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Burden of Chronic Disease in US Children and Adults: Model Technical Document

Supported by the Partnership to Fight Chronic Disease

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Overview

Background

This document describes the methods, data, and assumptions for estimating the economic burden of chronic illness among US adults and children and the potential value of intervention to improve clinical outcomes. The Disease Prevention and Treatment Microsimulation Model (DPTMM) projects 15-year health and economic consequences of chronic conditions and interventions at the individual level for adult populations as the state and national levels. An Excel-based model estimates the impact of childhood-onset chronic diseases including obesity, type-2 diabetes, asthma, depression/anxiety and cancers based on published literature.

DPTMM is an individual-based microsimulation model using a Markov chain framework with Monte Carlo simulation and yearly cycles to project health outcomes.[1–7] The model integrates data from the American Community Survey (ACS), Behavioral Risk Factor Surveillance System (BRFSS), National Health and Nutrition Examination Survey (NHANES), and CDC WONDER to construct synthetic populations and model causal relationships between diseases and risk factors. The model covers over 20 medical conditions across cardiovascular, metabolic, respiratory, neurological, mental health, cancer, and musculoskeletal domains, incorporating biomarker trajectories and health behaviors. Prediction equations derive from published clinical trials and observational studies, supplemented by empirical analysis using government surveys. The model quantifies direct medical costs and indirect economic impacts through workplace productivity measures for cost-effectiveness analyses of healthcare interventions.

Model Schematic

Adult medical conditions are modeled using individual-level influence diagrams that map patient characteristics to disease onset and progression, determining disease severity, medical expenditures, indirect economic outcomes (labor force participation and productivity), and mortality (Exhibit 1). Interventions can occur at multiple stages: primary prevention of disease onset, disease management to slow progression or reduce severity, and secondary prevention of complications. Each condition uses a condition-specific diagram reflecting its natural history and treatment pathways.

Childhood chronic conditions are modeled at the population level (Exhibit 2). Age-specific prevalence rates determine annual case numbers under three scenarios. The status quo scenario projects outcomes assuming continuation of current trends without additional interventions. The behavior change and treatment advance scenarios model outcomes under moderate and aggressive improvement interventions respectively. Change in chronic disease burden is calculated by comparing intervention scenario outcomes to status quo projections, yielding estimates of prevented cases, medical cost savings, indirect economic benefits, and reduced premature mortality.

