State of Wisconsin
Department of Health Services
Tony Evers, Governor
Karen E. Timberlake, Secretary

July 18, 2022

Michael J. Queensland
Senate Chief Clerk
Room B20 Southeast, State Capitol
Madison, WI 53707

Edward A. Blazel
Assembly Chief Clerk
12 West Main Street, Room 401
Madison, WI 53703

Dear Mr. Queensland and Mr. Blazel:

I am pleased to submit to the legislature the Department of Health Services (DHS) report on Wisconsin's Diabetes Action Plan. This report was prepared by the Bureau of Community Health Promotion and the Office of Health Informatics, Division of Public Health, and was done in consultation with the Department of Employee Trust Funds to develop a plan to reduce the incidence of diabetes in Wisconsin, improve diabetes care, and control complications associated with diabetes.

Wisconsin Stat. § 255.085 was enacted on March 3, 2020, requiring that the Diabetes Action Plan report be submitted to the legislature by January 1, 2021. The completion of this report was delayed because of reduced availability of key staff due to partial- or full-time reassignment to our COVID-19 response as well as logistical delays in acquiring data sources and receiving feedback from clinical partners.

This report includes:

- An assessment of the impact and reach of diabetes in Wisconsin.
- An overview of the implemented programs, activities, and funding aimed at preventing and controlling diabetes.
- A range of actionable items for consideration by the Legislature as well as other partners to reduce the number of new cases of diabetes, improve diabetes care, and manage diabetes-associated complications.

Diabetes is on the rise across Wisconsin and across the nation. National estimates are that annual healthcare expenditures for people with diabetes are 2.3 times greater than for those without diabetes. Diabetes is the seventh leading cause of death in Wisconsin, and it is the fourth leading cause of death for Hispanic, Native American/American Indian, and Black people and the fifth leading cause of death for Asian people.

While there is a robust network of public and private sector partners working across Wisconsin to prevent and address diabetes and its consequences, more must be done. This report lays out DHS's recommendations for action. We look forward to engaging the legislature, and other partners, in this vitally important work.

Sincerely,

Karen E. Timberlake
Secretary-designee

# Wisconsin Diabetes Action Plan

Report to the State Legislature


WISCONSIN DEPARTMENT of HEALTH SERVICES
P-03154 (07/2022)

Dear Members of the Wisconsin Legislature,

This report responds to the Diabetes Care and Prevention Action Program Act, Wis. Stat. § 255.085 (2019). It is the first required biennial report to the legislature that assesses the impact and reach of diabetes in Wisconsin.

Here's what we know:

- Over half a million adults in Wisconsin are living with diabetes.
- One in three adults in Wisconsin also has prediabetes. Every year, an estimated 5 to 10% of people with prediabetes progress to developing type 2 diabetes.
- Improvements in diabetes clinical management have stagnated in recent years.
- Every year, up to one in 10 pregnancies in Wisconsin are affected by gestational diabetes.
- Around 1,200 children living with type 1 diabetes are enrolled in Medicaid each year.
- Medicaid managed care medical costs for diabetes totaled an estimated $54.7 million in 2019.
- Medicaid diabetes-related pharmacy costs, including both diabetes-related drugs and insulin, were estimated at $237.7 million.

Chances are, if you do not already know someone personally living with diabetes, you will in the next few years. From 2012-2016, rates of newly diagnosed diabetes cases nearly doubled.

As called for in the Diabetes Care and Prevention Action Program Act, this report offers a range of actionable recommendations for consideration by the legislature to reduce the number of new cases of diabetes, improve care, and manage diabetes-associated complications. These recommendations focus on how changing systems, policies, and funding under legislative control can positively influence diabetes prevention and management, including:

- How community and clinical supports mitigate diabetes-related impacts.
- How equitable access to safe and healthy places to play, live, learn and work heavily influences diabetes-related outcomes.
- How health insurance, the costs of diabetes medications and supplies, access to quality care, and payments to providers impact the lives of ones we love when faced with a diabetes diagnosis, and how these factors currently affect the lives of those living with diabetes who we may not know personally.

Finally, this report assesses the current state of funding, programs and activities aimed at controlling and preventing diabetes within the Department of Health Services (DHS). DHS relies heavily on federal funding for diabetes prevention and control initiatives, projects, and interventions. General purpose revenue (GPR) allocations to DHS that fund diabetes directly total $71,550 annually—around $0.14 per adult with diabetes in Wisconsin.

We know there are many partners we need to bring together to prevent and manage diabetes effectively long-term. There are also steps the legislature can take now to improve the lives of people across Wisconsin. We look forward to working with you to move the recommendations in this plan forward.

Sincerely,

Paula Tran
State Health Officer
Wisconsin Department of Health Services

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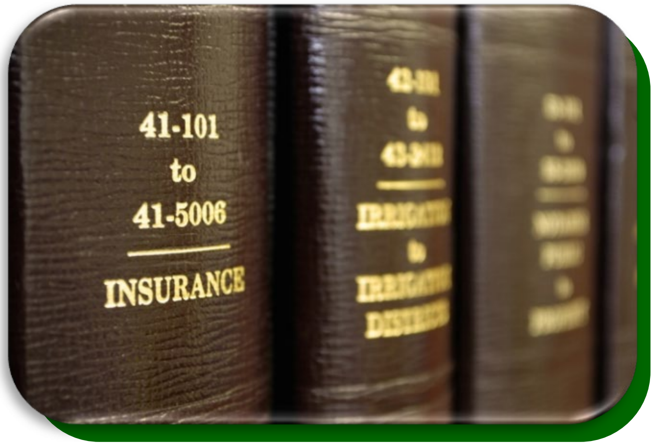
## Executive Summary

This report responds to the Diabetes Care and Prevention Action Program Act, Wis. Stat. § 255.085 (2019). It is the first required biennial report from the Wisconsin Department of Health Services (DHS) to the state legislature that assesses the impact and reach of diabetes in Wisconsin, provides an overview of the implemented programs and activities, and details state government investments aimed at controlling diabetes and preventing the disease. This report also lists a range of actionable recommendations for consideration by the legislature to reduce the number of new cases of diabetes, improve diabetes care, and manage diabetes-associated complications.


Key takeaways:

- The rate of newly diagnosed diabetes is rapidly rising in Wisconsin. The estimated case rate, even after adjusting for an aging population, nearly doubled from 4.7 per 1,000 in 2012 to 8.2 in 2016.
- Estimated Medicaid managed care medical costs for diabetes totaled $54.7 million in 2019. Medicaid diabetes-related pharmacy costs, including both diabetes-related drugs and insulin, were estimated at $237.7 million.
- There are two GPR DHS allocations that fund diabetes programming directly. They total $71,550 annually, or about 14 cents per adult with diabetes in Wisconsin.
- DHS relies heavily on federal funding for diabetes prevention and control initiatives, projects, and interventions.
- An estimated 525,808 adults in Wisconsin have diagnosed or undiagnosed diabetes.
- An estimated one in three adults, or 1.5 million Wisconsin residents, have prediabetes. Prediabetes a serious condition that can lead to type 2 diabetes.
- Wisconsin is home to strong, robust networks of diabetes self-management and education and support service and National Diabetes Prevention Program providers, but services and classes are underutilized.
- Rates of uncontrolled diabetes (those who are diagnosed, but their blood sugar levels are still too high) in Wisconsin have not improved in recent years.
- About 100,000 people experience diabetes-related hospitalizations in Wisconsin each year. In 2019, 656 people hospitalized with these complications were younger than 18 years old.
- Diabetes-related hospitalizations account for 16-17% of all hospitalizations annually.
- Diabetes is the seventh leading cause of death in Wisconsin.
- Diabetes deaths increased 19% from 2008-2018.
- Actionable items for the legislature focus on immediate steps that can be taken for GPR allocation and health insurance access and coverage.

The Diabetes Care and Prevention Action Program Act called for a report to the legislature, as legislative action to address the growing problem of diabetes in Wisconsin is critical. It is also important to note that there are many things that private insurance companies, private employers and plan sponsors, and other partners can do to make these recommendations a reality.




## Health Insurance Access and Coverage

**Reduce patient cost-sharing of diabetes self-management education and support services (DSMES), devices, supplies, and medicines.**

For people with diabetes, this includes the recurring costs of:

- Glucometers, including self-monitoring blood glucose and continuous glucose monitors.
- Test strips.
- Lancets.
- Supplies to deliver insulin in the form of an injection, pump, or pod.
- Emergency glucagon for severe hypoglycemia.


It's not just cost of insulin that poses a financial challenge—there are a host of medically necessary, life-saving supplies to consider.

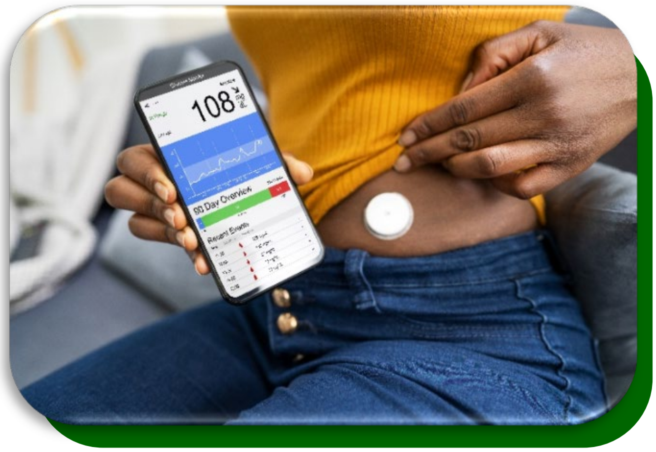
**Increase pricing and insurance coverage transparency for all diabetes medications throughout the supply chain**.

The average list price of insulin tripled between 2002 and 2013 and doubled again from 2012 to 2016.[1] According to a report by the Centers for Disease Control and Prevention, nearly a quarter of people with diabetes report asking their doctor for a cheaper medication, and one in 10 said they didn't take insulin as prescribed because of cost. Moreover, the cost of insulin to the state is significant.[2] In 2019 alone, Wisconsin Medicaid paid an estimated $29 million in insulin costs for members with type 1 diabetes (Appendix, Table 7).


The Governor's Task Force on Reducing Prescription Drug Prices and the Governor's 2021-2023 Budget recommend statutorily limiting the copay an insurer can charge for a month's supply of insulin, and improving transparency and reporting to better understand the drivers of high-cost prescription drugs, like insulin.[3] These recommendations align with the American Diabetes Association's policy recommendation to lower or completely remove patient cost-sharing for insulin for improved insulin access and affordability.[4] The American Diabetes Association (ADA) also recommends increasing pricing transparency throughout the insulin supply chain, competition through insulin biosimilars, and access to health care coverage for all people with diabetes.

Finally, the Governor's Task Force and the Governor's 2021-2023 Budget recommended creating an insulin safety net program, an urgent need program that allows eligible individuals who are in urgent need of insulin to get a one-time, 30-day supply of insulin from their pharmacy, for a $35 copay.

**Improve access for personal continuous glucose monitoring (CGM)** by expanding coverage across private and public marketplaces and expanding ForwardHealth's CGM device and accessory coverage by replacing the prior authorization requirement with revised qualifying criteria. Expansion should include individuals under 25 years of age, members with type 2 diabetes, and anyone out of ideal blood glucose control ranges.




In 2021, Wisconsin Medicaid covered personal CGM devices and accessories only for those with type 1 diabetes who are 25 years or older with prior authorization approval criteria.[5] Coverage is contingent on a member:

- Complying with intensive insulin treatment or an insulin pump and adequate self-monitoring of blood glucose with 6 to 10 finger sticks per day.
- Having the motivation to use the device daily, and having the ability and readiness as assessed by their medical team, including an endocrinologist, to make appropriate adjustments to their treatment regimen based on trending information from the device.
- Successfully completing a 72-hour trial using a professional CGM, where available, that was found to be both clinically meaningful and tolerated.
- Receiving in-depth diabetes education and remaining in regular close contact with their diabetes management team.
- Having documentation supporting hypoglycemic unawareness (e.g., nocturnal asymptomatic hypoglycemia) with recurrent ongoing hypoglycemia, a significant risk for hypoglycemia, or being unable to achieve optimal glycemic control as defined by the treating endocrinologist despite treatment compliance.

**Reimburse all DSMES delivered by all professional support providers, including pharmacists, nurses, Certified Diabetes Care and Education Specialists, and registered dietitian nutritionists (RDNs).**

This includes:

- Considering RDNs and diabetes educators to be Medicaid billable providers. This may allow RDNs to collaborate with behavioral health and medical providers in the care of patients.
- Reimbursing Medical Nutrition Therapy (MNT) provided by RDNs.

**Reimburse for DSMES delivered via telehealth.**

Include all areas, both urban and rural, and expand the definition of eligible providers to include all certified diabetes self-management education and support providers, including pharmacists, nurses, and dieticians. The COVID-19 pandemic highlighted this need.

**Require Wisconsin health insurers to maintain at least one non-insulin drug in every diabetes drug class available on-formulary:**

| | |
|---|---|
| Alpha-glucosidase inhibitors | Glucagon-like peptide-1 (GLP-1) receptor agonists |
| Amylin analogs | Incretin mimetics |
| Biguanides | Meglitinides |
| Bile Acid Sequestrants | Sodium glucose co-transporter 2 (SGLT2) inhibitors |
| Dopamine-2 Agonists | Sulfonylureas |
| Dipeptidyl peptidase (DPP)-4 inhibitors | Thiazolidinediones (TZDs) |
| Glucagon | Oral combination therapy |

**Reimburse community health workers who provide chronic disease management and care coordination services.**

**Cover the National Diabetes Prevention Program and diabetes self-management education and support as preventive services.**

## GPR Allocation

In addition to the policy and fiscal recommendations noted above, DHS is requesting a GPR allocation of $180,000 to support a 1.0 full-time staff at DHS as part of the 2023–2025 biennial budget. The program staff would be responsible for:

- Convening collaborating agencies for the creation of a diabetes action plan.
- Gathering and summarizing diabetes surveillance and cost data for monitoring action plan progress.
- Conducting sophisticated economic analyses detailing the impact of diabetes.
- Creating and submitting biennial legislative reports.

While DHS has existing staff positions dedicated to diabetes-related activities, these positions are funded by federal prevention grants and are at capacity.[6]

DHS will continue to build on the recommendations in the Governor's 2021–2023 budget proposal, the work of the Governor's task force on prescription drug costs and will engage other state agencies to present the legislature with a detailed budget proposal for consideration.

## Introduction

This report is intended for the chief clerk of each house of the legislature for distribution to the legislature.[7] It contains an assessment of the impact and reach of diabetes in Wisconsin, an overview of the implemented programs, activities, and funding aimed at controlling diabetes and preventing the disease by DHS, as well as a range of legislative recommendations to reduce the number of new cases of diabetes, improve diabetes care, and manage diabetes-associated complications. This report and its recommendations are a result of:

- Reviewing DHS data to document the impact of diabetes.
- Literature reviews to inform gaps where Wisconsin data were missing.
- Documenting existing state agency-led diabetes prevention and management initiatives.
- Soliciting input and data from diabetes prevention and care stakeholders across Wisconsin, including:
  - Wisconsin Department of Employee Trust Funds
  - Wisconsin Department of Corrections
  - DHS
    - Division of Public Health
      - Diabetes Advisory Group
      - Chronic Disease Prevention Program
      - Office of Health Informatics
    - Division of Medicaid Services
  - Wisconsin Health Information Organization
  - Wisconsin Collaborative for Healthcare Quality
  - Wisconsin Institute for Healthy Aging
  - Survey of the Health of Wisconsin

Scope and Scale

Here we describe the scope and scale of diabetes in Wisconsin. We estimate who is currently impacted by diabetes, and explore associated costs, risks, and outcomes. We organized this information into the following sections:

| | | |
|---|---|---|
| I. Diabetes | II. Type 1 Diabetes | III. Gestational Diabetes |
| IV. Prediabetes | V. Type 2 Diabetes | VI. Care and Quality |
| VII. Hospitalizations | VIII. Medical Costs | IX. Mortality |

## I. Diabetes

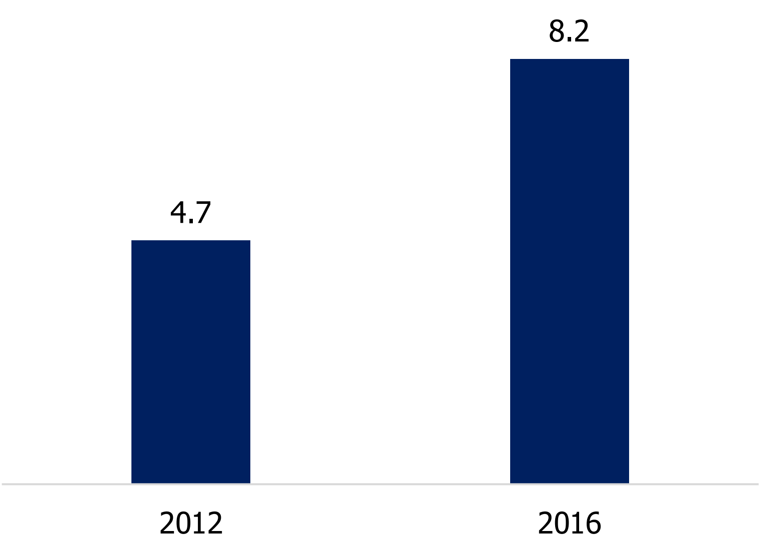
Diabetes is a chronic disease that affects how the body turns food into energy. It results from a lack of insulin production by the pancreas, or the body's ineffectiveness in using the insulin it makes. Insulin is a hormone produced naturally in the body that regulates blood glucose to maintain normal levels. The most common types of diabetes are type 1, type 2, gestational diabetes, and prediabetes. Type 2 diabetes accounts for 90–95% of all diagnosed diabetes cases. Type 1 accounts for approximately 5–10% of cases.

