*New Zealand has a serious and growing type 2 diabetes problem. It is predicted that within the next 20 years, the number of people with type 2 diabetes will increase by 70-90%. Of these people, Māori, Pacific and Asian will be worst affected. Allowing this to occur will have a hugely detrimental impact on the wellbeing of our people, but also on the sustainability of our health system and economy. There is an urgent need to recognise diabetes as a Government health priority and to invest in future prevention, treatment and care.*

# The Economic and Social Cost of Type 2 Diabetes

diabetes new zealand

EDGAR DIABETES & OBESITY RESEARCH
A UNIVERSITY OF OTAGO RESEARCH CENTRE

HEALTHIER LIVES He Oranga Hauora National SCIENCE Challenges

Tony and Heather Falkenstein Sponsors

pwc

***This study was conducted by PwC and funded by: Diabetes New Zealand; Edgar Diabetes and Obesity Research Centre (University of Otago); Healthier Lives – He Oranga Hauora National Science Challenge and Tony & Heather Falkenstein***

# *Foreword*

There have been many attempts to highlight the burden of disease and inequity of health outcomes associated with type 2 diabetes. In the late 1980s the New Zealand Medical Research Council identified diabetes as a condition warranting priority funding for research. In 2001, on behalf of Diabetes New Zealand, PwC New Zealand ('PwC') produced a report demonstrating the current and projected cost of diabetes. Then in 2008, an Expert Advisory Group appointed by the Ministry of Health at the request of the then Minister, developed a Quality Improvement Plan which recommended a series of measures considered necessary to stem the tide of the rapidly developing diabetes epidemic and its consequences.

Despite a range of Quality Standards for Diabetes Care and various well intended initiatives introduced by successive Governments, New Zealand still has no national strategy or plan for managing what is widely regarded as a disease which has reached pandemic proportions. It is largely up to District Health Boards (DHBs) to develop their own strategies. While it may be beneficial for services to be tailored to local needs, there are inevitably variations in the quality of service provision potentially leading to a worsening of the inequity of health outcomes. There is no national approach to diabetes prevention.

In collaboration with Diabetes New Zealand, Edgar Diabetes and Obesity Research Centre and the Healthier Lives – He Oranga Hauora National Science Challenge, PwC has produced this Report, which examines the current and projected economic and social costs of type 2 diabetes between 2020 and 2040. The findings, which in 2001 were considered worrying, might now more appropriately be described as alarming as rates of type 2 diabetes continue to escalate and inequities persist. However, the Report also provides some good news.

The researchers have examined the cost effectiveness of several strategies that have the potential to reduce the disease burden associated with type 2 diabetes. International research has convincingly shown that lifestyle changes (modifying diet and increasing physical activity) can appreciably reduce the risk of progression of pre-diabetes to type 2 diabetes. Similar measures, if adopted more intensively to the extent that appreciable weight loss is achieved, can result in the remission of type 2 diabetes even when the condition is well established and being treated by medication. These lifestyle related interventions are likely to change the lives of individuals; have considerable societal benefits; and likely achieve cost benefits in the longer term beyond the timeframe of the modelling undertaken in this project. The benefits of two relatively new medications and of providing adequate foot care services for all people with diabetes have also been shown in international trials and studies. The modelling studies presented in this Report show that the availability of these medications and ensuring access to podiatry throughout the country would result in substantial saving of Government expenditure as a result of reducing the long-term costs associated with the treatment of complications.

The Report has clearly not examined all the options relating to type 2 diabetes which should be included in a national strategy. In particular, it has not considered population-based approaches to primary prevention as this topic has been widely aired in New Zealand and internationally. It is generally accepted that legislative and other initiatives that enable healthy food and physical activity choices (e.g. a sugar levy) will reduce obesity rates and thus the risk of developing type 2 diabetes. At the other end of the spectrum of opportunities, there is a need to consider the role of bariatric surgery, currently available to a very limited extent in New Zealand, but which has the potential to produce remission of type 2 diabetes in association with appreciable weight loss. Further, while both conditions have common issues, this Report has not considered type 1 diabetes as there are a number of fundamental differences with regard to cause as well as the provision of services and treatments. The condition may be less frequent than type 2 diabetes, but type 1 diabetes is also increasing in frequency and the effects on individuals, their families and society require separate consideration.

It is hoped that Government will consider the full range of options in an urgently needed National Strategy for the prevention and management of this chronic disease pandemic. The disease burden of diabetes extends beyond the recognised complications and diabetes is now acknowledged as a major determinant of poor outcomes in people developing COVID-19 infections.

**Sir Eion Edgar**
*Patron of Diabetes New Zealand*
*Chair of the Advisory Panel of the Edgar Diabetes and Obesity Research Centre (University of Otago)*

**Sir Jerry Mateparae**
*Chair of the Governance Group Kahui Māori of the Healthier Lives – He Oranga Hauora National Science Challenge*

# *Objectives and approach of this study*

Through this study we aimed to achieve three primary objectives:

1. Reignite awareness amongst Government decision-makers and across the health sector of the realities of the economic and human cost of type 2 diabetes in New Zealand, including issues of inequity;

2. Provide a robust case for prioritisation of resources toward more equitable and effective type 2 diabetes prevention and management initiatives; and

3. Prompt the update and amendment of type 2 diabetes-related Government policy towards more effective and equitable diabetes prevention and management interventions.

To achieve this, we worked closely with our Expert Advisory Group (Table 2) to step through a series of key questions (which form the structure of this report). Our process is described below:

- **First**, we sought to understand type 2 diabetes as a condition, specifically the diabetes disease progression pathway, as this formed the basis of our analyses.

- **Second**, we developed 20-year population-based prevalence and cost projections as this allowed us to understand the size and cost of New Zealand's 'type 2 diabetes problem'.

- **Third**, we sought to understand the current national approach to diabetes prevention, treatment and care as well as key trends within the wider health and disability system as this provided important context.

- **Fourth**, we worked through a process to identify four of the opportunities associated New Zealand's current approach to diabetes prevention, treatment and care.

- **Fifth**, we designed a package of four individual diabetes interventions intended to address the identified challenges/opportunities.

- **Sixth**, we completed cost-benefit analysis on each intervention to understand the potential impact on New Zealand's economy and society if the Government were to invest in any one of these interventions.

- **Finally**, we used insight gathered throughout the study to develop a set of overarching conclusions and recommendations.

# *Executive summary*

| | | | | | |
|---|---|---|---|---|---|
| *Size of the problem* | *Cost to New Zealand* | *Holistic and system-wide response to the epidemic* | *Focus areas for this report* | *Impact of investment in four specific areas* | *How this might fit with the proposals from the New Zealand Health and Disability System Review* |

**New Zealand has a serious type 2 diabetes problem that is on a trajectory to reach epidemic proportions within the next 20 years. The health, social and economic consequences of this problem are severe. However, as type 2 diabetes is considered to be a largely preventable condition that can be effectively managed, and in some cases reversed, there is an opportunity to significantly reduce the trajectory and size of this problem with appropriate intervention.**

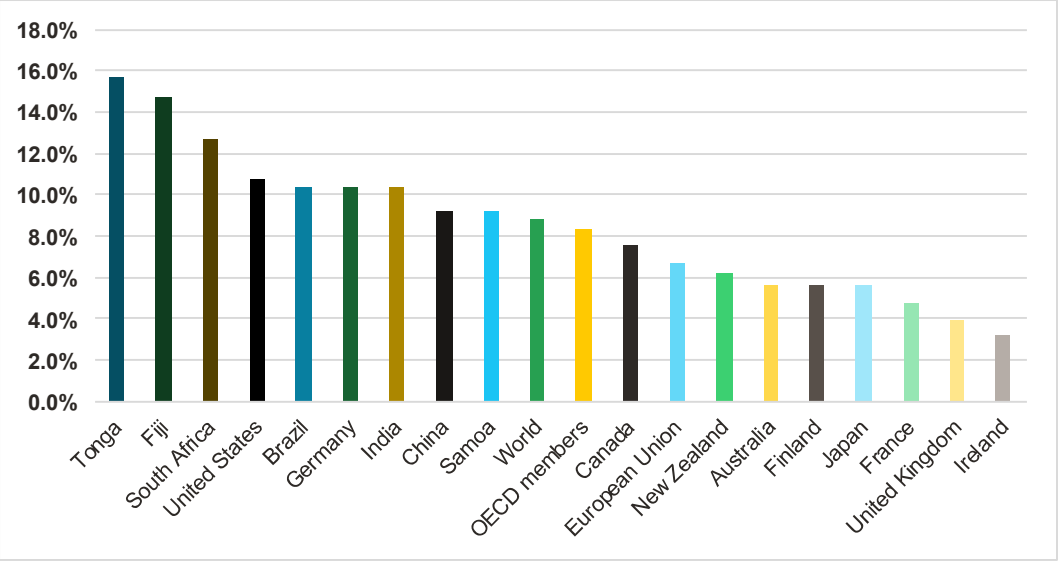
**This will require a collective, holistic and system-wide response from Government, society and individuals. At a system-level, there is a need to reduce prevalence and cost, and improve equity and health outcomes, by changing the diabetes model of care and developing a national diabetes (and other associated long-term conditions) strategy. At a population level, it is essential to create an environment which is conducive to healthy food and activity choices in order to reduce the high rates of obesity, the major preventative risk factor for type 2 diabetes. At a community level, there is a need to support our whānau and communities to make positive change. And at an individual level, we need to seek help and invest time and effort into improving our own health, which becomes feasible when the environment around us makes healthy choices the easy choice.**

## *Size of the problem*

With just under half a billion people living with diabetes worldwide (90% of whom have type 2 diabetes) and the number projected to increase by 25% in 2030 and 51% in 2045[1], **type 2 diabetes is likely to be the biggest global epidemic in human history[2]**. As seen in Figure 1, epidemic proportions of the condition are apparent in many individual countries, including; Tonga, Fiji, South Africa, United States of America, Brazil, Germany and India– all of which report prevalence of diabetes greater than 10% of the population[3].

While New Zealand does not yet rank amongst the worst affected nations, **our type 2 diabetes prevalence rates exceed both those of our closest comparators, Australia and the United Kingdom**[3]. Further, historical trends and future projections suggest that **New Zealand is on a trajectory to reach epidemic proportions of type 2 diabetes within the next 20 years.**

*Figure 1: Diabetes prevalence in selected countries (type 1 and 2 combined) - ages 20 to 79*



Today, there are ~228,000 New Zealanders suffering from type 2 diabetes (4.7% of the population). Within the next 20 years this number is **projected to increase by 70-90%** to ~390,000 to ~430,000 people (6.6%-7.4% of the population) as the population ages and becomes more ethnically diverse. Table 1 below provides a snapshot of actual and projected prevalence of diagnosed type 2 diabetes in New Zealand – the trajectory of increase paints a clear and concerning trend.

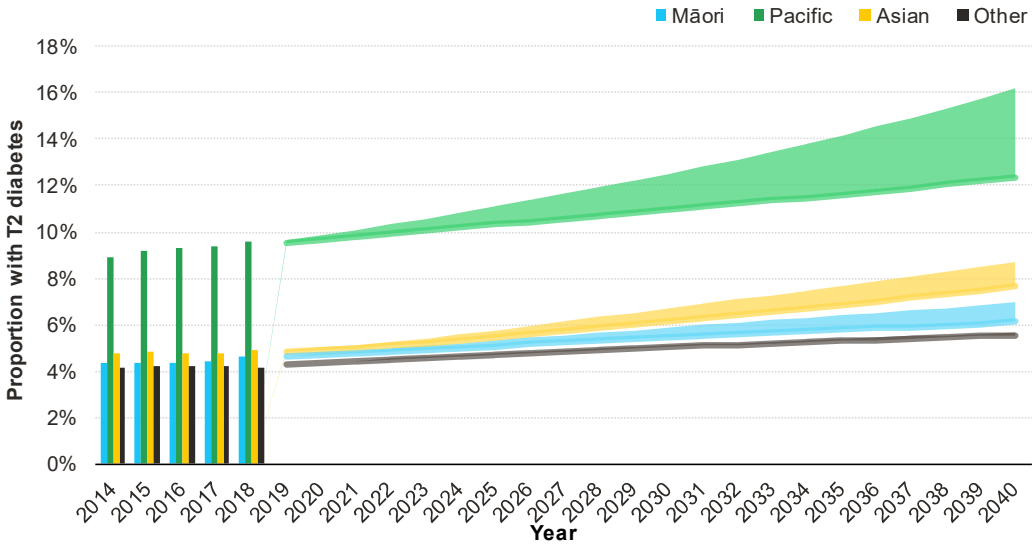
*Table 1: Change in prevalence of type 2 diabetes in New Zealand – by ethnicity (2018-2040)*

| | Other | Māori | Pacific Island | Asian | Total population |
|---|---|---|---|---|---|
| 2018 (actual) | 4.2% | 4.6% | 9.6% | 4.9% | **4.7%** |
| 2040 (projected) | 5.5%-5.7% | 6.1%-7.0% | 12.4%-16.2% | 7.6%-8.7% | **6.6%-7.4%** |
| **Change** | **+1.4%-1.5%** | **+1.5%-2.3%** | **+2.8%-6.6%** | **+2.7%-3.8%** | **+1.9-2.7%** |

In addition to these diagnosed type 2 diabetes prevalence projections, we also know there is a **high prevalence of people with pre-diabetes in New Zealand**, where the *2008/2009 Adult Nutrition Survey* found that the prevalence of pre-diabetes was 18.6% of the population (which equates to approximately 930,000 people today[i]). Pre-diabetes is a major issue as many people in this category will go on to develop type 2 diabetes.

With respect to ethnicity, **Pacific, Asian and Māori are disproportionately represented amongst New Zealand's type 2 diabetes population**. Table 1 above and Figure 2 below show current and projected prevalence of type 2 diabetes amongst these ethnic groups. The analysis shows that Pacific peoples have a current type 2 diabetes prevalence rate of 9.6% (2018), which is projected to increase to 12.4%-16.2% over the next 20 years. Asian people have current prevalence of 4.9% (2018) and projected to increase to 7.6%-8.7% in 20 years – and the current prevalence rate for Māori people is 4.6% (2018) and projected to increase to 6.1%-7.0% in 20 years.

*Figure 2: Estimated prevalence of type 2 diabetes by ethnicity (2018-2040)*



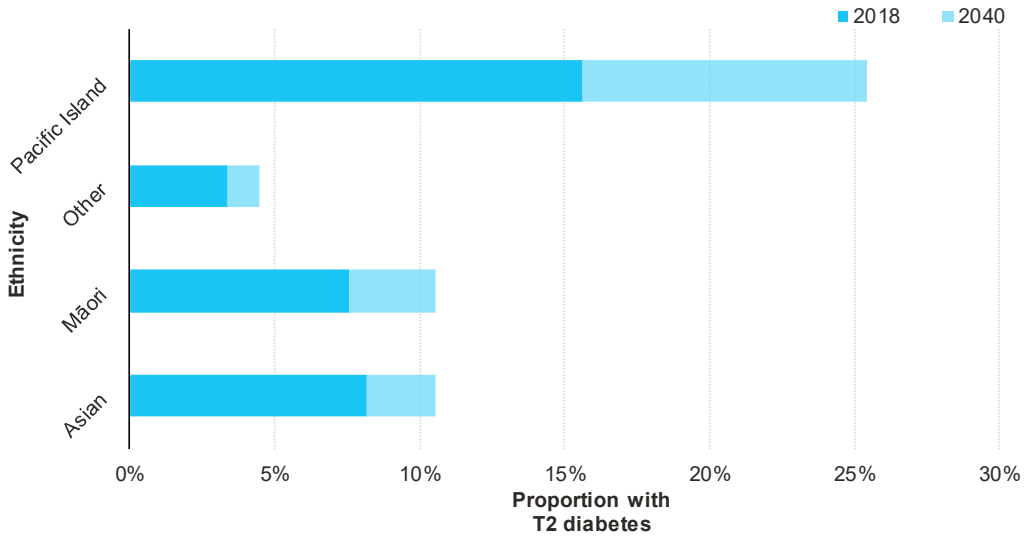

With respect to these results, it is important to note that age distribution within an ethnicity can distort prevalence. This is because prevalence is generally higher as age increases. This is a relevant consideration as Māori and Pacific populations are younger on average, which means the non-age standardised prevalence rates presented in Figure 2 are likely to understate the 'true' like-for-like prevalence. To address this, Figure 3 presents an alternative age-standardised version of the analysis, which has the effect of inflating prevalence rates for most of the ethnic groups – but **particularly for Pacific peoples**.

[i] *Assuming a population of 5 million people*

This analysis shows that the current and projected prevalence of type 2 diabetes is still highest for Pacific peoples, where current prevalence of 15.1% (2018) is projected to increase to a staggering 18.4%-25.4% over the next 20 years – meaning that a **quarter of all New Zealand's Pacific peoples could be diagnosed with type 2 diabetes in 20 years' time**. This concerning trend is similar for **Asian** people, where current prevalence of 8.2% (2018) is projected to increase to 9.3%-10.5% by 2040 – and for **Māori** people, where current prevalence of 7.5% (2018) is projected to increase to 9.5%-10.5% by 2040.

These projections clearly demonstrate that if no further action is taken to address New Zealand's type 2 diabetes problem, **inequities and health outcomes will worsen for Pacific, Asian and Māori populations**.

*Figure 3: Estimated prevalence of type 2 diabetes by ethnicity (2018 and 2040) – Age standardised*




With respect to prevalence trends by gender, our analysis shows that **current and projected prevalence is higher for males than females,** where males are projected to move from a prevalence of 5.0% (2018) to 7.0%-7.8% over the next 20 years (to 2040) and females from a prevalence of 4.4% (2018) to 6.3%-7.1% (to 2040).

And with respect to age, our analysis shows that the **current prevalence of type 2 diabetes is highest for people aged 80+ years** (at 15.4% of the population), but the **most significant area of growth over the next 20 years is for those aged 60-79 years**, where prevalence is projected to increase from 12.9% (2018) to 15.6%-16.4% by 2040. As New Zealand has an ageing population, there will be a greater proportion of people in the older age bands in 2040 than there are in 2018. Due to high prevalence of type 2 diabetes for older people, age is one of the key drivers of the projected overall increase in prevalence for the New Zealand population as a whole over the next 20 years.

# *Cost to New Zealand*

With greater prevalence comes greater cost. As shown in Figure 4 below, the **total current annual cost of type 2 diabetes in New Zealand is estimated to be $2.1 billion**, which represents a staggering 0.67% of New Zealand's total Gross Domestic Product (GDP).

And over the **next 20 years, the annual cost is projected to increase by 63% to $3.5 billion**[ii] in current dollars.

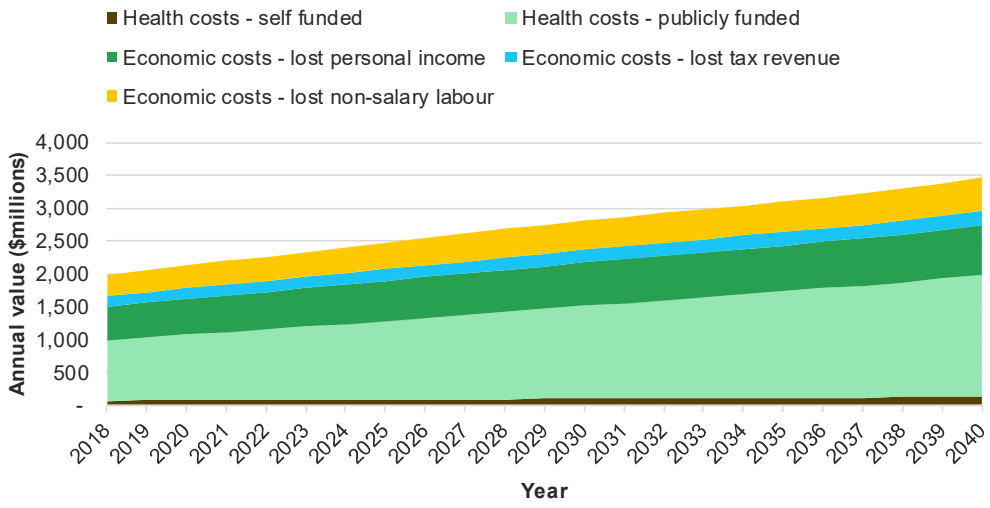
Of the different health and economic components of this cost, **publicly funded health costs** borne by the Government, currently estimated to be ~$1.0 billion (4.9% of Vote Health 2021/22 of $20.3 billion), are

[ii] *If we add superimposed inflation, the 20-year projected annual cost of type 2 diabetes is estimated at $5.1 billion. This analysis can be found in our sensitivity testing in section 3.2.3.*

projected to increase most, increasing by approximately $857m or 86% over the next 20 years (increasing to 9.1% of Vote Health 2021/22). Key drivers of the increasing cost of type 2 diabetes in New Zealand are:

- Increasing prevalence (as per the discussion above);
- Population growth;
- An ageing population;
- A steady shift towards younger cohorts of people developing type 2 diabetes; and
- More expensive treatment (as greater proportions of people require treatment for diabetes-related complications).

*Figure 4: Total annual cost of type 2 diabetes in New Zealand*




Our analysis also shows that the personal and economic impact of the disease is **most detrimental when a person is diagnosed early in life**. When comparing the lifetime cost of someone diagnosed with type 2 diabetes at age 25 years ($565k) to the lifetime cost of someone diagnosed at age 75 years ($44k), the cost differential is $521k or a factor of 13. This is significant given the shift towards younger cohorts of New Zealanders developing type 2 diabetes.

This trend alone provides a compelling case **for the Government to make a greater investment in the prevention of type 2 diabetes, both through interventions such as presented here, but also in terms of widespread environmental changes, such as reducing television and other advertising to children, or introducing a sugar levy.**

*Figure 5: Representative lifetime cost of type 2 diabetes beginning at age 25 ($565k)*

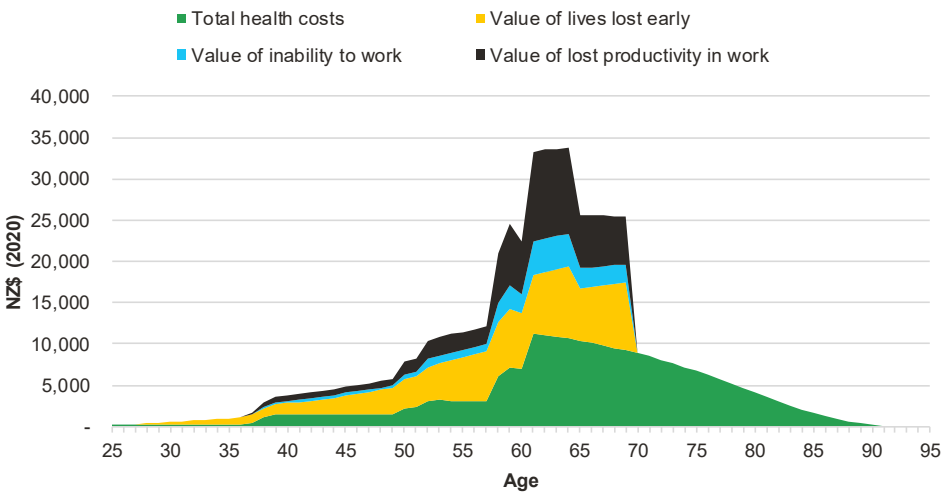
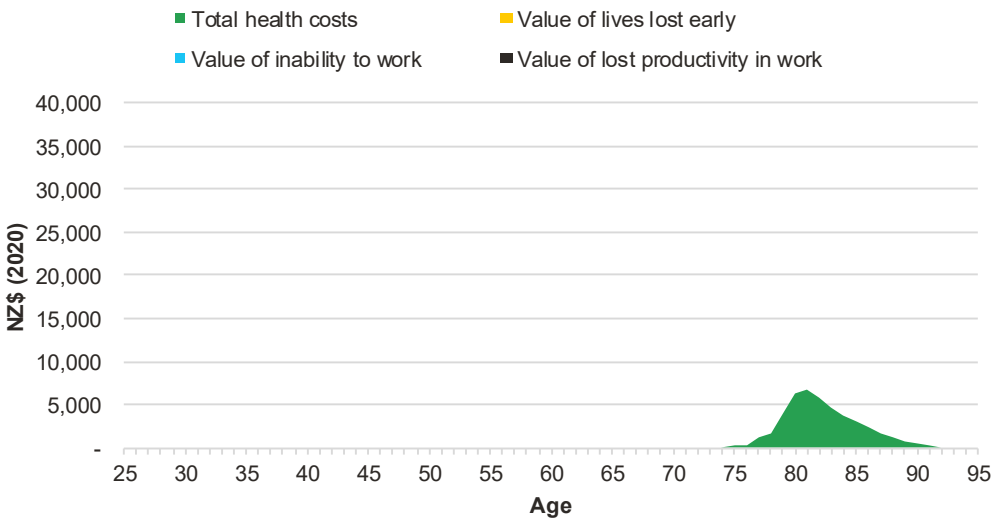



*Figure 6: Representative lifetime cost of type 2 diabetes beginning at age 75 ($44k)*




To provide a general basis of comparison to other chronic long-term conditions, New Zealand's rate of age adjusted new **cancer cases** for 2016 was 543 per 100,000 people in 2016 (calculating to a prevalence rate of 0.54%). Globally, this was second only to Australia (at 744 per 100,000 people or a prevalence rate of 0.74%)[4]. With respect to cost, a 2010 and 2011 study showed that the total public health system cost of treating cancer was $880 million annually[5]. Further, the prevalence of **ischaemic heart disease** in New Zealand adults was 5.5%[6] of the population (in 2011-2012) and **cardiovascular disease** accounted for $501 million worth of New Zealand public hospital casemix discharges during the same period[6].

These comparators show that the projected prevalence and cost of type 2 diabetes in New Zealand is significant – where **both 20-year prevalence and cost projections exceed the stated prevalence and cost of cancer and cardiovascular disease**[iii].

[iii] *Based on reported prevalence and cost per the studies above, where these studies may have had a different scope to this study.*

# *Holistic and system-wide response to the epidemic*

**A holistic and system-wide response from Government, society and individuals is needed** to change the trajectory of projected type 2 diabetes prevalence, costs and health outcomes in New Zealand.

At a **system-level**, there is a need to change the **New Zealand's diabetes[iv] model of care**. This would require identification of diabetes[v] as a Government health priority; identification of a national set of health and social outcome targets; and development of a national strategy to enable achievement of those outcomes. The strategy would need to adopt and **invest in a broad national package of interventions that target all stages of the type 2 diabetes disease progression pathway** (see Figure 7 below for an illustration of the pathway).

*Figure 7: Type 2 diabetes disease progression pathway*


Specifically, the **package of interventions** would need to incorporate:

- Population-based interventions aimed at reducing obesity and thus diabetes risk e.g. national policy change, legislative change etc. (i.e. targeting Group 0 on the disease progression pathway)
- Individualised lifestyle interventions to reduce risk of progression from pre-diabetes to type 2 diabetes e.g. lifestyle programmes that aim to achieve sustained change in diet and movement habits (i.e. targeting Groups 1 and 2 on the disease progression pathway)
- Treatment options for those with type 2 diabetes e.g. medication, bariatric surgery etc. (i.e. targeting Groups 2, 3 and 4 on the disease progression pathway)
- More appropriate delivery of on-going care to reduce the risk and impact of diabetes-related complications e.g. foot screening/care, retinal screening/care (i.e. targeting Groups 3 and 4 on the disease progression pathway).

# *Focus areas for this report*

By considering the landscape of existing diabetes work and research in New Zealand, we decided to explore the impact (through a cost-benefit analysis lens) of four possible interventions through this report. This package of interventions is not intended to be 'complete', rather, it is intended to provide a range of type 2 diabetes specific interventions that aim to address health behaviours. To achieve the kind of system-level change described above, **this package of interventions would need to be combined with a set of wider 'system focused' and population-based interventions** that address both health behaviours and healthcare factors.

[iv] *While this report is focused on type 2 diabetes, changing the national model of care would likely apply to all forms of diabetes.*

[v] *Due to the nature of the condition (which often involves comorbidities and complications), it is likely that in practice, a national strategy for diabetes prevention, treatment and care would need to link closely to the prevention/treatment/care strategy for other long-term conditions such as cardiovascular disease and cancer. However, as other long-term conditions are outside the scope of this report, our commentary relates to type 2 diabetes only.*

- The **Healthy People, Healthy Lives** intervention aims to prevent New Zealanders from developing type 2 diabetes by providing subsidised whānau/community-centred lifestyle change programmes (i.e. targeting Group 1 on the disease progression pathway).

- The **Owning our Futures** intervention aims to enable New Zealanders to reverse their type 2 diabetes and simultaneously reduce other obesity-related conditions by providing subsidised intensive whānau/community-centred lifestyle change programmes (i.e. targeting Group 2 on the disease progression pathway).

- The **Better Diabetes Medications** intervention aims to enable people to better manage their type 2 diabetes by providing access to 'gold standard' subsidised medication (SGLT2 inhibitors and GLP-1 receptor agonists) (i.e. targeting Groups 2, 3 and 4 on the disease progression pathway).

- The **Foot Screening and Protection** intervention aims to prevent people with type 2 diabetes from developing serious foot related complications such as amputation, by providing people access to optimal foot care services (i.e. targeting Groups 3 and 4 on the disease progression pathway).


# *Impact of investment in four specific areas*

Cost-benefit analysis on each of the four diabetes-specific interventions show how **Government investment** in the prevention, treatment and care of type 2 diabetes could have a **significantly positive impact on New Zealand's economy and society**. The benefits vary by intervention but are driven primarily by reducing health costs[vi] and increasing economic value through increasing life expectancy and productivity. In addition to economic benefits, significant societal benefit can be achieved by improving peoples' quality of life and their ability to participate in society.

Key results from our cost-benefit analysis are as follows:

- Investing in the **Healthy People, Healthy Lives** intervention is estimated to achieve a total Government benefit of $42 million and a societal benefit of $88 million, which equates to a Government Return on Investment (ROI) of 0.95 and a societal ROI of 2.95[vii].

- Investing in the **Owning our Futures** intervention is estimated to achieve a total Government benefit of $23 million and a societal benefit of $63 million, which equates to a Government ROI of 0.97 and a societal ROI of 2.69[vii].

- Investing in the **Better Diabetes Medication** intervention will achieve different benefits for each drug class. For SGLT2 inhibitors, investment is estimated to achieve a total Government benefit of $510 million and a societal benefit of $201 million, which equates to a Government ROI of 3.0 and a societal ROI of 4.2. For GLP-1 receptor agonists, investment is estimated to achieve a total Government benefit of $595 million and a societal benefit of $148m, which equates to a Government ROI of 1.2 and a societal ROI of 1.5[vii].

- The **Foot Screening and Protection** intervention is estimated to achieve net present value cost saving benefits of approximately $40,000 (major amputation) and $36,000 (minor amputation) for each

[vi] *Where health costs include medications, laboratory costs, secondary care costs, publicly funded primary care costs and self-funded primary care costs.*
[vii] *Where a ROI result of 1.0 means that every $1 invested, a corresponding $1 dollar of benefit will be realised over the 50-year period.*

diabetes-related lower limb amputation avoided. And if the intervention is implemented as intended, 390 major and 211 minor amputations would be avoided each year (based on 2020 data).

# *What do these results actually mean?*

## Individualised lifestyle interventions

**Healthy People, Healthy Lives** and **Owning our Futures** both have a Government ROI of approximately 1.0, which means every dollar spent by the Government results in a dollar saved. While this does not make a particularly compelling case for investment, the case is compelling when one considers that **most of the benefits generated by these interventions are societal benefits**, with total ROI's just under 3.0. These results are not surprising given **both interventions are designed to focus on, and change the lives of, individuals**, which mean they are typically more expensive than broader population-based interventions; require upfront investment; and require commitment and hard work of the individual to be successful. Viewed another way, one could argue that a Government ROI of 1.0 is cost neutral, so is simply a matter of shifting Government investment from one part of the health system to another. Rather than funding the treatment of diabetes related complications, funding could instead be used to give people the opportunity to transform their lives and avoid diabetes-related complications (for the exact same cost). This is a perfect example of moving from an **'ambulance at the bottom of the cliff to a fence at the top'.**

Our modelling for both these interventions relies heavily on the clinical results of existing comparable interventions to estimate benefits. Hence, the available results only capture the impact of each intervention up to the date of publication, not the entire lifetime of its participants. As such, we have only been able to model known results and have excluded 'potential' (but unproven) future benefits. This conservative approach particularly affects the Owning our Futures intervention, which builds upon the work of the DiRECT study in the United Kingdom. In the cost-benefit analysis for this intervention, we have only modelled the benefits/impacts five years into the future (as the study has not yet presented results beyond this timeframe). In reality, we expect that **many participants are likely to experience benefit from lifestyle change that extends many years beyond the timeframe that we have modelled**.

## Treatment and care interventions

**Foot Screening and Protection** and especially **Better Diabetes Medications** present opposite cost-benefit analysis results to the lifestyle interventions described above as **most of the benefits are Government benefits** (particularly reduced spending on secondary health care), while societal benefits make up a much smaller proportion of the total. We have taken the same approach in our cost-benefit analysis modelling in that we have also modelled the benefit/impact of the medication over the period of time an individual continues taking the medication. What this means is that both spending on medications and savings to other areas of health spending add up slowly over many years, unlike the lifestyle interventions discussed above. Interventions of this type, while still improving the lives of many individuals, are better characterised as **'spending a cent today to save a dollar tomorrow'**.

# *How this might fit with the proposals from the New Zealand Health and Disability System Review*

The recent *New Zealand Health and Disability System Review*[8] identified a range of 'system deficiencies' that have had a detrimental impact on New Zealanders' health outcomes. For the purpose of this report, we have **focused on deficiencies related to the structure of the system and funding arrangements** within the system.

With respect to **structure**, the system is complex and fragmented. This is particularly problematic for people with type 2 diabetes who can have comorbidities and complications that necessitate them to be actively involved in treatment and to interact with multiple parts of the system (i.e. both primary and secondary). The complexity and fragmentation of the system means **people don't always access the services they need** and don't always receive high quality care, which results in a **high proportion of unmet need and sub-optimal health outcomes**. This is especially the case for Pacific, Asian and Māori people who have greater levels of unmet need and experience higher rates of type 2 diabetes and disparate health outcomes than other ethnicities.

With respect to funding arrangements, **funding has not kept pace with increasing costs** and the DHBs are financially unsustainable[8]. Further, as funding for diabetes prevention, treatment and care is distributed to the DHBs as part of an annual population-based allocation or as part of a long-term conditions package, it can be **diluted resulting in a lack of specific investment in diabetes**. Finally, the complexity and lack of understanding as to the DHB funding model has raised concern that funds are **not being spent equitably**.

Through this report we have built a compelling case for changing the New Zealand diabetes (and associated long-term conditions) model of care. To ensure relevance of the **future model**, we recommend it is **developed in a way that aligns to the ambitions of the *New Zealand Health and Disability System Review*[7].** As discussed previously, this will require identification of diabetes and associated long-term conditions as a specific Government health priority; identification of a national set of health and social population-based outcome targets; and development of a national 'diabetes and associated long-term conditions strategy' to enable achievement of those outcomes. To align with the *New Zealand Health and Disability System Review*[7], this strategy should adopt and invest in a broad national package of interventions, which target both diabetes and associated long-term conditions; adopt a consumer, whānau and community-based delivery approach; incorporate Te Tiriti o Waitangi-based partnerships; address all stages of disease progression (with a strong focus on prevention); and address both health behaviours and health care factors.

To ensure **effective delivery of a new model of care and national diabetes (and associated long-term conditions) strategy**, it will also be necessary to review and refresh the Government funding approach to diabetes and associated long-term conditions; introduce appropriate accountability mechanisms for DHBs and providers (on both the use of funding and achievement of targeted health outcomes); and update and maintain the Quality Standards for Diabetes Care. The future national **approach to funding** diabetes prevention, treatment and care should be considered in conjunction with the core funding model changes of the *New Zealand Health and Disability System Review*[7]. Where the Review recommends legislation of DHB funding requirements (guaranteed yearly increases based on demographics, cost of services and changes to wages); ring-fenced funding for Tier 1 services; and development of a new Tier 1 service funding formula to adjust for communities with higher health needs[7].

# *Acknowledgements*

This study was conducted by PwC and funded/supported by Diabetes New Zealand; Edgar Diabetes and Obesity Research Centre (University of Otago); Healthier Lives – He Oranga Hauora National Science Challenge; and Tony and Heather Falkenstein.

*Figure 8: Funders and supporters of this study*


We would like to acknowledge and thank all those who have freely given of their time and knowledge to be part of our Expert Advisory Group.

*Table 2: Expert Advisory Group*

| Name | Role | Organisation |
|---|---|---|
| Heather Verry | Chief Executive Officer | Diabetes New Zealand |
| Professor Jim Mann | Director | Healthier Lives National Science Challenge |
| Professor Rachael Taylor | Director | Edgar Diabetes and Obesity Research Centre |

Expert advice was also provided by a range of national and international experts.

| Name | Role | Organisation |
|---|---|---|
| Belinda Ihaka | Lecturer | Auckland University of Technology |
| Dr Bryan Betty | College Medical Director | The Royal New Zealand College of General Practitioners |
| Dr Cristina Cleghorn | Senior Research Fellow | University of Otago |
| Graeme Jarvis | Chief Executive Officer | Medicines New Zealand |
| Helen Gibbs | Nutrition Development Advisor and Project Manager | WellSouth Primary Health Network |
| Dr Jade Tamatea | Senior Lecturer | The University of Auckland |
| Karen Reed | District Manager | Diabetes New Zealand |
| Liz Dutton | Service Development Manager | Diabetes New Zealand |
| Michele Garrett | Podiatry Professional Clinical Leader | Auckland DHB, Waitematā DHB |
| Dr Rosemary Hall | Executive Member / Senior Lecturer | New Zealand Society for the Study of Diabetes / University of Otago |
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*Figure 9: Organisations that have provided information, advice and direction*


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# 1. Objectives and scope of the 2020 study

## 1.1 Objectives of the 2020 study

The three primary objectives of the 2020 study are as follows;

1. Reignite awareness amongst Government decision-makers and across the health sector of the realities of the economic and human cost of type 2 diabetes in New Zealand, including issues of inequity;

2. Provide a robust case for prioritisation of resources toward more equitable and effective type 2 diabetes prevention and management initiatives; and

3. Prompt the update and amendment of type 2 diabetes-related government policy towards more effective and equitable type 2 diabetes prevention and management interventions.

### 1.1.1 Long-term outcomes of better prioritisation and funding of diabetes in New Zealand

By prompting prioritisation and investment of type 2 diabetes, this study aims to contribute toward achieving three key long-term outcomes in New Zealand;

1. Reduction in the prevalence and impact of type 2 diabetes in New Zealand;

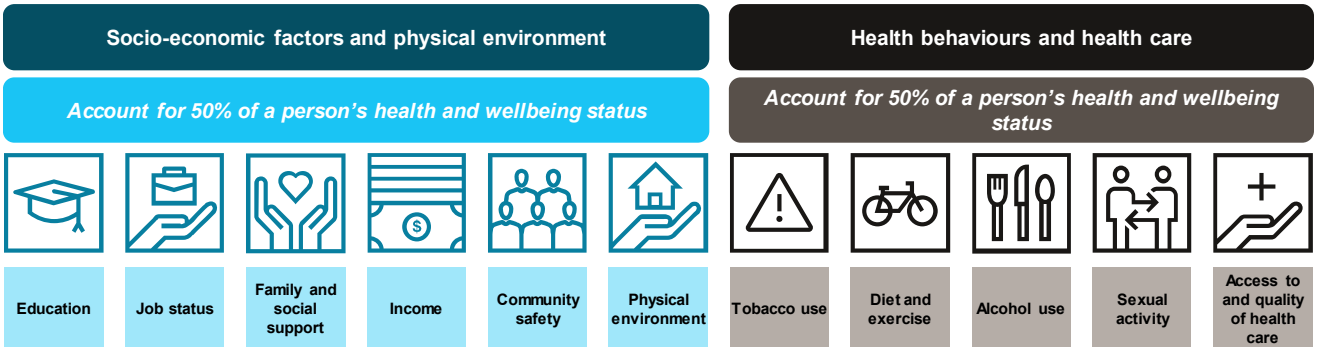
2. Reduction in health sector costs and improvement in wider economic impacts, which includes human costs such as reduction in wellbeing and societal participation; and

3. People with type 2 diabetes will have an improved quality of life and are able to contribute to society via work and other activities.

## 1.2 Scope of the 2020 study

With reference to Figure 10 below, this study is focused primarily on **promoting interventions around health behaviours and health care**, which account for ~50% of a person's health and wellbeing status. However, it is acknowledged that the remaining ~50% is determined by socioeconomic factors and the physical environment, which are not within the direct scope of this study[8].

*Figure 10: Determinants of health status*




The specific scope of the 2020 study incorporates the following:

- Projected prevalence of type 2 diabetes in New Zealand between 2020-2040;

- Projected health system costs and economic impacts (including social wellbeing) of type 2 diabetes in New Zealand between 2020-2040 (based on projected prevalence);
- Current trends in New Zealand for type 2 diabetes prevalence;
- Current trends in New Zealand for equity of access and health outcomes, with a focus on Māori and Pacific people, and geographical variation;
- Current and emerging strategies, approaches and technologies for the prevention, identification and management of type 2 diabetes;
- Identification of viable interventions for future prevention, identification and management of type 2 diabetes and diabetes associated complications – as a function of efficacy and equity;
- Health system costs of implementing these interventions;
- Projected economic impact of introducing these interventions (includes social wellbeing); and
- Likely impact of introducing these interventions on the future prevalence of type 2 diabetes in New Zealand.

# 2. What is type 2 diabetes?

## 2.1 Understanding type 2 diabetes

*Type 2 diabetes is a preventable, complex, progressive and chronic disease characterised by elevated blood glucose levels over an extended time period. There are a wide range of serious complications associated with the condition.*

*Due to the progressive nature of the disease, it is not uncommon for people with type 2 diabetes to move along the diabetes disease progression pathway over the course of their lives.*

### 2.1.1 Brief profile of type 2 diabetes

**Diabetes mellitus (diabetes) is a complex, progressive and chronic disease** caused by insufficient production of insulin and/or resistance to insulin. Insulin is a hormone produced in the pancreas. It promotes the uptake of glucose from the blood stream into the cells, where it is then metabolised as an energy source. When there is insufficient production of insulin and/or the body resists insulin, blood glucose levels become too high and type 2 diabetes can occur.

There are multiple types of diabetes[viii]. **Type 2 diabetes is a largely preventable and reversible form** that develops through age and weight gain in genetically susceptible people, when both the cells become resistant to insulin and the pancreas fails to produce enough insulin. As discussed above, insufficient insulin and/or a lack of response to insulin by the body's cells, leads to high blood glucose levels, which causes damage to blood vessels over time. Early symptoms of type 2 diabetes can easily go unnoticed and typically include fatigue, polydipsia[ix], polyuria[x], frequent infections, hunger, and blurred vision. Diagnosis can be made through a blood test which measures the average glycated haemoglobin (HbA1C) content of the blood over a two to three-month period[9]. A HbA1C test of ≥ 50 mmol/mol commonly results in a diagnosis of type 2 diabetes[10].

If **type 2 diabetes is not managed**, long-term damage of blood vessels can **lead to more serious complications** such as heart and blood vessel disease, nerve damage (which can eventually lead to amputation), kidney damage, eye damage, slow healing, hearing impairment, skin conditions, sleep apnoea and Alzheimer's disease[11]. Maintaining blood glucose levels within the normal range can help to prevent these complications from developing.

### 2.1.2 Type 2 diabetes disease progression pathway

**Type 2 diabetes is a progressive disease**, meaning that an individual gradually produces less insulin over time[12]. Figure 11 shows the **type 2 diabetes disease progression pathway**[xi]. This pathway is intended to depict the four 'typical' stages that an individual may move through during their type 2 diabetes journey.

---

[viii] *This report focusses on type 2 diabetes. Other variations of the disease include type 1 diabetes, pancreatic diabetes and gestational diabetes. In type 1 diabetes the pancreas cannot produce sufficient insulin and the condition appears to be autoimmune in nature. Pancreatic diabetes occurs after damage to the pancreas, such as pancreatitis. Gestational diabetes can occur during pregnancy if a mother cannot produce enough insulin. Both type 1 diabetes and gestational diabetes are outside the scope of this report.*

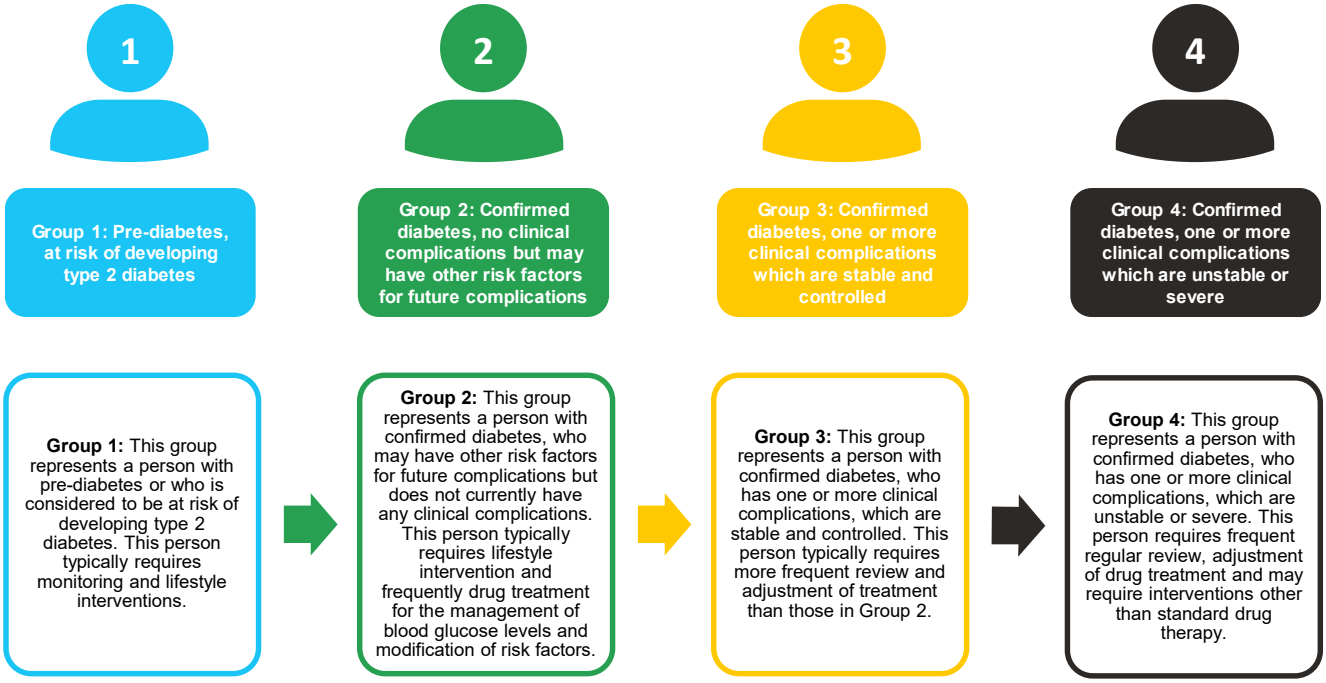
[ix] *Polydipsia is the medical term for feelings of extreme thirst. This condition is considered one of the earliest symptoms of diabetes mellitus.*

[x] *Polyuria is the medical term for excessive urination. Passing urine volumes of more than 2.5L/day is considered excessive and should not last more than several days.*

[xi] *This pathway was developed specifically for use/reference in this report and through consultation with the Expert Advisory Group (Table 2).*

It is important to note that in practice, this pathway is not linear, individuals can enter at any stage and move backwards and forwards over time. We have used this pathway as an overarching framework to guide our population-based cost projections and cost-benefit analysis (in later sections of this report).

*Figure 11: Type 2 diabetes disease progression pathway (excluding 'population')*




While it is now possible to reverse most type 2 diabetes without needing medication through significant weight loss, the general treatment goal for people with type 2 diabetes is to maintain blood glucose levels within a 'normal' range and to avoid developing diabetes-related complications. However, due to the progressive nature the disease, it is **not uncommon for people with type 2 diabetes to move along the type 2 diabetes disease progression pathway** over the course of their lives. As shown in

Figure 11, movement along the pathway drives a corresponding increase in the level and type treatment and intervention required.

## 2.2 Risk factors for type 2 diabetes

*The two key risk factors of developing type 2 diabetes are lifestyle/circumstantial and genetic/demographic factors.*

Certain **lifestyle/circumstance** and **genetic/demographic** factors can increase a person's risk of developing type 2 diabetes.

**Lifestyle factors** that increase a person's risk of developing type 2 diabetes include being overweight – the dominant cause (high body mass index (BMI)), inactivity, dietary risks, tobacco use and alcohol/drug use. **Circumstantial factors** can also increase risk; people living in socioeconomically deprived positions and those with a long-term history of mental illness have significantly higher rates of type 2 diabetes than those who do not experience these circumstances[13].

**Genetic and demographic** factors that increase a person's risk of developing type 2 diabetes include age, ethnicity and family history. While there is a concerning trend of children and young people developing type 2 diabetes, the risk of type 2 diabetes increases with age, especially after age 45. Certain ethnicities are also at greater risk. In New Zealand, **Māori, Pacific and Asian people are more likely to develop type 2 diabetes than other ethnicities, and often at a younger age**[12]. Family history and medical comorbidity are also contributing factors. Those with type 2 diabetes in their immediate family (parent or sibling) are more

likely to develop the condition themselves. Finally, those who have previously had, or currently have, another form of diabetes (e.g. pre-diabetes[xii] or gestational diabetes[xiii]) or women with polycystic ovarian syndrome[xiv] are also at greater risk of developing type 2 diabetes[14].

## 2.3 Impact on quality of life

*Type 2 diabetes can affect almost every aspect of a person's life, including their physical health, mental health, social life and employment. It can also have a profound impact on the person's family, whānau and friends. However, the impact of type 2 diabetes can be reduced with appropriate treatment and care.*

Experiencing an initial diagnosis of type 2 diabetes and managing the ongoing physical symptoms of the disease can be all-consuming. It aggravates the impacts of being overweight or obese which can **affect almost every aspect of a person's life**, including their physical health, mental health, social life and employment. It can also have a profound impact on the person's family, whānau and friends.

The impact on a person's physical health is clear – from early symptoms to later complications (as described in section 2.1 above). Those living with type 2 diabetes report significant **negative effects on perceived quality of life**. This is especially the case for people with severe diabetes-related complications and those undergoing diabetes care and treatment[15] (e.g. daily injections of insulin or daily dialysis). In New Zealand, diabetes and cardiovascular disease account for 17% of all **health loss**[xv] across the population[16]. Further, long-term conditions such as diabetes and arthritis are the most significant contributors to New Zealand's steadily increasing **disability**[xvi] **impact**[17], which has increased by 3% each decade over the last 25 years[18].

A diagnosis of type 2 diabetes is also implicated in **worsening mental health** and **reduced social contact**[19]. People with diabetes are twice as likely to experience anxiety or depression than those without[20]. They may be concerned about whether they are managing their condition appropriately, what other people think and the possible complications of the disease. There is a **common negative social stigma** surrounding diabetes as a condition, specifically type 2 diabetes. The *Diabetes New Zealand Stigma Survey* highlighted that one in three respondents under 65 reported that having type 2 diabetes made them feel 'ashamed' or 'a failure'[21].

Further, the physical and psychological impacts of type 2 diabetes can have a detrimental impact on a person's ability to fully participate in the workforce as it **contributes to work loss** through absenteeism and health-related work limitations in the workplace and can ultimately reduce employment[22].

However, the **impact of type 2 diabetes can be reduced with appropriate treatment and care**.

