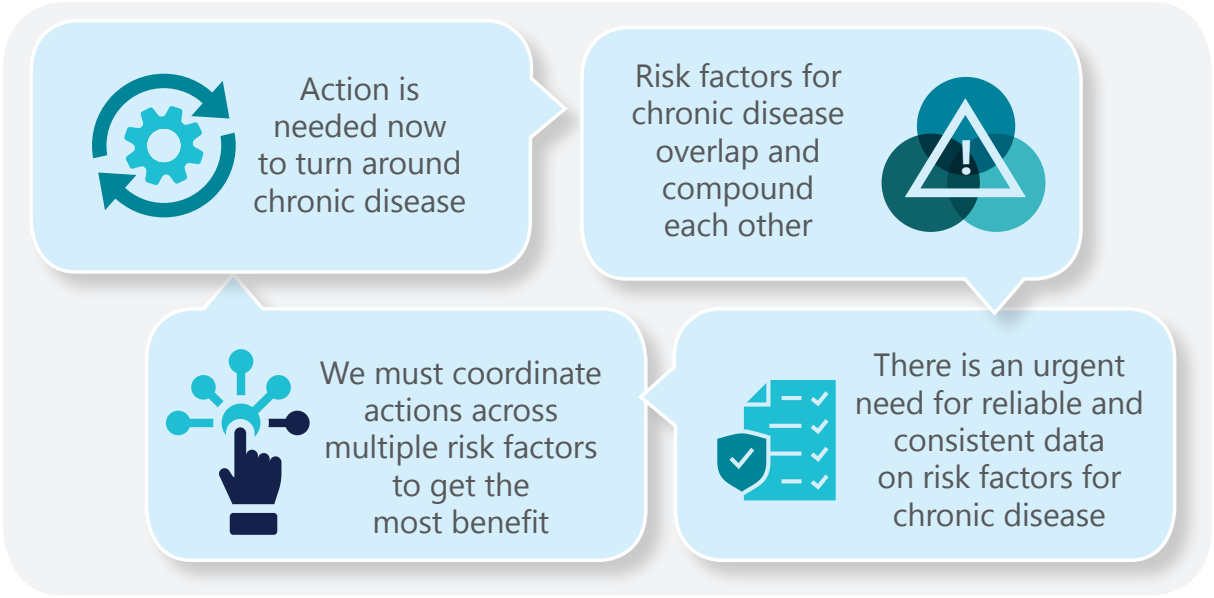
FINDINGS BRIEF

The Australian Prevention Partnership Centre
Systems and solutions for better health

More investment in robust data is needed to support our case for chronic disease prevention



Key messages

- The Prevention Centre is a pioneer of dynamic simulation modelling to provide synthesised advice for policy on chronic disease prevention. Dynamic simulation models are computer models that are simplified representations of the real world.
- We developed a national dynamic simulation model of chronic disease prevention, the GoHealth model. Based on trends in prevalence of nine modifiable risk factors, the model aimed to project the health burden and economic costs of preventable disease in Australia and allow scenario testing to understand how best to allocate investments and actions across risk factors to achieve the greatest impacts on chronic disease.
- To the best of our knowledge, the GoHealth model is the first dynamic simulation model in the world that captures the dynamic relationships between risk factors for chronic disease in a comprehensive way and links these to burden of disease and associated economic costs.
- Lack of consistent and reliable Australian data on risk factor prevalence meant we could not sufficiently reduce uncertainty to enable its use as a decision support tool for policy.
- However, the model demonstrates underlying behaviour in the system, enabling us to offer policy-relevant recommendations and make a compelling case for action on chronic disease prevention.
- Investments are needed to build a more robust data ecosystem to support the advanced chronic disease decision support infrastructure the GoHealth model provides.

