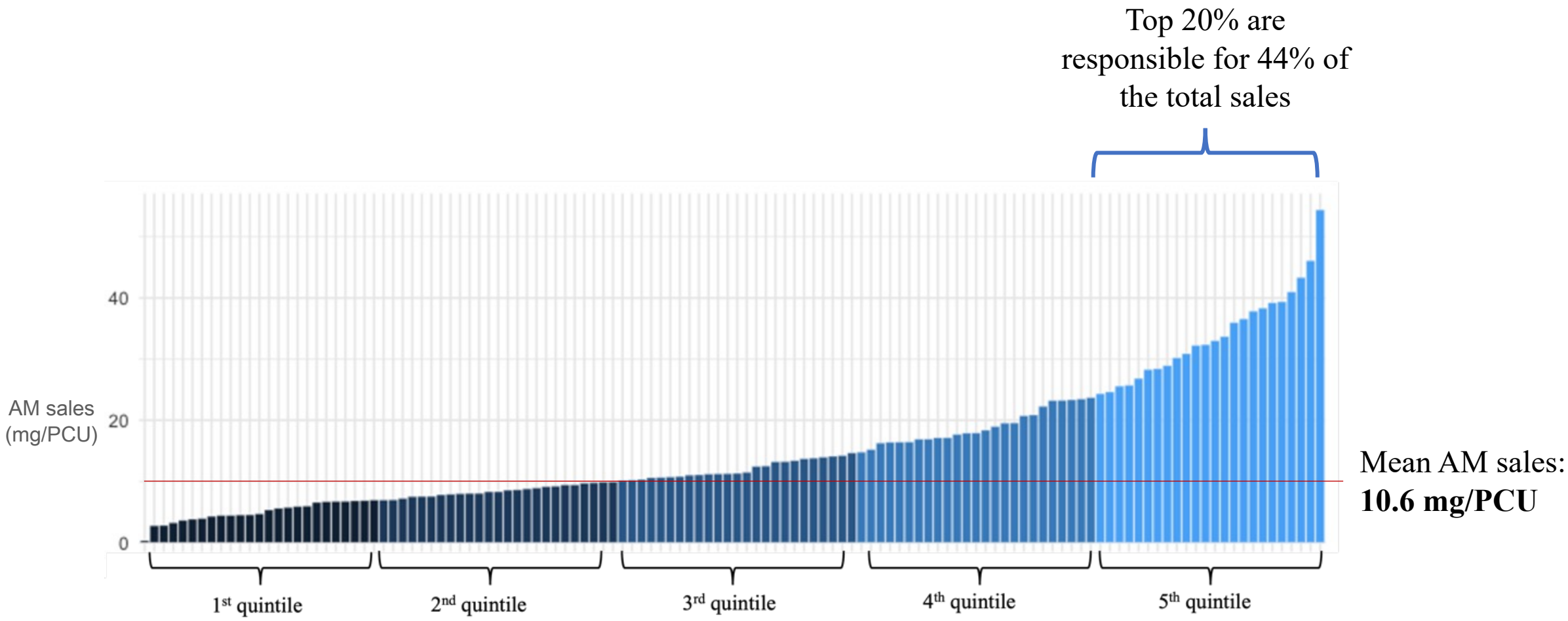
1) Massey, J. (2021) *Barriers to Population Level AMR research in UK livestock and opportunities for data science*. Dissertation. University of Bristol.

