



Modelling National Savings Potential of Type 2 Diabetes Prevention in Finland

- Estimates for an outcomes-based financing agreement initiative

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The logo for SITRA, consisting of the word "SITRA" in a bold, black, sans-serif font. The letters are stylized, with the 'S' and 'I' having a unique, blocky appearance.



Background

- Type 2 diabetes (T2D) (ICD-10: E11) is usually an adult-onset metabolic disease associated with elevated blood glucose levels
- T2D is one of the most common metabolic diseases and represents a leading cause of morbidity and mortality because of its related micro- and macrovascular complications
- The number of persons with T2D is expected to increase dramatically in the next decades
- Overweight and obesity associated with western dietary habits and low physical activity are the major determinants of the growth of T2D prevalence
- Fortunately, lifestyle interventions have shown to be effective in reducing or delaying the incidence of T2D in several studies, one of the first of which was the Finnish Diabetes Prevention Study (DPS).
- In Finland, **The Centre of Expertise for Impact Investing** is currently planning an outcomes-based financing agreement initiative to prevent or delay T2D among persons at elevated risk of T2D
 - In performance-based agreement projects, e.g. private capital enables the production of activities and services. The return on capital (incl. financial return) is based on the savings or other economic/welfare benefits made possible by profitable operations for the public sector.



Aims of the Study

- The purpose of the initial model-based assessment was to produce estimates of the lifetime savings potential that can be achieved at the national level through T2D prevention measures in Finland among persons at elevated risk of T2D.
 - The savings potential estimates consider changes in both direct health care and productivity costs related to functional and work capacity.