Wisconsin data highlights:

For all types of diabetes combined from our review:

- Newly diagnosed diabetes (incidence) rates are rapidly rising in Wisconsin. The age-adjusted rate nearly doubled from 4.7 per 1,000 in 2012 to 8.2 in 2016.[8] In recent years, Wisconsin's newly diagnosed rates have outpaced both Minnesota's and Iowa's.[9]
- An estimated 525,808 adults in Wisconsin have diagnosed or undiagnosed diabetes (Appendix, Table 1).
- The Survey of the Health of Wisconsin estimated that 495,800 people had a previous diagnosis of type 1 or type 2 diabetes or had a hemoglobin A1C (HbA1c or A1C) greater or equal to 6.5, between 2014 and 2016.[10] An A1C test measures the average blood sugar for the past two to three months.

Newly Diagnosed Diabetes (incidence) Rates in Wisconsin Per 1,000 People



## II. Type 1 Diabetes

Type 1 diabetes is caused by an autoimmune reaction that destroys the beta cells in the pancreas that produce insulin. Insulin is a hormone required to help your body turn blood sugar (glucose) into energy. Insulin also helps your body move glucose into cells to store it. Glucose is stored in your muscles, fat cells, and liver to use later when your body needs it.

For people with type 1 diabetes, where the body is not making insulin, insulin must be taken in the form of injections, pump, or pod to live. Type 1 diabetes most typically manifests during youth, however, it can develop at any age. The risk factors for developing type 1 diabetes are largely unknown, except that genetics play a strong role. Of all cases of diabetes, type 1 accounts for an estimated 5 to 10%.

Wisconsin data highlights:

- An estimated 27,000 to 52,600 adults have type 1 diabetes (Appendix, Tables 1 and 2).
- We estimate that 5,980 youth currently have diagnosed diabetes (combination of all types), with the majority having type 1 (Appendix, Table 3).
- In 2019, 8,889 people covered by Wisconsin Medicaid had claim encounters where type 1 diabetes was indicated. 1,177 were under the age of 18. (Appendix, Table 4).
- There were 12,167 people represented in the payers claims database have type 1 diabetes. This database includes approximately 70% of Wisconsin's population (Appendix, Table 5).

Type 1 diabetes cases among youth are rising globally and nationally. Between 2002 and 2015, the rate of new cases among youth less than 20 years increased by 2% annually.[11] We can't say for certain why this increase in type 1 diabetes is happening. Researchers believe that, because changes in genetics cannot evolve over this short of time, environmental factors seem to be the most likely explanation.

## III. Gestational Diabetes

Gestational diabetes develops in pregnant people who have never had diabetes before. Every year, up to one in 10 pregnancies are affected. In 2019, 7% of Wisconsin births involved gestational diabetes (Appendix, Table 9). There are generally no symptoms, and, although gestational diabetes usually goes away after the baby is born, both the mother's and the baby's risk of eventually developing type 2 diabetes increases.[12] Gestational diabetes is on the rise nationally and in Wisconsin. In 2011, the rate of births to mothers with gestational diabetes was 58.1 per 1,000 (Appendix, Table 9). It has steadily increased each year. In 2019, the rate of births to mothers with gestational diabetes reached 72.1 per 1,000 births, a 24% increase over eight years.

Having gestational diabetes increases the risk of hypertension during pregnancy.[13] For mothers with gestational diabetes, 11% of births between 2011 and 2019 involved hypertension during pregnancy. In mothers without gestational diabetes, only 6% of births involved hypertension (Appendix, Table 10). Hypertension during pregnancy can put the mother and baby at risk for other problems: preeclampsia, eclampsia, and stroke for mothers, and preterm delivery for babies.[14] Gestational diabetes can also increase the risk having a large baby that needs to be delivered by cesarean section (C-section).[15] In 2019, 35% of births to mothers with gestational diabetes were delivered by C-section compared to 26% of those without gestational diabetes (Appendix, Table 8).

Although all pregnant people have some insulin resistance during late pregnancy, some people have it even before they become pregnant, making them more likely to have gestational diabetes.[16] We know that a person's health prior to, during, and after pregnancy is influenced by a variety of environmental, genetic and social factors, such as access to medical care, experiencing interpersonal racism, experiencing food insecurity, and chronic stress.[17] [18] [19] [20] [21] [22] [23] Below are highlights of Wisconsin women's health, and social and economic factors impacting it, before they give birth, during pregnancy, and after birth. These data come from the Wisconsin Pregnancy Risk Assessment Monitoring System (PRAMS), a population-based survey of individuals who recently gave birth in Wisconsin. PRAMS collects state-specific data on maternal attitudes and experiences before, during, and shortly after pregnancy.

Before birth or during pregnancy:[24]

- One in 10 Wisconsin mothers did not have health insurance in the month prior to becoming pregnant. In fact, they were more likely to be uninsured than the Wisconsin general adult population of the same age (18–44).
- Twenty-three percent of non-Hispanic Black mothers and 14% of Hispanic mothers report experiencing interpersonal racism in the 12 months before their baby was born.
- Forty-four percent of women are living in poor or near-poor households before giving birth.


During pregnancy:
Of Wisconsin mothers who sought prenatal care later than they wanted, 8% cited lack of transportation as a reason.[25]
Twenty eight percent of Wisconsin mothers received Women, Infants, and Children (WIC) Program benefits during their pregnancy. WIC provides care for about 19,550 moms and 22,100 babies each month.[26]


After giving birth (postpartum):[27]

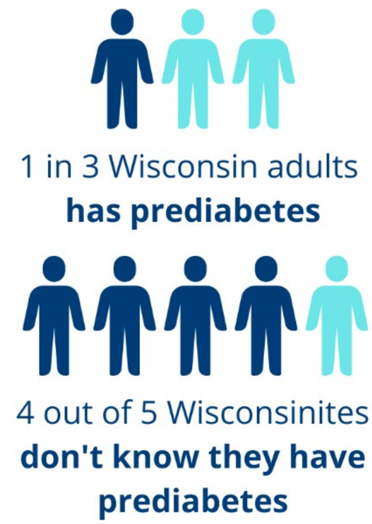
- New mothers who had public insurance are three times less likely than mothers with private insurance to receive a postpartum visit.
- **One in four mothers without insurance after their pregnancy reported that they did not receive a postpartum check-up.**
- For new mothers who did receive a postpartum check-up, only 58% were told about healthy eating and exercise, and only 17% reported being tested for diabetes.

## IV. Prediabetes

Prediabetes occurs when your blood sugar levels are consistently higher than normal, but not yet high enough to be diagnosed as diabetes. It is a serious condition that can lead to type 2 diabetes, and increases the risk of developing cardiovascular disease, which can lead to heart attack or stroke. Although prediabetes is commonly thought of as a precursor to type 2 diabetes, it is far from harmless. In fact, there is evidence associating prediabetes with early forms of chronic kidney disease and diabetic retinopathy.[28] [29]

Prediabetes is more common than most people realize:

- An estimated one in three Wisconsin adults, or 1.5 million people, have prediabetes.
- The effects of prediabetes are serious, but the symptoms can go undetected for years. An estimated four out of five people with prediabetes don't know they have it.[30] Without knowing their risk, many people are unlikely to engage in measures to prevent type 2 diabetes.
- In 2019, 9,868 people covered by Wisconsin Medicaid had claim encounters where prediabetes was listed (Appendix, Table 4).
- Although the risk of prediabetes and type 2 diabetes increases with age, younger adults are not immune. National surveys estimate that 35% of adults over age 20 have prediabetes.[31]




Every year, an estimated 5 to 10% of people with prediabetes progress to developing type 2 diabetes.[32] According to an American Diabetes Association expert panel, up to 70% of all individuals with prediabetes could develop diabetes if no intervention occurs.

Prediabetes is a reversible condition. We know that moderate lifestyle changes to improve physical activity and nutrition can significantly reduce the risk of developing type 2 diabetes.

**Could you have prediabetes?**

Take the risk test.

https://www.diabetes.org/widhsrisktest

## V. Type 2 Diabetes

Type 2 diabetes occurs when the body does not produce enough insulin or resists the effects of insulin. This can cause serious health problems, including heart attack, stroke, blindness, kidney failure, and loss of toes, feet, or legs. It is estimated that two out of five adults living today are expected to develop type 2 diabetes in their lifetime.[33]

Wisconsin data highlights:

- An estimated 473,200 to 499,500 adults in Wisconsin have type 2 diabetes, and up to 124,000 may be undiagnosed (Appendix, Tables 1 and 2).
- Although the risk for developing type 2 diabetes increases with age, roughly 120,000 adults with type 2 diabetes in Wisconsin are under 65 (Appendix, Table 1).
- In 2019, 80,103 people covered by Wisconsin Medicaid had claim encounters where type 2 diabetes was indicated (Appendix, Table 3). This is a slight increase from 78,698 people in 2017.
- In Wisconsin, 176,911 people represented in the state's all payers claims database have diagnosed type 2 diabetes.[34] This database includes approximately 73% of Wisconsin's population (Appendix, Table 5).

Type 2 diabetes is generally thought to be caused by a combination of genetics and risk factors such as obesity, unhealthy diet, and lack of physical activity. Although type 2 diabetes was previously limited to adult populations, the number of cases among children is on the rise. Many health experts believe that this increase correlates with the increase of obesity among children.[35]

# VI. Care and Quality

## Preventing and Delaying Type 2 Diabetes

Type 2 diabetes can be delayed or completely prevented by adopting a healthy lifestyle. For adults with prediabetes or those at high risk of developing type 2 diabetes, lifestyle intervention programs, such as the National Diabetes Prevention Program (DPP) are recommended. The National DPP is a year-long program structured around:

- **Centers for Disease Control and Prevention (CDC)-approved curriculum** with lessons, handouts, and other resources to help make healthy changes.
- **A lifestyle coach** specially trained to lead the program and help participants learn new skills and encourage them to set and meet goals. The coach facilitates discussions to help make programming fun and engaging.
- **A support group** of people with similar goals and challenges. Groups share ideas, celebrate successes, and work to overcome obstacles.

Research on the National DPP shows that participants who lost at least 5% of their body weight and exercised 2.5 hours each week cut their risk of type 2 diabetes by up to 71% for those aged 60 and older, and 58% for ages 59 and younger.[36] Even a decade later, 33% of participants in the original study were less likely to develop type 2 diabetes.

Wisconsin is home to 39 National DPP providers recognized by the Centers for Disease Control and Prevention (to find current locations, visit dhs.wisconsin.gov/prediabetes/control.htm). Between 2014 and 2020, 7,593 people have participated in programming.[37] Four of the 39 National DPP providers are also Medicare Diabetes Prevention Program (MDPP) suppliers. MDPP is available to those with Medicare Part B with qualifying eligibility requirements. **Although we have a robust network of programs in our state, the National DPP is vastly underutilized. We estimate that less than 1% of Wisconsin adults with prediabetes have ever participated in programs.**

In 2020, the DHS performed a cost-effectiveness analysis of offering the National DPP to Wisconsin Medicaid members and state employees covered under the Department of Employee Trust Funds group health insurance program who had been screened for prediabetes. We found that offering this program could produce cost savings after eight to ten years for the Medicaid population, and nine years for group health insurance program members.[38] That same analysis also found that the economic rate of return for offering two programs designed to prevent diabetes progression: the National DPP for people with prediabetes, and Healthy Living With Diabetes for those diagnosed with diabetes, is 16%. This economic rate of return is higher than 10%, which is the threshold where benefits are considered to outweigh costs after adjusting for time and value of money.[39]

## Diabetes Self-Management Education and Support Services

Better health management can help people with diabetes live longer, healthier lives. Evidence-based services exist to help people with diabetes, and their healthcare teams prevent or delay diabetes complications.

DSMES is an evidence-based, cost-effective program that helps people with diabetes improve health behaviors and healthy outcomes. Guided by evidence-based standards, it is an ongoing process of facilitating the knowledge, skill, and ability necessary to empower people with diabetes to navigate self-management decisions and activities.

There are four critical times to receive DSMES:[40]

- At diagnosis.
- During annual assessment.
- When a person with diabetes has new complicating factors.
- Upon transitions in care.

Organizations offering DSMES can apply for recognition by the ADA or accreditation by the Association of Diabetes Care and Education Specialists (ADCES), making them eligible for reimbursement by Medicare (as Diabetes Self-Management Training, DSMT) and many private health plans. However, covered benefits for DSMES vary by insurer, which can cause confusion for people with diabetes and their medical providers.[41]

In Wisconsin, we have 54 ADA-recognized programs operating across 155 sites.[42] We also have 10 ADCES-accredited main sites, and 35 branch sites. Accredited and recognized DSMES locations can be found on this DHS maintained Google Map. **Although we have a robust network of programs and locations in our state, clinical DSMES are vastly underutilized.** In 2019, our state's ADA and ADCES programs reported 47,683 DSMES encounters with certified diabetes care and education specialists such as registered nurses, registered dietitian nutritionists, pharmacists, and providers.[43] If each encounter represented one Wisconsin adult with diagnosed diabetes, only 12% received DSMES through an accredited or recognized program in 2019.


## Diabetes Self- Management Training (DSMT)

The Centers for Medicare and Medicaid Services (CMS) uses the term "training" instead of "education" when defining the reimbursable benefit for diabetes self-management. DSMT is provided by diabetes educators who:

- Are licensed or nationally registered health care professionals.
- Provide overall guidance related to all aspects of diabetes.
- Increase the person with diabetes's knowledge and skill about the disease.
- Promote self-care behaviors for effective self-management and glycemic control.

## Medical Nutrition Therapy

Medical nutrition therapy (MNT) is a key component of diabetes education and management. MNT is a nutrition-based treatment provided by a registered dietitian nutritionist (RDN). It includes a nutrition diagnosis as well as therapeutic and counseling services to help manage diabetes. MNT:

- Is an intensive, focused, and comprehensive nutrition therapy service.
- Involves in-depth individualized nutrition assessment.
- Relies heavily on follow-up to provide repeated reinforcement to aid with behavior change.
- Establishes goals, a care plan, and interventions.
- Plans for follow-up over multiple visits to assist with behavioral and lifestyle changes relative to each individual's nutrition problems and medical condition or disease(s).

## Diabetes Self-Management Programs

The Diabetes Self-Management Program (DSMP) is a community-based course developed by the Stanford University for people with type 2 diabetes. The Wisconsin Institute for Healthy Aging supports evidence-based DSMP classes called Healthy Living with Diabetes (HLWD) in community settings. HLWD workshops:

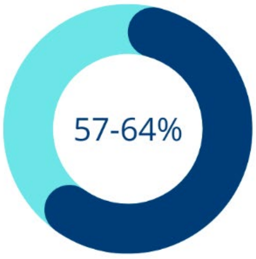
- Are facilitated by two trained leaders.
- Are offered in small group settings.
- Provide tools and resources to enhance knowledge of diabetes.
- Meet for two and a half hours, once a week, for six weeks.
- Are offered in both English and Spanish.

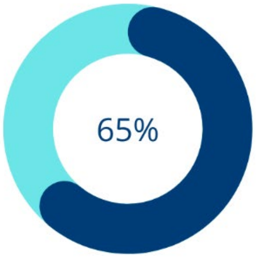
Between January 2018 and January 2020, approximately 1,600 participants from 61 counties and one tribal reservation engaged in HLWD workshops.[44]

DHS reviews the percentage of Wisconsin adults with diabetes who self-reported ever attending a diabetes self-management class.

- The percent of Wisconsin adults 18 to 64 with diagnosed diabetes who report attending a diabetes self-management class has hovered between 57–64% since 2011.[45]
- The percent of older adults who report ever taking a self-management course for their diabetes has increased slightly. The percent of Wisconsin adults 65 and older with diagnosed diabetes who report attending a diabetes-self management class rose from 56% in 2013 to 65% in 2016.[46]

**Diabetes Self-management Class Participation**



## Blood Glucose Monitoring and Management

Following a diagnosis of diabetes, management usually requires self-monitoring blood glucose with a glucometer: the two main types are **standard meters** that use a drop of blood to check levels at that given moment, and **CGMs** that check levels regularly day and night.

