Early warning systems for life-threatening companion animal diseases: Heartworm and Tick Alert

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Why we need early warning systems for animal infectious diseases?

Prevent zoonotic diseases

Global mobility of humans enable rapid spread of disease

Biosecurity

Protect industries and environment from any disruption

Economic impact

Any delay in mitigation can result in huge health and disease control costs

Promote One Health

Interconnection of human, animal and environmental health considered in study

Overview of Diseases

Tick Paralysis

Neurotoxins present in saliva of paralysis ticks cause life threatening conditions in dogs and cats

Require immediate medical attention

Seasonal – spring till autumn. Warm and humid climate

Prevalent in the east coast regions of Australia and Tasmania

When and where?

Overview of Diseases

Heartworm (Dirofilaria immitis)

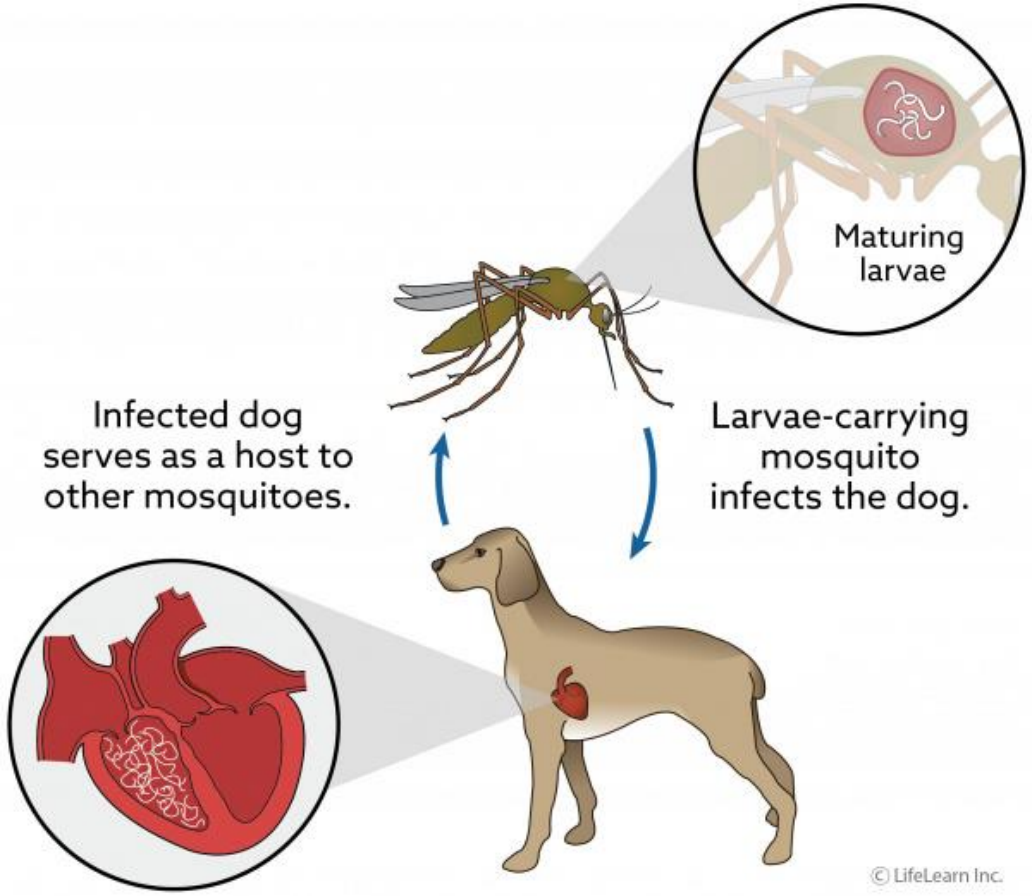
Vector borne disease – transmitted through mosquitos

Worms grow in heart and major blood vessels disrupting the blood flow

Prevention is the best treatment as diagnose is a challenge and treatment has serious side effects

Highly prevalent in US and east coast of Australia especially QLD

When and where?



Data source

VetCompass Australia

- *9.5 million* patients
- *55 million* clinical documents
- *181 million* treatments
- Continuously updated with new clinics

Bureau of Meteorology

Bureau of Statistics

Partners

Australian Government
Australian Research Council

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Components of the system

To be run every fortnight to provide information on real-time basis

Data exploration and NLP classification

- ❑ Use trained veterinarians to validate and label the training data
- ❑ Create NLP classifier to classify clinical text to positive and negative cases

Spatiotemporal Forecasting

- ❑ Quantify spatiotemporal variation of diagnosed cases
- ❑ Predict future trend of disease
- ❑ Identify sites on risk of disease exposure

Web-based dashboards and alert system

- ❑ Interactive plots on dashboard to explore around variation in diagnosed cases and show insights
- ❑ Send alerts to users of platform when there is increase in cases predicted