Exhibit 1. Modeling Diagram for Adult Diseases

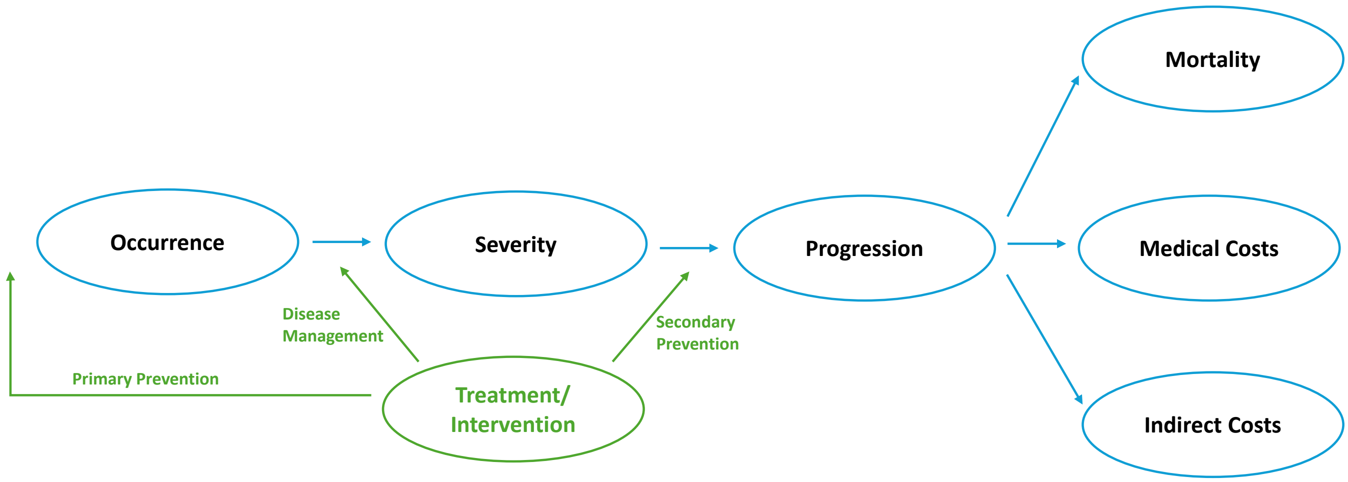
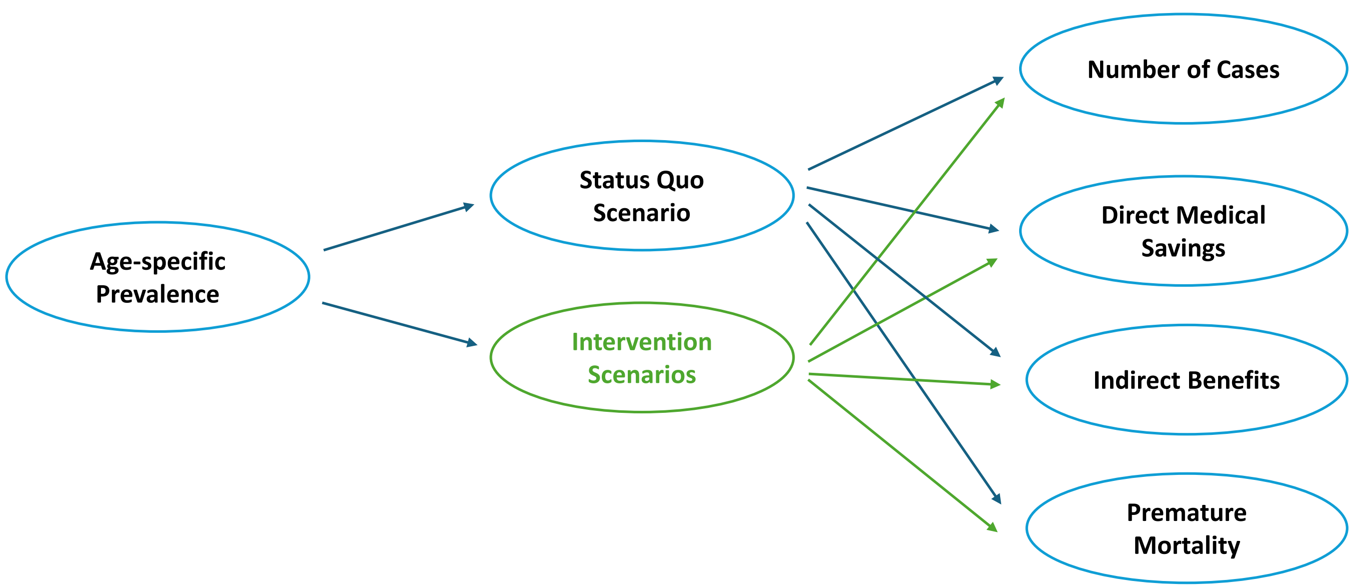


Exhibit 2. Modeling Diagram for Childhood Diseases



Population

Adult population datasets for each state were constructed through sequential data integration from multiple public sources. State-level records from the ACS (2023) serve as the foundation and are merged with BRFSS (2022-2023) data using exact matching on age, sex, race/ethnicity, and insurance status. Non-institutionalized adults are matched to BRFSS records, while nursing home residents are linked to CMS Minimum Data Set (MDS) and residential care facility residents are matched to Medicare Current Beneficiary Survey (MCBS) data. Annual sample weights are calibrated using states' demographic projections to maintain population representativeness over the simulation period. New 18-year-old cohorts are introduced annually through bootstrapping from existing young adult profiles to account for demographic transitions.