**Standard meters** require people with diabetes to prick their finger with a lancet and place a drop of blood on a disposable test strip. This type of management, called self-monitoring of blood glucose (SMBG), has been the recommended standard of care since about the 1980s.

**CGM** technology was introduced in the early 2000s. CGM involves a sensor, which is placed under the skin, and measures real-time blood sugar levels (e.g., every five minutes). The sensor sends a signal to a small recording device. CGM technology provides insight into glucose trends throughout the day. Personal CGM technology can alert people with diabetes to blood glucose trending low or high, allowing for insulin adjustment to prevent hypoglycemia and long-term effects of the disease. CGM has become increasingly reliable, and has demonstrated efficacy through improved A1C, reducing hypoglycemia, and improving the time in target glucose range.

Early CGM technologies were costly, painful to insert, bulky in size, and required multiple fingerstick calibrations to accurately measure blood glucose. As the technology has improved, data have shown improved management and decreased rates of hypoglycemia in those using personal CGM. Today, the Endocrine Society and the American Diabetes Association say that personal CGM use represents standard of care for patients with type 1 diabetes. Personal CGM use in Americans with type 1 diabetes is rising rapidly. In 2016, an estimated 38% of patients with type 1 diabetes use personal CGM.[47]

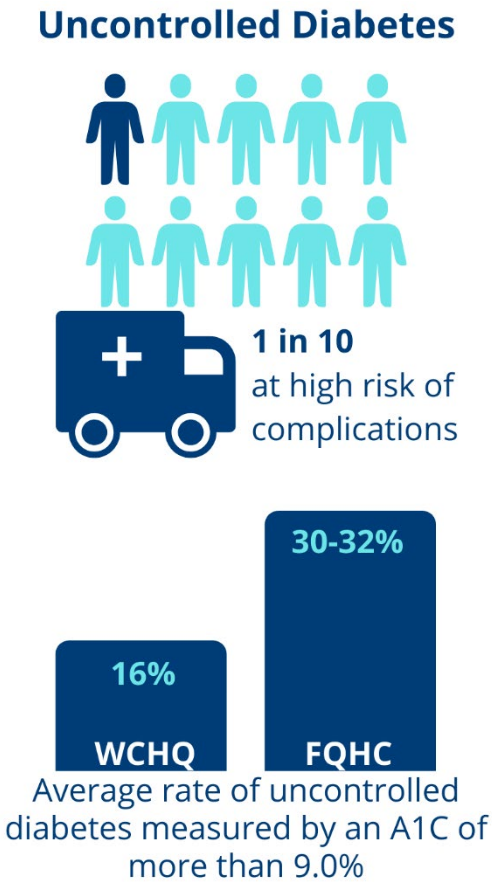
For people with type 2 diabetes, high costs and uncertainty over efficacy and necessity have kept CGM from widespread use. The newest CGM models address many technical barriers experienced with older systems:

- Newer sensors can be inserted painlessly and are small enough to fit easily under clothing. They can remain in place for about one to two weeks, and are FDA approved as sufficiently accurate to use in lieu of fingersticks to make insulin-dosing decisions.
- Data can now be seamlessly and continuously uploaded wirelessly to the cloud via a user's smartphone, allowing people to share their data with health care providers and trusted family members.
- Newer, lower-priced personal devices have been released, ranging from $75 to $150 each month for sensors (2 sensors that last 14 days each), translating to $900 to $1800 per year. This is significantly less than compared with older CGM technology, which ranged from $3,000 to $5,000 annually.

Blood glucose monitors are essential in measuring and managing daily blood sugar for many diabetes patients and their providers. An important clinical measure of blood sugar management is known as A1C. A1C is a simple blood test that provides information on a patient's average blood sugar level over the past two to three months. In general, it helps people with diabetes and providers see if treatment goals are being met.[48] From a statewide perspective, clinical population A1C results help measure progress in improving care and management for patients with diabetes.

**Uncontrolled** blood glucose rates for Wisconsin people with diabetes:

- A1C levels greater than 9.0% in clinical data indicate poor blood sugar control.
- **Rates of uncontrolled diabetes in Wisconsin have not improved in recent years.** Many Wisconsin health systems participate in public reporting of diabetes quality of care measures as members of the Wisconsin Collaborative for Healthcare Quality (WCHQ). Since 2015, the average rate of uncontrolled diabetes measured by an A1C more than 9.0%, has plateaued at about 12% for WCHQ member health systems.[49] This means more than one in 10 people with diabetes obtaining care from these health systems remain at high risk of complications from the disease.
- Federally-qualified health centers (FQHCs) also publicly report uncontrolled diabetes rates. In Wisconsin, FQHCs who deliver primary care report uncontrolled diabetes rates between 30% and 32%.[50]




**Controlled** blood glucose rates for Wisconsin patients with diabetes:

- WCHQ reports that blood sugar control rates in patients with diabetes are substantially lower for Hispanic/Latino adults (62%) compared to White (74%) adults. Control rates were lower for American Indian/Alaska Native (65%), Asian/Pacific Islander (69%), and Black (66%) adults compared to White adults, too.[51]
- WCHQ also reports that blood sugar control rates are substantially lower for adults with Medicaid (61%) or who were uninsured (64%) compared to those with Medicare (78%) and commercial insurance (72%).[52]

## Blood Pressure and Cholesterol Management

Over time, high blood sugar can damage blood vessels and the nerves that control the heart. People with diabetes are more likely to have other conditions that raise the risk for cardiovascular disease, including high blood pressure, elevated triglycerides, and elevated LDL cholesterol, with smaller, denser, LDL particles.

Maintaining healthy cholesterol levels is important for preventing and reducing cardiovascular complications. The American College of Cardiology and the American Heart Association (ACC/AHA) guidelines state that statins of moderate or high intensity are recommended for adults with established clinical ASCVD.[53] The American Diabetes Association and the ACC/AHA guidelines also recommend statins for primary prevention of cardiovascular disease in patients with diabetes, based on age and other risk factors.[54, 55]

DHS reviews quality of care measures for statin prescriptions, as well as blood pressure control for people with diabetes:

- Several Wisconsin commercial plans voluntarily submit annual quality of care data to the Chronic Disease Quality Improvement Project (CDQIP). In 2018, CDQIP reported that **an average of 67% of patients with diabetes who met clinical recommendations for statin therapy actually received it.**[56] This means about one in three people with diabetes are not getting all of the treatments available to reduce their risk of cardiovascular disease progression.
- **Rates of blood pressure control for patients with diabetes remain high overall but have not changed significantly since 2013**. WCHQ member health systems who publicly report blood pressure control rates for their patients with diabetes have maintained rates between 80% to 83%.[57]

### Patients at High Cardiovascular Risk

In 2020, the ADA added recommendations to its annual revision of the *Standards of Medical Care in Diabetes* to include two drug classes used to treat patients with type 2 diabetes and comorbidities: sodium glucose co-transporter 2 (SGLT2) inhibitors and glucagon-like peptide-1 (GLP-1) receptor agonists.[58] Both treatments have shown cardiovascular protection for patients with type 2 diabetes at high cardiovascular risk. The latest annual revision stated that these medications should be considered for patients when atherosclerotic cardiovascular disease (ASCVD), heart failure, or chronic kidney disease predominates, independent of A1C. The American College of Cardiologists (ACC) also released a 2020 expert consensus on the use of these drugs for reducing cardiovascular risk in patients with type 2 diabetes.[59]

## VII. Hospitalizations

Diabetes is often considered an ambulatory care condition: one in which opportune and effective primary care can reduce hospitalizations. While some hospitalizations are anticipated, many can be prevented with optimal disease control and management. Access to quality care, receiving the recommended tests and exams, and increasing or enhancing self-care skills (including support for behavior and lifestyle change) may help decrease the number of diabetes-related hospitalizations.

When a person is admitted to a hospital, the main reason for the admission is recorded as the primary diagnosis. In many cases, one or more additional diagnostic codes are listed as well. A diabetes-related condition (such as diabetic ketoacidosis) or diabetes itself may be listed in one or more of the subsequent diagnostic codes. In this report, we present hospitalizations for where diabetes is the primary diagnosis, and also when it is present in the other diagnostic codes.

Diabetes-related hospitalization data are from the Wisconsin Inpatient Hospitalization Discharge database. These data include all ages, but do not include hospitalizations at any Veteran's Administration (VA) hospitals, which are exempt from the state reporting requirements. Hospitalizations for non-Wisconsin residents and for Wisconsin residents hospitalized outside of Wisconsin are not included. Many Wisconsin counties share borders with other states. Therefore, diabetes-related hospitalizations are likely underreported, and this limitation should be taken into consideration when examining the data.

Wisconsin data highlights:

- About 100,000 people experience diabetes-related hospitalizations in Wisconsin each year. In 2019, 656 were younger than 18 years old (Appendix, Table 13).
- Diabetes-related hospitalizations make up about 16–17% of all hospitalizations each year (Appendix, Table 13).
- About 8,600 people are hospitalized each year with diabetes as their primary diagnosis. In 2019, 433 were less than 18 years old (Appendix, Table 14).
- The average length of hospital stay for primary diabetes hospitalizations is about 4.5 to 5 days.[60]


## VIII. Medical Costs

The financial impacts of diabetes can be categorized into direct costs (e.g., health care spending) and indirect costs (e.g., reduced work productivity or inability to work due to disability). **For this report, we focused on diabetes-related health care spending (direct costs)**.

National estimates indicate that annual health care costs for people with diabetes are estimated to be 2.3 times greater than for those without diabetes.[61] To describe medical costs specific to Wisconsin, we collaborated with the Wisconsin Health Information Organization (WHIO), the Wisconsin Division of Public Health's Office of Health Informatics, Wisconsin Division of Medicaid Services, and the Wisconsin Department of Employee Trust Funds. All of these organizations provided data and analytical support.

We summarized total estimated medical costs by diabetes type and organization.

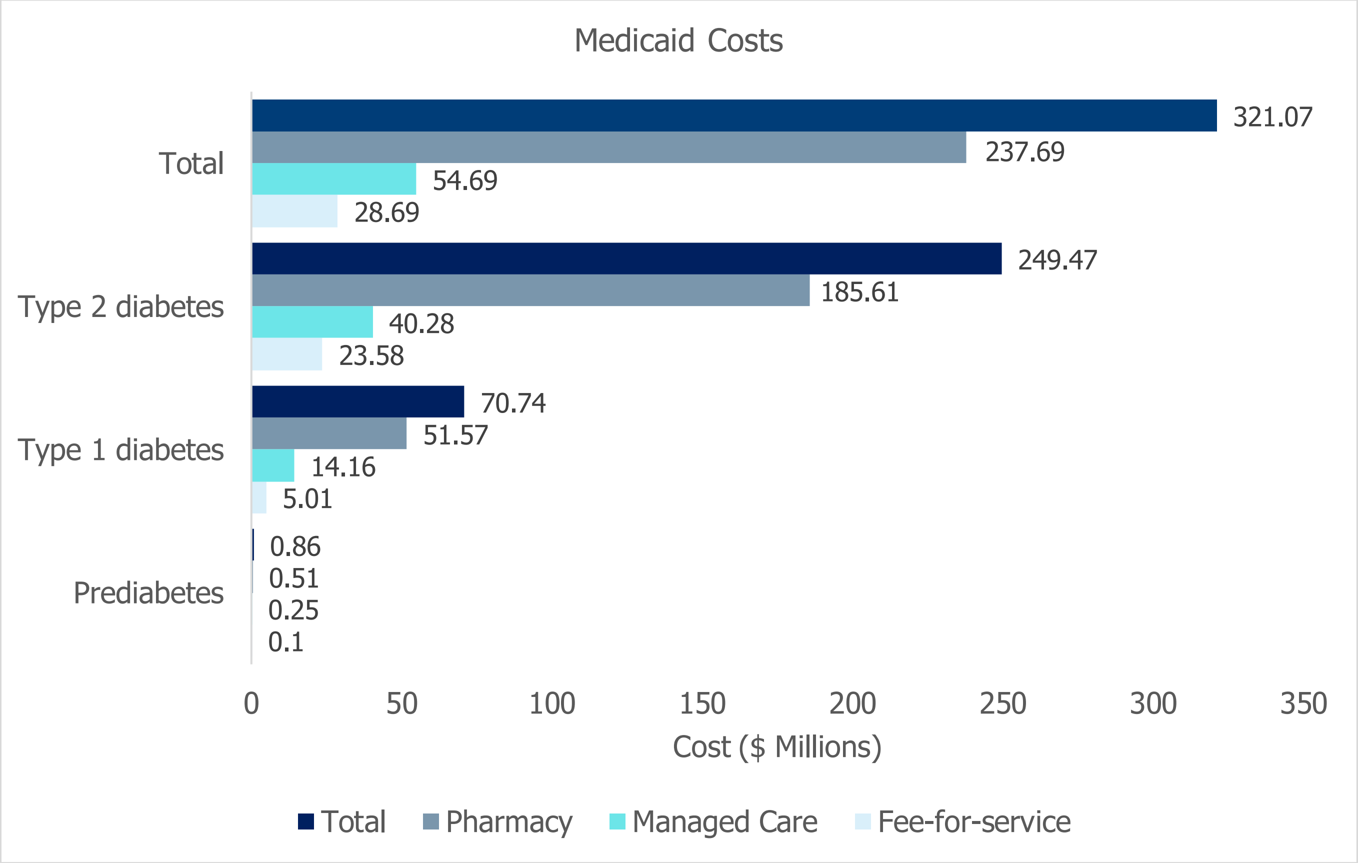
There are three different kinds of costs available across the data sources we reviewed:

- **Billed cost**: the amount a physician, a hospital, or a pharmacy submits as charges to the payer.
- **Allowable cost**: the maximum amount a payer is willing to pay for an encounter, adjusted for hospital cost-to-charge ratio, and patient characteristics. It includes out-of-pocket and third-party costs. While it is possible to adjust the charges at a patient and illness level, it is difficult to get that level of detail from data sources. Where needed, the allowable amounts are adjusted for hospital cost-to-charge ratio.
- **Payable cost**: the amount the payer pays the service provider after deducting out of pocket and third-party costs.

In this report, total **allowable costs** were estimated by diabetes type.

## Medicaid

We queried Wisconsin Medicaid managed care and fee-for-service (FFS) medical and pharmacy claims databases for diabetes-related encounters and pharmacy claims. We estimate that over 75,000 adults and children covered by Wisconsin Medicaid in 2019 had encounters or claims that suggest they have diabetes from relevant ICD-10 codes (Appendix, Table 15). Diabetes-related pharmacy costs, including both diabetes-related drugs and insulin, were estimated at $237.7 million. Estimated managed care medical costs (non-pharmacy) for diabetes total $54.7 million. We also estimated the per capita annual costs for diabetes medical encounters and pharmacy claims (Appendix, Table 16).




In Table 15 of the Appendix, we detail total costs by type of diabetes:

- **Type 1 diabetes** annual estimated costs to Medicaid are $51.57 million for annual pharmacy costs, and $14.16 million for medical cost via managed care, and an additional $5.01 via fee-for-service ($70.74 million total).
- **Prediabetes** annual estimated costs to Medicaid are $0.51 million for annual pharmacy costs, and medical costs are $0.25 million in managed care and $0.10 million in fee-for-service ($0.86 million in total costs).
- **Type 2 diabetes** annual estimated costs to Medicaid are $185.61 million for annual pharmacy costs, and medical costs of $40.28 million for managed care and $23.58 for fee-for-service ($249.47 million total).

## Wisconsin Department of Employee Trust Funds

The Department of Employee Trust Funds administers benefit programs for current and former public employees, retirees, and their beneficiaries. They manage the State of Wisconsin Group Health Insurance Program (GHIP): an employer-sponsored group health coverage to employees of state agencies, the University of Wisconsin System, UW Hospitals and Clinics Authority, and participating local government employers.[62]

Total GHIP enrollees as of January 2020:[63]

- State employee health benefit plans represent:
  - 166,604 active employees and their dependents.
  - 40,450 retirees and their dependents.
- Wisconsin public (local government) employers that have elected to participate:
  - 28,933 active employees and their dependents.
  - 2,830 retirees and their dependents.

We partnered with Department of Employee Trust Funds to estimate the cost of diabetes-related episodes for GHIP members with diagnosed prediabetes, type 1 or type 2 diabetes (Appendix, Table 17). These data represent state employee-covered lives and are not representative of Wisconsin. Additionally, these data differ from what is available in the Medicaid claims databases. Specifically, the Department of Employee Trust Funds negotiates their contracts with private insurers. They report allowable costs, which are higher than Medicaid allowable costs. They were also able to provide costs in greater detail (out-of-pocket, inpatient, and outpatient claims) than Medicaid.