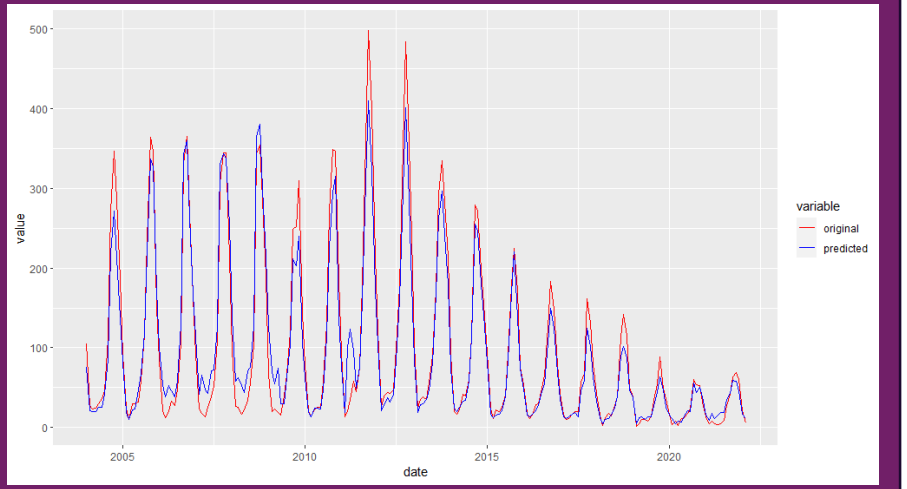
Data Exploration and NLP Classification

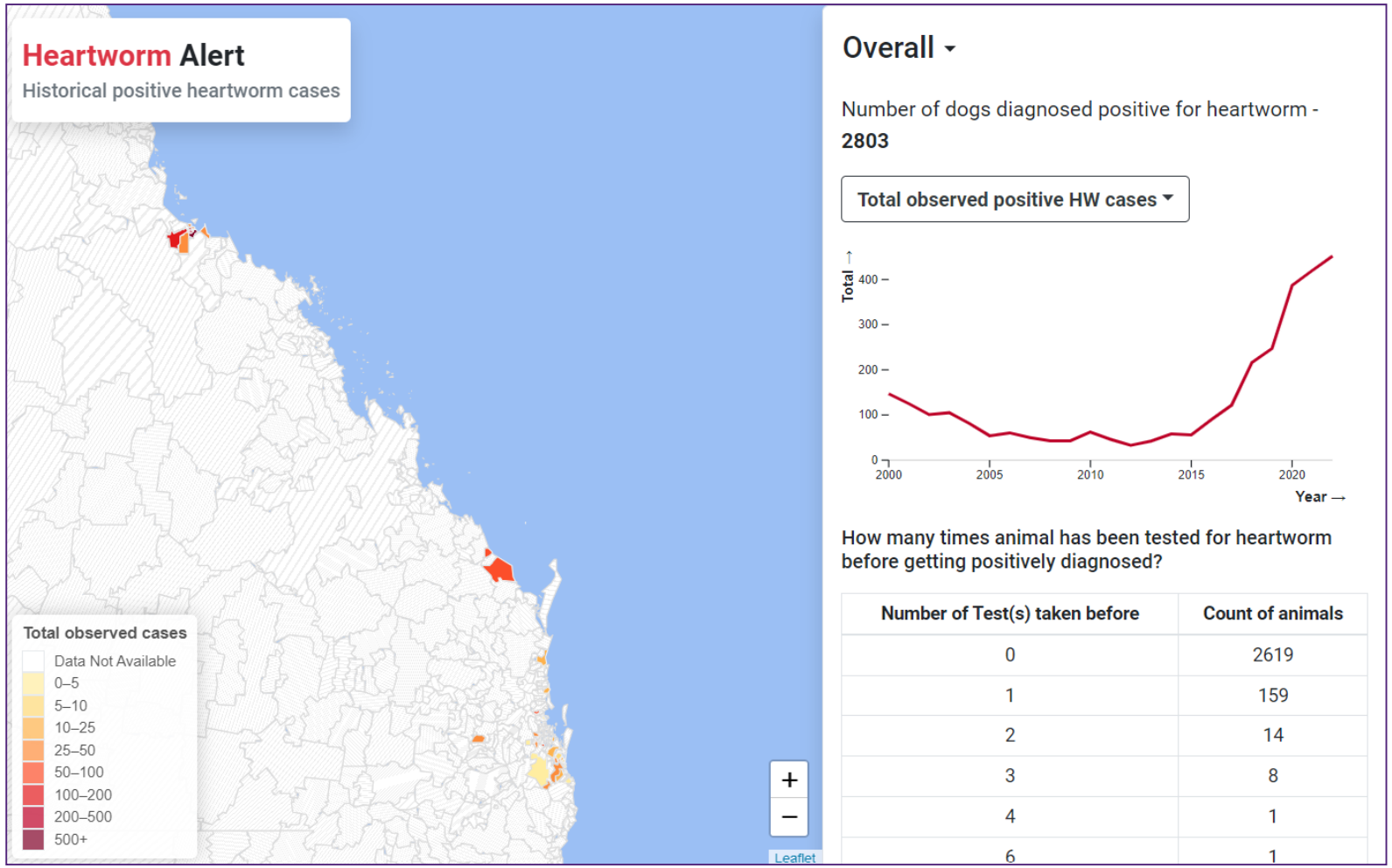
Tokenize and spell check examination text