Linking AM sales and farm contextual information



Lucy Vass, Bristol Veterinary School

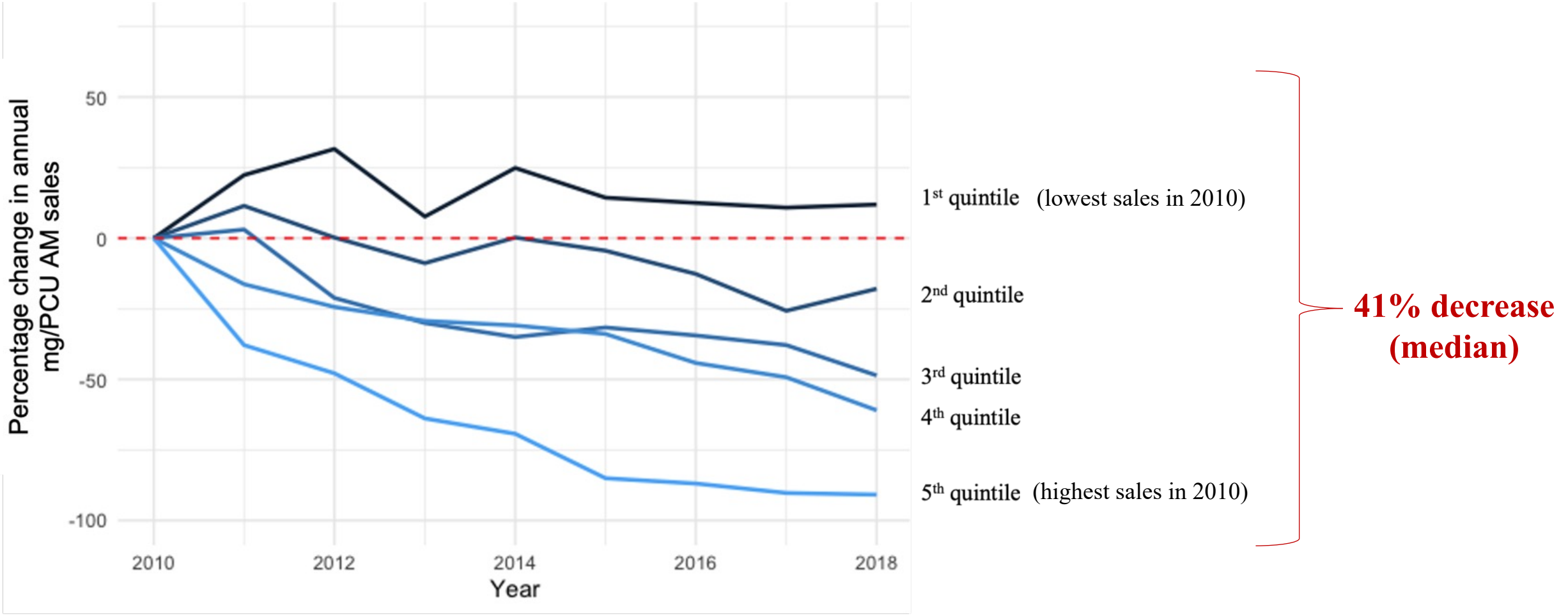
Total annual AM sales, 2018



Study farms ranked by annual AM sales (mg/PCU) in 2018

Lucy Vass, Bristol Veterinary School

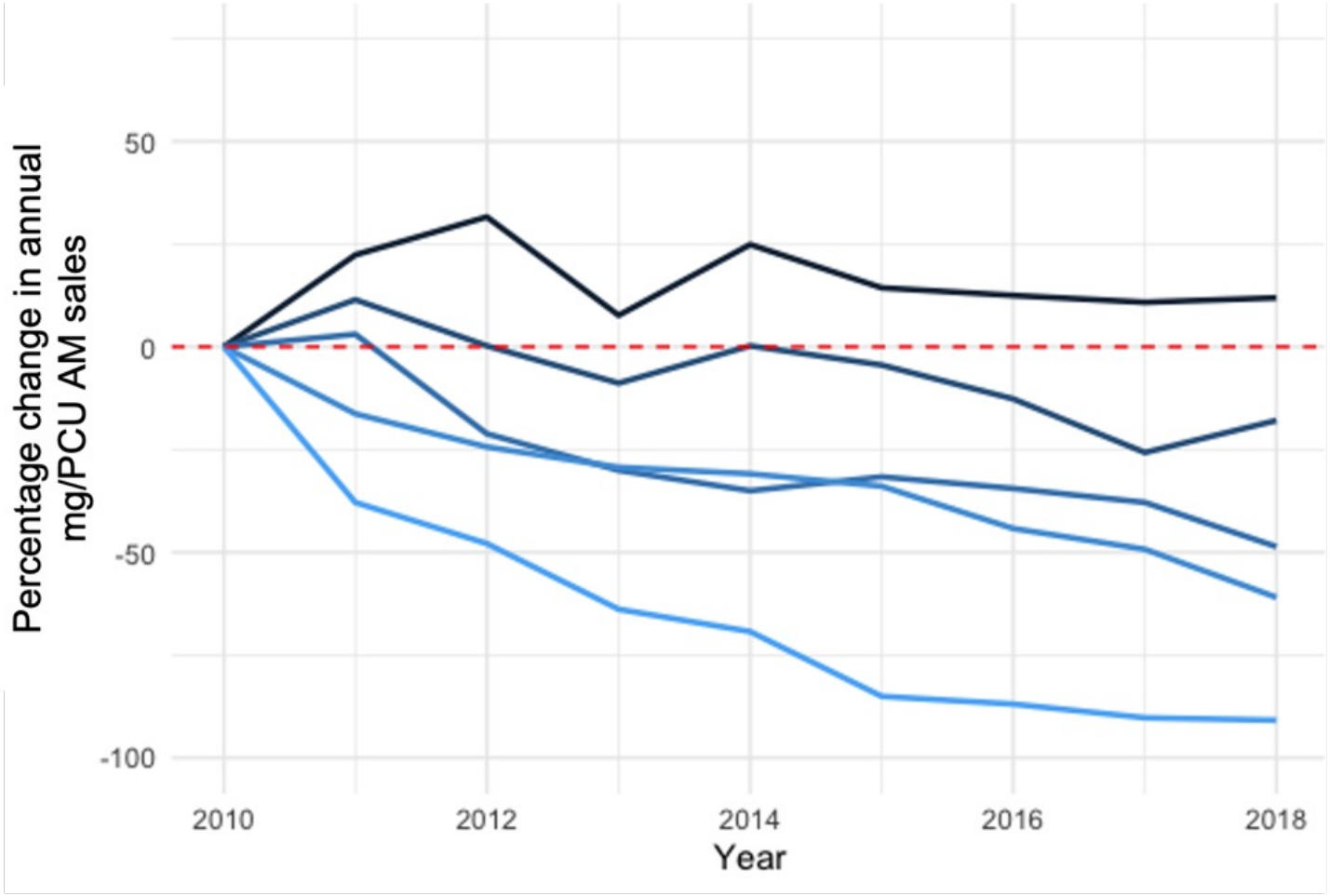
Largest decreases seen in historically high AM purchasers



Lines showing the median percentage change in AM sales (mg/PCU) each year in comparison to 2010

Lucy Vass, Bristol Veterinary School

Largest decreases seen in historically high AM purchasers



1st quintile (lowest sales in 2010)