Figure 12 below provides a 'snapshot' of the impacts of type 2 diabetes on 'real' people. We gathered this insight by talking to people with type 2 diabetes and clinicians who provide services, treatment and care to people with type 2 diabetes.

---

[xii] *Pre-diabetes or impaired glucose tolerance (IGT) occurs when glucose levels in the blood are higher than normal but have not yet passed the threshold to be considered 'diabetes'. In New Zealand, individuals with an HbA1c of 41-49mmol/mol are considered to have pre-diabetes.*

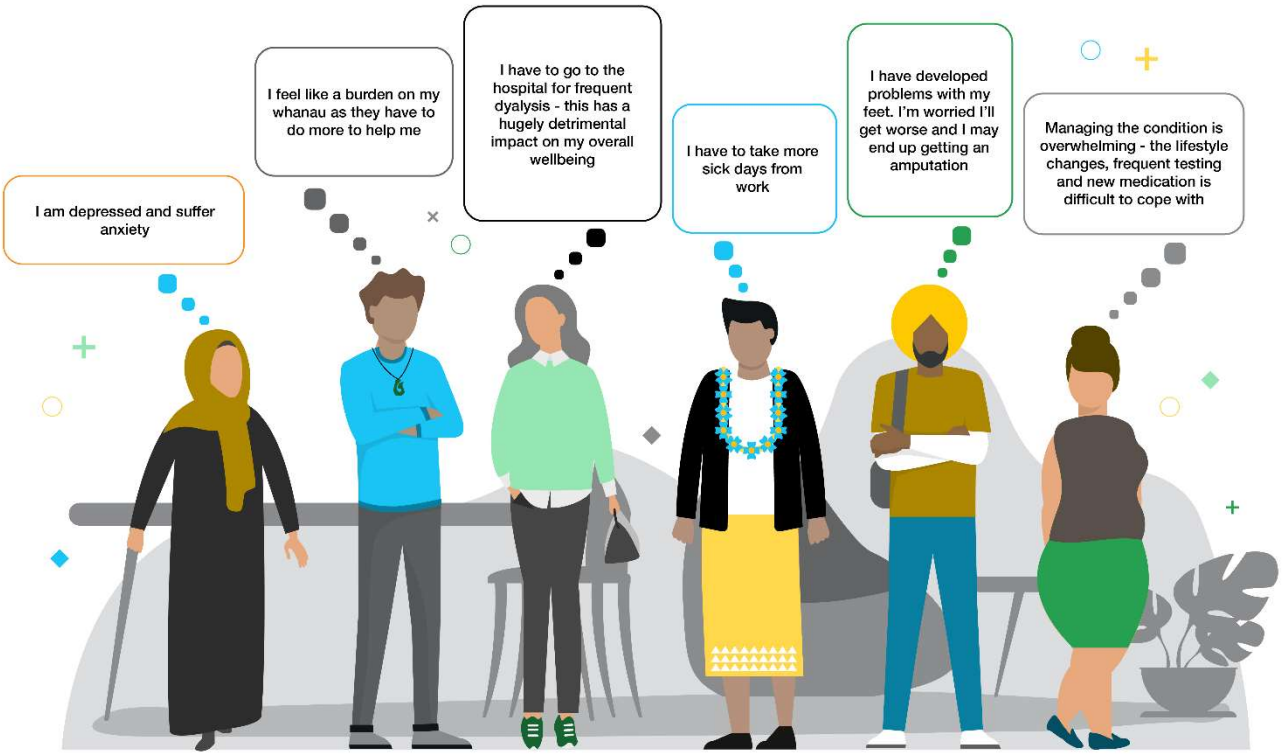
[xiii] *Gestational diabetes can occur during pregnancy if a mother cannot produce enough insulin (as insulin requirements rise during pregnancy to 2-3 times the normal requirement). This is a temporary condition that typically disappears following pregnancy. However, a woman with gestational diabetes has a 50-60% increased risk of developing type 2 diabetes in the future*[xiii].

[xiv] *A common condition characterised by irregular menstrual periods, excess hair growth and obesity.*

[xv] *Health loss is measured in diasability-adjusted list years (DALYs) and one DALY represents the loss if one year lived in full health.*

[xvi] *According to the World Health Organisation, disability has three dimensions: (1) impairment in a person's body structure of function, or mental functioning – examples include loss of a limb, loss of vision or memory loss; (2) activity limitation, such as difficulty seeing, hearing, walking or problem solving; and (3) participation restrictions in normal daily activities, such as working, engaging in social and recreational activities, and obtaining health care and preventative services.*

*Figure 12: The impacts of type 2 diabetes on 'real' people*



# 3. What is the size of the problem and what does it cost?

## 3.1 Current and 20-year projected prevalence of type 2 diabetes

*New Zealand has a serious and growing diabetes problem. Today, there are ~228,000 New Zealanders suffering from type 2 diabetes (4.7% of the population). Within the next 20 years this number is projected to increase by 70-90% to ~390,000 to ~430,000 people (6.6%-7.4% of the population).*

*In addition to diagnosed diabetes, New Zealand also has a high prevalence of pre-diabetes at approximately 18.6% of the total population.*

*Amongst those who experience type 2 diabetes, Pacific peoples are worst affected, with a current prevalence rate of 15.6%, which is projected to increase to 18.4%-25.4% over the next 20 years (these are age standardised figures). Other ethnicities disproportionately represented amongst New Zealand's type 2 diabetes population include Asian and Māori people. With respect to gender and age, males and those over the age of 60 have a higher current and projected prevalence of type 2 diabetes than females and young people.*

### 3.1.1 Basis for presentation

Below we present projected prevalence of type 2 diabetes in New Zealand over the next 20 years. The projections are presented at a **population-level** and by **ethnicity, age** and **gender**. For each 'lens', we present projected counts[xvii] and prevalence[xviii].

Within the figures and tables that follow, we include a 'projection band' to indicate **'static' and 'growth' estimates** of type 2 diabetes prevalence in New Zealand. The **'static'** projected prevalence is modelled assuming historical prevalence remains unchanged, with population growth and mix as the only drivers of increase (for instance, the ageing population drives an increase in type 2 diabetes due to higher prevalence in the older age bands). The **'growth'** projected prevalence is modelled assuming current prevalence increases by average growth factors based on 5 years of historical diabetes prevalence data. The range between the 'static' and 'growth' projections is shown as a shaded wedge in the figures below. All key assumptions can be found in Appendix 10.2.

### 3.1.2 Projected prevalence and counts of type 2 diabetes for the New Zealand population

Figure 13 and Figure 14 below show that **New Zealand has a serious and growing type 2 diabetes problem**. The number of New Zealanders with type 2 diabetes in 2018 is estimated to be 228k, which equates to a prevalence of 4.7% (of the population). Between 2018 and 2040, the number of people with type 2 diabetes is projected to increase by between 70-90%, to a total of between 390-430k people, which equates to a prevalence of 6.6%-7.4% (of the population).

[xvii] *The number of New Zealanders with type 2 diabetes.*
[xviii] *The percentage of the New Zealand population with type 2 diabetes.*

*Figure 13: Estimated number of New Zealanders with type 2 diabetes (2018-2040)*

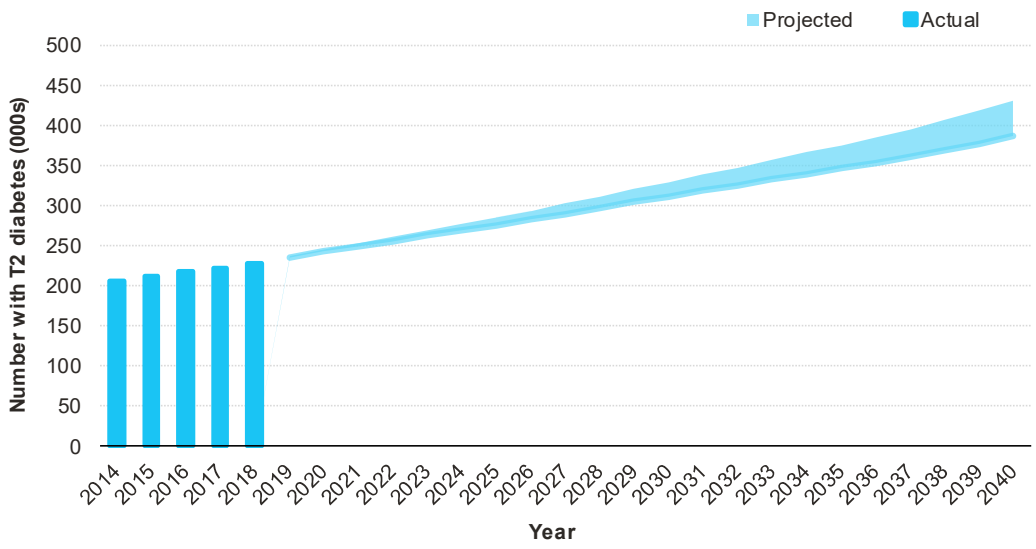



*Figure 14: Estimated prevalence of type 2 diabetes in New Zealand (2018-2040)*

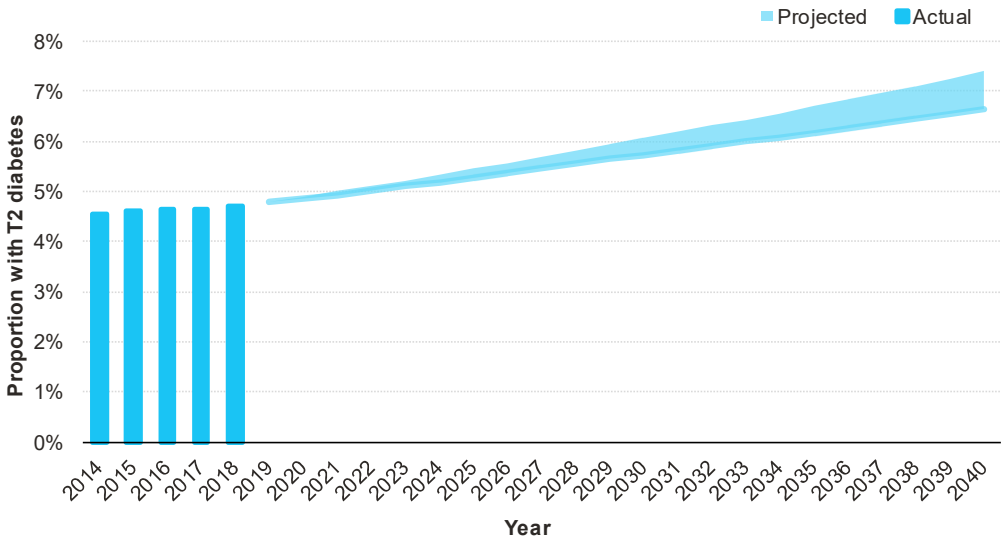



*Table 3: Change in prevalence of type 2 diabetes in New Zealand (2018-2040)*

| | Number with T2D (000s) | NZ population (000s) | Prevalence (%) |
|---|---|---|---|
| 2018 (actual) | 228 | 4,841 | 4.7% |
| 2040 (projected) | 386-431 | 5,817 | 6.6%-7.4% |
| **Change** | **+158-203** | **+977** | **+1.9-2.7%** |

In addition to these prevalence projections, we also know there is a **high prevalence of people with pre-diabetes in New Zealand**. Where the *2008/2009 Adult Nutrition Survey* found that the prevalence of pre-diabetes was 18.6% of the population (which equates to approximately 930,000 people today[xix]).

There is however recent research to suggest that the prevalence of undiagnosed diabetes is now less than 0.5% (which equates to between 5,000 and 25,000 people today[xix])[23]. Within this cohort, the ethnic group with the highest rate of undiagnosed diabetes was Pacific people (6.4%) followed by Māori (2.2%) and New Zealand European and Others (1.5%)[24]. This low rate of undiagnosed diabetes is likely due to the high levels of testing

[xix] *Assuming a population of 5 million people*

for diabetes (for example, 94% of people aged 35 and over living in metro Auckland had a test for diabetes in 2018[23]).

### 3.1.3 *Projected prevalence and counts of type 2 diabetes by ethnicity*

In the analysis below, ethnicity is split into **Other** (non-Māori/Pacific/Asian), **Māori, Pacific Island** and **Asian** (including Indian). Ethnicity is prioritised, which means that each person is grouped by their primary ethnicity, and is counted only once in the analysis, even though in practice an individual may identify as multiple ethnicities. With the exception of Table 6, the figures presented are not age standardised.

The figures and tables below show that current and projected **prevalence of type 2 diabetes is highest for Pacific Island** peoples, where current prevalence of 9.6% (2018) is projected to increase to 12.4%-16.2% over the next 20 years (to 2040). The same trends occur for the other ethnicities, but at slightly lower rates – where prevalence for **Asian** people is projected to increase from 4.9% to 7.6%-8.7%; **Māori** people from 4.6% to 6.1-7.0%; and **Other** people from 4.2% to 5.5%-5.7%.

With respect to these results, it is important to note that age distribution within an ethnicity can distort prevalence. This is because prevalence is generally higher as age increases. This is a relevant consideration as Māori and Pacific populations are younger on average, which means the non-age standardised prevalence rates presented in Figure 15, Figure 16, Table 4 and Table 5 are likely to understate the 'true' like-for-like prevalence. To address this, Table 6 presents an alternative age-standardised version of the analysis, which has the effect of inflating prevalence rates for most of the ethnic groups – but **particularly for Pacific Island and Māori people**.

This analysis shows that the current and projected prevalence of type 2 diabetes is **still highest for Pacific Island** people, where current prevalence of 15.1% (2018) is projected to increase to 18.4%-25.4% over the next 20 years (to 2040). And for **Māori** people, current prevalence of 7.5% (2018) is projected to increase to 9.5%-10.5% (to 2040).

*Figure 15: Estimated number of people with type 2 diabetes by ethnicity (2018-2040)*

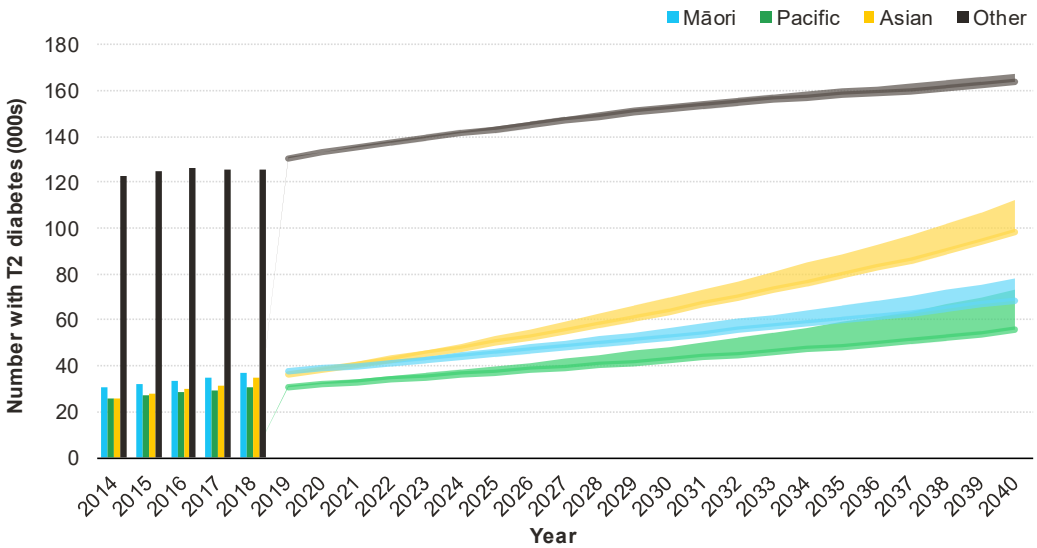


*Table 4: Change in the number of people with type 2 diabetes in New Zealand - by ethnicity (2018-2040)*

| 000s | Other | Māori | Pacific Island | Asian |
|---|---|---|---|---|
| 2018 (actual) | 126 | 37 | 31 | 35 |
| 2040 (projected) | 164-167 | 69-78 | 56-73 | 98-112 |
| **Change** | **+38-42** | **+32-41** | **+25-42** | **+64-77** |

*Figure 16: Estimated prevalence of type 2 diabetes by ethnicity (2018-2040)*

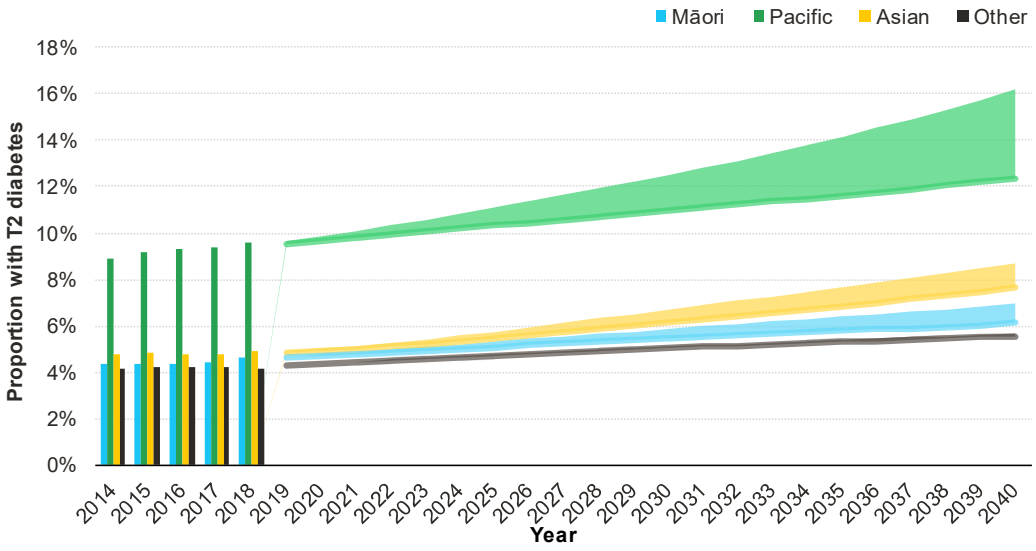



*Table 5: Change in prevalence of type 2 diabetes in New Zealand – by ethnicity (2018-2040)*

| | Other | Māori | Pacific Island | Asian |
|---|---|---|---|---|
| 2018 (actual) | 4.2% | 4.6% | 9.6% | 4.9% |
| 2040 | 5.5%-5.7% | 6.1%-7.0% | 12.4%-16.2% | 7.6%-8.7% |
| **Change** | **+1.4%-1.5%** | **+1.5%-2.3%** | **+2.8%-6.6%** | **+2.7%-3.8%** |

*Figure 17: Estimated prevalence of type 2 diabetes by ethnicity (2018 and 2040) – Age standardised*

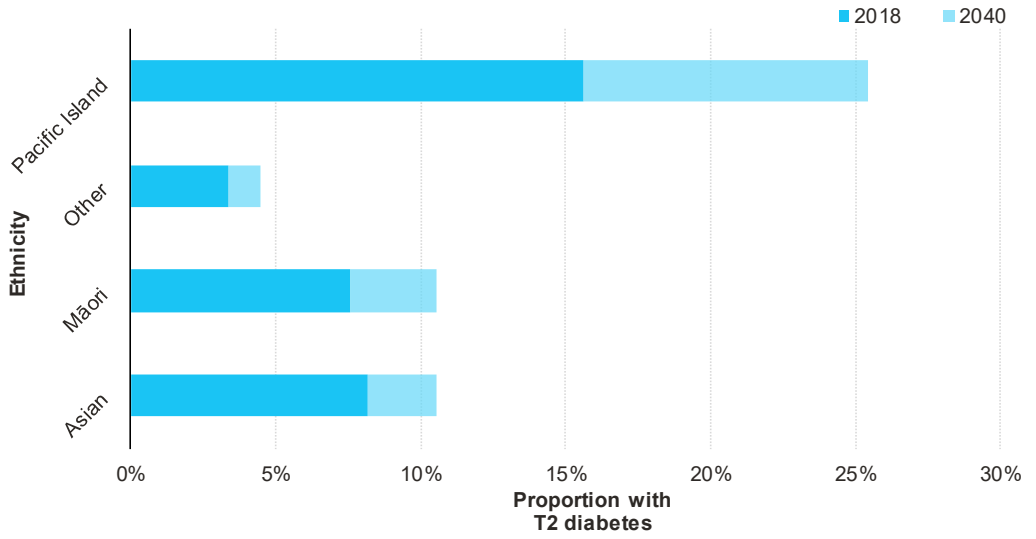


*Table 6: Age standardised[xx] change in prevalence of type 2 diabetes in New Zealand – by ethnicity (2018-2040)*

| | Other | Māori | Pacific Island | Asian |
|---|---|---|---|---|
| 2018 (actual) | 3.4% | 7.5% | 15.6% | 8.2% |
| 2040 (projected) | 4.3%-4.5% | 9.5%-10.5% | 18.4%-25.4% | 9.3%-10.5% |
| **Change** | **0.9%-1.1%** | **2.0%-3.0%** | **2.8%-9.8%** | **1.2%-2.4%** |

## 3.1.4 Projected prevalence and counts of type 2 diabetes by gender

The figures and tables below show the projected prevalence and number of people with type 2 diabetes in New Zealand between 2018 and 2040 by gender. The analysis shows that **current and projected prevalence is higher for males than females,** where males are projected to move from a prevalence of 5.0% (2018) to 7.0%-7.8% over the next 20 years (to 2040) and females from a prevalence of 4.4% (2018) to 6.3%-7.1% (to 2040).

*Figure 18: Estimated number of people with type 2 diabetes by gender (2018-2040)*

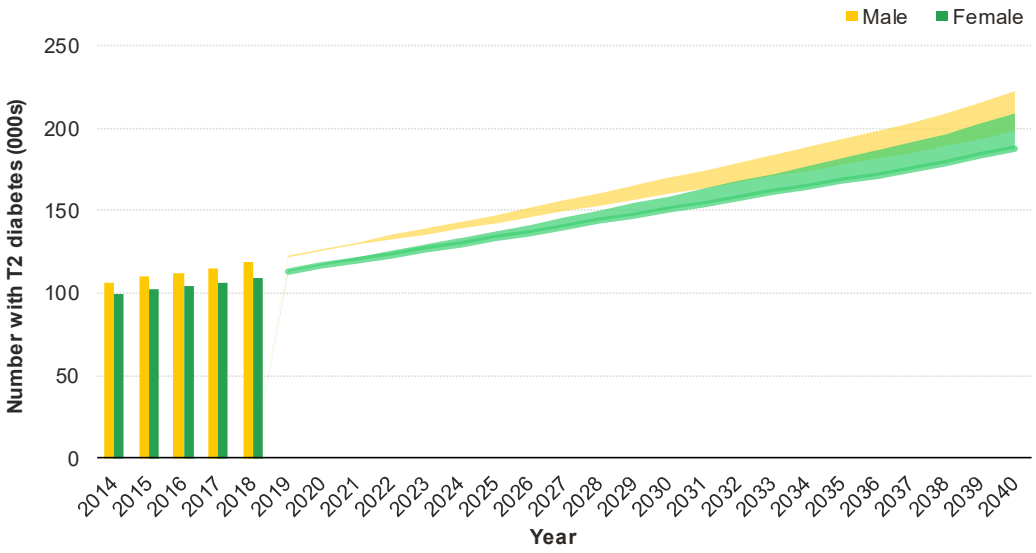



*Table 7: Change in number with Type 2 diabetes in New Zealand – by gender (2018-2040)*

| | Male | Female |
|---|---|---|
| 2018 (actual) | 119 | 109 |
| 2040 (projected) | 199-222 | 188-209 |
| **Change** | **+80-103** | **+79-100** |

[xx] *Standardised over the New Zealand national population age distribution for the given year*

*Figure 19: Estimated prevalence of type 2 diabetes by gender*

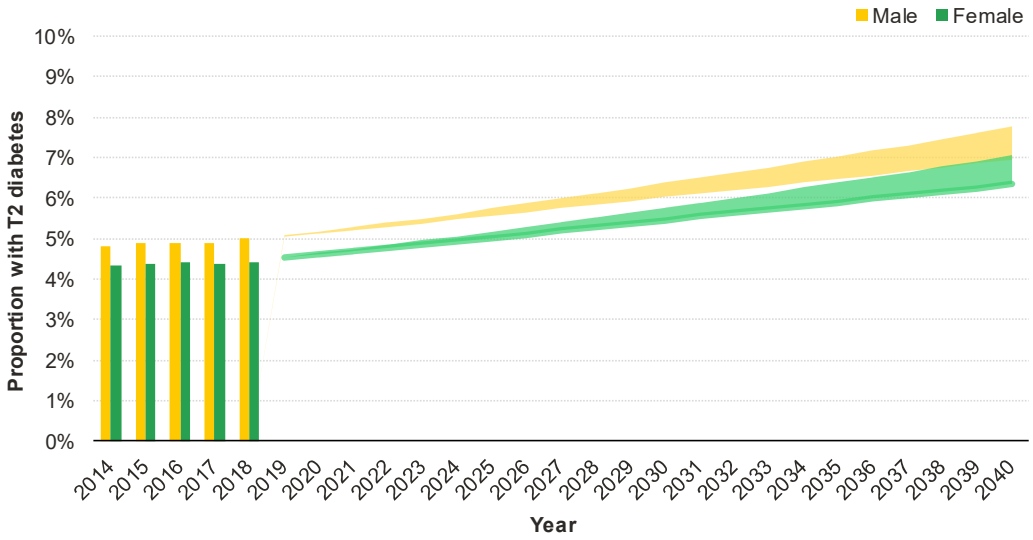



*Table 8: Change in prevalence of type 2 diabetes in New Zealand - by gender (2018-2040)*

| | Male | Female |
|---|---|---|
| 2018 (actual) | 5.0% | 4.4% |
| 2040 (projected) | 7.0%-7.8% | 6.3%-7.1% |
| **Change** | **+2.0%-2.8%** | **+1.9%-2.6%** |

## *3.1.5 Projected prevalence and counts of type 2 diabetes by age*

The figures and tables below show the projected prevalence and number of people with type 2 diabetes in New Zealand between 2018 and 2040 by age. We have split ages into 20-year bands as prevalence varies significantly with age. The analysis shows that the **current (2018) prevalence of type 2 diabetes is highest for people aged 80+ years** (at 15.4% of the population), but the **mostly significant area of growth over the next 20 years is for those aged 60-79 years**, where prevalence is projected to increase from 12.9% (2018) to 15.6%-16.4% by 2040.

As New Zealand has an ageing population, there will be a greater proportion of people in the older age bands in 2040 than there are in 2018. Due to high prevalence of type 2 diabetes for older people, age is one of the key drivers of the projected overall increase in prevalence for the New Zealand population as a whole over the next 20 years.

*Figure 20: Estimated number of people with type 2 diabetes by 20-year age bands (2018-2040)*

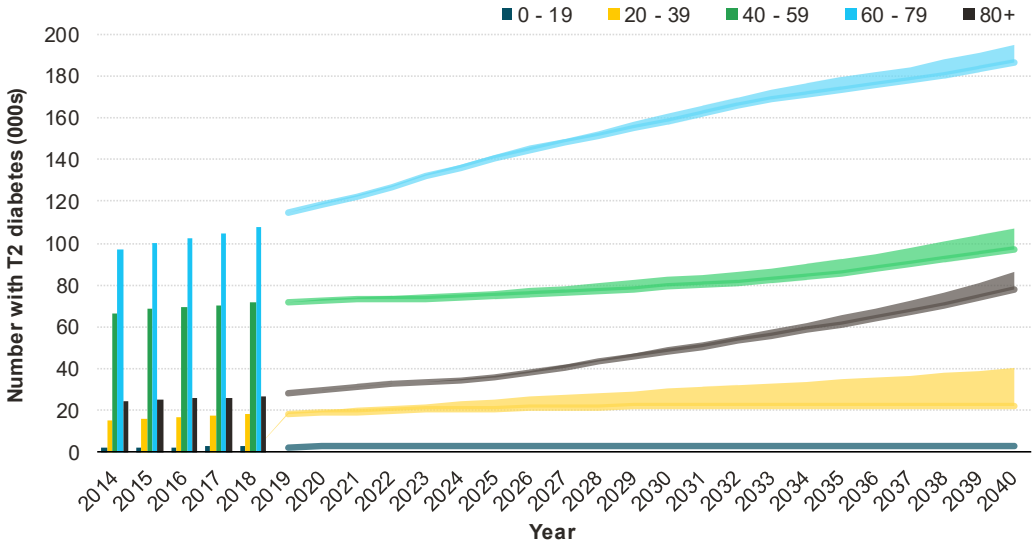



*Table 9: Change in the number of people with type 2 diabetes in New Zealand - by age (2018-2040)*

| 000s | 0-19 | 20-39 | 40-59 | 60-79 | 80+ |
|---|---|---|---|---|---|
| 2018 (actual) | 3 | 19 | 72 | 108 | 27 |
| 2040 (projected) | 3-3 | 22-40 | 97-107 | 186-195 | 78-86 |
| **Change (numbers)** | **+0-0** | **+4-22** | **+25-35** | **+78-87** | **+51-59** |

*Figure 21: Estimated prevalence of type 2 diabetes by 20-year age bands (2018-2040)*

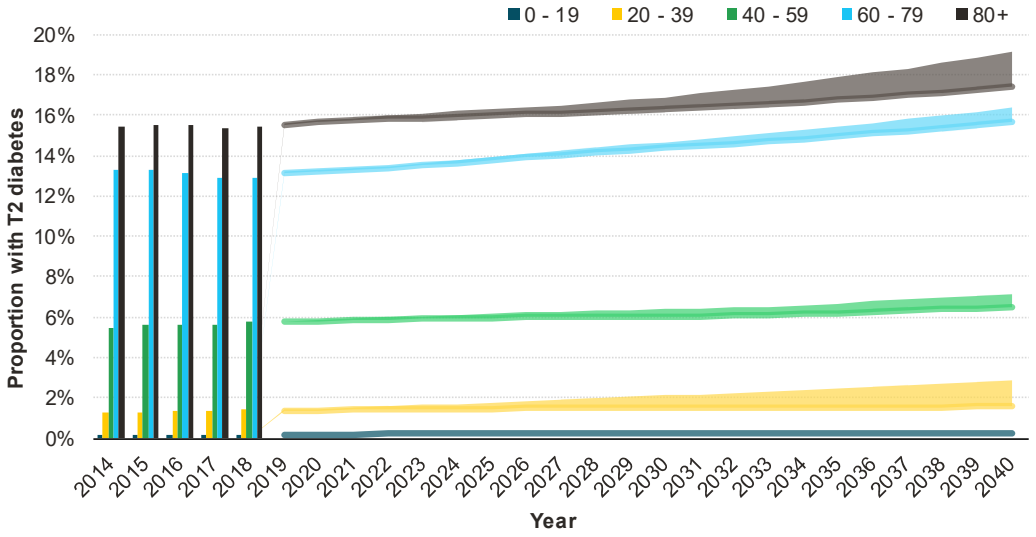


*Table 10: Change in prevalence of type 2 diabetes in New Zealand - by age (2018-2040)*

| | 0-19 | 20-39 | 40-59 | 60-79 | 80+ |
|---|---|---|---|---|---|
| 2018 (actual) | 0.2% | 1.4% | 5.8% | 12.9% | 15.4% |
| 2040 (projected) | 0.2%-0.2% | 1.6%-2.8% | 6.5%-7.2% | 15.6%-16.4% | 17.4%-19.1% |
| **Change** | **+0.0%-0.0%** | **+0.2%-1.4%** | **+0.7%-1.4%** | **+2.8%-3.5%** | **+1.9%-3.7%** |

## 3.2 Current and 20-year projected costs of type 2 diabetes

*The total current annual cost of type 2 diabetes in New Zealand is $2.1 billion, which represents a staggering 0.67% of New Zealand's total Gross Domestic Product (GDP). Over the next 20 years, the annual cost is projected to increase by 63% to $3.5 billion.*

*Of the different health and economic components of total annual cost, publicly funded health costs borne by the Government, currently estimated at $1.0 billion, increase most over the next 20 years, increasing by $857m or 86%.*

*The key cost drivers are population growth; an ageing population; increasing prevalence; and an increasing number of younger people developing type 2 diabetes. A greater proportion of younger people in the diabetes population means a greater proportion of people who are likely to suffer from diabetes-related complications later in life. Where complications have a significant impact on the cost of treatment, but also an individual's life expectancy and productivity.*

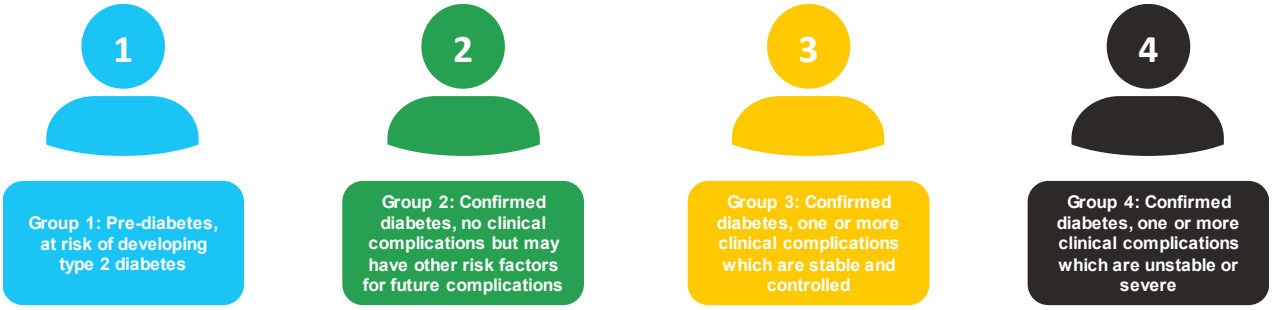
### 3.2.1 Basis of preparation

In this section, we present the current and future cost of type 2 diabetes in New Zealand. To calculate the total cost, it is necessary to distinguish between the **health costs** and the **economic costs**. Further, our costing relies heavily on the **type 2 diabetes disease progression pathway** and associated **four 'diabetes groups'** as an overarching framework. The discussion below provides a high-level description of our overarching framework; the methodology used to estimate health costs; and the methodology used to estimate economic costs. A more detailed description of methodology and assumptions can be found in Appendix 10.3.3.

#### 3.2.1.1 Basis of preparation – overarching framework

The health and economic burden of type 2 diabetes is not distributed evenly, in fact many people with type 2 diabetes live their lives in much the same way as the wider population while others face severe impacts. To simulate the differing distribution of impact and economic burden, and to enable estimation of the total cost of type 2 diabetes in New Zealand, we have utilised the **type 2 diabetes disease progression pathway** and the associated **four 'diabetes groups'** as an overarching framework (summarised in Figure 22 and shown in detail in Figure 11) as an overarching framework.

*Figure 22: Type 2 diabetes disease progression pathway and four 'diabetes groups' (summary)*




Using the type 2 diabetes prevalence projections presented in section 3.1, we have distributed the New Zealand type 2 diabetes population into the four 'diabetes groups' according to a linear progression assumption. The detailed methodology is explained in Appendix 10.3.3.1. The results of this distribution are shown in Figure 23, Figure 24 and Figure 25, which present the distribution by age for the years 2020, 2030 and 2040.

In line with the prevalence projections presented in section 3.1, Figure 23, Figure 24 and Figure 25 show that overall prevalence of type 2 diabetes is projected to increase by 76% between 2020 and 2040. In addition to increasing prevalence, our analysis **shows large increases in the number of people aged 45+ years in the most severely impacted 'diabetes groups' (being groups 3 and 4)**. This is the result of increasing numbers developing type 2 diabetes earlier in life.

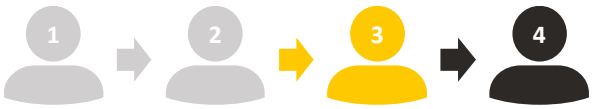



*Figure 23: Projected number with type 2 diabetes by age and 'diabetes group' – for the year 2020*

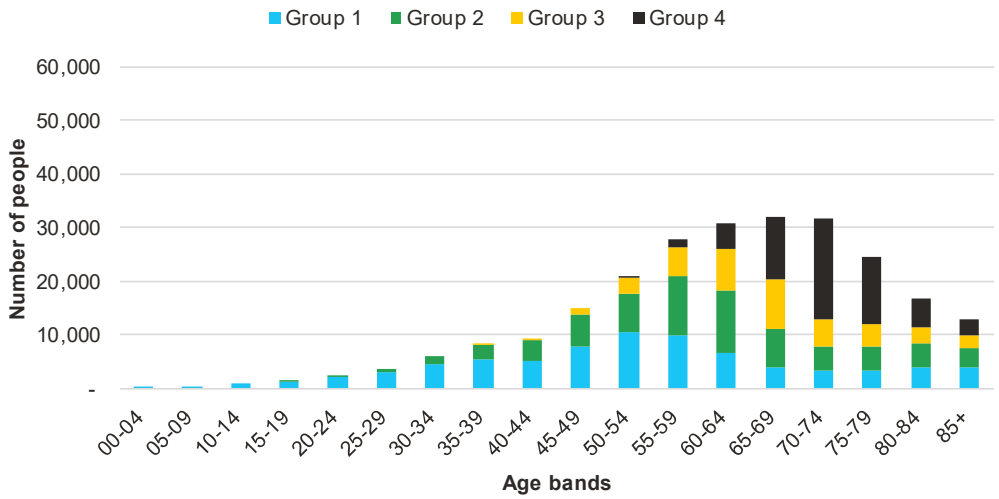


*Figure 24: Projected number with type 2 diabetes by age and 'diabetes group' – for the year 2030*

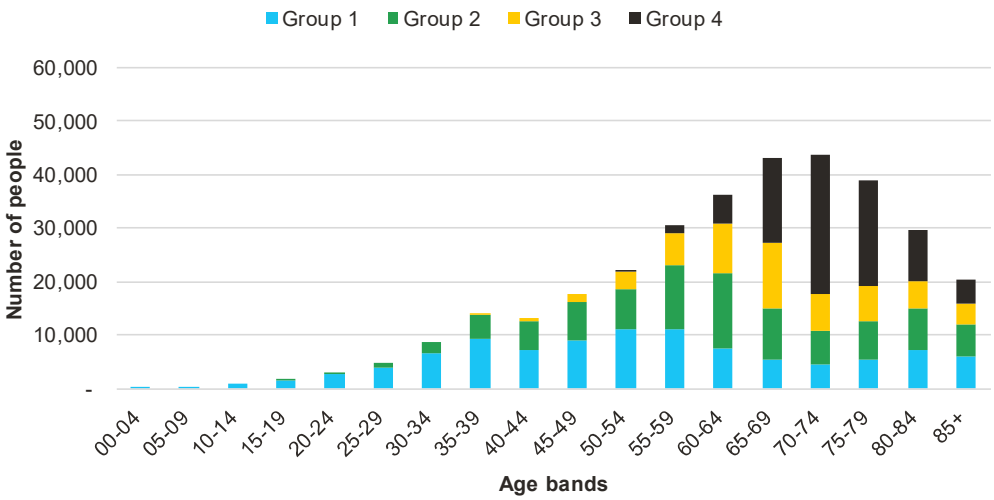
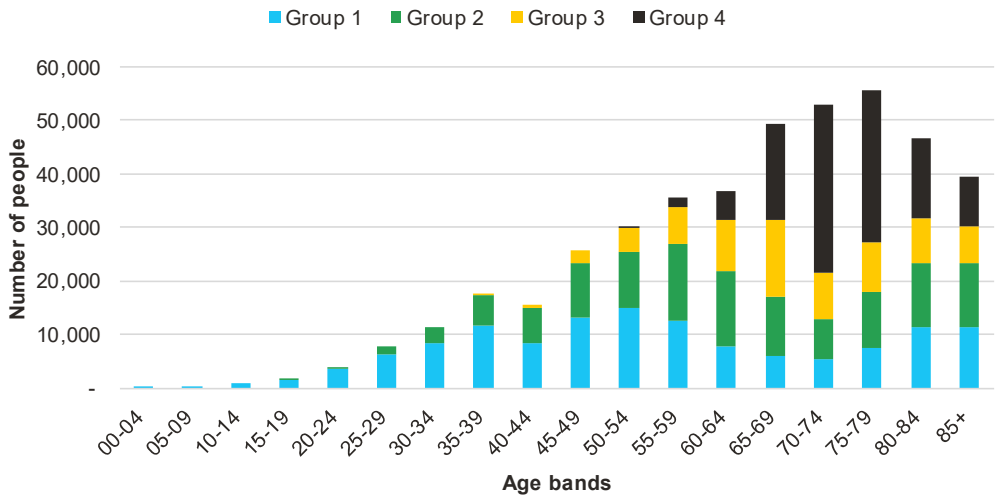



*Figure 25: Projected number with type 2 diabetes by age and 'diabetes group' – for the year 2040*




### 3.2.1.2 Basis of preparation – health costs

Creating the **four 'diabetes groups'** has enabled us understand the impact of type 2 diabetes on an individual as they move through the disease progression pathway. By understanding the impact of the disease, we are able to understand the 'typical' treatment required at each stage of the disease pathway[xxi]. In addition, by understanding treatment requirements, we are able to estimate the average weighted health costs of an individual within each 'diabetes group'[xxii]. We used the **overarching type 2 diabetes disease progression pathway framework** (as described above), **prevalence projections** (presented in section 3.1) and **New Zealand mortality tables** to estimate the **total health costs** of type 2 diabetes in New Zealand. For further detail on the methodology and assumptions see Appendix 10.3.3.

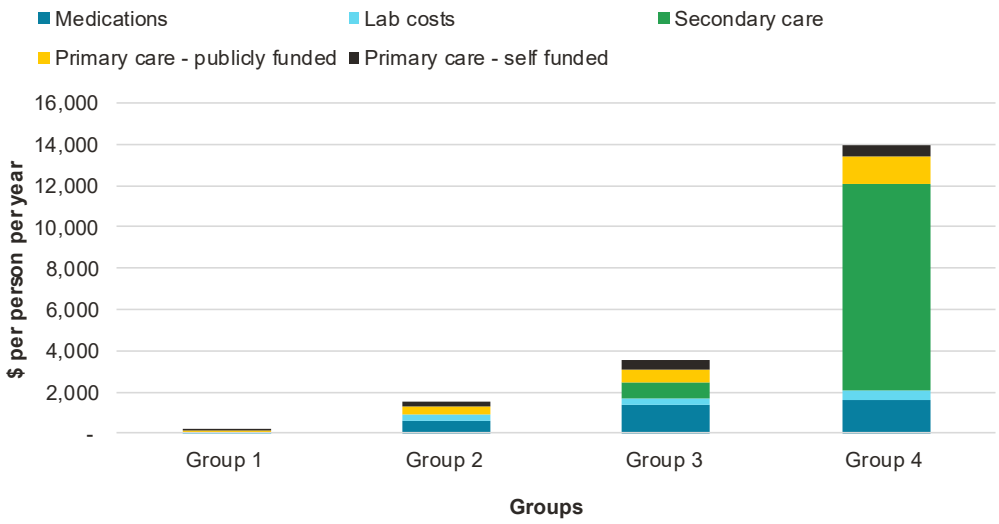
Figure 26 shows the health costs per person per year for each of the four 'diabetes groups' and clearly illustrates the cost differential and relativity between groups. At an estimated cost of $14,000 per person, the cost of

[xxi] *Where 'treatment' includes primary care services (both publicly funded and self-funded), secondary care services, laboratory tests and pharmaceuticals.*

[xxii] *While we acknowledge that type 2 diabetes is not necessarily a 'linear pathway' and individuals do not necessarily move through the complete disease progression pathway during their lives, to enable cost modelling, it was necessary to assume that when averaged across a large population, individuals generally move through the disease progression pathway in a linear fashion.*

treating an individual in group 4 (confirmed diabetes, one or more clinical complications which are unstable or severe) is substantially higher treating an individual in any of the other three groups, which range from $180 (group 1) to $3,500 (group 3) per person.

*Figure 26: Health costs per person per year by 'diabetes group'*




### 3.2.1.3 Basis of preparation – economic costs

The **economic costs** of type 2 diabetes are lost personal income, lost tax revenue and lost non-salary labour. To estimate the quantum of these costs and assign economic costs to individuals, we have used the following overarching **economic impacts**:

- Economic value of lives lost early
- Lost economic value from the inability to perform labour due to disability
- Economic value of reduced labour productivity.

For each impact, we calculated the total of each economic cost type for the entire New Zealand type 2 diabetes population and divided this across the four 'diabetes groups' using relative impact scores[xxiii]. These became our group specific impacts. We then used the disease progression pathway (summarised in Figure 22 and shown in detail in Figure 11) to assign projected counts for each age group within each of the four 'diabetes groups. For each impact we then calculated the economic cost of each 'diabetes group' and each age and summed the results of all 'diabetes groups' and all ages.

For all economic impact calculations, we used March 2020 values and excluded all age bands below 15 and above 69 years of age[xxiv]. This is a conservative approach as many people continue to engage in paid employment after 69 years of age and many more continue to undertake non-salaried labour such as housework, community work and caring for children/family. Further, we did not distinguish between males and females for income, tax, workforce participation or unemployment.

### 3.2.1.4 Overarching valuation approach

When calculating costs and benefits, **we have taken a conservative approach and used "real value" amounts** (i.e. 2020 NZD values) unless otherwise stated[xxv]. This means we have assumed that the value of health costs, income and tax are all worth exactly the same in 2040 as in 2020. We have presented results in this manner to enable transparent comparison across years as this approach avoids the need to make

[xxiii] *Relative impact scores were developed via consultation with our Expert Advisory Group (Table 2).*
[xxiv] *This assume that people do not work prior to the age of year years and cease working from the age of 70 years.*
[xxv] *This differs from "nominal value" or "inflation-adjusted value".*

assumptions and predications around future inflation trends (where costs and benefits are likely to be impacted in different ways by future inflation).

To show the impact of including medical and income cost inflation above CPI see the sensitivity testing in section 3.2.3, which illustrates the potential increase in projected costs should there be future increases in medical costs and income.

We have used the 'growth' prevalence projection scenario when calculating costs and benefits. This is to ensure that recent changes in type 2 diabetes prevalence are captured in the cost scenario.

## 3.2.2 Total annual cost of type 2 diabetes in New Zealand

As shown in Figure 27 and Table 11 below, the **total current annual cost of type 2 diabetes in New Zealand is $2.1 billion**, which represents a staggering 0.67% of New Zealand's total Gross Domestic Product (GDP). **And over the next 20 years, the annual cost is projected to increase by 63% to $3.5 billion.**

Of the different health and economic components of total annual cost, **publicly funded health costs borne by the Government increase most** over the next 20 years, increasing by $857m or 86%. In the discussion that follows, we analyse **health costs** and **economic costs** separately.

*Figure 27: Total annual cost of type 2 diabetes in New Zealand*

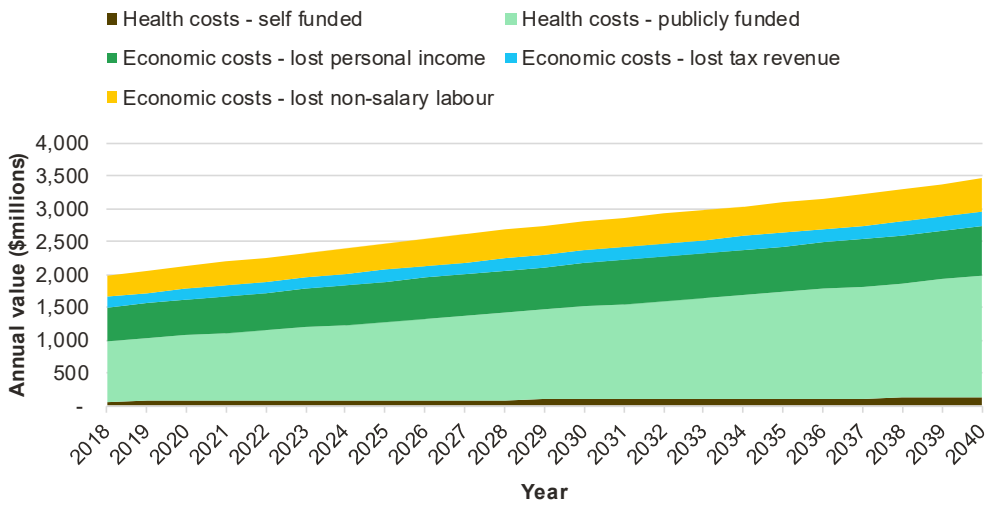



*Table 11: Total annual cost of type 2 diabetes in New Zealand (2020-2040)*

| | 2020 | 2030 | 2040 | % change per year | % change 2020 to 2040 |
|---|---|---|---|---|---|
| Health costs – self funded | $68m | $93m | $121m | 3.0% | 79.5% |
| Health costs – publicly funded | $999m | $1,410m | $1,856m | 3.1% | 85.9% |
| Economic costs – lost personal income | $562m | $661m | $755m | 1.6% | 37.8% |
| Economic costs – lost tax revenue | $164m | $193m | $221m | 1.6% | 38.1% |
| Economic costs – lost non-salary labour | $334m | $447m | $506m | 1.9% | 47.1% |
| **Total costs** | **$2,118m** | **$2,804m** | **$3,460m** | **2.5%** | **63.3%** |

### 3.2.2.1 Health costs

As shown in Table 11, **publicly funded health costs represent the largest portion of current total type 2 diabetes cost** in New Zealand (at 47%); and is also the **fastest growing cost component over the next 20 years** (growing to represent over 53% of total costs by 2040). Self-funded health costs, while much smaller in total, are also projected to grow at a rapid rate. This cost growth trend is the result of population

growth; an ageing population; increasing prevalence of type 2 diabetes which includes an increasing number of younger people developing type 2 diabetes.

Even though type 2 diabetes can reduce life expectancy by over 10 years[25], when younger people are diagnosed with type 2 diabetes, they are still expected to have a greater remaining life expectancy than an older person diagnosed with type 2 diabetes. This means there is a larger proportion of younger people in the 'type 2 diabetes population' who require diabetes treatment and care over a longer period of time, and this drives a corresponding increase in health care costs.

At a more detailed level, health costs can be broken down into the cost of publicly funded primary care, self-funded primary care, secondary care, medication and laboratory testing. Figure 28 and Table 12 show health cost trends over the next 20 years in these more detailed categories. The analysis shows **that secondary care costs, which often relate to the cost of treating diabetes-related complications, represent the largest portion of total health costs** at 57% in 2020 and 58% in 2040.

*Figure 28: Health cost breakdown of type 2 diabetes treatment and care (2018-2040)*

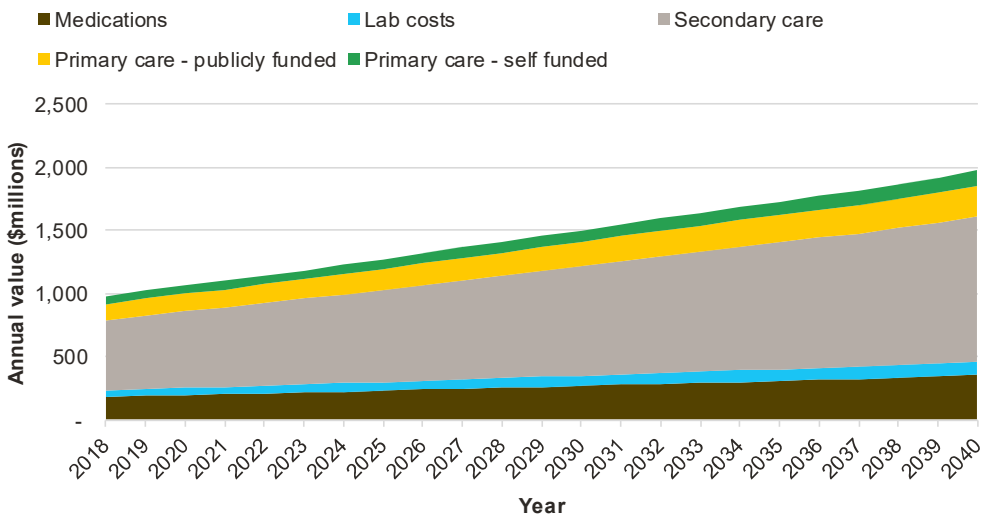



*Table 12: Annual health care costs of type 2 diabetes in New Zealand (2020-2040)*

| | 2020 | 2030 | 2040 | % change per year |
|---|---|---|---|---|
| Medications | $197m | $271m | $354m | 3.0% |
| Laboratory costs | $59m | $80m | $105m | 2.9% |
| Secondary care costs | $607m | $898m | $1,150m | 3.2% |
| Primary care costs – publicly funded | $136m | $189m | $248m | 3.0% |
| Primary care costs – self funded | $68m | $93m | $121m | 3.0% |
| **Total costs** | **$1,066m** | **$1,503m** | **$1,978m** | **3.1%** |

### 3.2.2.2 Economic costs

As previously discussed, the economic cost analysis will be presented with reference to the following overarching economic impacts:

- Economic value of lives lost early
- Lost economic value from the inability to perform labour due to disability
- Economic value of reduced labour productivity.

