

Using Natural Language Processing and VetCompass to understand antimicrobial usage patterns in Australia



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Background:

- Antimicrobial Resistance is a global emergency
- There is a lack of objective knowledge of what antimicrobials are being used in Veterinary Practices, especially small animal clinics
- VetCompass Australia collects veterinary medical records from 180 companion animal clinics across Australia
- This data is mostly in free text and difficult to analyse
- Natural Language Processing (NLP) is able to help us analyse the free text and report the antimicrobial usage patterns

Materials and Methods:

Annotate Subset of the Data

- Two experts annotated 200 records and Calculate agreement

MEDICATION_NAME	TOTAL_UNITS_OR_VOLUME_DISPENSED	ROUTE_OF_ADMINISTRATION	FREQUENCY_OF_ADMINISTRATION	LENGTH_OF_TREATMENT
Amacin Ear & Eye Oint	4Gm	Please apply to both eyes	TWICE daily	for 10 days.

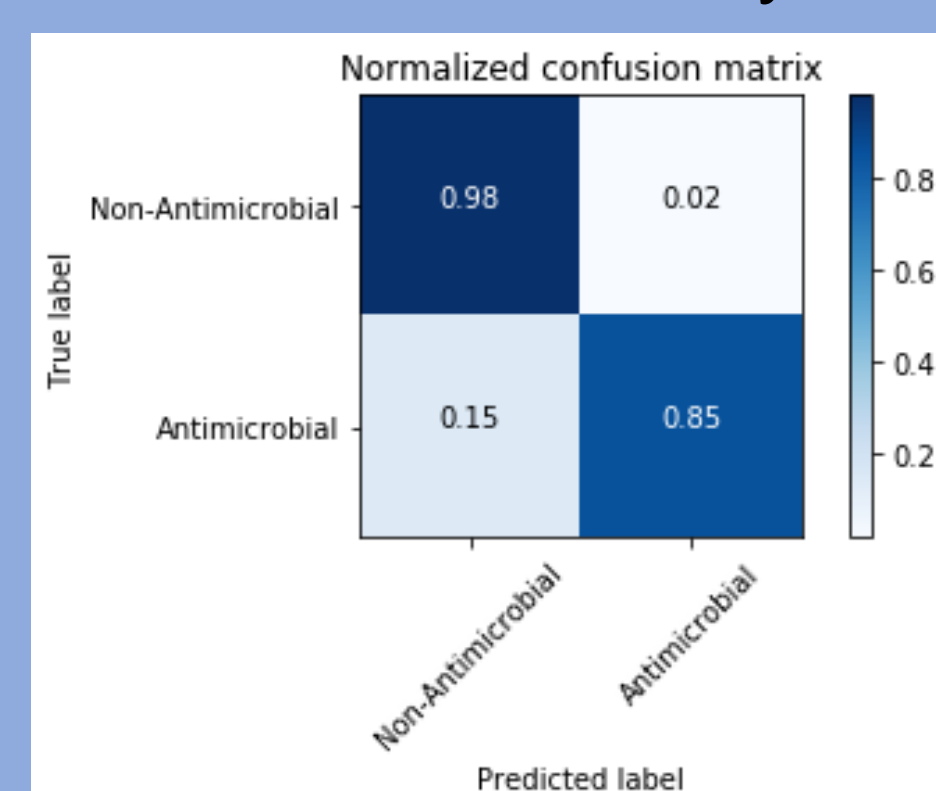
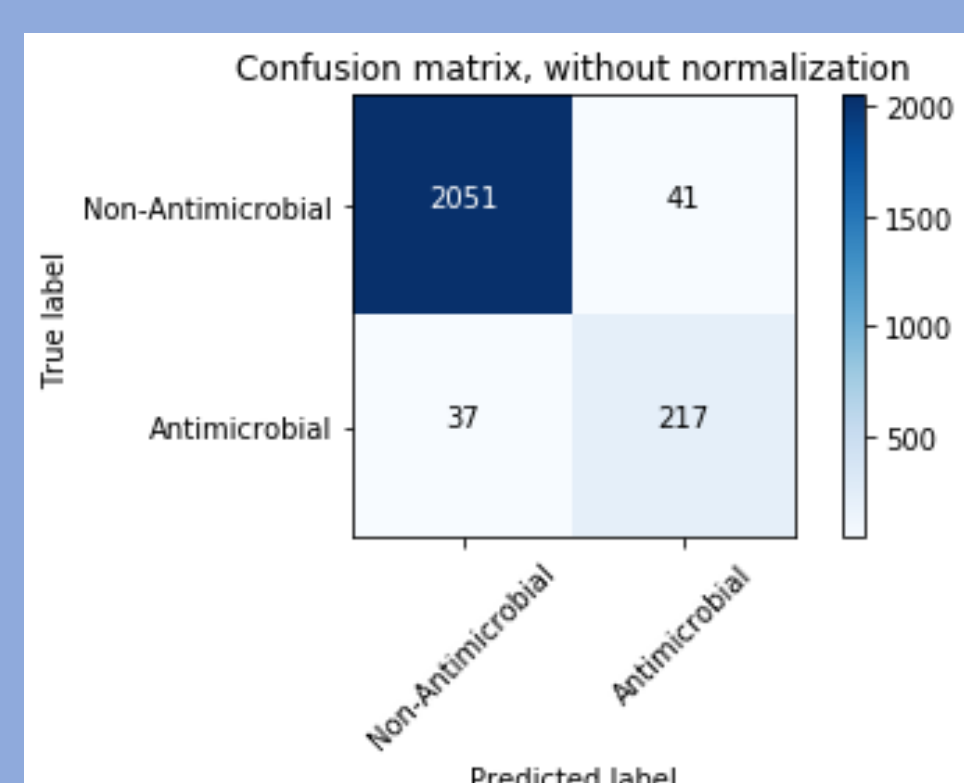
- Calculated Fleiss Kappa Score between annotators of 0.868 (95% Accuracy)

