An econometric investigation into the impact of external events on health conditions

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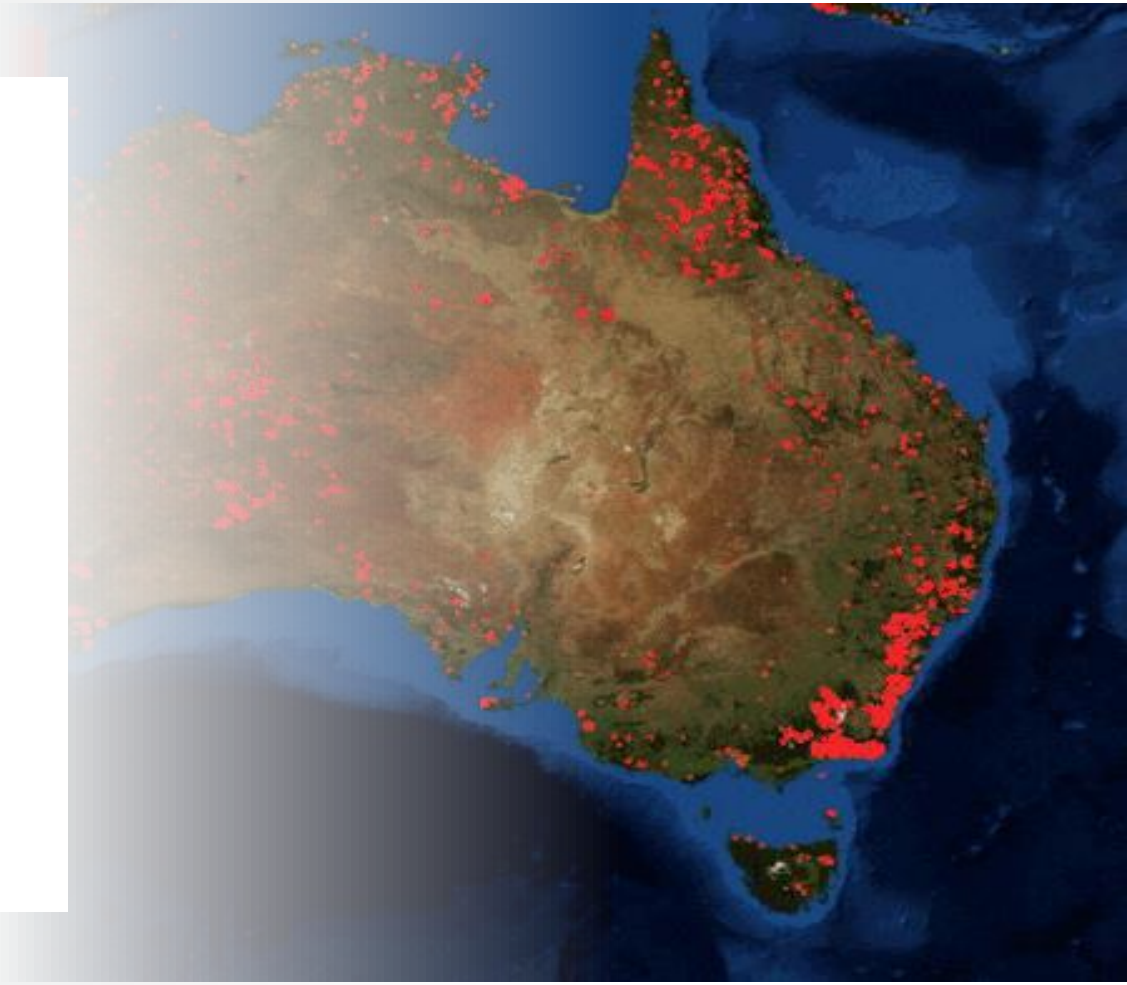
*These views are our own and should not be taken to represent the position of the Department of Health and Aged Care or the Australian Government

This module looks at future prevalence of different health conditions, and quantifies the impact caused by:

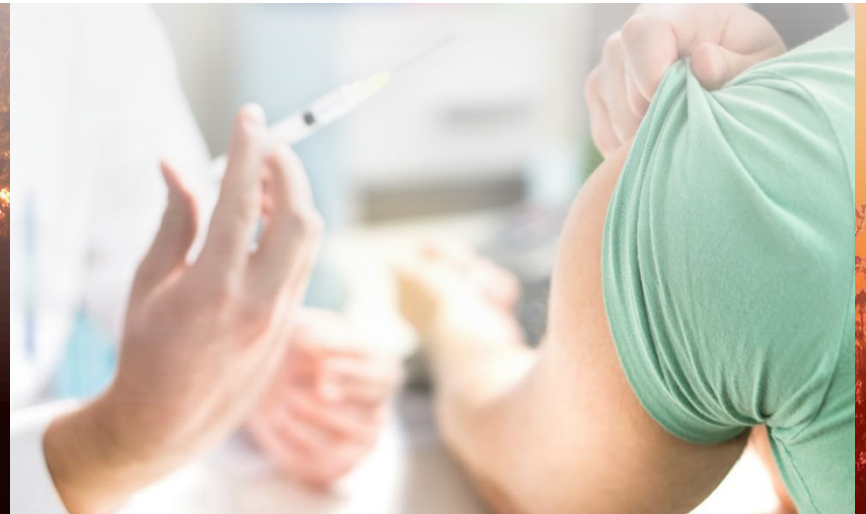
- Bushfires
- Severe influenza (flu)
- Heatwaves
- Severe storms

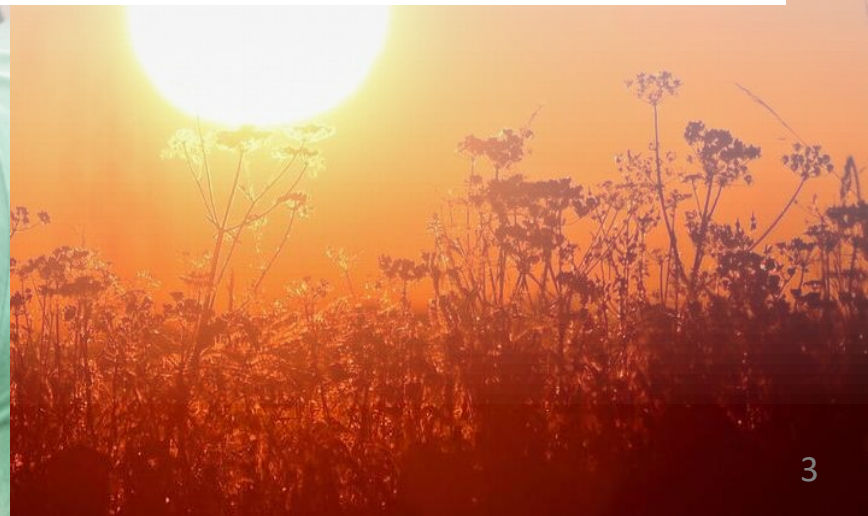


Research questions

1. Do external events, such as **large bushfires, heatwaves** and **severe flu seasons** have a significant effect on the prevalence of health conditions in the Australian population?