#### 3.2.2.2.1 Economic value of lives lost early

Among the worst impacts of type 2 diabetes is the **substantial reduction in life expectancy**, where research suggests that having type 2 diabetes can reduce life expectancy by over 10 years[25]. Figure 29 shows the total number of lives lost in New Zealand as a direct result of type 2 diabetes, which estimates **premature death of approximately 54,000 New Zealanders below the age of 85**. This impact is concentrated in the older age groups but also affects those of working age. By losing lives amongst the working population there is an associated economic impact, which is realised through lost productivity and subsequent lost personal income, tax revenue and non-salary labour.

In Figure 29, the 85+ year age group has been excluded. The increased mortality modelling for this age group is less robust than for younger age groups and this group exceeds the average life expectancy for both the general population and those with type 2 diabetes. As economic impacts are limited to those between 15 and 69, this age bracket would not affect economic impact calculations.

*Figure 29: Total lives lost as a result of type 2 diabetes (2020)*

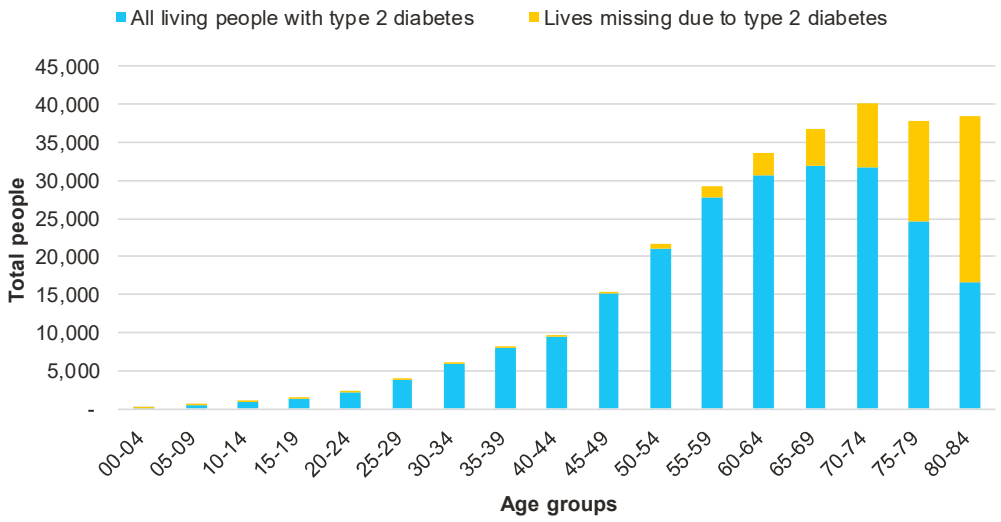
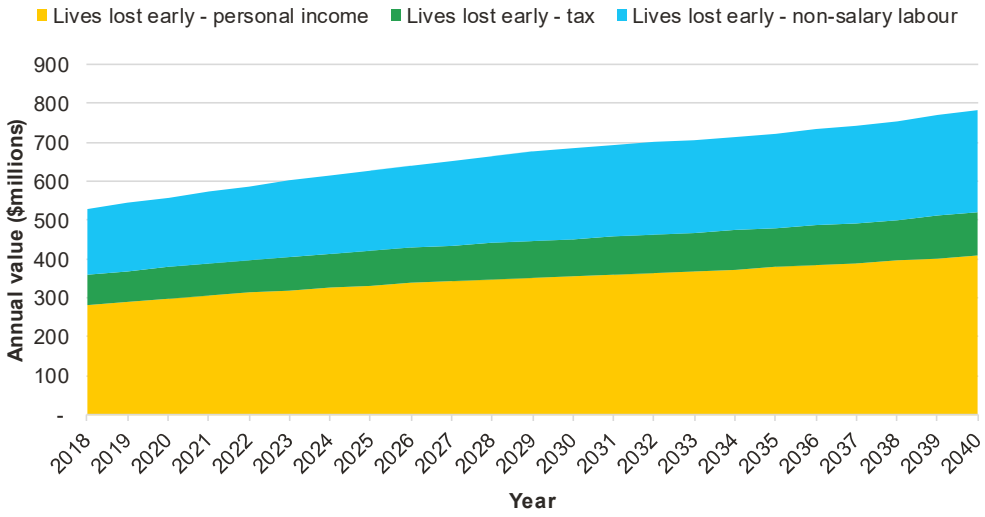



Figure 30 shows the effect of lives lost early on personal income, tax revenue and non-salary labour (definitions, calculations and assumptions for each economic cost type can be found in Appendix 10.3.3.4). The figure shows that premature death impacts all economic cost types.

Non-salary labour shows the most significant rate increase (percentage), with an increase of 47% over the next 20 years. This movement is due to a lower workforce participation rate of those aged 60+ years, and therefore a higher likelihood that they would have otherwise been undertaking non-salaried labour during this stage of life.

*Figure 30: Economic value of lives lost early due to type 2 diabetes (2018-2040)*




### 3.2.2.2.2 Lost economic value of inability to perform labour due to disability

Type 2 diabetes can lead to serious complications as the disease progresses. In some cases, the complications can be so severe that an individual is no longer able to work or perform unpaid labour. Research conducted by the ADA (American Diabetes Association) shows that **3.1% of people with type 2 diabetes are unable to participate in the labour force due to disability**[89]. This inability to perform labour results in a substantial loss of economic potential, which is realised through lost productivity and subsequent lost personal income, tax revenue and non-salary labour.

Figure 31 below shows the number of people unable to perform labour due to disability caused by type 2 diabetes. This shows that the inability to perform labour starts to have a notable effect amongst people aged 50-59 years and increases steeply for people aged 59-69 years. The pattern shown in Figure 31 shows the same growth pattern as age increases as Figure 29 mainly due to the progressive nature of the disease and the age at which people are diagnosed.

*Figure 31: People unable to perform all types of labour by age group (2020-2040)*

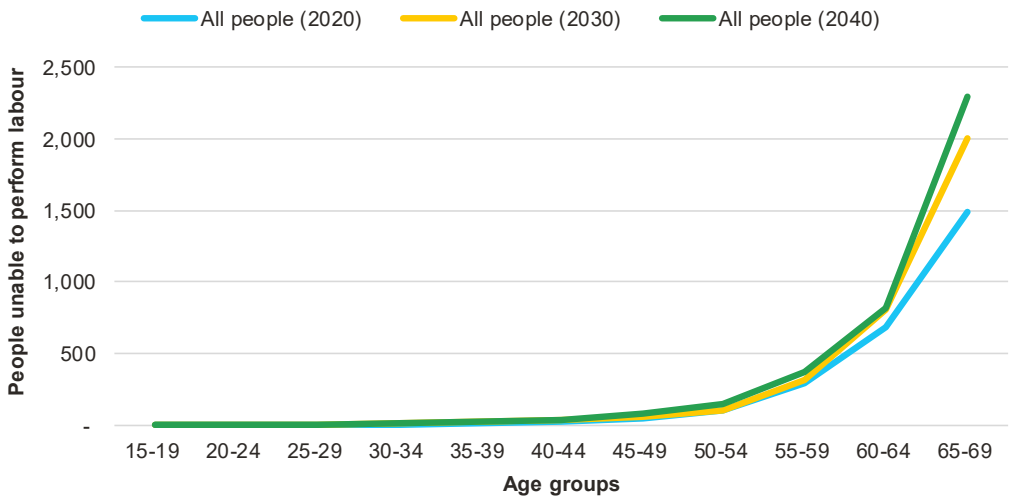
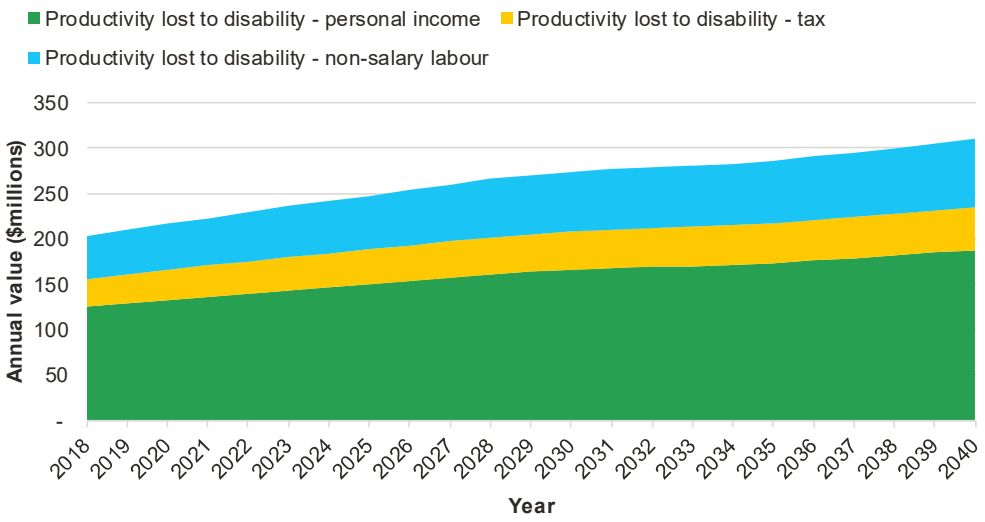



Figure 32 shows the economic value of productivity lost due to the inability to perform labour and the associated impact on personal income, tax revenue and non-salary labour (definitions, calculations and assumptions for each economic cost type can be found in Appendix 10.3.3.5). The figure shows that the inability to perform labour impacts all economic cost types and grows over time. This is because we predict a younger

type 2 diabetes population in the future, who are more likely to move through all stages of the type 2 diabetes disease progression pathway while still of working age. This means more working age people will lose the ability to undertake labour for a longer portion of their working lives.

Lost personal income shows the most significant value increase (dollars), with an increase of $55m over the next 20 years. Lost non-salaried labour shows the most significant rate increase (percentage), with an increase of 48%.

*Figure 32: Economic value of productivity lost due to the inability to perform labour (2018-2040)*




While the number of total people in each age group is calculated separately by gender, we applied the same economic impact assumptions to people of both genders. Building on the ADA's research which shows that 3.1% of people with type 2 diabetes are unable to participate in the labour force due to disability[89], we engaged with our Expert Advisory Group (Table 2) to determine the relative impact of this change across the four previously described 'diabetes groups'. This led us to assume that individuals in group 4 are most impacted from a lost productivity perspective as this group is primarily comprised of an older cohort and are likely to be most impacted by serious complications.


### 3.2.2.2.3 Lost economic value of reduced labour productivity

In addition to productivity lost as a result of the inability to perform labour, **type 2 diabetes has also been shown to reduce the productivity of those undertaking both salaried and non-salaried labour** by either **increasing absenteeism** and/or **decreasing presenteeism**.

- **Absenteeism** is the number of workdays missed due to poor health. The ADA estimate that workers with type 2 diabetes lost between 1.0 and 4.2 workdays per year with an average of 1.7[89] days per year. We have used this value as our average working days lost per year.

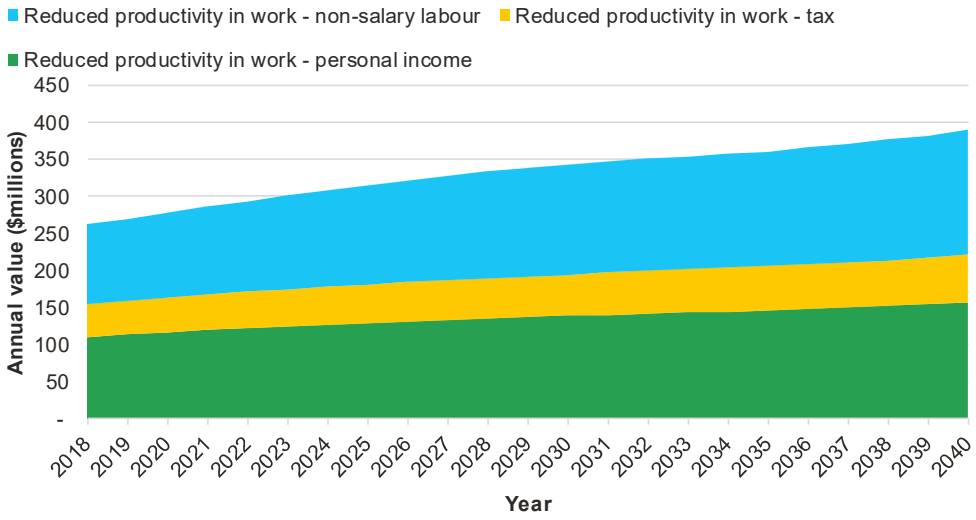
- **Presenteeism** is the reduction in levels of productivity while at work. The ADA estimate that workers with type 2 diabetes are 1.8-38.0% less productive[xxvi]. We have adopted the ADA's conservative value of a 6.6% reduction in productivity.

- Figure 33 below shows the economic value of reduced productivity of labour and the associated impact on personal income, tax revenue and non-salary labour (definitions, calculations and assumptions for each economic cost type can be found in Appendix 10.3.3.6). The figure shows that reduced labour productivity impacts all economic cost types but has the greatest


[xxvi] *Per an ADA study on the self-reported impacts of type 2 diabetes on productivity.*

impact on the cost of non-salary labour, which increases by $54m or 47% over the next 20 years. This is due to lower labour force participation rates in the older age groups combined with higher average incomes and the distribution of those with type 2 diabetes, especially those in 'diabetes groups' 3 and 4 (the most severely impacted). This trend is also evident in Figure 23, Figure 24 and Figure 25.

*Figure 33: Economic value of reduced productivity of labour (2018-2040)*




## 3.2.3 Total cost of type 2 diabetes – sensitivity testing

Our analysis is all presented in current dollars and assumes no real medical or economic inflation (which we will refer to as the 'base case' in this section), we have included cost sensitivity testing below. We have included this testing is to illustrate that should medical and economic costs continue to increase (in real terms) as they have in the past, total future costs of type 2 diabetes could be materially higher than projected in the base case.

In the scenario below we have shown the impact on total costs assuming the following increases above regular inflation:

- Medical costs, excluding secondary care costs, increase by 2.0% per annum above CPI
- Secondary care costs increase by 3.0% per annum above CPI
- Income increases by 1.0% per annum above CPI.

The medical cost inflation figures (first two bullets) are based on the difference between medical cost inflation and Consumer Price Index (CPI) used in other Government valuations. The wage assumption is based on the approximate difference between CPI and wage inflation. This inflation will be referred to as 'superimposed inflation' below, as it is in addition to regular inflation. When considering these projections, keep in mind that the values are still presented in NZ$(2020) and ignore the impact of general inflation (CPI). Superimposing CPI inflation would substantially increase the values presented.

Figure 34, Figure 35, Figure 36, Figure 37 and Figure 38 below show costs for the superimposed inflation scenario compared with costs projected in the base case between 2020 and 2040. In the superimposed inflation scenario, total cost (including medical and economic costs) reaches almost $5.1 billion by 2040, which is just under 50% higher than the base case projected costs.

*Figure 34: Total annual cost of type 2 diabetes in New Zealand with superimposed inflation (2020-2040)*

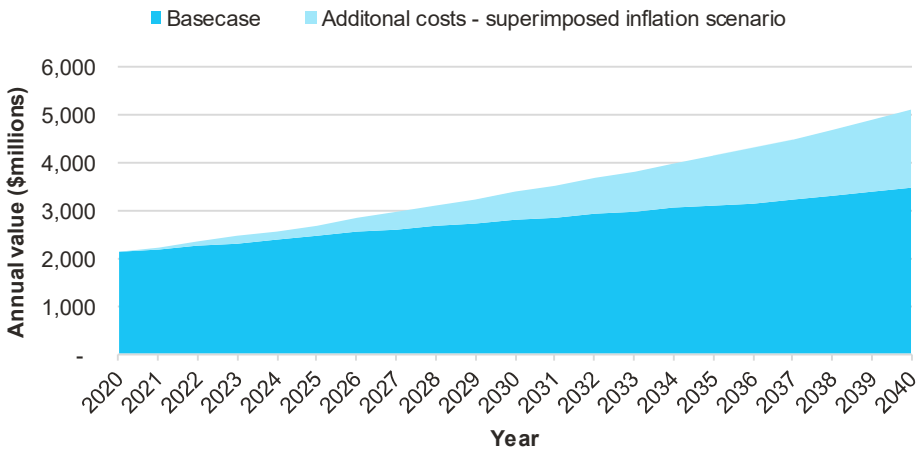



Figure 35, Figure 36, Figure 37 and Figure 38 below show the cost sensitivity of each **health and economic cost components** associated with type 2 diabetes – these costs are due to lost lives, disability and lost productivity.

*Figure 35: Health costs due to type 2 diabetes (2020-2040) – with superimposed inflation*

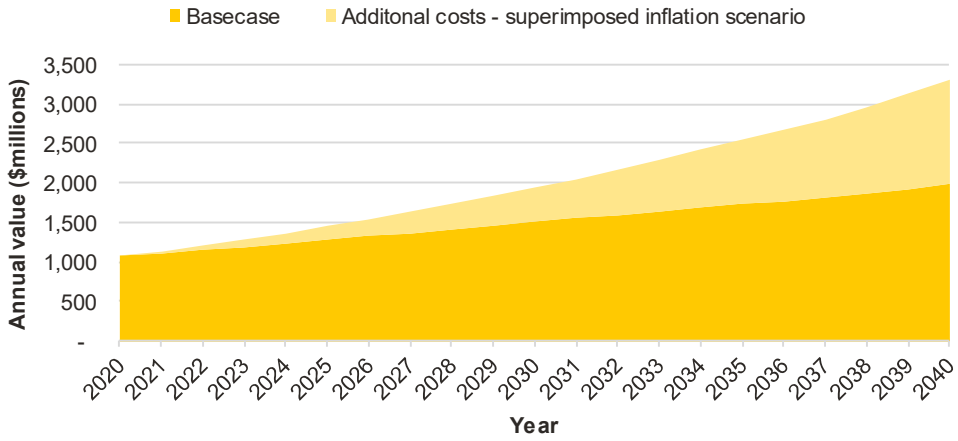



*Figure 36: Economic value of lives lost early due to type 2 diabetes (2020-2040) – with superimposed inflation*

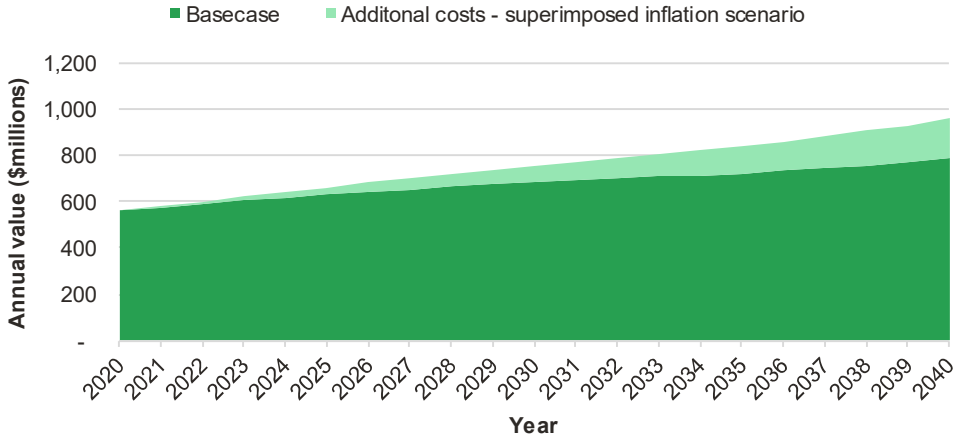


*Figure 37: Economic value of productivity lost due to the inability to perform labour (2020-2040) – with superimposed inflation*

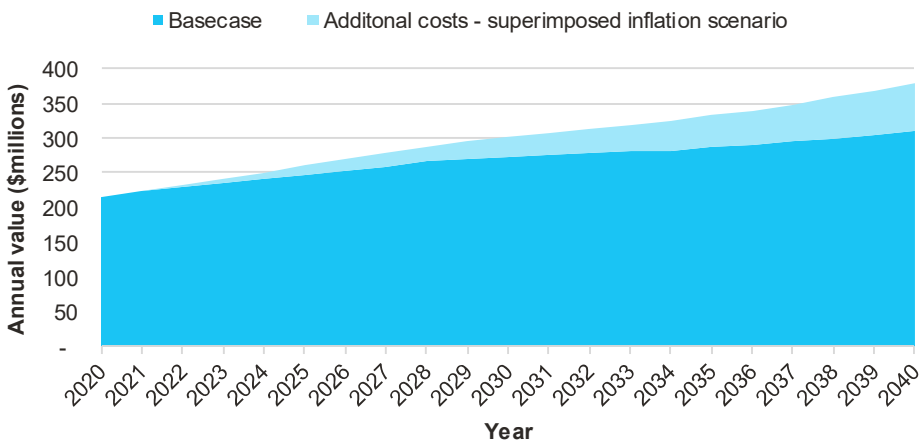



*Figure 38: Economic value of reduced productivity of labour (2020-2040) – with superimposed inflation*

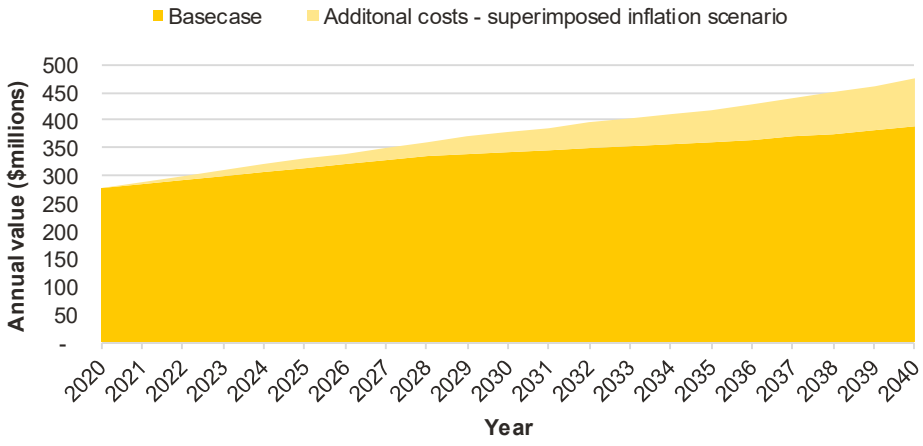



Table 13 below summarises the results of our cost modelling sensitivity testing. While all analysis throughout this report (unless otherwise stated) assumes no additional cost inflation, this sensitivity testing shows that total costs are very sensitive to increases in medical and economic costs. As such, the results presented in this report should be considered a conservative estimate, where it is possible that actual costs over the next 20 years may be materially higher than described.

*Table 13: Costs modelling sensitivity testing summary – 2040 projection*

| | Base case 2040 | Sensitivity scenario 2040 | Difference (actual) | Difference (%) |
|---|---|---|---|---|
| Health costs | $1,978m | $3,307m | $1,329m | 67% |
| Economic costs – lost lives | $784m | $956m | $173m | 22% |
| Economic costs – loss due to disability | $310m | $378m | $68m | 22% |
| Economic costs – lost productivity | $389m | $474m | $86m | 22% |
| **Total costs** | **$3,460m** | **$5,115m** | **$1,655m** | **48%** |

## 3.3 *Lifetime cost of type 2 diabetes*

*The detrimental personal and economic impact of type 2 diabetes is greatest when a person develops and is diagnosed early in life. The lifetime cost of a person diagnosed at age 25 is $565k as compared to $44k for a person diagnosed at age 75. This provides a strong economic and social case to invest in the prevention of type 2 diabetes, especially for younger people.*

Type 2 diabetes places a significant burden on both the individual and society regardless of when it is diagnosed. However, the **detrimental personal and economic impact of the disease is greatest when a person develops type 2 diabetes and is diagnosed early in life**.

To illustrate the relative impact of the disease over a lifetime, we have created several representative life cost profiles. These profiles do not represent any one individual, rather they represent the average values over all lives within a cohort. To create these representative life profiles, we simulated the lives of 100,000 people (50,000 male and 50,000 female) who were diagnosed with type 2 diabetes at age 25, 35, 45, 55, 65 and 75. We have included all impacts described in section 3.2 using NZ$(2020) costs and did not discount for time value. We divided the total cost of all impacts by 100,000 representing the number of lives at the simulation start point.

Our analysis shows that the **lifetime cost of a person diagnosed with type 2 diabetes at age 25 years is $565k**; $438k for someone aged 35 years; $314k for someone aged 45 years; $187k for someone aged 55 years; $90k for someone aged 65 years; and $44k for someone aged 75 years. When comparing the lifetime cost of someone diagnosed with type 2 diabetes at age 25 years vs. 75 years, there is a $521k or 13-fold increase. This finding alone makes a **strong economic and social case for the Government to make a greater investment in the prevention of type 2 diabetes**.

*Figure 39: Representative lifetime cost of type 2 diabetes beginning at age 25 ($565k)*

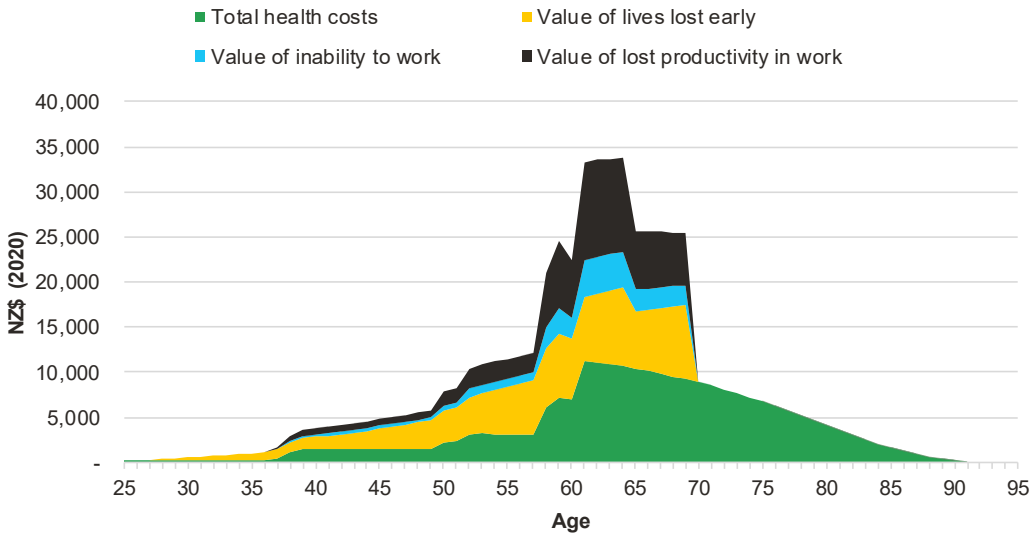


*Figure 40: Representative lifetime cost of type 2 diabetes beginning at age 35 ($438k)*

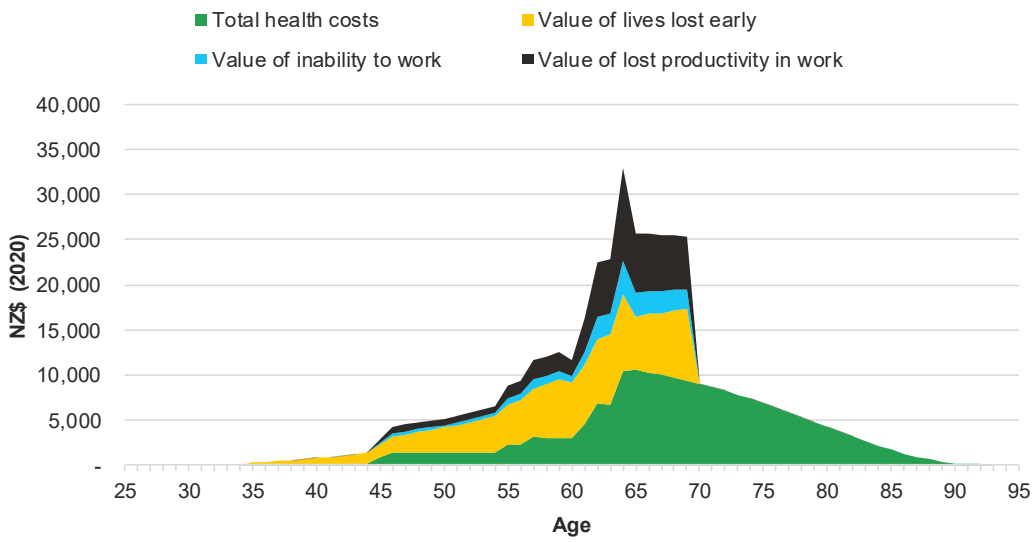



*Figure 41: Representative lifetime cost of type 2 diabetes beginning at age 45 ($314k)*

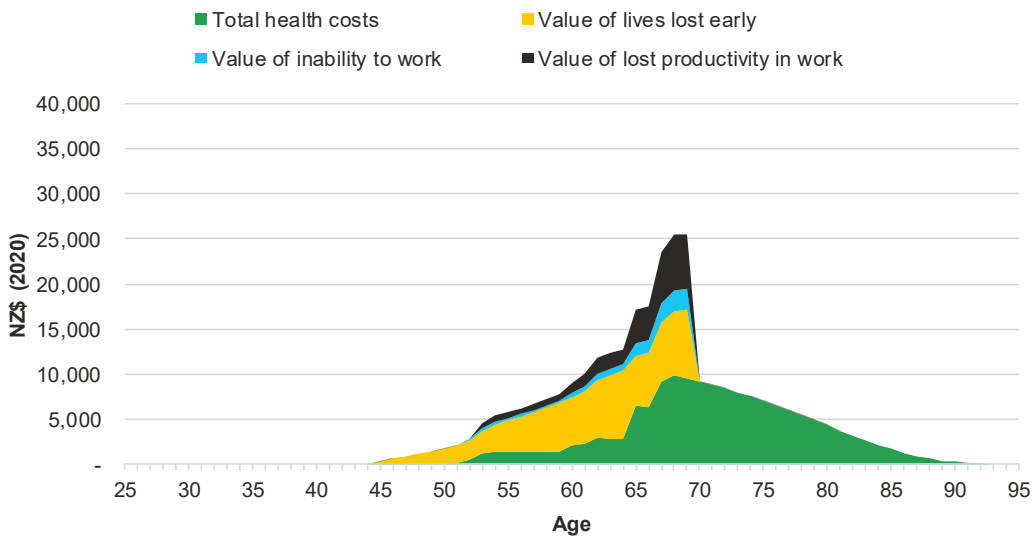


*Figure 42: Representative lifetime cost of type 2 diabetes beginning at age 55 ($187k)*

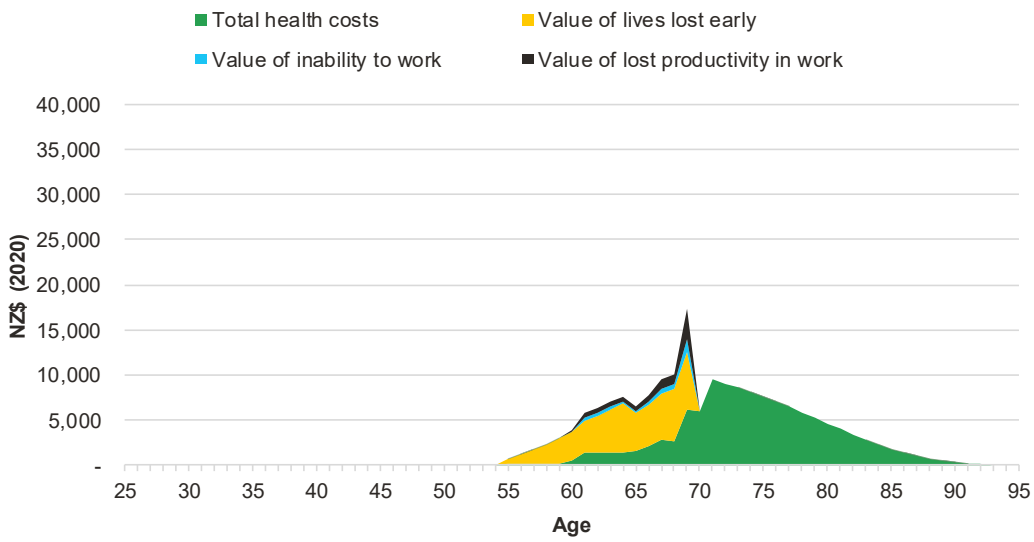



*Figure 43: Representative lifetime cost of type 2 diabetes beginning at age 65 ($90k)*

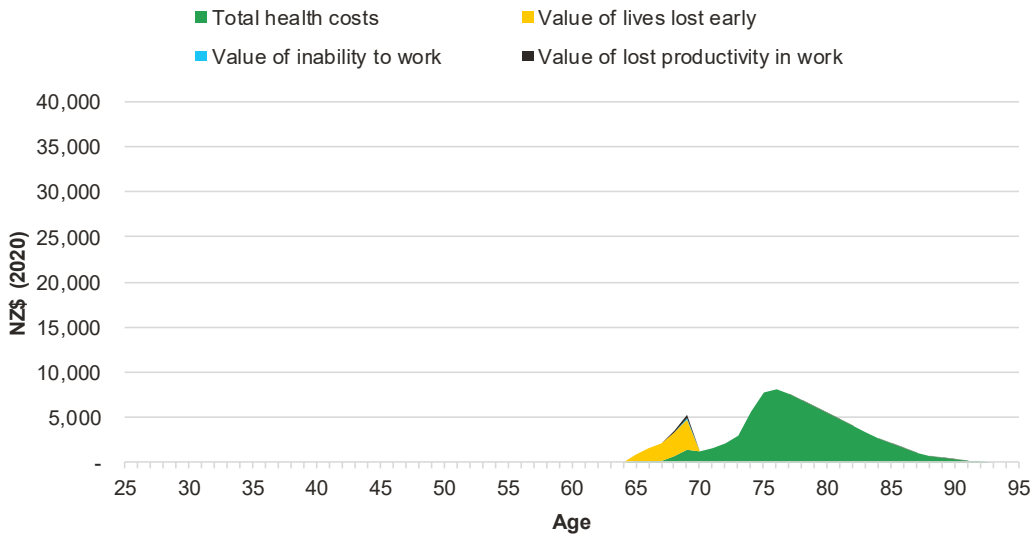
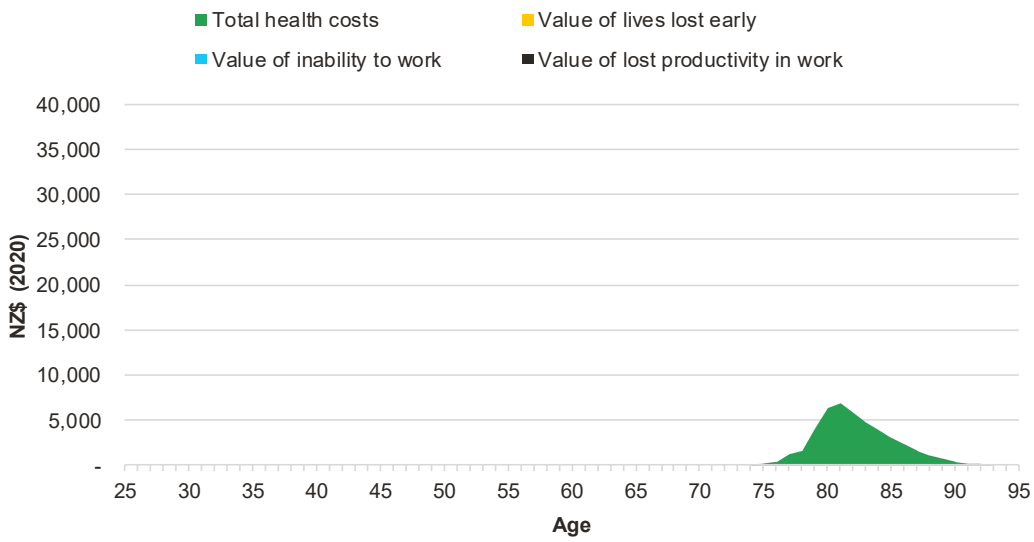


*Figure 44: Representative lifetime cost of type 2 diabetes beginning at age 75 ($44k)*



# 4. What is the current national approach to diabetes prevention, treatment and care?

## 4.1 Overview of the current national approach to diabetes prevention, treatment and care

*Diabetes does not feature as a clear Government Health priority nor is it tracked as a New Zealand health target. Further, there is no single current national strategy or approach to the prevention, treatment and care of diabetes in New Zealand.*

*The current national approach to diabetes prevention, treatment and care is guided broadly by the national Quality Standards for Diabetes Care and the Living Well with Diabetes (LWWD) Plan (2015-2020) – the standards have helped to introduce self-review and greater consistency amongst the DHBs, but the LWWD Plan hasn't had the level of impact anticipated as it was not enabled by specific funding nor robust health-outcome performance measures.*

*Via the Diabetes Care Improvement Package, each DHB is required to design and implement their own diabetes model of care – this has enabled tailoring to local needs but has also driven inconsistent/inequitable service levels and quality. This issue is exacerbated by a lack of accountability mechanisms for DHBs and providers to demonstrate how funds have been used or whether diabetes-related health outcomes have been achieved.*

This section provides an overview of the current national approach to diabetes prevention, treatment and care in New Zealand. This is important information and context for the design of our four proposed intervention presented later in the report. This overview also informs several of our core 'system-level' observations and recommendations. Below are the **key components** of New Zealand's current national approach to diabetes prevention, treatment and care:

- **Government health priorities** – overall health priorities set by the Government[xxvii]
- **New Zealand health targets** – core set of national health performance measures[xxviii]
- **Quality Standards for Diabetes Care** – the broad quality standards against which DHBs are expected to comply[26]
- **Diabetes Care Improvement Packages –** the broad national approach to diabetes prevention, treatment and care that which supports the allocation of a component of Government funding[27]
- **Living Well with Diabetes Plan –** the broad plan/approach developed by the Ministry of Health and intended to guide DHB diabetes service design and delivery[13]
- **Diabetes services** – Government funded/subsidised services and interventions available in New Zealand.

For completeness and context, we have shown the link to Government health priorities and the national mechanism for measuring performance against these priorities (being the New Zealand Health Targets). Each component of the approach is described in more detail below. Following each description is a brief reflection

[xxvii] *Government health priorities are not necessarily diabetes-specific but have been included in this discussion for context and completeness.*
[xxviii] *New Zealand health targets are not necessarily diabetes-specific but have been included in this discussion for context and completeness.*

piece (presented in grey boxes) on whether the diabetes-specific part of the named 'component' is working well and achieving the outcomes/objectives intended. Where no formal evaluation has been completed, we have included an anecdotal assessment.

### *4.1.1 Government health priorities*

The current Government and Ministry of Health have a strong focus on **improving the health and wellbeing of New Zealanders**. This is evident in a number of recently released documents including the *Wellbeing Budget 2020: Rebuilding Together*[28]; *Achieving Equity in Health Outcomes (2019)*[29]; *2019/20 Ministry of Health Output Plan*[30]; and *Whakamaua: Māori Health Action Plan 2020-2025*[31].

While **diabetes prevention, treatment and care does not currently feature as an explicit Government priority** in any of these documents, there are a number of specific objectives and priorities that will be strongly supported by investing in better diabetes prevention, treatment and care in New Zealand – these are:

- *Wellbeing Budget 2020: Rebuilding Together* identifies physical and mental health of New Zealanders as a key priority i.e. 'Priority E: Physical and Mental Wellbeing – Supporting improved health outcomes for all New Zealanders'[28].

- In *Achieving Equity in Health Outcomes*, Māori are identified as having the poorest overall health status and most likely to experience significant health inequities[29]. In response, Ministry of Health has made an explicit commitment to reduce the health disparities for Māori by reiterating the 'strong and equitable public health and disability system' priority in the *2019/20 Output Plan*[30]. The commitment to reduce these inequities is also highlighted in the *Whakamaua: Māori Health Action Plan 2020-2025*, which has four high-level outcomes including 'ensuring the health and disability system is fair and sustainable and delivers more equitable outcomes for Māori'[31].

- In addition to the equity-related priority mentioned above, two additional relevant priorities from the *2019/20 Output Plan* are 'wellbeing through prevention' and 'primary health care'[30].

### *4.1.2 New Zealand health targets*

Health targets are a set of national performance measures specifically designed to improve the performance of health services that reflect significant public and Government priorities (where each DHB reports their performance against the health targets). The Ministry of Health are currently working on a new set of health targets that align with the Government's current health priorities. The focus of the new targets will be on population health outcomes and will aim to ensure that health resources are used optimally, and the best investment/resource allocation decisions are being made to improve the health of New Zealanders. The criteria for the new health targets are as follows[32]:

- A mix of health system and population health improvement measures

- Alignment with current Government priorities i.e. mental health, cancer care and child wellbeing

- Be quantified and timebound

- Availability of data to monitor progress

- Sector engagement and support

- Focus on health issues and alignment to socio-economic determinants.

While work is underway to develop these new targets, DHBs will continue to report against the current set of health targets:

1. Shorter stays in emergency departments
2. Faster cancer treatment
3. Increased immunisation
4. Better help for smokers to quit
5. Raising healthy kids.

Health targets that have been **removed** from the current set include:

6. Improved access to elective surgery (no longer reported as a health target)
7. **More** heart and **diabetes checks** (no longer reported as a health target).

Dropping the 'more heart and diabetes checks' target provides an indication that long-term conditions such as cardiovascular disease and **diabetes are no longer considered core Government health priorities**.

***Did the 'more heart and diabetes checks' health target work well?***

The 'more heart and diabetes checks ('*Checks*') health target was evaluated by Allen+Clarke in May 2016[33]. Nationally, the coverage goal for the health target was met, with the coverage rate increasing from 49% to 90% of the population cohort (Māori, Pacific and Indian men aged 35-75 years and women aged 45-74 years; and other ethnicities men aged 45-74 years and women aged 55-74 years). Further, the *Checks* programme was successful in achieving coverage and driving awareness around the risk of cardiovascular disease (CVD) and diabetes, but some changes and refinements would be required for future delivery. Finally, the programme would need to be in place for a longer period to determine whether it changes health outcomes and offers value for money.

### *4.1.3 Quality Standards for Diabetes Care*

The current version of the Quality Standards for Diabetes Care ('Quality Standards') was released by the Ministry of Health in 2014. The Quality Standards are specific to people with diabetes and are intended to provide guidance for clinical quality service planning and implementation of equitable and comprehensive patient-centred care. There are 20 individual Quality Standards, which cover five key areas (the complete Quality Standards can be found in Appendix 10.1):

- Basic care, self-management and education
- Management of diabetes and cardiovascular risk
- Management of diabetes complications
- Management of diabetes while in hospital
- Special groups.

DHBs are expected to **self-assess** and report to the Ministry of Health on whether the implementation of their diabetes prevention, treatment and care programmes is delivered in line with the Quality Standards.

***Are the Quality Standards for Diabetes Care working well[xxix]?***

Anecdotal discussion suggests the quality standards have been very well received by the DHBs and clinicians. In particular, the standards are clear and accessible; provide a common reference point for all providers; and help to clarify expectations around quality and consistency of diabetes care. There is however general acknowledgement and agreement amongst the sector that the standards need to be refreshed to incorporate equity considerations and to provide more guidance around diabetes care for young people.

### *4.1.4 Diabetes Care Improvement Package*

The **'Get Checked'** programme was set up by the Ministry of Health in 2000. This was a nationally managed and DHB delivered programme that entitled people with diabetes to a free annual consultation (where the purpose of the consultation was to ensure key tests were completed to allow people to plan treatment for the year ahead). While the programme resulted in some improvements, these were not as significant as hoped (with a lower than expected absolute reduction in HbA1c levels and only two-thirds of patients accessing their free check-ups) and GPs felt that the programme was not improving diabetes healthcare, because[27]:

- The funding did not cover the costs of delivering checks or completing documentation
- They saw the check as an information-collecting exercise
- A higher proportion of people failed to attend the pre-arranged appointment than failed to attend for acute complaints.

Consequently, Government funding for the Get Checked programme ceased in 2012[27] and the programme was replaced by the **'Diabetes Care Improvement Package' (DCIP)**. This is a community and primary care-based programme, which aims to build on core diabetes services that are already being provided. The programme essentially devolves responsibility for planning, coordinating and delivering diabetes care to the DHBs. Under the DCIP approach, each DHB has responsibility to build their own diabetes model of care based on the New Zealand Diabetes guidelines[xxx], the Quality Standards for Diabetes Care (as above) and the needs of their local patient population. It is the intention that the DCIP will drive[27]:

- More patient involvement through increased health literacy, health seeking behaviour and self-management of care
- A greater role of nurses in coordination and the delivery of resources
- Greater use of information technology in order to streamline care and enhance recall, audit and management procedures, especially in primary care
- Involvement of allied care and community care providers, doctors and primary health organisations (PHOs) in the development phase
- Moving towards a 'clinical outcome' rather than 'output' basis of measuring quality of care.

The DCIP is also a mechanism by which Government funding is allocated to the DHBs for diabetes prevention, treatment and care. However, the largest portion of Government funding is provided to the DHBs as part of their individual annual distribution (which is a population-based allocation). Where these annual distributions are intended to fund or purchase services to meet the needs of each district's population. Among the many services provided or funded by DHBs from this distribution are hospital care; most aged care, mental health and primary care services; the combined pharmaceuticals budget; and some public health services[34].

[xxix] *We understand the Ministry of Health aim to issue a report on the DHBs collective self-assessment results against the Quality Standards late 2020.*

[xxx] Where the relevant guideline for type 2 diabetes is: New Zealand Guidelines Group. *Guidance on the Management of type 2 diabetes 2011*. Wellington: New Zealand Guidelines Group; 2011.

### *Is the Diabetes Care Improvement Package approach working well?*

The DCIP allows DHBs autonomy to design and delivery a diabetes model. While this enables DHBs to tailor their diabetes model of care to meet the needs for their local population/community (see case studies below), it also means there is great inconsistency/inequity in the level of quality of diabetes services across New Zealand. Further exacerbating this issue is a lack of accountability mechanisms for DHBs and providers to demonstrate how funds have been used and/or whether diabetes-related health outcomes have been achieved.

To illustrate different ways DHBs can tailor their individual approaches to diabetes prevention, treatment and care – we have included two case studies on DHBs that have demonstrated excellence and innovation – these are **Canterbury DHB** and **Waitematā and Auckland DHBs**. In both cases, the key success factors are **review of the current state**; **adoption of an integrated/service level alliance approach** with **shared governance/leadership**; and **deliberate prioritisation and planning**.

### *Case study: Canterbury DHB*

**Canterbury DHB has approximately 9% of New Zealand's diabetes population (2018, VDR)**

In 2017, Canterbury DHB undertook a 'Diabetes Service Review' ('the Review') of all services offered in the region. The Review made 17 recommendations aimed at addressing identified gaps and weaknesses in Canterbury's diabetes services/care. Specifically, the recommendations were centred around providing patients with more service in the community, which were closer to home. The Review proved to be a successful catalyst for change and improvement.

Canterbury DHB now follow an integrated model of care and 'service level alliance' approach to diabetes service/care. This approach utilises a connected system, that is centred around people that aims not to waste their time. Through this integrated approach, Canterbury DHB has three strategic objectives:

- People are healthier and able to take greater responsibility for their own health
- People stay well in their own homes and communities
- People with complex illnesses have improved health outcomes.

Central to the success of this integrated approach is an overarching governance group called the Integrated Diabetes Service Development Group (IDSDG). This group provides oversight, clinical leadership, performance monitoring and decision/guidance on service change. The members of the group provide representation from consumers, podiatry, retinal screening and service providers. Under the IDSDG is the Integrated Diabetes Service Operational Group (IDSOG), which provides decision/guidance on operational issues and the implementation of service change. Finally, under the governance structure are smaller focused diabetes working groups, who are tasked with implementing specific recommendations from the Review.

This structure has enabled close coordination across all diabetes services, effective information/data sharing across the system, clinical leadership, and effective focused implementation – all of which have driven better patient/whānau experiences and improved health outcomes. At a service delivery level, the integrated model of care focusses on the following areas/services:

- The Patient Journey
- Monitoring of Canterbury wide data
- Retinal Screening Services & High-Risk Foot
- Community & Secondary Care Specialist Services
- Education e.g. diabetes group classes,

- Health Promotion /Whānau support e.g. smoking cessation, green prescriptions, Before School Checks, paediatric care, adolescent care etc.

Future focus areas for Canterbury DHB include achieving improved system visibility [of patient information] for providers, greater use of enabling technology, general practice education, integrated nursing services, community education, and increased dietitian services in the community.

***Case study: Waitematā and Auckland DHBs***

**Waitematā and Auckland DHBs have approximately 38% of New Zealand's diabetes population (2018, VDR)**

In 2015, Waitematā DHB, Auckland DHB and the six regional PHOs formed a Diabetes Service Level Alliance (DSLA). The DSLA is comprised of the clinical leaders (nurse or doctor) of each PHO; the two DHB diabetes services; senior management from each DHB; and representation from the funder. The DSLA is overseen by the 'Waitematā and Auckland Alliance Leadership Team' (AWALT), which is comprised of the Chief Executive of Auckland DHB, senior managers of the two DHBs, Treaty partners and the six PHOs (as such, we refer to Waitematā and Auckland DHBs ('the DHBs') collectively). Formation of this structure has enabled clinical leadership and a clear shared direction.

The first tasks undertaken by DSLA were to complete a stock-take of diabetes services offered across the two DHBs and reviews of the community podiatry services and diabetic retinal screening services. The stock-take aimed to identify services; assess service quality, equity and health outcomes achieved; and determine how much of the flexible funding pool was being allocated to diabetes services. The stock-take and reviews identified inequitable access, variable patient health outcomes, differences in quality of care and differences in the competency of service providers/clinicians. This provided a successful catalyst for change and improvement.

In response to the stock-take, two key actions occurred. The first action was development of key clinical indicators. Where these clinical indicators show the health status of the Auckland and Waitematā diabetes population and help to measure and monitor progress of initiatives undertaken. The second action was the development of a 12-project roadmap with five projects prioritised for initial delivery (note: delivery was planned for 2020, but COVID-19 has caused some delay) – these are:

- Service co-design – work with a group of general practices and patients to redesign diabetes services to better meet the needs of people with diabetes.
- Podiatry services – supporting and upskilling community podiatrists to provide a consistent level of care and improving communication between secondary services and community podiatrists with the goal of improving care and health outcomes for people with medium/high risk of foot ulceration.
- Retinal screening – identify a model of care that meets the needs of people with diabetes and procure a new screening service across both DHBs.
- Diabetes Care Improvement Plan (DCIP) funding – change the approach to funding the DCIP for PHOs by redesigning service specifications and giving PHOs more freedom to tailor their services to meet local needs and incorporate innovation e.g. extended consultations, use of health coaches etc.
- Text messaging – introduce a one-way text messaging service to support better self-management.