In Table 17 of the Appendix, we detail Department of Employee Trust Fund's total costs by type of diabetes:

- **Type 1** annual estimated costs are $17.62 million.
- **Prediabetes** annual estimated costs are $1.88 million.
- **Type 2** annual estimated costs are $66.97 million.

## Wisconsin Health Information Organization

The Wisconsin Health Information Organization (WHIO) database includes about 4.9 million insured individuals, or 73% of Wisconsin's population. WHIO's database is comprised of commercial (including self-funded) insurance, Medicaid, and Medicare Advantage. Between January 2019 and June 2020, WHIO received enrollment data on 3.4 million insured lives (60% of Wisconsin's population). While most insurance members remain covered on the same plan over the course of a calendar year, members can be added and removed from coverage at any given time, and they will still be represented in this data set. The demographic data for a covered life is limited to age, sex, zip code, and county. It does not include race, ethnicity, or income. For this analysis, we limited our analysis to commercially-insured covered lives.

Table 18 (Appendix) presents annual costs for WHIO. Unlike Medicaid and the Department of Employee Trust Funds, WHIO provides its costs as billed costs; these are unadjusted for hospital cost-to-charge-ratio. To convert them to allowable costs, we use the cost-to-charge-ratios from the hospital association's fiscal survey and calculate the minimum, 21%, and mean, 35%, cost-to-charge-ratios. These ratios represent the lower and upper bounds, respectively, of potential allowable costs.

In Table 18 of the Appendix, we show detail billed charges and bounded allowable costs:

- **Type 1** annual total billed medical costs are $34.44 million, and pharmacy costs are $2.60 million. This results in total annual allowable costs are bounded between $7.77 and $12.96 million. Third party medical and pharmacy allowable amounts are bounded between $6.07 million and $10.13 million.
- **Prediabetes** annual total billed costs are $9.51 in medical costs, and $4.51 million in pharmacy costs for a total of $14.02 million. This results in total annual allowable costs bounded between $2.94 and $4.91 million. Similarly, third-party medical and pharmacy allowable amounts are bounded between $0.15 million and $0.25 million.

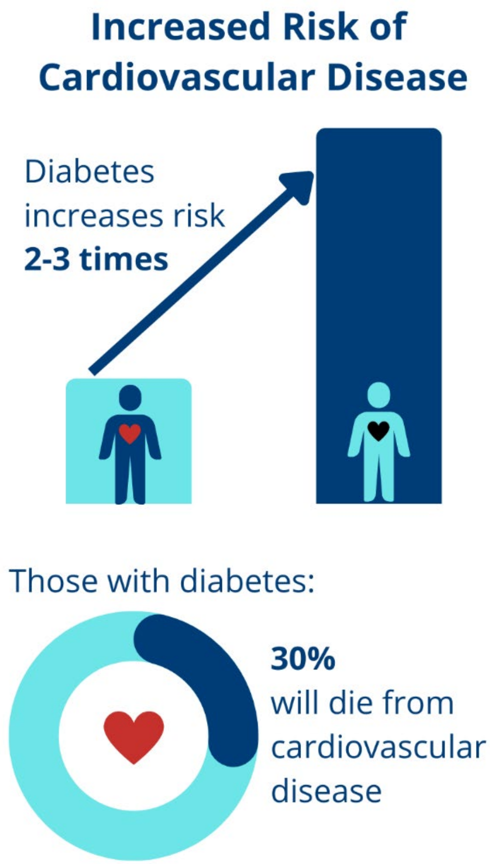
- **Type 2** annual total billed medical costs are $123.56 million and pharmacy costs are $180.15 million. This results in total annual allowable costs bounded between $63.77 and $106.30 million. The third party medical and pharmacy allowable amounts are bounded between $5.99 million and $9.99.

For more detail on diabetes cost estimates and our methodology, a separate, technical brief is available for reference: Economic Costs, Incremental Cost Effectiveness Ration, and Economic Rate of Return, P-03154A.

## IX. Mortality

Over time, diabetes can contribute to other chronic conditions, and lead to complications like chronic kidney disease, loss of vision, or nerve damage—all of which culminate in lower life expectancy. We know that diabetes:[64]

- Reduces life expectancy, even for middle-aged adults. For adults 40 to 60 years of age, diabetes reduces life expectancy by 4 to 10 years.
- Independently increases the risk of death from cardiovascular disease, renal disease, and cancer by 1.3 to 3 times.
- Is the leading cause of non-traumatic lower limb amputation and blindness, especially in working-age adults.
- Increases the risk of cardiovascular disease by 2 to 3 times. About 30% of individuals with diabetes die from cardiovascular disease.




Routinely reported statistics for diabetes mortality are based on death certificates, and often underestimate diabetes-related deaths. This is because people with diabetes most often die as a result of the chronic complications of diabetes, such as cardiovascular and renal disease, and not of acute complications of diabetes (e.g., hypoglycemia or ketoacidosis). **Each death certificate contains a single underlying cause of death, and up to twenty additional multiple causes**. The single underlying cause of death listed is often referred to as the **cause of death**, or the disease or injury initiating the sequence of events leading to death. Below we describe diabetes deaths in terms of the underlying cause of death, and as one of the multiple causes of death.

Wisconsin data highlights:
Diabetes is the seventh leading cause of death in Wisconsin when measured by underlying cause of death.[65] Diabetes is the fourth leading cause of death for Hispanic, Native American/American Indian, and Black people. It is the fifth leading cause of death for Asian people.[66]

- In Wisconsin, 1,508 adults in 2018 had diabetes listed as the underlying cause of death on their death record, and 388 (26%) were under the age of 65.[67]
- Diabetes deaths have increased 19% from 2008-2018.[68]
- The average age of death for those with diabetes is 2 years younger than all other causes combined (73.3 years compared to 75.2 years of age).[69]
- Black and American Indian Wisconsinites who die from diabetes pass away 6 to 9 years earlier than Whites. This difference has persisted for the last 20 years (Appendix, Table 19).

In 2018:

- 5,748 deaths listed diabetes as one of the multiple causes of death.[70]
- 1,966 deaths listed circulatory diseases as the underlying cause of death and diabetes as one of the multiple causes of death.[71]
- 896 individuals died of renal (kidney) failure. Diabetes and high blood pressure are the most common causes of renal failure.[72]

Social Determinants of Health and Diabetes Disparities

Social determinants of health are the conditions in which we are born, grown, live, work, and age. They are factors in the physical and social environments that interact with one another, and they affect our health in complex ways. Social determinants of health are increasingly being recognized for their relationship to increasing type 2 diabetes incidence, as well as opportunities to reduce it.[73]

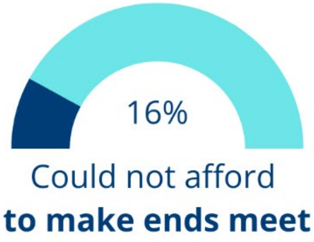
Research demonstrates that:

- Income level, educational attainment, and employment status are associated with the disproportionate development of chronic conditions and difficulties encountered during chronic disease management.
- Clinical factors and behavioral choices do not fully explain the disparities observed in diabetes-related health outcomes, particularly among those with lower socioeconomic status.[74]
- Type 2 diabetes incidence and prevalence rates follow a social gradient: individuals with lower income and less education are significantly more likely to develop diabetes than more advantaged individuals.

Wisconsin data highlights:

- Nearly one in four adults with diagnosed diabetes say they could not afford to eat balanced meals often or sometimes in the last 12 months.[75]
- Thirteen percent of adults with diagnosed diabetes reported that there was a time in the past 12 months that they could not take their medications as prescribed due to cost. This rate twice as high as for the overall adult population without diagnosed diabetes (5.5%).[76]
- Sixteen percent of adults who say they do not have enough money to make ends meet at the end of the month report having diagnosed diabetes. This rate is over two times higher than adults who report ending up with some money left (6.8%) (Appendix, Table 20).






**Currently, many diabetes interventions focus on biologic and behavioral factors, like diet and physical activity. However, to make meaningful, sustainable progress on combatting rising type 2 diabetes incidence, we must also address the influence of social and physical environments on health outcomes.[77]**

Social determinants are often the root causes of illnesses and are key to understanding health disparities. We often describe health disparities for risk behaviors and outcomes by demographic or socioeconomic groupings (e.g., income and education level, race and ethnicity, gender, and sexual orientation).

Here are some notable diabetes disparities observed in Wisconsin:

- American Indians/Alaskan Native, Hispanic, and Black adults are 2 to 3 times more likely to have been told they have diabetes compared to Whites (Appendix, Table 12).
- Some communities have diabetes rates significantly higher than others.
    - In some communities across Wisconsin, an estimated nearly one in five adults has diabetes. In others, 1 in 10 do.[78]
    - In Milwaukee County, 29% of Black residents responding to a research survey reported they have diabetes. Of these, 82% indicated they also had comorbid hypertension (Appendix, Table 21).[79]
- Type 2 diabetes prevalence in the adult Hmong population (19.1%) may be three times higher than that of the non-Hispanic White population (7.8%). The Hmong are one of Wisconsin's newest immigrant populations who came from an area of the world with low rates of diabetes.[80]
- People living with a disability are about 6 times as likely to have been told they have diabetes compared to those without.[81]
- White Wisconsinites, and those with commercial insurance (72%) or Medicare (78%) are more likely than those with Medicaid (61%) to have their blood sugar in control.[82]

What surrounds and influences observed health disparities between demographic and socioeconomic groups are the social, political, and institutional contexts in which they develop. Emerging public health practice is moving further upstream in an attempt to address the contexts and environments that shape health inequities and disparities.

# DHS' Federal Funding

The amount of federal funding spent on preventing disease and improving health comes primarily from the Centers for Disease Control and Prevention (CDC). CDC's chronic disease prevention funding is awarded to states in a combination of population-based formula grant programs (often based on disease rates or other incidence formulas), and a series of competitive grants. DHS' Division of Public Health (DPH) relies heavily on both competitive and non-competitive CDC grants to support diabetes prevention and management activities across Wisconsin.

## DPH's Diabetes Prevention and Control Program

Between 1994 and 2013, Wisconsin DPH maintained a standalone Diabetes Prevention and Control (DPCP) program that implemented pre-determined core interventions and grant strategies outlined by the CDC's Division of Diabetes Translation. During this time, DPCP supported multiple initiatives and projects, including:

- Wisconsin Diabetes Advisory Group meetings.
- Diabetes self-management programming.
- Wisconsin's essential diabetes guidelines for health care providers.
- Clinical improvements in patient-centered team-based care.
- Diabetes surveillance and strategic planning.

Between 2013-2018, CDC provided grant funds that combined four previously standalone programs including diabetes, heart disease, nutrition and physical activity, and school health. The total funding for this grant was $2,394,840 annually. The diabetes portion was $816,985 annually.

## DPH's Nutrition and Physical Activity Program

From 2013-2018, DPH spearheaded a cross-cutting Nutrition and Physical Activity Program with competitive federal funding from the Centers for Disease Control and Prevention. This program addressed chronic disease prevention through:

- Promoting the adoption of food service guidelines and nutrition standards, as well as physical activity guidelines in early child care centers, schools, and work sites.
- Increasing access to healthy foods and beverages, physical activity opportunities and outreach, and breastfeeding-friendly environments.

This program operated on an annual budget of approximately $300,000. In the most recent five-year award cycle (2018), no federal funds from the CDC's Division of Nutrition, Physical Activity and Obesity were awarded to DPH. This program and its momentum have ceased and may be completely lost without a state-level funding commitment. Limited and unstable funding can cause public health programs to fail, impact staff retention, limit ability to track progress, and inhibit program momentum.

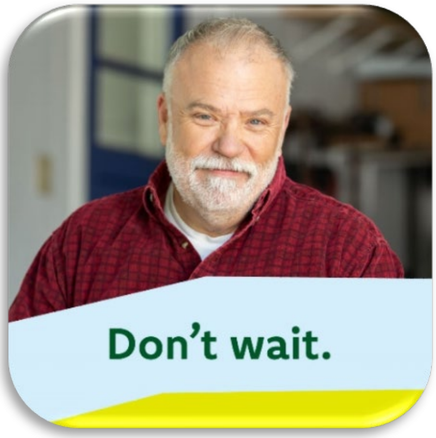
## DPH's Chronic Disease Prevention Program

The Chronic Disease Prevention Program at DPH currently has both competitive and non-competitive federal grants dedicated to diabetes prevention and management activities. The current federal grant cycle for these funds runs from 2018-2023. Combined, the annual diabetes prevention and management funds from these sources total $1.9 million (Appendix, Table 22). These funds support programming, surveillance, evaluation, and staffing to meet CDC's grant objectives.

Diabetes prevention and control funding under these grants support the following program strategies:

- Assist health care systems in implementing systems to identify people with prediabetes and refer them to the National Diabetes Prevention Program (DPP).
- Implement bi-directional e-referral systems between health care systems and National DPP organizations.
- Collaborate with payers, and public and private sector organizations to expand the availability of the National DPP as a covered benefit.
- Increase enrollment in the National DPP.
- Support organizations to establish new, and sustain existing, National DPP programs.
- Use tailored communication/messaging to reach underserved populations at greatest risk for type 2 diabetes to increase awareness of prediabetes and the National DPP.
- Support advanced training for National DPP lifestyle coaches to strengthen skills needed to engage and retain participants.
- Explore and test innovative ways to eliminated barriers to participation and retention in National DPP and DSMES.
- Work with health care systems to establish or expand the use of telehealth technology to increase access to National DPP in underserved areas.
- Improve access to and participation in ADA/ADCES DSMES.
- Develop a statewide infrastructure to promote long-term sustainability and reimbursement for community health workers to establish and/or expand their involvement in National DPP and DSMES programing and service delivery.
- Increase engagement of pharmacists in medication management and DSMES for people with diabetes.





## DHS GPR Allocations

There are two GPR DHS allocations that fund diabetes programming directly. They total $71,550 annually (Appendix, Table 22).

GPR American Indian Diabetes Prevention and Control funding is designated through Wis. Stat. § 20.435(1)(kf). This allocation totals $22,500 and is distributed as mini-grants to the 11 federally-recognized American Indian Nations of Wisconsin. The funding is intended to create community infrastructure to address diabetes prevention and management.

Since 2013, $29,500 of GPR General Aids and Local Assistance allocation have been provided to the Wisconsin Lions Foundation. This funding supports Wisconsin's National DPP programming, primarily by training Lifestyle Coaches in Wisconsin. Based on our knowledge, this is the only financial support any state agency provides specific to National DPP program delivery in Wisconsin.

"A community health worker is a frontline public health worker who is a trusted member of and/or has an unusually close understanding of the community served. This trusting relationship enables the worker to serve as a liaison/link/ intermediary between health/social services and the community to facilitate access to services and improve the quality and cultural competence of service delivery."[57]

American Public Health Association, 2021.

Since July 2018, $20,000 of GPR General Aids and Local Assistance allocation has supported community health worker involvement in diabetes prevention and management through value-based financing (outcome-based payments) for care coordination. This funding was kept level between July 2019 and July 2020. However, due to client level decreases as a result of COVID-19 pandemic impacts, not all of the GPR dollars were spent. Between July 2020 and July 2021, $20,000 was allocated to Great Rivers HUB at United Way in La Crosse for value-based financing for diabetes care coordination using Pathways HUB invoicing structure. For more information on the Great Rivers programming, please read their 2020 Impact Report. Page 11 of that report includes detail on the health impacts of care coordination for last year's clients with diabetes.

Next Steps

The Diabetes Care and Prevention Action Program Act, Wis. Stat. § 255.085 passed by the state legislature in March 2020 coincided with the beginnings of the COVID-19 pandemic in Wisconsin. Additionally, the bill's passing in March 2020 afforded DHS and supporting agencies less than a year window to plan and execute this report to the legislature by January 2021.

In the next biennial legislative report, we will more intentionally include the Department of Public Instruction and the Department of Corrections as specified in Wis. Stat. § 255.085. We will prioritize standardizing indicators and setting expectations across state agencies for this report to the legislature. We will also prioritize aligning the Diabetes Action Plan release and biennial legislative report submission with the development of the legislative state budget.

Finally, we recognize that our assessment of diabetes-related funding and program implementation across Wisconsin is not comprehensive. There are federal, state, and local efforts not captured in this document (e.g., Special Diabetes Program for Indians (SPDI) within Indian Health System clinics, National Diabetes Prevention Program efforts within the facilities operated by the Wisconsin Department of Corrections). Future assessments and reports should prioritize more comprehensive documentation of these sources and efforts, so that state agency staff and legislators can strategically align funding.

