Emerging from lockdown:
modelling, outputs and assumptions

Around the world, countries are struggling with the pandemic - some never emerged from their first wave while others are experiencing a second.

- COVID-19 has caused 26 million global infections and 1 million deaths
- Many countries have never emerged from their first wave
- Early action in Victoria enabled control to be quickly regained

Victoria has recently experienced a second wave of infections. Outside Australia, New Zealand, and Taiwan, which have pursued aggressive suppression and elimination strategies, these have been common.

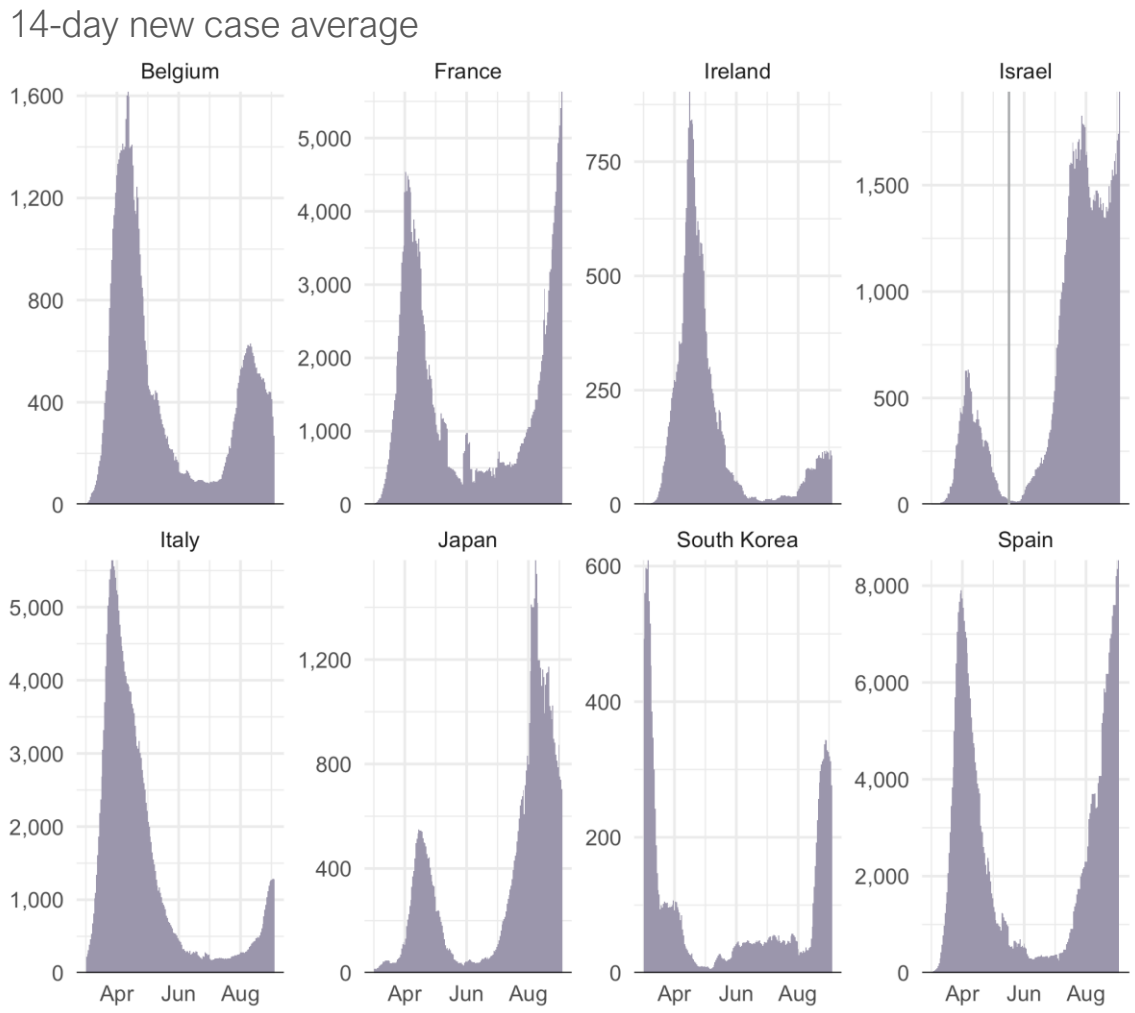
Second waves have typically occurred following premature easing of restrictions, with jurisdictions underestimating just how challenging it is to maintain control with even low numbers of infections.