N-grams to identify patterns in text

Decision algorithm for classification

Use common tokens as predictors to train GBM classifier



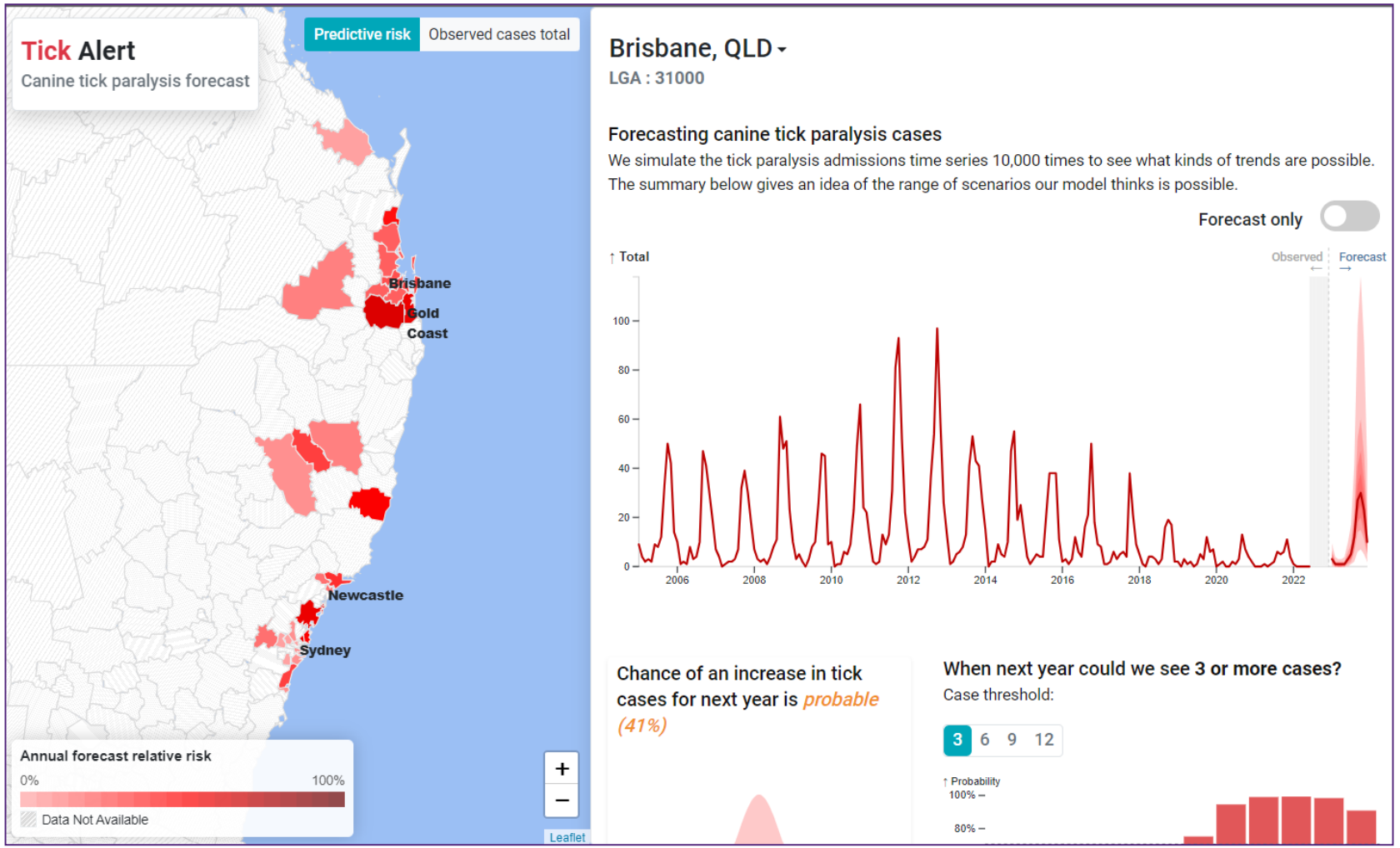


Spatiotemporal forecasting

Multivariate forecasting model using the ***mvgam*** package

A history of climatic values such as evaporation and temperatures of different regions from BOM data are used as parameters

To avoid bias, an offset of number of dogs seen per clinic is used to compute standardised relative risk



Benefits

Early detection

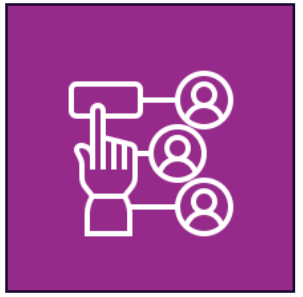
Efficiently strategize a control plan by identifying unusual patterns or outbreaks

Rapid response

Minimize the effect on population by providing timely response

Monitoring & awareness

Better understand the prevalence and trend of disease



Resource allocation

Efficient medical personnel, supplies and vaccine allocation

Challenges and future

- Incorporating new clinics data into the study and the variation in clinical text affecting NLP algorithm
- Risk of false positive from a very detailed clinical text
- Missing key data such as consultation time data to identify the date o the case

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