

## Appendix 1: Extended methodology

### Chronic Health States (CHS)

- **CHS-0:** Metabolically healthy (fasting blood glucose (FBG): <100 mg/L; blood pressure (BP): <130/85 mm Hg with no self-report of hypertension or antihypertensive medication; HDL cholesterol (HDL):  $\geq$ 60 mg/dL; LDL cholesterol (LDL): <130 mg/dL; triglycerides (Trig): <150 mg/dL; total cholesterol (Tchol): <200 mg/dL)
- **CHS-1:** Develop either pre-diabetes mellitus (FBG: 100-126 mg/L) only; pre-hypertension only (BP: >130/85 mm Hg & <140/90 mmHg); hypertension only (BP:  $\geq$ 140/90 mm Hg or self-report of hypertension or antihypertensive medication); hyperlipidemia only (HDL: <40 mg/dL in males and <50 mg/dL in females, LDL: 130-159 mg/dL, Trig: 150-199 mg/dL, Tchol: 200-239 mg/dL); pre-Hypertension + hyperlipidemia
- **CHS-2:** Develop either pre-diabetes mellitus (FBG:100-126 mg/L) + pre-hypertension, pre-diabetes mellitus + hypertension, pre-diabetes mellitus + hyperlipidemia (HDL:<40 mg/dL in males and <50 mg/dL in females, LDL: 130-159 mg/dL, Trig: 150-199 mg/dL, Tchol:200-239 mg/dL); pre-diabetes mellitus + pre-hypertension + hyperlipidemia; or pre-diabetes mellitus + hypertension + hyperlipidemia
- **CHS-3:** Develop either diabetes mellitus only (FBG:  $\geq$  126 mg/L or self-report of diabetes or self-report of medication); hypertension + hyperlipidemia (HDL:<40 mg/dL in males and <50 mg/dL in females, LDL:>160 mg/dL, Trig: >200 mg/dL, Tchol:>240 mg/dL)
- **CHS-4:** Develop either diabetes mellitus + hypertension; diabetes mellitus + hyperlipidemia; or diabetes mellitus + hypertension + hyperlipidemia

### Detailed description of cost calculations

Each simulated year, each agent accrued state-, health outcome-, and age-specific medical costs, productivity losses, and quality-adjusted life years (QALYs).

Direct medical costs included costs from outpatient visits, hospitalization, emergency room visits, and medications.

Indirect medical costs included productivity losses and QALYs. Productivity losses derived from annual wages attenuated by utility weights for a given health condition served as a proxy for productivity losses.

Annual QALYs for each health state were calculated using age-specific healthy QALYs attenuated by a utility value associated with the health state and/or outcome an individual developed over the year. Utility values represent the strength of individual's preferences for their own health on a scale from 0.0 (death) to 1.0 (perfect health).<sup>(1, 2)</sup> The progression of health state and resulting health outcomes will result in a decrease in the health utility value.

As the model allows for individuals to develop multiple health outcomes in each time step, we looked to attribute costs and health effects conservatively. Direct medical costs incorporated the highest cost amongst the multiple health outcomes and health effects used the lowest QALYs values. Table 1 details the cost and utility values sources.

### **Population sampling and trials**

We created a representative sample of the entire U.S. youth population of 31,741,731. For each portion of the model, we empirically determined the number of agents needed in order to be representative of the variation in the national population data and sample the stochasticity in the system. This was 6,823 and 100,000 agents for the first and second stages of the model, respectively. Similarly, we found 10 runs per scenario in part one of the model and 1000 runs per agent in part two were sufficient for producing representative results.

## **Physical Activity Intensity**

To quantify the level of intensity of PA, we used Metabolic Equivalent (METs), which ranged from 6.5 to 10.5. Moderate PA, as delineated in the “Active to a Healthy Level” and CDC recommendations, was defined as 8.5. Vigorous activity was defined as 10.