The resulting synthetic population file undergoes propensity score matching with National Health and Nutrition Examination Survey (NHANES, 2015-2023) data based on demographics, BMI, insurance status, diabetes, smoking, hypertension, and hyperlipidemia status to incorporate biomarker and clinical measurements. This process generates representative population files for each state projected into the future containing demographics, health risk factors including metabolic markers, and presence or history of various diseases.

Population projections for children and adolescents comes from state's population projections.

Direct and Indirect Cost Outcomes

Medical Costs
Direct medical costs in DPTMM were estimated using Medical Expenditure Panel Survey (MEPS) data from 2018, 2020, and 2022. A two-part zero-inflated gamma model predicts annual spending: logistic regression estimates likelihood of any cost, and gamma regression with log-link estimates amounts for positive costs. Costs are divided by service type using a log-ratio model. Predictors include demographics, insurance, smoking, BMI relative to 30, and health conditions including diabetes, hypertension, heart disease, kidney disease, arthritis, stroke, cancer, and disability. Childhood illness costs were derived from published studies as detailed in subsequent sections. All economic values are expressed in 2025 dollars.

Indirect Economic Costs
Productivity losses were modeled using National Health Interview Survey (NHIS) 2020-2023 and MEPS data across five areas: employment, disability, income, missed workdays, and presenteeism. Logistic and gamma regressions account for probabilities and skewed income distributions. Individual outcomes are stochastically assigned to match population-level predictions. Income losses use Bureau of Labor Statistics median earnings by age and sex. Social Security Insurance costs follow Social Security Administration schedules.

Modeled Scenarios

Chronic disease burden was calculated as the difference between expected outcomes in a status-quo scenario and each of two improvement scenarios.

'Status Quo' Scenario

This scenario captures the implications of a growing and aging population without additional interventions. Modeling assumptions are that age-, sex-, and race-specific prevalence rates of health risk factors and chronic diseases remain constant at current levels over the 15-year projection period (with the exception that prevalence of some childhood diseases have been rising and these trends are projected to continue though at a non-linear rate). Total disease burden increases due to population growth and demographic aging. This scenario serves as the baseline for comparison, reflecting continued healthcare utilization at current rates, existing treatment effectiveness levels, and current patterns of disease progression and mortality. The status quo scenario accounts for established trends in biomarker changes, disease onset probabilities, and healthcare costs within each demographic group.

'Behavioral Changes' Scenario

The behavioral changes scenario assumes modest improvements in lifestyle and treatment. This scenario reflects outcomes that could be achieved with existing medicine and technology.

Adults:

- Double annual smoking cessation rates
- Increase proportion at healthy weight
- Reduce binge drinkers by 25%

- Increase treatment adherence by 15%
- Improve timely diagnosis rates by 15%
- Reduce healthcare cost growth by 10%
- Expand treatment access

Children:

- Reduce annual prevalence increase rates by 50% for childhood-onset depression/anxiety, type 2 diabetes, obesity, and cancers
- Reduce childhood asthma attack prevalence by 5%
- Double the annual decline in overall cancer mortality rates

'Treatment Advances' Scenario

The treatment advances scenario incorporates all behavioral scenario changes plus additional improvements from medical advances, enhanced coverage, and better medication adherence. This scenario illustrates what could be achieved in the future with continued innovation in medicine and technology.

Additional Adult Improvements:

- Delay dementia/Alzheimer's onset by 5 years
- Reduce cancer mortality risk by 25%
- Cure breast cancer within 1 year of onset
- Improve mental health treatment efficacy
- Reduce stroke mortality by 25%
- Enhance cholesterol-lowering treatments
- Slow COPD progression by 25%
- Increase overall treatment efficacy by 25%
- Reduce healthcare cost growth by 25%
- Increase adherence by 35%
- Improve timely diagnosis by 35%

Additional Child Improvements:

- Maintain current prevalence levels of childhood-onset depression/anxiety, type 2 diabetes, obesity, and cancers
- Reduce childhood asthma prevalence by 15%
- Reduce overall cancer mortality rates by 50%

Modeling Childhood Chronic Conditions

Five categories of childhood chronic conditions were modeled using population-level approaches with age-specific prevalence rates, treatment patterns, and economic costs derived from published literature. These conditions were selected because they have high economic impact due to either high prevalence or high cost per case, and their outcomes can be reduced through behavioral changes or improved treatment. Each condition was analyzed for direct medical costs, indirect economic impacts, and mortality effects where applicable. The conditions modeled were anxiety and depression, obesity, asthma, type 2 diabetes, and cancers.