## *4.1.5 Living Well with Diabetes Plan*

*Living Well with Diabetes* (LWWD) is the Ministry of Health's national medium-term plan to deliver diabetes prevention, treatment and care services to New Zealanders. The current version of the plan spans across the 5-year period 2015-2020. The plan identifies diabetes as a priority long-term condition and sets out a vision that

*"all New Zealanders with diabetes, or at high risk of developing type 2 diabetes, are living well and have access to high-quality, people-centred held services"*. The Plan's overarching objectives are to:

- **Reduce the personal burden** of disease for people with diabetes by providing integrated services along with the tools and support people need to manage their own health.
- **Provide consistent and sustainable services** across the country that improve health outcomes and equity for all New Zealanders, including through better use of health information.
- **Reduce the cost of diabetes** on the public health system, and the broader societal impact in the longer term.

The six priority areas of the Plan are in Figure 45 below.

*Figure 45: Living Well with Diabetes - Priority areas for action 2015-2020*

**Living Well with Diabetes Plan (2015-2020)** – *developed by the Ministry of Health (six priorities of the plan shown below)*

| *1. Prevent high-risk people from developing type 2 diabetes* | *2. Enable effective self-management* | *3. Improve quality of standards* | *4. Detect diabetes early and reduce the risk of complications* | *5. Provide integrated care* | *6. Meet the needs of children and adults with type 1 diabetes* |
|---|---|---|---|---|---|
| • Identify and implement a programme of health education and awareness-raising initiatives to improve people's knowledge and understanding of diabetes.<br>• Implement prevention and wellness programmes.<br>• Improve identification and management of pre-diabetes.<br>• Support action-oriented research. | • Support the ongoing development of self-management approaches.<br>• Improve patient/whānau peer support networks.<br>• Support people to self-manage their diabetes as effectively as possible.<br>• Support ongoing workforce development. | • Implement and use the Quality Standards for Diabetes Care 2014 to self-assess services and improve performance, with a specific focus on improving equity.<br>• Measure progress in improving health outcomes for people with diabetes. | • Implement risk management at population and practice levels, supported by assessment tools.<br>• Support IT-enabled patient and clinician monitoring for early intervention.<br>• Ensure eligible people access bariatric surgery.<br>• Consistently implement guidelines for gestational diabetes. | • Integrate practice across primary and specialist care, including outreach and navigator services and intensive support for some people with high health needs.<br>• Coordinate care across the health, disability and social sectors for people with complex needs. | *Outside the scope of the 2020 Study* |

### *Is the Living Well with Diabetes Plan working well?*

To date, there has been no formal evaluation of the effectiveness of the LWWD Plan. However, a range of themes have been identified from quarterly DHB reporting[xxxi]:

**Concerning themes from quarterly DHB reporting:**

- Issues with the primary care business model inhibits systematic and proactive care for people with diabetes.
- Poor access and referral to psychologists as well as limited podiatry and retinal screening services.
- Inconsistent and generally sub-optimal delivery of diabetes annual reviews.
- Inconsistent diabetes self-management education and support.
- Poor referral/access of people with complex type 2 diabetes to specialist services.
- Inadequate practice-level quality improvement and inconsistent use of medications to improve CVD/renal risk and glycaemic control.
- Inadequate access to SGLT-2i and GLP-1RA for people with type 2 diabetes and inadequate access to 'flash' monitors and continuous glucose monitoring for people with type 1 diabetes.

**Positive themes from quarterly DHB reporting:**

- Many of the DHBs have established active local diabetes teams (or an equivalent).
- All DHBs have performed detailed self-assessments of their services against the 20 Quality Standards and have identified priority areas for improvement.
- There has been a gradual improvement in diagnosis - most of the DHBs now know their diabetes population at PHO/practice level (with close alignment to the Ministry of Health Virtual Diabetes Register).
- Many of the DHBs have systems in place that allow practice-level identification/reports of local and individual patients.
- All DHBs now report diabetes metrics by ethnicity.
- DHBs report that 55% of people with diabetes are managing to maintain their HbA1c<65mmol/mol.
- There has been a slight reduction in the percentage of people with HbA1c >100mmol/mol.

[xxxi] *Themes provided directly to PwC by the Ministry of Health.*

## 4.1.6 Diabetes services

As shown in Figure 46, there are five broad categories of type 2 diabetes services available in New Zealand: technology; surgery and hospital; medication; specialist/general support; and lifestyle and education interventions. The discussion below provides a brief overview of the **major components** of each service type.

*Figure 46: Different type 2 diabetes services/interventions available in New Zealand*


## 4.1.7 Technology

Technology is used widely in the prevention, treatment and care of type 2 diabetes. Blood glucose meters, constant glucose monitoring (CGM) devices and insulin pumps are used for on-going blood glucose management. **Blood glucose meters** and strips are used by approximately 120,000 New Zealanders living with diabetes to test their blood glucose levels at home. For those who qualify, PHARMAC currently subsidises four different 'CareSens meters' and the associated testing strips[35]. **CGM** devices are an alternate and highly effective technology for type 2 diabetes management. CGM systems track glucose levels continuously, taking glucose measurements at regular intervals throughout the day and use this data to determine glucose direction. Currently CGM systems are not Government subsidised in New Zealand and with a minimum private cost of $50 per week, these systems are not affordable for many people[36]. Diabetes New Zealand currently has a petition with the Health Select Committee for CGM to be funded[36]. **Insulin pumps** are computerised devices that automatically monitor and administer insulin via a catheter – at present PHARMAC only subsidises insulin pumps for New Zealanders with type 1 diabetes.

Screening technology is used to monitor people with diabetes for the progression of complications. In New Zealand, the core screening service available is **retinal screening**. Subsidised diabetes retinal screening is provided once every two years from the time of diagnosis[37].

## 4.1.8 Surgery and hospital

**Bariatric surgery** is an effective yet extreme measure for the reversal and/or management of type 2 diabetes, specifically for those with severe obesity[38]. The surgery involved altering or removing part of a person's digestive system to restrict the amount of food they can eat or absorb. To be eligible for publicly funded bariatric surgery in New Zealand, there are numerous conditions an individual must meet. For example, Auckland DHB will only consider people for the surgery if they:

- have a BMI of 40 or more;
- have a BMI of 35 or higher and have obesity-related severe diseases that could be improved through surgery (e.g. heart disease, type 2 diabetes);
- have previously failed attempts to lose weight; and
- understand what the surgery involves and are committed to making permanent lifestyle changes (diet and exercise)[39].

If an individual meets these conditions, they must then be referred for surgery by a doctor and confirmed by a hospital. The focus for publicly funded bariatric surgery is on those who will benefit the most, typically adult patients who present with potentially reversible conditions alongside their obesity (e.g. type 2 diabetes). However, as publicly funded bariatric surgery is only available through DHBs for those who meet the criteria, there is a requirement for the Ministry of Health to prioritise urgency.

In addition to bariatric surgery, there are a wide range of other non-elective surgical or hospital-based treatments provided to people with type 2 diabetes e.g. amputation of a limb, on-going dialysis for kidney failure etc. These are generally publicly funded as they are often life-saving procedures.

### *4.1.1 Medication*

For people with type 2 diabetes it is important to maintain healthy blood glucose and blood pressure levels. This is especially important for reducing the chance of developing diabetes related complications. The majority of people with type 2 diabetes will require medication at some stage to manage their diabetes[40]. Tablet form medications are most common for helping to lower and maintain blood glucose within a normal healthy range[41].

Currently there are a number of subsidised medications available in New Zealand for type 2 diabetes management. These predominantly come as tablet form oral agents: biguanides (metformin), Sulphoylureas, alpha-glucosidase inhibitors, Glitazones and DPP-4 inhibitors.

Over time, oral agents typically become less effectiveness and insulin is eventually required for many people with type 2 diabetes. Insulin may be prescribed in isolation or in combination with oral agents. There are three analogues of insulin currently funded in New Zealand for the treatment of type 2 diabetes: isophane, basal insulin (glargine), and premixed insulin. Isophane is the first-line insulin treatment for type 2 diabetes in New Zealand. There are currently two, fully funded brands of isophane available in New Zealand (Protaphane and Humulin NPH)[42].

***'Current medication events'***

There are a number of second line 'gold standard' type 2 diabetes medicines not currently funded in New Zealand. In January 2020, PHARMAC began assessing proposals for the provision of: SGLT-2 inhibitors, GLP-1 agonists and DPP-4 inhibitors[43] and this proposal in the public feedback stage. It is expected that a medication in both classes will be funded from December 2020. Prior to this event, New Zealand is considered to have the worst range of funded diabetes drugs in the developed world[44], with funding for all medicines just 5% of the overall health budget compared to the OECD average of 15%[45].

### *4.1.2 Specialist and general support*

People with diabetes are eligible for a variety of publicly funded or subsidised services including additional GP visits and consultation with specialists such as podiatrists, diabetes nurses, dietitians etc.

### *4.1.3 Lifestyle and education interventions*

There are numerous diabetes-targeted lifestyle and education interventions delivered (by numerous organisations) in New Zealand. Some of the core examples are **green prescriptions**, **whānau and community-based lifestyle programmes** and **health promotion/education initiatives**.

**Green prescriptions** are tailored prescriptions written by a diabetes nurse or doctor to increase a person's level of physical activity as part of their diabetes management plan[46].

**Whānau and community-based lifestyle programmes** target local communities and aim to include the whole whānau, rather than just the individual. They take a holistic and community-based approach to diabetes education, prevention and management, favouring broad lifestyle changes rather than a more traditional 'treatment' approach. While there is strong anecdotal evidence for the efficacy and impact of these programmes, current limitations of these types of programmes delivered in New Zealand are that they are often designed and

delivered as pilots only and they tend to lack robust evaluation frameworks/practices. As a consequence, the programmes are often only delivered to small groups of people and present limited evidence as to their efficacy.

Two example programmes are presented below.

### *Example whānau and community programme: Mana Tū*

Mana Tū is currently being delivered as a pilot in five general practices (four in Auckland and one in Northland[47]). Mana Tū seeks to reduce inequity and improve the impact of clinical and lifestyle interventions for people living with diabetes by using a Whānau Ora approach. Co-designed with whānau, clinicians, health service planners and Whānau Ora providers, the programme focuses on prevention and increased management for people living with pre-diabetes or poorly controlled diabetes. Community case managers (Kaimanaaki) identify individuals who could benefit from the programme and work with them and their families to take control of their diabetes. Together they work to improve things that can impact on a person's ability to manage their diabetes such as poverty, housing, engagement with the health system, and discrimination they face in this system[48]. The project is jointly funded by the Healthier Lives Science Challenge, the Ministry of Health, and the Health Research Council of New Zealand as part of the Long-Term Conditions Partnership[47].

### *Example whānau and community programme: HOPE Programme*

The HOPE Programme is a whānau and community-centred programme aimed at breaking the cycle of type 2 diabetes in 'at risk' communities. The programme is delivered by HOPE champions in their own communities over four sessions, with an approach tailored to be culturally appropriate to the whānau. Participant families learn about diabetes, healthy eating choices and develop a Family Action plan that they can put into practice in order to make long term lifestyle changes in their homes. The programme includes a follow-up session after 1-3 months to check on progress[49].

**Health promotion/education initiatives** are predominantly run through Diabetes New Zealand who provide information and host events to help those with type 2 diabetes better understand and manage their condition, in addition to raising awareness of the disease. Resources available through their website include informative pamphlets, a 'take control toolkit' information application, which includes approximately 60 resources to help people manage their health, and the 'Diabetes Wellness' quarterly magazine[50]. In addition to educational resources, Diabetes New Zealand use their website to share diabetes news and events. Awareness and action campaigns such as Diabetes Action Month are also run by Diabetes New Zealand and focus on educating New Zealanders about diabetes.

# 5. What are the relevant trends in the wider New Zealand health and disability system?

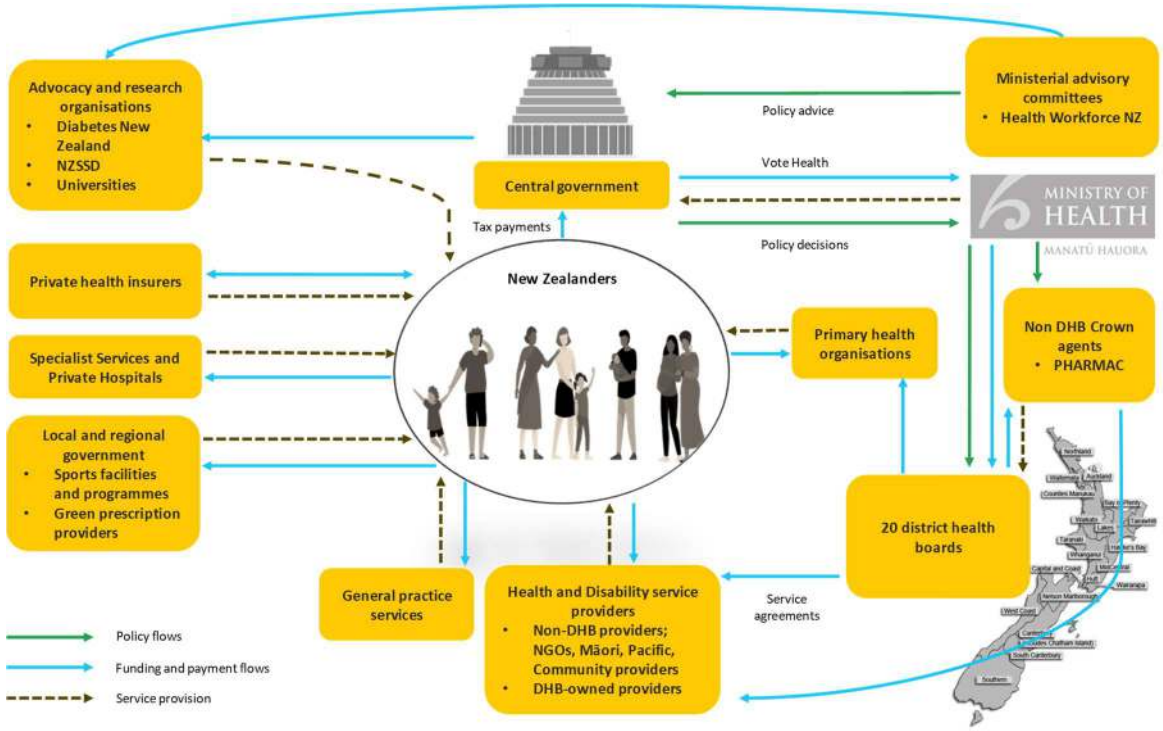
## 5.1 Key players and roles in the New Zealand 'diabetes health system'

*Much like the wider New Zealand health and disability system, the 'diabetes system' requires New Zealanders to navigate significant complexity and interact with multiple players.*

While this report is focused on the prevalence, cost and viable future interventions for type 2 diabetes in New Zealand, these subjects cannot be considered in isolation of the wider health system. As such, the discussion below briefly considers relevant aspects of the New Zealand health and disability system – through a diabetes lens.

Figure 47 below shows the key players and their roles in the New Zealand 'diabetes health system'[xxxii]. The Figure shows that **New Zealanders are required to navigate significant complexity and interact with multiple players** for different reasons.

*Figure 47: Key players and roles in the New Zealand 'diabetes health system'*




> *"We see communities and whānau facing a system that looms as a confusing monolith, telling people what is good for them, rather than a system that works with them to improve their overall wellbeing in ways designed for them not for the system[8]".*

[xxxii] *This diagram is simply intended to be illustrative rather than providing an exhaustive list of all players.*

## 5.2 Current state of the New Zealand health and disability system – through a diabetes lens

*The structure and funding arrangements of the New Zealand health and disability system do not enable effective and efficient use of resources; coherent decision-making; equitable high-quality diabetes health care that meets the needs of local populations and communities.*

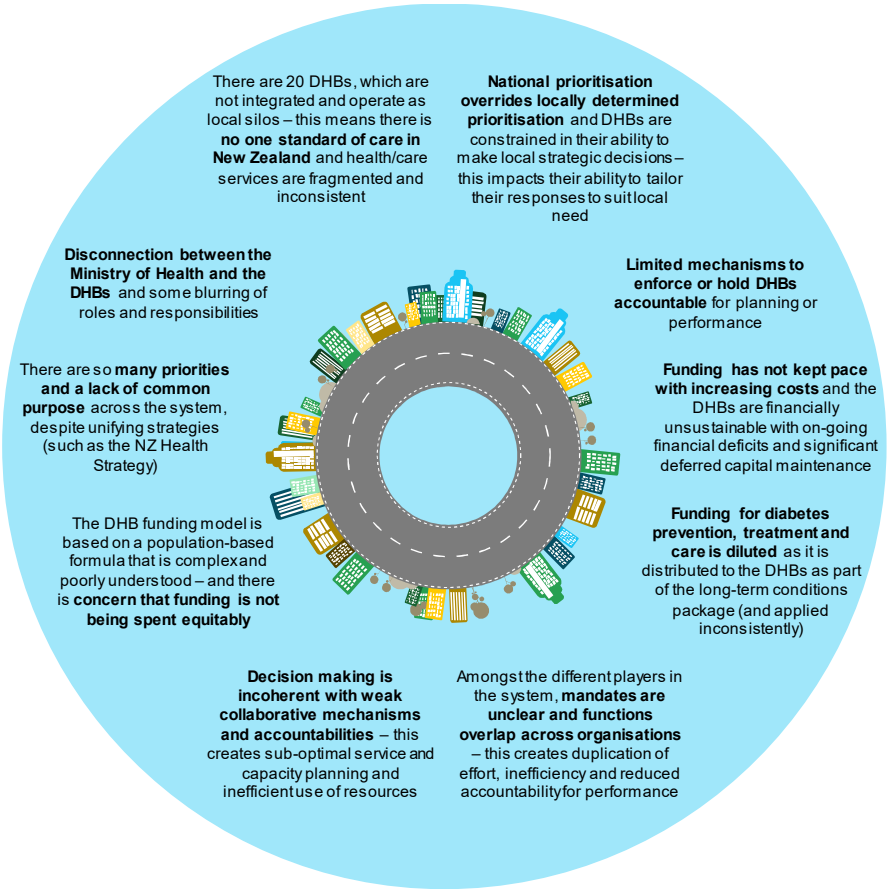
*The complexity and fragmentation of the system structure means people don't always access the services they need and don't always receive a high quality of care. This results in a high proportion of unmet need and suboptimal health outcomes. This is especially the case of Māori and Pacific people.*

*Health funding has not kept pace with increasing costs and the approach to allocate funding to long-term conditions means diabetes funding can be diluted. This has resulted in a lack of additional/new investment in diabetes prevention, treatment and care.*

### 5.2.1 System structure and funding arrangements

The recent *New Zealand Health and Disability System Review*[8] has identified a range of 'system deficiencies' that have had a detrimental impact on New Zealanders' health outcomes. For the purpose of this report, we have focused on deficiencies related to the **structure of the system** and **funding arrangements** within the system. Figure 48 below shows themes from the *New Zealand Health and Disability System Review*[8] relevant to diabetes and related to structure.

*Figure 48: Themes of the New Zealand health system – through a diabetes lens*[8]



Overall, the current system structure and funding arrangements do not appear to enable effective use of resources; coherent decision-making; or equitable high-quality diabetes health care that meets the needs of local populations and communities.

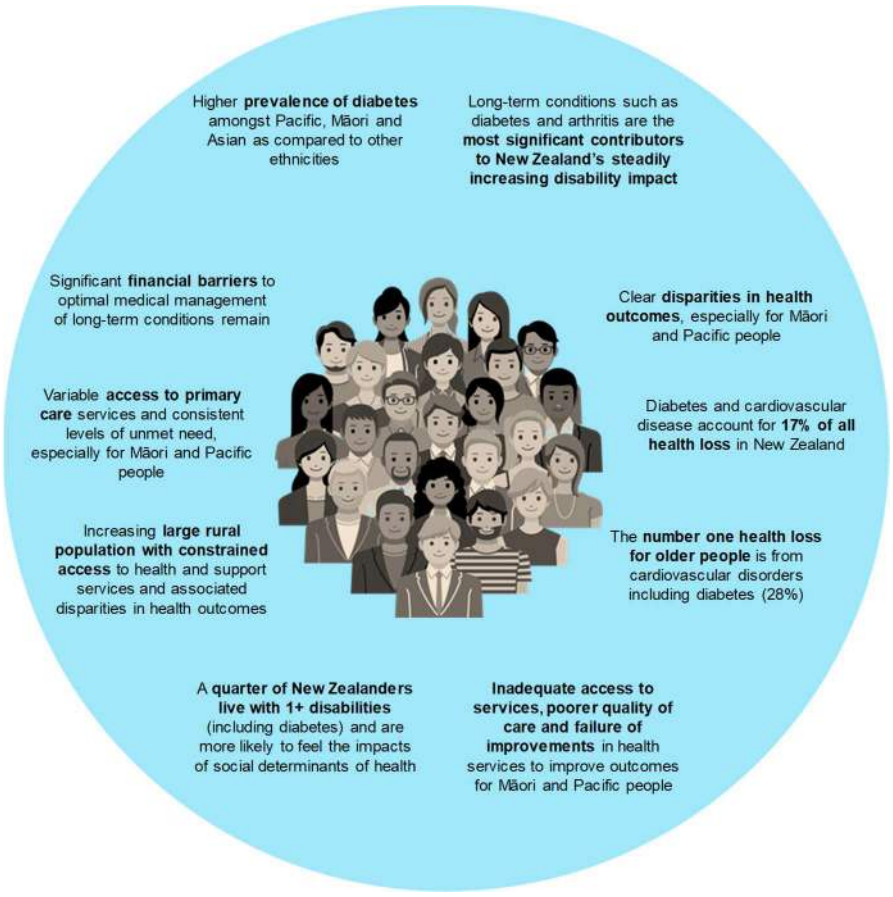
With respect to **structure**, the system is complex and fragmented. This is particularly problematic for people with type 2 diabetes who can have comorbidities and complications that necessitate them to be actively involved in treatment and to interact with multiple parts of the system (i.e. both primary and secondary). The complexity and fragmentation of the system means **people don't always access the services they need** and don't always receive high quality care, which results in a **high proportion of unmet need and sub-optimal health outcomes**. This is especially the case for Pacific and Māori people who have greater levels of unmet need and experience higher rates of diabetes and disparate health outcomes than other ethnicities.

With respect to funding arrangements, **funding has not kept pace with increasing costs** and the DHBs are financially unsustainable. Further, as funding for diabetes prevention, treatment and care is distributed to the DHBs as part of an annual population-based allocation or as part of a long-term conditions package, it can be **diluted resulting in a lack of specific investment in diabetes**. Finally, the complexity and lack of understanding as to the DHB funding model has raised concern that funds are **not being spent equitably**.

## *5.2.2 Health outcomes and equity*

Through section 3, we have already shown that Pacific, Asian and Māori people are disproportionately represented in the type 2 diabetes population. The discussion below provides a brief overview of health outcome and equity trends present in New Zealand' the health and disability system. Figure 49 below shows themes from the *New Zealand Health and Disability System Review*[8] relevant to diabetes and related to health outcomes.

*Figure 49: Current experiences and health outcomes for New Zealanders – through a diabetes lens*[8]




A recent review by University of Auckland experts in *The Lancet* presented similar themes to those shownin Figure 49, where the sysem was described as being *"a complex, fragmented health system [which] is compounding inequalities in New Zealanders' access to care and health outcomes"*[51]. Of particular note is the

inequality and inequity experienced by Māori and Pacific people – where the 2019 *Hauora: Report on Stage One of the Health Services and Outcomes Kaupapa Inquiry* finds that as a population group, Māori have on average the poorest health status of any ethnic group in New Zealand. And despite reform and readjustments, Māori health inequities have persisted[52].

The *Health and Disability System Review – Interim Report*[8], highlights that Māori continue to experience significant inequities in health outcomes. With specific reference to diabetes, Māori develop diabetes up to 10 years younger and progress earlier to more serious disease; yet are less likely to receive appropriate HbA1C monitoring and appropriate diabetes-related renal-screening tests than non-Māori. In addition, the rate of admission to hospital with diabetic ketoacidosis[xxxiii] is higher for Māori, and, while relatively rare, the rate of lower limb amputation linked to severe diabetes-related complications is a third higher for Māori than for non-Māori[8].

Pacific people face similar health inequities in New Zealand. Despite high rates of enrolment in PHOs and high GP utilisation rates, there is a high proportion of unmet need amongst Pacific people when compared to the total New Zealand population i.e. the *NZ Health Survey* shows that due to financial limitations, 1 in 3 Pacific people reported not seeing their GP when needed.[53]

*"Māori experience disparities in outcomes compared to the rest of the population across nearly all areas of health due to inequity in determinants of health, including access to quality health care services. For example, among those with diabetes, Māori are 5.5 times more likely to develop renal failure than non-Māori[8]".*

Table 14 below provides a snapshot of relevant life expectancy/mortality, hospitalisation and risk factors for different ethnicities. There is a clear trend for lower life expectancy, great mortality, greater hospitalisation and presentation of risk factors for Māori and Pacific people.

*Table 14: Comparison of life expectancy, mortality and risk factors by ethnicity*

| Category | *Date* | Māori | Pacific | Non-Māori / Non-Pacific | New Zealand |
|---|---|---|---|---|---|
| ***Life expectancy and mortality*** | | | | | |
| Life expectancy | *2015-2017* | 75.6 | 76.5 | 82.8 | **81.7** |
| Mortality rate per 100,000 population | *2017* | 631.3 | 619.5 | 339.3 | **378.6** |
| ***Hospitalisation*** | | | | | |
| Ambulatory sensitive hospitalisation (0-4 years) per 100,000 population | *2018* | 8,503 | 12,658 | 5,519 | **6,948** |
| Ambulatory sensitive hospitalisation (45-64 years) per 100,000 population | *2018* | 7,794 | 8,966 | 3,101 | **3,916** |
| Acute hospital bed days per 1,000 population | *2018* | 574.1 | 700.5 | 341.8 | **395** |
| ***Risk factors*** | | | | | |
| % adults obese | *2017/18* | 47.5% | 65.0% | 30.7% | **32.2%** |
| % children obese | *2017/18* | 16.9% | 30.0% | 9.8% | **12.4%** |

*Source: New Zealand Mortality Collection; M Walsh and Grey, C. 2019. The contribution of avoidable mortality to the life expectancy gap in Māori and Pacific populations in New Zealand: A decomposition analysis. New Zealand Medical Journal 132(1,492): 46–60; Statistics NZ (Infoshare); Ministry of Health (National Minimum Dataset and New Zealand Health Survey).*

[xxxiii] *A serious complication of diabetes that occurs when the body produces high levels of acids called ketones in the blood. This occurs when the body lacks the required insulin levels to burn sugar for energy and instead starts burning fat for energy. This reaction releases ketones which build up and can be fatal.*

## 5.2.3 Response to identified system deficiencies

The *New Zealand Health and Disability System Review* presents a comprehensive range of change recommendations. A summary of these recommendations is presented in Figure 50 below.

*Figure 50: Summary of relevant recommendations from the New Zealand Health and Disability System Review*

| | |
|---|---|
| **1 – Create clear leadership for the system** | • Establish new institutional leadership across the sector, with functions split between three organisations:<br>✓ Ministry of Health (policy, strategy and stewardship)<br>✓ Māori Health Authority (Māori health policy and strategy and monitoring performance of the system in achieving equity and health outcomes for Māori)<br>✓ NZ Health (operations of the system and service delivery). |
| **2 – Commitment to Hauora Māori** | In addition to the establishment of the Māori Health Authority, the Review recommends:<br>• Te Tiriti partnership is reflected in the governance of Health NZ with Board membership comprised of 50:50 Crown- Māori representation.<br>• Legislation be updated with te Tiriti principles.<br>• Greater investment in kaupapa Māori services.<br>• Actions to address institutional racism, cultural safety, and workforce diversity. |
| **3 – Strong focus on operations, planning and performance** | The new Crown Entity, Health NZ, would be charged with:<br>• Operational policy and service delivery, including new commissioning frameworks for services.<br>• Balancing financial performance of the system.<br>• Developing and overseeing a new planning framework for the system, including a 20- year NZ Health Plan to provide long-term direction and specific plans for workforce, data and digital, and asset management.<br>• A new strategic employment relationship function.<br>• Streamlining planning and prioritisation of the pipeline of health infrastructure projects and investment.<br>• Driving continuous improvement, reducing variation in performance, and facilitating and encouraging regional collaboration across DHBs. |
| **4 – DHB refresh** | The Review recommends a suite of changes to modernise, and strengthen accountability and performance of DHBs, including:<br>• Reducing the number of Boards from 20 to between 8-12 within five years.<br>• Replacing the current Board elections with an appointment process.<br>• Greater accountability for Tier 1 services, including commissioning powers for services currently contracted at a national level such as Well Child, maternity and general practice services, transitioning away from national contracts and the PHO<br>• Services Agreement.<br>• Enabling financial sustainability by legislating funding arrangements (guaranteed yearly increases based on demographics, cost of services and changes to wages). |
| **5 – Create a new model of community and primary health care (Tier 1) services, based on needs of local populations** | • Planning and delivery of primary and community services would be led by DHBs and organised by locality – geographically defined areas of up to 100,000 people.<br>• The requirement or expectation for general practice to be contracted via PHOs would be removed.<br>• DHBs would be required to guarantee availability of a defined group of services in each locality, and have the flexibility to commission services not routinely publicly funded, such as physiotherapy or adult dental services.<br>• Services would be required to be connected as a network, with shared accountability to DHB.<br>• A locality plan would guide locations, hours and access to services.<br>• Disability commissioning would ultimately be devolved to DHBs, and service design to be informed by the Enabling Good Lives principles.<br>• Funding for Tier 1 services to be ringfenced, and a new funding formula developed to adjust for communities with higher health needs. |
| **6 – A strategic approach to health workforce planning and employment relations** | • Use of commissioning and contracting policies to encourage more secure employment, particularly for home-based care and outreach service workforces.<br>• Streamline education requirements to be aligned to international standards and simplify the regulatory environment.<br>• Improve equity by encouraging the development of Māori and Pacific workforce, and improving cultural competency of the wider workforce, including leadership.<br>• Engage and work with the tertiary education ecosystem to support the development of the future workforce pipeline, including considerations of better support for on- the- job training. |

With specific reference to diabetes, the *New Zealand Health and Disability System Review* ('the Review) acknowledges that **chronic long-term conditions such as diabetes are the major cause of death, illness and disability in New Zealand and** that much of this health loss and health inequity is related to specific health behaviours and health care factors, such as tobacco use, unhealthy diet, physical inactivity, obesity and harmful use of alcohol (as shown in Figure 10).

In response, the **Review calls for urgent action to address these health behaviour and health care factors, and to promote interventions that prevent and control** them. It highlights a need for comprehensive and sustained action across multiple levels and sectors; use of relevant policy and regulatory levers; and engagement and empowerment local communities to support and promote change. The Review highlights that to achieve such change, the system would need to take a leadership role which spans from setting national policy and strategy through to supporting local community action. This would require population health approaches to be embedded at every level of the system, both inside the system and working in partnership with those outside of it. This approach would have an explicit focus on addressing the determinants of health – creating more supportive physical and social environments that promote health and wellbeing and make the healthy choice the easy choice.

## 5.2.4 'Real life' impacts of the health and disability system

To better understand how the shortcomings of the system impacts people in 'real life', we have created a series of illustrative 'personas' and 'system journeys' in Figure 52, Figure 53, Figure 54 and Figure 55 below. These are intended to show a range of 'real life' examples where people with diabetes experience difficulty accessing or interacting with the health and disability systems.

It is the intention that the New Zealand health and disability system meets the needs of all those who interact with it. However, this is often not the case. With a specific focus on type 2 diabetes, Figure 51 below illustrates how the system would function in an optimal scenario.

*Figure 51: How the health and disability system would operate in an optimal scenario - through a diabetes lens*


However, people do not always experience the system as detailed above. In practice, people have variable experiences and interactions with the system – some real-life scenarios are detailed below.

*Figure 52: Real-life journeys through the health and disability system - Michelle*

## Michelle

Michelle is an 80-year-old woman who lives alone in rural New Zealand. Her only daughter lives in Oamaru nearly half an hour away. She comes and helps Michelle as much as she can.

How the system would function in an optimal scenario:

- GP appointments are long enough to enable sufficient discussion and consultation.
- There is strong communication and information sharing (patient records) between primary and secondary care service providers– so patients are not required to repeat their history each time they see someone new.

**Stage 1: Initial interaction with the system and primary care services**

"Hi I'm Michelle. I live in the country and there isn't a doctor in my area. The nearest doctor is far away and I can't drive because of my age and eyesight. There's no public transport out here, so if I want to go to the doctor my daughter would have to come and take me into town, which is a hassle for her. I get by on my pension, but it's tight, so I can really only afford the 15-minute free appointments on offer."

Result: Michelle asked her daughter to take her to an initial doctors appointment. But she felt guilty for putting her daughter out and didn't attend her follow-up appointments. Michelle notices that her eyesight is blurry sometimes.

**Stage 2: Ongoing interaction with primary health services**


"My eyesight has been deteriorating for a while now and it makes it hard to fill out those new forms I need for my pension and something the council sent me. When I go to the doctor for my free appointment I get her help to fill them in. The pamphlets I was given on diabetes are confusing, so if we have time I ask my doctor to explain those to me as well. I've noticed my eyesight changing and getting worse but I often don't have time to discuss these with my doctor within the 15 minute appointment. If I don't fill out the forms with my doctor they said I could lose one of my payments and I can't afford that. The doctor said something about an optometrist appointment but I can't read the tiny writing on those letters everyone sends me and there are so many letters these days. Yesterday someone rang and told me I have missed it."

Result: Michelle's doctor arranged a retinal screen appointment but Michelle missed the appointment because she can't read her mail. Michelle's eyesight keeps getting worse.

**Stage 3: Interaction with secondary health services**

"My eyesight keeps getting worse and I thought it was just an age thing. This year the nurse from my doctors office rang to tell me when my retinal screening was and to make sure that I went. My daughter came and took me into town for it, now it turns out my eyesight problems are diabetes related after all. They have referred me for laser treatment at the hospital. The hospital didn't have all of my records from the doctors and now they are sending me for blood tests that I think I might have already had. I don't understand why all my care providers don't have the same information?"

Result: Michelle now has severe retinopathy and is likely to lose her sight in both eyes. Early diagnosis and appropriate medication could have prevented this outcome.

*Figure 53: Real-life journeys through the health and disability system - Ramesh*

## Ramesh

Ramesh and his wife moved to Hamilton from India and ran their own restaurant for over 30 years. He has recently retired and his son and daughter in law took over the restaurant. Ramesh and his wife love spending time with their two grandchildren who they look after while the restaurant is open.

How the system would function in an optimal scenario:

- People are not afraid of seeing their GP early on as they have learnt that going to the GP earlier will mean less better outcomes.
- A full range of medication for type 2 diabetes are subsidised and available for prescription.
- Clinicians are made aware of new medications as they become available

**Stage 1: Initial interaction with the system and primary care services**

"Hi I'm Ramesh. I don't want to go to the doctor because I feel worried that they'll give me bad news that will affect my day-to-day life. I also don't want my family to be worried about me if the doctor says my condition is serious. I don't feel too bad currently so I'll just wait until I feel worse and then reassess."

Result: Ramesh waited until he could no longer hide his symptoms from his family before going to his GP.

**Stage 2: Ongoing interaction with primary health services**

"My doctor prescribed me two different medications for my diabetes. He did mention another pill but the government doesn't pay for it. I'm sure they would be really effective but I already have to pay prescription fees at the pharmacy for the other two. I'm retired now so it's hard for me to pay for non-subsidised tablets. My family are already worried about me enough, I can't ask them to pay for the medication, it is so expensive and they have their own worries. Out of the other two medications, I try to buy them both but sometimes I have extra bills at home so I can only afford to get one of them.

Result: Ramesh didn't take all the medication he was prescribed by his GP. His family eventually managed to convince him to go back to his GP because they are worried about him skipping his pills.

**Stage 3: Interaction with secondary health services**

"My diabetes has been getting worse and I'm now taking medications for diabetes and cardiovascular problems. I still can't afford the non-subsidised medication, but I try to take the other ones. I have so many tablets to take that it's easy to get confused about what to take and when. I often miss doses or take the wrong medication. I asked my pharmacy to put my tablets into daily blisters to make things easier, however they said they don't provide this service because it's takes them too long to do."

Result: Ramesh didn't take his medication as prescribed. His diabetes and heart condition continued to worsen. His overall wellbeing and quality of life deteriorated significantly. Subsidised medication and better support to use it could have prevented this outcome.

*Figure 54: Real-life journeys through the health and disability system - Sililo*

## Sililo

Sililo is 50 and lives in Auckland with his wife, three children and first grandchild.
He has been working in a distribution centre now for 15 years and they are hiring new truck drivers which would mean higher pay and is something Sililo has always wanted to do.

How the system would function in an optimal scenario:

- The stigma around diabetes is minimised by increasing general education about the condition. People have a better understanding of the condition and the benefits of being diagnosed earlier.
- There are subsidised services available to help those who are struggling to access appropriate services in a timely manner

**Stage 1: Initial interaction with the system and primary care services**

"Hi I'm Sililo. I'm pretty sure I have type 2 diabetes from what I've read online. A lot of the stuff I found on the websites sounds similar to how I feel, especially being thirsty and always going to the bathroom. I'm a bit overweight and my mates give me a bit of a hard time about it, if the doctor confirms I have diabetes I reckon he will tell me off. I'm sitting my heavy vehicles licence next month so I can drive trucks and I read online that sometimes having diabetes can affect your employability."

Result: Sililo didn't go to the doctor because he felt embarrassed. His symptoms continued to worsen over time.

**Stage 2: Ongoing interaction with primary health services**

"Last time I went to the doctor he said the tablets are not working and my body is not producing enough of its own insulin. The doctor was worried because my feet are getting numb and wants me to go to the podiatrist but I have already taken too much time off work and they charge $210 to go. He put me on insulin to manage my blood glucose. I have to inject the insulin, which is hard to do when I am driving my truck at work and I'm worried the other drivers will think it's weird. I also hate doing the finger prick tests. The doctor said I can still drive the truck if I get sign-off from my local DHB or something, but it's hard to know who to contact and I'm not even sure where to find my local DHB. I don't feel too bad even though I don't always take my insulin."

Result: Sililo's feel ok but he doesn't realise that his blood glucose is all over the place which can be dangerous when he is driving. He keeps gets pins and needles in his feet but he doesn't think it is important.

**Stage 3: Interaction with secondary health services**


"I haven't been able to take my insulin as regularly as I should. I developed a sore on my foot a few weeks ago. When I went to the doctor he said it was an ulcer and referred me to a podiatrist at the hospital. This ulcer is getting bad, I'm really scared of needing an amputation and that would mean I can't work and look after my family. I don't know what to do!

Result: Sililo's ulcer continued to worsen. He now faces the potential of amputation and the lost ability to drive trucks. If Sililo had support to find an insulin regime that worked for him and had seen a podiatrist earlier, this complication may not have developed and this outcome could have been prevented.

*Figure 55: Real-life journeys through the health and disability system - Manaia*

## Manaia

Manaia is in her 40s and works for a big company in Auckland in the accounts team. She lives with her parents so she can help her mum who had a stroke a few years ago. Her younger brother and his girlfriend live there too with both of their kids.

How the system would function in an optimal scenario:

- There are community providers, telehealth or afterhours practices available for those who struggle to access primary care due to a multitude of reasons.
- There is strong communication and information sharing between community and clinical practitioners so that doctors are aware of culturally appropriate interventions available in the community.

**Stage 1: Initial interaction with the system and primary care services**

"Hi I'm Manaia. I love my job but I have to run the files from Australia every evening and it's hard to get an appointment with a GP that fits around my schedule. Most doctors close to home shut at 5pm and I don't finish work until way after 7pm."

Result: Manaia couldn't find a GP clinic that worked with her schedule so she didn't see her GP or access medication until her she started to feel tired often making it hard to concentrate at work.

**Stage 2: Ongoing interaction with primary health services**

Manaia: "My doctor said I need to do more exercise and improve my diet. I live with my extended whānau, and because of my shift work, don't have time to cook. I tried to explain 'healthy eating' to my whānau but they don't really want to eat the food I'm supposed to be eating. My doctor gave me some pamphlets about healthy eating but it don't really resonate with my whānau and there wasn't an option to read a te reo Māori version. Also, I don't feel confident going into a gym, I wish there were other options out there for me."

Result: Manaia struggled to change her diet because she couldn't get her whānau on board. Further, she didn't start an exercise program as she was afraid of the gym and didn't know where to find information about other physical activity groups she could join.

**Stage 3: Interaction with secondary health services**

"Manaia: "I've been going to the same clinic for a while now but I always seem to get a different doctor. It's really frustrating because I spend most of the appointment repeating the same things to a new doctor. Last year I was prescribed Metformin, but the side-effects were bad so I stopped taking it. At my last appointment a new doctor prescribed the same medication. I tried to explain about the side-effects but I feel like I'm being a pain. I'm still finding it hard to get my family to cook different food, but the doctors don't seem to understand. I've lost trust in the system because I'm not getting the help I need.

Result: Manaia started avoiding doctors all together. Her health worsened and she developed further complications. Better information sharing (across the system) and improved cultural competency could have prevented this outcome.

## 5.3 COVID-19 and diabetes

*The COVID-19 pandemic has exposed a general lack of understanding around diabetes and a lack of adequate consideration around the susceptibility of people with diabetes to the impact of viral infection.*

The COVID-19 pandemic has had a profound impact on the world. In New Zealand, the Government took prompt action to lock the nation down, which meant New Zealand suffered a moderate number of 1,674 confirmed and probable cases and 22 deaths (as at 24 August 2020)[54]. During this time, the pandemic has tested and exposed many of the existing weaknesses in the health system[55] (as described in Figure 48 and Figure 49. For example, the disconnect between the Ministry of Health and the DHBs and the lack of integration between DHBs was clearly demonstrated by the inability to coordinate equitable distribution of personal protective equipment (PPE) and flu vaccinations amongst the DHBs[9].

With direct reference to diabetes, it is known that people with diabetes are at greater risk of infection generally and it can be harder to treat a viral infection due to fluctuations in blood glucose levels and, in some cases, the presence of diabetes complications. There are two reasons for this: (1) the immune system is already compromised in people with diabetes, making it harder to fight the viral infection and (2) the virus may thrive in an environment of elevated blood glucose[56]. At present, there isn't enough data to conclude whether people with diabetes are more likely to contract COVID-19 than the general population. What is known however, is that if people with diabetes contract COVID-19, they are more at risk of severe disease and mortality[57].

The pandemic has exposed a general lack of adequate consideration around the susceptibility of people with diabetes to the impact of viral infection (of any variety). This supports the argument that diabetes does not adequately feature as a health or Government priority in New Zealand.

# 6. What are the challenges for the prevention, treatment and care of type 2 diabetes in New Zealand?

## 6.1 Our focus areas for this study

*Existing preventative lifestyle interventions are primarily short-term in nature, do not include sufficient follow-up support and are not always tailored to the individual/community. As a consequence, these interventions are not always effective and many New Zealanders with pre-diabetes do not receive support to prevent them from developing type 2 diabetes.*

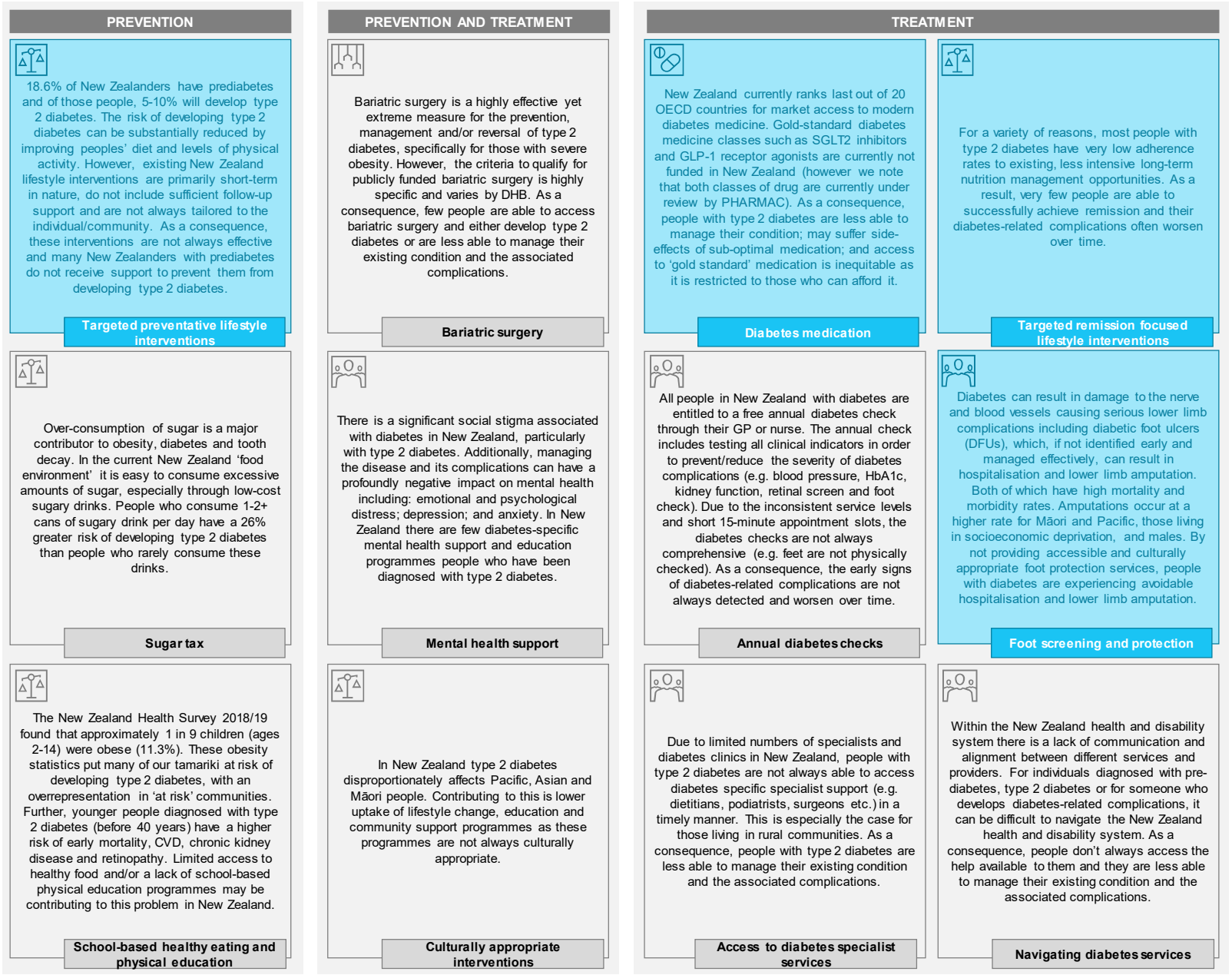
*The majority of New Zealander's with type 2 diabetes have very low adherence rates to existing, less intensive long-term nutrition management opportunities. As a result, very few people can successfully achieve remission and their diabetes-related complications often worsen over time.*

*Gold-standard diabetes medicine classes such as SGLT2 inhibitors and GLP-1 receptor agonists are currently not funded in New Zealand, however PHARMAC is in the public feedback stage of a proposal to fund these medications. Consequently, people with type 2 diabetes are less able to manage their condition and/or may suffer side-effects of sub-optimal medication until funding is approved.*

*Amputations occur at a higher rate for Māori and Pacific populations, those living in socioeconomic deprivation and males. By not providing accessible and culturally appropriate foot protection services, people with diabetes are experiencing avoidable hospitalisations and lower limb amputations.*

Figure 56 below provides a summary of the core current challenges around the prevention, treatment and care of type 2 diabetes in New Zealand (this is not intended to be an exhaustive list of all challenges). Each identified challenge is linked to a specific type of related intervention. **The challenges highlighted in blue are the challenges we have chosen to focus on as key opportunities to change type 2 diabetes prevalence, health outcomes and costs in New Zealand**. For each challenge we have designed proposed future interventions and completed cost-benefit-analysis on each. Descriptions of these interventions and investment impacts are presented in sections 7 and 8 respectively.

*Figure 56: Current challenges around the prevention, treatment and care of type 2 diabetes in New Zealand*



# 7. Are there opportunities to change diabetes prevalence, health outcomes and costs in New Zealand?

## 7.1 Opportunity to change the current diabetes model of care in New Zealand

*At a system level, there is an opportunity to change the trajectory of projected diabetes prevalence, costs and health outcomes by changing New Zealand's diabetes model of care in a way that aligns to the ambitions of the New Zealand Health and Disability System Review.*

Earlier sections of this report considered diabetes prevention and treatment in the context of the wider New Zealand health and disability system. Our analysis identified an opportunity to change the trajectory of projected diabetes prevalence, costs and health outcomes by **changing New Zealand's diabetes (and associated long-term conditions) model of care in a way that aligns to the ambitions of the *New Zealand Health and Disability System Review***[xxxiv].

Changing the diabetes model of care and driving effective implementation would require identification of diabetes[xxxv] and associated long-term conditions as a specific **Government health priority**; identification of a **national set of health and social population-based outcome targets**; and **development of a national 'diabetes and associated long-term conditions strategy' strategy** to enable achievement of those outcomes.

The strategy would need to **adopt and invest in a broad national package of interventions**. To be successful, this package of interventions would need to target both diabetes and associated long-term conditions; adopt a consumer, whānau and community-based delivery approach; incorporate Te Tiriti o Waitangi-based partnerships; address all stages of disease progression (with a strong focus on prevention); and address both health behaviours and health care factors (as per Figure 10). The Smokefree Aotearoa 2025 case study below provides a comparable example of such a package of interventions that was successfully implemented in New Zealand.

As suggested by the *New Zealand Health and Disability System Review*, this level of change will require comprehensive and sustained action across **multiple levels and sectors**; use of relevant national policy and regulatory levers; and engagement and empowerment of local communities to support and promote change. At a regional service delivery level, DHBs and providers would need to adopt a **population-focused and integrated service level alliance approach with shared governance and leadership**[xxxvi]. Finally, to ensure effective delivery of the national strategy, it will be necessary to review and refresh the Government funding approach for diabetes and associated long-term conditions[xxxvii]; introduce population-based national health target/s that incorporate both diabetes and associated long-term conditions; introduce appropriate accountability mechanisms for DHBs and providers; and update and maintain the Quality Standards for Diabetes Care.

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[xxxiv] *Per the New Zealand Nurses Organisation, a model of care broadly defines the way health services are delivered. It outlines best practice care and services for a person, population group or patient cohort as they progress through the stages of a condition, injury or event.*

[xxxv] *Due to the nature of the condition (which often involves comorbidities and complications), it is likely that in practice, a national strategy for diabetes prevention, treatment and care would need to link closely to the prevention/treatment/care strategy for other long-term conditions such as cardiovascular disease. However, as other long-term conditions are outside the scope of this report, our commentary relates to type 2 diabetes only.*

[xxxvi] *Per the Canterbury DHB and Waitematā and Auckland DHBs case studies.*

[xxxvii] *In-depth analysis of the current Government funding approach was outside the scope of this study; however, our analysis suggests that better outcomes may be achieved by allocating specific packages of funding to diabetes prevention, treatment and care (rather than being part of a larger pool of funding).*

In section 8 of this report, we present a proposed package of diabetes interventions. This package is not intended to be 'complete', rather, it is intended to provide a range of **diabetes specific interventions that aim to address health behaviours**. To achieve the kind of system-level change described above, this package of interventions would need to be combined with a set of wider 'system focused' interventions that aim to address both health behaviours and healthcare factors (such as national policy change, legislative change and creating mode supportive physical and social environments that promote health and wellbeing).