2nd quintile

3rd quintile

4th quintile

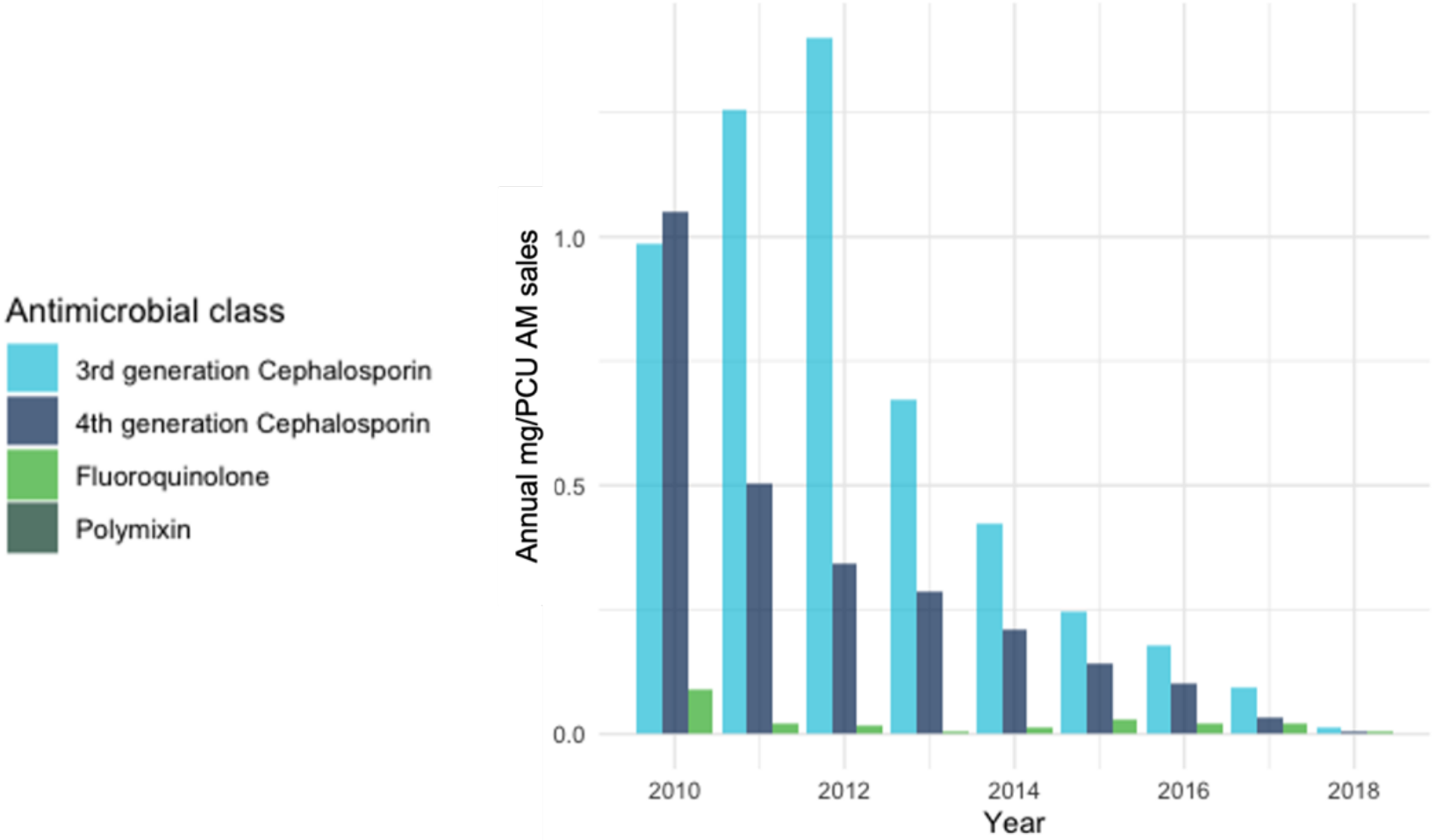
5th quintile (highest sales in 2010)

91% decrease in sales

Lines showing the median percentage change in AM sales (mg/PCU) each year in comparison to 2010

Lucy Vass, Bristol Veterinary School

EMA Category B sales decreased to almost zero

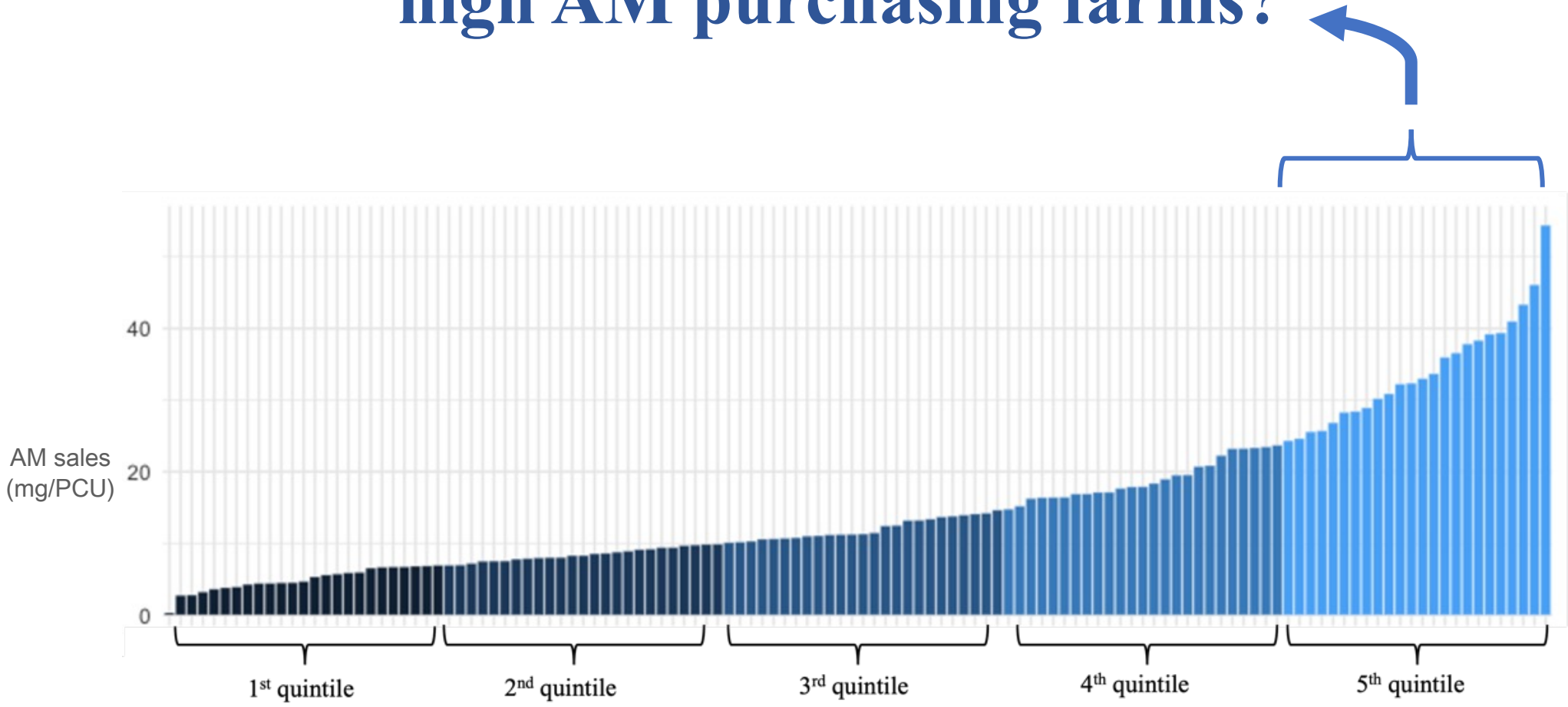


Annual EMA Category B sales across the study herds, split by AM class.

