FINAL REPORT

Understanding the value of the Total Wellbeing Diet Online

A research impact assessment for the Health & Biosecurity Business Unit of the CSIRO

Prepared for
The CSIRO

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CANBERRA

Centre for International Economics
Ground Floor, 11 Lancaster Place
Canberra Airport ACT 2609

GPO Box 2203
Canberra ACT Australia 2601

Telephone +61 2 6245 7800
Facsimile +61 2 6245 7888
Email cie@TheCIE.com.au

Website www.TheCIE.com.au

SYDNEY

Centre for International Economics
Suite 1, Level 16, 1 York Street
Sydney NSW 2000

GPO Box 397
Sydney NSW Australia 2001

Telephone +61 2 9250 0800
Facsimile +61 2 9250 0888
Email ciesyd@TheCIE.com.au

Website www.TheCIE.com.au

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Abstract

- The CSIRO and SP Health's investment in the Total Wellbeing Diet Online has provided a stream of benefits that exceed costs by approximately 2.5:1, with a net present value of $68.6 million, using a 3 per cent discount rate.
- Over 80 per cent of the payoff from the technology relates to a productivity benefit to those that lose weight (94 per cent of program adopters), and benefits of reducing the risks/costs of managing Type 2 Diabetes for those that 'complete' the program **and** achieve sustained weight loss. Residual benefits relate to revenue from the sale of the online program.
- Other identified benefits that have not been quantified include from the impact of sustained weight loss on lowering of cardiovascular disease risk factors, the potential impact on the use of antihypertensive medication, and the impact of increased fruit and vegetable consumption on health if these habits are sustained over time.
- The CSIRO has been particularly successful in leveraging its reputation to establish a successful partnership with SP Health that delivers benefits of a public nature. The benefit cost ratio of the CSIRO's investment is particularly higher, as it has invested relatively little in the online platform. Assuming CSIRO's branding has just a 10 per cent impact on uptake of the program, the benefit cost ratio of CSIRO's investment is 4:1. This assumes 30 per cent of the platform development investment in the Total Wellbeing Diet is attributable to TWD Online.
- These estimates are sensitive to the assumptions around the productivity benefit from the better management of chronic disease across individuals that have lost any weight with the program. This is based on the international literature that shows high protein and low carbohydrate diets have more sustainable results than other diets. However, the CSIRO could improve their understanding of payoffs by examining the robustness of a key assumption that individuals that lose any weight achieve a one year productivity improvement, compared to the case where they did not adopt the program.
- The study highlights the need to continue to improve the understanding of longer–term health outcomes, of two years and beyond, for the TWD Online adopters.

1 Addressing the problem of obesity and overweight in Australia

Background

Overweight and obesity is a significant contributor to the impact of chronic disease in Australia. Approximately 63 per cent of the Australian population is overweight or obese. Recent estimates for Australia suggest that poor diet costs Australia around $5 billion each year ($6.2 billion in today's terms)[1], with around two thirds due to direct health-care costs. Other studies including overweight and obesity (for which poor nutrition can be a causal factor) find that this costs an additional $11.6 billion per year[2] or $12.5 billion in today's terms.

CSIRO's TWD Online solution

The Total Wellbeing Diet (TWD) Online was launched in 2015 by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and SP Health. The TWD Online platform was developed as a result of the research around weight loss conducted within the CSIRO's Health and Nutrition Program since 1999, which provided the scientific substantiation that a high protein, lower carbohydrate diet is safe and effective in diabetes and weight loss management.[3] The Total Wellbeing Diet also aimed to improve the nutrition status of Australians.

The original output of the research was the book: *The CSIRO Total Wellbeing Diet*, which was adopted by around 10 per cent of Australian households in some way and delivered weight loss benefits to nearly 290 700 Australians.[4] Harrison and Noakes suggest that this may be a lower bound of weight loss achieved across the Australian population as a result of the Total Wellbeing Diet.[5]

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[1] Estimate relates to 2007. Australian Institute of Health and Welfare, 2012, Australia's food and nutrition 2012 http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=10737422837.

[2] Ibid, 2012. Estimate relates to 2009.

[3] For patients without renal and kidney impairment.

[4] The CIE, 2015. *Economic value of the food and nutrition flagship*. November 2015.

[5] The authors suggest that, as of 2010, as many as 547 200 people may have lost weight through the Total Wellbeing Diet. This is based on a household survey of self-reported weight loss from the Total Wellbeing Diet that is then projected across the Australian population. See Noakes, M., and Harrison, A., 2010. 'The CSIRO Total Wellbeing Diet Book 1: sociodemographic differences and impact on weight loss and well-being in Australia'. *Public Health Nutrition*, April 2010.

The value of TWD Online is in extending the original value proposition of scientifically substantiated weight loss and improved dietary nutrition status, to an entirely new group of users. It delivers a similar level of weight loss and nutrition benefit per individual as the original format/book for those completing the program, either through the 12 week program or shorter 4 week program which primarily focuses on nutrition.

The status of research and adoption

The CSIRO has invested approximately $130 000 per year in TWD Online since 2014, one year prior to the launch of the online platform. In addition, it has invested an additional $30 000 per year, for three years, towards the development of Healthy Diet Score and Diet Types (alongside the University of South Australia).

This has occurred alongside ongoing research and development associated with the Total Wellbeing Diet since 1999. None of the TWD research prior to 2006 targeted the audience of the TWD Online program and expenditure, which was all dedicated to the development of the TWD (book format). Now some of the TWD research supports the improvement in the TWD Online program.

SP Health has made substantive investments in the TWD Online platform and in operationalising the platforms' online marketing tools: the Diet Score, Diet Types and Weight Loss Calculator. Between 2013-14 and 2015-16, it invested $1.63 million in its product development, excluding intellectual property and marketing expenditures, or around $543 000 per year for three years. Marketing expenditure has increased each year, reaching $848 000 in 2016-17.

The online platform of delivery has established *a new population* of subscribers completing the diet program as well as a broader online community.

TWD Online enables individuals to engage in a 12-week program of weight loss and improved health through diet modification to a higher protein and lower GI diet, with higher rates of *sustained weight loss* rather than necessarily superior immediate results compared to other forms of weight loss strategies.

As of 31 March 2017, there were 27 173 paid members, with 26 051 completing the $149 program of weight loss for 12 weeks.[6] The CIE considers it reasonable to count this as the benefit from substantiation, or the private willingness to pay for a substantiated weight loss program. Other benefits related to productivity benefits and reduction in disease risk are considered to be additional, as these are predominantly *public* benefits or benefits to third parties.

Paid members completing the TWD special edition tailored for members with prediabetes or Type 2 Diabetes derive additional benefit.

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6 The remaining members complete the 4 week program focused on nutritional benefit, rather than weight loss.

Value to consumers

The value to the consumer of the TWD Online compared with other diets is that it is substantiated by a trusted scientific agency, and this value is reflected in the rate of continuation on the program and sustainability of weight loss and nutritional intake compared to alternatives. In addition to substantiation, the program offers superior convenience to many alternatives by providing meal plans with the ability to link in to Woolworths for purchasing grocery items associated with those meals. This also feeds into the ability of program adopters to maintain weight loss over time.

Over 90 per cent of TWD Online customers have typically used other types of diets and weight loss strategies. Data suggests alternatives chosen include counting calories, fitness trackers, cutting carbohydrates, intensive exercise, meal replacements shakes, and the sourcing of dietary and pre-prepared meal services. Thus, the *alternative* (counterfactual) without the TWD Online program is not the TWD book but more of the same dietary strategies previously adopted, characterised by low levels of weight loss/benefit.

Consumers may be willing to pay more for substantiated health and wellbeing products and services. A consumer's *willingness to pay* reflects the difference between the total amount that consumers are willing to pay for a good or service and the total amount that they actually do pay. The more inelastic the demand curve, the greater the consumer surplus or willingness to pay. Price is not the best estimate of the consumer surplus. To determine the value of the surplus would require a willingness to pay study. This could be further examined by the CSIRO through undertaking exit surveys.

Achieving retention

Participants are incentivised to complete the program by receiving a refund on completion. The programs are also tailored to fit the needs of specific groups, such as Type 2 Diabetes, through a low glycaemic and macronutrient diet, as well as a shorter program for individuals with a healthy starting weight.

TWD Online also supports a much broader community, attracting a significant number of Australians to the website. Outside of the formal program for weight loss, the platform provides individuals with an opportunity to engage in three main educative tools:

- CSIRO Healthy Diet Score — a scientifically-validated survey that assesses eating habits against the Australia's Dietary Guidelines
- Diet Types — developed by behavioural scientists to provide individuals with a free profile describing personal Diet Type, a personality breakdown showing the characteristics of Diet Type, a recommendation level of weight loss and, for members, weight loss tips tailored to the Diet Type. The TWD Online weight loss program is tailored to each of the 5 different Diet Types.
- Weight Loss Calculator — a Body Mass Index calculator that estimates potential weight loss on the 12 week program and the risk of any weight-related diseases.

These education tools are designed to increase sales/participation in the TWD Online program. They act as a 'sales funnel', while also collecting valuable data on what now constitutes a significant survey of the Australia population, compared to the size of other

household surveys. Although not quantified in this study, the existing database captured through the CSIRO/SP Health partnership shold lead to future product development that derives benefit for the consumer (as well as to the 'producers' of future products).

Members of the online community receive newsletters containing educational content and promotions. These are likely to deliver some (lower order) benefit, from potentially changing dietary habits, and should help extend the duration of benefits of TWD Online over time. New tools are expected to need to be developed as a part of sustaining the rate of adoption across new customers.

2 Impact pathway for TWD Online

Chart 2.1 sets out the impact pathway for TWD Online.

Inputs

The CSIRO has invested approximately $130 000 per year since 2014, one year prior to the launch of the online platform. Over the equivalent period to June 2017, this amounts to approximately $445 000.

While additional investment has been made in ongoing research and development associated with the underlying Total Wellbeing Diet, it is difficult to accurately assess how much of this can be attributed to TWD Online. This uncertainty will be subject to sensitivity analysis of the results when later modelled.

SP Health has made substantive investments in the TWD Online platform and the online operation of its marketing tools: the Diet Score, Diet Types and Weight Loss Calculator. Since 2014, it has invested $1.63 million to date in its development. This excludes marketing, intellectual property and other operational costs such as hosting. SP Health has invested over $2 million to date in the marketing of the TWD Online platform, including $433 000 in 2014-15, $803 000 in 2015-16 and $848 000 in 2016-17. It is anticipated that the marketing expenditure for the few years will increase, as SP Health considers launching another product to maintain uptake of the program.