Examples of resurgence include:

Israel, which gained control over new COVID-19 outbreaks after their first wave in April. But schools were opened on May 17, which soon led to outbreaks in classrooms that spread to homes. Another national lockdown has just been announced.

Spain, which used stringent stay-at-home orders until May. Restrictions were removed in June, and international tourism was encouraged. This soon led to a second wave. European countries have since banned travel to Spain. Its hospitals are reaching capacity again. Madrid is tightening restrictions, and gatherings of over 10 people are banned.

France, which after strict lockdowns in March and April is now facing a second wave. Masks are being made compulsory. Some schools remain closed. Local lockdowns are being considered. A national lockdown has not been ruled out.



Source: Our World in Data (2020).
Note: These countries have increased their testing capacity, meaning their first and second waves are not perfectly comparable.

Victoria will not be in a safe position to re-open in mid September

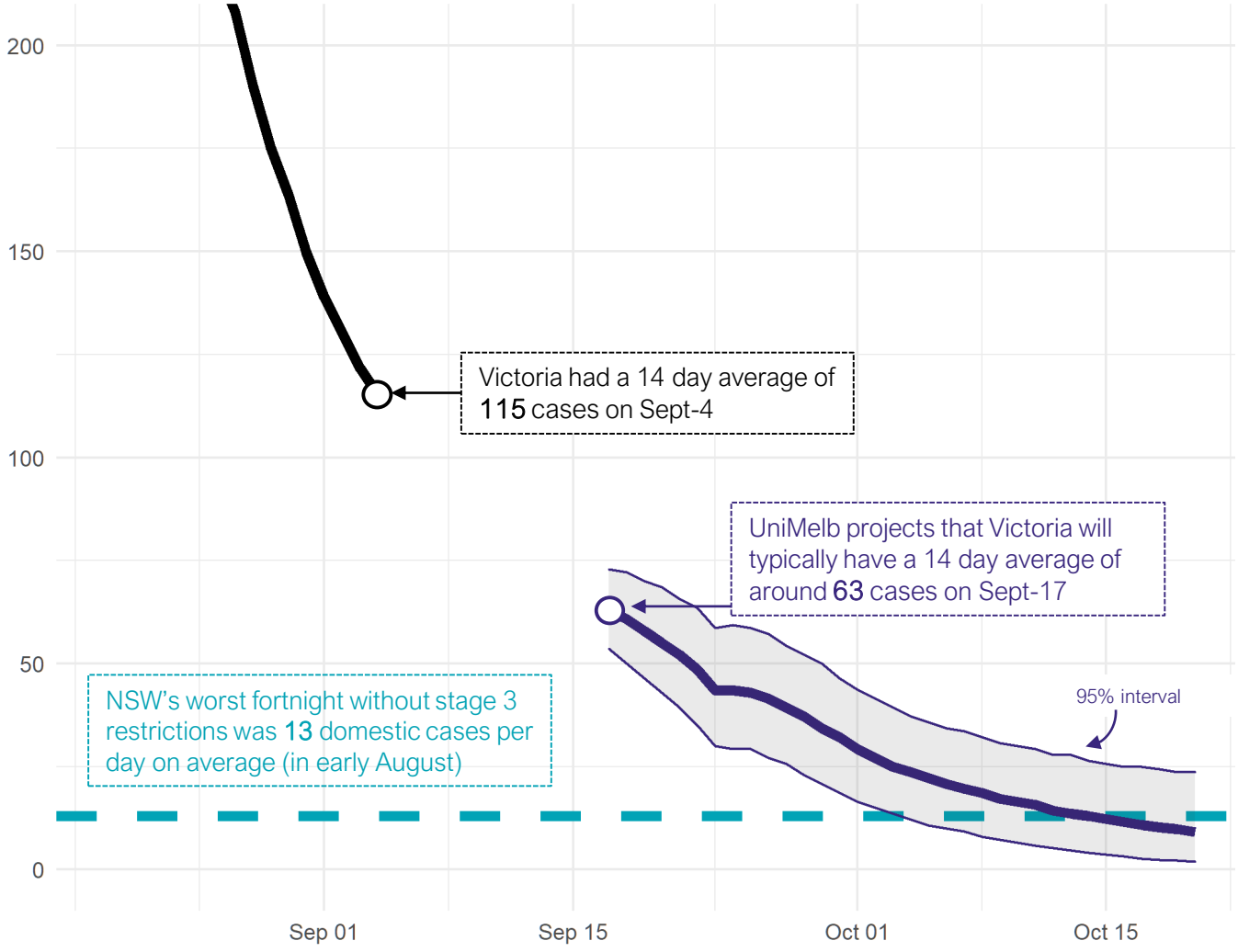
- On September 4th, we had a 14-day average of **115** cases (1,608 total)
- In mid-September, we will have an average of **63** cases (882 total)
- With so many cases in the community, re-opening at this point will risk a resurgence, undoing all of the gains achieved from lockdown.