$$\kappa = \frac{\bar{P} - \bar{P}_e}{1 - \bar{P}_e}$$

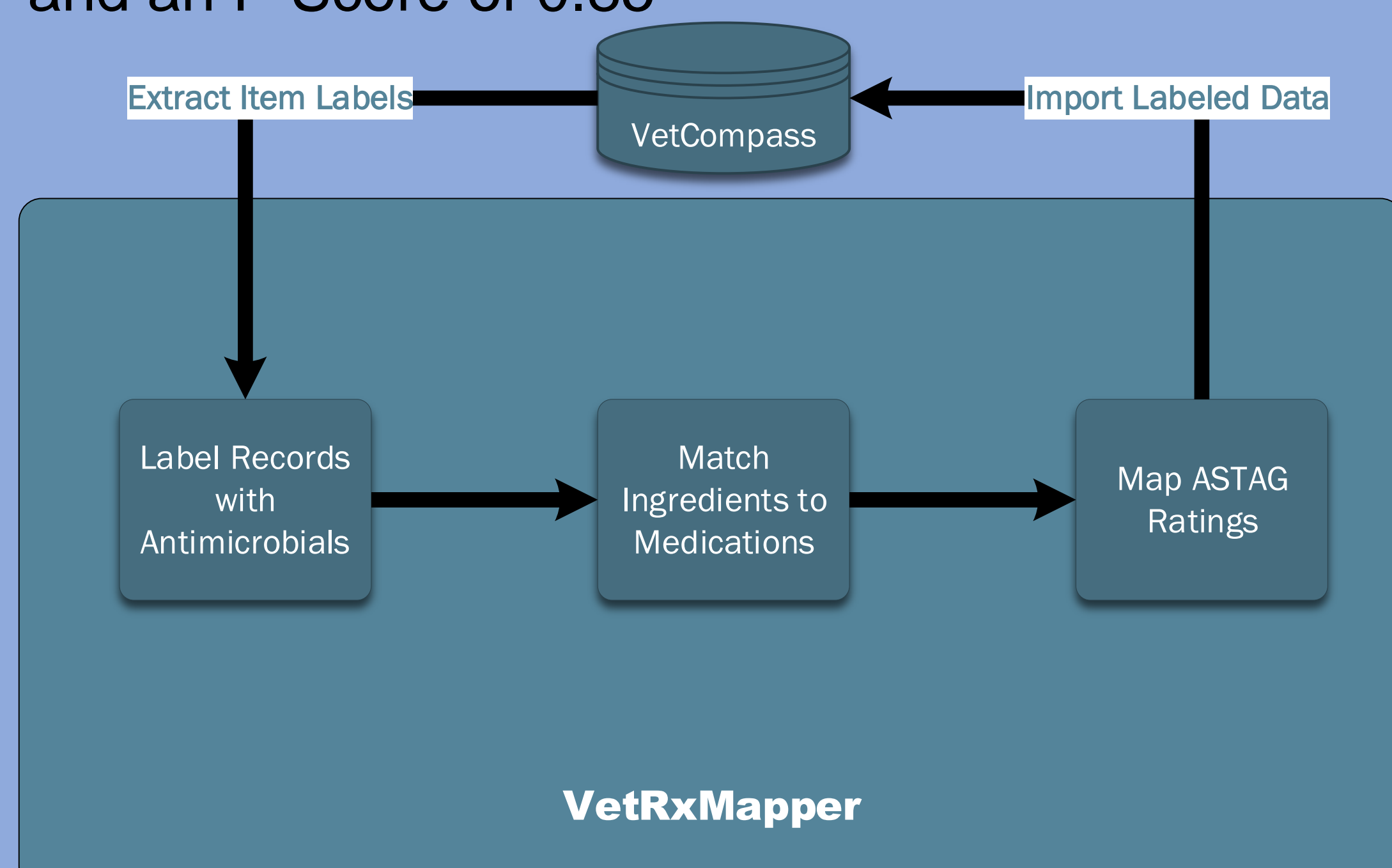
- Single annotator can label with estimated accuracy rate
- In our case we used a subset of VetCompass containing distinct inventory items from all clinics in Victoria