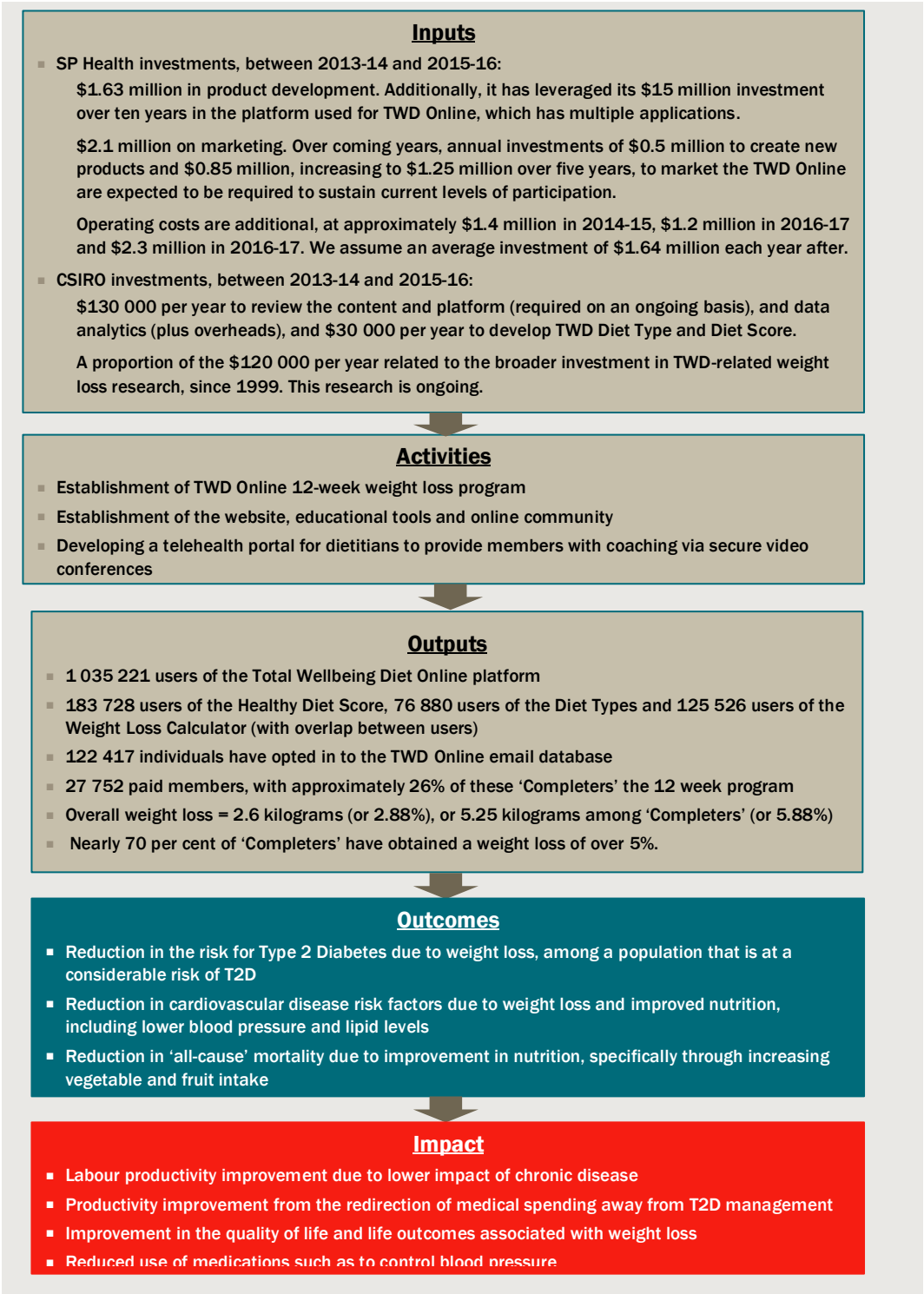
Although used for other applications, the investment by SP Health in the intellectual property development associated with the online platform used for the TWD Online was $15 million. A portion of this investment would associated with the TWD Online.

Future investment in marketing the TWD Online is expected, as future uptake is expected to directly reflect the level of expenditure in marketing. SP Health expects that to continue to gain exposure and attract new paid members will require a significant increase in marketing expenditure.

To remain relevant and attract new customers over time, SP Health anticipates it will continue to introduce new products in collaboration with the CSIRO. SP Health estimates that the marketing of a new product would involve a marketing budget each year of up to $1.27 million in real terms.

To develop these new products to market, they plan to spend around $500 000 per year in the platform for the foreseeable future.

2.1 Impact Pathway



Data source: CIE.

Outputs

Key outputs of TWD Online include the online platform itself, the tools available on the website, the online program itself, and the level of participation and knowledge sharing. The output measure that is most directly relevant to the evaluation of TWD Online is participation, which then leads to changes in knowledge, behaviour, and health outcomes.

At one end of the participation scale, there is a large number of individuals with a relatively low level of participation (knowledge sharing and use of tools rather than adoption of the diet) that are, therefore, receiving only modest benefits. There have been approximately 1 035 221 users of the TWD Online platform, with each user participating in an average of two sessions, lasting approximately 5 minutes each, with 11 page views.

Many of these individuals have viewed the website and participated in one or more of the educational tools, with a total between 1 January 2015 and 11 April 2017 of:

- 183 728 uses of the Healthy Diet Score
  - including 7 352 paid members
  - 11 413 users have done Diet Score two or more times
- 76 880 uses of the Diet Types
  - with around 13 360 individuals having also completed the Healthy Diet Score.
- 125 526 uses of the Weight Loss Calculator.

The population groups completing the Healthy Diet Types and Weight Loss Calculator differ considerably to the Healthy Diet Score, suggesting that the program is appealing to different subsets of the population.

- The Healthy Diet Score completers are more likely to be of a healthy weight (48.4 per cent) compared to the Australian population (35.5 per cent), with a smaller combined share of overweight and obese individuals (49 per cent) compared to the population (62.8 per cent).
- The Diet Type and Weight Loss Calculator completers are more likely to be obese at 42.3 per cent and 40.6 per cent, respectively, compared to the Australian population average of 27.5 per cent.

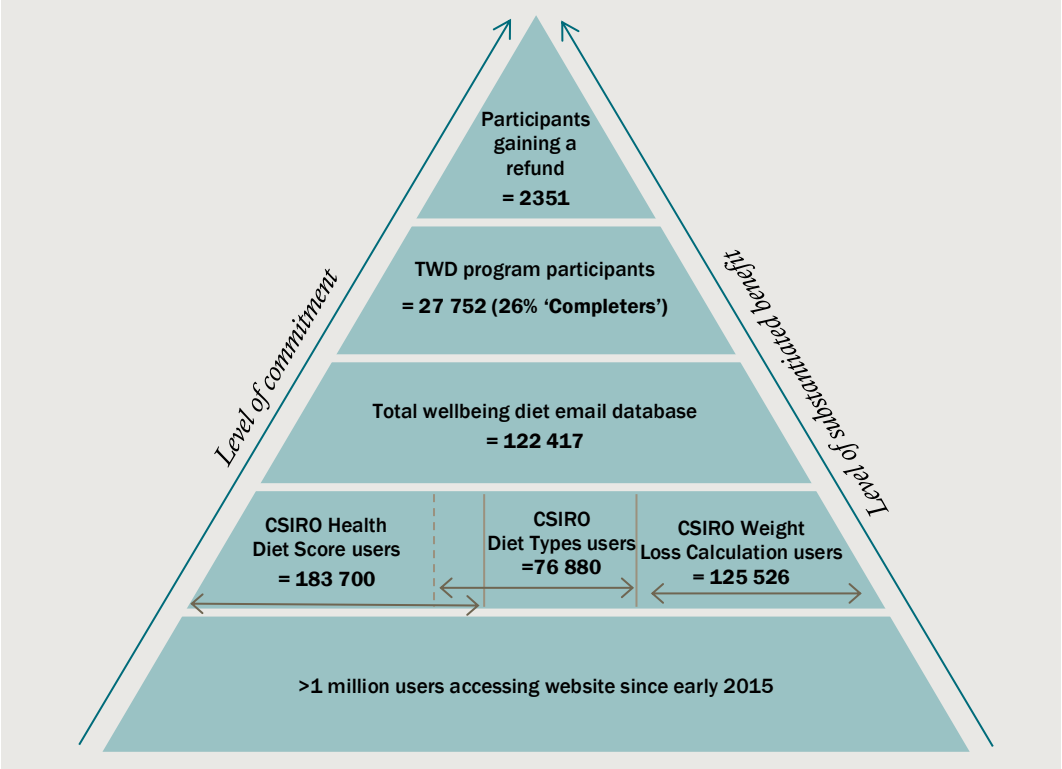
At the 'deeper' end of the participation scale, between 1 January 2015 and 31 March 2017, 122 417 individuals have opted in to the total wellbeing email database (excluding unsubscribers) with 27 173 having paid for the program, including 1122 having completed the 4 week program. This includes:

- a small share of individuals primarily targeting a nutritional benefit— around 10.4 per cent of individuals subscribing to a program that are normal weight, receiving a nutritional benefit from a 4 week or 12 week program.
- a disproportionate share of individuals that are obese and overweight, compared to the population — with around 34.6 per cent of individuals being overweight and 54.9 per cent obese, or a total of 89.5 per cent (compared to 62.8 per cent across the Australian population)

- a higher share of individuals than across the population that are at risk of age related chronic disease — where approximately 48.2 per cent of the participants are in the 51-70 year age bracket, compared to 30.5 per cent across the general population.

Chart 2.2 shows the nature of the benefits derived through Total Wellbeing Diet Online and the level of substantiation surrounding each.

2.2 Participation in the TWD Online and level of substantiation of benefits



Data source: CIE.

Assumed behaviour in absence of the TWD Online

It is important to identify the level of benefit of a substantiated weight loss program, compared to unsubstantiated one, and how these benefits are sustained over time. Diets include those that focus on energy restriction/calorie counting (such as Weight Watchers, Celebrity Slim or fasting) and/or macronutrient balance, such as low fat or low carbohydrate diets (including the Paleo or Zone Diet), high protein levels including meal replacement shakes or by focusing on intensive exercise regimes.

The CIE notes that there are also pharmacological interventions in weight loss such as the weight loss drug orlistat (sold in Australia as Xenical), which 'has been shown to increase the proportion of subjects achieving modest weight loss and maintenance, along with diabetes prevention and sustained improvement of CVD risk factors'.[7] However, we

[7] Vidal, J., and Jimenez, A. 2016. Definition, history and management of the Metabolic Syndrome and management gaps. *Metabolic Syndrome and Diabetes.* Edited by Kurian, M., Wolfe, B., and Ikramuddin, S., 2016, New York.

consider only non-pharmacological interventions as relevant comparators for the TWD Online program adopters.

Data supplied by SP Health provides considerable background on the types of individuals that are accessing the TWD Online website, using the educational tools and undertaking a weight loss program. The data suggests that nearly 90 per cent of paid members (completing a weight loss program) are overweight or obese. Around two thirds of overweight and obese individuals engaging with the TWD Online are classed as having the Diet Type of a 'Craver' or a 'Thinker'. By analysing previous weight loss attempts of the individuals in these categories, we can determine the profile of individuals participating in the paid weight loss program.

Importantly, 'cravers' are more likely to have tried each of the dietary methods that are alternatives to the TWD Online, suggesting a high rate of unsuccessful attempts rather than having not tried to alter their lifestyles. The most popular of the previous weight loss strategies has been counting calories (for instance, Weight Watchers) with between 60-70 per cent having tried that strategy.[8]

In addition, around half of all individuals completing a diet profile had previously tried a low carbohydrate diet and around half had tried 'lots of exercise'. Furthermore, a higher percentage of cravers had tried meal replacements shakes at around 46 per cent. Prescribed weight loss programs and seeing a dietician were the least common strategies across all Diet Types at approximately 20 per cent each.