Anxiety and Depression

Serious mental health disorders such as depression and anxiety affect millions of U.S. children, imposing a substantial burden on their health and well-being. Age-specific prevalence rates and annual percentage changes were derived from Xiang et al. (Exhibit 3).[8] Prevalence increased steadily from 2017 to 2021. The model assumes prevalence will continue rising until reaching twice current levels—within six years for depression and ten years for anxiety—then remain constant.

Exhibit 3. Prevalence and APC of Childhood Depression and Anxiety

Condition	Age 6-11	Age 12-17	Annual percentage change
Depression	1.7%	6.1%	12.5%
Anxiety	6.6%	10.5%	7.8%

A recent study showed among children aged 3-17 years, nearly 80% of those with depression received treatment in the previous year, compared with 59.3% of those with anxiety problems.[9] The model used a weighted mean of 66% as the average treatment rate among diagnosed children.

Direct healthcare costs were derived from Pella et al.'s randomized controlled trial of children with anxiety disorders.[10] Given the substantial clinical overlap and comorbidity between anxiety and depression, anxiety disorder costs served as proxy estimates for depression expenditures. Total annual direct costs included: mental health services ($1,566), psychiatric office consultations ($106), mental health clinic visits ($325), psychology services ($544), outpatient counseling ($666), general medical care ($341), primary care consultations ($89), emergency department visits ($46), inpatient psychiatric admissions ($22), inpatient medical stays ($70), and additional primary care visits ($89).

Indirect costs were estimated at 79% of direct medical expenditures, reflecting the substantial non-medical economic burden of these conditions.[10] The indirect cost burden was primarily attributed to two components: educational disruption costs of $465, corresponding to an average of 6.5 missed school days per child annually, and caregiver productivity losses of $466, reflecting an average of 2 days of missed parental work annually due to caregiving responsibilities.[11–13] The average cost of each missed school day for a student was estimated to be $72 based on funding of school district, and cost of each missed work day for parents was based on median daily wage of $239 in the US.[12,14] This cost structure highlights the significant societal impact of pediatric mental health disorders beyond direct medical care, encompassing both educational system effects and workforce productivity implications.

Obesity

Age-specific prevalence data were derived from Tsoi et al.'s analysis of BMI data from the US National Health and Nutrition Examination Survey (1999-2018, Exhibit 4).[15] Annual percentage change rates were modeled using Global Burden of Disease Study 2021 projections: 1.4% for children aged 6-11 years and 1.2% for adolescents aged 12-17 years.[16] Prevalent cases were calculated by applying these rates to Forum on Child and Family Statistics population estimates.[17]

Exhibit 4. Prevalence of Childhood Obesity and Annual Percentage Change

	Age 6-11	Age 12-17
Obesity prevalence	21.0%	22.2%
Annual percentage change	1.4%	1.2%

Direct costs were derived from Ling et al.'s systematic literature review, which identified a mean annual cost of $302 per child with obesity: non-medical healthcare costs ($68), prescription medications ($64), and outpatient visits ($20).[18]

Indirect costs included educational disruption and parental productivity losses. A Philadelphia-based randomized controlled trial documented 2.1 missed school days annually per child with obesity.[19] Parental work absences for healthcare needs and educational support were estimated at 30% of school absences (0.6 days annually).[11]

Cost estimation applied the proportional attributable factor (PAF) method to adjust for conditions that are both consequences of obesity and modeled separately (depression, type 2 diabetes, asthma). Condition-specific PAFs were applied to subtract the obesity-attributable share of costs for these overlapping conditions, preventing double counting and ensuring cost estimates reflect only incremental burden beyond comorbidities.