Lucy Vass, Bristol Veterinary School

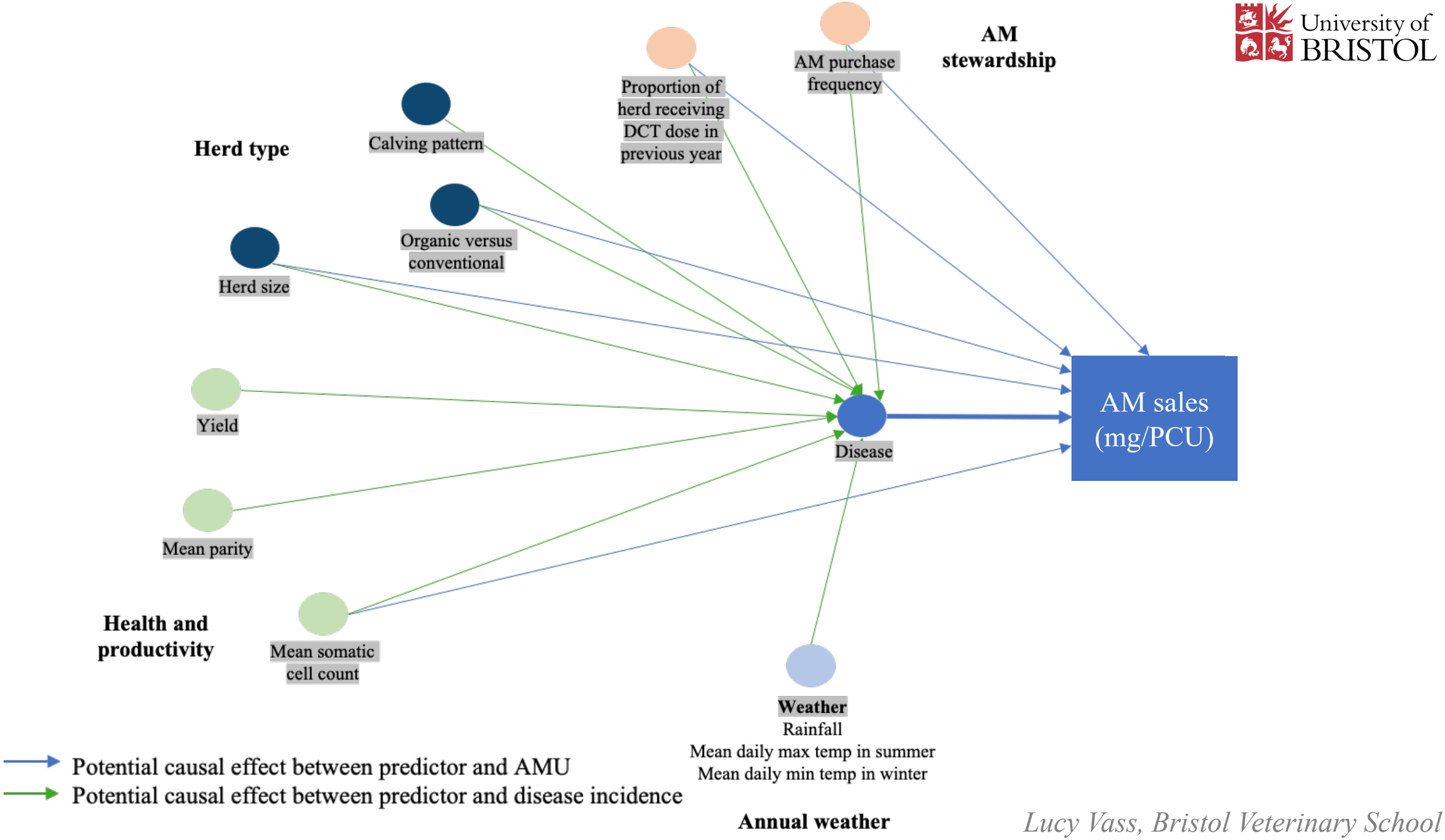
University of BRISTOL

What factors are associated with high AM purchasing farms?