This provides evidence that the profile of individuals engaging in the weight loss program with the CSIRO are likely to have come from many unsuccessful attempts at sustained weight loss, in particular with calorie counting programs. Without the TWD Online program, it would be reasonable to assume that there would be limited success in sustained weight loss.

First level outcomes: weight loss achieved for participants

The first order of outcomes associated with TWD Online is weight loss for participants. This then leads to a change in risk profile for adverse health states, which is directly linked to the weight loss achieved.

The literature suggests that many of the other competing diets such as calorie counting perform well to 12 weeks compared with a high protein, low carbohydrate diet (the Total Wellbeing Diet). However, the evidence provided across most of the literature for the performance of diets beyond 12 weeks is more limited.

It is important to note that bariatric surgery is not considered to be an alternative weight loss comparator to the Total Wellbeing Diet Online, given its considerably different attributes and therefore potentially limited suitability for TWD users at that point in their weight loss journey.

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[8] 69 per cent of cravers and 61 per cent of thinkers had chosen calorie counting.

As shown in table 2.3, the average weight loss from the Total Wellbeing Diet book with other lifestyle improvements at 8-12 weeks was **3.7 per cent**. The performance of the TWD Online was similar, with:

- an average weight loss of 2.88 per cent (or 2.6 kilograms) at 12 weeks across all program subscribers
- around 22 per cent of individuals undertaking the program achieving weight loss of at least 5 per cent or 69.7 per cent of completers
- higher weight loss for those that complete the program (around 26.5 per cent of all participants)
  - the weight loss achieved by completers is 5.25 kilograms, on average, or 5.88 per cent at 12 weeks.

This is consistent with the broader experience of the TWD (book), where Wyld et al in 2015 found that the average weight loss from the Total Wellbeing Diet was even better, at 5.7 kg, from those actively using the plan and achieving weight loss.

The literature shown in table 2.2 suggests that *at 8 weeks* the weight loss under a low calorie diet may be at least as good as and possibly better than under a high protein, reduced carbohydrate diet such as the TWD.[9] However, the value of the high protein, low carbohydrate diets is in its potential for superior weight loss, long term weight maintenance and cardiometabolic risk. A meta analysis by Wycherley et al shows that an isocalorically prescribed High Protein diet provides a beneficial effect on weight loss, body composition (in terms of increasing fat mass loss and mitigating the impact of Fat Free Mass loss) and Resting Energy Expenditure, compared to a Standard Protein Diet.

The potential for greater weight loss and maintenance from a high protein diet may be due to the preservation of Fat Free Mass (FFM) and its skeletal muscle component, which plays a role in Resting Energy Expenditure (REE) and protein metabolism.[10] As REE accounts for the majority of daily energy expenditure, and is strongly correlated with FFM, the maintenance of higher REE via preservation of FFM with the HP diet may induce a greater net energy deficit over time and, as a result, promote greater FM and weight loss. A further observation is that (in 3 of 5 studies) the HP diet is associated with greater satiety.[11]

A systematic review by Hession et al in 2008 found that weight loss was significantly greater among individuals with a low carbohydrate/high protein diet after 6 and 12 months compared with a low fat high carbohydrate diet. Consistent with the literature on high protein, low carbohydrate diets, Wyld et al in 2010 found that close to **two thirds** of TWD participants had maintained their weight loss for 3 to 6 months. Approximately

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9 See Khoo, J., et al., 'Comparing Effects of a Low-energy Diet and a High-protein Low-fat Diet on Sexual and Endothelial Function, Urinary Tract Symptoms, and Inflammation in Obese Diabetic Men'. *The journal of sexual medicine*, 2011. 8(10): p. 2868-2875.

10 Wycherley, T., Moran, L., Clifton, P., Noakes, M., and Brinkworth, G. 2012. 'Effects of energy-restricted high-protein, low-fat compared with standard-protein, low-fat diets: a meta-analysis of randomized controlled trials'. *American Journal of Clinical Nutrition*. 2012; 96 (6), Pp 1281-98.

11 Wycherley et al, 2012.

30 per cent had maintained their weight loss in excess of 6 months. A review of the role of high protein diets in weight control and obesity-related comorbidities suggested that the effect of high protein diets was favourable in preventing weight regain following significant intense weight loss for up to six months, and maintaining weight (compared to alternative, weight increasing scenarios).[12]

The intent of the TWD Online program is to provide a nutritional training to individuals to sustain behavioural changes over a lifetime.

- **Data of a small sample of Completers of the TWD Online program[13] suggests that for the 26 per cent completing the program, on average, they continue to increase their weight loss to 6 months.**

This suggests early evidence that the TWD Online delivers a higher rate of retention of weight loss than was achieved previously.

Therefore, we suspect that the TWD Online could enable **up to two thirds** of program 'Completers' to achieve weight loss in the order of **at least 2 kilograms** after two years (the threshold for receiving sustained health benefits such as lowering of Type 2 Diabetes risk). However, there is not sufficient evidence to provide conclusive. Therefore, this assumption is an upper bound, and should be further investigated to confirm. The CIE tests this assumption with a lower bound of 30 per cent.

It should be noted, however, that 'Completers' represent a conservative estimate of the pool of individuals potentially receiving sustained weight loss benefits. These are individuals that have recorded their weight loss at 12 weeks and, therefore, formally completed the program. However, there may be other participants that have enjoyed similar benefits, without formally engaging in the program completion. In other published studies on the SP Health platform, the ratio of members deemed 'Completers' to members still engaging with the program at 12 weeks was 1:2. That is, the estimate of the pool of individuals that may achieve sustained weight loss benefit may be understated.

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12 Astrup, A., Raben, A., and Geiker, N. 2015. 'The role of higher protein diets in weight control and obesity-related comordbidities'. *International Journal of Obesity*, 39, Pp 721-726.

13 These individuals have recorded their weight loss at 12 weeks and, therefore, formally completed the program.

2.3 Weight loss achieved by strategy, Total Wellbeing Diet Online, TWD book and other commonly adopted diets in Australia

Source	Diet	Weight loss at 8 weeks	Weight loss at 12 weeks	Weight loss at 24-26 weeks	Notes
Total Wellbeing Diet Online and Book					
SP Health (unpublished)	Total Wellbeing Diet Online		3.64% or -3.25kg		Completers and non-completers, all program participants to date
SP Health (unpublished)	TWD Online		-5.4kg	-6.8kg	Small population group, completers
Khoo, 2011	Low fat, high protein, reduced CHO (TWBD)	5%			31 obese T2Dm males
Brindal, 2012	TWBD delivered with information only, with support or with personalised support)		2.76%		No difference in results of different methods delivered
Keogh, 2012	TWBD Book		3% (2.7kg)		120 T2DM obese participants
Wyld, et al, 2010	Total Wellbeing Diet		5.7 kg		5026 men and women aged 18-60 years, adopters that had lost weight
Alternatives- calorie restriction					
SP Health	Get Healthy program, NSW Government		-3.8 kg		Completers only
Khoo et al, 2011	Low calorie diet	10%			8112 self-reported overweight or obese individuals
Milsom et al, 2014	Weight watchers		-4.37%		132 obese individuals
Pinto et al, 2013	Weight watchers		-5%		141 overweight or obese adults
Jolly et al 2011	Weight watchers		-6% (5.15kg)		740 obese individuals
Johnston et al 2013	Weight watchers		-5%		292 overweight or obese individuals

Source	Diet	Weight loss at 8 weeks	Weight loss at 12 weeks	Weight loss at 24-26 weeks	Notes
Heshka et al 2003	Weight Watchers		-4.5%		423 overweight or obese individuals
Other alternatives					
Keogh, 2012	Meal replacement		5% or 5.3 kg		120 T2DM obese patients
Johnston et al 2013	Self help		-1%		
Pinto et al 2013	Behavioural treatment		-4%		
Gardner et al 2007	Zone Diet		-3.5%		311 overweight or obese individuals

Source: Griffith University, 2015. *Leveraging online and in-pharmacy support to enhance weight loss: a population based analysis.*

Second level outcomes: improved health status

The Total Wellbeing Diet Online delivers sustainable weight loss for participants, resulting in a reduction in risk of chronic disease for high risk populations. While approximately 5.5 per cent of the burden of disease in Australia is estimated to be attributable to high body mass and 7 per cent from inadequate dietary requirements, it is necessary to tease out how *weight loss* among those already overweight or obese, rather than the avoidance of overweight, can lead to improved health outcomes. This requires conservative estimation of the attribution of the dietary and lifestyle change, given the broad range of factors that influence health outcomes.

There is a strong scientific basis for linking weight loss outcomes to:

- a reduction in the risk factors for Type 2 Diabetes:
  - depending on the type of intervention used to achieve it, the level of weight loss achieved for high risk populations and the duration over which a lower weight level is sustained (typically at least 3 years)[14]
  - most of the literature focuses on the reduction in risk factors for those with diabetes so that the condition is well managed and disease events are avoided or minimised, as opposed to the avoidance of the disease onset
- a reduction in the cardiovascular disease risks, including:
  - reducing the development and complications from cardiovascular disease — to quantify this benefit would require further substantiation
  - *possibly* reducing the cost of medication associated with cardiovascular disease.

Furthermore, the impact of weight loss on the incidence of Type 2 Diabetes is one outcome domain that is expected to generate more productive health system spending.

In addition, there is also strong evidence linking the increase in vegetable intake to the reduction of chronic disease risk, irrespective of any weight loss.

Substantiation of weight loss impacts on Type 2 Diabetes risk

The CIE previously found that the evidence of the impact of weight loss on possible avoidance of Type 2 Diabetes (T2D) disease *onset* is sparse, but rather that the literature focuses on the impact of better management of other disease risk factors such as diet, including cereal intake and dietary fibre. However, the Diabetes Prevention Program suggested that relatively modest weight loss for individuals at high risk of diabetes[15] may delay or avoid developing Type 2 Diabetes' through losing weight, regular physical activity and a diet low in fat and calories. A meta analysis of lifestyle interventions to promote weight loss in high-risk adults suggested that sustained weight loss of 3 per cent

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14 NHMRC 2013, *Clinical practice guidelines for the management of overweight and obesity in adults, adolescents and children in Australia*. Department of Health, Canberra.

15 Individuals were all overweight and had blood glucose levels higher than normal but not higher enough for a diagnosis of diabetes (pre-diabetes).

to 5 per cent was likely to lead to clinically meaningful improvements in blood glucose stabilisation, including by lowering blood triglyceride, blood glucose, and HbA1c levels and in the risk of developing T2D.

Risk of Type 2 Diabetes among TWD Online program adopters

SP Health data shows that the TWD Online program adopters are at a *higher risk* of diabetes than the general population due to both the higher average age and Body Mass Index of participants. Both age and body mass index contribute significantly to the risk of Type 2 Diabetes (T2D). Sex also plays a significant role in diabetes prevalence after 55 years of age, with men at a higher risk than women.

Table 2.4 shows the age-related prevalence of T2D across men and women in Australia.[16] As risk is related to body mass index, which increases over age, a weighted average of prevalence (and therefore risk) based on age will account for BMI to some extent. We note that approximately 62 per cent of TWD Online paid program members are over the age of 44 years, including 29 per cent of TWD Online paid members in the 45-54 year bracket, 24 per cent in the 55-65 year bracket and a smaller share (of 9 per cent) in the 65 and over age bracket. That is, a higher percentage of TWD Online paid members are in the higher age brackets compared to the general population.