Asthma

Diagnosed prevalence rates were obtained from CDC national and state surveillance systems. Age-stratified rates increase with age: 2.1% in children aged 0-5 years, 7.9% in ages 6-11 years, and 9.9% in adolescents aged 12-17 years.[20] Total prevalent cases were estimated by applying these rates to Forum on Child and Family Statistics demographic data.[17]

Direct medical costs were derived from Wang and Nurmagambetov's analysis of 2016-2021 Medical Expenditure Panel Survey (MEPS) data.[21] Annual per-capita cost was $4,843, stratified by service category: prescription medications ($1,007), office-based visits ($1,090), emergency department visits ($79), hospital inpatient admissions ($295), hospital outpatient services ($257), and home health services ($329).

Indirect costs included school absenteeism (1.9 days annually, $136 economic impact) and caregiver productivity losses (1.5 missed work days annually, $367 per child).[12,14]

Mortality data from CDC reported 145 asthma-related deaths among children aged ≤18 years in 2021, corresponding to approximately 3 deaths per 100,000 cases.[20]

Type 2 Diabetes

The prevalence of type 2 diabetes in U.S. youth has shown a significant upward historical trend, more than doubling between 2002-2003 and 2017-2018. Factors like increasing childhood obesity, inactivity, and genetics are driving this trend.[22] Age-specific diagnosed prevalence of type 2 diabetes mellitus (T2DM) in pediatric populations was derived from an observational, cross-sectional, multicenter study conducted by Lawrence et al. and published in JAMA in 2021.[23] The study documented a diagnosed prevalence of 0.29 per 1,000 children in the 10-14 year age group and 1.04 per 1,000 children in the 15-19 year age group as of 2017.

Temporal trend analysis revealed significant increases in prevalence from 2009-2017, with annual percentage increase of 0.31% in the 10-14 year cohort and 0.55% in the 15-19 year cohort. These empirically derived annual percentage changes were employed to project age-specific prevalence rates across the study forecast period. Total diagnosed prevalent cases of pediatric T2DM in the United States were estimated by applying these age-stratified prevalence rates to demographic data from the Forum on Child and Family Statistics.[17]

Direct and indirect costs were derived from the Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) clinical trial.[24] Direct healthcare costs included: healthcare provider consultations ($27), outpatient visits ($117), urgent care ($133), emergency department visits ($319), inpatient hospitalizations ($232), and non-diabetes-related pharmaceuticals ($106).

Indirect costs were dominated by caregiver assistance with diabetes management ($2,893), reflecting intensive treatment support requirements. Additional components included caregiver assistance with exercise programs ($919), transportation to appointments ($18), and diabetes-related exercise equipment ($593).[24] These costs represent productivity losses from caregiver time allocation for diabetes management.

Mortality risk from acute complications (hypoglycemia, diabetic ketoacidosis) was estimated using CDC and SEARCH for Diabetes in Youth study data.[25,26]

Cancers

Age-specific incidence data were obtained from the National Cancer Institute's SEER Database (Exhibit 5).[27] The SEER registry provides population-based cancer data representing approximately 48% of the US population. Prevalent cases were calculated by applying these rates to Forum on Child and Family Statistics population estimates.[17]

Exhibit 5. Incident Rate of Childhood Cancer

	Age 0-5	Age 6-11	Age 12-17
Cases per 100,000 children	21.5	13.2	18.8

Current epidemiological data indicate that childhood cancer cases are increasing at an annual rate of 0.5%, as documented in recent surveillance reports.[27] This modest but consistent upward trend reflects improvements in diagnostic capabilities, enhanced case ascertainment, and potential changes in underlying risk factors within the pediatric population.