### *Case study: Smokefree Aotearoa 2025*

In 2010, the Māori Affairs Select Committee started an inquiry into the tobacco industry and the effects of tobacco use on Māori. From the Inquiry, measures were outlined to remove tobacco from the future of New Zealand in order to preserve Māori culture for younger generations. The report submitted 42 recommendations centred around achieving a smoke-free New Zealand, with focus areas including social media, smoke free environments and support services. As a result of this inquiry, the Government adopted the Smokefree Aotearoa 2025 goal.

This approach utilises a number of interconnected campaigns, centred around reducing the burden of disease and death caused by tobacco use. With the long-term goal of reducing smoking prevalence and tobacco availability to minimal levels, Smokefree 2025 will be achieved by:

- Protecting children from exposure to tobacco marketing and promotion
- Reducing the supply of, and demand for tobacco
- Providing the best possible support for quitting.

Since the establishment of the campaign, the number of New Zealanders who smoke on a daily basis has decreased from 19.2% in 2009[58] to 13.1% in 2018[59]. Key success factors contributing to this result were the development of a single national strategy and approach; a focus on prevention; and significant investment in a package of interventions aimed toward multiple parts of the 'system' (including health behaviours and social determinants of health). The package of interventions comprised the following:

- Tobacco excise tax including an annual indexation increase .
- Increased availability of Stop Smoking Services including Quitline and free Nicotine Replacement Therapy (NRT).
- Smoke-free Environments Act 1990 – a comprehensive piece of tobacco control legislation which requires smokefree indoor workplaces, limited tobacco advertising and required tobacco packs to have graphic health warnings.
- Standardised packaging for cigarettes and tobacco was introduced in March 2018.
- Social media campaigns such as the 'Smoking Not *Our* Future' campaign.

As shown above, each 'intervention' addresses a different part of the system (i.e. tax, legislation, advertising/media, individual support and medication) and targets numerous populations/cohorts. Further, the focus on prevention has been especially effective for youth, where the 2018 ASH Smoking Survey showed only 1.9% of Year 10 students smoked on a daily basis. This is the first year in which this figure has dropped below 2%, a signifcant decrease from 15.2% of students in 1998[60].

## 7.2 Opportunity to address diabetes-specific problems

### 7.2.1 Package of interventions

In direct response to the four type 2 diabetes specific problems identified in section 6.1, we have designed four proposed interventions. As highlighted in the previous section, this package of interventions is not intended to be 'complete', rather, it is intended to provide a range of **diabetes specific interventions that aim to address health behaviours**.

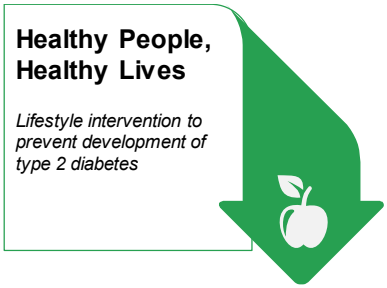
Figure 57 provides a summary of the four interventions. In the section that follows, for each intervention; we provide a description; details of the problem it aims to address; details of the associated opportunity; goals of the intervention; size and inclusion criteria; the performance measurement framework; the investment logic map (ILM); the timeline; evidence of efficacy; alternative approaches; and the counterfactual. This detailed design approach has enabled us to complete robust cost-benefit analysis for each intervention, which is presented in section 8.

*Figure 57: Package of four proposed type 2 diabetes interventions*

# 7.3 Healthy People, Healthy Lives intervention

*Through the Healthy People, Healthy Lives intervention, there is an opportunity to prevent New Zealanders from developing type 2 diabetes by providing subsidised whānau/community-centred lifestyle change programmes.*

## 7.3.1 Summary intervention description





Healthy People, Healthy Lives is a proposed New Zealand intervention, which is modelled on the Finnish Diabetes Prevention Study (FDPS)[61]. Healthy People, Healthy Lives **aims to prevent people with pre-diabetes progressing to type 2 diabetes**, where pre-diabetes can be identified in people with HBA1c between 41-49mmol/mol. By targeting people with pre-diabetes, this intervention aims to impact people at the start (group 1) of the diabetes disease progression pathway.

The intervention supports people to adopt positive long-term lifestyle changes by providing people individualised treatment plans for diet and exercise. The treatment plans have a 3-year duration. The first year is intensive as the individual follows their treatment plan; years 2-3 are less intensive and provides individuals with periodic follow-up consultations. Detail on the delivery approach of this intervention can be found in Appendix 10.2.1.

## 7.3.2 Problem that the intervention aims to address

There is a high prevalence of people with pre-diabetes in New Zealand. Where the *2008/2009 Adult Nutrition Survey* found that the prevalence of pre-diabetes was 18.6% of the population and an estimate 5-10% of people with pre-diabetes develop type 2 diabetes over three years.[6263] The two most significant lifestyle factors contributing to the development of pre-diabetes are:

- Unhealthy diet (high in sugar and saturated fats)
- Low levels of physical activity.

The risk of developing type 2 diabetes can be substantially reduced by improving these two areas of a person's lifestyle. However, existing New Zealand lifestyle intervention programmes are primarily short-term in nature, do not include sufficient follow-up support and are not always tailored to the individual/community. As a consequence, these programmes are not always effective and many New Zealanders with pre-diabetes do not receive support to prevent them from developing type 2 diabetes.

## 7.3.3 Opportunity

The FDPS has shown that a targeted, individualised and long-term lifestyle intervention can lead to long-term beneficial changes in diet and physical activity, thus reducing the risk of developing type 2 diabetes.[1] By tailoring advice to what is achievable for each person and taking into consideration factors such as income and location, participants are more likely to complete the programme and achieve long-term beneficial lifestyle changes. The results of the FDPS exceeded those gained by the study control group, who followed a similar programme to those currently offered in New Zealand. Under the FDPS, after three years 9% of the intervention group developed type 2 diabetes, compared to 22% in the control group.[61]

There is an opportunity to implement an intervention similar to the FDPS in New Zealand – Healthy People, Healthy Lives. Where this intervention would be tailored to suit the New Zealand culture/environment but

would incorporate the key features of the FDPS – being targeted, individualised and long-term (with sufficient follow-up consultation and support).

An intervention such as this will provide New Zealanders with pre-diabetes an opportunity to access the support needed to avoid developing type 2 diabetes. This would create a large public benefit by reducing the long-term public health costs of treating type 2 diabetes in the future. It will also contribute to the achievement of societal benefits, by improving the participants quality of life and ability to participate in society.

### *7.3.4 Intervention goals*

The primary goals of the intervention are:

- Preventing the progression of pre-diabetes to type 2 diabetes - measuring the decrease of people who develop type 2 diabetes from a baseline figure.
- Weight reduction ≥ 5% and maintaining the weight loss beyond the intervention.
- Moderate intensity of physical activity ≥ 30 mins/3 times a week.
- Following individualised dietary advice and goals from a dietician. Participants will maintain food and exercise diaries to compare to the dietary advice they received.
- Individualised Whānau Ora approach to enable cultural appropriateness and support programme participants to navigate other support as required.

### *7.3.5 Intervention size and inclusion criteria*

The Healthy People, Healthy Lives intervention would be available to all New Zealanders with pre-diabetes. The intervention will target those who have pre-diabetes and are at risk of developing type 2 diabetes. We have based our analysis on a target intervention size of 1,000 new participants per year. Based on the FDPS, we estimate 90% of year one participants will progress to year two, and 92% of year-two participants will progress to year three of the programme.

To be eligible to participate in the publicly funded intervention, people must have:

- BMI of >25kg/m$^2$
- HbA1c in the pre-diabetes range of 41-49mmol/mol.

Other factors such as age will not be included in the inclusion criteria, but clinicians would need to use their best judgement when deciding who to refer to the programme.

### *7.3.6 Performance measurement framework*

As this is a lifestyle intervention focused on preventing the progression of pre-diabetes to type 2 diabetes, performance measures will include both lifestyle and clinical measures. Success will be measured using the following criteria:

1. Preventing the progression of pre-diabetes to type 2 diabetes - this is the primary focus of the intervention and will be the primary factor in determining success. This goal can be measured through consistently testing participants' HbA1c levels over a 10-year period. Under this measure, the intervention will be considered successful if the percentage of participants with HbA1c levels above 50mmol/mol is lower than those with pre-diabetes who did not participate in the programme. This will be measured over a three-year period to measure the immediate impact of the intervention, and over a 10-year period to measure long-term changes.

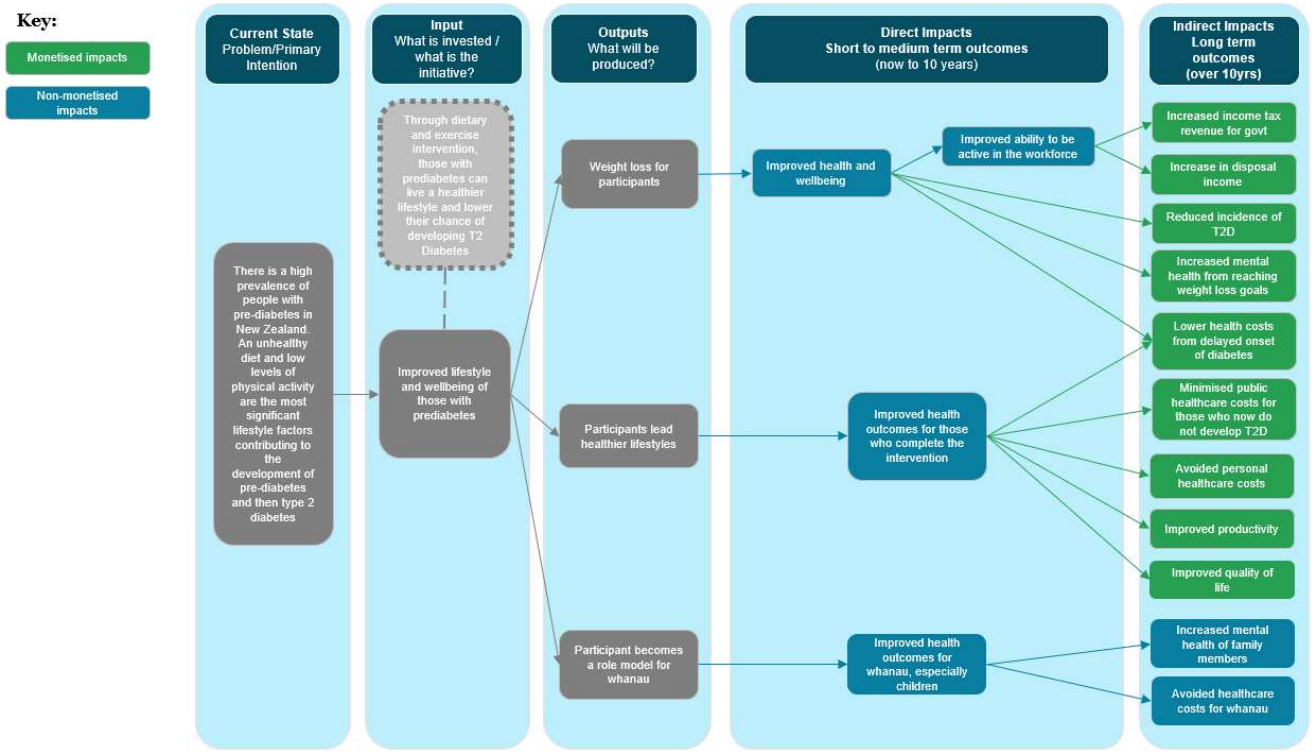
2. Weight reduction - weight reduction is a key intermediate goal of both the dietary and exercise elements of the intervention. This will be measured by weighing participants over three years. Under this measure, the intervention will be considered successful if participants lose an average of 5% of their body weight in the first year and maintain this weight over the next two years.

3. Improvement in diet - a large focus of the intervention is dietary improvement. Dietary improvement will be measured by comparing participants' food diaries to recommended advice over a three-year period. This part of the intervention will be considered a success if 70% of participants adhere to dietary advice over the three-year period. Clinicians will use best judgement when deciding if a participant has adhered or not.

## *7.3.7 Investment logic map*

The investment logic map (ILM) for Health People, Healthy Lives is shown below and replicated in large format in Figure 80. This ILM shows how investment in this intervention can create outputs and impacts that ultimately lead to beneficial long-term outcomes.

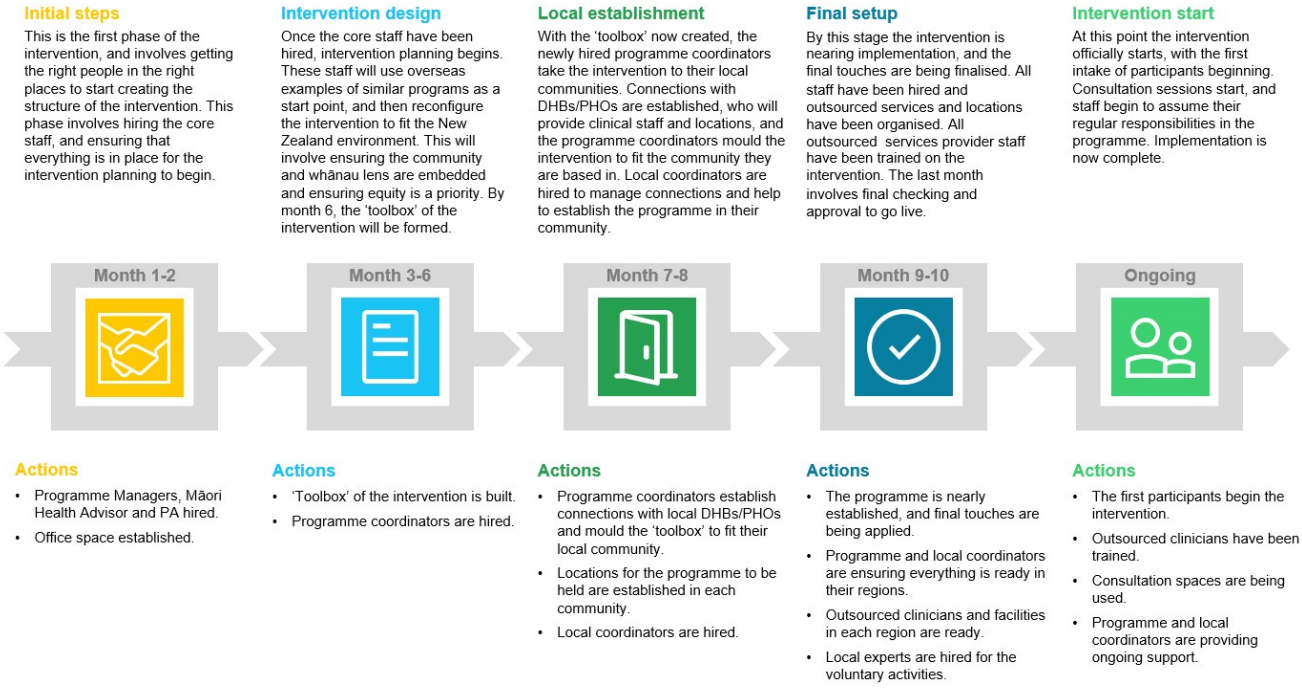
*Figure 58: Investment logic map for Healthy People, Healthy Lives*




## *7.3.8 Implementation timeline*

Figure 59 below shows the implementation timeline for Healthy People, Healthy Lives. This timeline has been developed with reference to the intervention delivery detail in Appendix 10.2.1.

*Figure 59: Implementation timeline for Healthy People, Healthy Lives*




## 7.3.9 *Evidence of efficacy*

There are numerous past studies that have evaluated the effectiveness lifestyle interventions comparable to the proposed Healthy People, Healthy Lives intervention. Results from a selection of these studies are presented below.

### 7.3.9.1 Finnish Diabetes Prevention Study

The key results from this study were[61]:

- Average weight reduction of 4.5kg after year one and 3.2kg after year three; and 46% of the intervention group lost more than 5% of their body weight
- HbA1c levels decreased on average by 0.1 after year one and 0.2 after year three
- By the end of the study 9% of the intervention group developed type 2 diabetes as compared to 22% of the control group
- The cumulative incidence of diabetes was 11% (95% CI 6–15) in the intervention group and 23% (95%CI 17–29) in the control group after four years; thus, reducing the risk of developing type 2 diabetes by 58%
- The relative risk reduction of the cumulative incidence of type 2 diabetes during the total follow-up of seven years was 43%, indicating a long-lived change in lifestyle
- Three years after the intervention concluded, there were 31 new cases of type 2 diabetes from an intervention group of 221 as compared to 38 new cases from the control group of 185 people. This calculates to incidences rates of 4.6 and 7.2 per 100 person-years respectively (log-rank test, P = 0.0401) (i.e. 36% relative risk reduction)
- None of the high-risk individuals with impaired glucose tolerance (IGT) developed type 2 diabetes during the initial trial period if they reached four or five out of five predefined lifestyle targets

- The 10-year follow-up results of the FDPS showed that total mortality was 2.2 vs. 3.8 per 1,000 person-years for the intervention and control groups respectively.

### 7.3.9.2 Diabetes Prevention Meta-analysis

The Diabetes Prevention Meta-analysis, which evaluated a range of type 2 diabetes lifestyle interventions such as the FDPS, concluded that prevention of progression to diabetes is achieved for 1 in 6.4 patients when the duration of intervention ranges from 1.8 to 4.6 years[64].

### 7.3.9.3 Malmo Feasibility Study

By the end of the 5-year study period of the Malmo Type 2 Diabetes Prevention study, 11% of the intervention group and 29% of the reference group had developed type 2 diabetes. The 12-year follow-up results revealed that all-cause mortality[xxxviii] among men in the intervention group was lower than that among the men in the control group (6.5 vs. 14.0 per 1,000 person-years)[64].

### 7.3.9.4 Da Qing Study

The Da Qing study observed a 17% reduction in cardiovascular disease death between the intervention group and the control group[64].

### 7.3.9.5 Diabetes Prevention Program (DPP)

An intensive lifestyle intervention was administered to 1,079 patients in America. After a mean follow-up time of 2.8 years, the intervention reduced type 2 diabetes risk by 58% when compared to the placebo control group. The lifestyle intervention delivered superior results to metformin treatment, which resulted in a 31% reduction in type 2 diabetes risk when compared to the placebo control group. After a follow-up period of 10 years, the intervention group showed a 34% reduction in the incidence of type 2 diabetes as compared with the control group. Finally, the intervention group gained an average of 0.57 QALYs[xxxix] per person over a lifetime as compared to the control group[64].

## *7.3.10 Alternative approaches*

We have considered a range of potential alternatives to help slow or halt the progression of pre-diabetes to type 2 diabetes:

### 7.3.10.1 Metformin medication

Biguanides (Metformin) is the 'front-line' drug for people with type 2 diabetes. It is particularly effective in people who are overweight, as it works by increasing body sensitivity to insulin action[65]. As such, Metformin is more commonly used to treat people with diabetes rather than those at risk of developing diabetes. This medication has been proven to work more effectively when combined with a healthier lifestyle, so could supplement the Healthy People, Healthy lives intervention, especially for participants with HbA1c levels nearing 50mmol/mol. However, as pre-diabetes covers a wide range of HbA1c levels, individuals in the lower range of the pre-diabetes HbA1c range may be overmedicated if this was given to all participants.

### 7.3.10.2 Food related policy and legislative change

By altering New Zealand's food environment through policy and legislative change, there is an increased likelihood that individual's diets may improve, thus lowering their risk of developing type 2 diabetes. This could be achieved by:

- Introducing a sugar tax (likely targeted at sugary drinks initially)
- Removing goods and services tax (GST) from fruit and vegetables

[xxxviii] *All-cause mortality is defined as the death rate from all causes of death for a population.*
[xxxix] *The quality-adjusted life-year is used to measure the burden of disease on the quality and quantity of life lived for an individual. One QALY equates to a year in perfect health.*

- Introducing restrictive policies around fast foods, such as higher tax rates and location restrictions.

Altering the food environment requires a national long-term approach, which does not necessarily guarantee people will adopt healthier dietary options. It is also less targeted toward the type 2 diabetes population as it is not specific to diabetes. Finally, there is likely to be resistance both by the public and businesses involved in the production of sugary drinks and fast food. As a consequence, such policy changes are likely to take a significant amount of time to be passed into legislation (if at all).

#### 7.3.10.3 Urban development

Urban development can be used to encourage and better enable people to be more physically active. Examples of how this might be achieved include:

- Designing urban environments to make walking between locations more achievable and enjoyable e.g. building pathways and sidewalks

- Installing free-to-use exercise equipment into public spaces.

This approach is geographically limited, thus making it less able to reach New Zealand's whole pre-diabetes population. It is also less likely that significant urban development would occur in areas of high deprivation, meaning this intervention would not reach those people who need it most. Finally, the expense and time required to implement this type of intervention at a national level would be significant. Even if urban development is successfully delivered, this intervention requires people with pre-diabetes or type 2 diabetes to be self-directed with no help or support, so there no guarantee that it will encourage people with pre-diabetes or type 2 diabetes to be more physically active.

### *7.3.11 Counterfactual*

Failure to fund a targeted intervention focused on preventing people from developing type 2 diabetes would result in the continuation of the status quo (i.e. increasing prevalence of type 2 diabetes, especially for Māori, Pacific and Asian people). The Government does not currently fund any nationally available lifestyle intervention programmes for New Zealand's pre-diabetes population. As such, we assume that any existing lifestyle interventions are comparable to the FDPS control group, whose health-related outcomes were considerably less successful when compared to the intervention group.

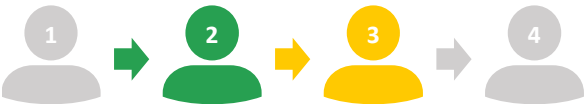
## *7.4 Owning our Futures intervention*

*Through the Owning our Futures intervention, there is an opportunity to enable New Zealanders to reverse their type 2 diabetes by providing subsidised intensive whānau/community-centred lifestyle change programmes.*

### *7.4.1 Summary intervention description*

**Owning our Futures**

*Lifestyle intervention to achieve remission from type 2 diabetes*




Owning our Futures is a proposed New Zealand intervention, which is modelled on the Diabetes Remission Clinical Trial (DiRECT)[66], led by Mike Lean in the United Kingdom. This intervention **targets people within the first six years of their type 2 diabetes diagnosis and aims to achieve sustained remission through weight loss.** By targeting people within their first six years of diagnosis, this intervention aims to impact people in the middle stages ('diabetes groups' 2 and 3) of the diabetes disease progression pathway.

The intervention has a 30+ month duration would consist of an intensive 12-week formula diet followed by food reintroduction and weight loss management phases to

help participants develop sustainable long-term healthy lifestyle changes. Detail on the delivery approach of this intervention can be found in Appendix 10.2.2.

## 7.4.2 Problem that the intervention aims to address

For a variety of reasons, importantly including a low awareness of the seriousness of type 2 diabetes among the public and healthcare workers, most people with type 2 diabetes have very low adherence rates to existing, less intensive long-term nutrition management opportunities, which have commonly targeted only 5% weight loss. This is insufficient to reverse type2 diabetes. As a result, very few people are able to successfully achieve remission of their type 2 diabetes and go on to experience diabetes-related complications that worsen overtime.

## 7.4.3 Opportunity

There is now evidence from the DiRECT study that adherence to a dietitian-supported nutritional intervention aimed at more substantial weight loss can result in remission of type 2 diabetes. The DiRECT study has also shown that with over 10kg weight loss, over 70% of participants have been able remain in remission for two to three years (and the researchers are continuing to monitor more long-term results)[66]. Remission of type 2 diabetes, at least for a period, allows patients to stop taking medication for diabetes management and can prevent or delay complications from diabetes developing.

The weight loss intervention also brings improvement in blood pressure, substantially reducing the need for antihypertensive medications. Within the context of UK National Health Services, implementing the DiRECT intervention in routine practice has been shown to be highly cost-effective as savings accrue from fewer drug prescriptions and medical complications. Over a patient-lifetime horizon, a DiRECT style intervention can extend life expectancy and reduce total healthcare costs.

There is an opportunity to implement an intervention similar to the DiRECT study in New Zealand – Owning Our Futures. This intervention would be tailored to suit the New Zealand culture/environment but would incorporate the key features of the DiRECT study – being focused on remission, targeted, individualised, long-term (with sufficient follow-up consultation and support).

An intervention such as this will provide New Zealanders with type 2 diabetes an opportunity to access the support needed to achieve remission via weight loss. This would create a large public benefit by reducing the long-term public health costs of treating type 2 diabetes in the future. It will also contribute to the achievement of societal benefits, by improving the participants quality of life and ability to participate in the workforce and society.

## 7.4.4 Intervention goals

The goal of this intervention is to support participants to achieve remission of type 2 diabetes through an intensive total diet replacement plan, which will result in significant in weight loss.

## 7.4.5 Intervention size and inclusion criteria

The Owning our Futures intervention would be available to all New Zealanders who have been diagnosed with type 2 diabetes within the last six years. We have based our analysis on a target intervention size of 1,000 new participants per year.

To be eligible to participate in the publicly funded intervention, people must have:

- HbA1c less than 6.5%, or less than 6% if on blood glucose lowering medication
- Diagnosis of type 2 diabetes within 6 years
- Age 20-65

- BMI: 27+ (25+ for people of Asian origin).

## 7.4.6 Performance measurement framework

The goal of this intervention is diabetes remission which is measured by HbA1c. Measurements would be collected by the provider on day one of the programme and every 12 months under the current clinical guidelines. This annual HbA1c test is essential, but quarterly tests are encouraged because this is a changing treatment for participants.

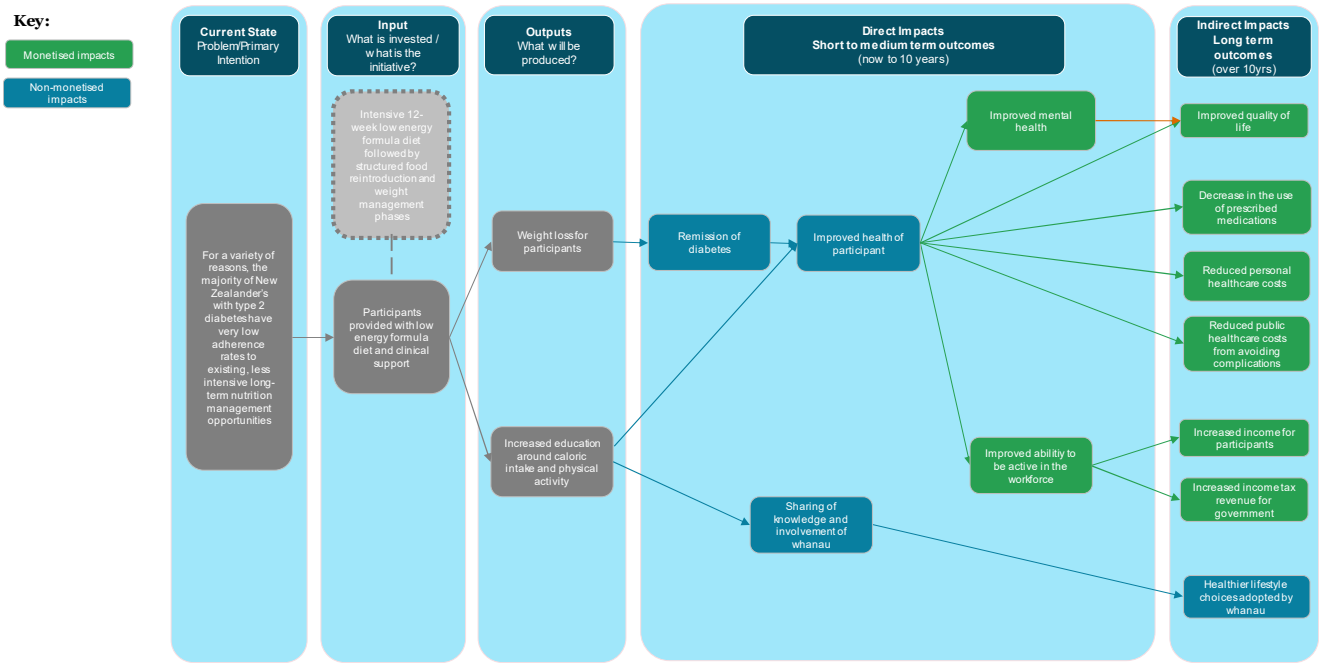
Other useful measurements include weight loss and the discontinuation or reduction in the use of many medications prescribed for people who are overweight/obese and have type 2 diabetes, including drugs for diabetes, blood pressure, lipids, and depression. These measurements will be taken where possible but are not the primary performance measures for the success of this intervention. Other valuable but non-essential health measures include blood lipids and waist circumference.

Programme coordinators will collate and report these results. The longer-term results are more important than the short-term results, as it is apparent that success in the weight management phase is more difficult than the adherence to the 12-week formula diet.

## 7.4.7 Investment logic map

The ILM for Owning our Futures is shown below and replicated in large format in Figure 81. This ILM shows how investment in this intervention can create outputs and impacts that ultimately lead to beneficial long-term outcomes.

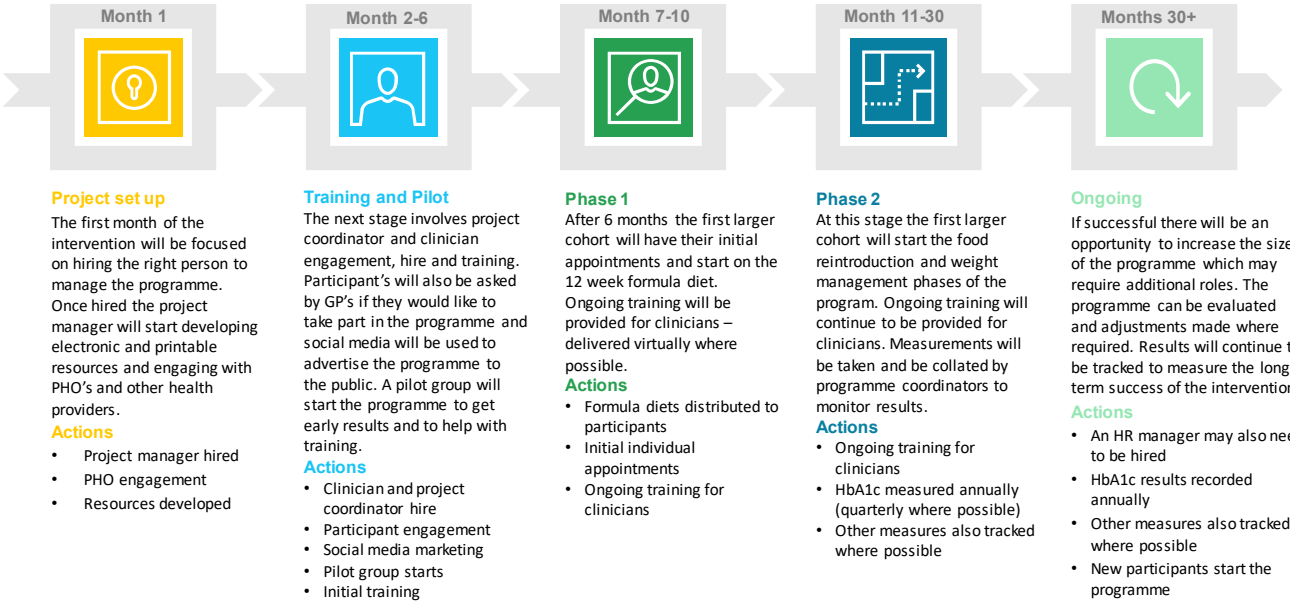
*Figure 60: Investment logic map for Owning our Futures*



## 7.4.8 Implementation timeline

Figure 61 below shows the implementation timeline for Owning our Futures. This timeline has been developed with reference to the intervention delivery detail in Appendix 10.2.2.

*Figure 61: Implementation timeline for Owning our Futures*




## 7.4.9 Evidence of efficacy

The DiRECT study lead by Mike Lean in the United Kingdom provides the strongest evidence on the effectiveness of a comparable programme to Owning our Futures. No previous trial has assessed sustained type 2 diabetes remission as a primary outcome.

The key results from this study included[66]:

- Diabetes remission was achieved in 46% of participants in the intervention group
- Remission was achieved in 7% of participants who maintained a 0-5kg weight loss, 34% of participants with 5-10kg weight loss, 57% of participants with 10-15kg weight loss and 86% of participants who lost 15kg or more
- Participants in the intervention group who engaged in the total diet replacement phase showed their weight decreased sharply by an average of 14.5kg, followed by small increases during the food reintroduction and weight loss management phases
- At 12 months, 74% of participants in the intervention group were taking no antidiabetic medications compared with 18% of participants in the control group
- Overall, 21% of participants withdrew from the programme. For participants who commenced treatment, the main reason for withdrawal was a social reason
- At 24 months, diabetes was in remission for 36% of participants in the intervention group
- Over the 24 months from baseline, those who maintained in remission lost an average of 10.4kg bodyweight

- Type 2 diabetes was reversible to a non-diabetic state over 24 months. Notably, 70% of participants who maintained a weight loss of more than 15kg remained in remission at 24-months
- Participants who reverted to type 2 diabetes between 12 and 24 months regained more weight than those who remained in remission
- The two-year results confirm that sustained remission of type 2 diabetes is linked to sustained weight loss and is achievable for more than a third of people with type 2 diabetes diagnosis within six years.

## *7.4.10 Alternative approaches*

We have considered a range of potential alternatives to enable remission of type 2 diabetes:

### 7.4.10.1 Bariatric surgery

Substantial weight loss is the only proven and effective way to achieve remission of type 2 diabetes. Moderate weight loss from small improvements in lifestyle are simply insufficient to achieve remission.

Bariatric surgery is a proven approach to achieve substantial weight loss as it alters/removes part of a person's digestive system to restrict the amount food they can eat or absorb. To date, bariatric surgery is the most successful treatment for extreme obesity. it is effective immediately and has been shown to achieve remission in about 75% of people with type 2 diabetes[67]. While bariatric surgery is effective, like any surgery it is also expensive and the criteria to qualify for publicly funded bariatric surgery is highly specific and varies by DHB. Consequently, few people can access bariatric surgery. Further, as a bariatric surgery is highly invasive, this option can be too high risk for many people with type 2 diabetes (especially those with severe complications).

In comparison to bariatric surgery, intensive lifestyle/nutrition interventions such as the DiRECT study are able to achieve comparable weight loss results but are non-invasive, lower risk, adaptable and scalable.

### 7.4.10.2 Less intensive nutrition and lifestyle interventions

Less intensive nutrition and lifestyle interventions such as green prescriptions and healthy eating education programmes can reduce or stop the requirement for medication and/or improve diabetes management, but do not generally result in weight loss sufficient enough to enable complete remission. Further, the target group for this intervention are also likely to have tried these options in the past without long-term success.

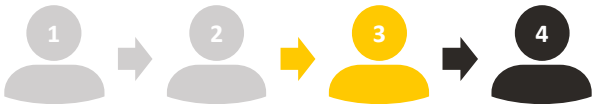
## *7.4.11 Counterfactual*

Failure to fund a targeted intervention focused on supporting people with type 2 diabetes to achieve sustained remission would result in the continuation of the status quo (i.e. people with type 2 diabetes will not be able to achieve sustained remission – this is especially the case for Māori, Pacific and Asian people). The Government does not currently fund any nationally available lifestyle intervention programmes for New Zealand's type 2 diabetes population. As such, we assume that if this intervention is not implemented, people with type 2 diabetes will likely move along the disease progression pathway. This will mean a greater likelihood of developing diabetes-related complications and the need for more intensive (and expensive) treatment in the future.

# 7.5 Better Diabetes Medication intervention

*Through the Better Diabetes Medications intervention, there is an opportunity to enable people to better manage their type 2 diabetes by providing access to 'gold standard' subsidised medication (SGLT2 inhibitors and GLP-1 receptor agonists).*

## 7.5.1 Summary intervention description


At the time of publication **PHARMAC have a live proposal to fund empagliflozin, a SGLT2 inhibitor and Dulaglutide, a GLP-1 receptor agonist**. This proposal is currently in the public feedback stage and funding is scheduled to commence from 1 December 2020. The Better Diabetes Medication intervention describes the impact of these important change to better understand the likely outcomes and enable comparison with different intervention types.

Better Diabetes Medication is a proposed New Zealand wide intervention. This intervention **aims to provide people with type 2 diabetes easy access to subsidised 'gold standard' SGLT2 inhibitor and GLP-1 receptor agonist medication**.

This type of medication will enable people with type 2 diabetes to better manage their condition; avoid or reduce the impact of diabetes-related complications; and avoid negative side-effects associated with other drugs. By targeting people with type 2 diabetes, this intervention primarily aims to impact people at the later stages ('diabetes groups' 3 and 4) of the type 2 diabetes disease progression pathway (i.e. with emerging or existing diabetes-related complications).

The intervention requires ongoing drug funding from PHARMAC and investment in a 12-month intensive awareness creation campaign targeted toward both clinicians and people with type 2 diabetes. Detail on the delivery approach of this intervention can be found in Appendix 10.2.3.

## 7.5.2 Problem that the intervention aims to address

Key problems associated with existing diabetes medication in New Zealand are:

1. New Zealand currently ranks last out of 20 OECD countries for market access to diabetes modern medicine[68]. 'Gold-standard' type 2 diabetes medicine classes such as SGLT2 inhibitors and GLP-1 receptor agonists have historically not been funded. As a consequence, people with type 2 diabetes are less able to manage their condition; may suffer side-effects of sub-optimal medication; and access to 'gold standard' medication is inequitable as it is restricted to those who can afford it.

2. While a range of subsidised type 2 diabetes medications have been available in New Zealand, many of those who need medication do not receive it in accordance with best practice. This is often due to barriers inherent to the structure/design of the current health and disability system and the nature of interactions between the system and patient (being time limited, numerous, inconsistent, disconnected etc).

While both identified problems are important, the Better Diabetes Medication intervention will focus largely on the first, as the second describes challenges that are systemic and broader than type 2 diabetes.

### 7.5.2.1 Opportunity

There is an opportunity to benefit those with type 2 diabetes with the approval of funding for SGLT2 inhibitors and GLP-1 receptor agonists drugs. These drugs have proven advantages as compared to those funded prior to December 2020 in New Zealand. SGLT2 inhibitors are a class of medication that prevent the reabsorption of glucose that has been filtered through the kidneys. They are frequently used as a second line drug if Metformin and lifestyle interventions cannot adequately control blood glucose. GLP-1 agonists are an incretin[xl] mimetic, which help to maintain blood glucose levels by stimulating the release of insulin from the pancreas and decreasing glucagon[xli] release. It is often prescribed in conjunction with Metformin and may be prescribed with SGLT2 inhibitors.

International guidelines including the soon to be released new NZ guidelines describe that for people with both type 2 diabetes and either cardiovascular or renal disease, the use of SGLT2 inhibitors or GLP1 receptor agonists is considered best practice.

Benefits of SGLT2 inhibitors and/or GLP-1 receptor agonists[69]:

- Reduces the chances of serious complications such as kidney and heart disease, renal failure, heart failure, heart attacks, gout and death.
- Keeps glucose levels more constant than many existing medications in New Zealand.
- Often leads to weight loss (predominantly GLP-1 receptor agonists).
- Reduces the chances of progressing to dialysis (by helping to avoid renal failure).
- Patients taking these medications may reduce or cease insulin injections.

To realise the full societal benefit of these medications, they must be easily accessible. GPs, nurse practitioners and nurse prescribers should have the ability to prescribe them to patients. PHARMAC must work with the health sector upon the medications' release to increase awareness, and ensure all clinicians are aware of the drugs and their relative advantages so they are able to identify those patients who would benefit most. Clear guidance should be developed to identify and focus on where and when medication should optimally be used. Ensuring equitable access to this medication is critical especially for Māori, Pacific and Asian people as these communities are most impacted by type 2 diabetes and its complications.

### 7.5.2.2 Intervention goals

The primary goals of the intervention are:

- Reducing the risk and progression of comorbidities such as cardiovascular and renal disease for individuals with type 2 diabetes.
- Providing New Zealanders with a better range of medication options.
- Improving access to 'gold standard' type 2 diabetes medications for all New Zealanders who need it, thus making diabetes treatment more equitable.
- Increasing life expectancy for those taking the medication.

[xl] *Incretins are a type of protein hormone. Their functions include modulating glucose metabolism by stimulating the release of insulin by beta cells, while simultaneously inhibiting the release of glucagon by pancreatic alpha cells*[xl].
[xli] *A hormone that is produced by pancreatic alpha cells. It is released in response to low blood glucose levels and signals the liver to release glucose into the blood*[xli].

### 7.5.2.3 Intervention size and inclusion criteria

The Better Diabetes Medication intervention will be available to and target all New Zealanders with type 2 diabetes. We have based our analysis on a target intervention size of 40,000 individuals.

As this is a New Zealand wide intervention, the only exclusion criteria will be the severity of an individual's type 2 diabetes. This intervention is targeted at people in 'diabetes groups' 3 and 4 of the disease progression pathway (as described in Figure 11). These are individuals with stable/controlled or unstable/severe clinical complications.

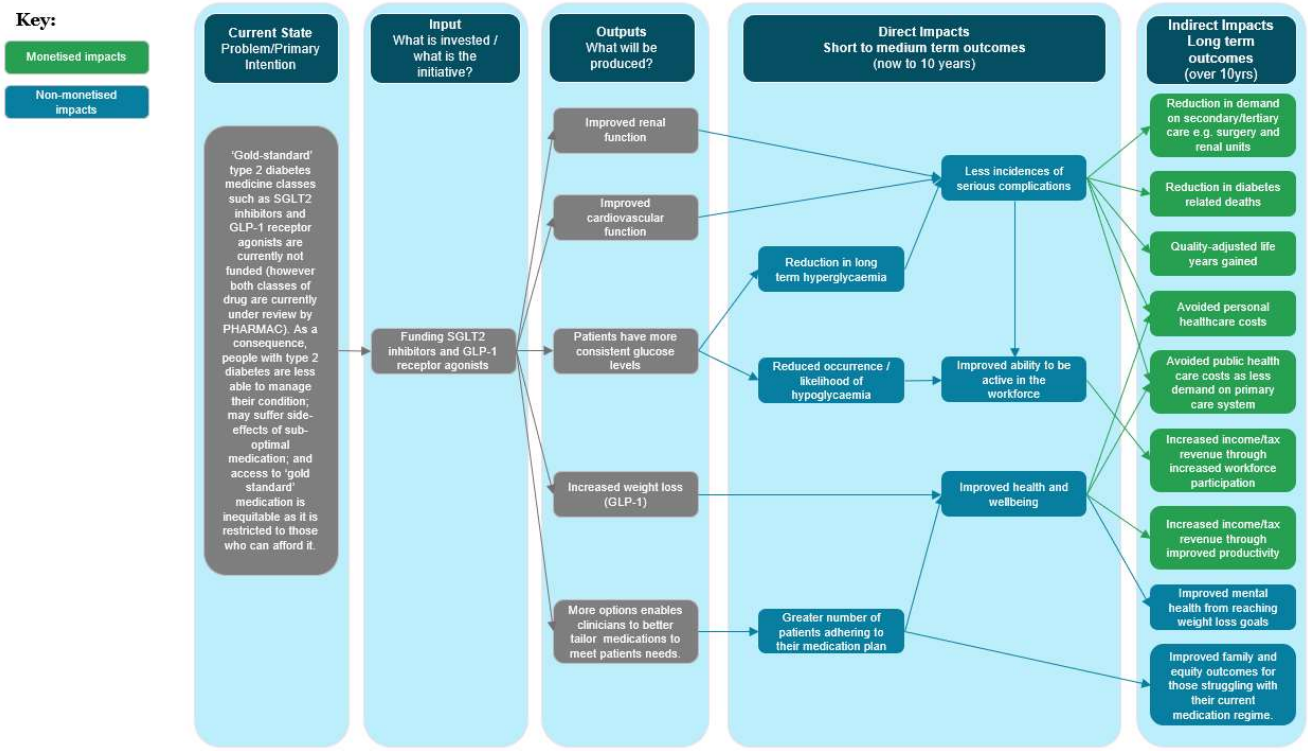
## *7.5.3 Performance measurement framework*

As Diabetes New Zealand's role in this intervention focuses on raising awareness and distributing information on the proposed medications, a successful intervention would be indicated by widespread prescription and use of the medication, specifically for those classified as priority needs such Māori, Pacific and Asian communities and those in deprivation deciles 9 and 10.

## *7.5.4 Investment logic map*

The ILM for Better Diabetes Medication is shown below and replicated in large format in Figure 82. This ILM shows how investment in this intervention can create outputs and impacts that ultimately lead to beneficial long-term outcomes.

*Figure 62: Investment logic map for Better Diabetes Medication*

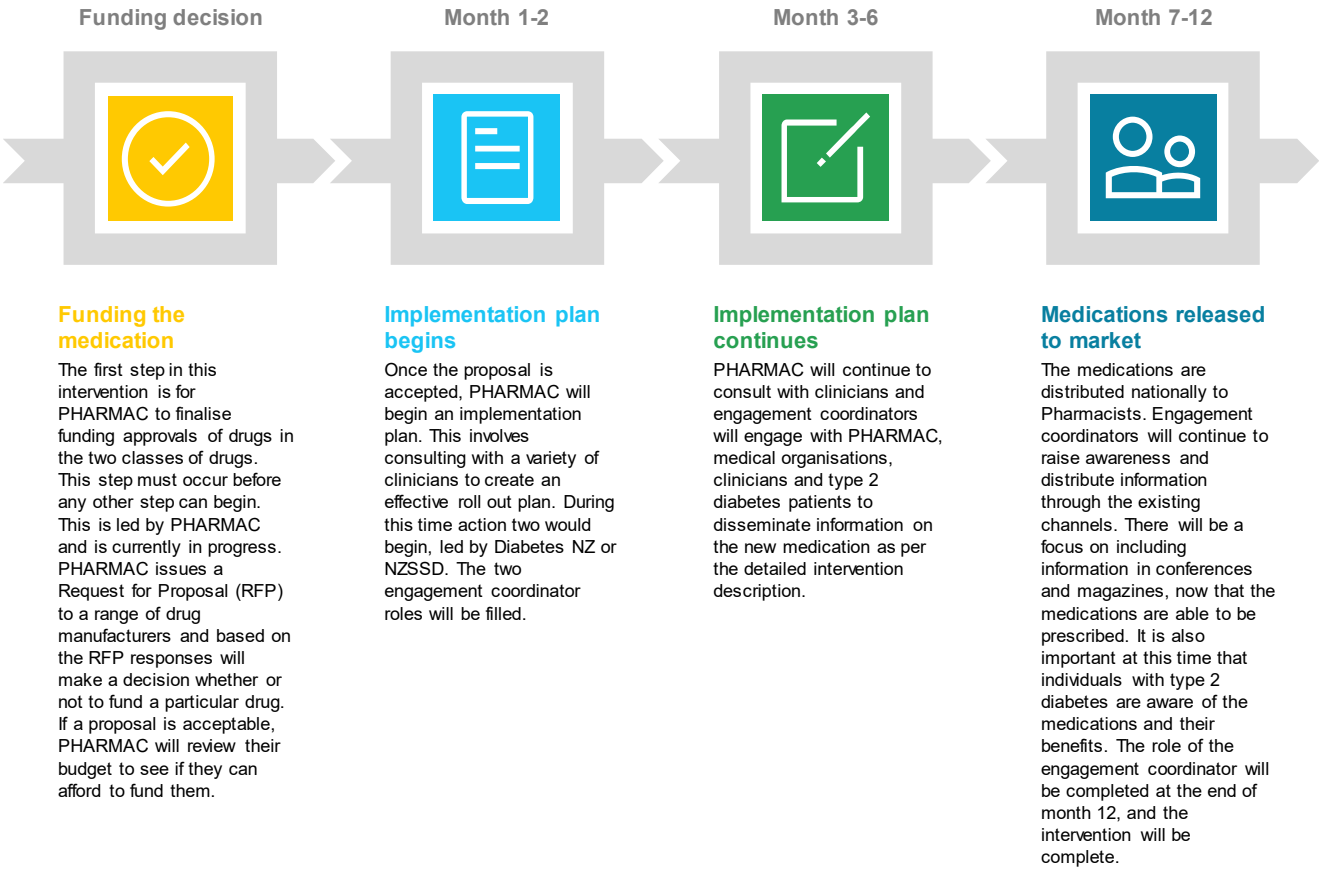


## 7.5.5 Implementation timeline

Figure 63 below shows the implementation timeline for Better Diabetes Medication. This timeline has been developed with reference to the intervention delivery detail in Appendix 10.2.3.

PHARMAC are currently seeking feedback on their funding proposal and are therefore part way through the implementation process outlined.

*Figure 63: Implementation timeline for Better Diabetes Medication*




## 7.5.6 Evidence of efficacy

Both SGLT2 inhibitors and GLP-1 receptor agonists have been proven to reduce major adverse cardiovascular events, hospitalisation for heart failure, cardiovascular death or chronic kidney disease[69]. Findings from Nagahisa and Saisho's 2019 research on multiple drug trials[70] are as follows:

### 7.5.6.1 SGLT2 inhibitors

The EMPA-REG OUTCOME trial enrolled 7,020 participants with type 2 diabetes who were randomly assigned empagliflozin (a type of SGLT2 inhibitor) or a placebo. This study found that empagliflozin demonstrated significant risk reduction in 3-point MACE[xlii] (cardiovascular death, nonfatal myocardial infarction and nonfatal stroke) of 14% over a 3.1-year period. This was largely driven by a 38% reduction in cardiovascular death, and a marked reduction in the incidence of hospitalisation for heart failure. It also found that empagliflozin reduced the risk for the composite renal end point by 39%[70].

[xlii] *MACE stands for major adverse cardiovascular events. The 3 components of 3-point MACE are nonfatal stroke, nonfatal myocardial infarction and cardiovascular death.*

The CANVAS programme was a separate SGLT2 inhibitor trial studying the effects of canagliflozin. During the study, a 33% reduction in the secondary endpoint of hospitalisation for heart failure was observed over a 2.4-year period. Canagliflozin also produced a 40% reduction in the risk of the prespecified composite renal outcome. Canagliflozin significantly reduced the relative risk of the primary composite outcome comprising end-stage renal disease, doubling of serum creatinine, or death from renal or CVD by 30%[70].

The "Management of Hyperglycaemia in Type 2 Diabetes, 2018" consensus report found that there is likely cardiovascular benefit, with the evidence of benefit stronger for empagliflozin than canagliflozin, for patients with established CVD. A meta-analysis studied in this report found that SGLT2 inhibitor–insulin combination was associated with a greater reduction in HbA1c, an advantage in terms of body weight THAN A DPP-4-insulin combination[71].

#### 7.5.6.2 GLP-1 receptor agonists

The LEADER trial, which tested the drug liraglutide and consisted of 9,340 participants, demonstrated a 13% reduction in the 3-point MACE composite over a median 3.8-year follow up period. Patients showed a relative risk reduction of 15% in all-cause mortality, largely driven by a reduction in cardiovascular death. This study proved safety, but absolute risk reduction alone is insufficient to justify specific treatments for cardiovascular risk reduction.

This trial also showed a 22% relative risk reduction in nephropathy (kidney disease caused by diabetes). This reduced the need for continuous renal replacement therapy, or death from renal disease by the same amount[66].

The SUSTAIN-6 trial, which tested the drug Semaglutide and consisted of 3,297 participants, showed a significant 26% relative risk reduction in 3-point MACE. It also showed a 39% relative risk reduction in both nonfatal strokes and the risk of new or worsening nephropathy[70].

The REWIND trail, which researched the effects of the GLP-1 receptor agonist Dulaglutide found that the MACE outcome occurred in 2.7 per 100 patient-years with an HR of 0.88 (95% CI 0.79, 0.99) in favour of dulaglutide. It also suggests that to reduce risk of MACE, GLP-1 receptor agonists can also be considered in patients with type 2 diabetes without established CVD with indicators of high risk[72].

The "Management of Hyperglycaemia in Type 2 Diabetes, 2018" consensus report suggests that the effect of Semaglutide taken once weekly has the greatest effect, followed by Dulaglutide and liraglutide[73].