Study farms ranked by annual AM sales (mg/PCU) in 2018

Lucy Vass, Bristol Veterinary School



Lucy Vass, Bristol Veterinary School

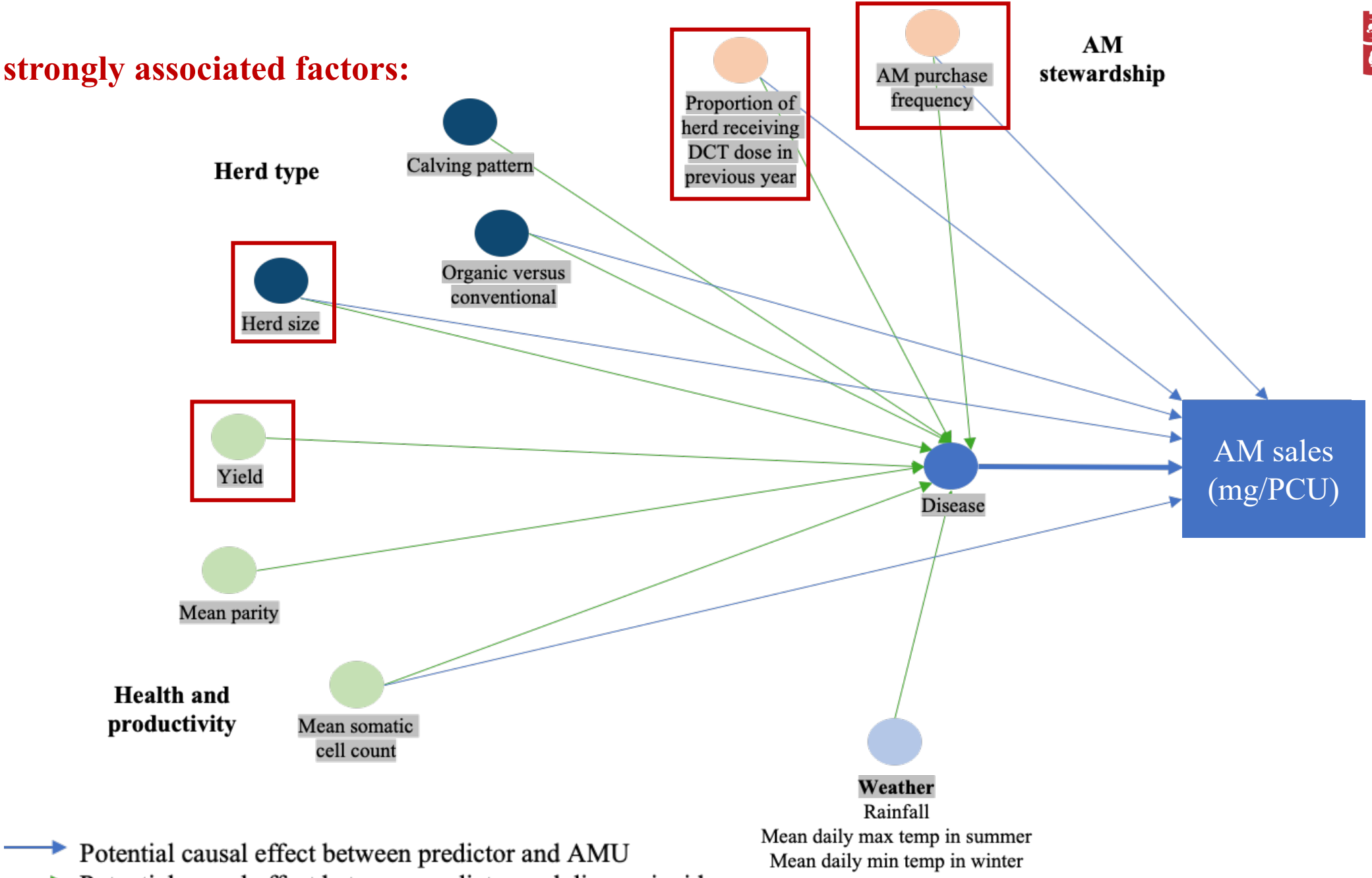
Modelling factors associated with AM sales

- Built a Bayesian multivariable regression model
  - Outcome: **total AM sales per year per farm (mg/PCU)**
  - Included random effects to account for the repeated outcomes from the same farms

- Used a variable selection method to find the factors most **strongly associated** with AM sales (projpred[1])

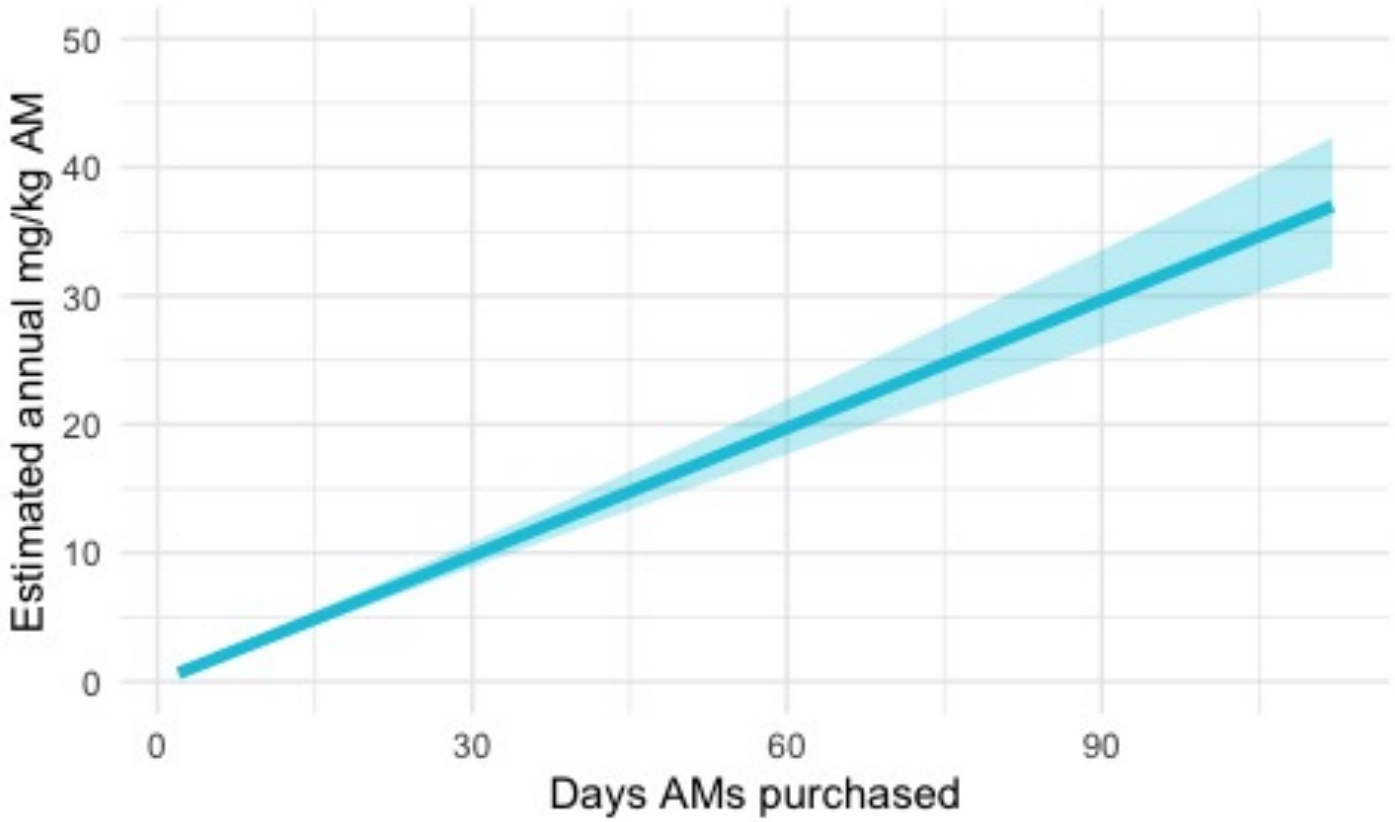
1) Projpred: Piironen J, *et al.* (2022). "*projpred: Projection Predictive Feature Selection*." R package version 2.2.2, https://mc-stan.org/projpred/