Determine the best model

- Train and test machine learning models on the labelled dataset and determine the best accuracy for detecting antimicrobials:
- Machine Learning Models tested – xgboost, naïve bayes, logistic regression, random forest: Xgboost highest – 91.9% accuracy
- Deep Learning (Neural networks)– 92.7% accuracy
- Rules based algorithm developed: 96.7% Accuracy



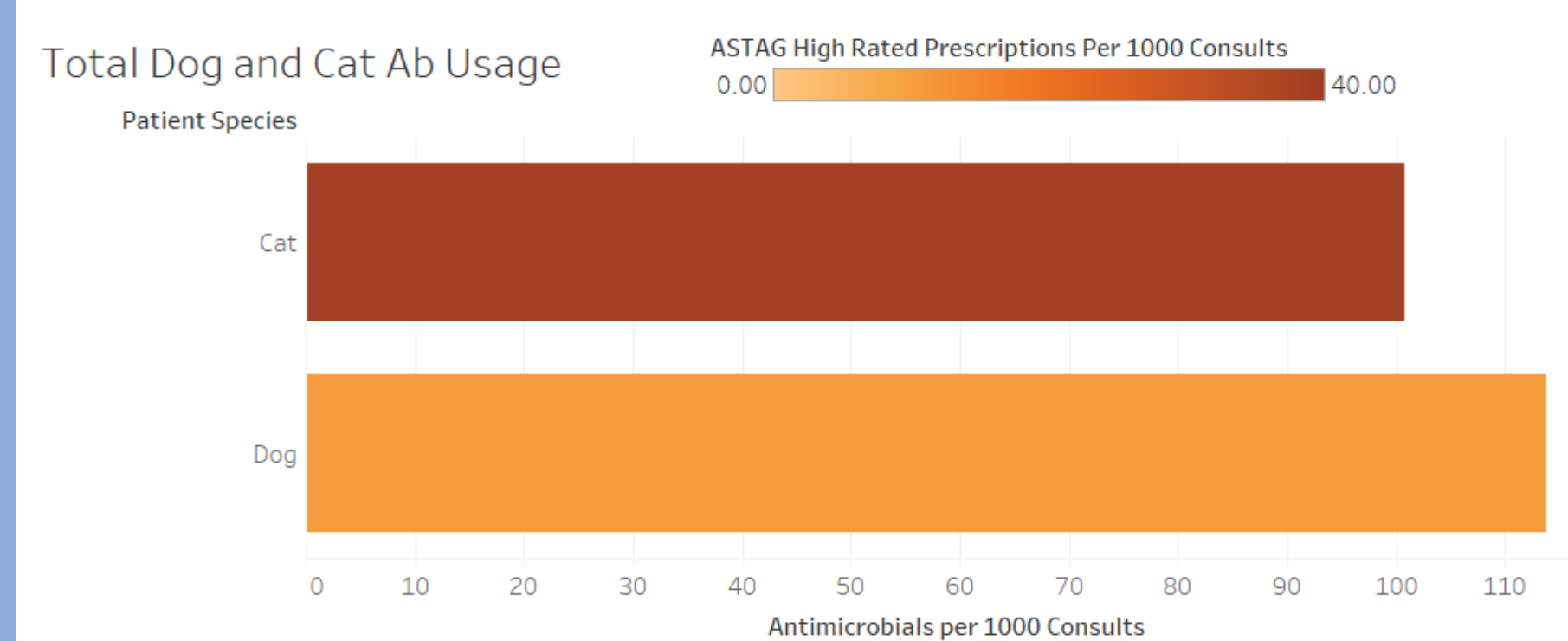
Use selected rules based model to label the remainder of the unlabelled dataset with an estimated accuracy of 96.7% and an F-Score of 0.85