Direct healthcare costs average $27,218 per child annually. The cost of childhood cancer varies across the care continuum, with the first year of treatment typically being the most expensive due to intensive diagnostic procedures, hospitalizations, chemotherapy, surgery, and radiation. The last year of life can also generate high expenses, as children who relapse or require end-of-life care often need aggressive interventions, palliative support, and frequent hospital admissions. Costs in the last year of life may reach $71,600.[28,29]

In addition to direct medical costs, families incur indirect costs including lost income from parents reducing work hours or leaving jobs to provide care, transportation and lodging expenses when treatment occurs at specialized centers, and long-term impacts on survivors who may face educational or employment challenges related to late effects of therapy. Nelson et al. estimated indirect costs associated with childhood cancer at approximately three times the direct cost, a finding consistent with other studies showing that indirect costs can exceed direct medical expenses.[30]

Cancer mortality rates for youth aged 0-19 years declined from 2.75 per 100,000 in 2001 to 2.10 per 100,000 in 2021 (24% lower), corresponding to an annual 7% decline.[31] This downward trend in mortality reflects improvements in treatment and is assumed to continue throughout the modeled years under the status quo and behavior change scenarios, while the treatment advance scenario projects the annual mortality rate to fall to half the level observed under the status quo.

Modeled Adult Chronic Conditions

DPTMM models nearly 40 clinical outcomes across physiological systems: metabolic and endocrine conditions (diabetes progression and complications), cardiovascular disease (hypertension, dyslipidemia, coronary events, stroke), 13 obesity-related cancers, respiratory conditions, mental health disorders (depression, anxiety), and musculoskeletal conditions. Economic outcomes include direct medical expenditures across healthcare settings, indirect costs (employment, disability, absenteeism, presenteeism, income changes), quality-adjusted life years (QALYs), and mortality benefits. DPTMM has been applied to evaluate cardiometabolic interventions across diverse healthcare settings and payer populations.[1–7] Data source of key model components are listed in Exhibit 6, more details of DPTMM can be found in the online model technical documentation here.

Exhibit 6. Data Sources by Model Component

Outcome	Diabetes status	Risk factors linked	Source
Annual biomarker changes (in absence of intervention)			
Body mass index	No diabetes Diabetes	Age, sex, weight category (normal, overweight, obesity) Age, sex, weight category	Analysis of 2017-2023 NHANES Emmerich et al., 2024[32] Leal et al., 2021[33]
Cholesterol Ratio	No diabetes Diabetes	Total cholesterol, HDL cholesterol Cholesterol ratio at diabetes diagnosis, previous year's cholesterol ratio	Calculated by dividing total cholesterol by HDL Analysis of 2017-2023 NHANES [34]
Diastolic Blood Pressure	Diabetes No diabetes	Age, sex, gender Change in BMI, aging	Leal et al., 2021[33] Analysis of 2017-2023 NHANES [34]
HbA1c Level	Diabetes No diabetes	Age, sex, gender Change in BMI, aging	Leal et al., 2021[33] Wang et al., 2020 [35]
HDL Cholesterol	Diabetes	Age, sex, gender	Leal et al., 2021[33]
Systolic Blood Pressure	Diabetes No Diabetes	Change in BMI, aging Age, sex, gender	Yang et al., 2023 [36] Leal et al., 2021[33]
Total Cholesterol	Both	Change in BMI, aging, race	Leal et al., 2021[33]
Disease onset			
Atrial Fibrillation	Diabetes No diabetes	Age and sex Age and sex	Sohail et al., 2025[37] Khurshid et al., 2023[38]
Chronic Back Pain	No diabetes	Incidence rates by age, relative risks by BMI, smoking	Stevans et al., 2021[39]
Chronic Kidney Disease	Both	Age, smoking, HbA1c, SBP, HDL, BMI, PVD, eGFR	Khan et al., 2023[40]
Congestive Heart Failure	Both	Age, smoking, HbA1c, SBP, HDL, BMI, PVD, eGFR	Khan et al., 2023[40]
Diabetes	Diabetes	Age at diabetes diagnosis, BMI, eGFR, LDL, PVD, history of amputation	Khan et al., 2023[40]
Prediabetes	Both	HbA1c, FPG	American Diabetes Association[41]
End Stage Renal Disease	Diabetes	Age at diabetes diagnosis, race, smoking status, HbA1c, SBP, HDL, LDL, BMI, WBC, PVD, heart rate, history of IHD, CHF, stroke	Leal et al., 2021[33]
Amputation	Diabetes	Age at diabetes diagnosis, race, smoking status, HbA1c, SBP, HDL, LDL, BMI, WBC, PVD, heart rate, history of IHD, CHF, stroke	Leal et al., 2021[33]
Blindness	Diabetes	Age at diabetes diagnosis, race, smoking status, HbA1c, SBP, HDL, LDL, BMI, WBC, PVD, heart rate, history of IHD, CHF, stroke	Leal et al., 2021[33]
Myocardial Infarction	No diabetes	Age, sex, race, hypertension	Aggarwal et al., 2023[42]
	Diabetes	Age at diabetes diagnosis, race, smoking status, HbA1c, SBP, HDL, LDL, BMI, WBC, PVD, heart rate, history of IHD, CHF, stroke	Leal et al., 2021[33]
Stroke	Diabetes	Age, smoking status, HbA1c, SBP, HDL, BMI, PVD, eGFR	Khan et al., 2023[40]