Coronavirus can quickly get out of hand, and the national strategy to make sure we do not have 1,000s of daily cases is to suppress community transmission.

University of Melbourne modelling finds that it is unlikely we will have aggressively suppressed the virus by mid-September.

Based on current levels of social distancing, the 14-day case average is likely to be over **60** cases by mid-September. By contrast the *worst* fortnight that NSW has experienced outside of Stage 3 restrictions was **13** domestic cases per day on average.

If restrictions are eased while the virus is still circulating widely in the community, there is a real risk that infections will rebound – causing restrictions to be reimposed and last much longer.



Note: UniMelb's DPM model begins on the 3rd of September, and 14 day averages are only available from the 17th.

Reopening too soon risks more lock-downs by Christmas

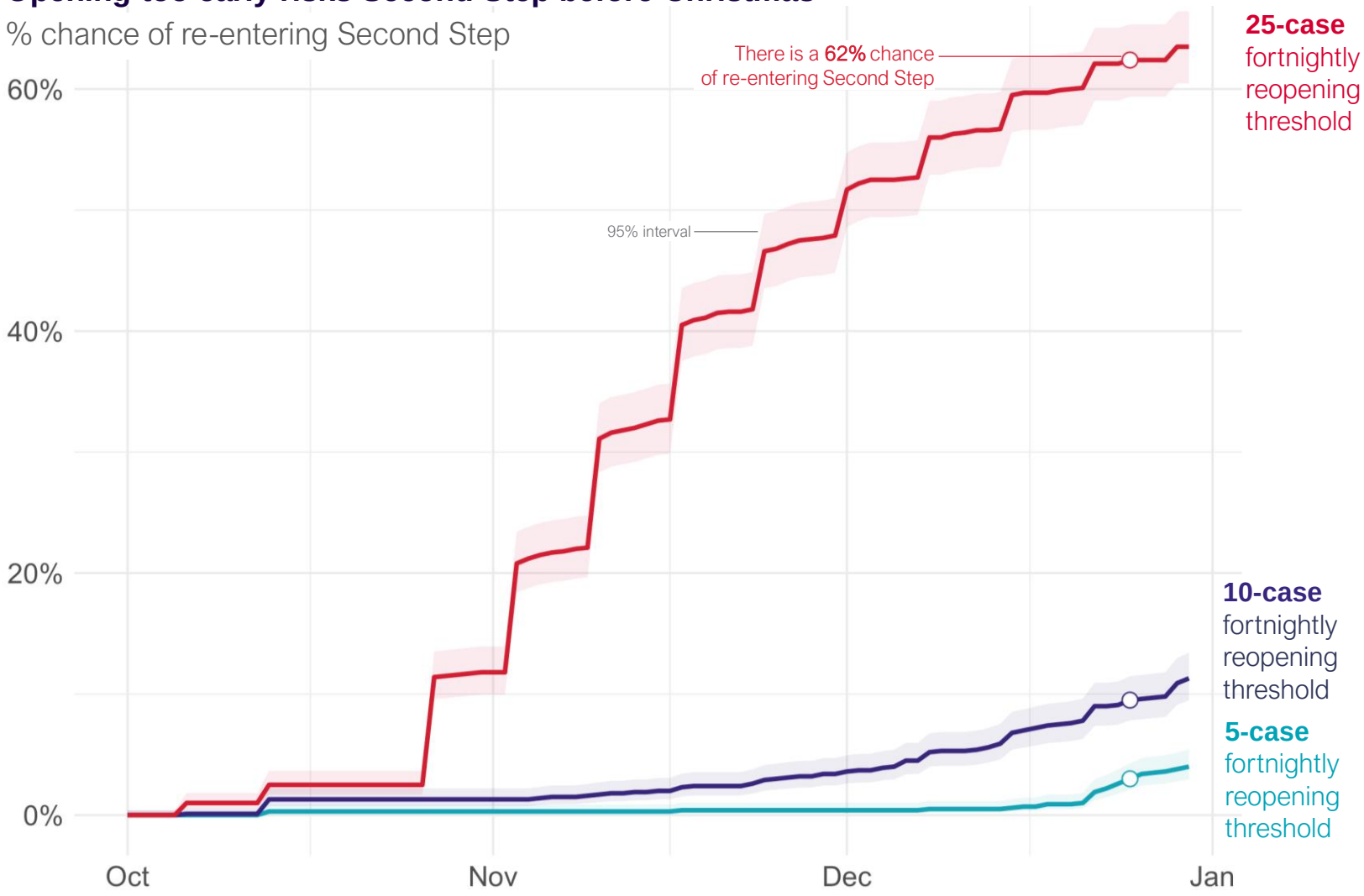
The fewer cases of coronavirus in the community when we ease, the lower the chance of locking down by Christmas.