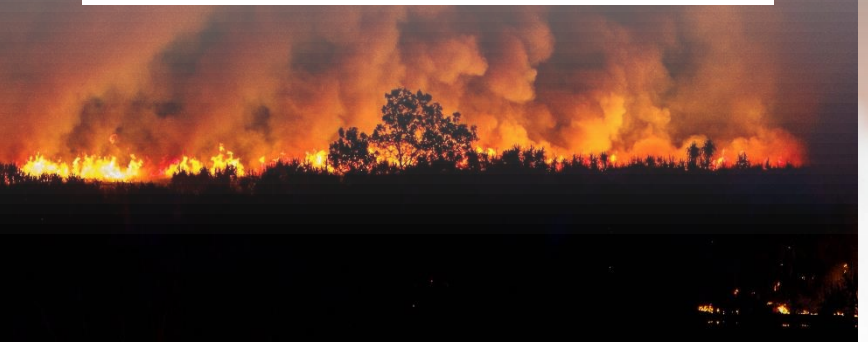
2. Does incorporation of external event magnitude impacts improve forecast accuracy for these health conditions?





Motivation

Disaster management plans are key in minimising the consequence of an event, and in the recovery process following an event.



Better disaster management plans = better preparation and response.

How do we 'better' our plan?

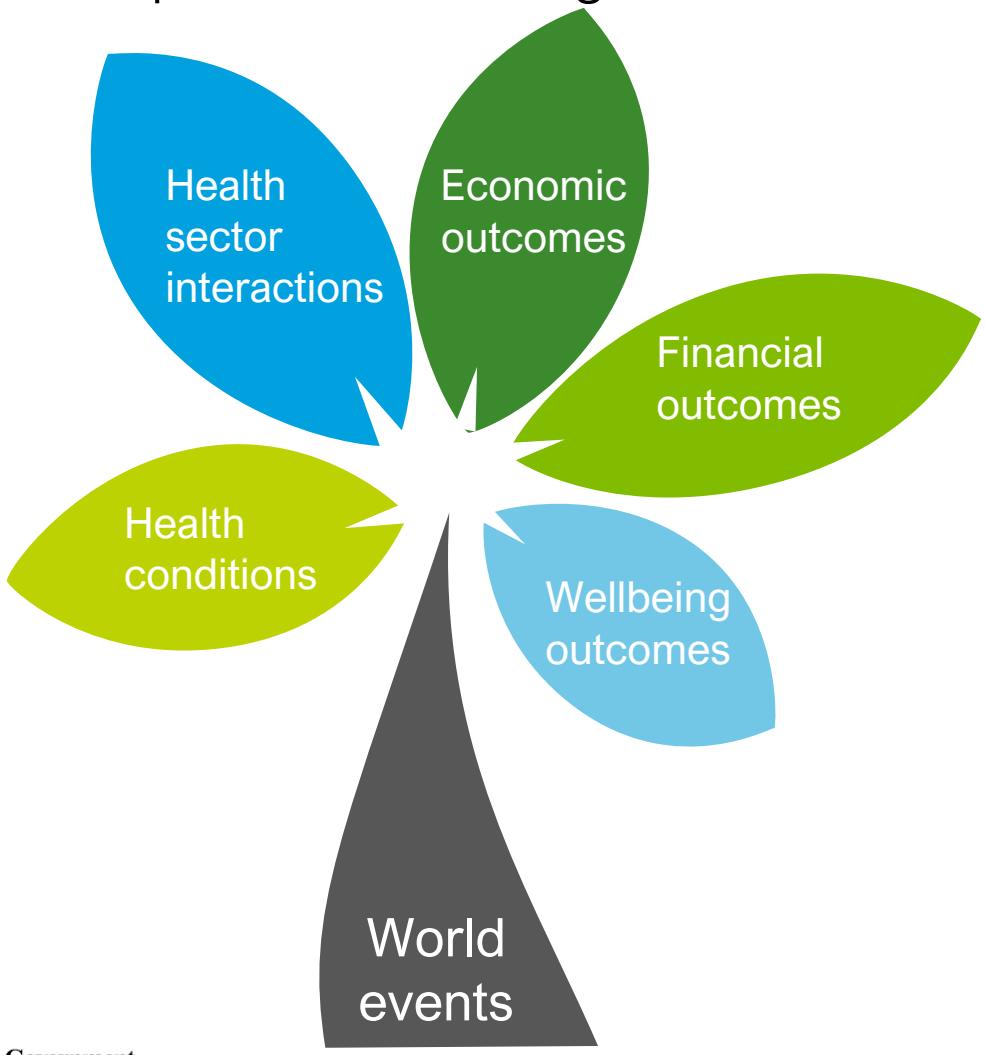
By predicting the impact on health conditions, **we anticipate the consequence of an event.**

By improving the forecast accuracy, **we more accurately predict the effect on health burden.**

By incorporating these predictions into our disaster management plan, **we optimise our response to the aftermath of a future event.**

Motivation

World events impact a wide range of outcomes



Health conditions
World events have the ability to directly impact the prevalence and incidence of health conditions in the Australian population (this presentation).

Health sector interactions
With changing health condition profiles, we can measure changes to health and aged care service usage.

Economic outcomes
Economic implications such as workforce impacts, productivity impacts and so on, are influenced by the broader system of individuals health and ageing.