Outcome	Diabetes status	Risk factors linked	Source
Left Ventricular Hypertrophy	Diabetes	Age, smoking status, HbA1c, SBP, HDL, BMI, PVD, eGFR	Khan et al., 2023[40]
Peripheral Vascular Disease	Diabetes	Age, smoking status, HbA1c, SBP, HDL, BMI, PVD, eGFR	Khan et al., 2023[40]
History of Arterial Hypertension	Both	Age and sex specific prevalence rates for general population	Khurshid et al., 2023[38]
History of Peripheral Vascular Disease	Both	age, race and sex specific prevalence rate	Allison et al., 2023[43]
Ischemic Heart Disease	Both	Age, smoking status, HbA1c, SBP, HDL, BMI, PVD, eGFR	Khan et al., 2023[40]
Non-Alcoholic Fatty Liver Disease	Diabetes No diabetes	Age, Sex, BMI, Hypertension, HDL, Triglycerides, Serum Albumin/Creatinine Liver enzyme concentration, HbA, eGFR, waist circumference HTN, Obesity, HLD, Age, Sex, Race Hyperlipidemia	Castera et al., 2023[44] Hamid et al., 2022[45]
Osteoarthritis	No diabetes	weight adjusted weight index (stratified by sex, race, age, education level, smoking, alcohol, sleep disorders, working hours)	Wang et al., 2023[46]
Pneumonia	Both Diabetes	Age, Smoking, comorbid conditions, obesity Age	Grant et al., 2023[47] Brunetti et al., 2021[48]
Pulmonary Embolism	No diabetes Diabetes	Age, Sex, Race, HDL, BP, blood glucose, healthy diet score, smoking, BMI HbA1c	Evans et al., 2020[49] Charlier et al., 2022[50]
Breast Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban BMI, age at menarche, age at first birth, family history, menopause status (and subsequent BMI interaction)	CDC Seer Database[51] McCarthy et al., 2021[52]
Cervical Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban Smoking BMI, menopause	CDC Seer Database[51] Capps et al., 2024[53] Abulajiang et al., 2025[54]
Colorectal Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban BMI, smoking, alcohol	CDC Seer Database[51] Wang et al., 2021[55]
Endometrial Cancer	No Diabetes Both	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban BMI, physical activity, smoking, diet	CDC Seer Database[51] Romanos-Nanclares et al., 2023[56]
Esophageal Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban Smoking, obesity, alcohol	CDC Seer Database[51] Shao-Ming et al., 2021[57]
Gallbladder Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban	CDC Seer Database[51]
		Diet, infections, pro-inflammatory cytokines	Perez-Moreno et al., 2022[58]
Kidney Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban	CDC Seer Database[51]