The project: Dynamic simulation modelling to support investment decisions across the common risk factors for lifestyle-related chronic disease
Model architect: Dr Danielle Currie
Project start: November 2018 **Project end:** June 2022

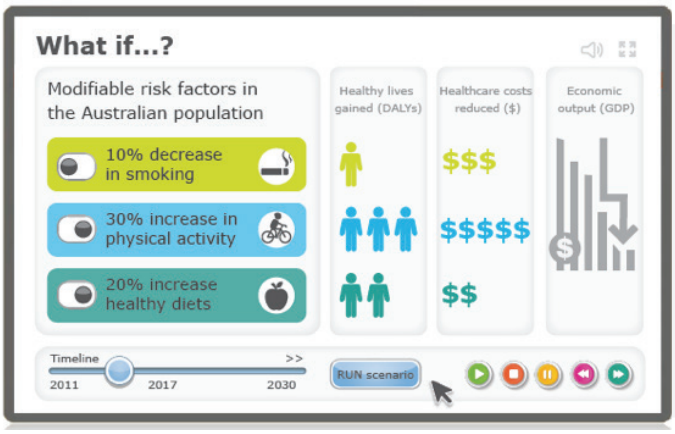
Why is this issue important?

The prevalence and cost of chronic disease is growing in Australia and globally, causing a substantial health and economic burden.[1,2,3] Limited government resources and widening inequities in distribution of chronic disease mean it is increasingly important for governments to target money for prevention as effectively and efficiently as possible.

As much as 38% of chronic diseases are caused by a complex interaction of modifiable risk factors including tobacco and alcohol use, a diet low in fruit and vegetables, a lack of physical activity, and environmental risk factors.[4] The highly complex interplay between these risk factors and their related burden of disease makes it difficult for policy makers to know where to best target action in order to generate the greatest return on investment.

While there are some data looking at individual risk factors and their effects on different diseases, this does not consider the synergistic and overlapping effects of different risk factors or interventions.

There is a pressing need for a decision support tool to support policy makers to make evidence-informed decisions about what combination of risk factor reduction, at what scale, targeted at whom, at what time, and for how long, represents the best strategy for reducing Australian's burden of disease.



Dynamic simulation models are computer models that are simplified representations of the real world. Simulation modelling enables users to map complex problems by bringing together a variety of evidence sources such as research, expert knowledge, practice experience and data. The resulting dynamic model is a 'what-if' tool that can simulate various policy scenarios to see which is likely to have the most effect.

The Prevention Centre's dynamic simulation models are built using a participatory approach that brings multidisciplinary stakeholders together to collaborate and explore policy and health service scenarios.

What did we do?

Since 2013, the Prevention Centre has developed several separate system dynamics models to support decision making on a range of issues, including how best to reduce harmful alcohol consumption, smoking prevalence, childhood overweight and obesity, diabetes in pregnancy, and deaths from cardiovascular disease.

We knew that tackling different risk factors or different disease outcomes separately in our models failed to look at the problem of how to prevent behaviour-related chronic disease systemically and missed an opportunity to inform how best to invest in a more targeted and coordinated way across the portfolio of risk factors to achieve the greatest impact.

The first phase of the Compelling Case project aimed to provide a proof-of-concept for a single systems model to link risk factors to disability-adjusted life years and health expenditure. It tested four agreed interventions.

The second phase of the project expanded the model to drive insights for policy, planning and advocacy. The aim was to inform policy makers how to invest in a targeted and coordinated way across a portfolio of risk factors to achieve the greatest impact. It also aimed to make explicit the links between population risk factors and their diseases or causes of ill-health. The questions explored included:

1. Can we capture the complexities of modifiable risks and related disease burden and costs using system dynamics?
2. If so, what could this simulation model tell us?

We gathered datasets and evidence on Australia's health burden and economic costs of preventable disease.[5] We collaborated with experts and policy partners to develop a conceptual map that was then converted to a computer model of Australia's burden of disease – the GoHealth model.

We then ran and validated the model to produce insights that could help inform decision making and explore the underlying behaviour of these interacting risks and their linked diseases.

What did we produce?