Based on age and sex alone, we could expect the average risk of T2D across Total Wellbeing Diet adopters to be approximately 6.1 per cent. By chance, the risk of Type 2 Diabetes among TWD adopters based on age and sex is similar to the population wide risk.

2.4 Prevalence of self reported diabetes, by sex and age

Age group	Men	Women	Total
AIHW data	%	%	%
18–44	1.2	1.5	1.3
45–54	5.4	5.3	5.4
55–64	14.1	9.1	11.5
65–74	19.7	13.7	16.7
75+	21.7	16.2	18.7
Total, weighted by the share of men and women (Australian population)	6.8	5.4	6.1
Extrapolation to estimate expected prevalence of self reported diabetes based on age and sex alone – TWD Online program			
Weighted average based on age and share of men and women (population of TWD Online paid members)			6.1

Source: AIHW analysis of ABS Microdata: National Health Survey (NHS) 2014–15 and The CIE.

16 Australian Institute of Health and Welfare, 2016. 'Diabetes web pages data tables'. Table 1.1: Prevalence of self reported diabetes, among persons 18 and over, by age and sex, 2014-15.

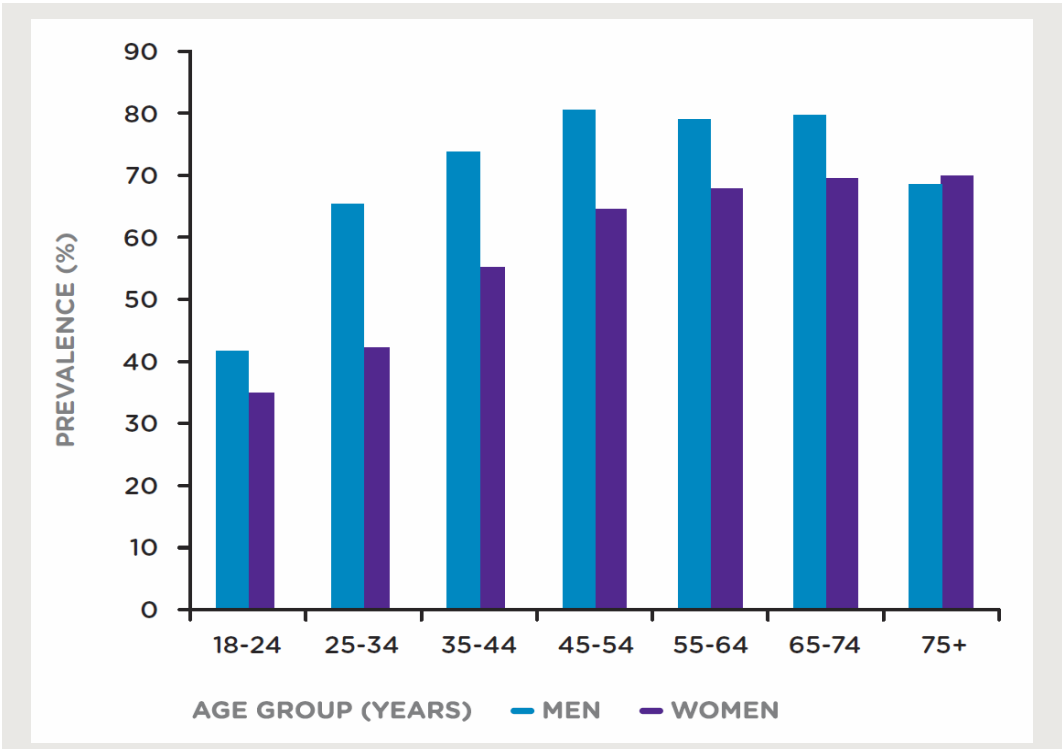
However, the age profile alone is not likely to fully account for the diabetes risk profile of the users. This is due to the fact that around 55 per cent of the TWD Online participants is obese, compared to the population average of 27.5 per cent (as well as similar levels of overweight of around 34.6 per cent, or a total of 89.5 per cent). That is, overweight and obesity prevalence in TWD Online program users is higher than the rest of the population.

Chart 2.5 shows the average BMI by age and sex across the population. At any age group, the maximum share of the population that is overweight or obese is around 80 per cent, or 10 per cent less than the TWD Online program users. This suggests that the age and sex-weighted risk calculation for T2D in the TWD Online population is understated for 10 per cent of the group.

The Relative Risk of Type 2 Diabetes has been estimated to be 1.8 for overweight adults and 3.2 for obese individuals compared to a normal weight person. This compares with the ratio of self-reported type 2 diabetes in obese individuals of around 8 times higher than those with normal/under weight.[17]

- **This suggests that the risk of Type 2 Diabetes among participants of the TWD program could be higher. We could, for instance, conduct a sensitivity analysis on the impact of a higher risk of Type 2 Diabetes, for instance of 8 per cent to reflect the literature around Relative Risk.**

2.5 Proportion of the adult population above a healthy weight, by age and gender



[17] Heart Foundation, 2015. *Australian heart disease statistics: Overweight, obesity and cardiovascular disease — past, present and future*.

Data source: ABS Australian Health Survey: First Results, 2011-12.

Impact of weight loss on diabetes risk

Weight loss and physical activity lowers the risk of diabetes by improving the body's ability to use insulin and process glucose. It is 'at least as effective in older participants as it was in younger participants', in terms of intensive lifestyle intervention.[18]

A meta analysis by Norris et al in 2005[19] has shown that:

- weight losses of 3-12 kg due to lifestyle interventions are associated with a reduction in HbA1c of 0.7 per cent
- weight losses of 5kgs are associated with reductions in cholesterol and triglycerides of 0.25mmol/L and 0.45 mmol/L respectively[20]
- together, the combined result is a 6 per cent reduction in Type 2 Diabetes when cereal intake is increased by 2g/day in low versus high intake comparisons.[21]

Vidal and Jimenez report that the Diabetes Prevention Program conducted in the United States in 1996 shows the reduction in risk of diabetes achieved by moderate weight loss and exercise may be higher than indicated by Norris et al.[22] The Diabetes Prevention Program involved a clinical trial involving persons at 27 centres who were at high risk of diabetes. It measured the results of combined dietary interventions and exercise.

- Data from the Diabetes Prevention Program (DPP) would suggest that the risk of diabetes is reduced by 16 per cent for every kilogram of weight loss in individuals at a high risk for diabetes as a result of impaired glucose tolerance at the baseline.[23]
- A study in Finland in 2001 found similar results, where modest weight loss after two years of 3.5 kilograms in the intervention group as a result of dietary improvement

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18 Dalton M, Cameron AJ, Zimmet PZ, et al. Waist circumference, waist-hip ratio and body mass index and their correlation with cardiovascular disease risk factors in Australian adults. J Intern Med. Dec 2003;254(6):555–563.

19 Norris, S., Zhang, X., Avenell, A., Gregg, E., Brown, T., Schmid, C., and Lau, J., 2005. *Long-term non-pharmacological weight loss interventions for adults with type 2 diabetes mellitus*. Cochrane Database of Systematic Reviews.

20 Christian JG, Bessesen, DH., Byers, TE., Christian KK., Bock, BC. 2008, 'Clinical-based support to help overweight patients with type 2 diabetes increase physical activity and lose weight', *Archives of Internal Medicine 2008;* 168(2): 141-146.

21 Yao, B., Fang, H., Xu, W., Yan, Y., Xu, H., Liu, Y., Mo, M., Zhang, H., Zhao, Y. (2014), 'Dietary fibre intake and risk of type 2 diabetes: a dose-response analysis of prospective studies', *European Journal of Epidemiology* 2014, 29: 79–88.

22 Vidal, J., and Jimenez, A. 2016. Definition, history and management of the Metabolic Syndrome and management gaps. *Metabolic Syndrome and Diabetes.* Edited by Kurian, M., Wolfe, B., and Ikramuddin, S., 2016, New York.

23 Hamman, R., et al. 2007. 'Effect of weight loss with lifestyle intervention on risk of diabetes'. *Diabetes Care*. 2006. September; 29(9): 2102-2107.

and physical activity, compared to 0.8 kilograms in the control group, reduced diabetes risk by up to 58 per cent.[24]

- Another study conducted on the results of the Diabetes Prevention Program suggested that weight loss of at least 7 per cent, with at least 150 minutes of exercise activity each week, resulted in a reduction of diabetes risk (at 2.8 years) of 27 per cent (above metformin), and 58 per cent above the placebo. This is equivalent to the prevention of one case of diabetes during a period of three years across 7 participants.
- Over the longer term, weight loss of 2 kilograms that is maintained for an average of 10 years is associated with a 34 per cent reduction in diabetes risk compared to the placebo group.[25]

A study in China identified the separate impact on diabetes risk of diet and lifestyle and their impact in combination among individuals with impaired glucose tolerance. The results were a reduction of 31 per cent for diet only, 46 per cent for exercise only and 42 per cent risk reductions for developing diabetes, respectively.[26] This study suggests that either diet or exercise, or both, have an improvement on diabetes risk. It is speculated that increased physical activity is important to helping sustain weight loss, rather than in competing with the role of dietary intervention.[27]

The results of the Diabetes Prevention Program has led to an expansive range of studies attempting to translate this evidence into practice.[28] A meta analysis confirms a clinically significant reduction in the risk factors or indicators for diabetes such as blood trigluceride blood glucose, and HbA1c levels and risk of developing T2D associated with a 3 per cent to 5 per cent sustained weight loss.[29] The 'effect sizes' ranged from small, at 0.17, to medium, at 0.65, across the different measures.[30]

Furthermore, for those sustaining weight loss outcomes over the long term, we could expect a significant reduction in mortality risk. One study suggested that patients with diabetes that achieve intentional weight loss that is sustained over an average follow up

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[24] Tuomilehto, J., et al, 2001. 'Prevention of Type 2 Diabetes Mellitus by changes in lifestyle among subjects with impaired glucose tolerance'. *The New England Journal of Medicine*, Volume 344, Number 18, May 3 2001.

[25] Vidal, J., and Jimenez, A. 2016. Definition, history and management of the Metabolic Syndrome and management gaps. *Metabolic Syndrome and Diabetes.* Edited by Kurian, M., Wolfe, B., and Ikramuddin, S., 2016, New York.

[26] Note that the study suggests that these improvements were not from absolute weight loss, but lower levels of weight gain under the intervention compared to the control. See Pan XR, Li GW, Hu YH, et al. Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance: the Da Qing IGT and Diabetes Study. *Diabetes Care*. 1997;20:537–44.

[27] Hamman RF, Wing RR, Edelstein SL, et al, 2006. Effect of Weight Loss With Lifestyle Intervention on Risk of Diabetes. *Diabetes care*. 2006;29(9):2102-2107. doi:10.2337/dc06-0560.

[28] Hamman et al, 2006.

[29] Sun, Y., You, W., Almeida, F., Estabrooks, P., and Davy, B. 2017. 'The effectiveness and cost of lifestyle interventions including nutrition education for diabetes prevention: A systematic review and meta-analysis'. *Journal of the Academy of Nutrition and Dietetics*, March 2017, Volume 117, Number 3.