Results:

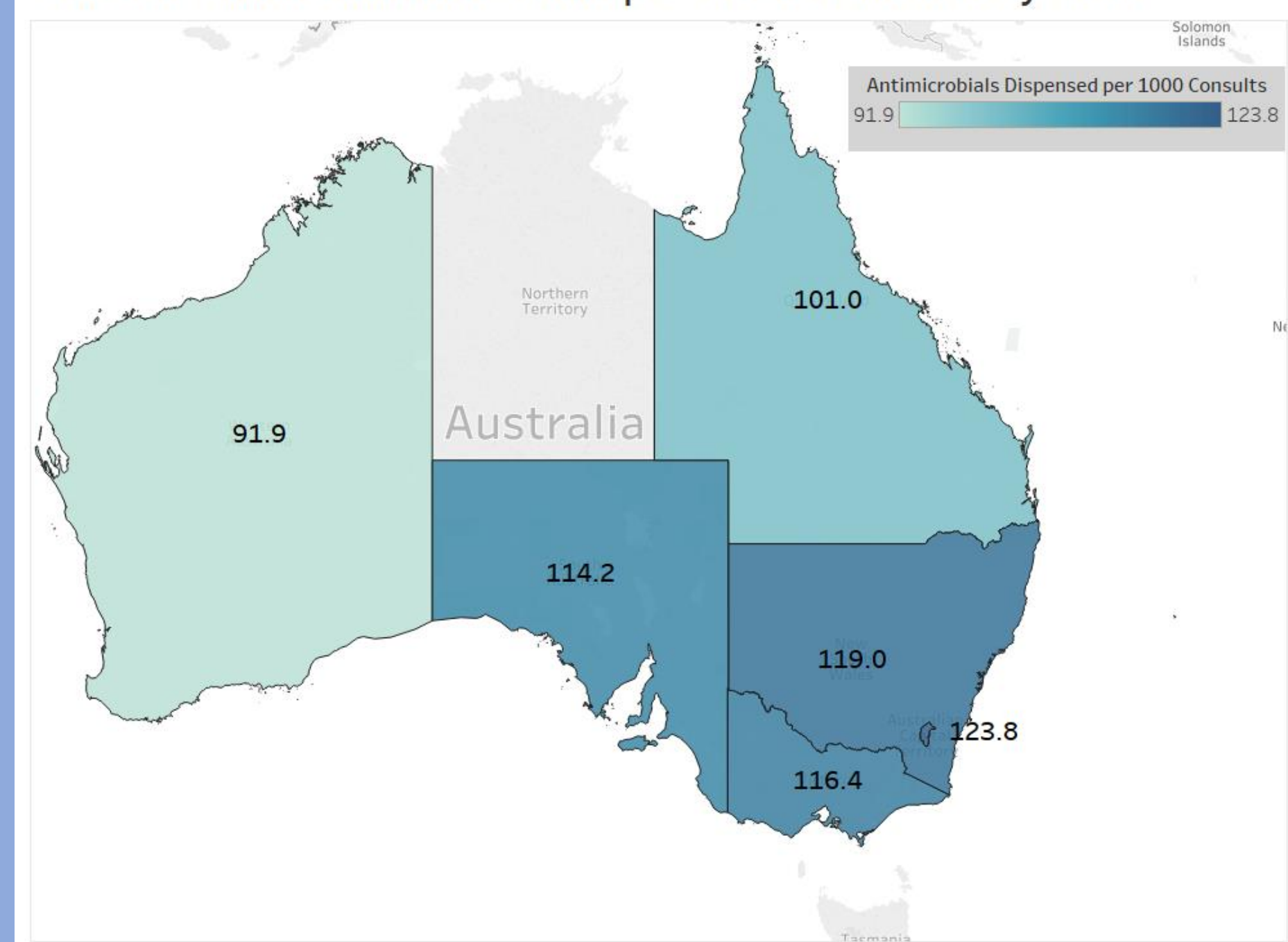
Total Dog and Cat Consults with ASTAG High Rated Antimicrobials Given per 1000 Consultations

Patient Species	Unique Consultation Records	Unique Patients	Antimicrobials per 1000 Consults	ASTAG High Rated Prescriptions Per 1000 Consults
Cat	1,132,452	199,329	101	39
Dog	3,263,615	519,842	114	11
Grand Total	4,394,493	713,038	110	18