We built the GoHealth model, Australia's first system dynamics model that demonstrates the complex interaction between risk factors, burden of disease and economic burden.

The model focused on nine key behavioural, dietary and biomedical risk factors identified by the Australian Burden of Disease study that contribute most to preventable health burden in Australia. We looked at how these risk factors interact with the top 16 diseases in terms of prevalence and burden (health and economic).

We also captured how our changing population demographics change the prevalence of the risk factors and associated disease burden.

The model is driven by an open population (based on the Australian population). That is, it accounts for births, migration, ageing, and mortality and can project health and economic outcomes over a 20-year period, based on trends in risk factor prevalence. The model is interactive, providing the capability to run scenarios to inform strategic decision making.

Due to lack of reliable and consistent data on risk factor prevalence in Australia, the GoHealth model should be seen as an exploratory and advocacy tool that provides key behavioural insights to guide policy direction and support the public health community to make a more united and compelling case for investing in chronic disease prevention.

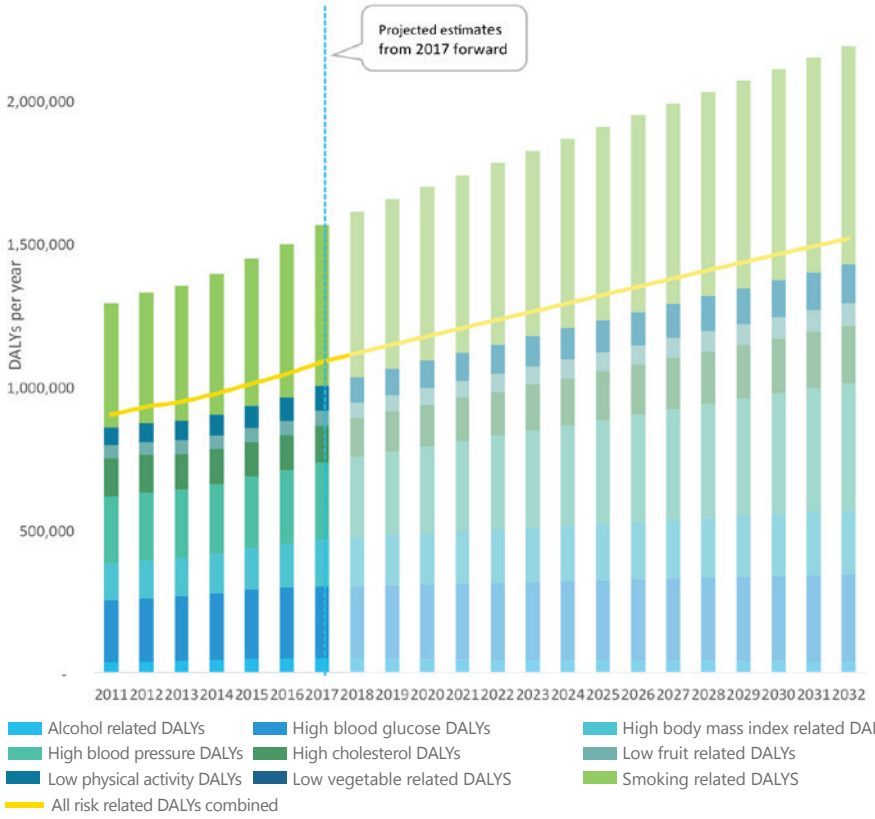
Why did the model show?

1. Urgent action is needed to turn around the trends in risk factor prevalence

As with climate change, the model shows that it is too late to halt the explosion of chronic disease in Australia. There is already significant momentum in the development of chronic disease, driven by risk factor exposures people had in the past or are still experiencing. Our ageing population will increase the burden of chronic disease even further.

Even if the prevalence of all risk factors were to stay at 2017 levels, the burden of chronic disease would still rise substantially over the next 10 years. Efforts to reduce the burden will require not only stopping the prevalence of risk factors from increasing but turning the trend around.