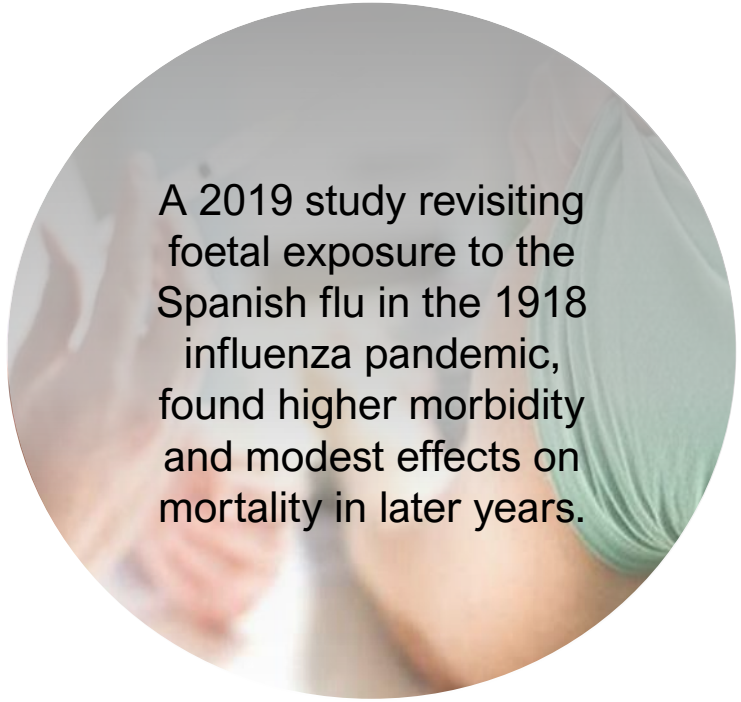
Financial outcomes
There is a direct financial implication of reduced health on government and private sector health expenses.

Wellbeing outcomes
In addition to financial outcomes, there is a direct relationship between health condition prevalence and the overarching burden of disease in the Australian population.

Literature review

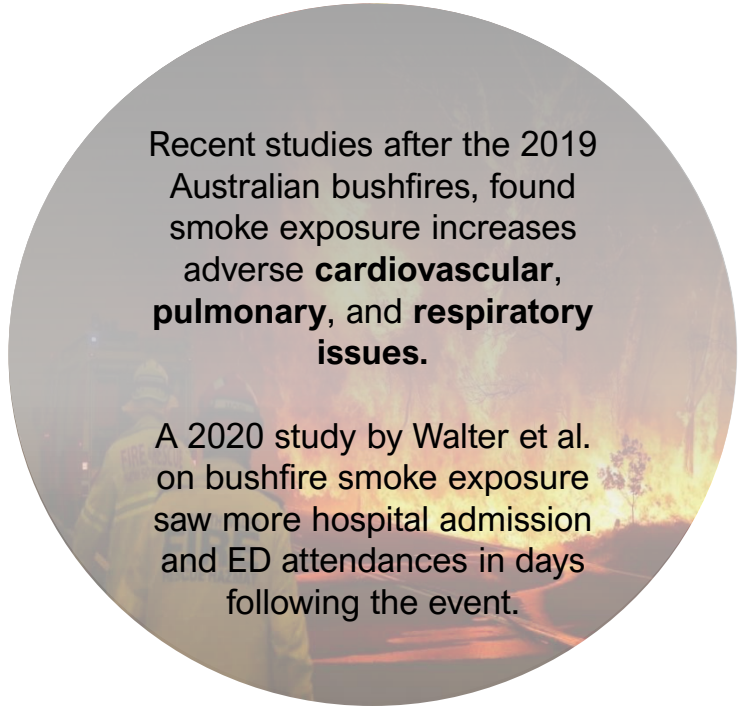
Studies have found links between heatwaves to heat-related conditions such as **heat exhaustion** and **heat stroke**, as well as increased **mental disorders** and **mortality**.

Guo et al., 2017; Peng Bi et al., 2011; Hansen et al., 2008; Doctors for the Environment Australia, 2017



A 2019 study revisiting foetal exposure to the Spanish flu in the 1918 influenza pandemic, found higher morbidity and modest effects on mortality in later years.

Helgertz and Bengtsson, 2019



Recent studies after the 2019 Australian bushfires, found smoke exposure increases adverse **cardiovascular**, **pulmonary**, and **respiratory issues.**

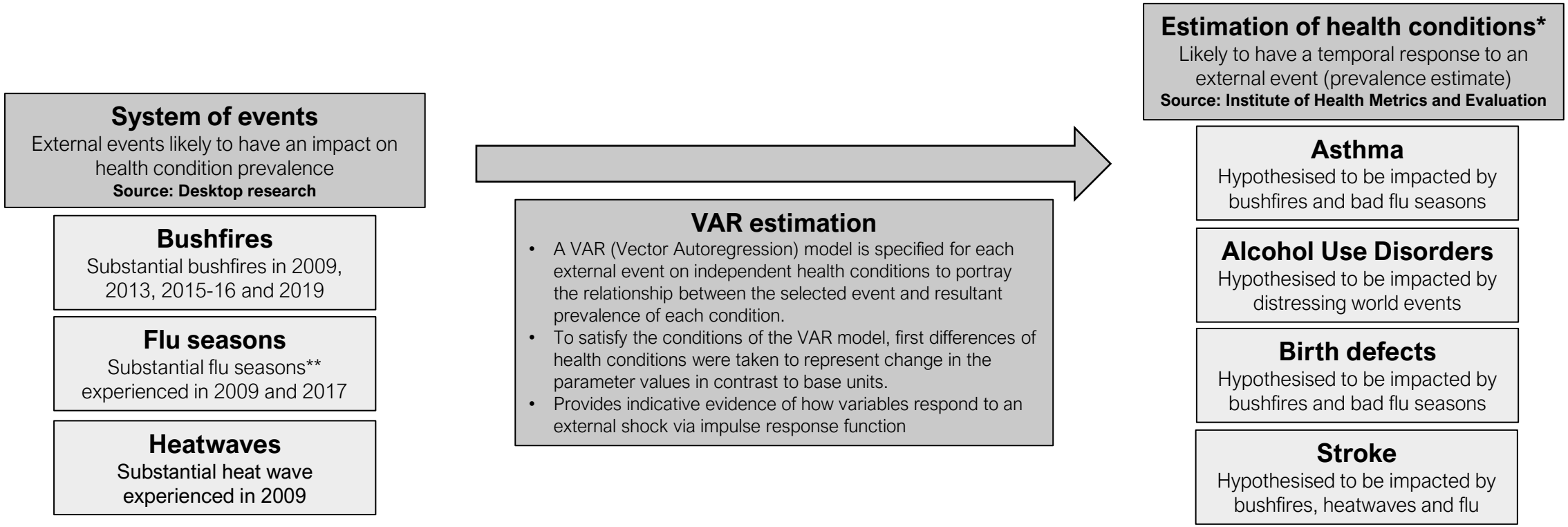
A 2020 study by Walter et al. on bushfire smoke exposure saw more hospital admission and ED attendances in days following the event.