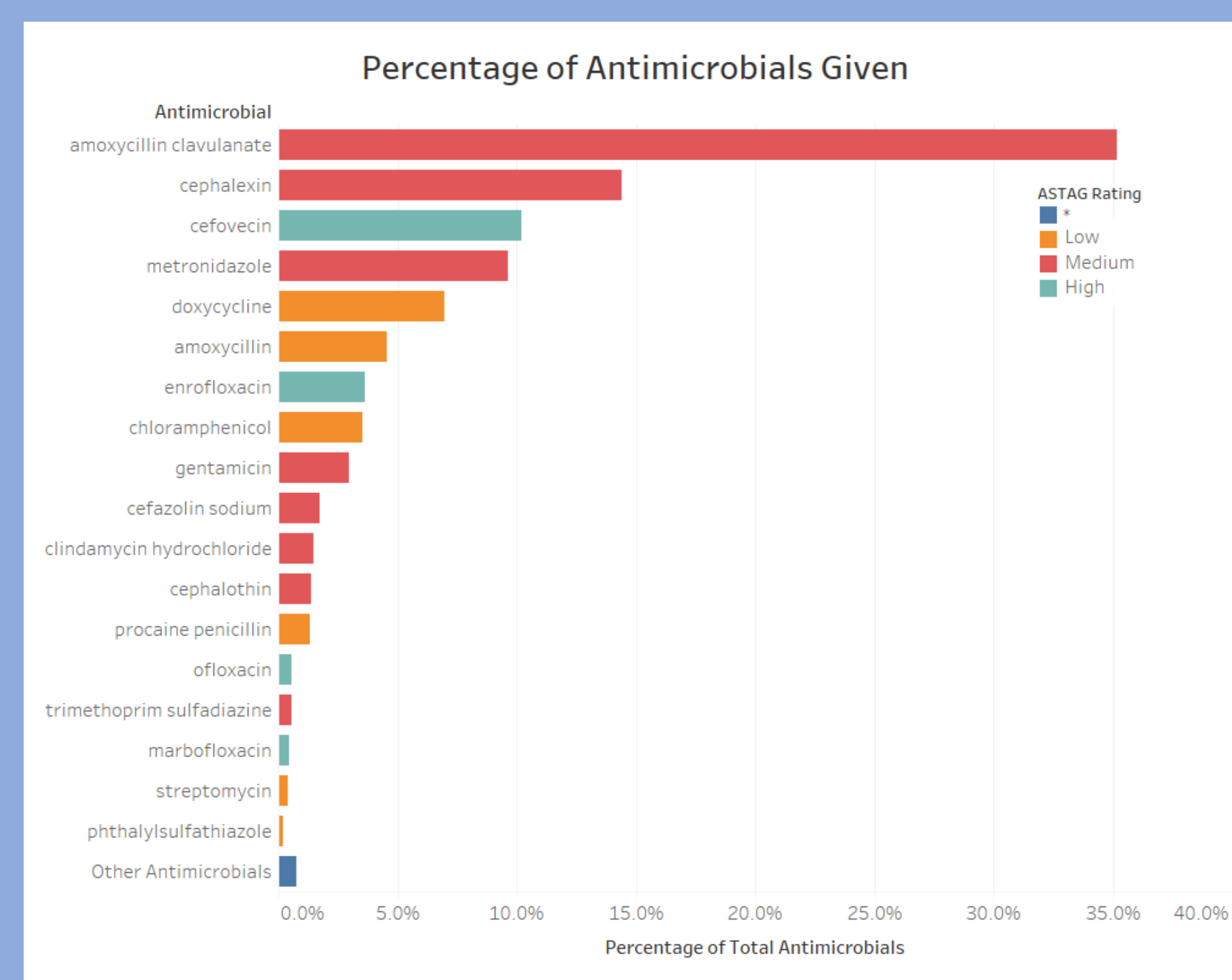


- 4,394,493 consultation records between 2013-2018 were analysed
- Dogs received antimicrobials more often than cats
- Cats received high rated antimicrobials more often than dogs

Consults with Antimicrobials per 1000 Consults by State



- Antimicrobials are prescribed at a similar rate throughout Australia



Conclusions:

- Amoxicillin/clavulanate, cephalixin and cefovecin are the three most commonly prescribed in small animal practice, accounting for around 60% of antimicrobial prescriptions
- The antimicrobials of high importance that are prescribed in companion animal practice are mostly limited to Cefovecin and Enrofloxacin
- Less than 1% of other Fluoroquinolones are prescribed
- There is relatively low usage of low importance antimicrobials in small animal practice