Risk factor DALYs* per year by type for all included diseases, 2011–2032



This graph shows how the burden of chronic disease will increase even if we kept the prevalence of risk factors at 2017 levels. The model demonstrates that smoking would continue to make the greatest contribution to the total burden of disease until 2032.

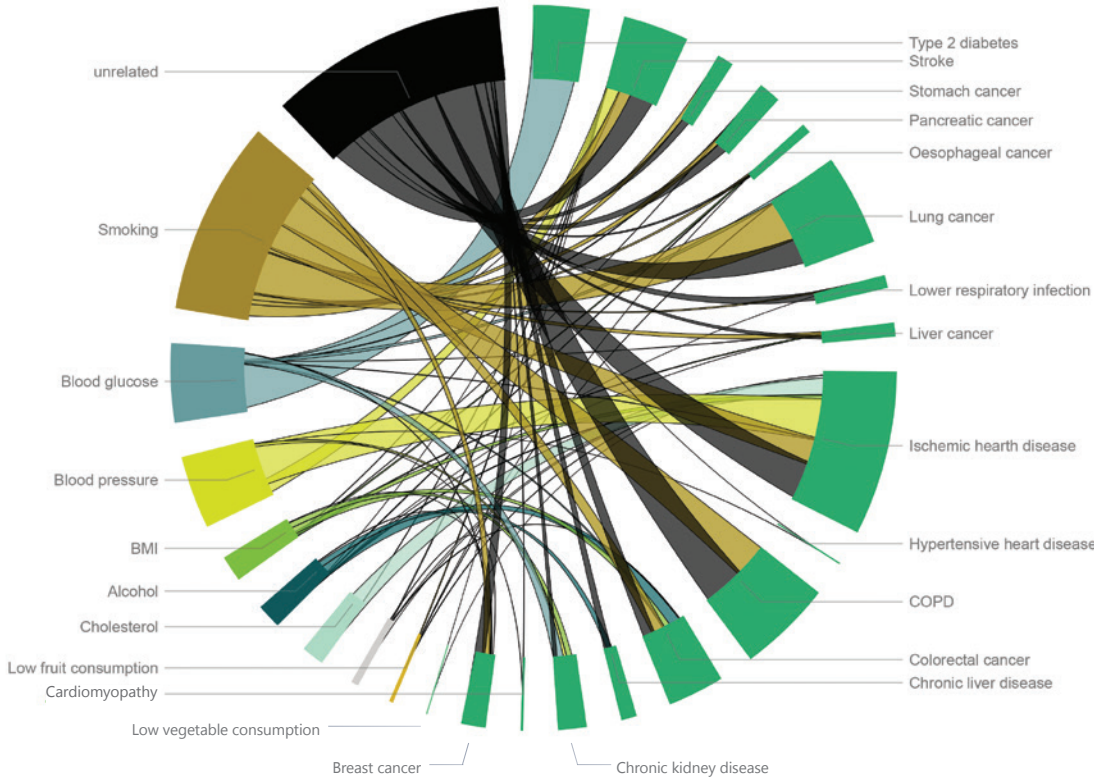
However, risk factors influence each other and when we adjust for this we can see the total attributable burden (yellow line) is estimated to be around two-thirds of what it would be if we simply summed the impact of all the individual risk factors together.

*Disability Adjusted Life Year (DALY)

2. We must coordinate actions to target multiple risk factors at once to get the most benefit

Many people have more than one risk factor for chronic disease. For example, the same person may have high blood pressure, high cholesterol, high BMI, poor diet and insufficient levels of physical exercise.

These risk factors overlap and compound each other. Simply concentrating our efforts on removing one risk factor is unlikely to significantly affect the rising rate of chronic disease in Australia.



This chart shows how risk factors contribute to different diseases. When the impact of all the risk factors we studied were combined, by far the greatest burden was for coronary heart disease, followed by lung cancer, stroke, pancreatic cancer, type 2 diabetes and chronic obstructive pulmonary disease (COPD).