University of Melbourne modelled several policy scenarios.

If we ease restrictions when the average number of cases over the previous fortnight is 25 (350 cases total) then it's more likely than not that cases will get out of hand and restrictions will have to be reinstated to regain control and protect the health system.

Waiting until the average is 5 cases a fortnight – or 70 cases total - reduces the chance of increased restrictions before Christmas to just 3 in 100.

Opening too early risks Second Step before Christmas



Aggressive suppression is our best bet for avoiding a yo-yo effect

A yo-yo effect is where lack of control is achieved, causing restrictions to be continuously lifted and reimposed. The University of Melbourne model suggests that if we ease restrictions when there is a fortnightly daily case average of 25, there is a 6 in 10 chance of having to lock down again before Christmas.

Ultimately, a wide range of different scenarios could play out over the coming months in Victoria. Our exact path will depend on policy decisions, how well Victorians can follow public health advice – and luck.

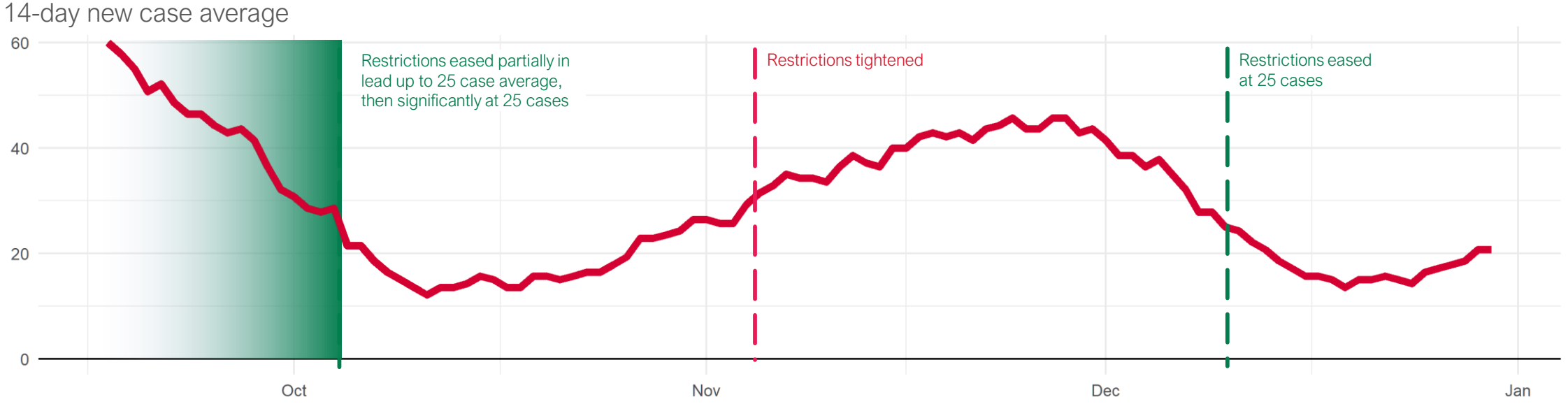
There are strong elements of randomness in how SARS-CoV-2 spreads throughout a community. One person who is infected with the virus might be very infectious to others, for a long time, and have lots of contacts before they are told to isolate. Another might have few contacts or be less infectious.