Framing of the Study

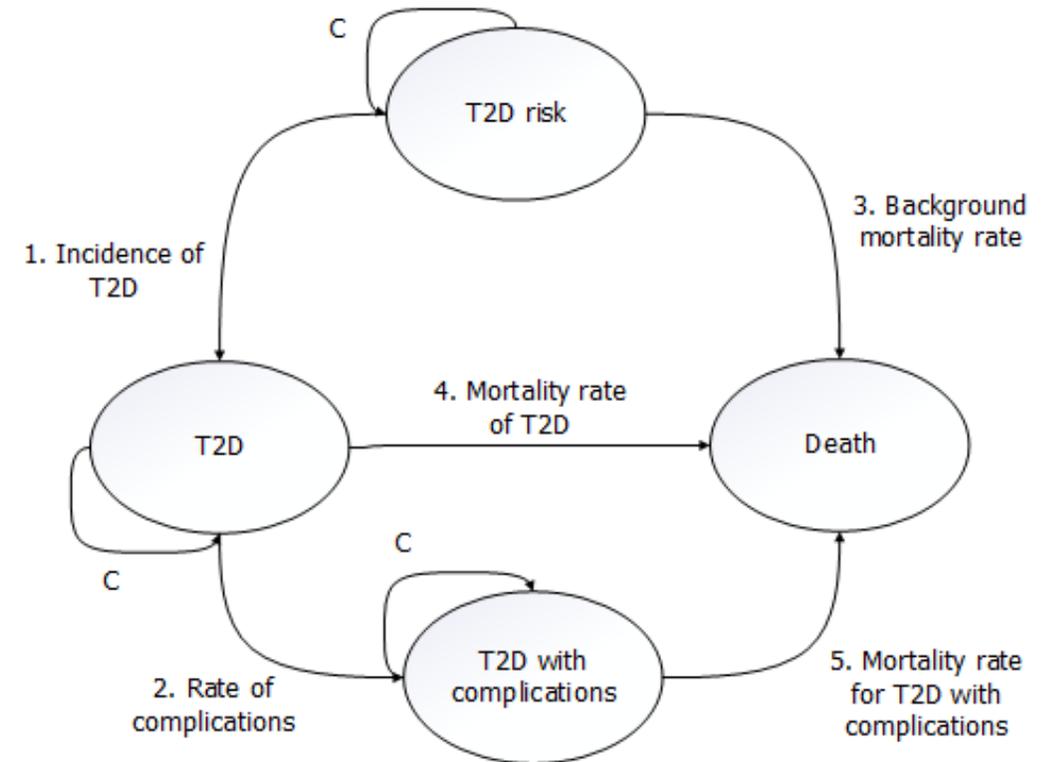
- PICOT Format

Population (P)	Finnish people aged 40–85 at elevated risk of T2D (FINDRISC \geq 12). Based on year 2017 demographics and the prevalence of T2D risk factors in population (based on the FinHealth 2017 study), the size of this target population is around 700,000 persons
Intervention (I)	Hypothetical lifestyle intervention enabling on average 2–5% weight loss during the first year of the intervention. In sensitivity analysis, weight loss was assumed to be 5-10% or > 10%
Control (C)	No intervention
Outcomes (O)	<ul style="list-style-type: none">• Lifetime savings potential at present value (applying 3% discount rate)• Social Return On Investment (SROI)• Quality adjusted life years (QALY) achieved through lifestyle guidance at present value (applying 3% discount rate)
Time horizon (T)	Follow-up period 15–45 years, depending on age group and applied scenario



Health Economic Model

- Discrete-time, closed cohort Markov-type state transition model, which is commonly used in health economic modelling, was applied in the present study
- The model used was originally developed in the StopDia project (www.stopdia.fi) funded by the Strategic Research Council of the Academy of Finland (2016–2019).
 - Simplified interactive web-based model version of the model is available [here](#) (currently only in Finnish)
- The model can be used to predict the long-term health and economic impacts of prevention measures based on available research evidence