Walter et al., 2020; MacIntyre et al., 2021; Laugharne and Janca, 2011

Methodology

Figure 1. High level methodological overview

Note the current data only reaches 2019 and hence does not support analysis of COVID-19 impacts on health conditions



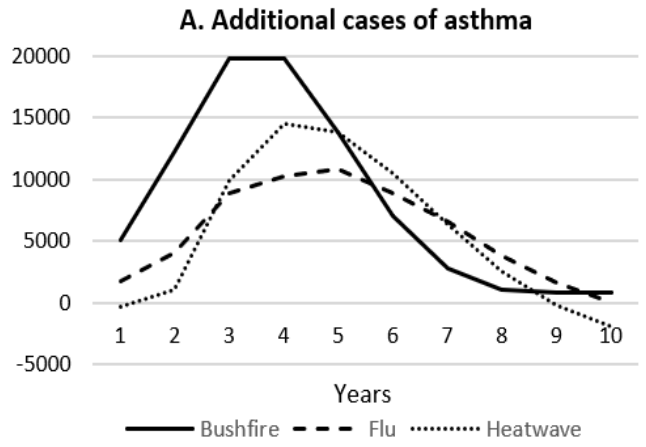
*Additional health conditions will be included in the model build – the conditions included in this pack are to demonstrate the methodology and preliminary findings.. The full model will include projections and magnitude impacts by age, gender and locality (where possible).

Methodology

- Stationarity tested using **Augmented Dickey Fuller test**.
  - All variables were found to be stationary
  - Therefore VAR was chosen for analysis.
- Optimal lag length was selected based on the **Akaike Information Criterion (AIC)**
- VAR results visualised using **Impulse Response Functions (IRFs)**
- **Test + train accuracy testing** was undertaken for the years 2011–2019 to determine whether incorporation of the magnitude event to the existing forecast yields significant impacts on predictive accuracy.

Results

Figure 2. Preliminary IRFs by condition



- Impulse response functions defined as a Cholesky 1 standard deviation (d.f. adjusted) shock applied to the prevalence of each health condition for all age and gender categories
  - x axis: years post event
  - y axis: direction and intensity of the impulse in the dependent variable
- Note that all conditions see an increase in prevalence over 10 years post-event

Results

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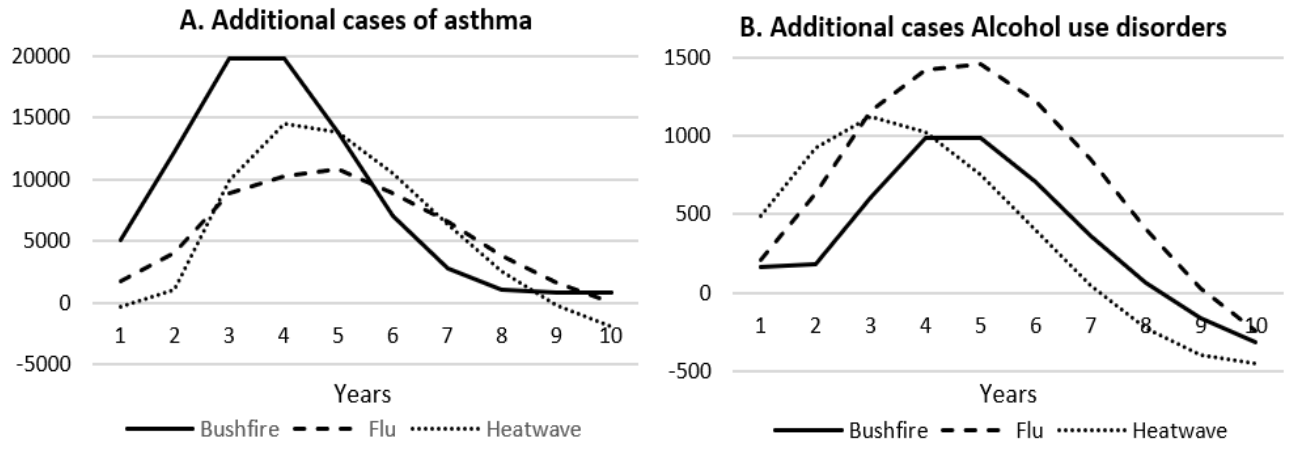

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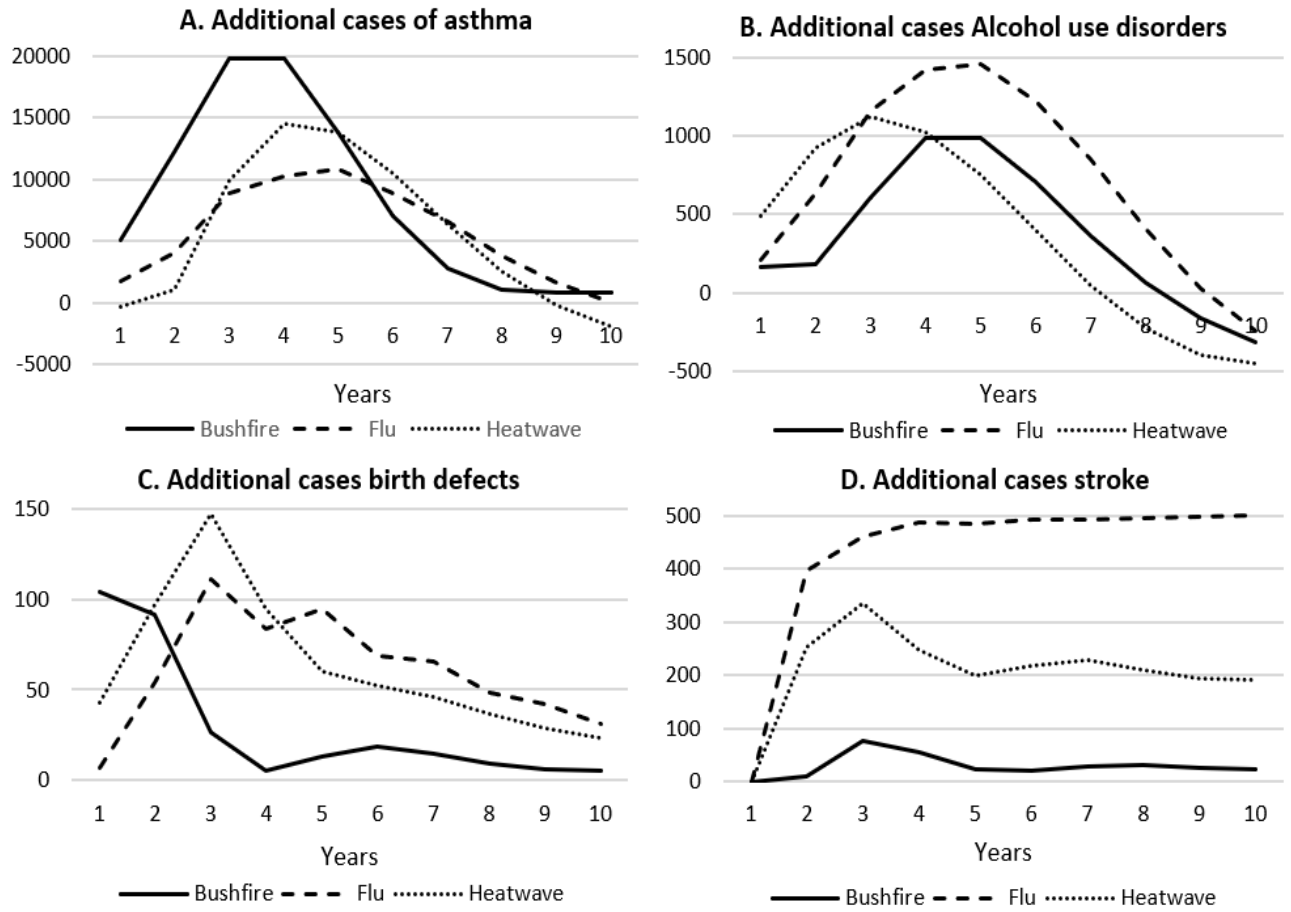

