# HEALTH ECONOMIC MODELLING OF PREDIABETES PROGRESSION AND TYPE 2 DIABETES RISK BASED ON A SWEDISH INTERVENTION PROGRAM

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# Introduction

The rising incidence of type 2 diabetes (T2D) in combination with increased costs for the healthcare system emphasizes the growing importance of identifying and analyzing risk factors for the cost-effectiveness (CE) of primary diabetes prevention and the effects of therapeutic innovations.

# Objectives

The objective of this exploratory cost-effectiveness study was to enhance the current understanding of risk factors associated with the development from prediabetes to type 2 diabetes as well as the effects and costs of relevant therapeutic interventions of Tirzepatide, Semaglutide and Metformin from the perspective of the German Statutory Health Care System.

#### Methods

Based on risk equations from a Swedish population-based lifestyle intervention program (n=29,937 persons) to prevent and monitor T2D (1), a cost-effectiveness Markov-Monte Carlo model was programmed in the software TreeAge Healthcare Pro V2024 R5.1. The model was first validated against a pre-existing model based on these data (2) and then enhanced in its capabilities to compute additional intervention strategies.

The model comprises the states normal glucose tolerance (NGT), impaired glucose tolerance (IGT), impaired fasting glucose (IFG), the combination of IGT and IFG (Combined), type 2 diabetes (T2D), and death (see Figures 1 & 2). The compared scenarios were, lifestyle intervention alone as the base case and the on-top therapeutic options Metformin (3), Tirzepatide (4, 5), and Semaglutide (5, 6) based on their published effectiveness for prevention of and progression to T2D as well as the potential remission back to prediabetic states.







Figure 2: TreeAge Markov model structure exemplary for one of the four comparators (here base case).

State costs for Germany were derived from a publication by Neumann et al. (7) and adapted to the reference year 2023 according to health sector specific expenditures from the Federal Statistical Office of Germany. Medication costs were noted from a German pharmacy price catalogue. Quality of life parameters were taken from the Swedish intervention program (8).

Risk factors for prediabetes, such as physical inactivity, hypertension, smoking, and elevated triglyceride levels, were incorporated into the model. Key outcome measures included health-related quality of life and net monetary benefit (NMB), with comparisons made against a predefined willingness-to-pay (WTP) of 23,500 € per quality adjusted life year (QALY) gained. All results were discounted at 0% and 3% according to IQWIG regulations. The time horizon spanned over life-time in annual cycles.



## Results

Regarding the importance of risk factors and their influence on the life expectancy in the base case scenario the five most influential parameters determined in a one-way tornado analysis were the age with  $\pm$  8.660 years (from 45 to 55 years at start), sex (male, female) +4.549 years if female, BMI with  $\pm$  0.390 years (from  $\leq 25$  to  $\geq 30$  kg/m<sup>2</sup>), blood pressure with  $\pm$  0.2 years (from <140/90 to  $\geq 140/90$  mmHg) and dyslipidemia with  $\pm$  0.177 years (triglycerides from  $\leq 1.69$  or > 1.69 mmol/l).

**Table 1:** Discounted cost-utility estimates per intervention (WTP of 23,500 €/QALY gained).

Strategy	Costs [€]	Incr. Costs [€]	Life expect- ancy [LY]	Incr. life expectancy [LY]	Utilities [QALY]	Incr. Effective- ness [QALY]	ICER [C/QALY gained]	NMB [€]
Lifestyle (Base case)	128,052.41		29.21		22.3153			396 <i>,</i> 356.58
Metformin	124,282.11	-3,770.30	29.23	0.02	22.3258	0.0105	dominant	400,374.28
Tirzepatide	143,141.36	15,088.95	29.34	0.13	22.4346	0.1193	126,479.04	384,071.28
Semaglutide	162,077.82	34,025.41	29.34	0.13	22.4265	0.1112	305,983.90	364,944.77

The superior effectiveness to prevent T2D of Tirzepatide and Semaglutide against lifestyle intervention leads to reduced progression towards T2D (see Figure 3) and more remission back to prediabetes. In the base case scenario 28.246% of NGT persons will progress at least once to T2D (Metformin 23.146%), whereas only 16.016% and 18.052% under Tirzepatide and Semaglutide respectively. In the base case scenario 19.295% of patients will die from diabetes (Metformin 15.652%), whereas only 1.905% and 2.450% under Tirzepatide and Semaglutide respectively. The calculated health economic outcome parameters are illustrated in Table 1.

#### Figure 1: State transition diagram of the Markov model.



**Figure 3:** Annual probability to progress from NGT or any other prediabetic state to T2D across a time horizon of 60 cycles applying the four comparators.

# References

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# Conclusion

In this exploratory health economic modelling study typical cardiovascular risk factors exert only small influence on mortality in contrast to what is known for type 2 diabetes. Therapeutic innovations such as Tirzepatide and Semaglutide offer impressive improvements in diabetes prevention, and they relevantly increase remission to prediabetic states.

However, these effects do not translate into favorable health economic outcomes. Since the model used is not designed to simulate the progression of type 2 diabetes and in particular the development of its associated complications, the effects of medications are systematically underestimated. Thus, further research is needed that examines both prediabetes and diabetes in a holistic approach.