## Appendix 2: Model input parameters

Variable	Distribution type	Mean	Range or standard deviation	Source	
<i>Model First Stage: Childhood Years</i>					
Age distribution (years)	Uniform		8-11	(3)	
Percentage of males		49.7%			
Race distribution					
White		28.16%		(3)	
Black		29.05%			
Others		42.79%			
Anthropometry					
Height (cm)	Normal	141.1	105.5-173.9	(3)	
Lean tissue mass (g)	Normal	27018.74	14339.4- 53622.3		
Fat tissue mass (g)	Normal	12969.1	4029.3-41046		
Probability of engaging in PA at baseline		33.27%		(4-6)	
<i>Model Second Stage: Adult Years</i>					
General	Annual wages	Triangular	\$48,320	\$37,286-\$94,873	(7)
	All other cause mortality (annual)				
	Ages 18–24 years		0.00076		(8)
	Ages 25–34 years		0.00106		
	Ages 35–44 years		0.00171		
	Ages 45–54 years		0.00404		
	Ages 55–64 years		0.00883		
	Ages 65–74 years		0.01918		
	Ages 75–84 years		0.05003		
Ages 85 and over		0.21222			
CHD	Mortality risk (by age)				
	at CHS-2	Triangular	0.01023	0-0.04	(9, 10)
	at CHS-3	Triangular	0.01193	0-0.047	
	at CHS-4	Triangular	0.03700	0.0007-0.113	
	increased risk being overweight	Triangular	1.17500	0.98-1.37	
increased risk being obese	Triangular	1.37500	1.3-1.45		
CHD	Risk of developing CHD (by age)				
	at CHS-2	Triangular	0.01023	0-0.04	(9, 10)
	at CHS-3	Triangular	0.01193	0-0.047	
	at CHS-4	Triangular	0.01813	0-0.063	
	increased risk being overweight	Triangular	1.31000	1.22-1.4	(10)
	increased risk being obese	Triangular	1.56000	1.54-1.58	
	Risk of recurring CHD (by age)				
	at CHS-2	Triangular	0.04275	0-0.1	(11)
	at CHS-3	Triangular	0.03470	0-0.057	
at CHS-4	Triangular	0.03970	0-0.074		

Stroke	Mortality risk (by age)				
	- First year	Uniform		0.135-0.241	(12)
	- After First year	Uniform		0.0596-0.1064	
	Risk of developing Stroke (by age)				
	at CHS-0	Uniform		0-0.012	(9, 10, 13)
	at CHS-1	Uniform		0-0.015	
	at CHS-2	Uniform		0-0.017	
	at CHS-3	Uniform		0-0.015	
	at CHS-4	Uniform		0-0.028	
	increased risk being overweight	Uniform		1.06-1.17	(14, 15)
	increased risk being obese	Uniform		1.23-1.42	
	Risk of recurring Stroke				
	- First year	Uniform		0.0924-0.165	(12)
	- After First year	Uniform		0.0318-0.0567	
Diabetic nephropathy	Risk by years of having T2DM	Uniform		0-0.28	(16)
	Probability of developing ESRD	Uniform			(17)
	Mortality risk from ESRD (by age)	Uniform		0.081-0.239	(18)
Diabetic neuropathy	Risk by years of having T2DM	Uniform		0-0.72	(16)
Diabetic neuropathy	Risk by years of having T2DM	Uniform		0	(16)
	Probability of developing blindness	Uniform		0-0.8	(19, 20)
Cancer	Risk of developing Cancer (female)				
	Breast	Uniform		0-0.0191	(21, 22)
	Cervical	Uniform		0-0.0007	
	Colorectal	Uniform		0-0.0066	
Esophageal	Uniform		0-0.0004		
Cancer	Renal	Uniform		0-0.0018	(21, 22)
	Pancreatic	Uniform		0-0.0025	
	Stomach	Uniform		0-0.001	
	Uterine	Uniform		0-0.0044	
	Risk of developing Cancer (male)				
	Colorectal	Uniform		0-0.0071	(21), (22)
	Esophageal	Uniform		0-0.0013	
	Renal	Uniform		0-0.0031	
	Pancreatic	Uniform		0-0.0025	
	Prostate	Uniform		0-0.0284	
	Stomach	Uniform		0-0.0017	
	Risk of death from Cancer (female)				
	Breast	Uniform		0.008-0.06	(22)
	Cervical	Uniform		0.006-0.083	
Colorectal	Uniform		0.027-0.105		
Esophageal	Uniform		0.035-0.426		
Renal	Uniform		0.011-0.057		
Pancreatic	Uniform		0.033-0.289		

	Stomach	Uniform		0.03-0.314		
	Uterine	Uniform		0.007-0.048		
	Risk of death from Cancer (male)					
	Colorectal	Uniform		0.016-0.162	(22)	
	Esophageal	Uniform		0.018-0.409		
	Renal	Uniform		0.008-0.069		
	Pancreatic	Uniform		0.018-0.335		
	Prostate	Uniform		0.015-0.051		
	Stomach	Uniform		0.015-0.264		
Utility Values	Stroke	Beta	0.600	0.090		(23-68)
	CHD	Beta	0.730	0.100		
	Diabetic nephropathy	Beta	0.740	0.090		
	Diabetic neuropathy	Beta	0.650	0.040		
	Diabetic retinopathy	Beta	0.780	0.040		
	ESRD	Beta	0.630	0.030		
	Blindness	Beta	0.520	0.060		
	Renal Cancer	Beta	0.700	0.060		
	Cervical Cancer	Beta	0.630	0.110		
	Pancreatic Cancer	Beta	0.660	0.080		
	Gastric Cancer	Beta	0.520	0.080		
	Hypertension	Beta	0.970	0.010		
	DM2	Beta	0.850	0.080		
	Utility Values (Breast Cancer)	- First year	Beta	0.660	0.060	
		- After First year	Beta	0.770	0.060	
- Last year		Beta	0.230	0.001		
Utility Values (Colon Cancer)	- First year	Beta	0.520	0.120		
	- After First year	Beta	0.830	0.050		
	- Last year	Beta	0.300	0.001		
Utility Values (Esophageal Cancer)	- Early years	Beta	0.710	0.220		
	- Last year	Beta	0.340	0.001		
Utility Values (Uterine Cancer)	- Early years	Beta	0.690	0.150		
	- Last year	Beta	0.790	0.110		
	Prostate Cancer	Beta	0.710	0.160		