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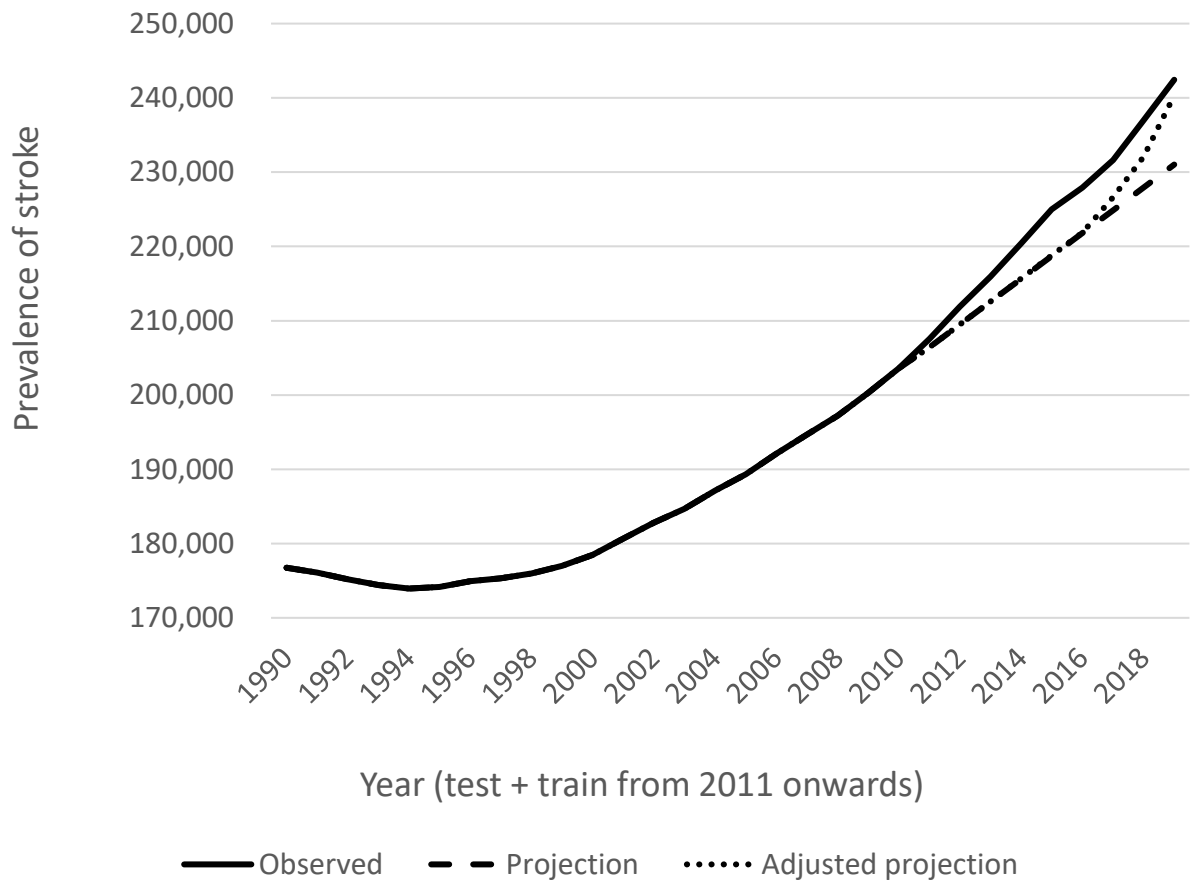
Results