4 strongly associated factors:



Lucy Vass, Bristol Veterinary School

1: Purchase frequency



Effect of purchase frequency on AM sales (mg/PCU)
Ribbon shows 95% CI: 18.91% - 20.0%

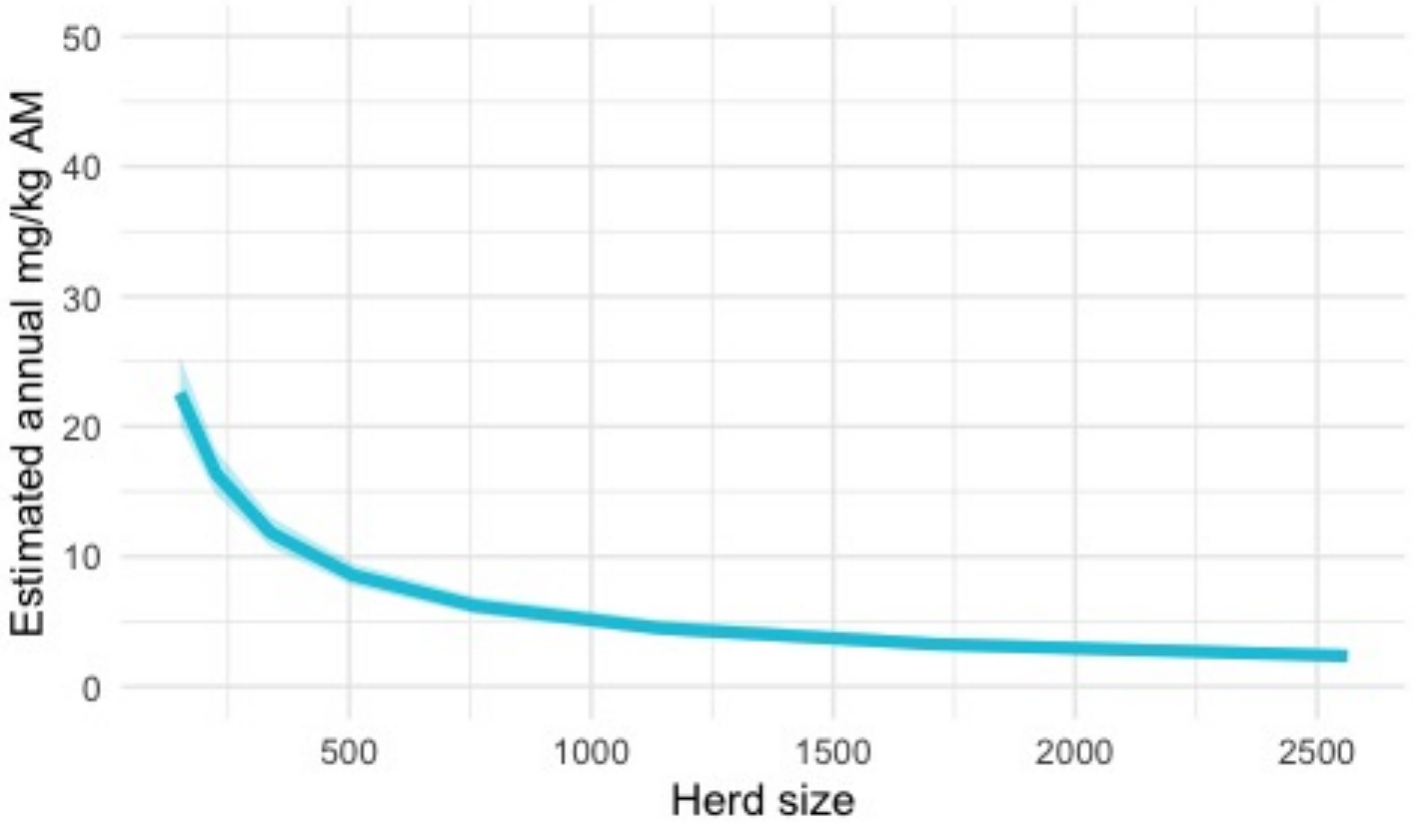
Positively associated

50% ↑ in purchase days ~ **19%** ↑ in AM sales

Median purchase frequency = **37 days/year**

Lucy Vass, Bristol Veterinary School

2: Milking herd size



Effect of herd size on AM sales (mg/PCU)
Ribbon shows 95% CI: 12.9% - 13.3%

Negatively associated

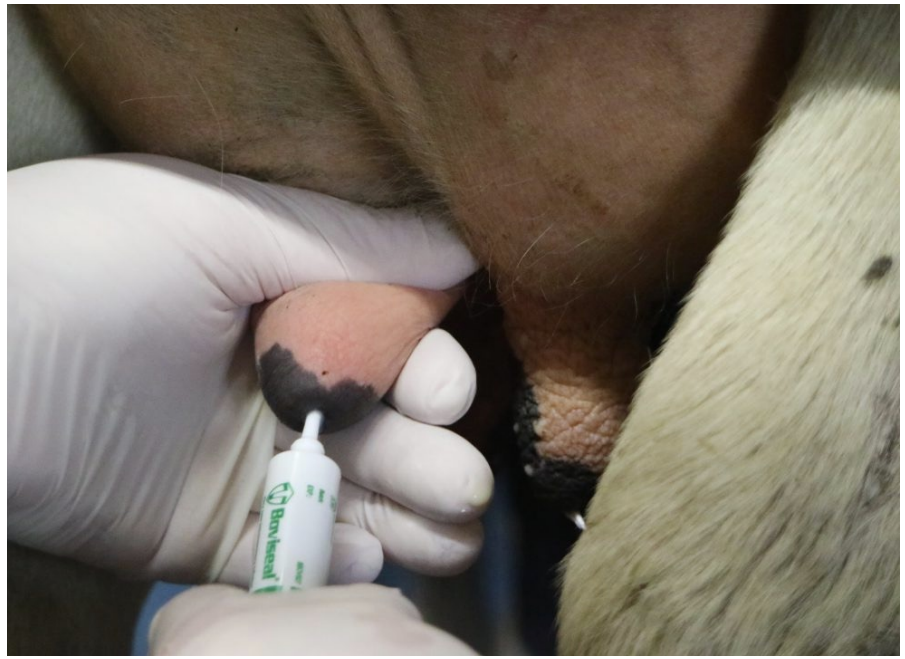