[30] Sun et al, 2017.

of 13 years, receive **a 25 per cent reduction in total mortality**.[31] These were, however, based on limited studies and not sufficiently robust to appropriately translate to this study.

It would be reasonable to assume that the TWD Online program delivers short and long term benefits, however the longer term benefits cannot be substantiated at this point. Based on estimates in the literature, for this analysis we assume that up to **two thirds** of TWD Completers achieve **at least 2 kilograms of weight loss** for at least 2 years, resulting in a reduction in Type 2 Diabetes risk. These individuals have an average risk of Type 2 Diabetes higher than the general population, of **6-8 per cent**, and reduce their disease risk of type 2 diabetes by between **6-32 per cent**. The period over which these benefits are sustained is uncertain, however, we assume that the lower diabetes disease risk is maintained for **five years.**

Substantiation of weight loss impacts on CVD risk

In addition to its relationship with diabetes, obesity is clearly an established risk factor for cardiovascular disease. On average, the self-reported prevalence of cardiovascular disease is 14.5 per cent for adults with normal weight, 24.6 per cent for overweight adults and 39.8 per cent for obese adults. A meta-analysis of studies assessing the impact of body weight on CVD suggests there was a 29 per cent increase in CVD for each 5 unit increase in BMI.[32] The risk of a high BMI is compounded by the frequent co-existence with other coronary heart disease risk factors such as hypertension, dyslipidaemia and diabetes. One study suggested that adverse effects of overweight on blood pressure and cholesterol levels could account for about 45 per cent of the increased risk of cardiovascular disease.[33]

However, the Royal Australian College of General Practitioners states that the research does not (yet) provide evidence that weight loss in high risk groups results in a reduction in cardiovascular events.[34] The RACGP refers to just one study of modest weight loss of approximately 3.5 kilograms having an independent effect on cardiovascular events, showing a hazard ratio for recurrence of hypertension or cardiovascular events of 0.65 for

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[31] See Aucott, L. Poobalan, A., Smith, W., Avenell, A., Jung, R., Broom, J., Grant, A. 2004. Weight loss in obese diabetic and non-diabetic individuals and long-term diabetes outcomes – a systematic review. Diabetes, obesity and metabolism. Volume 6, Issue 2, Pp 85-94.

[32] Bogers, R., Bemelmans W., Hoogenveen R., Boshuizen H., Woodward, M., Knekt, P., van Dam, R., Hu F., Visscher T., Menotti, A., Thorpe RJ Jr, Jamrozik K, Calling, S., Strand, B., Shipley, M., 2007. 'Obesity, weight reduction, and cardiovascular disease', Centre for Prevention and Health Services Research, National Institute for Public Health and the Environment, PO Box 1, 3720 BA Bilthoven, The Netherlands.

[33] Bogers et al, 2007.

[34] National Vascular Disease Prevention Alliance, 2012. *Guidelines for the management of Absolute cardiovascular disease risk*. Available at: https://www.heartfoundation.org.au/images/uploads/publications/Absolute-CVD-Risk-Full-Guidelines.pdf

weight loss compared with controls.[35] While the Look AHEAD (Action for Health in Diabetes) trial was associated with sustained weight loss and improved CVD risk factors in individuals with T2D, the trial was terminated as a result of the lack of translation into CVD events.[36] Significant weight loss through bariatric surgery would suggest that an improvement in cardiac structure and function is possible, with the 10 year risk of cardiac events declining by up to 50 per cent in patients undergoing weight loss surgery. However, these surgeries typically involve weight loss of around 23 kilograms.[37]

While it is uncertain whether cardiovascular disease events reduce with *modest* weight loss[38], there is strong evidence of an improvement in CVD risk factors as a result of a fall in blood pressure and stabilisation of blood lipid levels and lipoproteins, including HDL cholesterol and triacylglycerols, as a result of weight loss.[39]

- A systematic review of randomised controlled trials by Semlitsch et al in 2016 of patients with primary hypertension, systolic blood pressure was found reduced by a mean of 4.5 mmHg (95% CI -7.2 to -1.8 mm Hg) and diastolic blood pressure by 3.2 mmHg (95% CI -4.8 to -1.5 mm Hg) in patients assigned to weight loss compared to the corresponding control interventions (non-dietary interventions).[40]
- Similar results[41] were found by Wing et al in 2011.[42]
- The literature suggests that low carbohydrate, high protein diets (such as the Total Wellbeing Diet), in particular, perform well compared to a low fat, low calorie diet, with respect to impacts on HDL cholesterol and triacylglycerols at 6 and 12 months, and diastolic and systolic blood pressure at 6, 12 and 17 months.[43]

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[35] Includes stoke, ischemic attack, myocardial infarctions, angina pectoris, congestive heart failure, arrhythmias or other events.

[36] Vidal, J., and Jimenez, A. 2016. Definition, history and management of the Metabolic Syndrome and management gaps. *Metabolic Syndrome and Diabetes.* Edited by Kurian, M., Wolfe, B., and Ikramuddin, S., 2016, New York.

[37] Benraoune, F., and Litwin S. 2014. *Reductions in cardiovascular risk after bariatric surgery*. National Institutes of Health. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4070434/

[38] Vidal, J., and Jimenez, A. 2016.

[39] The American Heart Association confirmed this in 2006 in their statement that 'strong evidence indicates that weight loss in overweight and obese individuals reduces risk factors for diabetes and CVD'.

[40] Semlitsch, T., Jeitler, K., Berghold, A., Horvath, K., Posch N., Poggenburg S., Siebenhofer A., 2016. *Longer-term effects of weight-reducing diets in people with hypertension*. Cochrane Database Syst Review. 2016 March 2, 3.

[41] A weight loss of 5 to 10 per cent in overweight and obese individuals with Type 2 Diabetes increased the odds of achieving a 5-mmHg decrease in systolic blood pressure, a 5-mmHg decrease in diastolic blood pressure, as well as a 0.5 per cent reduction in HbA1, a 5 mg/dL increase in HDL cholesterol, and a 40 mg/dL decrease in triglycerides.

[42] Wing, R., Lang, W., Wadden, T., Safford, M., Knowler, W., Bertoni, A., Hill, J., Brancati, F., Peters, A., Wagenknecht, L. 2011. 'Benefits of modest weight loss in improving cardiovascular risk factors in overweight and obese individuals with Type 2 diabetes'. Diabetes Care. Volume 34, July 2011.

[43] The impact on HDL cholesterol was not significant at 17 months, which may be caused by the reintroduction of carbohydrates in the low carbohydrate/high protein group. See Hession, M.,

The longevity of gains is more uncertain, with questions remaining around the impact of weight loss on blood pressure beyond 18 months.[44]

Lowering of medication requirement

One possible outcome of lower blood pressure is a change in the management of hypertension.

Two studies that have used the withdrawal of antihypertensive medication as their primary outcome[45] indicate the possibility of successful withdrawal from medication or avoidance of the need to start medication.

Blaufox (1984) speculated that the possibility exists that dietary modification may increase the number of patients who remain normotensive after drug withdrawal.[46] It found higher rates of success in the withdrawal from anti-hyperintensive medication among mild overweight hypertensives with weight reduction of 72 per cent success, compared with those withdrawing from medication without dietary intervention, of 35 per cent success. This raises the question of whether people with higher or lower blood pressure or higher or lower body weight at baseline might benefit in a different way from dietary intervention aiming to reduce body weight.[47]

A larger and more up-to-date base of evidence is required to understand the impact of weight loss on clinical management of specific subsets of overweight/obese and hypertensive individuals over time. It would need to determine the impacts of sustained weight loss on blood pressure and the management of medication over the longer term, before and after dietary intervention and at different levels of baseline blood pressure and body weight.

Based on the available evidence, it is not possible to estimate the proportion of TWD Online adopters that will not require medication, such as antihypertensive medication, as a result of losing weight.

Outcomes from health gains associated with better nutritional intake

Increasing fruit and vegetable consumption has been shown to have an independent impact on chronic disease risk, although the exact mechanism is unknown. Increasing

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Rolland, C., Kulkarni, U., and Broom, J. 2008. Systematic review of randomized controlled trials of low-carbohydtate versus low-fat/low-calorie diets in the management of obesity and its comorbidities. *Obesity Reviews.* 2009, January, 10(1), Pp 36-50.

[44] Semlitsch et al, 2016.

[45] Semlitsch et al, 2016.

[46] Blaufox MD, Langford HG, Oberman A, Hawkins CM, Wassertheil-Smoller SW, Cutter GR. 1984. Effect of dietary change on the return of hypertension after withdrawal of prolonged antihypertensive therapy (DISH). Dietary Intervention Study of Hypertension. *J Hypertens Suppl.* 1984 Dec;2(3):S179-81.

[47] Semlitsch et al, 2016.

vegetable consumption has been shown to reduce the risk of disease for CHD and stroke, with 'probable' evidence of a reduction in the risk of a wide range of cancers, and some evidence that increased consumption helps to prevent body weight gain and therefore potentially reducing the risk of type 2 diabetes mellitus.[48] There is also 'possible' evidence that increasing the consumption of fruit and vegetables lowers the risk of certain eye disease, dementia and the risk of osteoporosis.[49]

Uptake of fruit and vegetables by TWD Online participants

Individuals completing the TWD Online program consume vegetables and fruit to a level consistent with the Australian guidelines. This includes five serves of a range of different vegetables and at least two serves of fruit.

It is assumed that all participants comply with this while on the program, and most do upon program completion.

One of the challenges in quantifying the benefit of improved nutritional intake is ascertaining the nutritional value of diet prior to program adoption. Some information is provided through the completers of the Diet Score, although this cohort of consumers has a much lower share of overweight and obese individuals than the completers of the TWD Online program.

The literature suggests that there is a significant inverse relationship between BMI and vegetable intake, with overweight participants having a lower intake of vegetables.[50] The literature also points to the prevalence of the practice of preparing vegetables by adding fatty substances, reducing the low density nature of vegetables.

Australian Bureau of Statistics data suggests that around 90 per cent of women and 96 per cent of men did not have an adequate intake of vegetables in accordance with the Australian guidelines, and 80 per cent of Australian men and three quarters of Australian women consume three or less vegetables per day.[51]

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[48] As assessed in the National Health and Medical Research Council, 2013. *Australian Dietary Guidelines: Providing the scientific evidence for healthier Australian diets*, Ref No 55. https://www.nhmrc.gov.au/_files_nhmrc/file/publications/n55_australian_dietary_guidelines1.pdf

[49] Boeing, H., Bechthold, A., Bub, A., Ellinger, S., Haller, D., Kroke, A., Leschik-Bonnet, E., Muller, M., Oberritter, H., Schulze, M., Stehle, P., and Watzl, B. 2012. 'Critical review: vegetables and fruit in the prevention of chronic diseases', *European Journal of Nutrition*, 2012, 51, Pp 637-663.

[50] See Pem, D., and Jeewon, R., 2015. 'Fruit and vegetable intake: benefits and progress of nutrition education interventions – Narrative review articles'. *Iran Journal of Public Health*, 2015 (October); 44 (10), Pp 1309-1321.