Figure 3. Stroke forecast

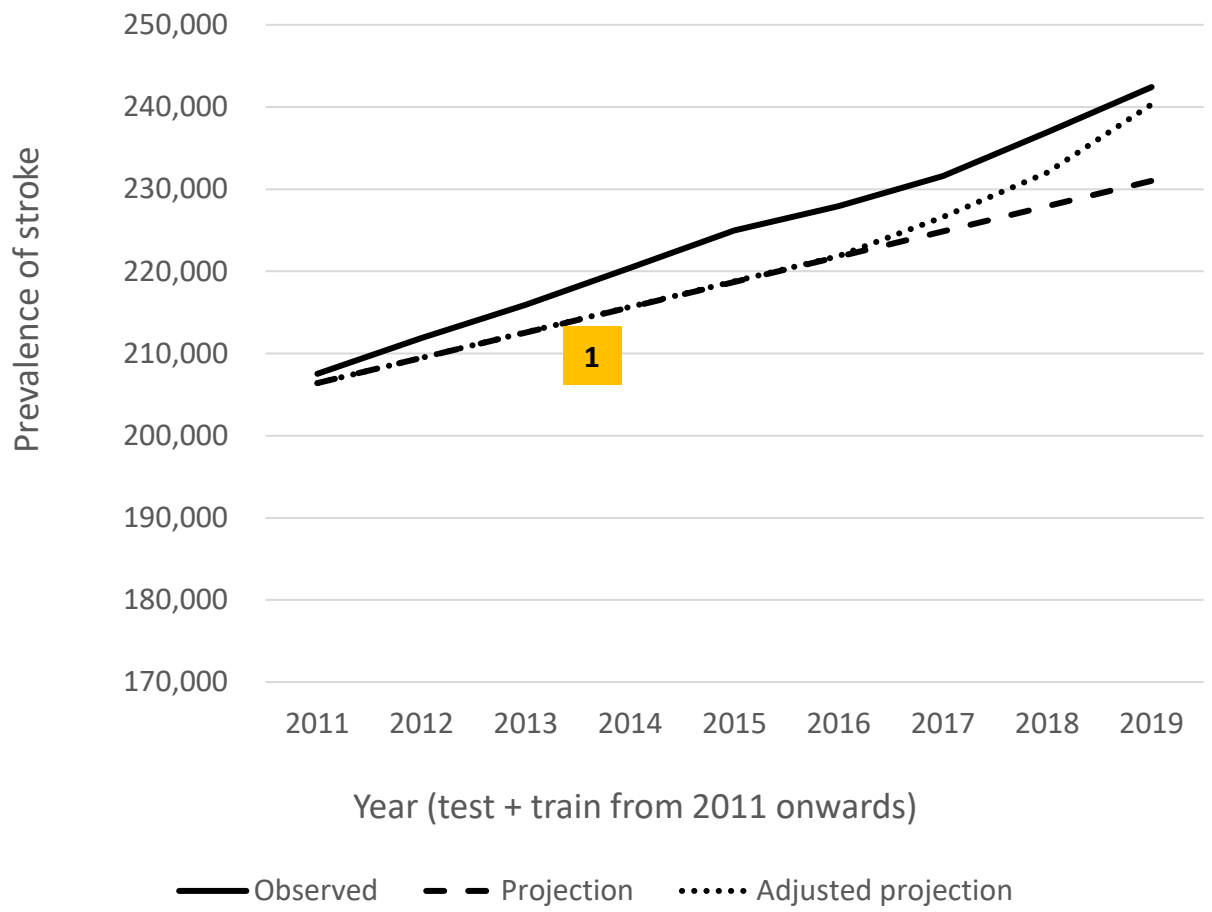


- Alcohol use disorders
  - Improved total and cumulative prevalence
  - Improved correlation
- Asthma
  - Improved total and cumulative prevalence
  - Improved correlation
- Birth defects
  - No improvement
- Stroke
  - Improved total and cumulative prevalence
  - Improved correlation

Note heatwaves were not included in calibration as the heatwave event fell into the 'train' dataset.

Results

Figure 4. Stroke forecast zoomed in



1. Bushfire in Blue Mountains 2013
    1. Magnitude impact restricted to 0.33% impact on prevalence
    2. No visual change

Results

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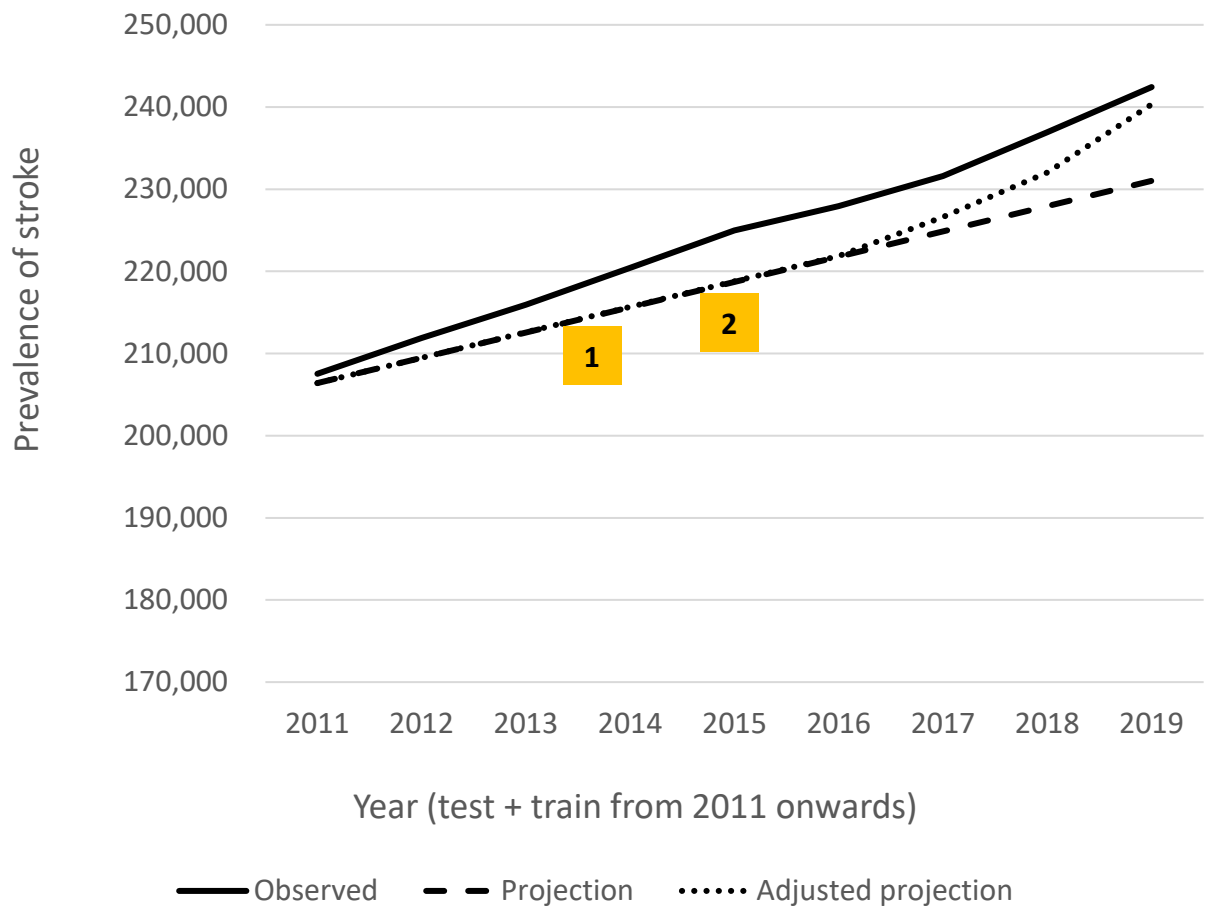

1. Bushfire in Blue Mountains 2013
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2. Bushfire in Esperance 2015
    1. Magnitude impact restricted to 0.04% on prevalence
    2. No visual change