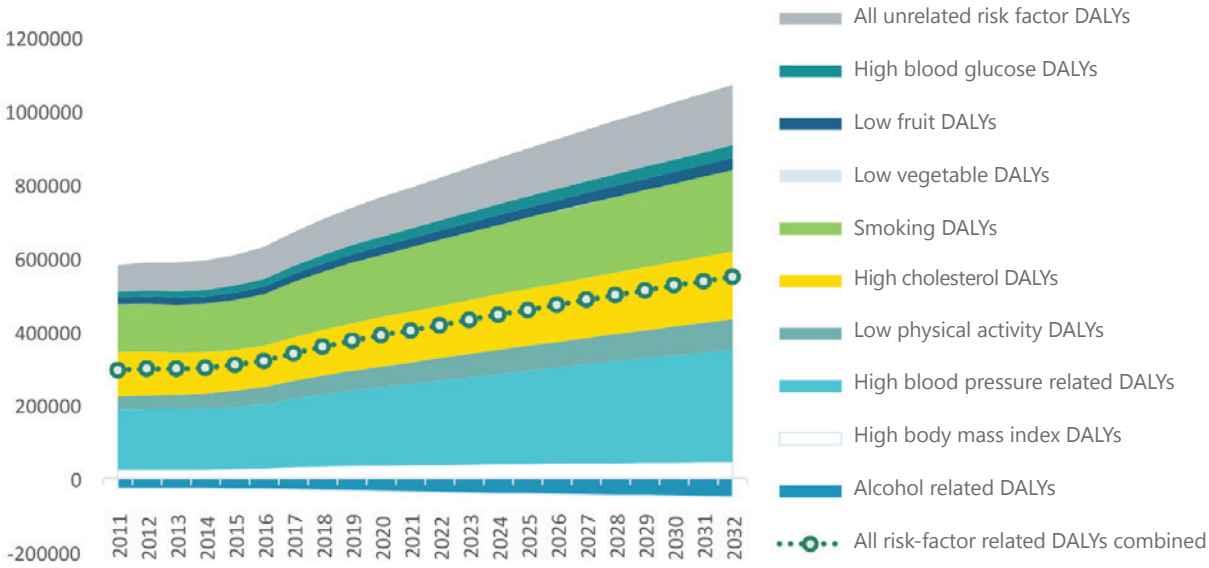
The model suggests that policy makers must make commitments that address blood glucose, high blood pressure, high BMI and high cholesterol together, whilst not losing sight of the sustained efforts still needed to reduce smoking levels.

The model shows that some risk factors strongly interact with others. While these findings may already be understood, the model itself provides a mechanism that attempts to quantify the relative impacts of these collective risks.

When focusing on disease prevalence, the model magnifies the relationships between risk factors and adds to our understanding of total risk at an overall level.

Individual disease projections can show us the relative increases that we might expect to see over time. Despite smoking-related prevalence being forecast to increase overall coronary heart disease burden, it is high blood pressure that is expected to grow the fastest (below).

Modelled attributable risk-factor DALYs[a] for ischemic heart disease[b]



a. Disability Adjusted Life Year (DALY)
b. This brief uses the terms coronary heart disease (CHD) and ischemic heart disease (IHD) interchangeably throughout. It is noted that CHD is the preferred term of use in the Australian healthcare system, however IHD is more commonly used in the international literature, from which much of this model's data is drawn.

This graph shows the projected contribution of different risk factors to years lost due to premature death and disability (DALYs) for ischemic heart disease over time, assuming all risk factor prevalence is held to 2017 levels. It shows that while overall heart disease DALYs will increase, this is largely being driven by high systolic blood pressure, smoking, and, to a lesser extent, high cholesterol. Alcohol consumption is shown as slightly protective (negative DALYs over time) as per the causal evidence literature on alcohol used by the Global Burden of Diseases study.

The over-laid dotted line graph shows the adjustment for the impact of overlapping risk on ischemic heart disease compared to the sum of individual risk factor contributions to ischemic heart disease (IHD).