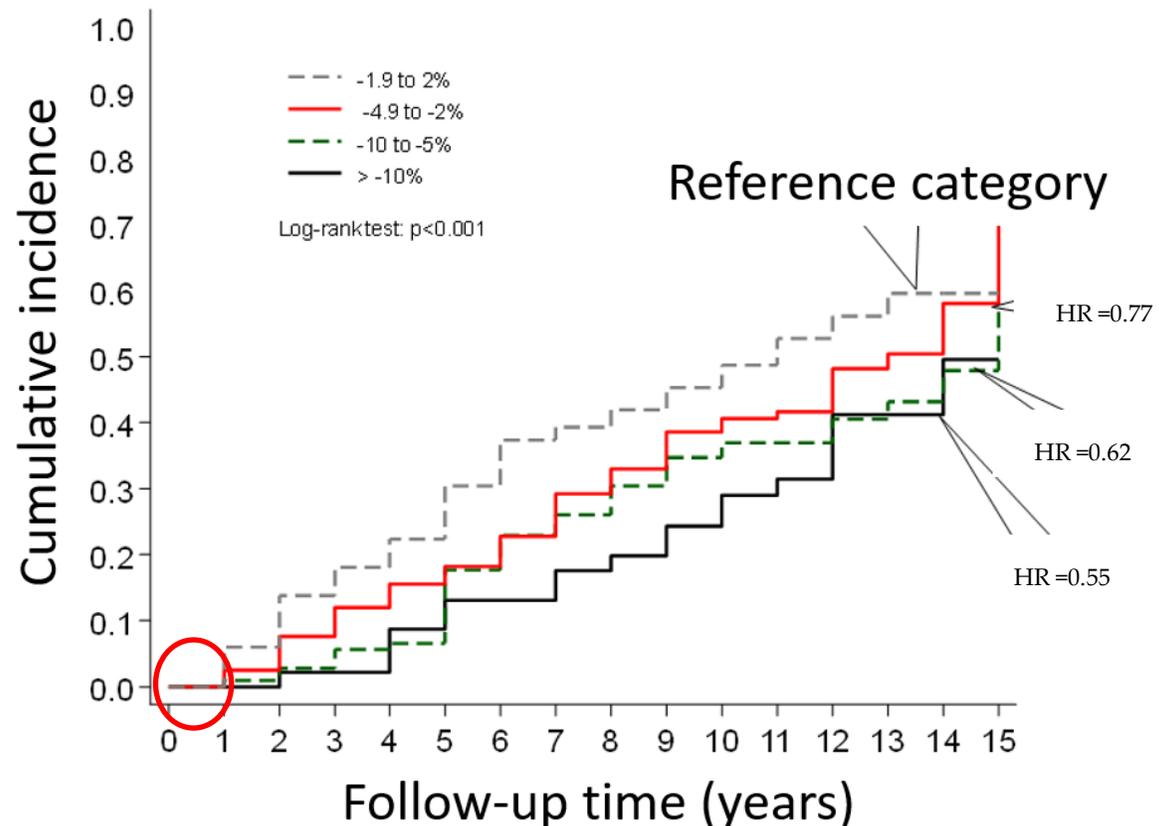
Structure of the Developed Markov Model



Model Parameters

- Association between Weight Loss and the Incidence of T2D

- The post-hoc analysis of the Finnish DPS study dataset was conducted to determine the association* between the obtained weight loss (%) during the year 1 and the long-term incidence of T2D (14 years of follow-up)
 - In the base-case, moderate 2-5% weight loss was expected to reduce the risk of T2D by 23% (HR 0.77) during the 14 years of follow-up
 - In Scenario 1, the achieved weight loss 5-10% was expected to reduce risk of developing T2D by 38 % (HR 0.62)
 - In Scenario 2, the achieved weight loss > 10% was expected to reduce risk of developing T2D by 45% (HR = 0.55)
 - In all scenarios, lifetime study horizon was applied, but the effectiveness of lifestyle intervention was assumed to be maintained only for the first 15 years



(THL/ unpublished data 2018)



Model parameters

- Transition Probabilities

- Incidence of T2D
 - Parametric survival regression modelling approach applying the register-enriched national FINRISK survey data was used to estimate the incidence (i.e. transition probabilities) of T2D conditional on age, sex, and FINDRISC score points (THL/ unpublished data 2018)
- Risk of T2D complications
 - Regional electronic health record (EHR) data from the North Karelia area was used to estimate the incidence of T2D-related micro- and macrovascular complications in persons with newly diagnosed T2D (unpublished data).
- Background mortality
 - National all-cause mortality data by age and sex from Statistics Finland
 - Published relative risk (RR) estimates were used to adjust the higher risk of death among persons with T2D and T2D with complications



Model Parameters

- The Additional Costs Associated with T2D

- The additional costs associated with T2D were estimated from the multiple national sources
 - Direct health care costs were obtained from a national register study
 - Productivity costs due to sick leaves, premature retirements, and premature deaths were obtained from a national register study

Additional costs of T2D and its complications

	Treatment of T2D	Comorbidities of T2D	Primary health care (outpatient visits)	Productivity costs
Additional costs per year per person	3 129 €	4 156 €	Men: 550 € Women: 532 €	7 461 €



Model Parameters

- Population-Based Utility Weights for QALY Estimation

- Health-related quality of life were assessed in the model using Finnish-specific age- and sex-specific utility weights defined for the model states.
- Disutility associated with T2D and T2D with complications were also considered in the QALY estimation
- The utility weights were obtained from previously published Finnish studies

Age and gender-specific population utility weights and disutility caused by T2D estimated using EQ-5D-3L		
Female	30-44	0.906 (0,003)
	45-54	0.865 (0,005)
	55-64	0.810 (0,006)
	65+	0.770 (0,008)
Male	30-44	0.917 (0,003)
	45-54	0.876 (0,005)
	55-64	0.821 (0,006)
	65+	0.781 (0,008)
Disutility of T2D and "T2D with complications state, EQ-5D		0.041 (0.012)



Sensitivity Analysis

To investigate the uncertainty associated with model parameters and applied assumptions, e.g. the following sensitivity analyses were performed:

- The effect of the time horizon applied in the assessment on the magnitude of the savings potential was studied by shortening the analysis interval from the lifetime to 15 years.
- A scenario where weight loss was assumed to be 2-5% during the first year and the cost of intervention was expected to be € 100 or € 500 per person.
- Number of one-way sensitivity analyses were also conducted, and the results of these analyses are presented in the form of a tornado diagram



Main Results

- Currently, the expected total lifetime T2D-related costs among people aged 40-80 who are currently at risk of T2D are almost € 9 billion (a discounted present value).
- Lifestyle interventions leading to weight loss between >2% and >10% could reduce these total costs by between €1.0 and €2.1 billion.
- At the individual level, the expected total lifetime costs are on average €13,500 (a discounted present value) and the corresponding achievable savings potential between 1,600 - 3,200 euros.
- Furthermore, 73,000 to 146,000 QALYs could be produced at the population level due to decreased T2D-related morbidity and mortality at the population level.