Outcome	Diabetes status	Risk factors linked	Source
	Both	Sex, eGFR, POI, physical activity, alcohol, smoking	Chang et al., 2021[59]
Leukemia	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban BMI, occupational exposure to benzene and formaldehyde, smoking	CDC Seer Database[51] Yi et al., 2020[60]
Liver Cancer	No diabetes Both	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban Hepatitis b/c, smoking, alcohol consumption, physical inactivity, overweight/obesity, hypertension, HDL	CDC Seer Database[51] Huang et al., 2021[61]
Lung Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban BMI, smoking	CDC Seer Database[51] Chen et al., 2024 [62]
Multiple Myeloma	No diabetes Both	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban BMI	CDC Seer Database[51] Arnold et al., 2024[63]
Non-Hodgkin's Lymphoma	No diabetes Both	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban BMI	CDC Seer Database[51] Maskarinec et al., 2023[64]
Ovarian Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban Diet, alcohol, genetic factors, BMI, smoking, age of menopause	CDC Seer Database[51] Tanha et al., 2021[65]
Pancreatic Cancer	No diabetes Both	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban BMI, smoking, blood group	CDC Seer Database[51] Yuan et al., 2022[66]
Prostate Cancer	No diabetes Both	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban BMI, smoking, alcohol, hypertension, diabetes	CDC Seer Database[51] Yang et al., 2025[67], Liu et al., 2024[68]
Stomach Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban Dietary Intakes (vitamin specific), BMI, Smoking	CDC Seer Database[51] Zhang et al., 2024[69]
Thyroid Cancer	No diabetes	Age, sex, race/ethnicity incidence rates, stage at diagnosis, subtype, rural/urban Diet, BMI, physical activity, smoking, alcohol	CDC Seer Database[51] Feng et al., 2022[70]
Mortality Rate by Disease Condition			
Mortality, associated with cancers (except gallbladder)	Both	Mortality Rates state for all cancers	CDC Seer Database[51]
Chronic Kidney Disease		Type 2 diabetes mellitus, hypertension, and obesity,	Vaduganathan et al., 2024[71]
Congestive Heart Failure	Both	Age, sex, Heart Failure outcome	Bozkurt et al., 2025[72]
Diabetes	Diabetes	T2D, hypertension, insulin resistance, hyperglycemia, obesity, and dyslipidemia	CDC Wonder Database, 2022[73]
Gallbladder Cancer	Both	Mortality Rates state for all cancers	CDC Seer Database[51]
Ischemic Heart Disease	Both	Obesity, exercise, smoking, diet, hyperlipidemia, diabetes, hypertension	Farman et al., 2024[74]

Outcome	Diabetes status	Risk factors linked	Source
Myocardial Infarction	Both	Age, Sex, CVD, DM, Creatinine, PCI, CABG, T2D	Siraw et al., 2024[75]
Pulmonary Embolism	Both	Sex	Zuin et al., 2023[76]
Stroke	Both	Age, Sex, Race	Ahmad et al., 2024[77]
All other causes	Both	All factors	CDC Wonder Database, 2022[73]
Medical Expenditures			
All cancers other than gallbladder cancer, liver cancer, multiple myeloma, and thyroid cancer	Both	All cancers (costs in US$2019)	Mariotto et al., 2022 [78]
Gallbladder cancer, liver cancer, multiple myeloma, and thyroid cancer	Both	International $2017	Chen et al., 2023 [79]
Chronic Kidney Disease	Both	CKD, DM, and HF	National Institute of Health, 2022 [80]
Gallstone Disease	Both	Age, Sex, race	Unalp-Arida and Ruhl, 2024 [81]
Pneumonia	Both	Age, Sex	Weycker et al., 2020[82]
Pulmonary Embolism	Both	Age, Sex, Race	Bledsoe et al., 2021[83]
Osteoarthritis	Both	BMI	Graham et al., 2022[84]
Gastroesophageal Reflux Disease	Both	Age	Maresova et al., 2024[85]
Chronic Back Pain	Both	Income	American Health & Drug Benefits [86]
Non-Alcoholic Fatty Liver Disease	Both	Age, biomarkers	Hagstrom et al., 2020 [87]
Last Year of Life	Both	Age	Arapakis et al., 2022[88]
Productivity and Income			
Employment status			Analysis of 2020-2023 NHIS
Missed Workdays			Analysis of 2020-2023 NHIS
Disability benefit			Analysis of 2020-2023 NHIS
Household Income			CPS
SSI Disability			Analysis of 2020-2023 NHIS
Quality Adjusted Life Years			Falk et al., 2023[89]

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