#### 7.5.6.3 Life expectancy

Harvard Medical School professor Brian Claggett's analysis of data from the EMPA-REG SGLT2 inhibitors trial showed a 12-15% increase in life expectancy from the drugs. This equates to up to four additional years of life for younger patients[73].

#### 7.5.6.4 Improvements in quality of life

During a study on the cost effectiveness of SGLT2 inhibitors, quality-adjusted life-years (QALY) was found to increase by 0.24[74].

A further study in the Netherlands on the effectiveness of GLP-1 receptor agonists suggested that Semaglutide was associated with improved quality-adjusted life expectancy by 0.19 QALYs as compared to insulin[75].

### *7.5.7 Alternative approaches*

Alternatives to these classes of medications include:

#### 7.5.7.1 Alternative types of insulin

Insulin itself is a relatively inexpensive option for treatment however, individuals may need substantial professional support when this option is used increasing overall costs. It typically requires multiple injections of varying doses daily, making adherence difficult (unless using an insulin pump, which is a technology currently

only funded for people with type 1 diabetes). Further, insulin has a greater chance of inducing negative side-effects such as weight-gain or hypoglycaemia[xliii] as compared to SGLT2 inhibitors and GLP-1 receptor agonists.

#### 7.5.7.2 Bariatric surgery

Bariatric surgery is a highly effective yet extreme measure for the prevention, management and/or reversal of type 2 diabetes, specifically for those with severe obesity. The objective of the surgery is to enable significant weight loss by altering/removing part of a person's digestive system to restricting the amount food they can eat or absorb. This kind of surgery, like most surgeries has a substantial cost, the criteria to qualify for publicly funded bariatric surgery is highly specific and varies by DHB. Consequently, few people can access bariatric surgery. Further, as bariatric surgery requires an anaesthetic', this option can be too high risk for many people with type 2 diabetes (especially those with severe complications).

#### 7.5.7.3 Lifestyle intervention

Lifestyle interventions are an effective, low cost and non-invasive approach to achieve better management of type 2 diabetes and should always be promoted to patients. However, as lifestyle intervention require intensive, continual and active participation by the patient, not all patients achieve the same level of sustained success. As such, lifestyle interventions are almost always used in conjunction with medication.

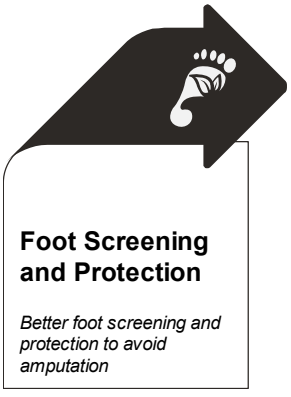
### *7.5.8 Counterfactual*

As of 9 September 2021, PHARMAC are in the process of seeking public feedback on a proposal to fund a drug in both classes of medications specified in the Better Diabetes Medications intervention. Assuming the PHARMAC proposal progresses as planned, this will mean funded medication is made available to the target population from 1 December 2020.

## *7.6 Foot Screening and Protection intervention*

*Through the Foot Screening and Protection intervention, there is an opportunity to prevent people with diabetes from developing serious foot related complications that may result in amputation, by providing people access to optimal foot care services.*

### *7.6.1 Summary intervention description*





The Foot Screening and Protection intervention delivers optimal foot care to all New Zealanders with diabetes, prioritising those with at higher risk of developing diabetic foot ulcers (DFUs) and related complications. Optimal foot care includes foot screening, specialist podiatry services, multidisciplinary foot-care teams, provision of therapeutic footwear and orthotics and medical/surgical treatment. The aims of this intervention are to successfully reach those who are at highest risk of DFUs and other complications and to decrease the number of lower limb amputations performed. To reach high risk populations, Foot Screening and Protection services must be delivered in a culturally appropriate manner.

This intervention differs to the other three interventions presented in the report – rather than designing a new bespoke intervention to address a gap or deficiency, this intervention aims to support DHBs to deliver optimal foot care at the 'best practice' levels, where 'best practice' is described Appendix 10.2.4.

[xliii] *Hypoglycaemia or low blood sugar is defined as blood glucose levels below 70mg/dL[xliii].*

## *7.6.2 Problem that the intervention aims to address*

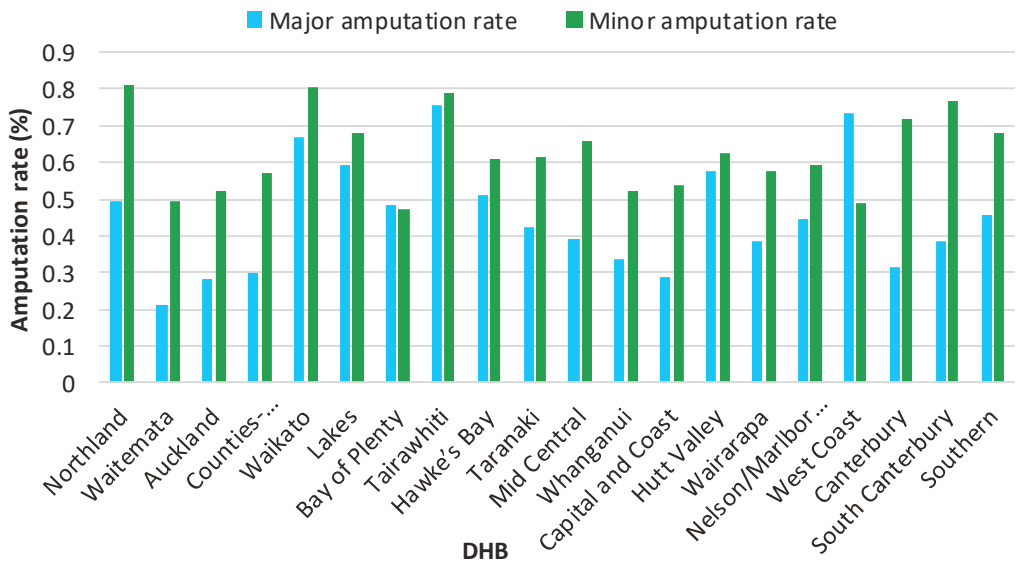
Diabetes can result in damage to the nerve and blood vessels causing serious lower limb complications including diabetic foot ulcers (DFUs), which, if **not identified early and managed effectively, can result in hospitalisation and lower limb amputation**. Both DFUs and lower limb amputations have high mortality and morbidity rates. Amputations occur at a higher rate for Māori and Pacific, those living in socioeconomic deprivation, and males. By not providing accessible and culturally appropriate foot protection services, people with diabetes are experiencing avoidable hospitalisation and lower limb amputation.

It is estimated that the foot risk level stratification for the New Zealand diabetes population is as follows[xliv]:

- Low risk: 67%
- Moderate risk: 19%
- High risk: 13%[xlv]
- Active risk: 1%

Figure 64 shows major and minor amputation rates, by DHB, amongst New Zealand's diabetes population (for 2011-2014). The figure shows that amputation rates vary between 0.21% to 0.75% for major amputations and 0.47% to 0.81% for minor amputations[76].

*Figure 64: Major and minor amputation rates by DHB (2011-2014)[76]*




[xliv] *Where risk categories are defined by the referral pathway for diabetes foot screening and assessment shown in Appendix 10.2.4.1.*

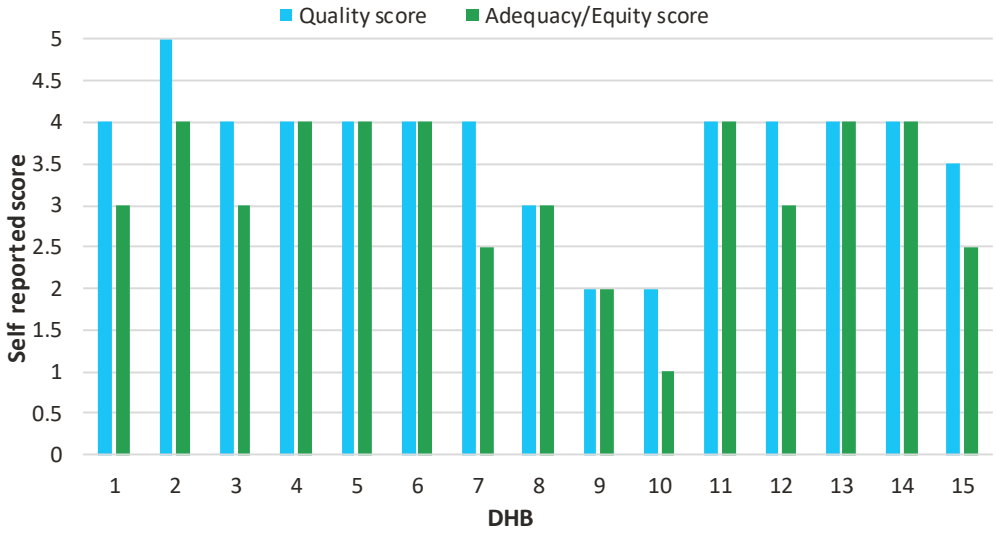
[xlv] *We note that the New Zealand high risk rates may be higher than international rates because Māori ethnicity is included as a risk factor for the high-risk classification.*

## 7.6.3 Opportunity

Figure 65 shows the anonymised results of DHB self-assessment on the quality and adequacy/equity of their existing podiatry services against the LWWD Plan priorities (see Figure 45) and the Quality Standards for Diabetes Care (discussed in 4.1.3 and detailed in Appendix 10.1). Self-assessment using this system specifies a score of 0 to indicate 'poor/non-existent' and 5 for 'excellent/best practice'. These assessment results highlight the variation in service quality and equity across New Zealand – where equity is consistently rated below service quality. Responses were recorded from 15 DHBs while results from 5 DHB's were unavailable (DHBs scores have been anonymised).

In light of these results, there is an opportunity to improve equity of access and to reduce the number of lower limb amputations by providing optimal footcare to all New Zealanders with diabetes who are at risk of developing DFUs and related complications. Where optimal foot care includes foot screening, specialist podiatry services, multidisciplinary care teams, provision of therapeutic footwear and orthotics, medical/surgical treatment and delivery of services in a culturally congruent manner. This may result in improved physical and mental health for individuals, increased life expectancy, improved quality of life and an improved ability to participate productively in the workforce and society.

*Figure 65: Anonymised self-reported score by DHB - on foot care/service quality and equity*




## 7.6.4 Intervention goals

The aims of this intervention are to successfully reach those who are at highest risk of DFUs and other complications and to decrease the number of diabetes-related lower limb amputations performed.

## 7.6.5 Intervention size and inclusion criteria

Foot Screening and Protection should be provided (by all DHBs) to all New Zealanders with diabetes who are at higher risk of developing DFUs and related complications. The inclusion criteria for this intervention is informed by the referral pathway for diabetes foot screening and assessment found in Appendix 10.2.4 – where this pathway is used to identify and prioritise people according to their level of risk.

## 7.6.6 Performance measurement framework

The effectiveness of this intervention can be evaluated by measuring the following:

- Decreased number of unplanned diabetes-related foot hospitalisations (day and events)

- Decreased number of diabetes related lower limb amputations (major and minor)
- Increased number of ulcer free days – for people both with and without previous ulcers
- Increased self-rated improvement in quality of life
- Increased frequency of foot screening
- Increased uptake of services for Māori and Pacific populations.

With the delivery of the optimal Foot Screening and Protection intervention, we would expect to see a decrease in the number of amputations and the frequency/duration of hospital stays caused by DFUs/complications. We acknowledge that even the best service would not eliminate all diabetes-related amputations, as this can be a necessary and life-saving procedure. However, the goal is to prevent all avoidable diabetes-related amputations and hospitalisation.

The following additional performance measurements would be beneficial but currently reporting standards differ widely meaning it would be difficult to measure accurately:

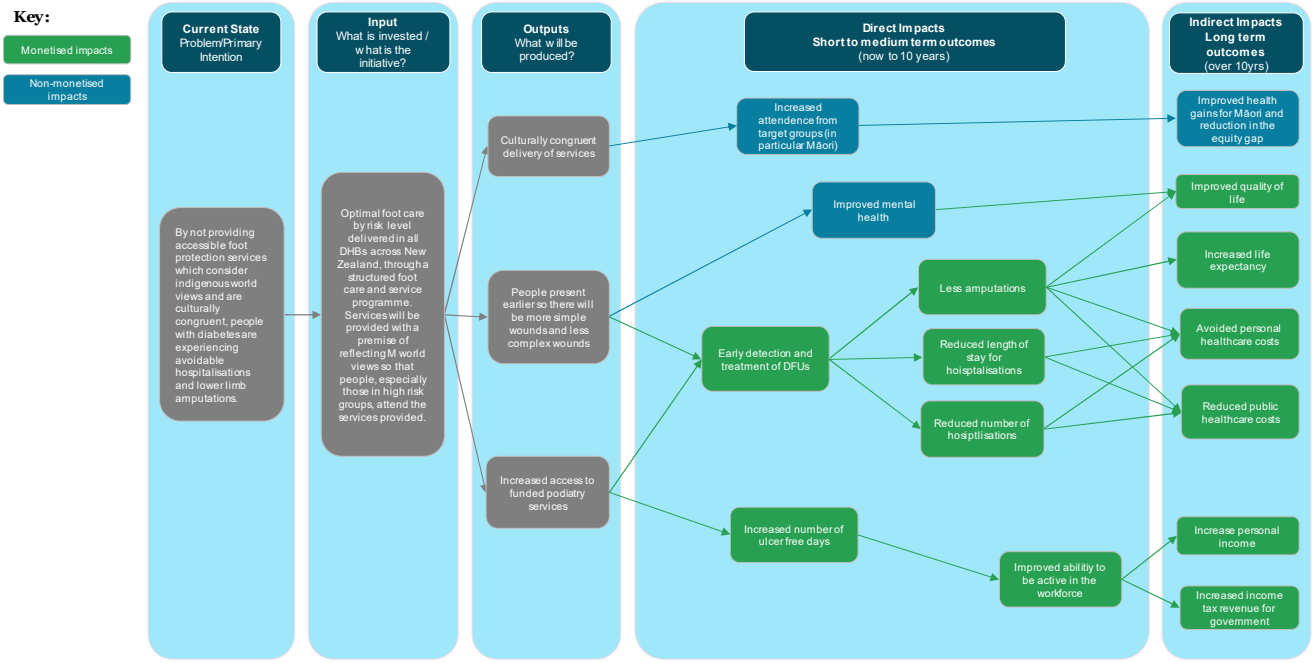
- The number of people referred to the appropriate level of service according to the foot risk
- The number of people in each risk level category and movement between risk levels over time.

Improved and standardised data collection in conjunction with supportive IT systems and a national diabetes register could improve data collection, collation and reporting.

## *7.6.7 Investment logic map*

The investment logic map (ILM) for Foot Screening and Protection is shown below and replicated in large format in Figure 83. This ILM shows how investment in this intervention can create outputs and impacts that ultimately lead to beneficial long-term outcomes.

*Figure 66: Investment logic map for Foot Screening and Protection*



## 7.6.8 Implementation timeline

*Figure 67: Implementation timeline for Foot Screening and Protection*

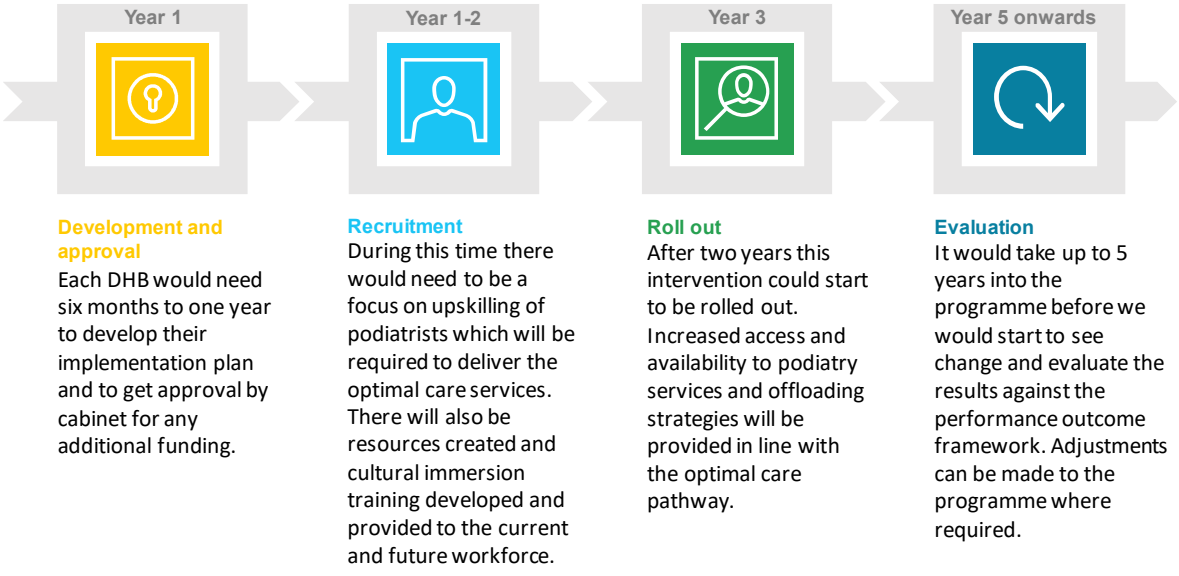



Figure 67 below shows the implementation timeline for Foot Screening and Protection. This timeline has been developed with reference to the intervention delivery detail in Appendix 10.2.4.

*Figure 67: Implementation timeline for Foot Screening and Protection*

Year 1
Year 1-2
Year 3
Year 5 onwards
Development and approval
Each DHB would need six months to one year to develop their implementation plan and to get approval by cabinet for any additional funding.
Recruitment
During this time there would need to be a focus on upskilling of podiatrists which will be required to deliver the optimal care services. There will also be resources created and cultural immersion training developed and provided to the current and future workforce.
Roll out
After two years this intervention could start to be rolled out. Increased access and availability to podiatry services and offloading strategies will be provided in line with the optimal care pathway.
Evaluation
It would take up to 5 years into the programme before we would start to see change and evaluate the results against the performance outcome framework. Adjustments can be made to the programme where required.

## 7.6.9 Evidence of efficacy

At the time of publication, the reported amputation rates for Waitematā DHB's Foot Screening and Protection services appeared to be closely aligned to the optimal Foot Screening and Protection described in Appendix 10.2.4. The efficacy of the services is evidenced by having the lowest major amputation rate (at 0.21%), and close to the lowest minor amputation rate (at 0.50%) when compared to all other DHBs in New Zealand. These can be compared to the average major amputation rate of 0.46% and average minor amputation rate of 0.63%

across all the DHBs. Other factors such as the population demographic in this area may also be an influencing factor. It is however noted that Waitematā DHB still has some performance deficiencies around universal diabetic foot screening, timely referrals for active foot ulceration and the provision of orthotics and therapeutic footwear. The provision of orthotics and therapeutic footwear is constrained by the level of funding provided and is insufficient to meet population requirements.

Further evidence of efficacy can be seen in Australia, where over the last decade, Queensland and Western Australia have reported a ~40% decrease in hospitalisation rates associated with diabetes foot care/treatment and a 30-72% decrease in diabetes-related amputations. These reductions occurred following the implementation of coordinated clinical improvement programs, which incentivised evidence-based treatment in primary, secondary and tertiary care and introduced monitoring of clinical process indicators and outcomes[77].

### *7.6.10 Alternative approaches*

An alternative to the Foot Screening and Protection intervention would be to provide individual, but better quality, components of the foot care service range. Some examples are as follows:

- New technology for socks, mats and insoles with digital monitoring. This technology would use thermal measurement to detect heat and foot ulcers earlier as people with diabetes are often unable to feel foot ulcers developing.
- Provision of protective footwear, hosiery and orthotics.
- Increased availability of health navigators, psychologists and for people with diabetes-related foot complications.
- Improved access to vascular services for people with diabetes.
- Education programmes to enable people with diabetes to perform home foot checks for those people who are at low risk that would not necessarily be referred to a podiatrist. This approach encourages a level of efficacy and could also increase education for whānau, thus providing additional home support for people with diabetes.

While these interventions would provide people with diabetes greater support and may help them to avoid future lower-limb amputation/serious complications, none of them are sufficient if delivered in isolation.

### *7.6.11 Counterfactual*

The counterfactual for this intervention is the status quo, which is a static, if slightly increasing, rate of lower limb amputations in New Zealand; variable foot service/care quality; inequitable access to services; and a disproportionately large number of lower limb amputations for Māori and Pacific peoples.

## *7.7 Strategic alignment with Government priorities*

**All four interventions presented above support existing Government priorities.** By preventing the development of type 2 diabetes; supporting people with type 2 diabetes to achieve remission; slowing progression via better disease management; and preventing serious diabetes-related complications – all four interventions aim to achieve better health outcomes for New Zealanders, thus contributing to 'Priority E: Physical and Mental Wellbeing – Supporting improved health outcomes for all New Zealanders' of *Wellbeing Budget 2020: Rebuilding Together*.

Further, as this report has identified, type 2 diabetes disproportionately impacts Pacific, Asian and Māori populations. By incorporating an 'equity lens' and utilising a whānau/community centred delivery approach, all four interventions contribute to the desired outcomes of the *Māori Health Action Plan* by delivering **more equitable outcomes for Māori** across the health and disability system.

Finally, by supporting people with pre-diabetes to avoid developing type 2 diabetes and supporting people with type 2 diabetes to achieve remission – the Healthy People, Healthy Lives and Owning our Futures interventions deliver on the Ministry of Health 2019/20 commitment to **'wellbeing through prevention'**.

# 8. What is the impact of investing in diabetes-specific interventions?

In this section we present detailed cost-benefit analysis for each of the four interventions detailed in section 7. For each intervention, we present summary cost-benefit analysis results as well as detail on costs, benefits and funding/scaling. Our analysis on the Foot Screening and Protection intervention differs slightly in that we present benefits only (that rationale for this is described in section 8.5).

## *8.1.1 How to interpret the cost benefit ratios*

The **cost benefit ratios measure the projected return for each dollar invested**. A higher ratio means the investment creates more positive change per dollar invested so is generally better/preferred to a lower ratio. The Return on Investment (ROI), is essentially the positive change part of this equation which is split into two: **Government ROI (or benefits)** and **societal ROI (or benefits)**.

**Government benefits** are things such as collecting more tax and reducing public health care spending; while **societal benefits** are things such as more take-home income, increased ability to contribute in the home and community, lower out-of-pocket health care costs and improved quality of life.

### 8.1.1.1 Individualised lifestyle interventions

Healthy People, Healthy Lives and Owning our Futures both have a Government ROI of approximately 1.0, which means every dollar spent by the Government results in a dollar saved. While in isolation, this does not make a particularly compelling case for investment, the case is compelling when one considers that **most of the benefits generated by these interventions are societal benefits**, with total ROI's just under 3.0. These results are not surprising given **both interventions are designed to focus on and change the lives of individuals.** Intensive people focused programmes are typically relatively expensive; require upfront investment; and require the commitment and hard work of the individual to be successful. Viewed another way, one could argue that a Government ROI of 1.0 is cost neutral, so is simply a matter of shifting Government investment from one part of the health system to another. Rather than funding the treatment of diabetes related complications, funding could instead be used to give people the opportunity to transform their own lives and avoid diabetes-related complications (for the exact same cost to the government). This is a perfect example of moving from an **'ambulance at the bottom of the cliff to a fence at the top'.**

Our modelling for both these interventions relies heavily on the clinical results of existing comparable interventions to estimate benefits, many of which is still in progress. In these cases, available results only capture the impact of each intervention up to the date of publication, not the entire lifetime of its participants. As such, **we have only been able to model known results and have excluded 'potential' (but unproven) future benefits.** This conservative approach particularly affects the Owning our Futures intervention, which builds upon the work of the DiRECT study in the United Kingdom. In the cost-benefit analysis for this intervention, we have only modelled the benefits/impacts five years into the future (as the study has not yet published results beyond this timeframe). In reality, we expect that **many participants are likely to experience benefit from lifestyle change that extends many years beyond the timeframe that we have modelled**.

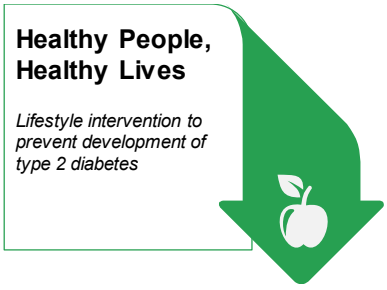
### 8.1.1.2 Treatment interventions

Foot Screening and especially Better Diabetes Medications produce opposite cost-benefit analysis results to the lifestyle interventions above as **most of the benefits are Government benefits** (particularly reduced spending on secondary care), while societal benefits make up a much smaller proportion of the total. We have taken the same approach in our cost-benefit analysis modelling in that we have also modelled the benefit/impact of the medication over the period of time however, as the effects of each drug are already known, benefits continue to accrue as long as an individual continues taking the medication. What this means is that both spending on medications and savings to other areas of health spending add up slowly over many years, unlike the lifestyle interventions discussed above. Interventions of this type, while still improve the lives of many individuals, are best characterised as **'spending a cent today to save a dollar tomorrow'**.

# 8.2 Healthy People, Healthy Lives intervention

*Investing in the Healthy People, Healthy Lives intervention will achieve a total Government benefit of $42 million and a societal benefit of $88m, which equates to a Government Return on Investment (ROI) of 0.95 and a societal ROI of 2.95.*

## 8.2.1 Cost-benefit analysis results

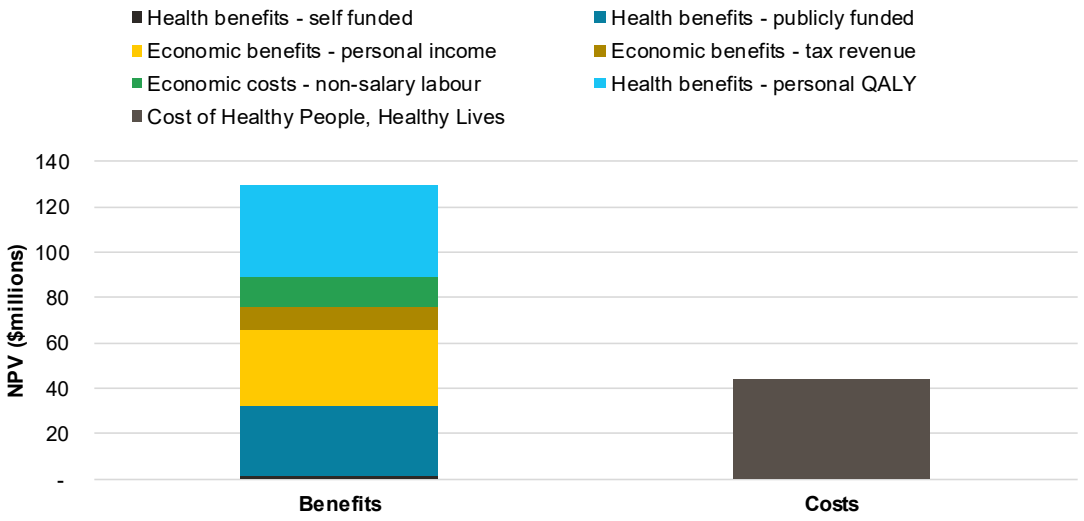



Healthy People, Healthy Lives represents an opportunity for Government to invest in supporting New Zealanders with pre-diabetes to avoid developing type 2 diabetes. Reductions in publicly funded health costs and increases in tax revenue make the investment cost neutral from a public finance perspective. However, investment in this intervention would produce substantial positive economic benefits for the individual by enabling increased productivity as well as improved quality of life.

Specifically, over a 50-year period the Healthy People, Healthy Lives intervention will achieve **total Government benefit of $42 million, and societal benefit of $88 million**. This equates to a Government Return on Investment (ROI) just below 0.95 and a societal ROI of 2.95. This indicates that for every dollar the Government spends, $0.95 of Government benefit and $2.00 of societal benefit is achieved – making a total benefit of $2.95 produced over a 50-year measurement period.

Figure 68 below shows that the Government benefit comprises health cost savings and increased tax and ACC levy revenue from more productive individuals. The societal benefit includes personal health savings, personal revenue increases and QALY increases. As this intervention is targeted toward individuals, individuals receive the most significant benefit by way of improved quality of life (QALYs).

*Figure 68: 50-year cost benefit breakdown of Healthy People, Healthy Lives*




### 8.2.1.1 Cost details

The **discounted cost of running the intervention for 10 years is $44 million**. This works out to be a $5,480 cost per participant for the three-year program. The majority of this cost is the wages of 55 internal staff (costing approximately $3.5 million per year) and the fee for service cost of clinical staff (costing approximately $1.2 million per year). The other significant cost is gym memberships, costing approximately $1.8m per year.

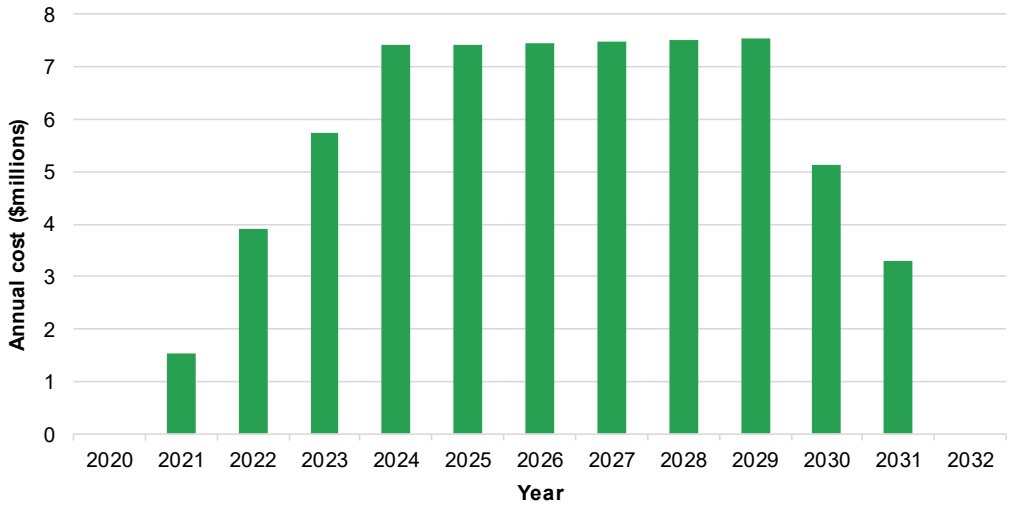
#### 8.2.1.1.1 Method and key assumptions

The Healthy People, Healthy Lives intervention has been costed for one year of setup, followed by 10 years of operation. The target cohort is 1,000 new participants per year, starting from 2022 and ending in 2029. This means that the participants in 2029 will complete the intervention in 2031. The completion rate for the intervention is estimated to be the same as the FDPS at 83%[61], hence out of the 1,000 starting participants, 830 of the group will complete year three. The intervention group is assumed to be a 50/50 split between male and female.

*Table 15: Total cost breakdown of Healthy People, Healthy Lives (not discounted)*

| Cost Category | Total nominal cost over intervention ($000) |
|---|---|
| Fixed costs | 469 |
| Non-personnel costs | 18,595 |
| Personnel costs | 34,904 |
| Fee for service costs | 9,894 |
| Optional dietary activity costs | 6,753 |
| Optional exercise activity costs | 2,549 |

*Figure 69: Annual cost of operating Healthy People, Healthy Lives*




### 8.2.1.2 Benefit details

The **0.95 Government ROI** means that every $1 invested in Healthy People, Healthy Lives will produce $0.95 dollars of benefit to the Government over a 50-year period. This benefit only considers the decrease in public health costs and the increase in income tax and ACC levy revenue, which is the result of increased productivity in the workforce. Therefore, if the Government were to invest in Owning Our Futures, the investment would effectively close to breakeven over a 50-year period.

The **2.95 societal ROI** means that every $1 spent by the Government on Healthy People, Healthy Lives will produce $2.00 of benefit to society (excluding the government) over a 50-year period. This is driven by increased personal income generated by a reduction in lives lost early, and an increase in the number of years an individual is able to contribute productively in the workforce. In addition to increased personal income, there is also a benefit created by an increase in the ability of individuals to perform non-salary labour such as caring for others or engaging in voluntary community work. There is a further benefit to individuals who avoid developing type 2 diabetes by way of reduced personal health care costs.

#### 8.2.1.2.1 Quality of life

Avoiding type 2 diabetes results in a significant improvement to quality of life (measured in Quality-Adjusted Life Years (QALYs)). The DPP found that individuals partaking in the **intervention gained an average of 0.57 QALYs over their lifetime**. This figure is divided by the average remaining life expectancy to calculate a yearly QALY increase. This results in a 0.019 yearly increase for males and a 0.017 yearly increase for females. The Treasury Cost-Benefit Analysis ('CBAx') tool makes use of the PHARMAC Annual Report 2017[78] value for a QALY gained of $27,027 in 2016 or $33,306 when inflation adjusted to NZ$2020. We have adopted the PHARMAC value for this benefit.

#### 8.2.1.2.2 Equity and sustained lifestyle change

By using a whānau-centred delivery approach (i.e. delivering group sessions in community centres including maraes and churches), this intervention is likely to be more effective for and accepted by Pacific and Māori communities. And if successfully implemented, the intervention should result in **better health outcomes for Pacific and Māori, thus addressing existing inequities**.

By engaging with intervention staff, participants will gain knowledge of diet and exercise, which will help them to develop healthy lifestyle changes; maintain weight loss achieved during the programme; and share knowledge with their whānau. While this benefit is potentially significant, it is difficult to quantify, so has not been monetised in the cost-benefit analysis.

#### 8.2.1.2.3 Method and key assumptions

To be conservative, only benefits that are quantifiable with a strong evidence base have been modelled. Evidence from the above studies show that the leading benefits are from delaying a person from developing type 2 diabetes, and in some cases preventing it. We have assumed that the average age of participants upon entry into the programme is 40 years old for all benefits modelling.

As detailed above, the FDPS found that 13% less people developed type 2 diabetes in the intervention group compared to the control group after three years.[61] This figure is used as evidence to support the modelling of a three-year delay in developing diabetes.

The Diabetes Prevention Meta-analysis on multiple lifestyle interventions also found that prevention of the progression to type 2 diabetes was achieved in 1 out of 6.4 participants (16% success rate)[64]. This figure is used as evidence to support the modelling of the prevention of progression.

The prevention and delay statistics above are used to model the change in an individual's journey through type 2 diabetes as described in the diabetes disease progression pathway shown in Figure 11. By modelling an alteration to the prevalence cost outputs for a subset of people with type 2 diabetes either by creating a delay or prevention in developing type 2 diabetes, we can calculate the benefits to health cost savings, increased income and tax revenue, and increased non-salary productivity. These are shown as lifetime Net Present Value (NPV) figures in the cost-benefit analysis.

### 8.2.1.3 Funding and scaling

It is proposed that this intervention will be **funded by the Ministry of Health** through the budget bid process and will **cost NZ$(2020)64 million over 11 years in undiscounted real terms**.

Scalability of this intervention will be limited by the number and availability of clinicians and programme and local coordinators with the right skills/experience. To provide the service to 1,000 new participants per year, the programme will need to hire 55 additional internal staff and engage approximately 20 full time equivalent (FTE) clinicians (this equates to 50 individual clinicians).

The minimal viable option for this programme is to deliver services to 500 new participants each year (rather than 1,000). This would reduce resource requirements to 25 individual clinicians and 38 FTE additional internal staff.

# 8.3 Owning our Futures intervention

*Investing in the Owning our Futures intervention will achieve a total Government benefit of $23 million and a societal benefit of $63m, which equates to a Government ROI of 1.0 and a societal ROI of 2.7.*

## 8.3.1 Cost-benefit analysis results

**Owning our Futures**

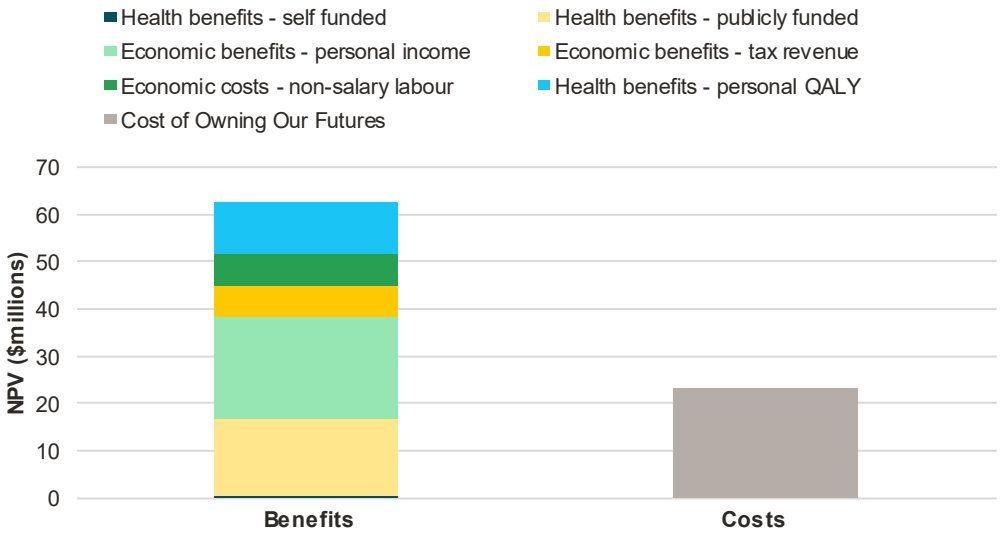
*Lifestyle intervention to achieve remission from type 2 diabetes*

Owning Our Futures represents an opportunity for Government to invest in supporting New Zealanders with type 2 diabetes to achieve remission. From a Government funding perspective, this intervention is approximately cost neutral. This is due to the cost of the intervention being offset almost equally by reduced public healthcare costs and increased tax and ACC levy revenue. From a societal perspective, investment in this intervention would produce a substantial positive economic and quality of life benefits for the individual by enabling increased productivity and longer life expectancy.

Specifically, over a 50-year period Owning Our Futures will achieve a **total government benefit of $23 million and a societal benefit of $63 million.** This equates to a Government ROI of 0.97 and a societal ROI of 2.69. This indicates that for every dollar the Government spends, $0.97 of Government benefit and $1.72 of societal benefit is achieved – making a total benefit of $2.69 produced over a 50-year measurement period. The net benefit over a 50-year period is $3,932 for each participant who starts the programme and $5,410 for each participant who successfully completes the programme.

A breakdown of benefits is shown in Figure 70. This shows that the majority of benefits are achieved by individuals by way of increased personal income from an improved productivity. There is also a significant reduction in public health care costs as a result of individuals achieving remission from type 2 diabetes.

*Figure 70: 50-year cost benefit breakdown of Owning our Futures*




### 8.3.1.1 Cost details

Table 16 and Figure 71 show the breakdown of costs for Owning our Futures over an 11-year period. The cost of the programme consists predominantly of three cost components: the 12-week formula diet for each participant, outsourced sessions and personnel/staff. The **50-year NPV cost for Owning Our Futures is $23 million**. This equates to $2,328 per participant who enters into the programme or $3,203 for every

participant who successfully completes the programme (a 72.7% completion rate is assumed – see discussion below for detail).

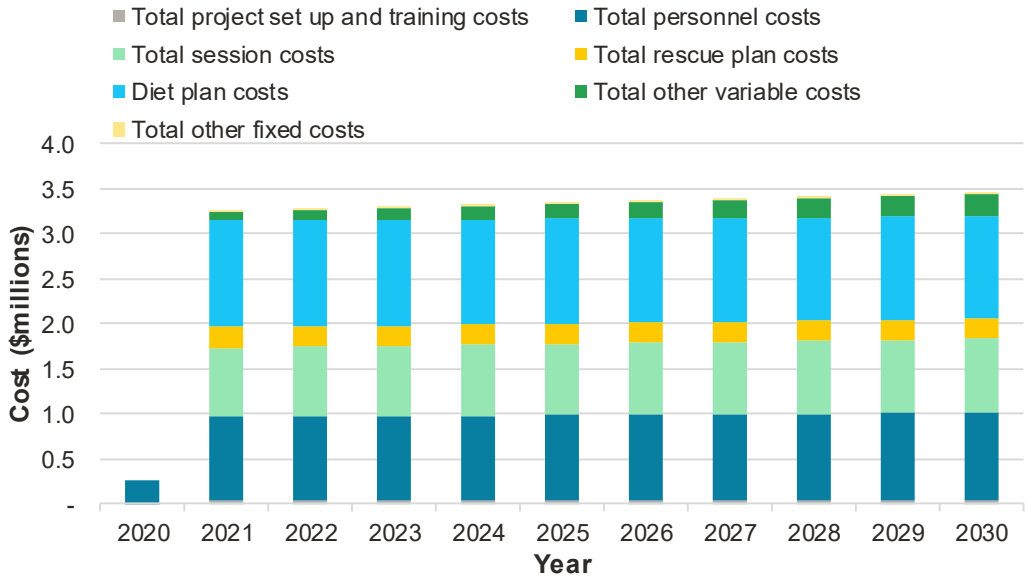
#### 8.3.1.1.1 Method and key assumptions

To calculate the cost of Owning our Futures we assumed a one-year implementation period for project set-up and training, and a cohort of 1,000 new participants each year for 10 years. There are many factors which may result in individuals being unable to complete all three phases of the programme, making it unrealistic to assume a 100% participant completion rate. As such, we have assumed an attrition rate of 10% for the formula diet phase, 5% for the food reintroduction phase and 15% for the weight management phase. The combined impact of these attrition rates was an overall programme completion rate of 72.7% for all three stages of the programme.

*Table 16: Total nominal cost breakdown for Owning our Futures*

| Cost Category | Total nominal cost over intervention ($000) |
|---|---|
| Total project set up and training costs | 350 |
| Total personnel costs | 9,798 |
| Total session costs | 7,921 |
| Total rescue plan costs | 2,261 |
| Diet plan costs | 11,608 |
| Total other variable costs | 1,730 |
| Total other fixed costs | 11 |

*Figure 71: Total costs of operating Owning our Futures*




### 8.3.1.2 Benefit details

The **0.97 Government ROI** means that every $1 invested in Owning Our Futures will produce $0.97 dollars of benefit to the Government over a 50-year period. This benefit only considers the decrease in public health costs and the increase in income tax and ACC levy revenue, which is the result of increased productivity in the workforce. Therefore, if the Government were to invest in Owning Our Futures, the investment would approximately breakeven over a 50-year period.

The **2.69 societal ROI** means that every $1 spent by the Government on Owning Our Futures will produce $1.72 of benefit to society over a 50-year period (excluding government). This is driven by increased personal income generated by a reduction in lives lost early, and an increase in the number of years an individual is able

to contribute productivity to the workforce. In addition to increased personal income, there is also a benefit created by an increase in the ability of individuals to perform non-salary labour such as caring for others or engaging in voluntary community work. There is a further benefit to individuals who achieve remission of type 2 diabetes by way of reduced personal health care costs.

#### 8.3.1.2.1 Quality of life

Weight loss and subsequent remission of type 2 diabetes results in a significant improvement to quality of life. This improvement is the result of achieving both physical and mental health benefits – including an increased ability to participate productively in the workforce and in society. The DiRECT study reported a **discounted lifetime increase of 0.06 QALYs per participant** in the intervention group. We have applied this same value in our analysis, which corresponds to an average monetised value of $726 per participant who completes the Owning Our Futures programme[xlvi].

#### 8.3.1.2.2 Equity and sustained lifestyle change

By using a whānau-centred delivery approach (i.e. inviting whānau to be involved and delivering group sessions in community centres including maraes and churches), this intervention is likely to be more effective for and accepted by Pacific and Māori communities. And if successfully implemented, the intervention should result in better health outcomes for Pacific and Māori, thus **addressing existing inequities**.

By engaging with intervention staff, participants will gain knowledge of diet and exercise, which will help them to develop healthy lifestyle changes; maintain weight loss achieved during the programme; and share knowledge with their whānau. While this benefit is potentially significant, it is difficult to quantify, so has not been monetised in the cost-benefit analysis.

#### 8.3.1.2.3 Method and key assumptions

To calculate the benefits produced by Owning Our Futures, we assumed a success rate equivalent to that achieved in the DiRECT study completed in the United Kingdom. Where the net remission rate of the DiRECT intervention group compared to the control group was 41.6% at year one and 32.4% at year two[67]. Assuming a constant annual relapse rate, 13% of participants would be expected to remain in remission beyond five years. As such, we have assumed 13% of participants will remain in remission for five years and that this to be the maximum length of time spent in remission. In reality, it is likely some participants remain in remission for longer.

Average life expectancy for the intervention group in the DiRECT study increased by 0.30 years for a person in remission at year one[67]. As there was a lack of evidence of greater increases in life expectancy for participants achieving remission beyond one year, we applied the value of 0.30 to all participants who achieved remission through Owning our Futures.

The remission statistics described above were used to model the change in an individual's journey along the diabetes disease progression pathway model described in Figure 11. Remission of type 2 diabetes was modelled as a delay in the development type 2 diabetes from the point in time that remission was achieved. The increase in life expectancy was modelled by reducing the value for the increased mortality risk due to diabetes for the number of years the individual was in remission to increase the expected remaining years of life for each group.

### 8.3.1.3 Funding and scaling

It is **proposed that this intervention will be funded by the Ministry of Health** and will cost **NZ$(2020)32.5 million over 10 years in real undiscounted** terms for a cohort size of 1,000 new participants each year.

The smallest viable participant group size for this intervention would be a large PHO or Māori health provider. For a cohort of similar size to the DiRECT study (~300 participants) there would be only one combined programme coordinator, delivery lead and clinical lead position.

[xlvi] *Using the New Zealand Treasury CBAx QALY value of $33,306.*

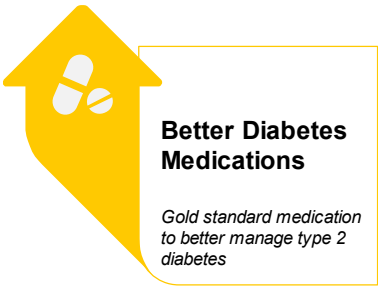
The programme could be implemented as a trial in an area where we may expect the greatest results before being offered nationwide. Performance measures would show the programme's success within 18 months to 2 years to guide further investment into the full-scale programme.

Reducing the appointment time would result in a cost saving, however this would create a risk to the effectiveness of the intervention. We would not recommend removing the follow up appointments with clinicians from the programme. Long-term behavioural changes and weight loss management require ongoing support and there is evidence to suggest that regular interaction with healthcare providers or in group settings significantly improves long-term outcomes of weight management. Obesity treatment guidelines also state that weight loss interventions should include long-term comprehensive weight loss maintenance programmes that continue for at least one year[79].

## 8.4 Better Diabetes Medication intervention

*Investing in the Better Diabetes Medication intervention will achieve different benefits for each drug class. For SGLT2 inhibitors, investment will achieve a total Government benefit of $510 million and a societal benefit of $201m, which equates to a Government ROI of 3.0 and a societal ROI of 4.2. For GLP-1 receptor agonists, investment will achieve a total Government benefit of $595 million and a societal benefit of $148m, which equates to a Government ROI of 1.2 and a societal ROI of 1.5.*

### 8.4.1 Cost-benefit analysis results



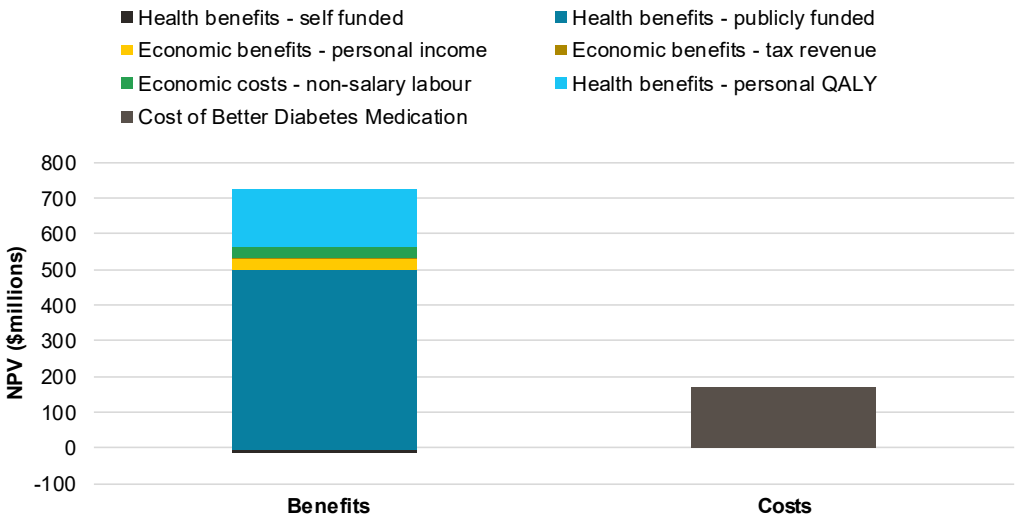

Better Diabetes Medication represents an opportunity for the Government to invest in supporting New Zealanders to better manage their type 2 diabetes and avoid severe diabetes-related complications. Savings in publicly funded health costs, especially from secondary care, and increases in tax revenue significantly outweigh the cost of funding and creating awareness around the medications. **Investing in this intervention would produce substantial positive economic benefit for the Government and individuals**, increasing total GDP and improving the quality of life for individuals taking the medications.

In the cost-benefit analysis below, we have modelled the costs and corresponding benefits of 40,000 individuals starting in year one and continuing over their remaining projected lifetime, as they can be expected to continue to take the medication indefinitely. We have completed separate cost-benefit analysis for each drug class (SGLT2 inhibitors and GLP-1 receptor agonists) as each has different prices and benefits.

#### 8.4.1.1 SGLT2 inhibitors

Over the lifetime of the target population, SGLT2 inhibitors will achieve **total Government benefit of $510 million, and societal benefit of $201 million**. This equates to a government ROI of 3.0 and a total societal ROI of 4.2. This indicates that for every dollar the Government spends, $3.00 of Government benefit and $1.20 of societal benefit will be produced – making a total benefit of $4.20 over the lifetime of the target population. Figure 72 below shows that the majority of the benefit achieved is a result of publicly funded healthcare cost savings.

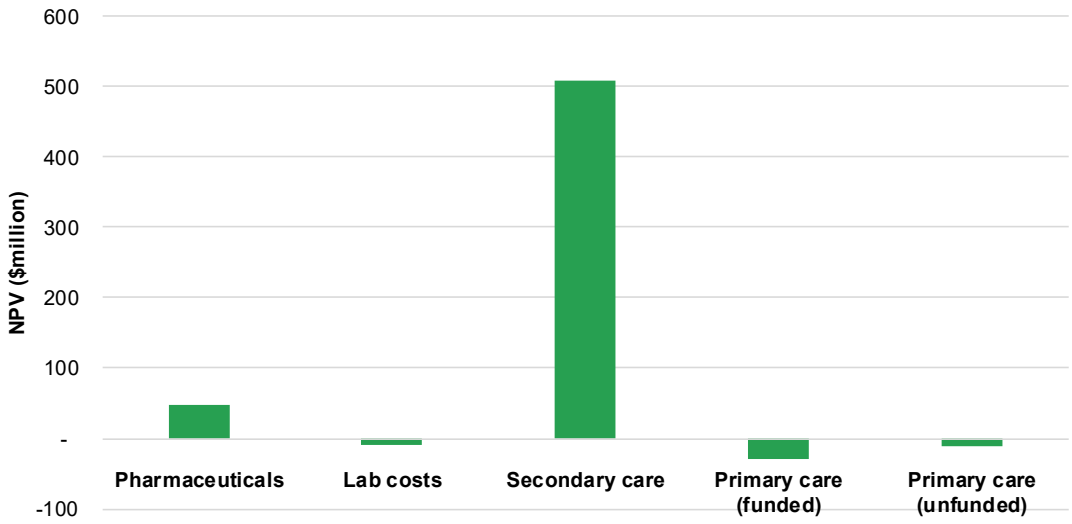
*Figure 72: 50-year cost benefit breakdown of Better Diabetes Medication – SGLT2 inhibitors*




#### 8.4.1.1.1 Benefits details – SGLT2 inhibitors

Figure 73 shows a more detailed breakdown of the benefits achieved by SGLT2 inhibitors. The figure shows that most benefit is received through savings in secondary care. This is to be expected, due to the reduced risk of severe cardiovascular and renal outcomes. Savings in pharmaceuticals are also produced as a result of less individuals taking insulin. The cost of primary care increases due to the increased life expectancy, but this cost increase is strongly outweighed by QALY and productivity benefits realised by individuals living longer lives.

