Appendix: Microsimulation methodology

Model prediction equations came from published clinical trials, de novo database analysis, and observational studies such as Look AHEAD,(1) UK Prospective Diabetes Study (UKPDS),(2-6) and Framingham Heart Study.(7-10) The CONQUER trial involving adults with BMI of 27-45 found that A1c declines by 0.071% for each 1kg decrease in excess body weight.(11;12) Meta-analysis of clinical trial outcomes suggests each 1kg loss in body weight reduces SBP by 1.05-mmHg.(13) We modeled disease-specific and all-cause mortality risk based on disease presence, demographics, current smoking status, and biometric data as reported in the literature and government sources.(3;14-19)

The relationship between patient characteristics and annual medical expenditures, employment probability, and work absenteeism was modeled using regression analysis with the 2009-2013 files of the Medical Expenditure Panel Survey (MEPS) (n=165,913). As described in our previous publication,(20) we used a set of zero-inflated log-ratio regressions to model the allocation of total medical expenditures across cost categories - inpatient, outpatient, emergency department, prescription drugs, and “all other” care. We estimated prediction equations separately for adults with and without obesity. Regression specifications and validation results are described elsewhere, but explanatory variables include age group, sex, race, Hispanic ethnicity, insurance status, body weight (normal weight, overweight, or obese), presence of the modeled diseases, and interaction terms for diabetes and other modeled diseases.(21) We used logistic regression to model employment probability and negative binomial regression to model annual missed work days due to illness for employed adults. All costs are presented in 2015 US dollars.

The simulation produced annual results over 15 years—beyond the 10-year window used by the Congressional Budget Office to score federal legislation—to explore whether the 10-year window adequately captured societal benefits to inform long-term policy.(22)

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Appendix Table 1. Overview of the NHANES population with obesity

|  |  |
| --- | --- |
| **Patient Characteristics** | **Total (N=100,000)** |
|  | **Weighted average** | **Standard Deviation** |
| Age (years) | 48.3 | 15.5 |
| BMI (kg/m2) | 35.6 | 5.6 |
| SBP (mmHg) | 125.4 | 17.0 |
| HDL-C (mg/dl) | 47.0 | 13.1 |
| T-C (mg/dl) | 197.4 | 41.0 |
| Hemoglobin A1c (%) | 5.8 | 1.1 |
| Prevalence (%) |  |  |
| Male | 48.6 |  |
| Prediabetes | 50.4 |  |
| Type-2 diabetes | 20.7 |  |

Appendix Table 2. Multivariate analysis on reduction in absenteeism from work (N=412,629)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Coefficient** | **Standard Error** | **Significance Probability** | **Relative Risk** |
| Intercept | 1.215 | 0.011 | <.0001 |   |
| Time span a |   |   |   |   |
| 10 years | 0.841 | 0.007 | <.0001 | 2.319 |
| 15 years | 1.375 | 0.01 | <.0001 | 3.955 |
| Obesity class a |   |   |   |   |
| Class II | -0.174 | 0.022 | <.0001 | 0.840 |
| Class III | -0.136 | 0.026 | <.0001 | 0.873 |
| Age group a |   |   |   |   |
| 35 to 44 | 0.089 | 0.024 | <.0001 | 1.093 |
| 45 to 54 | 0.349 | 0.027 | <.0001 | 1.418 |
| 55 to 64 | 0.438 | 0.03 | <.0001 | 1.550 |
| 65 to 74 | 0.318 | 0.036 | <.0001 | 1.374 |
| Glucose levels a |   |   |   |   |
| Prediabetes | 0.223 | 0.019 | <.0001 | 1.250 |
| Type-2 diabetes | -0.003 | 0.03 | 0.9287 | 0.997 |
| Hypercholesterolemia | 0.015 | 0.019 | 0.4323 | 1.015 |
| Hypertension | 0.139 | 0.019 | <.0001 | 1.149 |
| Male | -0.249 | 0.018 | <.0001 | 0.780 |
| Weight loss of 12% (vs 5%) | 0.194 | 0.006 | <.0001 | 1.214 |

Notes: Negative binomial regression on missed work days. a Reference categories are age 25 to 34; obesity class I; time span of 5 years; normal blood glucose levels; normal cholesterol and blood pressure levels; female; and weight loss of 5%.

Appendix Table 3. Multivariate analysis on reduction in diabetes onset (N=515,919)

|  |  |  |  |
| --- | --- | --- | --- |
|   | **Odds ratio (OR)** | **95%** **Confidence Interval** | **Significance Probability** |
| Time span a |   |   |   |   |
| 10 years | 1.565 | 1.528 | 1.603 | <.0001 |
| 15 years | 1.723 | 1.683 | 1.765 | <.0001 |
| Obesity class a |   |   |   |   |
| Class II | 1.12 | 1.095 | 1.145 | <.0001 |
| Class III | 1.251 | 1.217 | 1.285 | <.0001 |
| Age group a |   |   |   |   |
| 35 to 44 | 0.71 | 0.692 | 0.729 | <.0001 |
| 45 to 54 | 0.525 | 0.511 | 0.54 | < 0.001 |
| 55 to 64 | 0.396 | 0.383 | 0.41 | <.0001 |
| 65 to 74 | 0.36 | 0.344 | 0.376 | <.0001 |
| Prediabetes a | 2.119 | 2.072 | 2.167 | <.0001 |
| Hypercholesterolemia | 1.009 | 0.989 | 1.03 | 0.3817 |
| Hypertension | 0.973 | 0.953 | 0.994 | 0.0100 |
| Male | 1.061 | 1.04 | 1.081 | <.0001 |
| Weight loss of 12% (vs 5%) | 1.904 | 1.868 | 1.942 | <.0001 |

Notes: Logistic regression with random effect on binary outcome variable. a Reference categories are age 25 to 34; obese class I; time span of 5 years; normal blood glucose levels; normal cholesterol and blood pressure levels; female; and weight loss of 5%.

Appendix Figure 1. Projected 15-Year Cumulative Per Capita Health Expenditures



Appendix Figure 2. Distribution of cost savings from 5% weight loss



Appendix Figure 3. Distribution of cost savings from 12% weight loss