	Age-Groups				
Age-groups (the number of persons at T2D risk)	40-49 (n = 84 786)	50-59 (n = 201 533)	60-69 (n = 208 069)	70-80 (n = 168 297)	Total*
Expected lifetime cost per person at elevated risk of T2D	37 900 €	19 300 €	7 000 €	2 200 €	13 500 €
Expected savings potential per person at elevated risk of T2D, when weight loss is expected to be...					
≥ 2 % (2-5 %)	3 700 €	2 300 €	1 000 €	500 €	1 600 €
5-10 %	6 200 €	3 900 €	1 600 €	800 €	2 700 €
>10 %	7 400 €	4 700 €	1 900 €	900 €	3 200 €

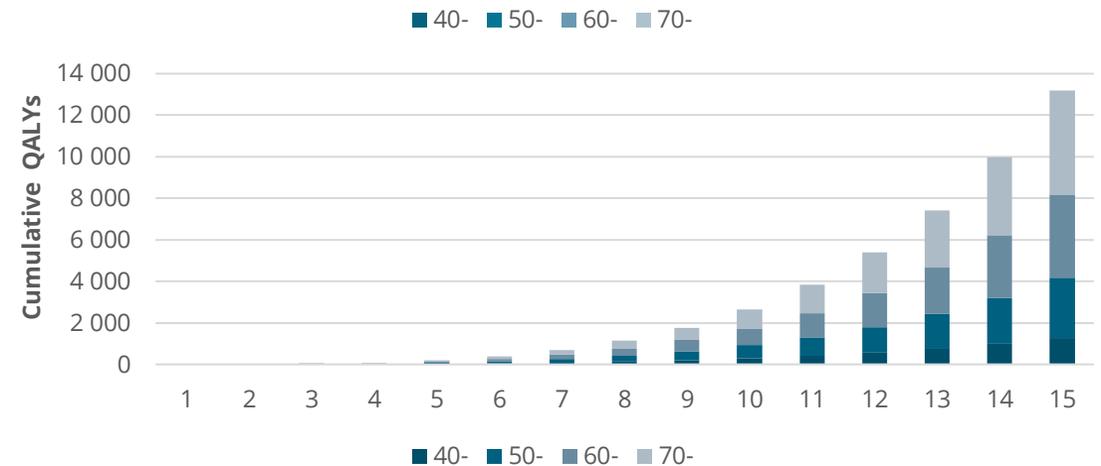
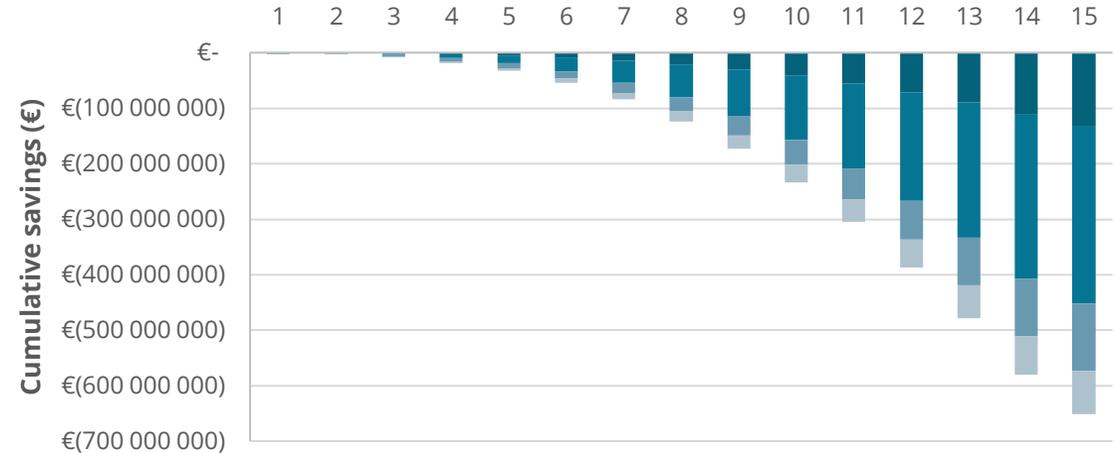
* Weighted average