[51] ABS Catalogue 4364.0.55.012 - Australian Health Survey: Consumption of Food Groups from the Australian Dietary Guidelines, 2011-12.

All-cause mortality and coronary heart disease

A study by Oyebde et al in 2013 found that, after adjusting for other risk factors such as age and BMI, the consumption of 7+ serves of fruit and vegetables was associated with a decrease in all-cause mortality of 0.67, including reduced cancer (0.75) and cardiovascular mortality (0.69) compared to eating less than one serve per day.[52]

In estimating the marginal improvement of dietary changes, it is important to know the starting point. For instance, the marginal improvement in 'all-cause mortality' of:

- shifting from less than 3 serves of fruit and vegetables per day to 3-5 serves is 0.12
- increasing to 5-7 is a further 0.06, and
- further increasing from 5-7 serves to above 7 serves is an additional 0.03.[53]

The results were even more significant for individuals that are overweight and obese.

- A 0.13 reduction in 'all-cause mortality' is achieved by moving from less than 3 serves of fruit and vegetables per day to 3-5 serves
- An additional 0.10 reduction is achieved by moving to 5+ serves per day, and
- An additional 0.03 is achieved by increasing from 5-7 serves per day to 7+ serves per day.[54]

Hence, it is possible that the TWD Online program accounts for a shift from less than 10 per cent compliance to potentially over 50 per cent compliance — reflecting estimates of the percentage of Completers and those that are expected to be actively engaged in the program at 12 weeks (but not weigh in to be a 'Completer').

- **It also may be possible that a broader range of members of the TWD Online community, not only those participating in the formal weight loss and nutrition program, will change their dietary habits particularly with respect to fruit and vegetable consumption.**

Based on the dietary habits of the broader Australian population, the nutritional benefit from undertaking the TWD Online program (and adhering to the Australian guidelines after the program) may be in excess of a 0.13 reduction in 'all-cause mortality' per person, for each year of adherence to the dietary guidelines.

Consistent with the reduction in all-cause mortality, a meta analysis by He et al in 2007 found that increasing fruit and vegetable consumption from less than 3 to more than 5 servings per day is related to a **17 per cent reduction** in coronary heart disease risk.

These benefits are additional to the modelling.

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52 Oyebode, O., Gordon-Dseagu, G., Walker, A., and Mindell, J. 2013. 'Fruit and vegetable consumption and all-cause cancer and CVD mortality: analysis of Health Survey for England data'. *Epidemiol Community Health*, 2014, 68, Pp 856-862.

53 Oyebode et al 2013.

54 Oyebode et al 2013.

Impacts

Improved health outcomes will impact on the economy by improving labour productivity. The TWD Online platform does this directly by contributing positively to health outcomes across a range of chronic diseases.

It is possible to measure this value through a broad workforce productivity improvement, which is not disease specific, and considers productivity changes in an economy-wide context. It is not the same as a burden of disease studies which 'count up' direct and indirect costs, without considering transfers in income and expenditure, and without imposing the discipline of a budget constraint.

This approach requires a link to be drawn between the adoption of program outputs and changes in chronic disease management that narrows the gap in workforce absenteeism between those living (and working) with, and without, chronic disease in Australia.

Economy-wide, the participation rate is currently **64.8 per cent**.[55] However, according to the Australian Institute of Health and Welfare, people living with chronic disease are less likely to be in full-time employment than those without a chronic disease (48 per cent versus 61 per cent).[56] This would mean that the potential pool of consumers likely to derive a workforce related benefit from accessing the TWD Online is around **48 per cent** of the estimated working population that are adopters of the program and expected to be managing a chronic disease (of approximately 75 per cent[57]).

People living and working with chronic disease have been found to have more days absent from work due to condition. The AIHW has found that people with chronic disease average nearly half a day (0.48) off work in the previous fortnight compared with a quarter of a day (0.25) for people without chronic disease.

Improved labour productivity as a result of improved health outcomes has been modelled based on the expected number of Australians expected to improve their health status after undertaking CSIRO's substantiated TWD Online program, and the reduction in workforce absenteeism they are able to achieve as a result.

The labour productivity improvement is **0.5 per cent** across 0.6 per cent of the Australian population, assuming a cohort of 201 059 adopt the TWD Online program by 2030. We assume that a maximum of 17 per cent of the cohort (of 0.6 per cent of the Australian workforce) or **0.1 per cent of the Australian employed workforce** experiences a productivity benefit at any one time, reflecting the assumption that one year of benefit is received by those losing weight, and five years in total for 'Completers' expected to achieve a sustained benefit. These assumptions are summarised in chart 2.6.

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55 Australian Bureau of Statistics 2015, Labour Force Survey Cat. No. 6202.0

56 AIHW, 2009. *Chronic disease and participation in wor*k. Cat. No PHE 109. Canberra. Gender breakdowns are even more stark with 82 per cent of males without chronic disease being in full-time employment compared with 69 per cent of those with chronic disease. For females, these figures were 38 per cent and 32 per cent, respectively.

57 The rate of chronic disease in the Australian community is approximately 50 per cent. Based on the age and weight profile of the TWD Online program adopters, we assume that the rate is higher, at 75 per cent.

The maximum annual benefit of the labour productivity shock at 18 per cent is **$5.8 million per year**.

2.6 Modelling assumptions underpinning labour productivity gains due to better managed disease

Key assumptions to 2030 include the following:

- 201 059 adopt a CSIRO substantiated program by 2030, with 94 per cent achieving weight loss and assumed to increase their productivity for one year. In addition, 'Completers' achieving sustained weight loss are assumed to increase their productivity for five years in total.
- 75 per cent of those achieving weight loss are assumed to be living with a chronic disease at the time of adoption.
- 48 per cent of those achieving improved health outcomes are likely to be in full time employment (less than would be the case for people that do not live with chronic disease)[58]
- The annual difference in workforce absenteeism between those living with, and without, chronic disease is **5.52 days**[59] Consumers accessing programs and technologies are able to achieve a **20 per cent** reduction in the differential in absenteeism, which is equivalent to 1.2 days per annum for each full-time working person impacted.
- In an economy-wide sense, this translates into a **0.5 per cent productivity gain** for a maximum of **0.1 per cent of the Australian employed workforce in a given year to 2030.**

[58] Based on AIHW (2009). Chronic disease and participation in work, AIHW, Canberra.

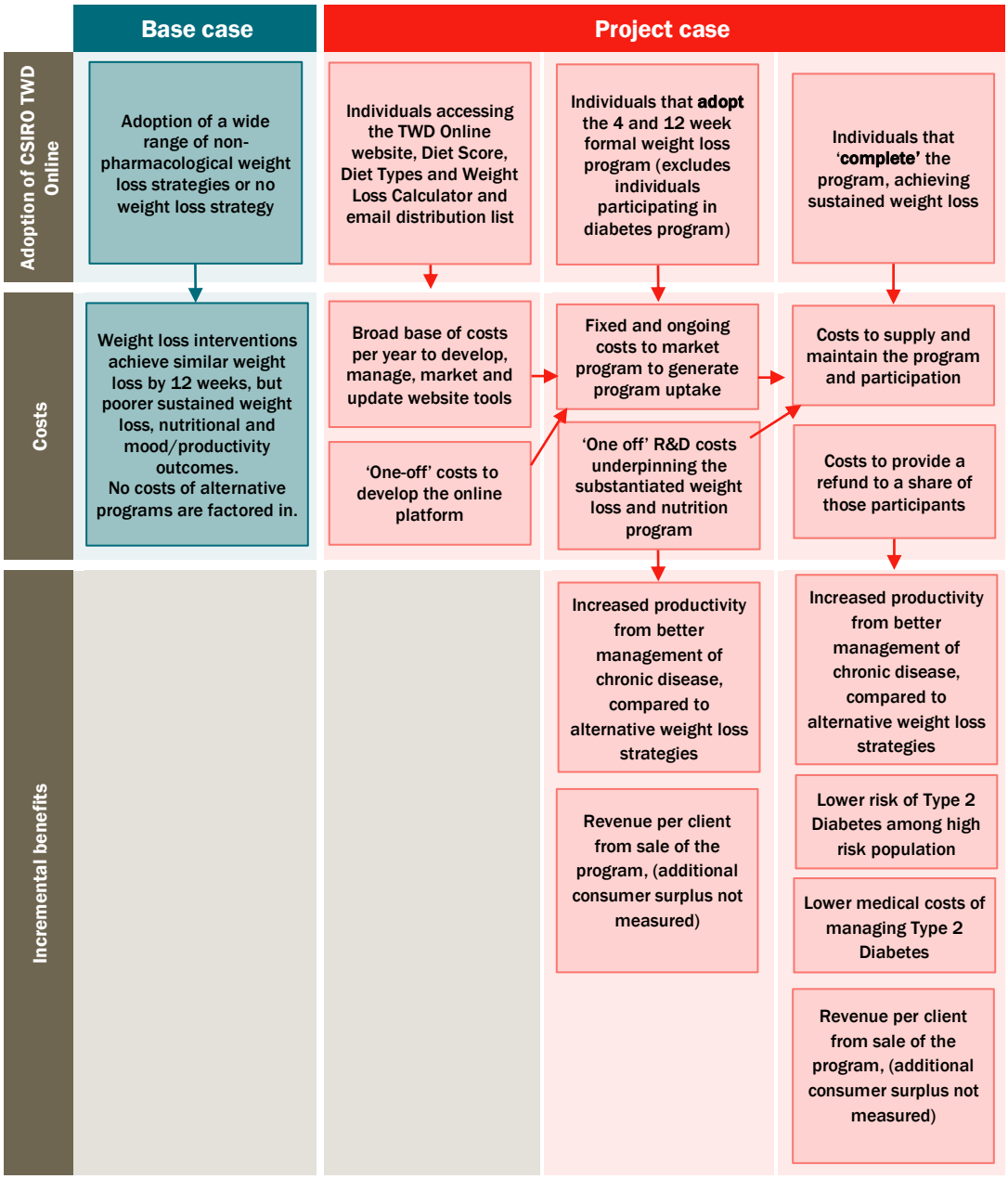
[59] Based on AIHW (2009) finding that those with a chronic disease average 0.48 days absents per fortnight, compared to 0.25 days for those without chronic disease, a difference of 0.23 days per fortnight, or 5.52 days per 48 weeks.

3 Quantification of costs and benefits

Benefits incorporated in the modelling

The benefits incorporated in the modelling are shown in chart 3.1.

3.1 Costs and benefits incorporated in modelling results – TWD Online



Source: The CIE.

The CIE has approached this evaluation by firstly developing a Benefit Cost Ratio for the joint investment by SP Health and the CSIRO in the technology/program.

Chart 3.1 shows that the benefits of the technology are counted in two separate groups:

- for those that **adopt** the TWD Online program and lose (any) weight —individuals receive a productivity benefit for one year from better management of chronic disease, compared to alternative weight loss strategies
- for those that **'complete'** the program —a *portion* of 'Completers' are expected to receive sustained weight loss benefits (up to 67 per cent), including:
  - a reduction in Type 2 Diabetes among those individuals with high risk
  - lower medical costs associated with Type 2 Diabetes management
  - an additional four years of improved productivity related to better management of chronic disease (a total of five years)
- both groups derive revenue from the TWD Online of $149 per individual (with a component of this directed to the CSIRO).