Cost (\$U.S.)	Beta CHS-1		\$497		(69)
	Beta CHS-2		\$1,123		
	Beta CHS-3		\$1,680		
	Overweight CHS-3		\$2,055		
	Obese CHS-3		\$3,930		
	Beta CHS-4		\$2,906		
	Overweight CHS-4		\$3,656		
	Obese CHS-4		\$7,406		
Cost (\$U.S.): CHD	In first year				
	- Age 18-44 years	Gamma	\$19,933	\$24,824	(69)
	- Age 44- 65 years	Gamma	\$17,244	\$11,109	
	- Age > 65 years	Gamma	\$13,724	\$9,324	
	After first year				
	- Age 18-44 years	Gamma	\$5,178	\$14,673	(69)
	- Age 44- 65 years	Gamma	\$6,926	\$18,766	
- Age > 65 years	Gamma	\$4,100	\$11,576		
Cost (\$U.S.): DM2	- Age 18-44 years	Gamma	\$11,706	\$17,764	(69)
	- Age 44- 65 years	Gamma	\$8,109	\$22,031	
	- Age > 65 years	Gamma	\$1,332	\$3,409	
Cost (\$U.S.): Hypertension	Hypertension				
	- Age 18-44 years	Gamma	\$672	\$3,373	(69)
	- Age 44- 65 years	Gamma	\$867	\$3,895	
	- Age > 65 years	Gamma	\$1,050	\$3,901	
Cost (\$U.S.): Diabetic Nephropathy	Diabetic Nephropathy	Gamma	\$593	\$220	(70)
	ESRD				
	- Initial year	Gamma	\$95,130	\$31,396	(71)
	- After Initial year	Gamma	\$62,578	\$15,802	
Cost (\$U.S.): Diabetic Neuropathy	Gamma	\$456	\$323	(69)	
Cost (\$U.S.): Diabetic Retinopathy	Diabetic Retinopathy	Gamma	\$650		\$363
	Blindness	Gamma	\$2,872		\$75
Cost (\$U.S.): Stroke	- Age 18-44 years	Gamma	\$11,034	\$16,744	(69)
	- Age 44- 65 years	Gamma	\$7,643	\$20,766	
	- Age > 65 years	Gamma	\$7,098	\$13,860	

Cost (\$U.S.): Cancer (female)	Breast			(72)
	- First year		\$25,386	
	- After First year		\$2,207	
	- Last year		\$78,570	
	Cervical			
	- First year		\$49,692	
	- After First year		\$1,425	
	- Last year		\$98,192	
	Colorectal			
	- First year		\$56,460	
	- After First year		\$3,159	
	- Last year		\$105,649	
	Esophageal			
	- First year		\$87,486	
	- After First year		\$6,853	
	- Last year		\$130,348	
	Renal			
	- First year		\$42,237	
	- After First year		\$6,255	
	- Last year		\$92,304	
	Pancreatic			
	- First year		\$102,808	
	- After First year		\$8,672	
	- Last year		\$137,426	
	Stomach			
	- First year		\$78,184	
	- After First year		\$3,977	
	- Last year		\$129,697	
Uterine				
- First year		\$29,452		
- After First year		\$1,535		
- Last year		\$87,719		



Cost (\$U.S.): Cancer (male)	Colorectal			(72)
	- First year		\$25,386	
	- After First year		\$2,207	
	- Last year		\$78,570	
	Esophageal			
	- First year		\$49,692	
	- After First year		\$1,425	
	- Last year		\$98,192	
	Renal			
	- First year		\$56,460	
	- After First year		\$3,159	
	- Last year		\$105,649	
	Pancreatic			
	- First year		\$87,486	
	- After First year		\$6,853	
	- Last year		\$130,348	
	Prostate			
	- First year		\$42,237	
	- After First year		\$6,255	
	- Last year		\$92,304	
	Stomach			
- First year		\$102,808		
- After First year		\$8,672		
- Last year		\$137,426		

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