Results of Sensitivity Analysis

Next 15-year savings potential

- Looking at the savings potential in the shorter term (15 years) in the base-case scenario:
 - The total savings potential is around € 640 million
 - The expected number of additional QALYs achieved at the population level is around 13,000
- The impact of lifestyle interventions on total costs depends largely on the weight loss achieved during the intervention and the baseline risk of developing T2D.





Results of Sensitivity Analyses

- In the base-case (i.e. weight loss 2–5%), while the cost of a lifestyle intervention was assumed to be € 100 per person compared to the current situation.
 - The social return on investment (SROI) was € 22.4
 - Looking at gender, the SROI estimate was 18.7 for women and 26.5 for men.
 - The payback time for the scenario was around 6 years for women and 5 years for men.
- When the cost of a lifestyle intervention was raised to € 500 per person:
 - The SROI was around € 3.6
 - The payback time was around 10 years for women and 8 years for men.

Estimates of the social return on investment (SROI) and payback time

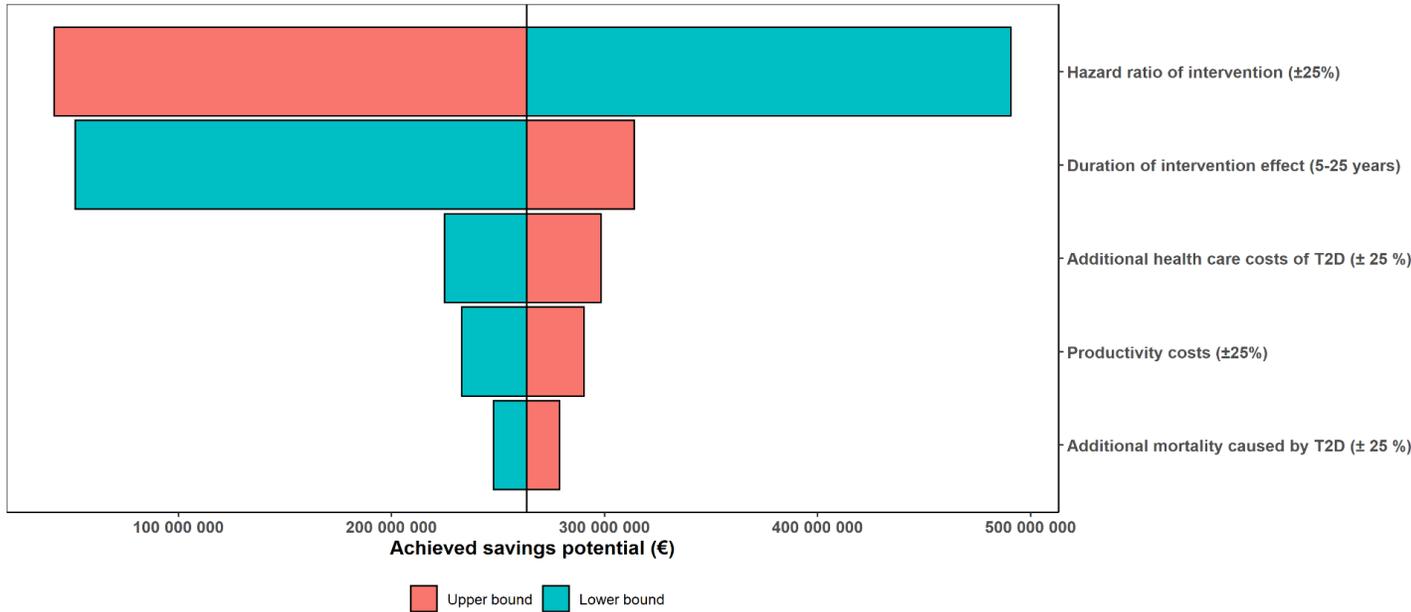
Weight loss	Cost of lifestyle intervention (€)	Average SROI (€)	SROI (€) Male	SROI (€) Female	Payback time (years) Male	Payback time (years) Female
≥ 2 % (2–5 %)	100	22,4	26,5	18,7	5	6
	500	3,6	4,5	2,9	8	10
5–10 %	100	38,2	45,3	31,9	4	5
	500	6,8	8,2	5,5	7	8
> 10 %	100	45,7	54,3	38,1	4	5
	500	8,3	10	6,8	6	8