In accounting for both the costs and benefits of CSIRO and SP Health's investments in the technology, the CIE builds in the revenue stream from the TWD Online of $149 per paid member. To CSIRO, the benefit stream (directly) is the value of the royalty that has been agreed between SP Health and the CSIRO of 10 per cent of this revenue.

Assumptions related to inputs over time

A summary of the key inputs of SP Health and the CSIRO over time is provided in table 3.2.

Areas of uncertainty

Assumptions that are uncertain are shown in red. For instance, there is a great degree of uncertainty with regard to the share of the platform development costs spent by SP Health that are attributable to the CSIRO. SP Health comments that the $15 million investment could not be justified on the TWD Online alone.

SP Health notes that each incremental investment made in intellectual property has benefited the TWD Online platform either directly or through 'learnings'.

- The CIE assumes that approximately **30 per cent** of the platform development investment is attributable to the TWD Online.
- Sensitivity analysis suggests that this assumption does not significantly alter the payoffs from the total investment in the TWD Online (individually).

The broader program of R&D on the TWD has been required to develop the TWD Online platform. The CSIRO has not conducted any research that is directly targeted towards the online platform per se, however the value or price of this research is not zero. In a commercial setting, this would have an explicit value.

- The CIE assumes that **30 per cent** of the R&D investment between 1999 and the launch of the TWD Online is included. The estimates include staffing related

overheads, which incorporate elements of communications and commercial expenses, which are inherently more difficult to attribute back to each program.

- While varying this assumption changes the level of payoff, the program continues to have been viable when this assumption is changed (holding all else constant) to 100 per cent.

3.2 Key assumptions related to inputs, real terms

	Prior to the 2015 launch	2015-2030
CSIRO's inputs		
CSIRO ongoing direct expenditure to review contents and further refine Online platform	$130 000 per year, plus overheads, for 3 years	n.a.
TWD Diet Score and Diet Score	$30 000 per year, for 3 years	n.a.
Total investment in weight loss research related to TWD, with some share attributable to TWD Online	$120 000 since 1999, multiplied by share attributable to TWD Online	$120 000 per year, multiplied by share attributable to TWD Online
Share attributable to TWD Online	**30%**	**30%**
SP Health's inputs		
Platform development costs, SP Health	$15 million	n.a.
Share attributable to TWD Online	**30%**	n.a.
SP Health investment in TWD Online	$1.68 million[a]	
SP Health investment in marketing platform *to maintain uptake*	$446 000 in 2014-15 [b]	$803 000 in 2015-16, $848 000 in 2016-17 and $848 000 in 2017-18 [b] and increased by a further $100 000 each year for five years
Future product development ***to maintain uptake***		$500 000 per year from 2018
Cost of the rebate to TWD program completers		$0.16 million
Operating costs	$1.4 million in 2014-15	$1.2 million in 2015-16 and $2.3 million in 2016-17. An average of $1.64 million thereafter.

[a] Nominal investment of $1.63 million over three years. [b] Nominal investment of $433 000 in 2014-15, $803 000 in 2015-16 and $848 000 in 2016-17.

Source: The CIE.

Summary of inputs

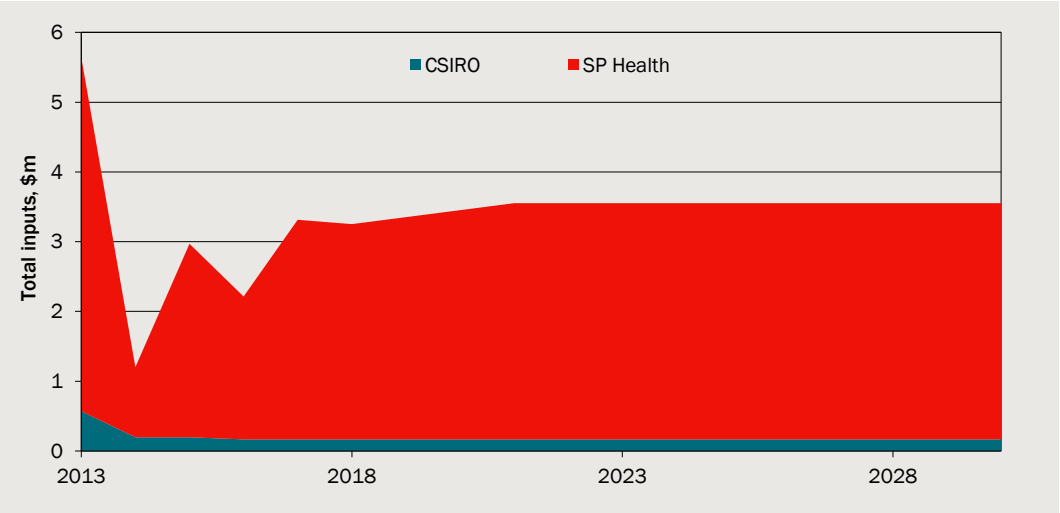
Chart 3.3 shows there has been substantive investment by SP Health in to the intellectual property underpinning the TWD Online platform (and others). The CIE treats investment made prior to 2013 as a lump sum payment in that year.

- SP Health continues to spend approximately $3.4 million per year on the marketing of the platform and future product development, as well as operating costs, in order to sustain a level of uptake consistent with the past.

- In contrast, the ongoing investment by the CSIRO is very modest.

- Following 2030, we assume that no further investments are made and there is no additional uptake of the program.

3.3 Inputs — the CSIRO and SP Health



Data source: The CIE.

Assumptions related to outputs and outcomes over time

The key inputs to the modelling are identified in table 3.4. The key sources of benefit included in the modelling include:

- the revenue from the members of the paid weight loss program, with 10 per cent paid as a royalty stream to the CSIRO
- from sustained weight loss leading to lowering of Type 2 Diabetes risk among 'Completers', including improved Quality of Life and lower medical expenses
- improved labour productivity, as a result of improved health outcomes across individuals improving their health status, where individuals losing any weight (94 per cent) is taken to reflect those improving their health status.

Additional benefits not included in the modelling are from the lowering of cardiovascular disease risk factors, and possible reduction in use of antihypertensive medication, as well as the improvement of health independent of weight loss as a result of increased vegetable and fruit consumption.

In addition, a broader range of individuals could potentially remain actively engaged in the program at 12 weeks than 'Completers'.

3.4 Key inputs to modelling related to outputs and outcomes

Item	1 Jan 2015 to31 March 2017	To 2030, upper bound (lower bound)
Participation and weight loss results		
Uptake	27 173	12 633 per year
Percentage of 'completers'	**26.45%**	**26.45%**
Share of 'Completers' sustaining weight loss > 2 yrs		**67% (33%)**
Revenue stream		
Revenue to SP Health	$149 per individual taking up program, less the rebate provided to 9% of completers, less the royalty to CSIRO	Continuation of same formula
Revenue to CSIRO	10% of the income from paid members (approx. $190 000)	Continuation of same formula
Benefit from lower risk of T2D (shared benefit the CSIRO and SP Health)		
Disease risk prevalence		8% (6%)
Impact of weight loss on disease risk factors		32% (6%)
Loss of Quality of Life (in QALY index)		0.04
Value of a statistical life, 2017		$187 104 [a]
Estimated health savings per person with T2D, per year		$4 345 [b]
Timeframe of benefits		5 years
Benefit from labour productivity improvement (shared benefit the CSIRO and SP Health)		
Increase in consumption ($m) per year of a 1% productivity improvement to 1% of (employed) workforce		$129.1 million
Share of the TWD participants with a chronic disease [c]		75%
Size of the shift in labour productivity		0.5%
Size of the shift in labour productivity, based on maximum adoption		0.4%
Adoption profile		Approximately 10% each year
Duration of productivity improvement		1 year for 94% of cohort that loses weight 5 years for 'Completers' with sustained weight loss (a maximum of 17% of total adoption)

[a] The statistical value of a statistical life year is currently appraised at $182 000 in 2014 dollars60, which is $187 104 in current terms. [b] According to the Baker IDI Heart and Diabetes Institute, the average annual health care cost for a person living with diabetes was $4 025 per year in 2012 or $4 345 in today's terms.61 [c] We assume that 75 per cent of the TWD participants have a chronic disease affecting their productivity, or 50 per cent higher than the general population due to higher age and weight related risks.

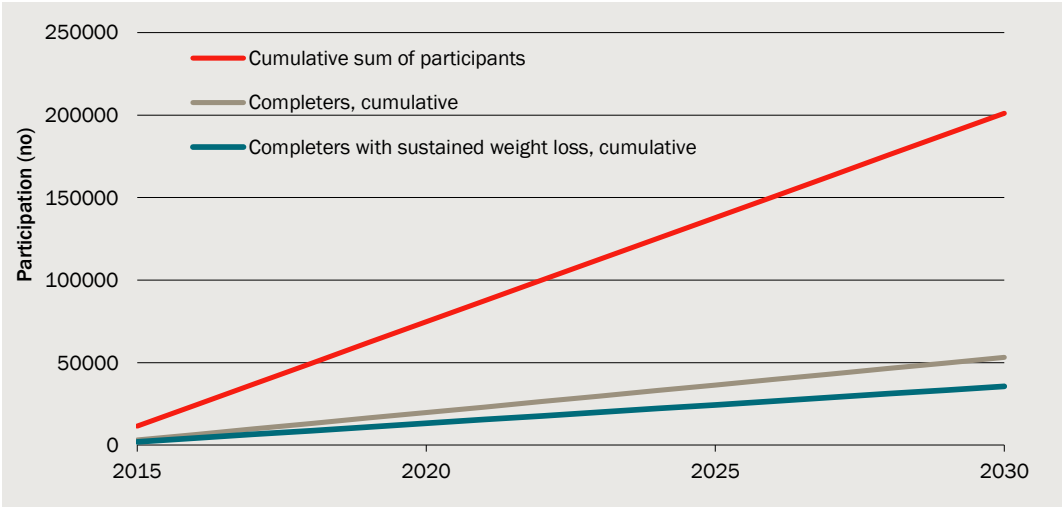
60 Department of the Prime Minister and Cabinet, 2014. *Best Practice Regulation Guidance Note: Value of statistical life*.

61 Baker IDI Heart and Diabetes Institute, 2012. *Diabetes: the silent pandemic and its impact on Australia.* https://static.diabetesaustralia.com.au/s/fileassets/diabetes-australia/e7282521-472b-4313-b18e-be84c3d5d907.pdf

Source: The CIE.

Chart 3.5 shows cumulative participation in the TWD Online program. The 'Completers' are shown in grey, representing approximately 26 per cent of program adopters. As previously identified, this may be considerably higher. Individuals achieving sustained weight loss benefits are assumed to be up to 67 per cent of 'completers', although this is considered to be an upper bound. In total, over 200 000 individuals participate in the program by 2030, with a total of 35 631 achieving sustained weight loss for at least two years.

3.5 Cumulative participation in TWD program



Data source: The CIE.

Chart 3.6 shows that the TWD Online program generates up to $6.5 million per year in benefit.