*Figure 73: Breakdown of benefits from SGLT2 inhibitors*




The SGLT2 inhibitor benefits that have been modelled are:

- 30% reduced risk of death from renal and CVD[70]
- 33% reduction in the secondary endpoint of hospitalisation for heart failure[70]
- 40% reduction in the risk of the prespecified composite renal outcome[70]
- 22% reduction in individuals taking insulin[80].

The benefits are modelled over the lifetime of an individual with type 2 diabetes using the disease progression pathway framework; calculating the reduction in health costs; increased personal and tax revenue through increased productivity; and non-salary benefits associated with longer life and increased productivity. These individual 'journeys' are then weighted by the age and gender of the current type 2 diabetes population to more accurately reflect the benefits received.

#### 8.4.1.1.1.1 Quality of life

Access to and use of SGLT2 inhibitors improves quality of life by enabling people with type 2 diabetes to better manage their condition and avoid severe diabetes-related complications. **Lifetime QALYs gained of 0.24[74] for SGLT2 inhibitors** are also modelled and costed. These QALYS are assumed to be solely attributable to longer life, hence the benefit is recognised at the end of an individual's life. This is the most conservative method to estimate the value of QALYs gained.

### 8.4.1.1.2 Cost details – SGLT2 inhibitors

The list price of SGLT2 inhibitors is $100 per month[81]. This figure is reduced by the average PHARMAC rebate of 52% to give a monthly cost of $48. The age and gender of the 40,000 people taking the medication is weighted by the population of disease progression pathway groups 3 and 4 described in Figure 11, to accurately estimate the 'health status' of individuals involved in the intervention. Using this population spread, the **discounted price of lifetime medication for 40,000 people is calculated as $173.4 million**.

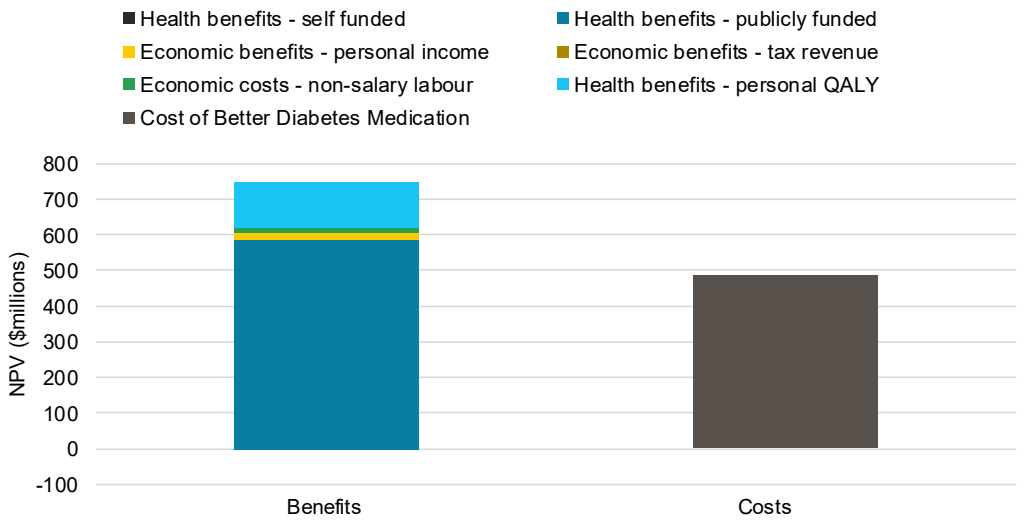
While we have used the average rebate, there is no guarantee of any specific rebate on any individual drug, or indeed any rebate at all. This assumption will rely on the specific contractual arrangements negotiated by PHARMAC.

The other costs associated with this intervention are the wages of two engagement coordinators for the first year at $101,583 each, and $10,000 per year for awareness costs, such as magazine features and conference costs. Most awareness campaigns should incur no cost as they will use existing channels, but a placeholder amount of $10,000 is included to be conservative.

## 8.4.1.2 GLP-1 receptor agonists

Over the lifetime of the population GLP-1 receptor agonists will achieve **total Government benefit of $595 million, and societal benefit of $148 million**. This equates to a Government ROI of 1.2 and a total societal ROI of 1.5. This indicates that for every dollar the government spends, $1.20 of Government benefit and $0.30 of societal benefit is achieved – making a total benefit of $1.50. Similar to SGLT2 inhibitors, Figure 74 shows that the majority of benefit received is a result of publicly funded healthcare cost savings.

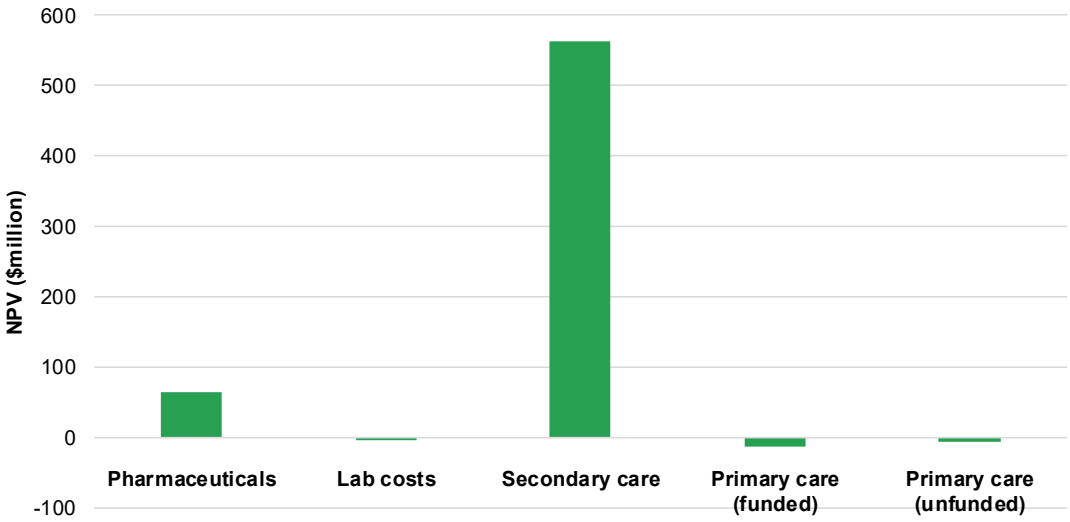
*Figure 74: Lifetime cost benefit breakdown for Better Diabetes Medication - GLP-1 receptor agonists*



#### 8.4.1.2.1 Benefit details – GLP-1 receptor agonists

Figure 75 shows a more detailed breakdown of the benefits achieved by GLP-1 receptor agonists. The benefits are largely attributable to reductions in secondary care spending, due to decreased risk of severe renal and cardiovascular events. As seen with SGLT2 inhibitors, increased life expectancy has led to higher primary care and lab costs, but these are once again outweighed by benefits achieved from increased productivity and quality of life (QALYs).

*Figure 75: Breakdown of health benefits from GLP-1 receptor agonists*




The GLP-1 receptor agonist benefits that have been modelled are:

- 15% reduction in all-cause mortality[70]
- 26% reduction in 3-point MACE[70]
- 39% reduction in the risk of new or worsening nephropathy[70]
- 22% reduction in individuals taking insulin[80].

As with SGLT2 inhibitors, benefits are modelled over the lifetime of an individual with type 2 diabetes using the disease progression pathway framework; calculating the reduction in health costs; increased personal and tax revenue through increased productivity; and non-salary benefits associated with longer life and increased productivity. These individual 'journeys' are then weighted by the age and gender of the current type 2 diabetes population to more accurately reflect the benefits received.

##### 8.4.1.2.1.1 Quality of life

Access to and use of GLP-1 receptor agonists improves quality of life by enabling people with type 2 diabetes to better manage their condition and avoid severe diabetes-related complications. **Lifetime QALYs gained of 0.19[6] for GLP-1 receptor agonists** are also modelled and costed. These QALYS are assumed to be solely attributable to longer life, hence the benefit is recognised at the end of an individual's life. This is the most conservative method to estimate the value of QALYs gained.

#### 8.4.1.2.2 Cost details – GLP-1 receptor agonists

The list price of GLP-1 receptor agonists is $300 per month[81]. This figure is also reduced by the PHARMAC rebate of 52% to give a monthly cost of $144. Using the same population approach outlined above, the **discounted price of lifetime medication for 40,000 people is $499 million**.

While we have used the average rebate, there is no guarantee of any specific rebate on any individual drug, or indeed any rebate at all. This assumption will rely on the specific contractual arrangements negotiated by

PHARMAC. The other costs associated with this intervention are the wages of two engagement coordinators for the first year at $102,000 each, and $10,000 per year for awareness costs, such as magazine features and conference costs. Most awareness campaigns should incur no cost as they will use existing channels, but a placeholder amount of $10,000 is included to be conservative.

Dulaglutide, the GLP-1 receptor agonist PHARMAC is currently in the process of approving funding for is an injectable form of medication generally used once per week and often self-administered. Teaching people to self-administer using a Dulaglutide pen correctly takes clinician time which comes at a cost. Once a person has learnt to use the Dulaglutide pen they can then continue to use it themselves into the future. This is similar to, but potentially somewhat less difficult than teaching a patient to self-administer insulin. Our costing calculations have not explicitly included the cost of this clinician time or counted any savings in clinician time due to reduced need to teach people to self-administer insulin. We have made the assumption that this is included in primary health care as it would take place during existing appointments.

#### 8.4.1.3 Funding and scaling (both medications)

**PHARMAC will make a funding decision based on proposals** provided by drug manufacturing companies. Scaling considerations are not required as drug funding decisions apply nationally.

Creating awareness of the new medication will be managed by Diabetes New Zealand (if provided with appropriate funding) and will require the co-operation of diabetes physicians and nurse specialists. **Funding will be sought from the Ministry of Health** or if this is not forthcoming, Diabetes New Zealand's could consider fitting this into their existing operating budget (which may require additional fundraising activity). As the engagement coordinators are using existing channels to create awareness (10.2.3.2), there will likely be no establishment costs. The largest cost will to be the coordinators' remuneration. Additional costs that Diabetes New Zealand may incur are advertising costs such as magazine space or conference fees. Successfully creating awareness will require the cooperation of several third parties and use of existing communication channels.

## *8.5 Foot Screening and Protection intervention*

*The Foot Screening and Protection intervention is estimated to achieve net present value cost saving benefits of $40,654 (major amputation) and $36,505 (minor amputation) for each diabetes-related lower limb amputation avoided. And if the intervention is implemented as intended, 390 major and 211 minor amputations will be avoided each year (based on 2020 data).*

### *8.5.1 Benefit analysis results*

#### 8.5.1.1 Benefit modelling results – major amputation

**Foot Screening and Protection**

*Better foot screening and protection to avoid amputation*

Preventing an individual from having a major lower-limb amputation provides an **NPV cost saving benefit of $40,654**. A breakdown of these costs savings is shown in Table 17 below. The largest cost saving occurs in publicly funded health costs, and this is largely the result of avoiding the cost of amputation surgery. There is also a significant increase in personal income and non-salary labour as a result of an individual's increased ability to engage in paid and unpaid labour. There is a smaller benefit produced from the increase in government revenue from tax and ACC levies.

We note that self-funded healthcare costs are higher when an individual avoids major amputation. This is because an individual who has an amputation typically has a much higher mortality rate than someone who avoids amputation – meaning the person who had an amputation will likely have a shorter life expectancy and thus lower lifetime self-funded health costs.

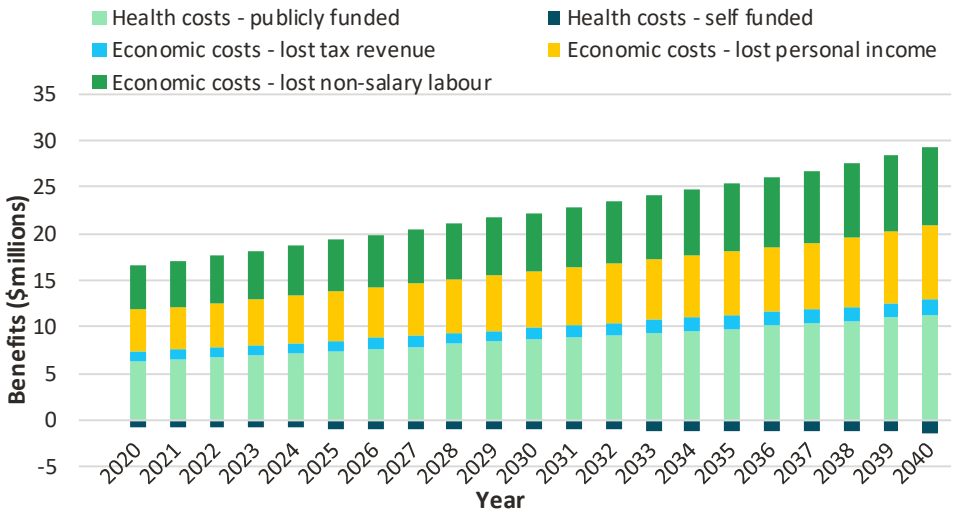
*Table 17: NPV cost breakdown of preventing a major amputation*

| Cost type | Cost saving |
|---|---|
| Health costs – publicly funded | $16,460 |
| Health costs – self funded | ($1,890) |
| Economic costs – lost tax revenue | $2,430 |
| Economic costs – lost personal income | $11,450 |
| Economic costs – lost non-salary labour | $12,190 |
| **Total benefit NPV** | **$40,650** |

If all DHBs are able to reduce their major amputation rates in line with the DHBs demonstrating the lowest national rate, a reduction from 0.42% (as the average major amputation rate) to 0.21% (the lowest major amputation rate) will be achieved and 40% of existing major amputations would be avoided. This equates to the avoidance of 390 major amputations in 2020.

With an increasing prevalence of type 2 diabetes, the number of major amputations avoided will also increase if the provision of Foot Screening and Protection can successfully reduce the average DHB major amputation rates to that of Waitematā DHB. Figure 76 below shows the total benefit of all major amputations avoided in this scenario.

*Figure 76: NPV of reducing the average major amputation rate reduction to 0.21%*




## 8.5.1.2 Benefit modelling results – minor amputation

Preventing an individual from having a minor lower-limb amputation provides an **NPV cost saving benefit of $36,500**. A breakdown of these costs savings is shown in Table 18 below. This breakdown shows that avoidance of a minor amputation generates a greater proportion of public health costs (by avoiding the cost of amputation surgery) as compared to major amputation. However, there is still significant economic benefit generated in the form of increased personal income, non-salary labour and government tax revenue.

As with major amputations, as a result of mortality rates, self-funded healthcare costs are higher for someone who avoids minor amputation.

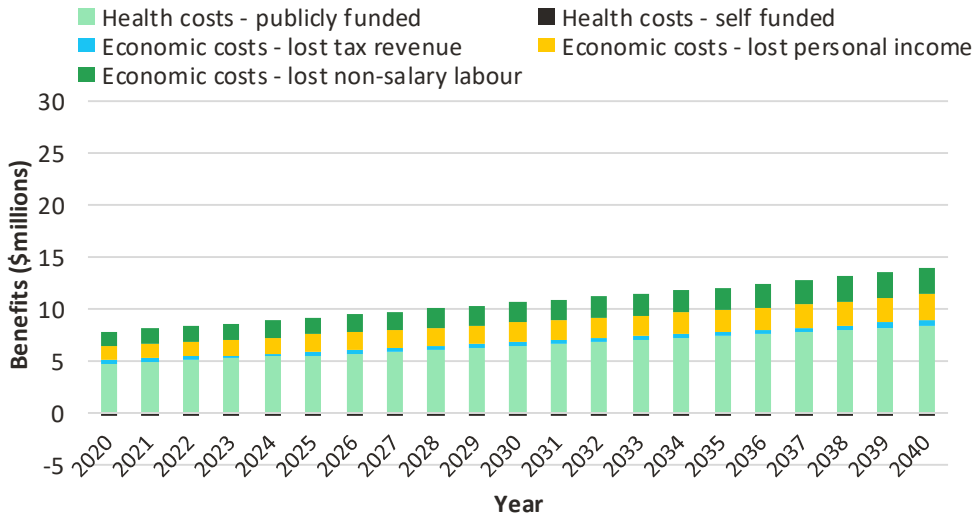
*Table 18: NPV cost breakdown of preventing a minor amputation*

| Cost type | Cost saving |
|---|---|
| Health costs – publicly funded | $22,570 |
| Health costs – self funded | ($770) |
| Economic costs – lost tax revenue | $1,360 |
| Economic costs – lost personal income | $6,590 |
| Economic costs – lost non-salary labour | $6,750 |
| **Total benefit NPV** | **$36,500** |

If all DHBs are able to reduce their minor amputation rates from 0.63% (the average minor amputation rate) to 0.50% (Waitematā DHB's minor amputation rate), 14% of existing minor amputations will be avoided. This equates to the **avoidance of 211 minor amputations in 2020**.

With an increasing prevalence of type 2 diabetes, the number of minor amputations avoided will also increase if the provision of Foot Screening and Protection can successfully reduce the average DHB minor amputation rates to that of Waitematā DHB. Figure 77 below shows the total benefit of all minor amputations avoided in this scenario (projected over a 40-year time period).

*Figure 77: NPV of reducing the average minor amputation rate to 0.50%*




## 8.5.1.3 Quality of life

Without strong research-based evidence for the quantified increase in quality of life that would result from avoiding a major or minor amputation, we have chosen not to monetise this benefit in our analysis. However, an amputation of any kind can have a significant impact on an individual's ability to perform everyday tasks. Amputees could also experience mental health challenges from their increased dependence on others and reduced optimism for the future.

Table 19 below shows the number of amputations that could be avoided from 2020 to 2030 if Foot Screening and Protection was successfully implemented and the average DHB amputation rates decreased in line with the lowest amputation rates. Each avoided amputation represents a New Zealander who will experience a better quality of life.

*Table 19: Amputations avoided as a result of Foot Screening and Protection intervention*

| Year | Major amputations avoided | Minor amputations avoided |
|---|---|---|
| 2020 | 390 | 211 |
| 2021 | 402 | 218 |
| 2022 | 415 | 225 |
| 2023 | 427 | 232 |
| 2024 | 441 | 239 |
| 2025 | 454 | 246 |
| 2026 | 468 | 254 |
| 2027 | 482 | 261 |
| 2028 | 496 | 269 |
| 2029 | 510 | 277 |
| 2030 | 524 | 284 |

### 8.5.1.4 Benefit modelling method and assumptions

As we did not design a bespoke intervention (rather the Foot Screening and Protection intervention is focused on lifting DHB performance to meet best practice standards) and we are taking a conservative approach and assuming that DHBs could deliver Foot Screening and Protection within their existing funding envelopes, we have only modelled the benefits associated with Foot Screening and Protection. We have used the following assumptions in our benefits modelling:

- As described in section 7.6.9, Waitematā DHB's podiatry services appear to be closest to the optimal Foot Screening and Protection intervention described Appendix 10.2.4. As such, we have **used Waitematā DHB as a New Zealand 'exemplar DHB'** from which to base our benefit modelling. Specifically, we have assumed that if all New Zealand DHBs implemented an approach consistent with that of Waitematā DHB, all DHBs would be able to reduce their amputation rates to levels consistent with Waitematā DHB[xlvii].

- The **treatment cost of diabetic foot ulcers and amputation** is high. In a 2009-2014 New Zealand study, the median cost per wound episode that included a major amputation was $42,774; and the median cost per wound episode that did not require a major amputation was $27,385[82]. In our benefits modelling, we used this value of $27,385 (inflated to 2020 value using the Treasury CBAx tool) as a conservative estimate to model benefits of reducing amputation rates across New Zealand.

- The **survival rates** for individuals after having a diabetes-related amputation are low. The five-year mortality rate for patients who have had a diabetes-related lower limb ulcer is between 43% to 55%; this increased to 74% for those who have experienced a lower limb amputation[83]. As such, avoiding an amputation can significantly increase in individual's life expectancy, thus enabling them to contribute productively to the workforce and society.

- Furthermore, approximately 50% of amputees are rendered 'functionally dependent', which also places a strain on family, carers and the community[82]. To be conservative, we used this value of 50% to model an individual's **inability to work** following a major amputation; and 25% to model an individual's inability to work following a minor amputation.

- Preventing an individual from having a lower limb amputation would likely **increase the quality of life** of an individual. An Australian cost-effectiveness analysis found that high-risk DFU patients who received optimal foot care gained 0.13 QALYs (aged 35–74 years) and 0.16 QALYs (aged 75+ years)[84]. To be conservative, we have chosen not to monetise these QALY effects in our benefits analysis.

[xlvii] *This assumption was informed by consultation with the clinical Expert Advisory Group.*

To model the benefits of providing the optimal version of Foot Screening and Protection, we compared an individual's journey along the diabetes disease progression pathway model (Figure 11) for an individual **without major/minor amputations** vs. an individual **with major/minor amputation**. This meant adjusting healthcare costs (cost of amputation) and economic values (productivity and mortality rates) for each scenario. These adjustments were made for multiple different age groups and separated by gender. A weighted average of the outcomes spread by the proportion of the type 2 diabetes population was then used to calculate the overall NPV of benefits for major and minor amputations.

#### 8.5.1.5 Funding and scaling

Due to the close alignment to the Foot Screening and Protection programme, we have used Waitematā DHB as a New Zealand 'exemplar DHB' from which to base our benefit modelling. As Waitematā DHB are able to deliver a near-optimal Foot Screening and Protection service, we have assumed that it is possible to provide this level of care within current levels of DHB funding (while noting that this may require reprioritisation of funding from other areas/priorities).

However, in practice, for DHBs to change their existing services, it is likely that they would require additional funding from the Ministry of Health if they are to deliver optimal Foot Screening and Protection and achieve the projected economic and social benefits.

# 9. Conclusions and recommendations

Key conclusions and recommendations relevant to our entire study are presented below.

## 9.1.1 Key conclusions

- **New Zealand is on a trajectory to reach epidemic proportions of type 2 diabetes within the next 20 years.**

- The current and **projected prevalence and cost** of type 2 diabetes in New Zealand is unacceptably high and Māori, Pacific and Asian people are disproportionately represented in New Zealand's type 2 diabetes population.

- Diabetes does not feature as a specific **Government Health priority**, nor is it tracked as a New Zealand health target. However, when taking a broader view of diabetes (as a condition that often occurs alongside comorbidities and other long-term conditions), future investment in the prevention, treatment and care of diabetes would **contribute strongly to a number of the Government's existing priorities**; including ; physical and mental wellbeing, preventative health care, mental health and equity.

- There is **no single national strategy** or approach to the prevention, treatment and care of diabetes or other associated long-term conditions in New Zealand.

- The current national approach to diabetes prevention, treatment and care; the structure of the health and disability system; and funding arrangements are driving **high proportions of unmet need, inequity and sub-optimal health outcomes**. This is especially the case for Pacific and Māori people.

- To affect the scale of change needed to address the emerging type 2 diabetes epidemic and prevent worsening inequities and health outcomes in New Zealand, a holistic and system-wide response is needed. This response will require **concerted action, effort and investment from Government, society and individuals**. In particular, there is an **urgent need for the Government to acknowledge, prioritise and invest in New Zealand's growing type 2 diabetes problem.**

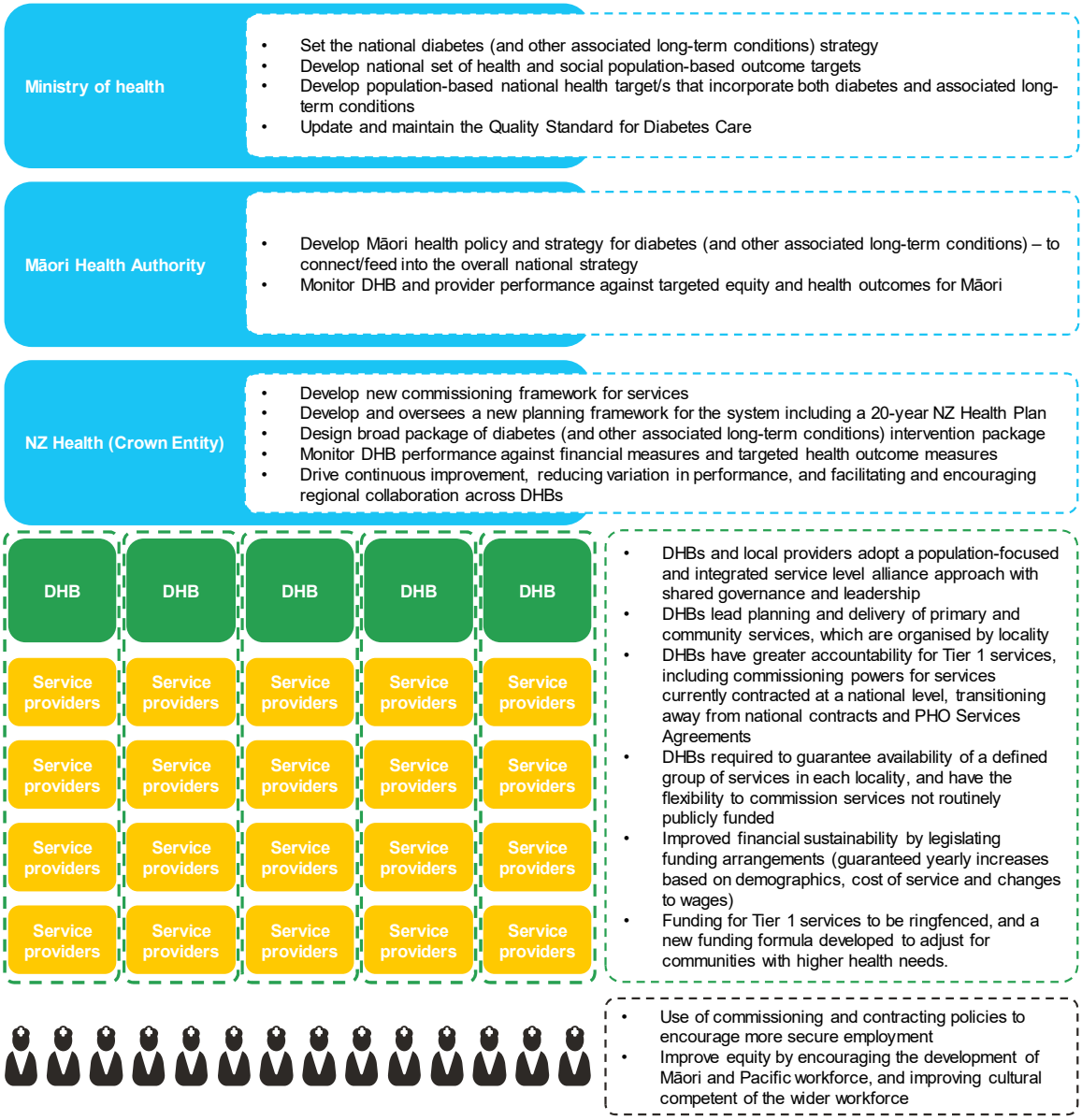
- There is **opportunity to change** the projected trajectory of prevalence and cost by changing New Zealand's current national diabetes model of care in a way that aligns to the ambitions of the *New Zealand Health and Disability System Review*.

- While not discussed in the body of the report – it is important to acknowledge **data limitations**. Using the Ministry of Health Virtual Diabetes Register, we are able to predict and monitor the prevalence of diabetes in New Zealand with a reasonable degree of accuracy. However, there is currently no cohesive or consistent national approach toward the collection and collation of diabetes-related treatment and cost data as this is done at a local DHB level. As a consequence, it is difficult to develop a national view of the treatment approach and funds spent on diabetes prevention, treatment and care in New Zealand.

## 9.1.2 Key recommendations

- As illustrated in Figure 78, change the New Zealand **diabetes (and associated long-term conditions) model of care in a way that aligns to the ambitions of the *New Zealand Health and Disability System Review***. To achieve and support this, identify diabetes and associated long-term conditions as a specific Government health priority; identify a national set of health and social population-based outcome targets; and develop a national 'diabetes and associated long-term conditions strategy' to enable achievement of those outcomes. This strategy should **adopt and invest in a broad national package of interventions**, which target both diabetes and associated long-term conditions; adopt a consumer, whānau and community-based delivery approach; incorporate Te Tiriti o Waitangi-based partnerships; address all stages of disease progression (with a strong focus on prevention); and address both health behaviours and health care factors.

*Figure 78: New diabetes (and associated long-term condition) model of care per the New Zealand Health and Disability System Review*




- To ensure **effective delivery of the national diabetes and associated long-term conditions strategy**, it will be necessary to review and refresh the Government funding approach to diabetes and associated long-term conditions (see specific funding recommendation below); introduce population-based national health target/s that incorporate both diabetes and associated long-term conditions; introduce appropriate accountability mechanisms for DHBs and providers (on both the use of funding and achievement of targeted health outcomes); and update and maintain the Quality Standards for Diabetes Care.

- The future national **approach to funding** diabetes prevention, treatment and care should be considered in conjunction with the core funding model changes of the *New Zealand Health and Disability System Review*. Where the Review recommends legislation of DHB funding requirements (guaranteed yearly increases based on demographics, cost of services and changes to wages); ring-fenced funding for Tier 1 services; and development of a new Tier 1 service funding formula to adjust for communities with higher health needs[85].

- To enable effective and equitable diabetes **service delivery at a regional level**, DHBs and providers should adopt a population-focused and integrated service level alliance approach with shared governance and leadership.

- To inform **design of the future national diabetes (and associated long-term conditions) model of care**, the Ministry of Health should complete a comprehensive review of the efficacy, impact and outcomes achieved by both the Diabetes Care Improvement Package approach and the Living Well with Diabetes Plan (and other programmes relevant to associated long-term conditions). This review should be performed in conjunction with an assessment of how much funding each DHB has invested in diabetes prevention, treatment and care during 2015-2020[xlviii].

- To inform the **future design/selection of diabetes (and associated long-term condition) interventions**, there is a need to understand which interventions are most effective and impactful in the New Zealand environment. As such, research organisations and service commissioners should conduct/commission research around the efficacy of New Zealand based diabetes (and associated long-term conditions) prevention, treatment and care programmes. This is particularly important for whānau-centred programmes, for which there is a current lack of robust research/evidence.

- To better **understand and monitor diabetes in New Zealand**, there is a need for a cohesive and consistent national approach to data collection and management.

[xlviii] *As the years covered by the existing Living Well with Diabetes Plan.*

# 10. Appendices

## 10.1 Quality Standards for Diabetes Care

The Quality Standards for Diabetes Care are as follows[26]:

### 10.1.1 Basic care, self-management and education

1. People with diabetes should receive high quality structured self-management education that is tailored to their individual and cultural needs. They and their families/whānau should be informed of, and provided with, support services and resources that are appropriate and locally available.

2. People with diabetes should receive personalised advice on nutrition and physical activity together with smoking cessation advice and support if required.

3. They should be offered, as a minimum, an annual assessment for the risk and presence of diabetes-related complications and for cardiovascular risk. They should participate in making their own care plans and set agreed and documented goals/targets with their healthcare team.

4. They should be assessed for the presence of psychological problems with expert help provided if required.

### 10.1.2 Management of diabetes and cardiovascular risk

5. People with diabetes should agree with their health care professionals to start, review and stop medication as appropriate to manage their cardiovascular risk, blood glucose and other health issues. They should have access to glucose monitoring devices appropriate to their needs.

6. They should be offered blood pressure, blood lipid and anti-platelet therapy to lower cardiovascular risk when required in accordance with current recommendations.

7. When insulin is required it should be initiated by trained healthcare professionals within a structured programme that, whenever possible, includes education in dose titration by the person with diabetes.

8. Those who do not achieve their agreed targets should have access to appropriate expert help.

### 10.1.3 Management of diabetes complications

9. All people with diabetes should have access to regular retinal photography or an eye examination, with subsequent specialist treatment if necessary.

10. They should have regular checks of renal function (eGFR) and proteinuria (ACR) with appropriate management and/or referral if abnormal.

11. They should be assessed for the risk of foot ulceration and, if required, receive regular review. Those with active foot problems should be referred to and treated by a multidisciplinary foot care team within recommended timeframes.

12. Those with serious or progressive complications should have timely access to expert/specialist help.

### *10.1.4 While in hospital*

13. People with diabetes admitted to hospital for any reason should be cared for by appropriately trained staff and provided access to an expert diabetes team when necessary. They should be given the choice of self-monitoring and encouraged to manage their own insulin whenever clinically appropriate.

14. Those admitted as a result of uncontrolled diabetes or with diabetic ketoacidosis should receive educational support before discharge and follow-up arranged by their GP and/or a specialist diabetes team.

15. Those who have experienced severe hypoglycaemia requiring ED attendance or admission should be actively followed up and managed to reduce the risk of recurrence and readmission.

### *10.1.5 Special groups*

16. Young people with diabetes should have access to an experienced multidisciplinary team including developmental expertise, youth health, health psychology and dietetics.

17. All patients with type 1 diabetes should have access to an experienced multidisciplinary team, including expertise in insulin pumps and CGMS when required.

18. Vulnerable patients, including those in residential facilities and those with mental health or cognitive problems, should have access to all aspects of care, tailored to their individual needs.

19. Those with uncommon causes of diabetes (e.g. cystic fibrosis, monogenic, post-pancreatectomy) should have access to specialist expertise with experience in these conditions.

20. Pregnant women with established diabetes and those developing gestational diabetes (GDM) should have access to prompt expert advice and management, with follow-up after pregnancy. Those with diabetes of child-bearing age should be advised of optimal planning of pregnancy including the benefits of preconception glycaemic control. Those not wishing for a pregnancy should be offered appropriate contraceptive advice as required.

## *10.2 Intervention delivery details*

We have created individual delivery details for each intervention. By understanding the expected real-world requirements and inputs for a given intervention, we have been able to more accurately calculate expected costs and benefits. Because the proposed interventions have not been delivered in New Zealand before, we have built up detailed costs using a bottom up approach i.e. identifying all the specific items and costs required to enact an intervention and adding them together. The intervention delivery details also provide a template following a funding decision.

### *10.2.1 Healthy Lives, Healthy People*

#### 10.2.1.1 Location

The programme is designed to be available nationwide and be implemented in a way that enables people from all areas of New Zealand to access the intervention. Existing infrastructure, such as community centres/churches/marae, would be used for meetings and consultations. Centralised programme management will be provided by Diabetes New Zealand. Programme delivery to individual clients will be outsourced to existing providers. By using many smaller community centres/churches/maraes rather than large inner-city venues and by outsourcing to already established providers, smaller communities and rural areas will be reached.

#### 10.2.1.2 Consultation Sessions

Participants will have eight consultation sessions in the first year (at weeks 0, 1-2, 3-4 and 5-6 and at months 3, 4, 6 and 9), and four sessions per year for the following two years. These sessions will also include group/whānau sessions as this approach aligns to the New Zealand culture and will enable greater staff efficiency. Every second session will be a group session, and the average group size will be four participants (and their whānau). Each consultation will be one hour long.

Consultations will be held with a dietician, who will help the participant with individualised dietary and exercise goals. Every second session will involve an exercise instructor and there will be a maximum of two staff at any one consultation session. HbA1c will also be measured every three months at the consultation sessions.

Video conference (VC) technology will be purchased for all centres, allowing sessions to be conducted from home. Technology licencing will be on a 'fee for service' basis and will incur technology support costs. A technology enabled system will be established to manage bookings and record notes from each session. This system will also include an online referral system, which local GPs and nurses can use to refer people to the program.

#### 10.2.1.3 Staff

Total dietician consultation hours will be eight hours per participant for the first year, and four hours for the following two years. Total exercise instructor consultation hours will be four hours per participant for the first year, and two hours for the following two years. All clinical staff and exercise instructors will be outsourced to existing practices around New Zealand. The cost to the programme will be on a 'fee for service' basis, inclusive of any costs the providers will incur. By taking this approach, the Healthy People, Healthy Lives intervention will use a pre-diabetes-lens/focus but will build on and utilise existing infrastructure and resources.

A Whānau Ora approach will be taken by training people in the community to lead certain aspects of the intervention, thus increasing community and whānau involvement. These people will be paid an hourly rate as contractors. Local coordinators will be responsible for training these community members.

Programme coordinators, local coordinators and other centralised staff will incur overhead costs which have been included in costings. Detailed explanations of centralised staff roles are found below.

##### 10.2.1.3.1 Programme managers and other centralised staff

There will be a centralised team of four programme managers. The programme managers will oversee the programme design and make executive decisions on the direction of the programme. They will effectively design the 'toolbox' intervention, which will be customised for each region by the regional programme coordinator. These will be full-time positions.

A personal assistant will be hired for the programme managers to manage their schedules and administration.

A cultural health advisor will also be hired centrally. This role will work alongside the programme managers to ensure the validity and appropriateness of the intervention for local communities. This role will also play a key role in the hiring process. This position is to make sure that the intervention is culturally appropriate.

##### 10.2.1.3.2 Programme coordinators

15 programme coordinators will be hired by the programme manager. Programme coordinators will be stationed in each location and will be responsible for tailoring the 'toolbox' intervention to meet the needs of the local community. As such, it is important that the programme coordinator has a deep understanding of the local community's culture and needs. The programme coordinator positions will be full time. Specific tasks/responsibilities of this role include:

- Continuously ensure their region is aligned to the latest version of the 'toolbox' program. This will be costed at five hours per week.

- Engage with DHBs and existing suppliers in their local region to establish connections with providers who are able to deliver the intervention in each region. The role will oversee the initial programme establishment.

- Train clinical staff on the intervention goals. This will be eight hours for each programme coordinator at the beginning of the intervention, and four hours for every six months following. Third party clinicians will also be paid for this training time.

- Creating awareness of the intervention in the implementation stage. This will include:

    - Visiting medical centres, community centres and other social spaces to build knowledge and promote referral of potential participants to the programme.

    - Placing posters and flyers in these centres with intervention information and contact details.

    - Meeting with community leaders to increase awareness in at risk communities.

  This will be 10 hours per week for the first month, and two hours per week following to maintain these relationships. They will also be responsible for putting in place a Pacific and Māori awareness campaign.

- Leading the 'navigation' aspect of the intervention, such as connecting with relevant Government Agencies (e.g. Ministry of Social Development (MSD)) and other relevant organisations to ensure participants in their region are supported to access other social services.

#### 10.2.1.3.3 Local coordinators

Local coordinators will be hired by the programme coordinators and stationed in each region to enable both face-to-face and virtual/phone meetings with participants. These roles will coordinate the day to day running of the programme, ensuring the programme is meeting participants' individual needs. The local coordinator roles will be full time. Each local coordinator will have a rented office space based in a PHO, or if this is unavailable, at a medical centre or other appropriate facility. They are each able to co-ordinate up to 80 participants.

Specific tasks that this role include:

- Take calls from participants about the programme or any needs they may have. This will be costed at five hours per week.

- Organise all events and manage external relationships with all providers of voluntary activities. This will be costed at 10 hours per week.

- Manage relationships with all outsourced clinical staff such as dieticians and exercise instructors. This will be costed at 10 hours per week.

- Travel to participants who are unable to access their local centre and do not have access to VC technology and relay information to clinical staff. The role will be reimbursed for their travel costs from the programme budget and will use their own cars. Travel will be five hours per week.

- Provide participants with information sheets throughout the intervention. These may contain key points from consultations, workout routines and healthy meal recipes etc. This will be costed at two hours per week.

### 10.2.1.4 Dietary intervention details

Intervention diet goals will be translated into practice at the consultation sessions, making these goals achievable. The goal of these sessions is to equip participants with necessary knowledge and skills to achieve gradual, permanent behavioural changes. Food diaries will be compared to dietary advice given at the start of the programme then every three months for the first year and every six months for years two and three. This will occur during consultation sessions. The food diary must contain information on the week leading up to each session.

In addition, there will be voluntary group sessions, expert lectures, low-fat cooking sessions, visits to local supermarkets and between-visit phone calls. Diabetes New Zealand already have similar supports in place, which can be expanded. These will be designed and put in place nationally by the programme managers and rolled out to each community by local coordinators. Cooking sessions and expert lectures will be outsourced to local experts in each area, such as local chefs and lecturers. They will be held once every two months and run for two hours and one hour respectively. Average attendance to the cooking sessions is expected to be 20 people, and average attendance to the lectures is expected to be 40 people. We estimate that 40% of participants will attend these voluntary sessions. These will also be made available online for participants who were unable to attend the session in person. The local coordinators will be responsible for making content available online. Sessions will be charged to the programme on a 'fee for service' basis and will be held at locations provided by the expert being hired or a community centre. This cost will be included in the fee of the provider. Visits to the local supermarket will be run by the local coordinator once a month and will take two hours.

'Between visits phone calls' will be taken by a dietician. We have budgeted for each participant to have two hours of 'between visit phone calls' in the first year, and one hour for the following two years. This will also be charged to the programme on a 'fee for service' basis.

### 10.2.1.5 Exercise details

Participants will be individually guided to increase their overall level of physical activity. This will be done during the dietary counselling sessions. Each participant's exercise routine will be tailored to their individual needs by the exercise instructor. Endurance exercise is recommended to increase aerobic capacity and cardiorespiratory fitness. Weight will be measured at the commencement of the programme, every three months for the first year and every six months for years two and three. Participant's individual exercise routines will also be compared on the same timeline. Each participant will be provided a gym membership or equivalent fitness subscription to support their exercise routine.

An optional exercise challenge between participants will be organised to increase motivation. These challenges will be provided in each community and will be organised by the exercise instructor. We expect the average community size to be 50 participants. Additional exercise instructor hours to organise this challenge will be 4 hours per community.

Voluntary group walking and hiking will also be organised. A walk and hike will take place once a month and will be led by an exercise instructor with an expected average group size of 20 people. Each walk will last two hours, and each hike will last four hours. We estimate 40% of the intervention group will attend these activities. The local coordinators will organise the location and time of these activities. This will be an extra four hours of their time per event.

### 10.2.1.6 Social navigators of health

This intervention will use a Whānau Ora approach to whānau care. Integration with primary care will also be designed in from inception through collaboration with local DHBs/PHOs. This role will be undertaken by the programme coordinator, who will correspond with MSD and other relevant organisations to ensure participants in their region are supported. The programme coordinators should have relevant previous experience. The intervention will look to follow Kaimanaaki workforce practices, which represents all people within the social services sector and support people to live well, embrace and exercise tino-rangatiratanga (self-determination) in navigating their own journey to Whānau Ora.

## *10.2.2 Owning our Futures*

### 10.2.2.1 Intervention procedure

Prior to beginning the low energy diet, participants will have a 1-hour individual appointment with a trained nurse/dietician.

Participants would then start on a 12-week low energy formula diet. At this stage participants would maintain their usual activity levels. Weekly group appointments would be provided with a maximum group size of eight participants (with participants being able to invite a support person/guest). These sessions would be delivered as a mix of virtual and in person sessions using existing spaces such as community centres, marae and churches. Providing group sessions would create cost/time efficiencies and create a support network amongst the participants.

The participants would then begin the progressive introduction of food over the next 2-8 weeks, while continuing weekly group-based consultations. Physical activity targets could be introduced with step counters provided to participants.

For the following 24 months, participants would undergo a weight maintenance phase with monthly group-based appointments. In the event of weight regain greater than 2kg, participants would be offered a 2-4 weeks partial meal replacement 'rescue plan'. If weight gain is greater than 4kg, participants would be offered total diet replacement for 4 weeks and phased food reintroduction for 4 weeks. In both cases, participants would also receive the corresponding support appointments at each phase of the intervention.

### 10.2.2.2 Staff

The following roles would be required for the programme implementation:

#### 10.2.2.2.1 Project clinical lead

A project clinical lead would oversee the intervention design and make decisions on the direction of the programme. They would need to have clinical knowledge and project management skills. This role would oversee the training and ongoing support provided for nurses/dieticians and be available to answer questions from project delivery staff. They would also be responsible for keeping track of records and results throughout the different phases of the intervention.

#### 10.2.2.2.2 Project delivery lead

A project delivery lead would have strong cultural knowledge and would work with programme coordinators to ensure the validity and appropriateness of the intervention for Māori, Pacific Island and Asian communities.

#### 10.2.2.2.3 Programme coordinators

Programme coordinators would focus initially on local recruitment and implementation, including supervision of project delivery staff. Each project coordinator could oversee no more than eight project delivery staff. Their role would include collating and reporting HbA1c results throughout the course of the intervention. As the program is established, programme coordinators may take on as much as a 50% clinical load.

#### 10.2.2.2.4 Administration support for programme coordinators

An administration support role would be created to prevent programme coordinators from doing administrative tasks in clinical time. This role would involve contacting participants and clinicians to organise appointments, facilitating the distribution of formula diets and step counters, entering referral information and collecting information from GPs. The role would also involve setting up virtual meetings and coordinating venue bookings group sessions.

#### 10.2.2.2.5 Project delivery staff

It is unlikely that there would be current capacity in GP surgeries for this intervention. There are however people who are employable and available for work, such as those with a nutrition qualification. As such, this role could be 'skills focused' rather than 'clinician focused' as there may be, for example, nurses or Māori and

Pacific Health educators who wish to perform this role. These roles would be delivering the programme appointments to participants.

## *10.2.3 Better Diabetes Medication*

The intervention can be divided into two actions:

1. Fund a SGLT2 inhibitor and a GLP-1 receptor agonist in New Zealand

2. Improve equitable and easy access to the drugs by providing information and creating awareness amongst the New Zealand medical community.

### 10.2.3.1 Action one – funding

Action one requires PHARMAC to fund SGLT2 inhibitor and a GLP-1 receptor agonist drugs in New Zealand. PHARMAC are currently in the process of finalising this funding and it is expected that a drug in both classes will be funded from December 2020.

### 10.2.3.2 Action two – creating awareness

Funding a medication does not guarantee its success. To ensure the medication is both prescribed and used, clinicians and patients must be made aware of the medication and its benefits.

To successfully create awareness, it is proposed that Diabetes New Zealand or New Zealand Society for the Study of Diabetes (NZSSD) hire two staff members as engagement coordinators for one year which will require additional funding. These coordinators will use existing communication channels/approaches engage with and provide information to all prescribing clinicians as well as type 2 diabetes patients.

Responsibilities of the coordinator role may include:

- Presenting information on these medications at the annual NZSSD conference.

- Engaging with NZSSD, PHARMAC and leading clinicians to develop and align key 'messaging' of the medication with the wider health sector.

- Dissemination of information to people with type 2 diabetes through existing Diabetes New Zealand channels – including their magazine, website and events.

- Building awareness and knowledge amongst GPs, as they will be the leading prescribers. This can be done through the following channels:

    - Submitting information to the New Zealand Medical Association (NZMA) weekly magazine

    - Sending information to individual clinics via email

    - Contacting the Goodfellow Unit to provide eLearning courses and podcasts about the medications

    - Contacting the Matui to include information in their annual report and on their website

    - Submitting information to the New Zealand Doctor magazine

    - Presenting at medical conferences such as the NZMA conference and the New Zealand College of Physicians annual conference.

- Contacting pharmacy groups such as the Pharmacy Society New Zealand (PSNZ), Pharmacy Guild and Pharmacy Today magazine to increase awareness and knowledge among pharmacists and other clinicians.

- Connecting with nurses through the New Zealand Nurses Organisation (NZNO) to engage with and inform them about the medications. It is important that nurse prescribers are familiar with the medications as they will prescribe them to patients. Nurse specialists also play a key role in education patients and the wider primary care community about medications.

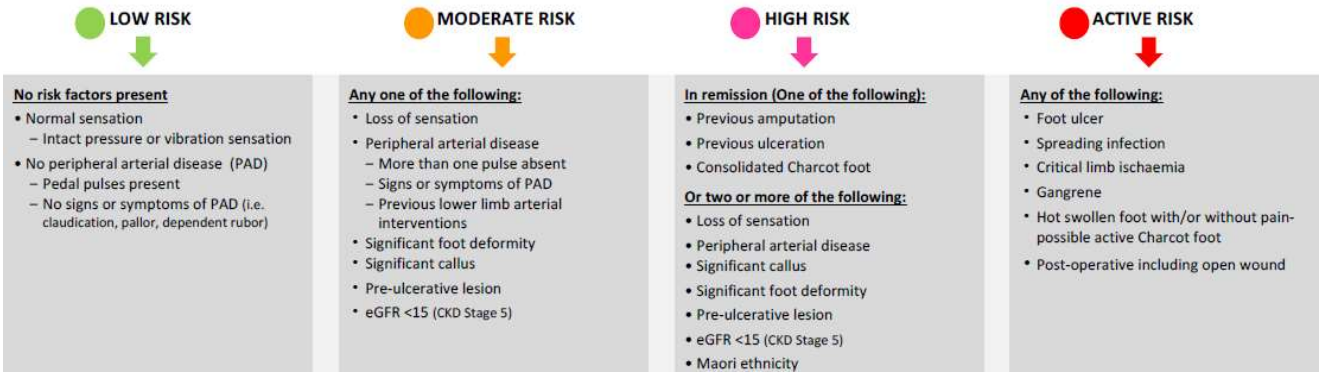
- Engage with the Ministry of Health (MoH) to inquire about funding for advertising and using their resources to further spread information about the medications.

## *10.2.4 Foot Screening and Protection*

### 10.2.4.1 Referral pathway for diabetes foot screening and assessment

The referral pathway for diabetes foot screening and assessment shown in Figure 79 is used to identify and prioritise people according to their level of risk. A person's level of risk will determine the specific Foot Screening and Protection services they receive.

*Figure 79: Referral pathway for diabetes foot screening and assessment*




### 10.2.4.2 Service detail

Foot Screening and Protection services by risk level are presented below:

#### 10.2.4.2.1At all risk levels

- Access to written and verbal educational resources relevant to the risk assessment and emergency contact details. A suite of resources would need to be developed for people with diabetes-related foot problems. This could be achieved in partnership with an organisation such as Health Literacy NZ and local iwi and hapu representatives.

- Advertising costs to increase education and awareness for diabetes, especially around New Zealand Diabetes Action Month.

- Patient-centred treatment plans according to patient needs.

- Annual foot checks as part of the diabetes annual review performed by GPs or practise nurses. This should already be provided so would not incur any additional cost for this intervention.

- Services provided in a culturally appropriate way. The main tool to support this would be up-skilling the health workforce.

#### 10.2.4.2.2 Low Risk

- Current footwear assessment and advice given at annual foot checks. These checks can be performed by a GP or practice nurse.

- Support to develop a self-management plan and regular physical self-assessment of feet.

- Referral to private podiatry as required.

#### 10.2.4.2.3 Moderate Risk

- Annual risk assessment performed by a qualified podiatrist with experience/knowledge of diabetes. This assessment should be 45 minutes in duration for new appointments and 30 minutes for follow up consultations.

- Foot examination every 3 to 12 months by a qualified podiatrist. These foot examinations should be of adequate duration to complete a comprehensive assessment. A person of moderate risk would generally be seen 1 to 4 times per year depending on their care plan.

- Reinforcement of the patient's self-management plan and inclusion of whānau.

- For those at increased risk and where clinically indicated the provision of specialist footwear, socks and/or insoles, measured or fitted by a podiatrist or orthotist. An estimated cost for this would be $500 per person but this would not be required for 100% of moderate risk individuals. This cost is comprised of socks costing $30 to $40 per pair; custom insoles at a cost of $180 to $300 per person; and footwear costing $180 to $250.