Running a large number of model simulations tell us what is *most* likely to occur.

In 620 out of 1,000 model simulations, reopening too early (at 25 cases per day over the fortnight, on average) causes a yo-yo effect in which infections rebound, requiring restrictions to be reimposed.

The below graph shows just 1 of these 640 scenarios. As cases fall, restrictions are eased slightly, and then significantly when fortnightly average case numbers hit 25 cases per day (350 cases total). As a result cases then soon start to rise, and restrictions need to be tightened again before Christmas to avoid a large third wave that overwhelms the health system.

What a yo-yo effect could look in Victoria, based on easing at a fortnightly average of 25 cases a day



Appendix: the model and its authors

Authors

Melbourne University's Dynamic Policy Model (DPM) is the result of an extensive international collaboration among a multi-disciplinary team from Australia and New Zealand over many months.

Primary contributors are:

- Dr Jason Thompson from Melbourne University's Transport, Health and Urban Design Research Lab,
- Professor Rod McClure from University of New England's Faculty of Medicine and Health,
- Professor Mark Stevenson from Melbourne University's Transport, Health and Urban Design Research Lab, and
- Professor Tony Blakely from the Population Interventions Unit at Melbourne University's School of Population and Global Health.

Contributors in the project have generously given their time pro-bono to DHHS to provide outputs from their model.

The model

The University of Melbourne's agent-based dynamic policy model (DPM) for COVID-19 imagines a simplified world where people (*agents*) move around like pieces on a chess board. Each person has their own characteristics. Some are old, some are young, some go to work and some go to school. Some are very infectious when they get COVID-19, and some are not.

If a person moves into the same square as another person who has COVID-19, they may catch the virus. People can reduce their risk by avoiding other people, keeping 1.5m distance or wearing a mask. If a person becomes infected and is traced by the health system, they are isolated and are less likely to infect others. As greater (or lesser) restrictions are imposed by the DPM, people change the way they move around the chess board – Following restrictions, some may stay at home more, or deliberately try to avoid interacting with others. If case numbers decline and restrictions are loosened, agents' mobility and interactions increase.

Agent based models are used throughout academia to model phenomena as diverse as economics, transport, and infectious diseases.

The DPM has parameters that are based on the disease mechanics of COVID-19, and have been validated against Australia and New Zealand's first and second wave of infections. This means that the model is helpful in predicting *more likely* outcomes of changes in social and health policies related to social contact and therefore, disease transmission.

This model has been peer-reviewed and published in the Medical Journal of Australia.[1] A detailed set of parameters is available online. It continues to be updated and enhanced as the pandemic progresses.

[1] Blakely et al (2020) *The probability of the 6-week lockdown in Victoria (commencing 9 July 2020) achieving elimination of community transmission of SARS-CoV-2.* Med J Aust 2020.

Appendix: Models should be used as a guide

Modelling a pandemic is challenging. The further out estimates are made, the more uncertainty there is about the outcome. With more time and more data to inform the forecast, assumptions can be either confirmed or altered to create a more accurate short-term forecast. While every effort has been taken to reflect the societal, epidemiological and policy settings in Victoria, as with all modelling there are limitations. Significantly this model can measure the number of new daily cases – but not the number of unknown source cases.

What the model is not currently specified to tell us
• The number of unknown source cases (community transmission or 'mystery cases') which should be core to the decision of whether to ease restrictions.
• The differences in infection rates in geographic areas – including high-risk LGAs and low-risk regional areas.
• The relative risk of catching coronavirus from going to work in certain industries (e.g. abattoir and healthcare workers).
• How the weather might affect transmission risk.
• When a vaccine will be available.
• What the risk of new cases arriving from overseas is.
• Fine details about the testing and tracing system.
• Details about differences in demographic risk outside of students and essential workers.

Each line in this graph below represents a single example of what the model predicts could happen before Christmas. The lines turn RED in the Second Step, and GREEN in the Third and Last Step. The lines do not all follow the same exact path, which reflects the uncertainty of coronavirus. However over many simulations, patterns start to emerge. Where restrictions are lifted too early, cases rebound and restrictions have to be re-instituted. When there is a fortnightly <5 case average threshold, cases are far less likely to rebound by Christmas.

5-case fortnightly reopening threshold
(42 cases total)

10-case fortnightly reopening threshold
(140 cases total)

25-case fortnightly reopening threshold
(350 cases total)