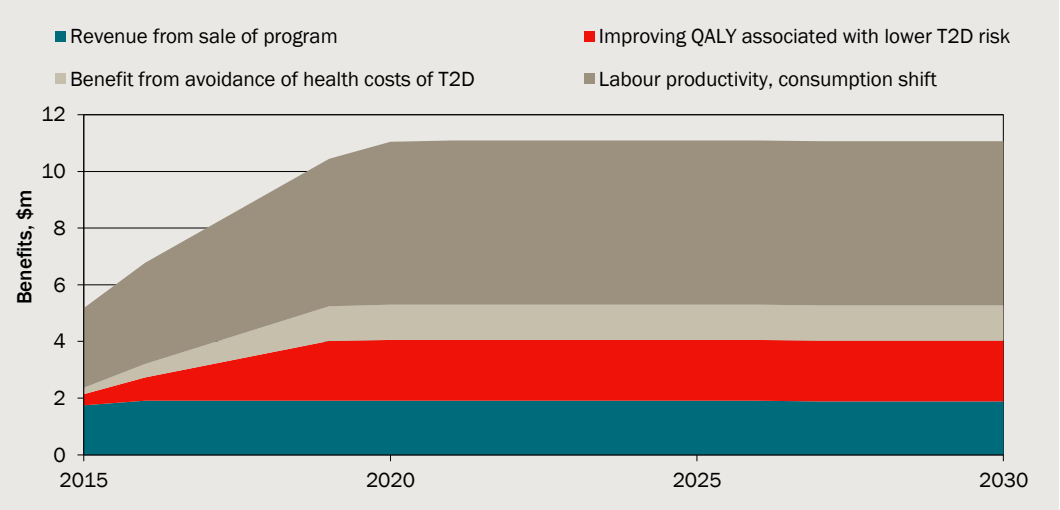
On average, the benefit per participant (outside of the consumer surplus from substantiation) is:

- $149 per year from the revenue stream from paid members, with 10 per cent paid to the CSIRO as a royalty from SP Health
- $34 per year in lower Type 2 Diabetes risk (and associated improvement in QALY)
- $20 per year in lower health costs associated with avoidance of Type 2 Diabetes
- $109 per year in increased productivity benefit.

The benefits of lowering Type 2 Diabetes risks and costs as well as productivity benefits, which accrue largely to third parties, are treated as additional to the revenue stream.

The analysis indicates that the benefit derived from individuals participating in the program is significantly more than the price that they are paying. That does not mean that the price paid for the program is too low, but that there are additional 'externalities' from the program.

3.6 Benefit from lowering cost of Type 2 Diabetes and labour productivity shift



Data source: The CIE.

Returns from CSIRO and SP Health investments

The results below, shown in table 3.7, are modelled for the CSIRO and SP Health inputs combined, and the combined impacts.

Based on reasonably conservative assumptions, the total investment in the Total Wellbeing Diet Online more than pays for itself. After discounting, the benefit cost ratio is approximately **2.5:1** (using a 3 per cent discount rate).

3.7 Benefit cost ratio, using base case assumptions

Discount rate	Net Present Value	Benefit cost ratio
3 per cent	$68.6m	2.5
5 per cent	$56.4m	2.4
7 per cent	$46.7m	2.3

Source: The CIE.

Sensitivity analysis

To take a more optimistic view of 'Completers' that are actively participating until the end of the 12 week weight loss program, at 52.9 per cent instead of 26.4 per cent, keeping all remaining assumptions constant, results in a BCR of **3.8:1** (using a 3 per cent discount rate).

Testing the lower bound assumptions identified in table 3.2 leads to a benefit cost ratio of **1.6:1** (at a 3 per cent discount rate), most significantly impacting the scale of the benefits from lowering of the Type 2 Diabetes risks.

The analysis is based on reasonably conservative assumptions, and exclude a range of other health benefits related to behavioural change resulting in better nutrition and other less well developed health impact pathways, including lower cardiovascular disease risk and possible reduction in hypertensive medications.

Of the benefits identified, a large share are externalities that will be received by the public, including from lower health care costs (of which a large share is likely to be saved by the taxpayer) and from societal benefits of more productive individuals.

SP Health is expected to make a small loss, given the assumptions above. However, the CIE is informed that SP Health is investing in the program for other commercial opportunities that may arise as a result of the database of participants of the TWD Online community, through either the applications or the program.

Disaggregation of impact of CSIRO and SP Health

This evaluation has been undertaken by the CSIRO to both understand the payoff from the technology, as identified above, and to identify specifically the potential net benefit (and success) of the CSIRO. It is therefore necessary to tease out the CSIRO's costs and benefits — requiring a disaggregation of the positive externalities back to either the CSIRO or to SP Health.

- **In practice, this requires that we make a judgement about the value of CSIRO's branding and substantiation of the diet in contribution to the program outcomes, as distinct from the marketing platform, which has facilitated its uptake.**

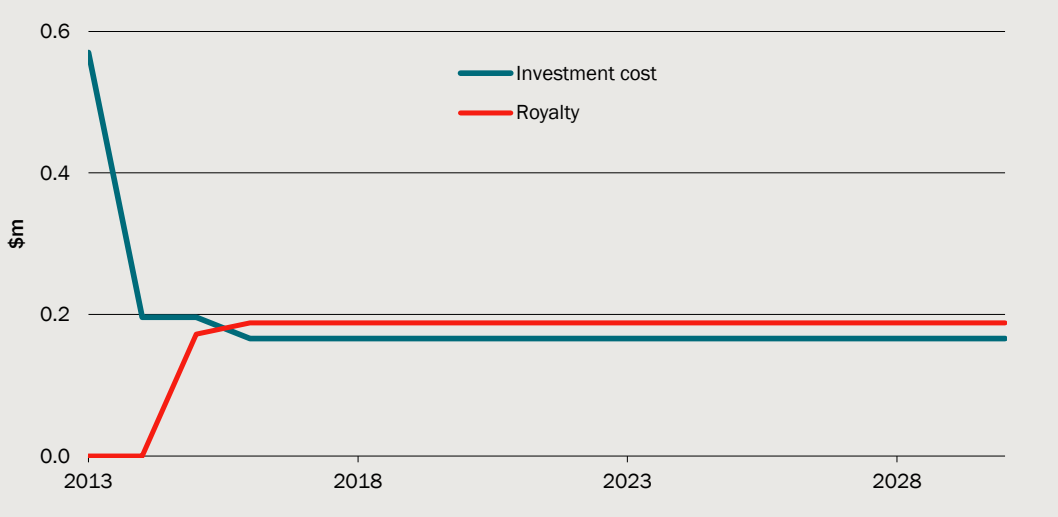
Costs and royalty stream

The CSIRO has undertaken research and development to substantiate the high protein, low carbohydrate diet that underpins the TWD Online. While the CSIRO has not specifically targeted the TWD Online through these R&D activities, it nonetheless represents a cost for the TWD Online and a benefit to the weight loss research program more broadly. The exact value of this is unknown, so we have assumed that 30 per cent of the investment in weight loss research related to the TWD is attributable to the TWD Online.

A small level of ongoing cost is incurred by the CSIRO to maintain the TWD Online. These are completely offset by the royalty stream paid by SP Health. That is, for a relatively small ongoing cost, the CSIRO has been able to create a successful partnership with SP Health to leverage a relatively small investment that derives *externalities* that are not captured through the revenue stream.

- **Importantly, the royalty stream paid to the CSIRO by SP Health is not a reflection of the benefit it derives.**

3.8 Upfront and ongoing costs incurred by the CSIRO and royalty stream



Data source: The CIE.

The contribution of the CSIRO to weight loss related 'externalities', which are not captured by SP Health or the CSIRO, is related to the value of CSIRO's brand. It would have been possible for SP Health to pick up the publically available literature on high protein, low carbohydrate diets to build its own diet.

- **Given there was limited new research and development undertaken by the CSIRO for the purpose of the TWD Online, the most significant value delivered is identified as its branding as a trusted scientific institution. This is likely to have been influential in the adoption of the TWD Online.**

In determining the value of the CSIRO's contribution, there are two counterfactuals to consider:

- what level of health and productivity benefit might have been achieved through the program by SP Health in the *absence of the CSIRO's branding*, noting the following **drivers** of the level of externality delivered through the platform:
  - the rate of uptake of the program
  - the rate of completion of the program
  - the rate of **sustained** weight loss outcomes.
- what level of health and productivity benefit might have been achieved by the CSIRO in the absence of the arrangement with SP Health, with respect to the key drivers of public benefit of uptake, completion and sustained weight loss?
- We consider two possible counterfactuals. Firstly, it is likely that, without the CSIRO, the level of success of SP Health in driving adoption and therefore public benefits would have been significantly lower. Similarly, had CSIRO commissioned another marketing agency to promote uptake there may have been less success. However, this requires further judgements around the potential cost to the CSIRO of an alternative arrangement and the expected level of success in delivering public good (externalities)? That is, with perfect information we would seek to know how SP Health has leveraged its skills and investments to deliver value to the public through the CSIRO's investment?

It is likely that the level of success of SP Health in driving adoption and therefore public benefits, *without the CSIRO*, would have been significantly lower. Similarly, had CSIRO commissioned another marketing agency to promote uptake there may have been less success in deriving public benefits or may have cost the CSIRO more.

The CSIRO may have a sense of the latter if it went to a competitive tender process. However, it would be particularly difficult to assess the hypothetical performance of alternative arrangements and as such, we focus on the first counterfactual of what SP Health might have achieved in the absence of the CSIRO.

We know from the review of the scientific literature that the *rate* of benefit from weight loss with a high protein and low carbohydrate diet, including productivity benefit and health outcomes (such as reduced diabetes risk) is driven by the biological responses to the change in diet and lifestyle themselves, which could be adopted with or without CSIRO. That is, had SP Health developed its own similar diet it may not have needed the CSIRO to achieve the *rate* of benefit per participant.

- **We note, however, that there is the question of whether SP Health may have marketed a different diet and lifestyle package, with lower levels of productivity and health benefit, had the CSIRO not done the work to substantiate and advocate for this particular package of dietary and nutritional information.**

If we were to be conservative in the attribution of benefits back to the CSIRO we could assume that SP Health may use the literature and previous work by scientists of the CSIRO on the Total Wellbeing Diet, without a formal partnership with the CSIRO.

The CSIRO is expected to have had a more direct impact on the level of public benefit through the **scale of adoption** of this model of weight loss and, secondly, by promoting **completion** the program. This would influence the size of the pool of individuals benefiting from short term and medium term weight loss outcomes.

Based on the CIE's evaluation methodology, the level of public benefit is being driven by the rate of uptake of the program more so than the rate of completion. As such, it is pertinent to think about whether the CSIRO's branding can account for up to 50 per cent of the participation in the program and therefor half of the public benefit?

Without consumer surveys, this is difficult to determine. Therefore, we provide the Net Present Value and Benefit Cost Ratio for the CSIRO's contribution to the TWD based on several different scenarios on adoption in table 3.9. The range of BCRs estimated is between 17.5:1 and 4.4:1.

3.9 Benefit cost ratio of the CSIRO

Scenario	NPV, using a 5 per cent discount rate	Benefit cost ratio
CSIRO accounts for 50 per cent of adoption	$40.1m	17.5
CSIRO accounts for 25 per cent of adoption	$19.8m	9.3
CSIRO accounts for 10 per cent of adoption	$7.6m	4.4

Source: The CIE.

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