Resources

Prediabetes awareness: ADA/WI DHS Prediabetes Risk Test

DHS information:

- Chronic Disease Prevention Program > Prediabetes
- Chronic Disease Prevention Program > Diabetes

National Diabetes Prevention Program, provider locations:

- Wisconsin National DPP provider locations: DHS, Prediabetes: Take Control of Your Health
- National DPP provider locations: CDC, Recognized Lifestyle Change Programs
- MDPP provider locations: CMS: MDPP Expanded Model

Diabetes Self-Management Education and Support, provider locations:

- Wisconsin accredited and recognized DSMES program locations
- Find a Wisconsin Institute for Healthy Aging's Healthy Living With Diabetes workshop

Helpful websites:

- Health Insurance Coverage Laws for Diabetes Self-Management Education and Training by State
- CDC's DSMES Toolkit

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Appendix

## Table 1. Estimated diabetes status by awareness and type by age.

| Age | Diagnosed[1] | Undiagnosed[2] | WI Population[3] | Diagnosed | Undiagnosed | Total Diagnosed and Undiagnosed |
|---|---|---|---|---|---|---|
| 18-44 | 2.0% (1.1 – 2.9) | 1.10% (0.70 – 1.80) | 1,978,625 | 39,675 | 21,765 | 61,440 |
| 45-64 | 11.7% (9.8 – 13.6) | 3.60% (1.80 – 4.80) | 1,549,840 | 181,928 | 55,794 | 237,722 |
| 65+ | 17.7% (15.4 – 20.0) | 5.40% (4.10 – 7.10) | 980,488 | 173,699 | 52,946 | 226,646 |
| | | Total | 4,508,953 | 395,303 | 130,505 | 525,808 |

[1]BRFS, 2019. Standard Estimates, (95% confidence interval).
[2]CDC Diabetes Surveillance Report, 2020, Table 1a. NHANES 2013-2016, crude estimates (95% confidence interval).
[3]DHS WISH, Population Module, 2018.

## Table 2. Estimated diabetes type by age. Diagnosed and undiagnosed estimates derived from table 1.

| | Type 2 Diabetes Estimate | | Type 1 Diabetes Estimate | |
|---|---|---|---|---|
| Age | 90% Diagnosed and Undiagnosed | 95% Diagnosed and Undiagnosed | 5% Diagnosed and Undiagnosed | 10% Diagnosed and Undiagnosed |
| 18-44 | 55,296 | 58,368 | 3,072 | 6,144 |
| 45-64 | 213,950 | 225,836 | 11,886 | 23,772 |
| 65+ | 203,981 | 215,313 | 11,332 | 22,665 |
| Total | 473,227 | 499,518 | 26,290 | 52,581 |

## Table 3. Estimated diagnosed diabetes in youth less than 18 years of age.

| Age | WI Population[1] | Percent[2] | SE Percent | 95 CI Low | 95 CI High |
|---|---|---|---|---|---|
| <18 | 1,319,138 | 0.453% | 0.144% | 0.171% | 0.736% |
| | Diagnosed Diabetes Estimate | 5,980 | RSE = 31% | 2,253 | 9,708 |

[1]DHS WISH, Population Module, 2018.
[2]Family Health Survey (2017-2019) estimates provided by the Office of Health Informatics.

## Table 4. Wisconsin Medicaid enrollees by age and type 1, type 2, or prediabetes, 2017-2019.

| | 2017 | | | 2018 | | | 2019 | | |
|---|---|---|---|---|---|---|---|---|---|
| Age | Type 1 | Type 2 | Prediabetes | Type 1 | Type 2 | Prediabetes | Type 1 | Type 2 | Prediabetes |
| 0 to 17 | 1,214 | 422 | 263 | 1,180 | 401 | 353 | 1,177 | 366 | 437 |
| 18 to 24 | 817 | 793 | 227 | 789 | 761 | 275 | 837 | 803 | 331 |
| 25 to 34 | 1,335 | 3,710 | 672 | 1,339 | 3,723 | 863 | 1,309 | 3,676 | 1,012 |
| 35 to 44 | 1,469 | 8,921 | 1,203 | 1,461 | 8,787 | 1,362 | 1,407 | 8,895 | 1,661 |
| 45 to 54 | 1,818 | 16,148 | 1,541 | 1,641 | 15,804 | 1,822 | 1,534 | 15,456 | 2,107 |
| 55 to 64 | 1,713 | 22,537 | 1,831 | 1,656 | 23,113 | 2,225 | 1,531 | 23,630 | 2,760 |
| 65 to 74 | 858 | 13,293 | 656 | 758 | 13,735 | 800 | 705 | 14,506 | 1,054 |
| 75 to 84 | 393 | 7,614 | 263 | 345 | 7,781 | 293 | 281 | 7,911 | 353 |
| 85+ | 142 | 5,260 | 111 | 127 | 5,018 | 124 | 108 | 4,860 | 153 |
| Total Members | 9,759 | 78,698 | 6,767 | 9,296 | 79,123 | 8,117 | 8,889 | 80,103 | 9,868 |

## Table 5. Number of patients by age and condition in Wisconsin represented in Wisconsin's all payer claims database, January 2019 to March 2020.

| Age | Total Population | Type 1 Diabetes | Type 2 Diabetes | Type 2 Diabetes and Hypertension |
|---|---|---|---|---|
| 0 to 17 | 910,037 | 1,499 | 418 | 28 |
| 18 to 24 | 322,858 | 1,446 | 1,031 | 93 |
| 25 to 34 | 483,073 | 1,979 | 4,456 | 765 |
| 35 to 44 | 408,898 | 2,026 | 12,688 | 3,095 |
| 45 to 54 | 368,606 | 1,752 | 26,040 | 7,974 |
| 55 to 64 | 414,772 | 1,856 | 46,781 | 16,242 |
| 65 to 74 | 293,896 | 1,115 | 43,988 | 17,567 |
| 75 to 84 | 144,732 | 377 | 28,100 | 12,280 |
| 85+ | 75,804 | 117 | 13,409 | 6,091 |
| Total members | 3,422,676 | 12,167 | 176,911 | 64,135 |

**Table 6.** Patient counts and prescription drug requested amounts for Medicaid members with type 1 diabetes-related encounters, January 2019 to March 2020.

| Age | Total Patients | Prescription Drugs, Total Requested Amount ($) | Insulin Only ($) and (%) of Total Costs | |
|---|---|---|---|---|
| 0 to 17 | 1,476 | 7,120,403 | 7,006,038 | (98%) |
| 18 to 24 | 1,416 | 7,311,273 | 7,212,586 | (99%) |
| 25 to 34 | 1,944 | 8,278,349 | 8,062,614 | (97%) |
| 35 to 44 | 1,986 | 9,018,196 | 8,587,167 | (95%) |
| 45 to 54 | 1,730 | 7,603,051 | 7,128,396 | (94%) |
| 55 to 64 | 1,826 | 7,441,636 | 6,733,760 | (90%) |
| 65 to 74 | 1,103 | 3,080,961 | 2,712,701 | (88%) |
| 75 to 84 | 372 | 737,743 | 671,917 | (91%) |
| 85+ | 116 | 201,891 | 183,309 | (91%) |
| Unknown | 276 | 861,448 | 827,232 | (96%) |
| Total | 12,245 | $51,654,951 | $49,125,720 | (95%) |

**Table 7.** Wisconsin estimated Medicaid pharmacy, emergency department and hospitalization visits and costs by diabetes type, 2019.

| | 2019 | | |
|---|---|---|---|
| Visits and Costs Category | Type 1 | Type 2 | Prediabetes |
| Pharmacy | | | |
| Estimated Cost | $57,518,266 | $249,965,900 | $20,487,845 |
| Estimated Insulin Cost | $28,809,341 | $50,824,464 | $37,231 |
| Emergency Department | | | |
| Total Visits | 25,687 | 141,119 | 5,529 |
| Estimated Cost | $17,706,540 | $51,428,009 | $2,169,440 |
| Hospitalizations | | | |
| Total Count | 2,895 | 16,130 | 778 |
| Estimated Inpatient Cost | $32,209,499 | $136,273,348 | $5,227,231 |
| Estimated Outpatient Cost | $8,331,411 | $40,114,746 | $1,993,605 |
| Total Estimated Cost | $115,765,716 | $477,782,002 | $29,878,121 |

**Table 8.** Wisconsin Medicaid enrollees by race and Hispanic ethnicity, and diabetes type, 2017-2019.

| | 2017 | | | 2018 | | | 2019 | | |
|---|---|---|---|---|---|---|---|---|---|
| Race and Hispanic Ethnicity | Type 1 | Type 2 | Prediabetes | Type 1 | Type 2 | Prediabetes | Type 1 | Type 2 | Prediabetes |
| AI/AN | 206 | 1,879 | 96 | 182 | 1,918 | 190 | 186 | 1,962 | 207 |
| Asian | 126 | 2,645 | 191 | 137 | 2,711 | 296 | 130 | 2,750 | 401 |
| Black | 1,508 | 14,904 | 1,480 | 1,390 | 14,721 | 1,883 | 1,345 | 15,024 | 2,384 |
| White | 5,865 | 42,172 | 3,303 | 5,599 | 42,339 | 3,739 | 5,303 | 42,654 | 4,403 |
| Hispanic | 759 | 6,972 | 765 | 757 | 7,085 | 926 | 730 | 7,198 | 1,105 |
| Unavailable | 1,295 | 10,126 | 932 | 1,231 | 10,349 | 1,083 | 1,195 | 10,515 | 1,368 |
| Total Members | 9,759 | 78,698 | 6,767 | 9,296 | 79,123 | 8,117 | 8,889 | 80,103 | 9,868 |

**Table 9.** Births by mother's gestational diabetes status. Wisconsin Vital Records, 2011-2019.

| | Mother's Gestational Diabetes Status | | |
|---|---|---|---|
| Year | Gestational Diabetes (%[1]) | No Gestational Diabetes | Rate per 1,000 births[1] |
| 2011 | 3,816 (5.8%) | 61,897 | 58.1 |
| 2012 | 4,064 (6.2%) | 61,370 | 62.1 |
| 2013 | 4,171 (6.4%) | 60,631 | 64.4 |
| 2014 | 4,212 (6.4%) | 61,055 | 64.5 |
| 2015 | 4,220 (6.5%) | 60,958 | 64.7 |
| 2016 | 4,033 (6.2%) | 60,580 | 62.4 |
| 2017 | 4,175 (6.6%) | 58,932 | 66.2 |
| 2018 | 4,380 (7.0%) | 57,877 | 70.4 |
| 2019 | 4,424 (7.2%) | 56,893 | 72.1 |

[1]Excludes births with unknown gestational diabetes status.

**Table 10.** Births by mother's gestational diabetes (GDM) and hypertension during pregnancy status, 2011-2019. Wisconsin Vital Records.

| | | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Percent Hypertension of Total 2011-2019[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GDM | Hypertension | 350 | 373 | 379 | 364 | 409 | 410 | 475 | 502 | 544 | 11.3% |
| | No Hypertension | 3,466 | 3,691 | 3,792 | 3,848 | 3,811 | 3,623 | 3,700 | 3,878 | 3,880 | |
| No GDM | Hypertension | 3,050 | 2,996 | 3,256 | 3,363 | 3,497 | 3,529 | 3,698 | 4,289 | 4,562 | 6.3% |
| | No Hypertension | 58,847 | 58,374 | 57,375 | 57,692 | 57,461 | 57,051 | 55,234 | 53,588 | 52,331 | |

[1]Excludes births with unknown gestational diabetes status.

**Table 11.** Births by delivery type and mother's gestational diabetes status. Wisconsin Vital Records, 2019. Excludes births with unknown gestational diabetes status.

| Delivery Type | No Gestational Diabetes | Gestational Diabetes |
|---|---|---|
| Vaginal Spontaneous | 38,436 | 2,563 |
| Primary C-Section | 8,341 | 812 |
| Repeat C-Section | 6,362 | 754 |
| Vaginal Birth After C-Section | 1,671 | 151 |
| Vaginal Vacuum | 1,656 | 115 |
| Vaginal Forceps | 389 | 28 |
| Unknown | 38 | 1 |
| C-Section (primary or repeat unknown) | 0 | 0 |
| Total | 56,893 | 4,424 |
| Vaginal Combined (% of Total) | 42,152 (74%) | 2,857 (65%) |
| C-section Combined (% of Total) | 14,703 (26%) | 1,566 (35%) |

**Table 12.** Adult diabetes awareness (self-reported as diagnosed by a health provider) rates by race and Hispanic ethnicity. All race categories are non-Hispanic. Wisconsin Behavioral Risk Factor Survey, 2017-2019.

| Race/Ethnicity | Unadjusted Rate | Age-adjusted rate |
|---|---|---|
| American Indian/Alaskan Native | 16% | 16.0% |
| Hispanic | 10% | 14.8% |
| Black | 12% | 12.8% |
| Asian[1] | 5% | 12.0% |
| Other | 9% | 9.6% |
| White | 9% | 6.7% |

[1]Asian race category estimate is unstable. Interpret with caution.

**Table 13.** Diabetes-related hospitalizations, any diagnosis. Wisconsin Inpatient Hospitalization records, 2016-2019.

| Age | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|
| Less than 18 | 674 | 679 | 689 | 656 |
| 18-44 | 9,890 | 9,997 | 9721 | 9,328 |
| 45-64 | 34,049 | 34,898 | 33494 | 31,891 |
| 65-74 | 25,855 | 28,325 | 27022 | 26,069 |
| 75+ | 30,224 | 33,142 | 32831 | 30,447 |
| Total Diabetes-related | 100,018 | 106,362 | 103,068 | 97,735 |
| Total All-Cause | 626,065 | 626,417 | 617,338 | 608,968 |

**Table 14.** Diabetes hospitalization, principal diagnosis only. Wisconsin Inpatient Hospitalization records, 2016-2019.

| Age | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|
| Less than 18 | 452 | 485 | 484 | 433 |
| 18-44 | 2,677 | 2,714 | 2,715 | 2,593 |
| 45-64 | 3,030 | 3,292 | 3,312 | 3,376 |
| 65-74 | 1,175 | 1,422 | 1,506 | 1,692 |
| 75+ | 1,069 | 1,242 | 1,318 | 1,387 |
| Total Primary Diabetes Hospitalizations | 7,951 | 8,670 | 8,851 | 9,048 |
| Average Length of Stay | 4.4 | 4.6 | 4.7 | 4.9 |

**Table 15**. Patient Count, Medical Encounters, and Total Allowable Costs[1] for Diabetes Medical Encounters[2] and Pharmacy Claims. Wisconsin Medicaid, 2019.

| | Claim/Encounter Type[1,2] | | |
|---|---|---|---|
| Category | Type 1 | Type 2 | Prediabetes |
| Managed care population, medical encounters and costs | | | |
| Patient count | 7,025 (9.3%) | 64,535 (85.7%) | 3,767 (5%) |
| Medical encounters | 61,248 | 330,128 | 5,540 |
| Total medical costs | $14.16 | $40.28 | $0.25 |
| Fee-for-service (FFS) population, medical encounters and costs | | | |
| Patient count | 4,056 (8.7%) | 41,100 (88.4%) | 1,313 (2.8%) |
| FFS encounters | 32,736 | 212,579 | 1,923 |
| Medical OOP[3] | $0.002 | $0.024 | $- |
| Medical third party | $0.16 | $0.16 | $0.002 |
| Total medical cost | $5.01 | $23.58 | $0.10 |
| FFS population, pharmacy encounters and costs[4] | | | |
| Patient count | 4,799 | 29,418 | 907 |
| Encounters | 108,605 | 561,927 | 4,176 |
| Total pharmacy costs | $51.57 | $185.61 | $0.51 |

Source: Wisconsin Division of Medicaid, DDS Warehouse: FFS and Managed Care claims tables. Wisconsin State Medicaid Analyst Calculations.
[1]Allowable amount determined by Medicaid pricing systems as the amount allowed for payment before adjusting for third party (TPL) and OOP (pharmacy claims).
[2]Medical encounters include only those with primary diabetes diagnosis and diabetes-related admission codes using ICD-10 codes R73.01-73.03, E10, and E11.
[3]Out-of-pocket and third-party costs are available only for FFS encounters in the Medicaid system.
[4]Pharmacy costs use drug codes for diabetes-related drugs.