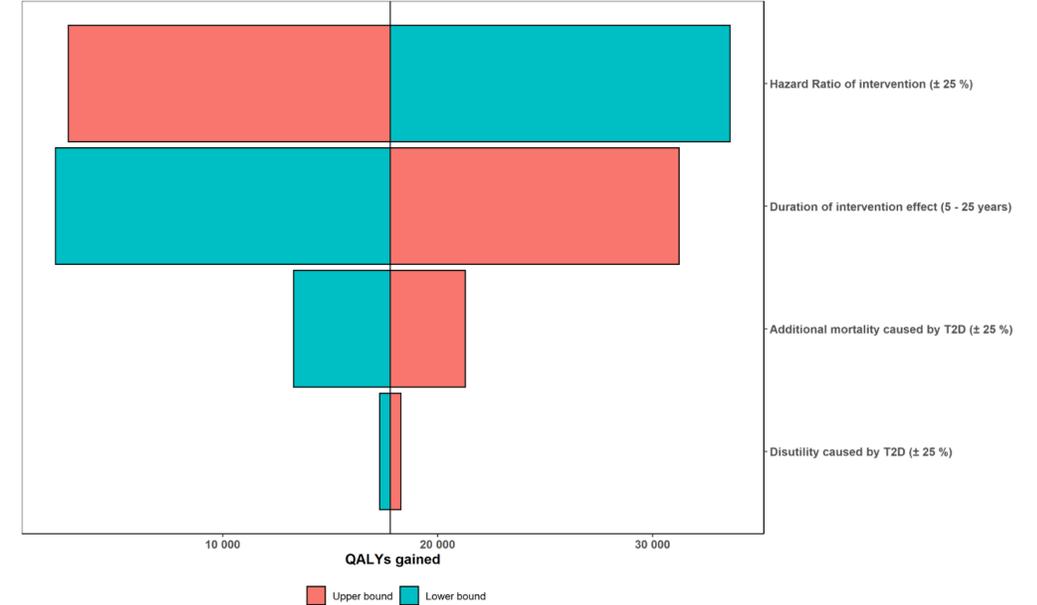
Results of one-way sensitivity analyses

- Cohort of 50-years old men as an example

Costs



QALYs





Conclusions

- Prevention measures for type 2 diabetes have significant potential for public health and cost savings.
- From a societal perspective, cost savings can be achieved by targeting prevention measures to the working-age population at elevated risk of T2D but targeting lifestyle interventions to older age groups will result in relatively more QALYs at the population level.
- The expected total lifetime cost of T2D to those currently at increased risk for T2D is in the order of almost € 9 billion. Conservatively, these costs could be reduced by around € 1.0-2.1 billion through lifestyle interventions.
- At the same time, 73,000 to 146,000 quality-adjusted life years could be gained by reducing the incidence of T2D and related comorbidities at the population level.
- Based on the results of the sensitivity analyses, the resources invested in lifestyle interventions will be recovered in 3 to 12 years, depending on the cost of the interventions used, as well as their real-world effectiveness and the baseline T2D risk of a target cohort.



Take a Home Message

- If lifestyle interventions (with high adherence levels) can be implemented and delivered efficiently and in a scalable way, for example through digital solutions, it is possible to achieve significant public health and economic benefits at the population level, as described above, from both a societal and individual perspective.



Further Information

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