50% ↑ in herd size ~ **13%** ↓ in AM sales

Lucy Vass, Bristol Veterinary School

3: Percentage of herd treated with dry cow therapy (AM)

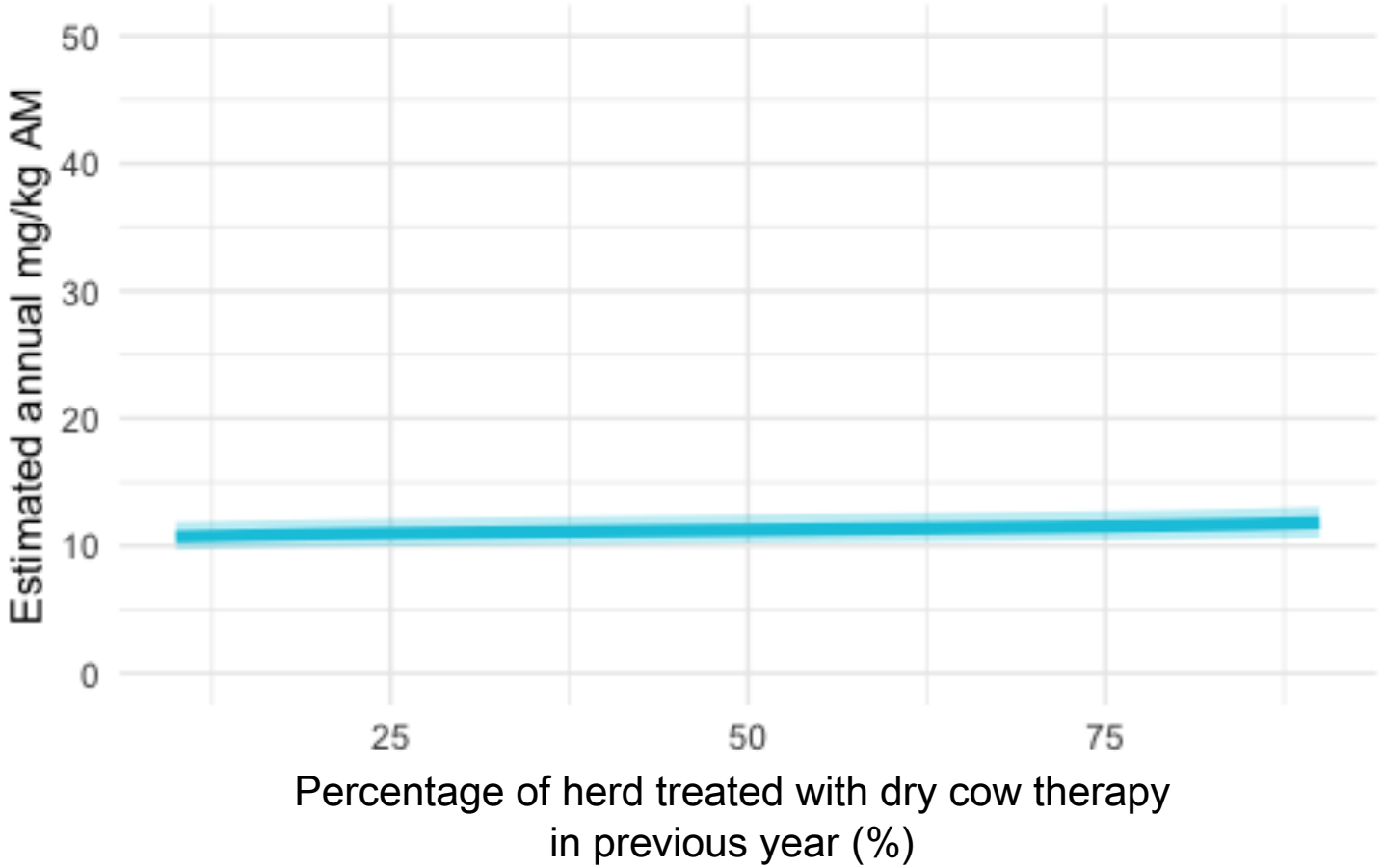
Dry cow therapy (DCT) – intramammary AM treatment given in the non-lactating period to treat and prevent mastitis (udder infection)

$$\text{\% of herd receiving DCT in previous year} = \frac{\text{Doses of DCT}}{\text{Milking herd size}}$$



Lucy Vass, Bristol Veterinary School

3: Percentage of herd treated with dry cow therapy (AM)