- Fully funded referrals to podiatrists for assessment and management. Noting that cost is a barrier for many of those most at risk of developing foot problems so this referral should be fully funded rather than subsidised at this point of care.

#### 10.2.4.2.4 High risk

- Physical foot checks and treatment review performed up to 12 times a year by a qualified podiatrist with experience/knowledge of diabetes. This frequency of visit would apply to patients in remission.

- Review of patient's current footwear and provision of specialist footwear, socks and/or insoles, measured or fitted by a podiatrist or orthotist. An estimated cost for this would be $500 per person and would be required for close to 100% of high-risk individuals. This cost is comprised of socks costing $30 to $40 per pair; custom insoles at a cost of $180 to $300 per person; and footwear costing $180 $250.

- Fully funded referral to podiatrists for assessment and management. Noting that cost is a barrier for many of those most at risk of developing foot problems so this referral should be fully funded rather than subsidised at this point of care. These foot examinations should be of adequate duration to complete a comprehensive assessment.

#### 10.2.4.2.5 Active risk

- Urgent referral to a multidisciplinary or hospital podiatry clinic if required. Approximately 25% of people with type 2 diabetes will require this service over their lifetime. On an annual basis this would be 2% to 4% of the type 2 diabetes population.

- Weekly appointments with a specialist diabetic foot podiatrist.

- Provision of dressings and other costs such as district nursing to manage DFUs.

- Emergency admission to hospital if rapidly deteriorating or systematically unwell. Approximately 1% of the type 2 diabetes population will require this service each year.

- Urgent referral to vascular service for critical limb ischaemia. 1% to 2% of the type 2 diabetes population with PAD will require this service. This value does not include any community services such as district nursing for ongoing wounds and podiatry for foot monitoring.

- Tailored management plan according to patient needs.

Providing optimal care extends beyond clinical care. Services should be delivered in a culturally appropriate manner. Models such as the Hui Process and the Meihana Model could be used to guide clinician interactions with patients. These models of care have been shown to be effective for all population groups, not just Māori, so will not disadvantage other patients with type 2 diabetes.

#### 10.2.4.3 Staff

The New Zealand podiatry profession is small with minimal growth indicating a workforce shortage[86]. There is a need to increase the number of podiatrist to provide this service as well as a requirement to upskill the health workforce to work with high and active risk diabetes patients; to perform accurate foot screening; to make appropriate and timely referrals; and to be culturally responsive/competent.

Ideally, the minimum criteria for a podiatrist working with high risk, active risk or patients in remission would be a 45-point postgraduate qualification such as the AUT Postgraduate Certificate in Health Sciences in Podiatry. This qualification costs approximately $3,000. Currently, podiatrists require a minimum of five years of clinical experience to work in this area.

Another possible way to improve the service received by Māori and Pacific populations is to increase the number of Māori and Pacific podiatrists in New Zealand.

## *10.3 Methodology and assumptions*

In the discussion below, we provide detail on our methodology and assumptions for:

- Our intervention identification and design
- Population-based prevalence projections
- Population-based cost projections
- Cost-benefit analysis.

### *10.3.1 Intervention identification and selection*

To identify and select the four diabetes interventions, we first worked with the Expert Advisory Group (Table 2) to identify the key challenges/problems associated with type 2 diabetes prevention, treatment and care in New Zealand. These key challenges/problems fell under four 'current state lenses': prevalence and outcomes; equity of access and health outcomes; political and funding landscape; and current New Zealand approach to type 2 diabetes prevention, care and management.

Using the key challenges/problems identified by the group, the diabetes disease progression pathway (Figure 11) and external research, we developed a 'long-list' of 18 potential future type 2 diabetes interventions. The Expert Advisory Group were then asked to assess and prioritise the interventions based on criteria below (section 10.3.1.1). We then collated this feedback to rank the interventions from highest to lowest priority. During a further workshop, the Expert Advisory Group and Ministry of Health participants worked in two groups to discuss and score the interventions based on the initial rankings. This workshop resulted in the group coming to a consensus on the preferred interventions. The Project Sponsor Group then made a final decision on the four interventions for assessment and cost-benefit analysis.

#### 10.3.1.1 Intervention criteria ranking/weighting

| Criteria | Weighting |
|---|---|
| 1. Proven efficacy of the intervention (as supported by international and/or New Zealand research/data to aide cost-benefit-analysis modelling) | 40% |
| 2. Extent to which the intervention will enable equity of access and equity of health outcomes | 40% |
| 3. Political feasibility/acceptance of the intervention (i.e. does the intervention align with current Government priorities/principles? Is the cost palatable to the Government when considering the size and reach of the intervention?) | 20% |
| **TOTAL** | **100%** |

**Each criterion will include a 3-point scale:**

1. Proven efficacy of the intervention (as supported by international and/or New Zealand research/data to aide cost-benefit-analysis modelling)

| | | |
|---|---|---|
| No-low evidence of efficacy | Moderate evidence of efficacy | High evidence of efficacy |

2. Extent to which the intervention will enable equity of access and equity of health outcomes

| | | |
|---|---|---|
| Enables no-low equity of access and health outcomes | Enables moderate equity of access and health outcomes | Enables high equity of access and health outcomes |

3. Political feasibility/acceptance of the intervention (i.e. does the intervention align with current Government priorities/principles? Is the cost palatable to the Government when considering the size and reach of the intervention?)

| | | |
|---|---|---|
| No-low political feasibility and/or acceptance | Moderate political feasibility and/or acceptance | High political feasibility and/or acceptance |

## *10.3.2 Population-based prevalence projections*

### 10.3.2.1 Methodology

Our model estimates the prevalence of diabetes in New Zealand between 2018 and 2040, based on four key characteristics: gender, age band, ethnicity and DHB. This has the advantage of allowing more granular prevalence modelling and enables us to 'cut' the projections by each of these demographics (or a combination of them).

The prevalence of type 2 diabetes is calculated as:

$$\frac{Number\ of\ individuals\ with\ T2\ diabetes}{Total\ number\ of\ individuals\ in\ population}$$

Note that the "total number of individuals in the population" may be a subset of the national population, if we are only considering prevalence of a select group. For example, if we were considering the prevalence of diabetes for Pacific Island ethnicity, ages 50+, the numerator would be the number of individuals in New Zealand that are Pacific Island ethnicity and aged 50+ with type 2 diabetes, the denominator would be the number of individuals in New Zealand that are Pacific Island ethnicity and aged 50+.

The model outputs both the number of expected individuals with type 2 diabetes by demographic and the prevalence of type 2 diabetes (percentage) over time.

Expected prevalence has been determined by fitting a logistic generalised linear model (GLM) to the past diabetes experience in New Zealand (2014-2018), using statistical tests from these results to determine which individual characteristics are significant. The factors that were determined to be significant were:

- Gender – Male or Female – males tend to have a higher rate of diabetes that females.

- Ethnicity – Māori, Pacific Island, Asian (including Indian) and Other (non-Māori/Pacific/Asian). Ethnicity is prioritised (in order listed above), which means that each person is grouped by their primary ethnicity, and is counted only once in the analysis, even though in practice an individual may identify as multiple ethnicities. Those with Pacific Island ethnicity have the highest prevalence, followed by Asian, Māori and then the 'catch-all' Other.

- Age band – the model projects on age bands of 5 years. There is a strong relationship between age and type 2 diabetes; as age increases prevalence of type 2 diabetes increases.

- DHB – the model uses enrolled DHB as a predictor. Location has an impact on the prevalence of diabetes (independent of the factors above) with some DHBs having higher prevalence than others.

There is also a factor incorporated to allow for demographic mix changes between years in the data used to train the model.

The parameters for each of the factors above were determined by the GLM and are used to estimate national prevalence. This resulted in 2880 specific prevalence rates corresponding to each of the cohorts.

The underlying data includes both type 1 and type 2 diabetes (although excludes other types of diabetes, such as gestational diabetes), and therefore an adjustment was needed to project only those with type 2 diabetes. It was assumed that 90% of those with diabetes in 2018 had type 2, which is the standard type 1/type 2 ratio used in New Zealand. Therefore, prevalence was reduced by 10% by cohort group (multiplicatively applied to each of the 2880 cohorts) to back out those with type 1 diabetes before running the model over 20 years. Note that it could be argued that type 2 may make up a higher proportion of diabetes than 90%, however robust data and analysis on the true split for New Zealand was unavailable at the time of this analysis, and therefore 10% is considered a reasonable and slightly conservative assumption.

The adjusted prevalence rates by cohort were then projected to the year 2040 using the Statistic New Zealand 20-year population projections. Two 20-years prevalence projections were output, in order to create a 'band' of possible future type 2 prevalence scenarios.

1. The first assumes **'static'** prevalence. Prevalence is assumed not to grow over time, remaining at the current modelled rates. Even applying static prevalence rates to each cohort national prevalence of type 2 diabetes is still expected to increase due to changes in demographic mix over time (an aging population for instance).

2. The second assumes **'growth'** in prevalence. Growth factors were established based on five years of historical data, and set based on age band (20 year) and ethnicity. The growth assumptions for this scenario can be found in the key assumptions section below.

Note that the higher estimated prevalence numbers are not intended to be an upper bound for future prevalence. There are some countries, for instance the USA, that currently have much higher prevalence than even the New Zealand 20-year projected prevalence presented in this report. Therefore, if diabetes rates in New Zealand were to deteriorate over time, actual prevalence could be materially higher presented here.

The next sections outline the **data** and **assumptions** used for the prevalence modelling in more detail.

### 10.3.2.2 Data

There were two key datasets used to model the prevalence projections; the Virtual Diabetes Register (VDR) maintained by the Ministry of Health and the New Zealand 20-year national population projections, produced by Statistics New Zealand (SNZ) for the Ministry of Health. The table below includes a description of each dataset, adjustments made to the data, and a brief comment on the limitations of the dataset.

*Table 20: Data sets used in prevalence modelling*

| Data | Adjustments | Limitations and other comments |
|---|---|---|
| **Virtual Diabetes Register** – Ministry of Health – 2014-2018<br><br>*Annual estimate by MoH of the prevalence of type 1 and type 2 diabetes in New Zealand. It contains information about people suspected of having diabetes, which are identified using diabetes health services (for instance, HbA1c tests above a certain threshold).* | • In the VDR data some individuals were assigned to "Unknown/Unassigned" DHB. This applied to 725 people across 5 years (around 0.06% of the total diabetes population). These people were excluded from the modelling.<br>• There were some instances where the number of those with diabetes estimated by the VDR for a given cohort were greater than those in the SNZ population projection. In these cases, the weighting given to the diabetes count was 0. Over the 5 years of data this impacted 166 cases (equivalent to a 0.014% adjustment across all years). | • The most recent VDR extract available at the time of analysis was 2018.<br>• As with all data, the quality of the VDR is dependent on how the data is collected and maintained. In particular, the VDR estimates diabetes rates based on health services used, and so can be impacted by factors unrelated to diabetes prevalence, for instance increased HbA1c testing. The VDR is the best national estimate of diabetes prevalence currently available and is considered a very good estimate of current prevalence rates, but it may be limited when used to infer future trends in diabetes. To mitigate these potential limitations, both 'static' and 'growth' prevalence scenarios have been modelled. The 'static' scenario is not impacted at all by any VDR trend limitations over time. The 'growth' scenario is considered conservative. |
| **New Zealand national population projections** – SNZ – 2019 update<br><br>*Estimate by SNZ that incorporates population trends that shows what the NZ population may be like in the future, including demographic mix.* | • The most recent SNZ projections were available until 2037. Population projections were required to 2040, therefore the final three years were estimated based on the average change in population over the three years prior to 2037, calculated based on the 2880 cohort groups (age band, ethnicity, gender and DHB). | • Ethnicity split for population projections was limited to the four listed above, which mean that Indian, for which there are significant levels of diabetes prevalence, could not be modelled independently of 'Asian'. The main impact was to the level of detail that could be presented in the report. |

## 10.3.2.3 Population-based prevalence projection assumptions

There were two key assumptions used in the prevalence modelling. These were the:

1. Type 1/type 2 ratio assumption, and

2. The additional growth in prevalence rates applied to the 'growth' prevalence scenario (the upper band of the prevalence range).

### *10.3.2.3.1 Type 1/type 2 diabetes assumption*

A ratio of 10% type 1 and 90% type 2 was assumed for the modelling of the diabetes population. As described above, this is the type 1/type 2 'rule-of-thumb' typically assumed in New Zealand. While it could be argued that the actual proportion of type 1 diabetes in the diabetes population may be less than 10%, due to lack of robust data and analysis, we have chosen to maintain a conservative the 10/90 split for the modelling.

Those with type 1 diabetes are backed out in the first year of the projection, which is applied multiplicatively across each of the cohort groups. An alternative method could have been to apply this assumption additively.

### *10.3.2.3.2 Additional growth in prevalence factors*

Table 21 shows the annual growth factors applied to the prevalence projections. The growth assumptions were based on the average change in diabetes prevalence over the previous 5 years. The growth assumption for volatile cohorts (for instance, those with few individuals) was set to 0%.

*Table 21: Growth factors applied in prevalence modelling (annual factor)*

| Cohort - Ethnicity | Cohort – Age band | 'Static' scenario or lower bound of band | 'Growth' scenario, or upper bound of band |
|---|---|---|---|
| Other | 0-19 | 0.0% | 0.0% (low counts) |
| Other | 20-39 | 0.0% | 1.3% |
| Other | 40-59 | 0.0% | 0.4% |
| Other | 60-79 | 0.0% | 0.0% |
| Other | 80+ | 0.0% | 0.0% |
| Māori | 0-19 | 0.0% | 0.0% (low counts) |
| Māori | 20-39 | 0.0% | 2.8% |
| Māori | 40-59 | 0.0% | 1.1% |
| Māori | 60-79 | 0.0% | 0.0% |
| Māori | 80+ | 0.0% | 0.2% (low counts) |
| Pacific Island | 0-19 | 0.0% | 0.0% (low counts) |
| Pacific Island | 20-39 | 0.0% | 2.4% |
| Pacific Island | 40-59 | 0.0% | 0.7% |
| Pacific Island | 60-79 | 0.0% | 0.5% |
| Pacific Island | 80+ | 0.0% | 3.7% |
| Asian | 0-19 | 0.0% | 0.0% (low counts) |
| Asian | 20-39 | 0.0% | 3.9% |
| Asian | 40-59 | 0.0% | 0.0% |
| Asian | 60-79 | 0.0% | 0.6% |
| Asian | 80+ | 0.0% | 0.0% (low counts) |

## *10.3.3 Population-based cost projections*

Population based costs were built up from four impact areas: health care costs, economic impact of missing lives, economic impact of reduced ability to undertake work and reduced productivity of work undertaken.

### 10.3.3.1 Breaking up the population into groups

To assign impacts to individuals within the wider population prevalence projections we first divided the projected counts into disease progression pathway groups (group 1, 2, 3 and 4 as described in section 2.1.2). As a starting point we divided the population into the four groups by using HbA1c test results as a proxy for disease progression and severity. This was then tested and adjusted following discussions with expert clinicians, as HbA1c levels are not a perfect determinant of severity.

Life expectancy by age and group was required to capture economic costs. We estimated the remaining life expectancy for males and females diagnosed with diabetes at every age from 0 to 120 years old (further detail can be found below). We divided the remaining life expectancy into unequal length periods of time by calculating the period that would match the known distribution of people into the four groups. Using mortality tables, we calculated the expected mortality at each age to allow for attrition. This was then combined with the counts of people by gender and age to estimate the age a person would have first been diagnosed with diabetes, their current age and therefore which disease progression pathway group they would be in at each point in time. By adjusting the length of time an average person would stay in each group, we were able to match the group totals calculated earlier to the more detailed breakdown by age, gender, current age and age of diagnosis.

We used the age/gender specific group distribution method calibrated on the 2018 data and then calculated all other years using the same model to approximate the age/gender/group breakdown for every year to 2020. This formed the basis for all the population-based cost projections.

#### 10.3.3.2 Creating representitive health costs

We created health costs in five baskets using two different techniques. For **laboratory costs and secondary care** costs we used the estimated total cost of providing these services to people with diabetes in Counties-Manakau DHB (CMDHB)[87]. We inflated these values to 2020 dollars and scaled by the relative prevalence counts to give a total system wide cost. The inflation factors applied were CPI plus superimposed medical inflation, in line with the assumptions used in other government valuations.

We interviewed clinicians to understand the range of laboratory and secondary care services used by people with type 2 diabetes and the estimated frequency of use. Based on the results of the interviews we assigned a weighting to each service type (list price for laboratory costs and average hospital nights for secondary care). We used these weighted scores to divide the total cost of laboratory and secondary care between the people in each progression group to give unique costs for each group.

For **medications and primary care** (both publicly funded and self-funded) we used the same clinician interviews to estimate the range and frequency of use of each service or medication type by each progression group. We then used actual cost prices and multiplied these by the use rates of each service to build a bottom up cost value for these cost baskets. We compared the bottom up basket prices with the inflated totals from the CMDHB paper and found they aligned within 5% of the totals given in the CMDHB paper, after adjusting for inflation.

We assigned one basket of health costs of each type to each person in the population projection depending on which progression group they would be in for every year they were expected to be alive.

#### 10.3.3.3 Creating representitive productivity costs

We used Statistics NZ data to find the average annual pre-tax earnings by age group[88]. This dataset provided values for people between the ages of 15-65 and 65+, the latter which we have used to represent the age group 65-69. For each age band we used a PAYE tax calculator to calculate the proportion of the average earnings that was take home pay, and the proportion that was PAYE (income tax) and ACC levies. We assumed $0 payments for both kiwisaver and student loans.

For non-salary labour, we multiplied the take home portion of earnings for each age group by 75% in line with the assumption for non-salary labour used by the American Diabetes Association (ADA)[89].

#### 10.3.3.4 Creating values for the economic values of missing lives

The discussion below provides definitions of each economic cost type, our calculation methodology and assumptions.

##### 10.3.3.4.1 Assumptions related to losses to personal income and tax (lives lost early)

The modelling assumes where a life is lost early and value is lost in the personal income and tax categories, that the person would have been employed were their life lost early. By default, this assumes full employment in the wider economy and that the job is not being filled by someone who would otherwise be employed.

##### 10.3.3.4.2 Assumptions related to losses to non-salary labour (lives lost early)

The modelling assumes where a life is lost early and value is lost in the non-salary labour category, that the work that would otherwise be performed were the life not lost early is essential and must otherwise be performed by someone else, either paid or unpaid.

In reality some non-salaried labour would not be essential were a person's life lost early e.g. domestic work within the persons dwelling. To help account for this type of loss, we have adopted the ADA assumption of non-salary labour being valued at 75% of after-tax salaried labour however, our modelling may overestimate this category.

#### 10.3.3.4.3 Loss of personal income (lives lost early)

This represents the value of lost production that would have accrued as salaries and wages to workers. It excludes tax revenue and ACC levies and only represents the 'take home' portion of income. We have calculated this by taking the average annual income of someone in full time employment in each age band and subtracting the value of tax and ACC levies at the average income value. We then multiplied this by the workforce participation rate and subtracted the unemployment rate at that age band.

#### 10.3.3.4.4 Loss of tax revenue (lives lost early)

This represents the value of lost income tax and ACC levies that would have been paid by the average worker. This is essentially the portion of total income not represented by personal income. We calculated this value in the same manner as personal income, substituting the term '1-tax' for 'tax'.

#### 10.3.3.4.5 Loss of non-salary labour (lives lost early)

This represents the value of labour not undertaken as paid employment. We have assumed that everyone of working age not engaged in paid employment is undertaking unpaid labour such as childcare, domestic work or voluntary community work. The ADA estimates the value of non-salary labour to be equivalent to 75% of the value of personal income[89]. We have applied this same assumption.

#### 10.3.3.4.6 Method to create values

To calculate the value of missing lives we first had to model the estimated number of missing lives by gender and age group. We did this by using the Stats NZ cohort life tables[90] to set a baseline for mortality rates. We then overlaid an increased mortality factor to the standard values and adjusted this to fit the United Kingdom Department of Health research that shows type 2 diabetes shortens life expectancy by 10.8 years[25]. We assumed the increased mortality rates were a fixed multiple of the general population mortality rates for all ages and applied this multiplier to every year once a person is diagnosed with type 2 diabetes to create adjusted life expectancies for people diagnosed with type 2 diabetes at every age between 0 and 120.

Using the adjusted life expectancies and the known number of people with type 2 diabetes in each age band we estimated the age at which each person was diagnosed and the excess mortality between the age of diagnosis and the current age. This gave the excess mortality for each age band and each gender or the "missing lives". We applied the same ratio of existing lives to missing lives for each age band and gender that we calculated for 2020 to all the type 2 diabetes population projected in future years to create a value for missing lives for every year.

Finally, we broke the missing lives down into those who would be working and those who would be undertaking non-salaried labour by using workforce participation rates and unemployment rates from the March 2020 Household Labour Force Survey[91]. We created separate values for each age band but did not separate by gender.

The missing lives in each age band that would be working were multiplied by the average take home earnings to produce the total missing personal income value and by average tax and ACC levies to produce the total missing tax revenue value. The missing lives in each age band that were not working were assumed to be undertaking non-salaried labour and these missing lives were multiplied by the average non-salaried labour value to produce the total missing non-salaried labour values.

### 10.3.3.5 Creating values for the economic impact of inability to perform labour due to disability

The discussion below provides definitions of each economic cost type, our calculation methodology and assumptions.

#### 10.3.3.5.1 Assumptions related to losses to personal income and tax (unable to perform labour)

The modelling assumes where a person is disabled and value is lost in the personal income and tax categories, that the person would have been employed were they not disabled. By default, this assumes full employment in the wider economy and that the job is not being filled by someone who would otherwise be employed elsewhere.

#### 10.3.3.5.2 Assumptions related to losses to non-salary labour (unable to perform labour)

The modelling assumes where a person is disabled and value is lost in the non-salary labour category, that the work that would otherwise be performed were the person not disabled is essential and must otherwise be performed by someone else, either paid or unpaid. This assumption is appropriate for this group of people as most non-salary labour not performed by a disabled person would still need to be performed by another person. The ADA assumption that non-salaried labour is valued at 75% of salaried labour may be an underestimate in this category.

#### 10.3.3.5.3 Loss of personal income (unable to perform labour)

This represents the value of lost production that would have accrued as salaries and wages to workers. It excludes tax revenue and ACC levies and only represents the 'take home' portion of income. We have calculated this by working out the difference between the labour force participation rate for the general population and the estimated labour force participation rates for each group based on the relative severity of impact. We then multiplied these disabled workers by the average annual income of someone in full time employment in each age band and subtracted the value of tax and ACC levies at that average income value.

#### 10.3.3.5.4 Loss of tax revenue (unable to perform labour)

This represents the value of lost income tax and ACC levies that would have been paid by the average worker. This is essentially the portion of total income calculated in 10.3.3.5.3 not represented by personal income. We calculated this value in the same manner as personal income, substituting the term '1-tax' for 'tax'.

#### 10.3.3.5.5 Loss of non-salary labour (unable to perform labour)

This represents the value of lost labour not undertaken as paid employment. We have assumed the same disability impact affects the group not in the labour force as for the group that is in the labour force. We have used the same assumption as in section 10.3.3.4.5 that the value of non-salary labour is 75% of the value of personal income for those in paid employment.

#### 10.3.3.5.6 Method to create relative impact values

To create these values, we needed to estimate the proportion of the population that would not be working due to disability that otherwise would be, either in paid employment or in non-salaried labour. We used an ADA finding that 3.1% of people with type 2 diabetes are unable to work due to disability and assumed this would apply to both salaried and non-salaried labour. Through our interviews with clinicians, we determined that the impact on someone in one disease progression pathway group is different to an otherwise identical individual in a different group. Estimates provided during the interviews enabled us to understand the relative impact of this burden on the population living with type 2 diabetes and developed a relative productivity impact scoring system. We used these results to differentiate the impact on the four disease progression pathway groups. After adjusting for group sizes this gave the following impacts by group:

*Table 22: Relative impacts by 'diabetes group'*

| Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|
| 0.0% | 0.5% | 1.6% | 11.5% |

We divided each age group and progression pathway group into those working in paid employment and those not working in paid employment using the Household Labour Force Survey data and multiplied each group by the appropriate impact score from above. This gave use the number of people that would normally be working by age that were predicted to not be working because of disability.

As with the missing lives calculations above, we multiplied the number of people predicted not to be working by the take home earnings and tax and ACC levy value for that age group to create the total value of missing personal income and total value of missing tax revenue. We multiplied the number of people predicted not to be doing non-salaried labour by the value of non-salaried labour for that age group to create the total value of missing non-salaried labour.

### 10.3.3.6 Creating values for the economic impact of reduced productivity of work undertaken

The discussion below provides definitions of each economic cost type, our calculation methodology and assumptions.

#### 10.3.3.6.1 How we used the relative productivity impact scores

The relative productivity impact scores represent the relative severity of an impact across sub-groups within a group e.g. if groups 1,2,3 and 4 got scores of 0, 5, 10, 25 this would indicate that group 1 is not impacted at all by factor X while group 2 has some impact, the impact on group 3 is twice as severe as group 2 and the impact on group 4 is five times as severe as group 2 and two and a half times as severe as group 3.

We demonstrate the mechanics behind this in a table below where the known average days of work lost is 1 day per person per year when considering all members of all groups to be impacted equally. We then show how members of each group would be impacted differently when adjusting the impact for the relative productivity impact score estimated by clinicians for that group.

*Table 23: Summary results of assigning relative impact scores per 'diabetes group'*

| Step | Group 1 | Group 2 | Group 3 | Group 4 | Total |
|---|---|---|---|---|---|
| People in group | 25 | 25 | 25 | 25 | 100 |
| Average days lost per person (all groups equal) | 1.0 | 1.0 | 1.0 | 1.0 | Average 1.0 |
| Total days lost by group | 25 | 25 | 25 | 25 | 100 |
| Relative productivity impact score | 0 | 5 | 10 | 25 | - |
| Total days lost by group adjusted for impact score | 0 | 12.5 | 25 | 62.5 | 100 |
| Average days lost per person after adjusting for impact score | 0.0 | 0.5 | 1.0 | 2.5 | Average 1.0 |

#### 10.3.3.6.2 Assumptions related to losses to personal income and tax (reduced productivity)

The modelling assumes where a person has reduced productivity due to absenteeism or presenteeism, that the value of that lost productivity is translated directly into a person's salary. This is an imperfect assumption.

In reality employees paid hourly may use sick leave or other leave to cover absenteeism. Employees paid fixed salaries will often still get paid their full salary. In these cases, at least in the short term the economic cost of reduced productivity is paid by the employer through lower productivity and lower profits. Over the longer term, employees with lower productivity will receive on average lower salaries and this cost will be paid by the individual. The true costs of this impact are split between the employee and the employer.

#### 10.3.3.6.3 Assumptions related to losses to non-salary labour (reduced productivity)

The modelling assumes where a person has reduced productivity due to absenteeism or presenteeism, that the impact is identical for non-salaried labour as it is for salaried labour. Non-salaried labour is often less structured than formal paid employment and can be performed as needed by an individual around periods of illness or temporary disability. We have kept the same 75% value of salaried labour assumption as the previous two categories which may be an over estimation for this category.

#### 10.3.3.6.4 Loss of personal income (reduced productivity)

We took the estimated number of people by gender and age group and multiplied them by the labour force participation rate after removing the group already identified as being unable to perform labour discussed in 10.3.3.5.3 to avoid double counting. We then multiplied this group by 1 minus the unemployment rate for each age group. This gave us the group of people in work by age.

We stratified the impact across the four 'diabetes groups' and applied the value for lost productivity to the average total income for that age group to create a reduced income. Finally, we calculated the tax component of the reduced income and compared the non-tax component to the non-tax component of the average total income for the age group. The difference was the lost productivity per person, which we multiplied by the people in this group.

#### 10.3.3.6.5 Loss of tax revenue (reduced productivity)

We calculated the lost tax revenue in the same manner as the lost personal income but compared the tax component of the reduced income by age with the tax component of the average income by age and multiplied this by the group size.

#### 10.3.3.6.6 Loss of non-salary labour (reduced productivity)

We used the same assumption in this calculation for unpaid labour as we did in section 10.3.3.4.5 ; that unpaid labour had a monetary value of 75% of the take home personal income. We multiplied this value by the number of people by gender and age group that were not in the labour force as well as those in the labour force but unemployed after subtracting those unable to perform labour.

#### 10.3.3.6.7 Method to create values

This calculation combines two different impacts, the value of productivity lost due to absenteeism and the value of productivity lost due to presenteeism. We have again used the ADA research values of 1.7 days lost per year or 0.71% for absenteeism and 6.6% for presenteeism[88]. Using the relative productivity impact scores, we have created unique impacts for each disease progression pathway group.

*Table 24: Absenteeism loss per 'diabetes group'*

| Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|
| 0.00% | 0.11% | 0.36% | 2.62% |

*Table 25: Presenteeism loss per 'diabetes group'*

| Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|
| 0.0% | 1.0% | 3.4% | 24.2% |

We then multiplied these values to give total productivity loss values.

$$Productivity\ loss_{Total} = 1 - (1 - Productivity\ loss_{Absenteeim}) \times (1 - Productivity\ loss_{Presenteeism})$$

*Table 26: Total productivity loss per 'diabetes group'*

| Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|
| 0.0% | 1.1% | 3.7% | 26.4% |

For each age group and progression pathway group we took the groups that would be in work and would be undertaking non-salaried labour and removed those already accounted for as unable to work due to disability.

We then adjusted the value of personal income, tax revenue and non-salaried labour down to account for the lost productivity percentages from Table 26. The difference between this lower value and the value for the general population represents the value of lost productivity of work undertaken. We multiplied the value for lost productivity for each age and progression pathway group by the number of people in that group (after subtracting the group predicted to be unable to work from section 10.3.3.5) to create the total value of lost productivity of work undertaken for personal income, tax revenue and non-salaried labour.

#### 10.3.3.7 Population-based cost projection assumptions

We have to make several assumptions to complete population-based cost projections. As the population-based costs inform the intervention specific cost-benefit calculations, by default these assumptions apply there too.

##### 10.3.3.7.1 Type 2 diabetes progresses in a linear manner from group 1 to group 4 throughout a person's remaining life expectancy

We have assumed that type 2 diabetes always progresses from group 1 through to group 4 in a linear manner throughout the persons remaining life expectancy from (approximated) the age of diagnosis. This assumption does not make allowance for any movement backwards to a less severe disease progression pathway group unless otherwise stated as part of an intervention.

##### 10.3.3.7.2 Mortality rate multiplier

Type 2 diabetes decreases life expectancy and therefore increases mortality. We used the value provided by the United Kingdom Department of Health that life expectancy is reduced by at least 10.8 years, but this source didn't provide age specific mortality rates which were required to complete our economic modelling. We back solved the mortality rates to fit the stated decrease in life expectancy. To do this we assumed a fixed multiplier for all ages and used diagnosis at year zero to fit the multiplier. This has the effect of making the reduction in life expectancy for all ages at diagnosis greater than zero, less than 10 years. The result is that for the vast majority of the population with type 2 diabetes, this will somewhat underestimate the decrease in life expectancy and increase in mortality. In simple terms, we have likely underestimated the excess mortality due to type 2 diabetes resulting in underestimating the value of missing lives. The static top-up multiplier to mortality rates used for all ages was 1.9 times the general population mortality rate.

##### 10.3.3.7.3 Earnings, tax and non-salaried labour

We used the average earnings for each age band and calculated tax and ACC levies on the average earnings values. In reality earnings at all ages will be distributed around the average with the tax component being a different proportion for each individual. Due to the progressive tax system, our method slightly underestimates the personal income portion and slightly overestimates the tax revenue portion of income while the combined total remains the same. Consider the following two examples: two people earning $60,000 would pay $23,708 in tax and ACC levies ($11,854 each) and take home $96,262 ($48,146 each). One person earning $80,000 and one earning $40,000 also averages $60,000 but they pay $24,488 in tax ($18,432 + $6,056) and take home $95,512 ($61,568 + $33,944).

Because the value for non-salaried labour is 75% of the value of personal income, this value will also be underestimated.

### *10.3.4 Cost-benefit-analysis (CBAx)*

To calculate the cost-benefit of each intervention, we have used the Treasury CBAx tool – a model designed to help agencies monetise quantitative and qualitative impacts and perform a cost benefit analysis. This approach was chosen to be consistent with other government agencies when evaluating the impacts of a proposed intervention.

Cost inputs have been retrieved from medical reports, online (such as Stats NZ data) and from Diabetes New Zealand. Costs have been entered in real dollars and inflated using the Treasury CBAx inflation rate. The tool then calculates the present value of costs over a 50-year period for the cost benefit analysis.

Benefits calculated in the diabetes disease progression pathway as outlined in section 2.1.2 are inputted into the CBAx tool. All benefits are entered as 2020 values, and are inflated using the Treasury CBAx inflation rate[92]. The targeted percentage of the population and success rates are then applied to the monetary impact to accurately reflect the per-person value that each impact will have. For example, the targeted percentage of the population for an impact may be the percentage of males or females in the program if the impact differs by gender. The success rate is the effectiveness of the impact, in terms of risk reduction of an impact or the percentage of the targeted cohort who successfully receive the impact.

The present value of each impact, now as a per-person value, is calculated and multiplied by the total population. The present values of all impacts are summed and compared with the present value of costs. This results in a Return on Investment calculated for government only impacts and total societal impacts.

## *10.4 Data and information limitations*

The two key sources of data relied on to model future prevalence of type 2 diabetes were the

- Virtual Diabetes Register (VDR) – Ministry of Health, and
- New Zealand national population projections – Statistics New Zealand.

The VDR is an annual estimate by the Ministry of Health of the prevalence of type 1 and type 2 diabetes in New Zealand. It contains information about people suspected of having diabetes, which are identified through the use of diabetes health services (for instance, HbA1c tests above a certain threshold). When compared with DHB records and other health information, such as the New Zealand Health Survey, the VDR is considered to have high accuracy, although there is some minor misalignment by demographic[49]. There are some limitations using the VDR to predict future prevalence, which are discussed in Appendix 10.3.2. While DHB's have access to the most accurate prevalence information, it is difficult to collect and connect this data nationally. Therefore, the VDR is considered the most accurate and reliable tool currently available to estimate actual prevalence in New Zealand. Other key inputs into the prevalence modelling included an assumed ratio of 10% as the split between type 1 and type 2 diabetes, applied multiplicatively across the various demographics. This is the standard split of type 1/type 2 used in New Zealand. For future information about the data, assumptions and limitations of the prevalence modelling see Appendix 10.3.2.

Sourcing data to estimate **current and future costs** of type 2 diabetes was challenging, with no complete national information available at the time of modelling. Therefore, a number of assumptions were required to estimate the current marginal medical and economic costs of type 2 diabetes, and project these over the next 20 years. These assumptions and estimations included extrapolating from the available data national cost estimates (for instance, cost experience across select DHBs used to estimate national costs), using international studies comparable with New Zealand to estimate productivity and mortality impacts, and expert clinician experience to sense check and estimate individual experiences. Due to the high level of judgement involved there is a reasonable level of uncertainty in the cost modelling. However, all information available was sense checked and cross-referenced wherever possible to ensure the modelling is as accurate as possible. For a more detailed discussion about the data, assumptions and limitations of the cost modelling see Appendix 10.3.3.

[49] *Based on conversations with the Ministry of Health data analytics team*

## 10.5 Larger format investment logic maps

We have reproduced the individual investment logic maps for each of the proposed interventions below in large format to improve readability.

*Figure 80 Investment logic map for Healthy People, Healthy Lives*

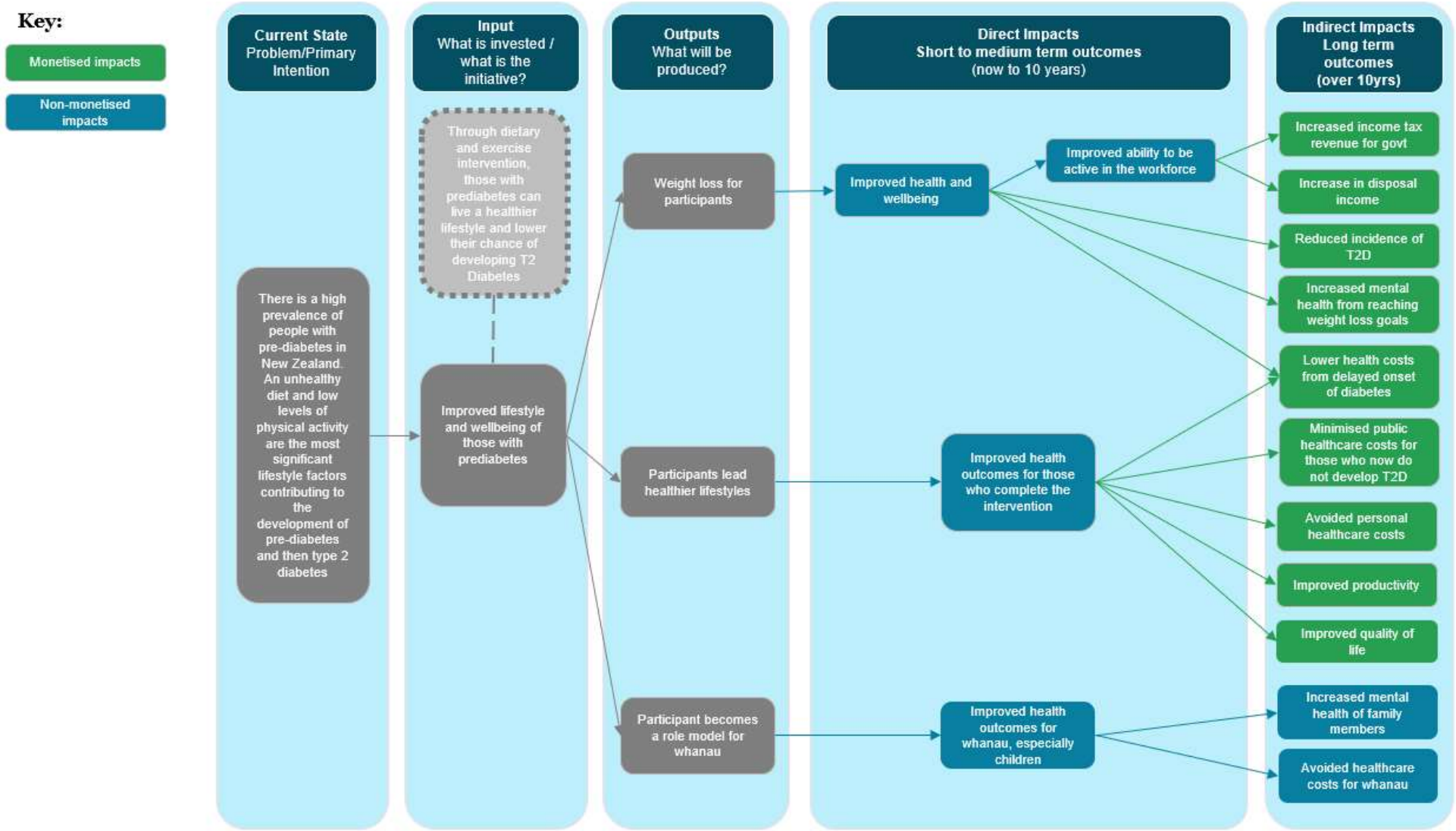


*Figure 81 Investment logic map for Owning our Futures*

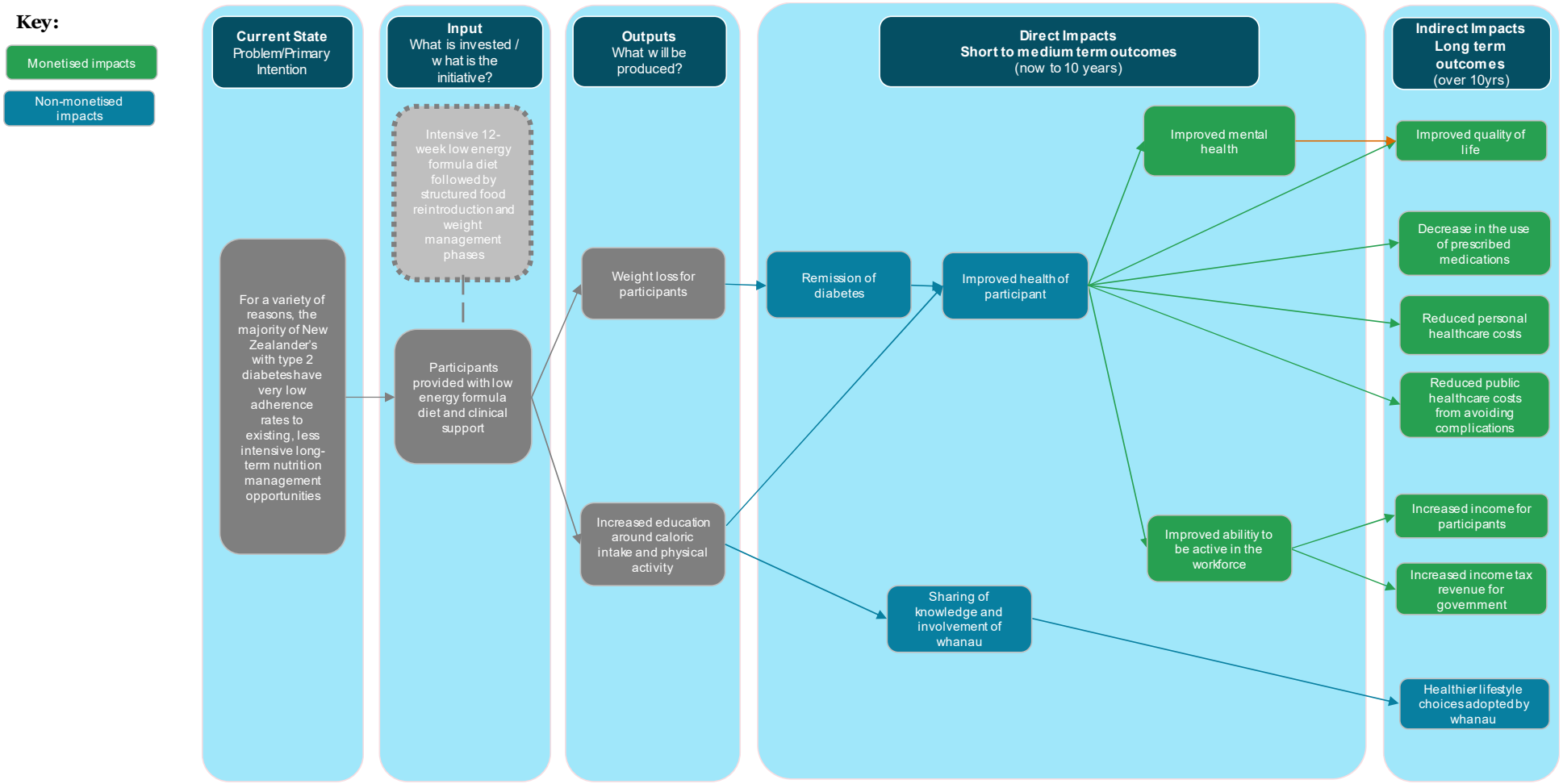


*Figure 82 Investment logic map for Better Diabetes Medications*

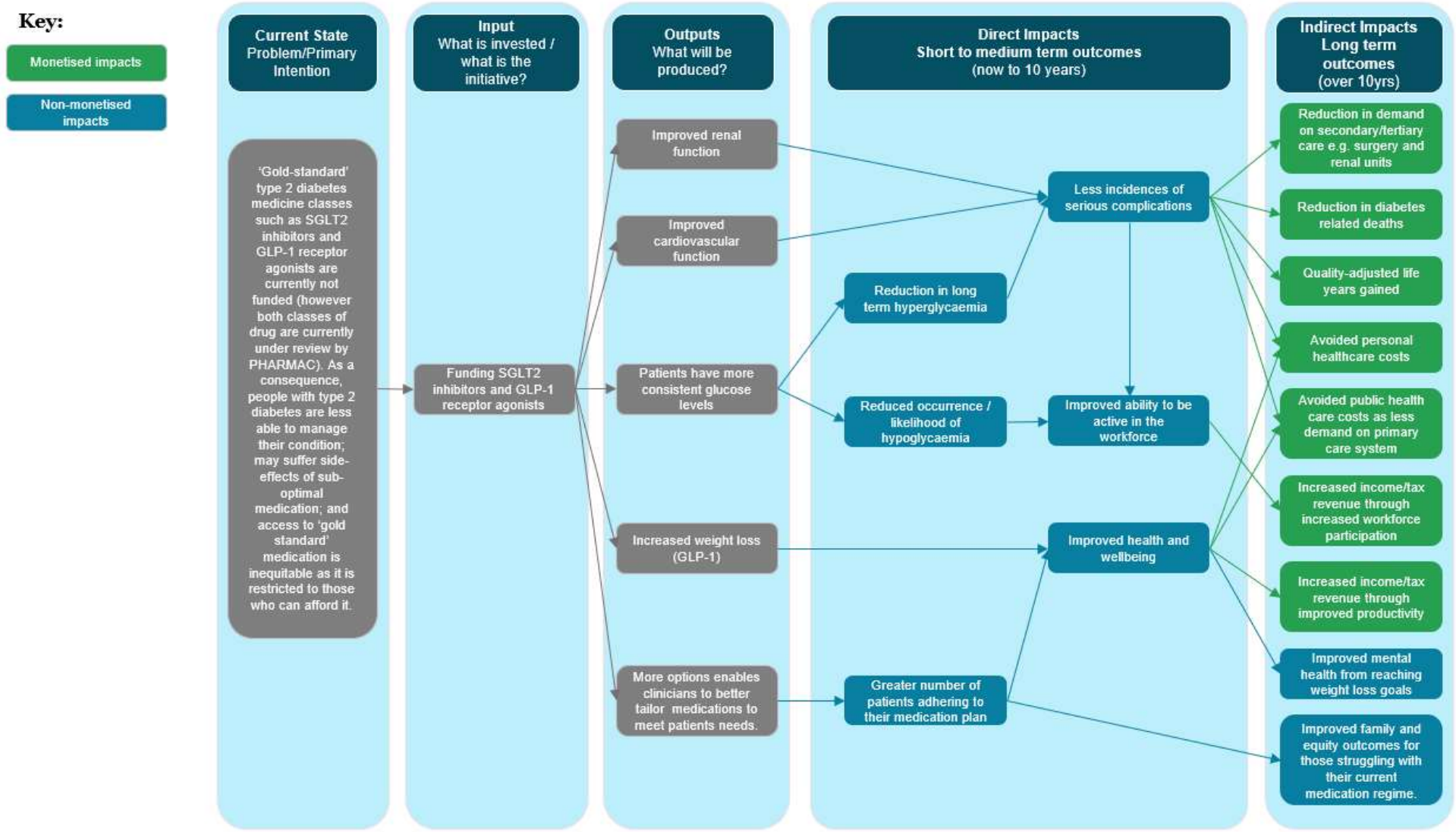
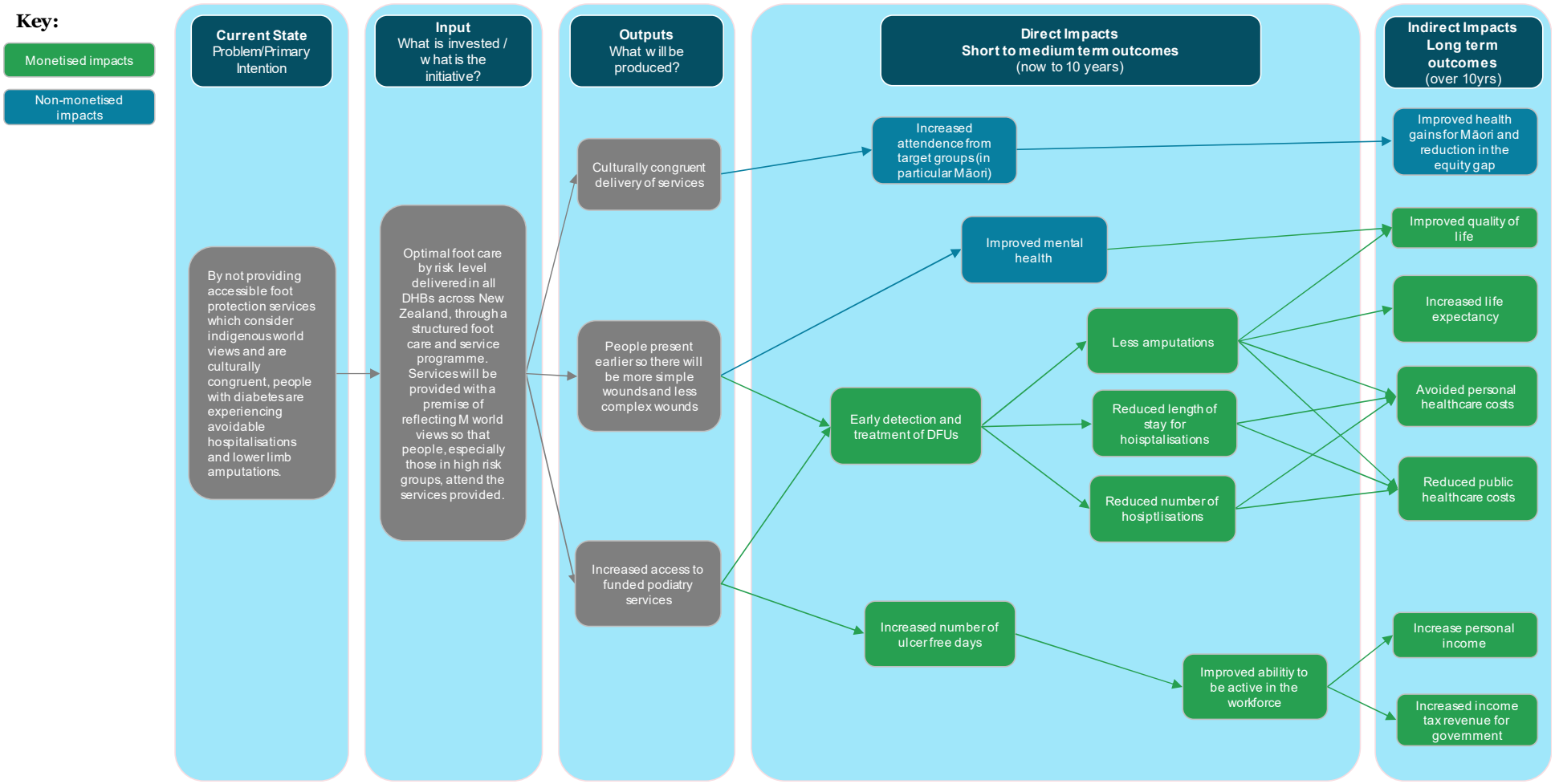


*Figure 83 Investment logic map for Foot Screening and Protection*



## 10.6 PwC disclosure for use of this report

This report, developed in conjunction with PwC, has been prepared solely for the purposes of the **20-Year Projection and Cost-Benefit Analysis of Diabetes in New Zealand ('2020 Diabetes Study')** and should not be relied upon for any other purpose. To the fullest extent permitted by law, PwC accepts no duty of care to any third party in connection with the provision of this presentation and/or any related information or explanation (together, the "Information"). Accordingly, regardless of the form of action, whether in contract, tort (including without limitation, negligence) or otherwise, and to the extent permitted by applicable law, PwC accepts no liability of any kind to any third party and disclaims all responsibility for the consequences of any third party acting or refraining to act in reliance on the Information.

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Any statements and opinions expressed in this report are based on information available as at the date of the report. PwC reserve the right, but will be under no obligation, to review or amend this report, if any additional information, which was in existence on the date of this presentation was not brought to our attention, or subsequently comes to light. This report is issued pursuant to the terms and conditions set out in the contract with PwC, dated **28 February 2020**.

## 10.7 References

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