Results

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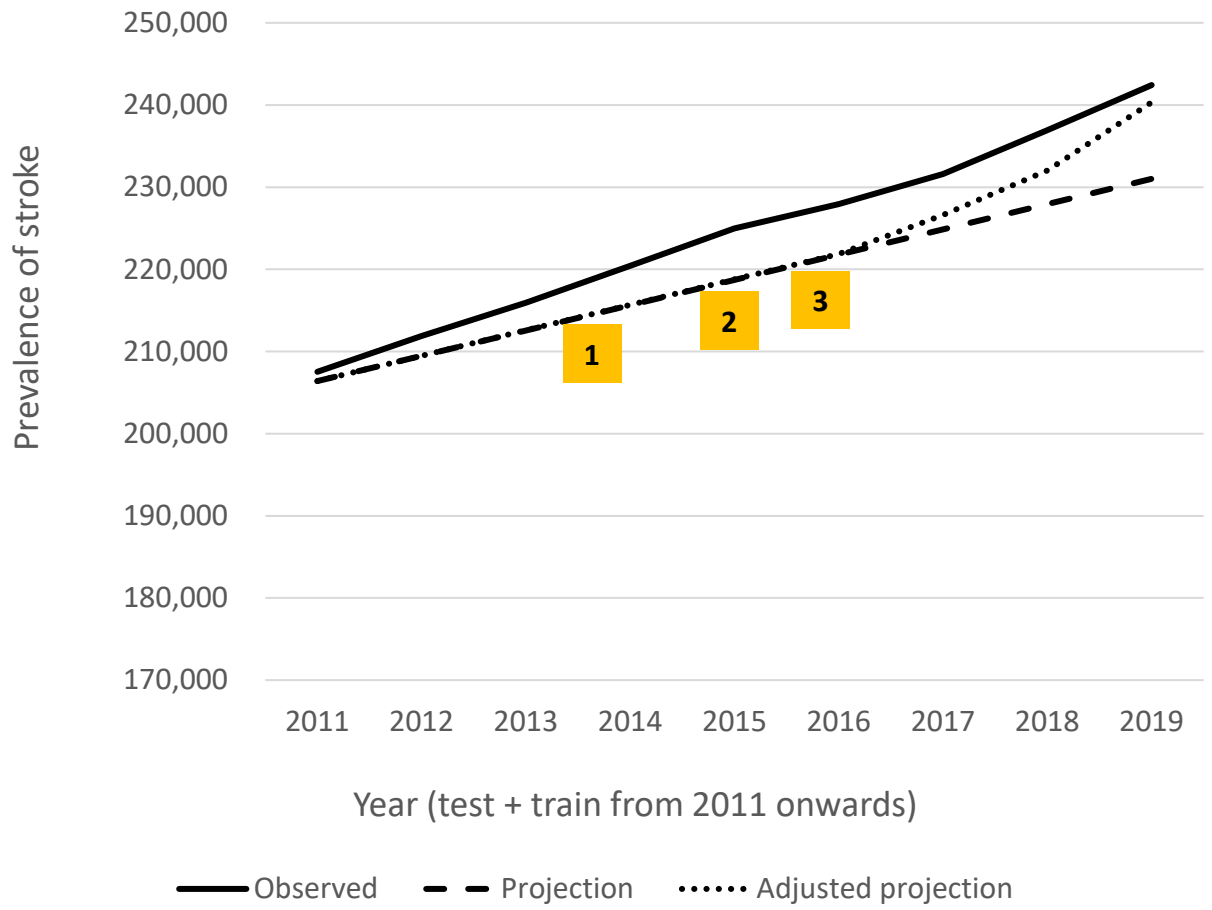

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2. Bushfire in Esperance 2015
    1. Magnitude impact restricted to 0.04% on prevalence
    2. No visual change
3. Bushfire in 2016 Yarloop
    1. Magnitude impact restricted to 0.002% on prevalence
    2. Slight visual change

Results

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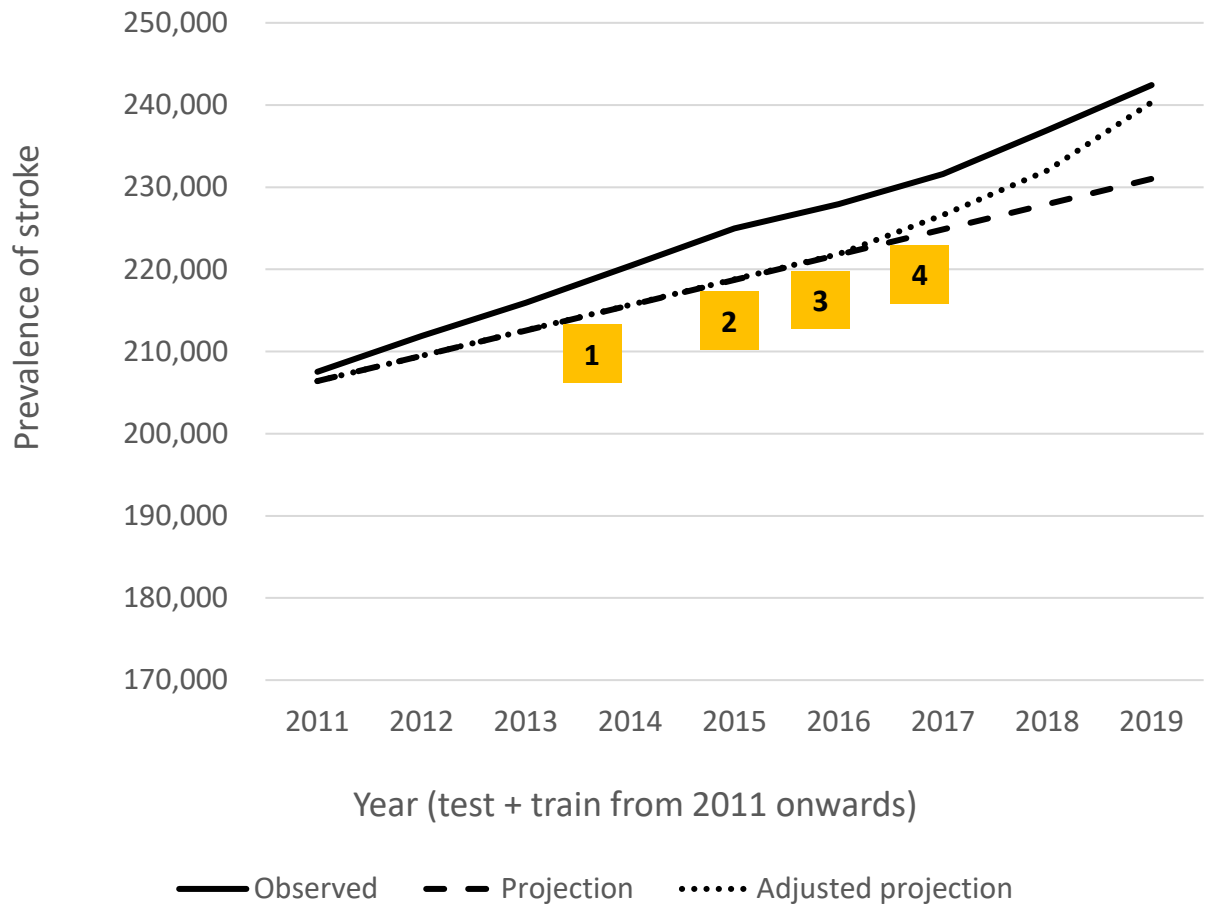