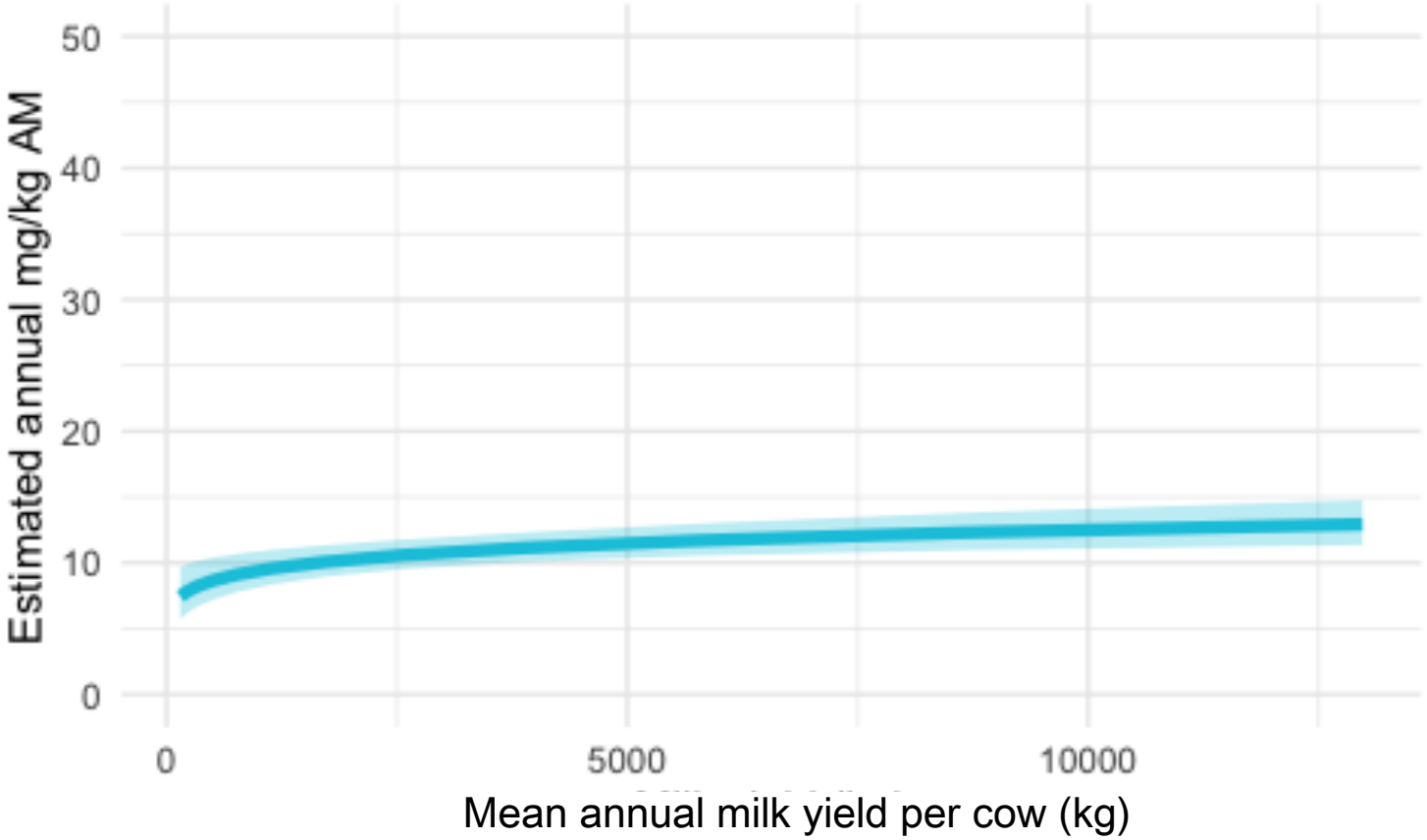
Positively associated

Change in percentage of herd receiving DCT	Resulting average change in AM sales
10-30%	**1.3%** (CI: 1.2% - 1.3%)
30-50%	**0.8%** (CI: 0.8% - 0.9%)
50-70%	**0.8%** (CI: 0.8% - 0.9%)
70-90%	**1.3%** (CI: 1.2% - 1.3%)

Effect of herd size on AM sales (mg/PCU)

Ribbon shows 95% CI

4: Milk yield



Positively associated

50% ↑ in milk yield ~ **2%** ↑ in AM sales

Average effect of milk yield on AM sales (mg/PCU)

Ribbon shows 95% CI: 1.7% - 2.7%

Lucy Vass, Bristol Veterinary School

Key takeaways…

- 41% reduction in AM purchases 2010-18 – historically high AM purchasers had largest relative reductions

- High AM purchasing dairy farms:
  - **Purchase AMs more frequently**
  - **Smaller herd size**
  - **Higher milk yield**
  - **Treated a higher proportion of the herd with dry cow therapies**

- AMU is complicated!

Vet practice data for AM research?

- Routinely collected = time saving
- Scalable
- Milk recording software – herd size, productivity and health data

Vet practice data for AM research?

- Routinely collected = time saving
- Scalable
- Milk recording software – herd size, productivity and udder health data

- AM sales ≠ usage
- No information on disease prevalence and reason for use
- Data sensitivity and privacy

Cow-side recording?

Acknowledgements

Thank you to Synergy Farm Health, who provided the data for this research. This includes Alasdair Moffat, whose ideas inspired the work, and Yvonne Mowlam for assistance in the data transfer.

PhD supervisory team and colleagues

Prof Kristen Reyher

Prof Andrew Dowsey

Dr Fernando Sanchez-Vizcaino

Dr Jon Massey (University of Oxford)

Work completed as part of a University of Bristol funded PhD

Further reading

Full analysis presented in my thesis

Name-based record Linkage for veterinary medicines - presented in Dr Jon Massey's thesis

Massey, J. (2021) *Barriers to Population Level AMR research in UK livestock and opportunities for data science*. Dissertation. University of Bristol.