3. There are major gaps in Australian national data collection

While Australia collects good data on **disease** prevalence, we do not collect robust, consistent data on **risk factor** prevalence. For some risk factors there are very few data points and the data is not stratified by age and gender.

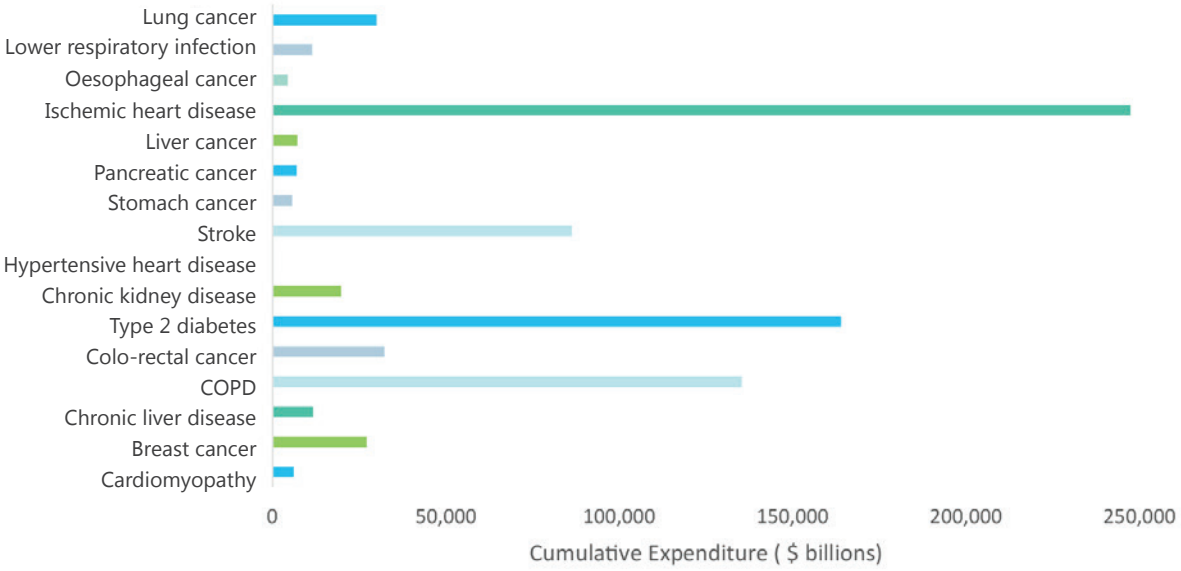
Understanding historical trends is essential to determining future disease burden in this model. If these trends have a great deal of uncertainty, then we cannot be confident in the policy implications.

There is an urgent need for consistent and reliable risk factor data.