**Table 16**. Per capita Annual Costs* and Utilization for Diabetes Medical Encounters and Pharmacy Claims. Estimated from Medical and Pharmacy Encounter Claims. Wisconsin Medicaid, 2019.

| | | Claim/Encounter Type[1,2] | | |
|---|---|---|---|---|
| | | **Type 1** | **Type 2** | **Prediabetes** |
| | **Member Count** | **8,889** | **80,103** | **9,868** |
| **Visits** | Office Visits | 14.4 | 7.8 | 3.5 |
| | Hospitalizations | 0.3 | 0.2 | 0.1 |
| | Emergency Visits | 2.9 | 1.8 | 0.6 |
| **Insulin** | Vial Units | 111.1 | 21.1 | 0.13 |
| | Cost* | $3,241 | $634 | $4 |
| **Medical Costs*** | Pharmacy Total[3] | $6,471 | $3,121 | $2,076 |
| | Emergency | $1,992 | $642 | $220 |
| | Inpatient | $3,624 | $1,701 | $530 |
| | Outpatient | $937 | $501 | $202 |

Source: Wisconsin Division of Medicaid, DDS Warehouse: FFS and Managed Care claims tables.
[1]ICD-10 diagnosis codes: R73.01-73.03 (prediabetes), E10 (type 1), and E11 (type 2).
[2]Costs include any claim with diabetes-related ICD-10.
[3]Pharmacy costs use drug codes for diabetes-related drugs (NQF #0541, PDC-DR) and insulin, and represent both FFS and Managed Care claimants.

**Table 17.** Primary Diagnosis Diabetes-Related Episodes Total Costs in Millions, Wisconsin Department of Employee Trust Funds, 2019.

| | Encounter Type[1] | | |
|---|---|---|---|
| | **Type 1** | **Type 2** | **Prediabetes** |
| **Member Count** | 1,207 | 10,603 | 1,696 |
| **Medical Costs[2]** | $7.86 | $19.76 | $1.20 |
| **Pharmacy Costs[3]** | $9.76 | $47.22 | $0.67 |
| **Total Allowable Out-of-Pocket** | $0.99 | $3.79 | $0.20 |
| **Total Allowable Third Party** | $1.83 | $19.46 | $0.45 |
| **Total Allowable** | $17.62 | $66.97 | $1.88 |

Source: Department of Employee Trust Funds.

[1]Patient counts and total costs are based on ICD10 codes (R73.01-73.03, E10, or E11) and IBM Watson Medical Episode Grouper (MEG) methodology. IBM Watson MEG was employed to ensure that the total costs of care (inpatient, outpatient and prescription drugs) for each diabetes condition were included. The numbers for each group were generated by constraining the IBM Watson episode of diabetes care in general with the relevant ICD10 codes. [2]Medical costs include inpatient and outpatient claims. [3]Pharmacy costs include prescription drug classes listed under NQF #0541, PDC-DR, and insulin.

**Table 18.** Costs in Millions for Primary Diagnosis Diabetes Medical and Pharmacy Encounters, Wisconsin commercially-insured lives only, Wisconsin Health Information Organization, 2019.

| | Encounter Type[1] | | |
|---|---|---|---|
| Costs[1,2] | **Type 1** | **Type 2** | **Prediabetes** |
| **Medical** | $34.44 ($7.23, $12.05) | $123.56 ($25.95, $43.25) | $9.51 ($2.00, $3.30) |
| **Third Party Medical** | $0.76 ($0.16, $0.27) | $14.23 ($2.99, $4.98) | $0.41 ($0.10, $0.10) |
| **Pharmacy** | $2.60 ($0.55, $0.91) | $180.15 ($37.8, $63.05) | $4.51 ($0.90, $1.60) |
| **Third Party Pharmacy** | $28.19 ($5.92, $9.87) | $14.31 ($3.01, $5.01) | $0.31 ($0.07, $0.09) |
| **Total** | $34.44 ($7.23, $12.05) | $123.56 ($25.95, $43.25) | $9.51 ($2.00, $3.30) |

Source: Wisconsin Health Information Organization (WHIO).

[1]WHIO provides billed costs; these are unadjusted for hospital cost-to-charge-ratio. To convert them to allowable costs, we utilized the cost-to-charge-ratios from the hospital association's fiscal survey and calculate the minimum, 21%, and mean, 35%, cost-to-charge-ratios. These ratios represent the lower and upper bounds of potential allowable costs, and are listed parenthetically.

[1]Encounter and costs only included if ICD-10 codes (R73.01-73.03, E10, or E11) were present in the primary diagnosis and principal admissions code.

[2]Since we were not able to acquire allowable amounts or adjust for cost-to-charge, we estimated the allowable amounts—listed as a range parenthetically—using billable amounts. Using the annual fiscal survey data from the Wisconsin Hospital Association, we computed the lower bound to be 21% of billed amount, and upper bound to be 35% of billed amount. This brings our estimates closer to the allowable amounts reported above for Medicaid and Department of Employee Trust Funds. See Appendix for more Detail.

**Table 19.** Three-year average age of death by race, diabetes cause-of-death. Wisconsin Interactive Statistics on Health, Mortality Module.

| | Average Age of Death | | | |
|---|---|---|---|---|
| Years | White | Black | American Indian | Asian |
| 2000-2002 | 75.6 | 66.3 | 66.4 | 76.0 |
| 2003-2005 | 75.1 | 65.1 | 63.6 | 73.9 |
| 2006-2008 | 75.0 | 67.3 | 69.0 | 71.3 |
| 2009-2011 | 75.0 | 65.4 | 63.5 | 70.8 |
| 2012-2014 | 75.1 | 66.8 | 65.4 | 75.6 |
| 2015-2017 | 74.3 | 65.3 | 67.9 | 68.7 |

**Table 20**. Adult diagnosed diabetes rates (95% confidence intervals) for select Social Determinants of Health Module questions, Wisconsin Behavioral Risk Factor Survey, 2017.

| | |
|---|---|
| During the last 12 months, was there a time when you were not able to pay your mortgage, rent, or utility bills? | |
| Yes | 12.5 (8.2-16.7) |
| No | 8.6 (7.5-9.6) |
| The food that I bought just didn't last, and I didn't have money to get more. Often, sometimes, or never true for you in the last 12 months? | |
| Often or Sometimes | 11.0 (7.3-14.7) |
| Never | 8.5 (7.4 to 9.5) |
| I couldn't afford to eat balanced meals. Often, sometimes, or never true in the last 12 months. | |
| Often or Sometimes | 12.2 (8.7 to 15.8) |
| Never | 8.1 (7.1 to 9.2) |
| In general, how do your finances usually work out at the end of the month? Do you find that you usually: | |
| Do not have enough money to make ends meet | 15.6 (10.3-20.8) |
| Have just enough money to make ends meet | 10.9 (8.7-13.2) |
| End up with some money left over | 6.8 (5.7-7.9) |

**Table 21.** Self-Reported Chronic Diseases among African American residents aged 44-94 in Milwaukee County, Wisconsin who completed the baseline MIDUS survey of Milwaukee African Americans in 2005, and follow-up MIDUS III in 2016-2017.

| Chronic Disease | Number (Percent of Surveyed)* |
|---|---|
| **Diabetes** | 112 (28.8) |
| **Medication for diabetes** | 101 (90.0) |
| **Hypertension** | 239 (61.4) |
| **Co-morbid Diabetes and Hypertension** | 112 (82.1) |
| **Medication for co-morbid diabetes and hypertension** | 66 (58.9) |
| **Diabetes and severe obesity (BMI > 40)** | 112 (25.0) |

*389 adult African American residents aged 44-94 in Milwaukee County, Wisconsin completed the baseline MIDUS survey of Milwaukee African Americans in 2005 (ICPSR Study 22840), and the follow-up MIDUS III in 2016-2017. The sampling design was a stratified area probability sample of households in Milwaukee County, Wisconsin. The sampling frame included Census tracts in which at least 40% of the population was African American. The Census tracts were stratified by income, with roughly half coming from tracts in which the median household income was $40,000 or greater, and the rest coming from tracts in which the median household income was below $40,000.

**Table 22**. Current federal and state funding for diabetes prevention, control, and management programming in Wisconsin.

| Diabetes Funding Source | Total Annual | Years | Anticipated Increase |
|---|---|---|---|
| CDC Competitive Cooperative Grant: 1817 | $900,000 | 2017-2023 | No |
| CDC Non-competitive Cooperative Grant: 1815 | $1,026,453 | 2017-2023 | No |
| GPR General Aids and Local Assistance | $49,050 | Annual | No |
| GPR American Indian Diabetes Prevention and Control | $22,500 | Annual | No |
| **Total** | **$1,998,033** | | |

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# Economic Costs, Incremental Cost Effectiveness Ratio, and Economic Rate of Return of Diabetes in Wisconsin

WISCONSIN DEPARTMENT of HEALTH SERVICES
P-03154A (07/2022)

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# Executive Summary

In 2017, 24.7 million (9.7%) U.S. adults had diagnosed diabetes. An economic burden of diabetes study reported that costs to the U.S. in diabetes care and treatment were $327 billion.[1] This figure accounted for both direct medical costs of $237 billion and lost productivity costs of $90 billion. The same study reported that the total costs associated with diabetes are 2.3 times greater than other medical conditions because of the comorbidities associated with it. [1-2] Wisconsin reports a diabetes prevalence rate of 8.7%, but not much is known about state-specific costs.[3] Thus, we gathered data on costs associated with prediabetes, gestational diabetes, and diabetes. We used information from the Wisconsin Health Information Organization (WHIO), Wisconsin hospital discharge records, Wisconsin Medicaid claims, and the Wisconsin Department of Employee Trust Funds.

Diabetes is a lifelong medical condition associated with increasing costs as the disease progresses. While there are studies that discuss costs associated with diabetes, few studies provide cost estimates as comprehensively as we do here. We were fortunate to collaborate with various state and private entities who made data available to us for reporting. We report costs within estimated lower and upper bounds. The costs we present are bounded below by the estimated amount Medicaid is willing to pay for a typical patient with diabetes and bounded above by the estimated amount a private insurer will pay for a typical patient with diabetes. The costs also vary by stage and type of diabetes.

A typical patient in Wisconsin with a formal diagnosis of prediabetes annually costs[a] between $873 and $1,454 (Table 7). A typical person with type 1 diabetes annually costs between $4,324 and $7,207, and a typical person with type 2 diabetes annually costs between $3,394 and $5,656. Having type 2 diabetes with hypertension can cost between $4,530 and $7,551 annually. Having prediabetes with hypertension and obesity (BMI > 40) will cost between $5,137 and $8,562 per person per year.

For medical conditions like diabetes, it makes sense to exposit annual costs by stage of disease progression. The Department of Employee Trust Funds (ETF), the largest state insurance pool, has an average annual cost for stage 1 diabetes (which includes formally-diagnosed prediabetes and type 2 diabetes with local symptoms and no complications[b]), bounded between $5,471 and $15,706 for their population not covered by Medicare. The lower bound is the average diabetes-only cost and the upper bound is the 90th percentile of costs for members within this group (Table 11). A person with stage 2 (includes both a formal diabetes diagnosis and local complications associated with the condition), type 2 diabetes has costs bounded between $7,722 and $19,037, and those with stage 2, type 1 diabetes have average annual costs bounded between $16,758 and $31,058. Stage 3, or advanced diabetes, is associated with the highest average annual costs, bounded between $30,594 and $98,011. In the advanced stages of diabetes, we would expect higher costs because patients typically have severe symptoms like deep circulation problems, kidney failure, and other serious complications.

We use hospital discharge data to determine costs associated with birthing for expectant mothers who have diabetes and gestational diabetes. The costs for childbirth among those with gestational diabetes are between $4,319 and $8,358 (Table 13), and childbirth costs for

[a] Annual costs typically refer to estimated costs the insurance payers pay service providers. We also report costs to third parties and individual out-of-pocket costs when available.
[b] In IBM-Watson Methodology, local symptoms means no complications or symptoms of minimal severity. At stage 1, a patient has prediabetes (impaired fasting glucose, impaired blood glucose), diabetes mellitus type 1 or type 2 without complications.

mothers with type 1 or type 2 diabetes are between $5,693 and $9,260. Here, the high end of costs are due to Cesarean births.

Wisconsin offers two programs designed to improve population outcomes for diabetes: the National Diabetes Prevention Program (NDPP), and Healthy Living with Diabetes (HLWD).[c] We calculated the incremental cost-effectiveness ratio (ICER) and the economic rate of return (ERR) of these programs. The ICER compares two cost scenarios: those who participate in a program against a counter-factual of no intervention offered. If the benefits of participation out-weighs the costs over a specified period of time, then the program is economically favorable. The ERR looks at the potential of making a statewide DPP and HLWD mandatory or highly incentivized against the counter-factual of not promoting DPP or HLWD and letting enrollment continue to be voluntary. ERR is a single number—if it is greater than 10%, then a state should adopt a policy because its long-run benefits are significant compared to immediate costs. We evaluated the ICER and ERR for NDPP and HLWD in Wisconsin.

We found that compared to the counter-factual of not offering, offering the NDPP to pre-screened patients is cost-effective and results in cost savings after six years for the Medicaid population, and after nine years for ETF enrollees. We also find that the ERR for diabetes prevention is 16%, which is above the threshold of 10%. This means the state of Wisconsin should widely screen Wisconsinites for prediabetes and offer the NDPP to eligible residents. This result also means it would be cost-effective to widely offer HLWD for persons diagnosed with diabetes.

## Statement of Policy Relevance

Investments in diabetes prevention made through lifestyle change trainings could be welfare-enhancing for both the people at risk of getting a formal diabetes diagnosis, and beneficial to the healthcare system at large. Furthermore, disease management lifestyle change training could help mitigate the financial burden on, and improve quality of life of, those who are diagnosed with diabetes.

# I. Costs of Diabetes

In this section, we provide the cost of diabetes across several categories: programmatic costs, costs incurred by Medicaid, costs incurred by ETF, costs incurred by private insurers, costs of gestational diabetes, and costs incurred by the Department of Corrections. The type of cost data we present varies by data availability and by agency. Its purpose is to showcase current data available in different collaborating agencies, and work towards a standardized reporting system for data collection for the Diabetes Action Plan.

We wish to acknowledge the tremendous amount of inter-agency coordination and collaboration undertaken for this concerted data collection initiative and to put this cost structure together. To the best of our knowledge, we are the first state to go into this level of detail with costs.

The data collection involved:

1. Identifying interstate agencies and partners with data on diabetes and its related expenditures.
2. Designing and creating a comprehensive view of all elements of diabetes cost burden. This included identifying how to break down the costs of diabetes for an individual, depending on the type of diabetes and stage of diabetes progression they were experiencing.

[c] Note, Diabetes Self-Management Efficacy Scale and Medicare Diabetes Prevention Program are covered by Medicare. We do not discuss these here.

3. Identification of how to report costs, cost-effectiveness, and economic rate of return. This included being compliant with the diabetes impact tool provided by the Centers for Disease Control and Prevention, and collaborating with their staff to customize the tool where possible. We describe the diabetes impact tool kit in the cost-effectiveness section.
4. Constructing standardized aggregate tables for data requests from various agencies. Because this report is a mandatory state requirement to be renewed biennially, we prioritized our data requests to first fulfill a detailed aggregate cost report for this year, and then to start the process for making patient/client level data available. Patient-level data will be prioritized for the next round of reporting. The data-use agreements for aggregate data tend to be easier to solicit because they are not subject to Personal Health Information (PHI) and Health Insurance Portability and Accountability Act (HIPAA) compliance laws. To get access to HIPAA-compliant data there needs to be a data hub that hosts the data in a secure location with ease of access across agencies. This is a serious undertaking and not within the scope of this current reporting period. The SARS-CoV-2 pandemic diverted much of the state labor force to important COVID-response activities, so we were very careful in how we approached this data collection initiative. Our goals, though ambitious, were tempered in light of the pandemic response.
5. Each entity (Medicaid, Hospital Discharge Records, Wisconsin Health Information Organization, Employee Trust Funds, and Department of Corrections) has diabetes data at different levels of detail. It is our hope this report will enable better standardization for reporting data across these different groups in the future. There are some caveats that introduce variation into what we are able to report: First, race data for a state like Wisconsin is not readily available for two reasons: privacy and HIPAA rules. In Wisconsin, Blacks account for 7%, Asians for 3%, American Indians for 1.2%, and people of Hispanic origin for 7% (this can include Blacks or Whites) of the total population. Second, county level data will also pose problems, because reporting the small number of cases of diabetes per 1000 in certain counties could violate privacy rules.
6. Beyond data availability there are other serious limitations to list here:
    a) Hospital charges reported here are adjusted for cost-to-charge at a hospital level but not at the patient level. This means we do not have a way of accurately reporting what an individual patient faces for hospital charges, or what the insurer actually pays the hospital for an individual patient. The right interpretation of the cost-adjusted hospital charges reported here would be to view them as the upper-bound of total charges incurred with a formal diagnosis of prediabetes, or type 1 or type 2 diabetes. For hospital charges, we do have race information so we provide details for Black mothers with diabetes or gestational diabetes, given state efforts specifically to address the needs of these Wisconsinites.
    b) The Wisconsin Health Information Organization (WHIO) database includes about 4.9 million diabetes-insured lives, or 73% of Wisconsin's population, comprised of commercial (including self-funded) insurance, Medicaid, and Medicare Advantage. Between January 2019 and June 2020, WHIO received enrollment data on approximately 3.4 million insured lives (60% of Wisconsin's population). While most insurance members maintain their insurance plan throughout a calendar year, members can be added and removed from coverage within a plan year. If a member had health insurance in January 2019 and subsequently lost coverage in April 2020, that person is still counted in the 3.4 million insured lives figure. The demographic data for an insured life is limited to age, sex, zip code and county, and does not

include race, ethnicity, or income. For this analysis we use only the commercially insured covered lives in the data.[d,e,f]

c) Medicaid costs reported here are estimates of what Medicaid would have paid out if it were fee-for-service for each patient—they do not reflect the true costs Medicaid pays service providers. It is difficult to ascertain if this reflects the lower or upper bound of true costs. What we are able to provide here is the per-patient upper bound using WHIO data for Medicaid.

d) Employee Trust Funds (ETF) provides the most accurate cost-structure we have for patients experiencing diabetes. ETF is an employer sponsor who negotiates premiums with private insurers. Presumably, because they represent a very large pool of members, private insurers contracted with ETF are able to negotiate better rates as compared to other pools contracting with private insurers. The ability to negotiate rates depends on pool size and the premiums insurers are able to charge on the open insurance market. For smaller pool sizes, private insurers could offer a menu of contracts ranging from those with high deductibles and low premiums, to those with low deductibles and high premiums. Typically, a healthy individual (adjusting for age and disease) will choose a high deductible, low premium contract. For those living with diabetes, however, a high deductible, low premium contract would not make sense, because both pharmacy and medical out-of-pocket costs would drive the individual to seek coverage with more benefits. Large pools like ETF are better able to spread risk so its higher-need members, like people with diabetes, face better contract terms than they would outside ETF. ETF was able to provide both out-of-pocket costs and medical costs, so we report these in much more detail for the ETF contingent. The ETF data has two limitations: one, it is not representative of Wisconsin; two, we asked for costs by stages of diabetes, so the international classification of disease 10th revision (ICD-10) codes are interwoven, making it difficult to parse out pure diabetes-related costs.