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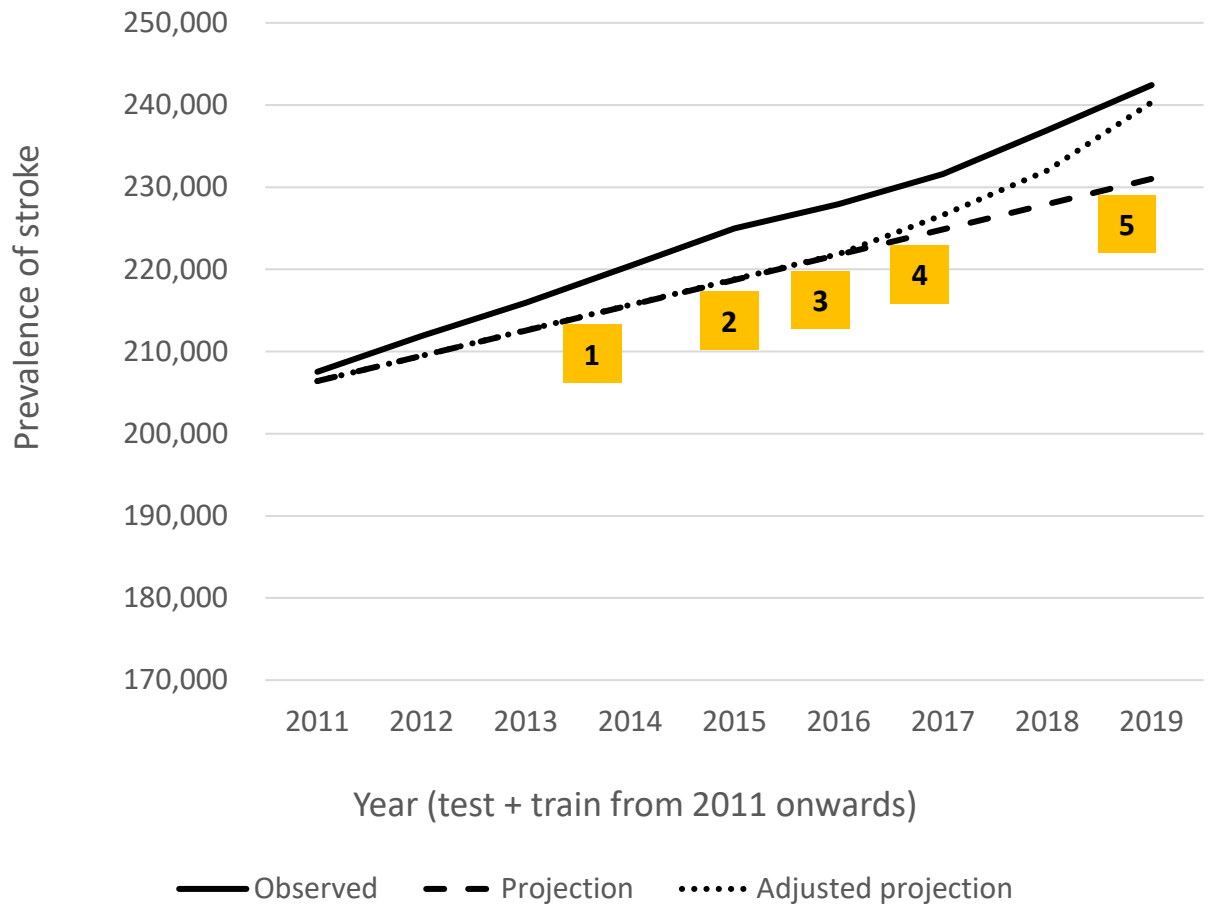
4. Severe flu season 2017
    1. National
    2. Growing visual change

Results

Figure 4. Stroke forecast zoomed in



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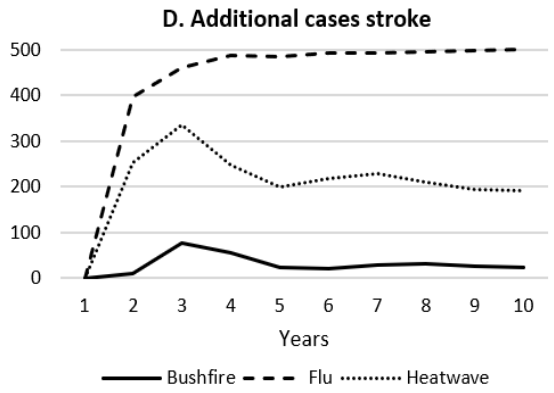
    2. Slight visual change
4. Severe flu season 2017
    1. National
    2. Growing visual change
5. Bushfire 2019
    1. Magnitude impact restricted to 9.23% of Australian population impacted by these bushfires
    2. Substantial correction back to observed values

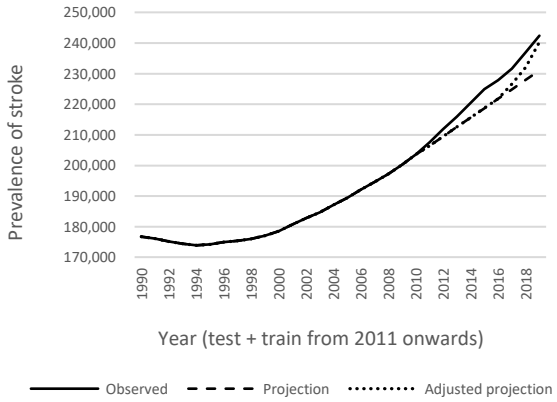
Conclusion

This module presents a novel approach to quantifying the impact of external world events on health conditions. In order to better understand the degree of health burden, our study forecasts the magnitude impact of a disaster on disease prevalence. Further analysis of VAR models at the age and gender level will forecast more granular impacts and improve projection accuracy.

Projected health burden



Maximise prediction accuracy



Improved disaster management plans

Australian Government
Department of Health and Aged Care