4. The economic burden of chronic disease in Australia is different to the health burden

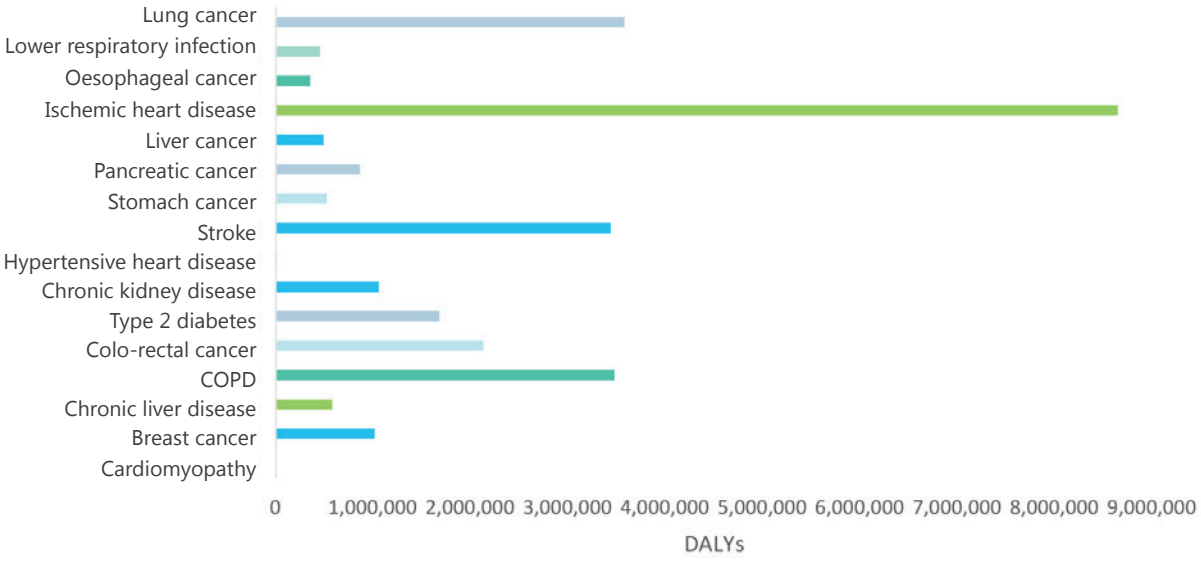
Even though ischemic heart disease causes by far the greatest health and cost burden, there are several other chronic diseases that highlight the need to measure and report burden in a way that considers the impact on both human lives and economic costs. For example, although modelled economic costs for lung cancer are relatively very low, especially compared to chronic diseases like type 2 diabetes, it causes a significant burden to human lives as lung cancer has a high mortality rate, and particularly impacts individuals who are relatively young and have a lot of life left to live.

Modelled cumulative total expenditure (health and productivity) by disease, 2017–2032



These graphs show projected expenditure (A$ billions)) for different chronic diseases compared with disease burden (DALYs)

Modelled cumulative total DALYs* by disease, 2017–2032



*Disability Adjusted Life Year (DALY)

Why does it matter?

The Compelling Case Project demonstrates that a systems approach is crucial to understanding the complex drivers of chronic disease and how best to address them. It illustrates how strategies to address one risk factor influence others, and how risk factors overlap in driving the incidence and prevalence of chronic disease.

We have built the architecture for a model that has great potential for providing a decision support tool to assist policy makers in more precisely targeting interventions against chronic disease.

We have shown that systems modelling is an important tool for capturing the complexity of preventable chronic disease and quantifying the impact of interconnections between different risk factors.

The GoHealth model supports governments to think differently about prevention. It illustrates that policy makers should:

- Consider the interactions of strategies, rather than the volume, and the sum benefit of strategic investment in prevention
- Consider the interactions between risk factors and their joint contribution to certain diseases
- Identify opportunities for intervention that address multiple interacting risk factors at once
- Consider the economic impacts of chronic disease beyond the healthcare costs, such as absenteeism and lost productivity, when making decisions on resourcing the prevention of risk factors for chronic disease.

Next steps

Australia now has an advanced chronic disease decision support infrastructure ready for deployment once it can be coupled with a more robust data ecosystem

There is an urgent need for improved population-level time series data on the risk factors for chronic disease, with consistent definitions and differential demographic trends.

To achieve consistent data for all relevant exposures requires national collaboration and effort. If we are to model chronic disease and risk factors in the same way as we modelled COVID-19, we need to strengthen the modelling workforce, physical infrastructure, and legislative environment to support data collection and sharing.

We support several initiatives outlined in the National Preventive Health Strategy[6], such as the establishment of a national prevention monitoring and reporting framework, that will allow us to achieve better data collection and understanding of risk factors in Australia.

Mapping, quantifying, testing, and validating a system dynamics model of the complex causal interrelationships between the common risk factors for chronic disease was a hugely ambitious undertaking. It pushed the boundaries of decision analysis using complex systems modelling and simulation. This project has thus contributed to building Australia's world-leading capacity in dynamic simulation modelling research for population health and decision making.

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Visit the Prevention Centre website for more information about the compelling case, preventioncentre.org.au

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