7. Programmatic Costs are cost estimates for Healthy Living with Diabetes and come from meta-literature searches using key words like "costs of Healthy Living with Diabetes," "Diabetes Self-Management costs," "Stanford Diabetes Self-Management Program," or "*Vivir Saludable con Diabetes*." NDDP costs are modeled internally through the diabetes impact tool kit provided by CDC.

# II. Conceptual Preliminaries

In this report we present diabetes cost two different ways; one, with a strict adherence to international classification of disease 10th revision (ICD-10) codes and two, using IBM-Watson episode grouper methodology for staging diabetes used by ETF.[g][4-5] When presenting costs using ICD-10 codes, the focus is solely on disease classification, which allows us to address disease costs by principal diagnosis and primary admissions. For example, we can determine the share of prediabetes-related costs for the state of Wisconsin. Reporting costs by stages of

[d] The unique WHIO member ID is consistent over time and is not associated with a private or public payer plan. WHIO uses an enterprise master person index software to maintain the same WHIO ID over time.

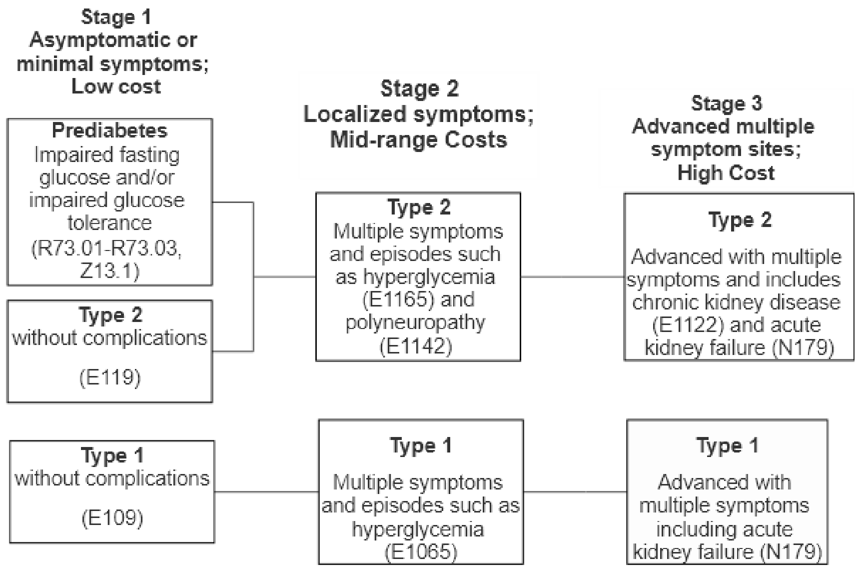
[e] While WHIO is the largest health care database of Wisconsin residents, the data includes out of state services for individuals insured in Wisconsin with Wisconsin addresses. For example, people who are on vacation or residing in Florida for the winter and maintain a Wisconsin address are in the WHIO database. Also, if a dependent goes to college outside of Wisconsin but remains on their parents' plan, they would be in the WHIO database.

[f] The data element "Disposition" from hospital includes the option "Death."

[g] This is a methodology IBM-Watson developed in collaboration with clinicians. To date there are no standardized disease stages for diabetes.

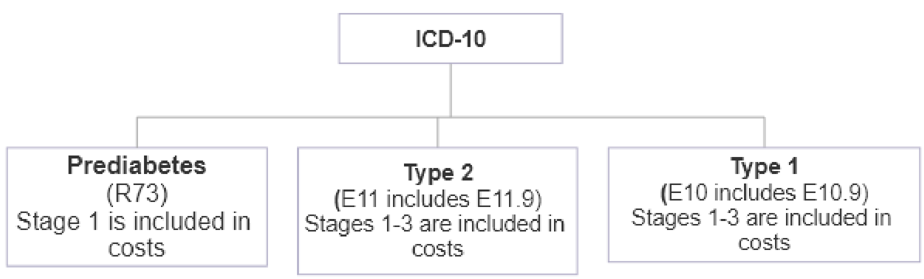
disease means we can show cost increases with stages of disease, and we can also estimate reduction in costs due to interventions at different stages. For Medicaid and WHIO data, we present costs using ICD-10 codes. For ETF data, we present costs using disease staging. ETF uses an IBM-Watson medical episode grouper methodology for staging. Figures 1 and 2 illustrate the distinction between the ICD-10 approach and the staging approach using a flow diagram.

Figure 1. Disease staging[1] approach to diabetes mellitus costs (ETF data only)




[1]This disease staging uses IBM-Watson methodology: using the Medical Episode Grouper (MEG), IBM-Watson is able to assign severity to every medical episode. The four stages of severity are:
Stage 1: Conditions with no complications or problems of minimal severity
Stage 2: Problems limited to an organ system, and significantly increased risk of complications
Stage 3: Multiple organ site involvement, generalized organ systemic involvement, and poor prognosis
Stage 4: Death (not included)

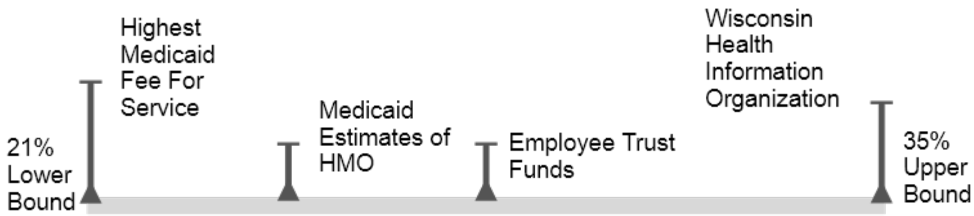
Figure 2. ICD-10 approach to diabetes mellitus costs




Note: we exclude ICD10 codes for drug induced, or other unspecified diabetes mellitus

Figure 2 gives the necessary ICD-10 view into diabetes with three classifications: prediabetes, type 1 diabetes, and type 2 diabetes. When costs are reported this way, we do not take into consideration variations in the costs of type 1 and type 2 diabetes due to disease progression. This presentation of costs using only ICD-10 codes is useful when we want to know the share of medical expenses due to a particular disease. But, when we want to know average per patient per year (PPPY) costs, the ICD-10-only approach will overstate the costs. The disease staging approach will give a more accurate average PPPY costs.

Figure 3. Lower and upper bounds to diabetes mellitus costs by reporting organization




Another concept to present before we go into the cost details is the bounds or limits for costs. Each contracting agency pays providers different amounts for medical or pharmacy charges. What appears as a billed charge is not what becomes the paid amount. We present costs from three organizations as shown in figure 3; each one uses a different algorithm to calculate costs. Medicaid lies on the lower bound of the cost structure with its fee-for-service structure for some enrollees. For Medicaid HMO members, we calculate an estimate of the total cost by treating the medical and pharmacy encounters as if they were fee-for-service. ETF is a large pool of state and city employees that negotiate contracts with insurance providers—akin to private insurance; their costs fall mid-range as compared to those that contract with private insurance on their own. All private insurance expenditures are presented using WHIO data. WHIO provided us with billed costs. Medicaid allowable costs form the lower bound, and WHIO costs adjusted for cost-to-charge-ratios (CCR) of individual pharmacies or clinics form the upper bound. We set 21% CCR as the lower bound, and 35% CCR as the upper bound—these are the minimum and maximum CCRs for Wisconsin Hospitals.[6-8]

## III. Total Costs of Diabetes Encounters[h] Only

In tables 1-3, we report the total costs of diabetes-only encounters by organization. Medicaid, WHIO-private insurance, and ETF collectively, during this reporting period, represent 70% of all Wisconsin residents. The costs provided here are delineated by ICD-10 codes only, and they are total allowable costs using principal diagnosis and admission codes.

Medicaid has two mechanisms for its enrollees: managed care, or fee-for-service (FFS). As table 1 illustrates, the total estimated amount paid by managed care is: $0.25 million for 3,767 enrollees with prediabetes, $14.16 million for 7,025 enrollees with type 1 diabetes, and $40.28

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[h] Note throughout this document: We use the word patient encounters. Encounters could also include patient claims. While both terms refer to data associated with services received by a patient, there could be a distinction between them depending on context. Claims may not equal encounters because a patient could be billed on two different claims for the same visit (e.g., a professional claim and a facility claim). During a single hospital stay, multiple professional and facility claims could be generated, depending on the type of service (e.g., room and board, imaging, lab work, surgery).

Claims data: is usually associated with fee-for-service arrangements between payers and providers — there is typically a clear line item association between the service claims records submitted by the provider and the payment made by the payer.

Encounter data: is usually associated with the Managed Care Organizations (MCO) paradigm. Here the payment arrangement is capitated - typically an agreed per member amount between providers and payers. This per member fee is paid for all members regardless of whether a particular member receives services or not. Even though it is not tied directly to payment, providers are still typically required to submit encounter information (very similar to claims data) for members that do not receive services.

million for 64,535 enrollees with type 2 diabetes. Strikingly, the number of annual medical per patient encounters is highest for type 1 diabetes enrollees (8.7 = 61,248/7,025), as compared to type 2 diabetes enrollees (5 = 330,128/64,535). Prediabetes enrollees typically average 1.5 (= 5,540/3,767) medical encounters in a calendar year. The distribution of medical claims directly impacts the PPPY medical costs. In table 1, Medicaid managed care costs are calculated by estimating costs as if the encounters were Medicaid FFS. Medicaid data also provides out of pocket (OOP) costs for FFS; cumulatively, these costs are very small for the Medicaid population.

The Medicaid data do not provide us with a complete cost structure for pharmacy costs using primary diagnosis codes alone. As shown in table 1, out of the 11,081(= 7,025 + 4,056) Medicaid enrollees with medical encounters, only 4,799 had documented pharmacy costs. The pharmacy costs are only available for Medicaid FFS encounters. We recognize this is likely an undercount, so we provide an estimate of total pharmacy costs for type 1 diabetes by calculating the average PPPY cost $10,745 (= $51.57 million/4,799) and if we multiply it by the total number (11,081) of Medicaid patient count with a type 1 diabetes primary diagnosis we would get a total pharmacy cost. This calculation results in the lower bound of total Medicaid pharmacy cost for type 1 diabetes of $119.08 (= $10,745 X 11,081) million per year. Through similar calculations, we estimate that the PPPY pharmacy cost for type 2 would be $6,309.4 (= $185.61 million/29,418), and the lower bound of total Medicaid pharmacy costs for type 2 diabetes is $0.67 billion (= $6,309 X 105,635) per year.

Table 1. Medicaid total allowable[1] costs of diabetes encounters[2] ($ millions) 2019

| Category | Type 1 | Type 2 | Prediabetes |
|---|---|---|---|
| **Managed care costs** | | | |
| Patient count | 7,025 (9.3%) | 64,535 (85.7%) | 3,767 (5%) |
| Medical encounters | 61,248 | 330,128 | 5,540 |
| Total medical costs | $14.16 | $40.28 | $0.25 |
| **Fee-for-service (FFS) costs** | | | |
| Patient count | 4,056 (8.7%) | 41,100 (88.4%) | 1,313 (2.8%) |
| FFS encounters | 32,736 | 212,579 | 1,923 |
| Medical OOP[3] | $0.002 | $0.024 | $- |
| Medical third party | $0.16 | $0.16 | $0.002 |
| Total medical cost | $5.01 | $23.58 | $0.10 |
| **Pharmacy costs[4] for FFS** | | | |
| Patient count | 4,799 | 29,418 | 907 |
| Encounters | 108,605 | 561,927 | 4,176 |
| Total pharmacy costs | $51.57 | $185.61 | $0.51 |

Source: Wisconsin State Medicaid Analyst Calculations

[1] Allowable amount is determined by Medicaid pricing systems to be the amount allowed for payment, before adjusting for third party (TPL) and OOP (pharmacy claims).

[2]Here costs are determined by primary diabetes diagnosis and diabetes-related admission codes only for ICD10 codes: R73.01-73.03, E10, and E11.

[3]Out-of-pocket and third-party costs are available only for fee-for-service claimants [encounters] in Medicaid system.

[4]Pharmacy costs use drug codes for diabetes-related drugs.

Table 2. Employee Trust Funds total allowable costs ($ millions) of diabetes related encounters[1] (no comorbid costs) 2019

| Category | Type 1 | Type 2 | Prediabetes |
|---|---|---|---|
| **Employee Trust Funds (patient count)** | 1,207 | 10,603 | 1,696 |
| **Total medical costs** | $7.86 | $19.76 | $1.20 |
| **Total pharmacy costs** | $9.76 | $47.22 | $0.67 |
| **Medical OOP[2]** | $0.99 | $3.79 | $0.20 |
| **Medical Third party[3]** | $1.83 | $19.46 | $0.45 |
| **Total allowable** | $17.62 | $66.97 | $1.88 |

Source: Wisconsin Employee Trust Funds (ETF) and IBM Watson analyst calculations.
[1]ETF: The stated patient counts and aggregate financials are based on a combination of the listed ICD10 codes, and the IBM Watson Medical Episode Grouper (MEG) methodology. This IBM Watson approach was employed to ensure that the total costs of care for the diabetes condition, including inpatient and outpatient claims, and prescription drugs are included. The numbers for each group were generated by constraining the IBM Watson episode of diabetes care in general with the appropriate ICD10 codes R73.01-73.03, E10, E11
[2]OOP — Total allowable out of pocket.
[3]Total allowable third-party.

Table 2 calculates the cost for diabetes-related episodes for ETF members with a diagnosis of prediabetes, type 1, or type 2 diabetes. The costs are restricted to diabetes episodes through IBM-Watson's medical episode grouper (MEG) methodology. Both inpatient and outpatient claims are included in the medical costs line. In the pharmacy costs line, both insulin and other prescription drugs are included. The total medical cost due to prediabetes is the lowest at $1.20 million, and highest for type 2 at $19.76 million. Although type 1 diabetes medical costs are $7.86 million and fall in between prediabetes and type 2, they are the highest PPPY medical costs. Again, total costs for OOP and third-party costs are lowest for members with prediabetes ($0.20 million, $0.45 million), and highest for type 2 diabetes ($3.79 million, $19.46 million). Consistently, PPPY costs remain highest for type 1 diabetes.

Table 3 provides the total billed costs of diabetes from private insurance in the WHIO system. As with ETF, private insurance total billed costs are the highest for type 2 diabetes, representing 44.9K patients at $123.56 million, and the lowest total billed costs are for prediabetes, representing 45K patients at $9.51 million. Even though total billed costs for type 1 diabetes are $34.44 million, they represent 4.4K patients, making it the highest cost PPPY category in diabetes, with average annual medical billed costs of $7,882 (= $34.44 million/4.4K). The striking feature of type 1 diabetes is that PPPY billed costs of prescriptions equal $6,998 (= $30.79 million Rx /4.4K patients), are nearly as high as these patients' medical costs which equal $7,882. Thus, the total costs for an individual with type 1 diabetes is substantially higher than costs for people with type 2 diabetes, even though type 2 diabetes is much more prevalent in the population.

Table 3. Wisconsin Health Information Organization billed costs [allowable $ million] from private insurance 2019[1]

| Category | Type 1 | Type 2 | Prediabetes |
|---|---|---|---|
| Medical cost | $34.44 [$7.23, $12.05] | $123.56 [$25.95, $43.25] | $9.51 [$2.00, $3.30] |
| Third party | $0.76 [$0.16, $0.27] | $14.23 [$2.99, $4.98] | $0.41 [$0.10, $0.10] |
| Pharmacy | $2.60 [$0.55, $0.91] | $180.15 [$37.8, $63.05] | $4.51 [$0.90, $1.60] |
| Pharmacy third party | $28.19 [$5.92, $9.87] | $14.31 [$3.01, $5.01] | $0.31 [$0.07, $0.09] |

Source: Wisconsin Health Information Organization
[1]These costs include primary diagnosis and principal admissions code and are not adjusted to cost to charge ratio. Thus, WHIO costs should be viewed as the high end of the estimated costs conditional on private insurance.

WHIO provides billed amounts and not allowable amounts. To stay consistent with ETF and Medicaid data, we use reasonable assumptions to create WHIO allowable amounts by using the smallest and largest values they could be. The annual fiscal survey from the Wisconsin Hospital Association gives us Hospital Cost-to-Charge-Ratios (CCR); we used the minimum and maximum CCR, and applied them to the WHIO billed amount to calculate WHIO allowable upper and lower bounds for Wisconsin.[i,j] The minimum CCR is 21%, which is the same ratio for Medicaid (Medicaid allowable is a maximum of 21% of total billable amounts), and average CCR is 35% for hospitals in the Wisconsin network. Applying these as lower and upper bounds, respectively, we estimate WHIO total allowable medical costs for prediabetes are between $2.00 million (= 0.21 X $9.51 million) and $3.30 (= 0.35 X $9.51 million) million, type 1 diabetes are between $7.23 million and $12.05 million, and type 2 are between $25.95 million and $43.25 million.[5,6]

Tables 1 to 3 are useful high-level tables because they provide an estimate of the total diabetes-related costs to Wisconsin. Between Medicaid, WHIO, and ETF, these costs cover 70-80% of total diabetes-related costs to Wisconsin.

# IV. Disaggregated Diabetes-Related Costs to the State of Wisconsin

There are many different ways to express disease-related costs as we explained in section II. In this section, we break down diabetes-related costs by agency, by ICD-10 codes, and by disease stage. For Medicaid and WHIO data, we present diabetes-related cost information only at the ICD-10 primary diagnosis level, and for the Wisconsin ETF data, we present diabetes-related costs at the disease staging level. In this section, we also provide CCR-adjusted hospital charges associated with births of mothers with either gestational diabetes, or type 1 or type 2 diabetes[k].

## Estimated Cost to the State of Wisconsin via Medicaid

For people who are eligible for Medicaid in Wisconsin, insurance becomes vital because the costs for diabetes treatments are high. To be eligible for Wisconsin Medicaid, a person needs to be a Wisconsin resident, a U.S. citizen, permanent resident or legal alien, with a need for health insurance, and have low household income. The actual income cut offs vary by household size.

[i] The mean hospital CCR in Wisconsin is 35%, the median is 34%, the min is 21%, which is the same as the Medicaid maximum, and the max CCR is 78%. We use 35% of billable amount to be our upper bound and 21% as lower bound. These estimates can be sensitive to regional variation in hospital CCR so should be interpreted loosely.
[j] We also calculated the Manski bounds for these costs, which can be made available upon request.
[k] Birth records data do not distinguish mothers with formal type 1 or type 2 diagnoses.

For example, a family of four qualify if their household income is less than $35.24K. Additional qualification criteria include pregnancy, responsibility for child or children 18 years or younger, blindness, having a disability or having a family member with disability, or being 65 years or older. Medicaid data are available to us by ICD-10 codes and not by disease stage. In 2019, 81% of people with diabetes enrolled in Medicaid had type 2 diabetes, 9% had prediabetes, and 10% had type 1 diabetes. Table 4 does not include the 16,000 mothers with gestational diabetes with Medicaid or BadgerCare.[l] Those members are presented separately in a section devoted to birthing mothers with diabetes.

Table 4. Medicaid costs for prediabetes, type 1 and type 2 diabetes, and all comorbid conditions (unless specified otherwise)

| PPPY[1] annual utilizations | Type 1 | Type 2 | Prediabetes |
|---|---|---|---|
| Total enrolled in Medicaid with diabetes | 8,889 | 80,103 | 9,868 |
| Typical office visits (mean) | 14.4 | 7.8 | 3.5 |
| Typical hospitalizations (mean) | 0.33 | 0.20 | 0.08 |
| Typical ED visits (mean) | 2.9 | 1.8 | 0.6 |
| Typical insulin vials or pens (mean) | 111 | 21 | 0 |
| **Estimated average PPPY costs** | | | |
| Insulin cost[2,3] | $3,241 | $634 | $4 |
| Pharmacy cost[2,3,4] | $6,471 | $3,121 | $2,076 |
| ED cost[2] | $1,992 | $642 | $220 |
| Inpatient cost[2] | $3,624 | $1,701 | $530 |
| Outpatient cost[2] | $937 | $501 | $202 |

Source: Wisconsin State Medicaid data and own calculations by Medicaid analyst.
[1]PPPY — per patient per year
[2]Costs here are an estimate of true costs.
[3]National Drug Code list of 2017 diabetes insulin codes. Note we call out insulin separately because in the diabetes literature it is often listed as the most expensive per-patient cost.
[4]Pharmacy costs include all diabetes pharmacy codes in the national drug code list of 2017 **excluding** insulin, plus all comorbid costs associated with a Medicaid enrollee with a primary diagnosis of diabetes by type. This includes ICD10 code E78.5 for hyperlipidemia and dyslipidemia.

Table 4 breaks up the costs associated with Medicaid by pharmacy costs, emergency department (ED) costs, and outpatient and inpatient costs for three forms of diabetes: type 1, type 2, and prediabetes. As mentioned earlier, Medicaid costs reported here are not the true costs incurred by Medicaid; the estimated costs here are a sum of fee-for-service cost plus an estimated amount of what Medicaid would have paid to health maintenance organizations.

In 2019, 80% of Medicaid enrollees with diabetes had type 2, 11% had prediabetes, and 9% had type 1 diabetes. Comparing office visits across the three classifications of diabetes, we found: type 1 averaged 14.4 visits a year, type 2 averaged 7.7 visits per year, and prediabetes averaged 3.5 visits per year. This distribution is expected, because onset of type 1 diabetes is typically in childhood and the requirements for insulin adjustments with growth and puberty changes make office visits routine for this population. Emergency department visits are also highest for type 1 diabetes, with approximately three visits per year. A person with type 2 diabetes typically makes two emergency department visits per year, and this finding is consistent across a three-year span (2017-2019). This may not be surprising because prediabetes and type 2 diabetes are typically adult-onset, so if the diagnosed patients self-

[l] Badgercare data is not included.

regulate and adhere to medication skillfully the need for emergency department visits decline. Whereas because type 1 is typically a childhood onset autoimmune disease and more sensitive to changes in the body, emergency department visits may be more common. Other factors, such as not using insulin optimally due to costs, could also drive emergency department visits for persons with type 1 diabetes.

Turning to the cost of disease, we found that insulin costs are the highest for those with type 1 diabetes. For a typical person with type 1 diabetes, Medicaid has to potentially pay out an insulin cost of $3,241, which is approximately $30 per vial of insulin. There is also an additional annual pharmacy cost of $6,471. Combined, these add up to a monthly $809 per person in prescription costs. In addition, Medicaid estimates a $6,553 annual per person cost for emergency department, inpatient and outpatient expenses. Similar PPPY cost analyses for people with type 2 diabetes are substantially lower, with the PPPY costs for treating prediabetes lower still.

Even though Wisconsin did not expand Medicaid under the Affordable Care Act, changes to the Medicaid program in 2014 made diabetes prescriptions more affordable to a segment of population. According to one study[9], when low-income adults (up to 100 percent of the federal poverty level) without dependent children obtained a less costly prescription drug coverage benefit, out-of-pocket costs for diabetes medication dropped by 70%. This prescription drug benefit also lead to a 4% overall increase in the use of antidiabetic drugs, driven primarily by an increase in the number of people using the drugs, rather than increased drug utilization by those previously enrolled in the program.

Table 5. Medicaid costs for enrollees with diabetes who have hypertension and BMI > 40

| | Type 1 | Type 2 | Prediabetes |
|---|---|---|---|
| Number enrollees with hypertension and BMI > 40 | 616 | 9,766 | 865 |
| **Estimated PPPY:** | | | |
| ED visits | 5.47 | 2.95 | 1.31 |
| Office visits | 22.26 | 12.63 | 6.73 |
| Hospitalizations | 0.61 | 0.42 | 0.21 |
| Quantity insulin units | 111.51 | 41.31 | 0.04 |
| **Estimated average PPPY costs:** | | | |
| Insulin [1] | $3364 | $1304 | $1* |
| Pharmacy [2] | $7208 | $4979 | $2680 |
| ED | $3436 | $1479 | $582 |
| Inpatient care | $5565 | $4187 | $1670 |
| Outpatient care | $1374 | $781 | $500 |

Source: Wisconsin State Medicaid data. Here costs are an estimate of true costs.
[1]National Drug Code list of 2017 diabetes insulin codes.
[2]National Drug Code list of 2017 diabetes pharmacy codes.
*There is a small positive $ amount because some patients get diagnosed mid-year with diabetes and start insulin prescriptions.

Table 5 presents the estimates of costs Medicaid for enrollees with comorbid hypertension and a BMI > 40 in addition to prediabetes, type 1 or type 2 diabetes.[m,n] Condliffe et. al. (2012) argue that hypertension and BMI > 40 along with diabetes add 40% more in costs. [10] We have the ability to test this with Medicaid estimated charges. We find that cost increases are greatest for those with type 2 diabetes. As compared to a person with type 2 diabetes alone, persons with comorbid hypertension and BMI > 40 had estimated insulin costs twice as high (=$1,304/$634); average pharmacy estimated costs were 59% more (=$4,979/$3,121); estimated ED costs were 230% more (=$1,479/$642); estimated inpatient costs were 246% more (=$4,187/$1,701); and estimated outpatient costs were 56% more(=$781/$501). For people with prediabetes, comorbid hypertension and BMI>40 increase combined estimated ED and inpatient costs by more than 300% (=$2,252/$750). Similar calculations for an average person with type 1 show comorbid hypertension and BMI>40 increase combined ED and inpatient costs by 160% (=$9,001/$5616).

## Wisconsin Health Information Organization

The WHIO database identifies individuals with diabetes using ICD-10 codes and pharmacy drug codes from the US Food and Drug Administration (FDA). The WHIO demographic data for an insured life is limited to age, sex, zip code, and county, and does not include race, ethnicity, or income.[o,p,q]

Table 6 shows the WHIO data universe, including members with Medicaid, Medicaid dual coverage, and Medicare Advantage. Because we have previously shown diabetes costs directly from Medicaid (Tables 4 and 5), we use WHIO data to report costs of diabetes only for private insurance members. The distribution of people with diabetes in Wisconsin is captured within the WHIO sample, differentiated by disease category of: prediabetes, type 1, type 2, type 2 with hypertension, and type 2 with hypertension and BMI > 40. Because of data availability, we distinguish type 2 diabetes with comorbidities, and highlight any changes in costs associated with having multiple chronic conditions.

In the WHIO sample of patients with diabetes[r], 12,167 (2.9%) have a formal diagnosis of type 1 without complications, 168,155 (40%) have a formal diagnosis of prediabetes, 176,907 (42%) have type 2 diabetes without complications, 64,133 (15%) have type 2 diabetes and hypertension, and 2,260 (.5%) have type 2 diabetes, hypertension, and obesity. Table 6 shows the distribution of diabetes by sex, age and insurance type.

In Table 6, we show that the vast majority of people with diabetes in the WHIO universe have public insurance (Medicaid, Medicaid dual eligible; 39%) or public-private insurance (Medicare

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[m] We focus on two main co-occurring diseases with diabetes, hypertension and obesity. A more thorough investigation would also include hyperlipidemia and dyslipidemia. The costs for these are included in total pharmacy costs. In this analysis, we point out insulin costs as a separate category because they are often cited as the most expensive of all diabetes costs.
[n] For managed care we can only estimate the total amount Medicaid would pay out using FFS as a guide. The actual amount Medicaid pays out is not known.
[o] The unique WHIO member ID is consistent over time and is not associated with a private or public payer plan. WHIO uses an enterprise master person index software to maintain the same WHIOID over time.
[p] While WHIO is the largest health care database of Wisconsin residents, the data include out of state services for individuals insured in Wisconsin with Wisconsin addresses. For example, people on vacation or residing in Florida for the winter who maintain a WI address are in the WHIO database. Also, if a dependent goes to college outside of WI, but remains on their parents' plan, they would be in the WHIO database.
[q] The data element "Disposition" from hospital includes the option "Death."
[r] In December 2020, the WHIO database had 2.93 million privately insured individuals from Wisconsin. The data contributors include 13 health plans, and one pharmacy benefits administrator.

Advantage; 23%). Because we can gather Medicaid data directly (Tables 4-5), we use WHIO data to characterize the diabetes-related costs for those with solely private insurance for this report. We do not report Medicare Advantage or Medicaid dual eligible diabetes-related costs here.

Table 6. Wisconsin Health Information Organization distribution of diabetes by disease and comorbid conditions

| Category | Type 1 | Type 2 | Prediabetes | Type 2 + hypertension | Type 2 + hypertension + BMI > 40 |
|---|---|---|---|---|---|
| Total patient count | 12,167 | 176,907 | 168,155 | 64,133 | 2,260 |
| Female | 5,857 | 90,421 | 95,212 | 31,675 | 1,288 |
| Male | 6,310 | 86,486 | 72,943 | 32,458 | 972 |
| Age | | | | | |
| Children (0-17) | 1,499 | 418 | 3,550 | 28 | 0 |
| Adults (18-44) | 5,451 | 18,175 | 43,338 | 3,953 | 276 |
| Adults (45-64) | 3,608 | 72,821 | 72,011 | 24,216 | 1,056 |
| Adults (65-74) | 1,15 | 43,988 | 30,801 | 17,567 | 642 |
| Adults (75+) | 494 | 41,509 | 18,462 | 18,371 | 286 |
| Insurance | | | | | |
| Private | 5,637 | 47,570 | 88,532 | 15,837 | 723 |
| Medicaid[1] | 4,040 | 36,551 | 33,517 | 10,695 | 399 |
| Medicaid dual eligible[2] | 1,531 | 47,860 | 12,214 | 17,917 | 505 |
| Medicare Advantage | 910 | 43,185 | 33,027 | 19,008 | 610 |

Source: Wisconsin Health Information Organization. Calculations by WHIO and DHS analysts

[1]Medicaid values here are different from the actual Medicaid values because they are separated into two categories: Medicaid including, and Medicaid excluding dual eligible, and continuous enrollment criteria were not imposed. Table 1 provides accurate Medicaid enrollment numbers.

[2] People who are simultaneously enrolled in Medicare and Medicaid, a population often referred to as "dual-eligible" beneficiaries

Table 7 presents the private insurance costs associated with diabetes by type of diabetes and cost category. WHIO data details cost categories by prescription costs "with insulin" and "other." We separate out drug and medical costs to highlight that diabetes is usually comorbid with other conditions like hypertension, obesity, and cardio-vascular disease. Because we were able to separate out specific drug and medical costs by primary diagnosis of diabetes with WHIO data, we can explore in greater detail how drug and medical costs are distributed among the population living with diabetes.

Among people with prediabetes and private insurance, only 42% get prescriptions for their medical condition. The largest PPPY billed cost for people with prediabetes is non-insulin diabetes-related drugs ($3,822). When this charge is adjusted for Cost-To-Charge-Ratio (CCR; 21-35% of billed rates), the range is between $802 and $1,338. Prediabetes patients also face $1,040 (CCR: $218 to $364) in other non-diabetes-related medical charges.

People with type 1 diabetes with private insurance in the WHIO database show an interesting pattern—only 29% have formal insulin prescriptions on file. This result is deeply concerning, because type 1 diabetes must be regulated with insulin. If 71% of patients with type 1 diabetes do not have insulin-related prescription costs, multiple explanations are possible: One, a fraction of the people who have type 1 diabetes may buy insulin out-of-pocket (OOP), and try to stretch their prescriptions out because they have a high deductible insurance plan, thus incurring a great risk to themselves. Two, some fraction of people with type 1 diabetes may attempt to regulate their blood sugar using other diabetes-related drugs and medical treatments. Three, and perhaps more critical, some people with type 1 diabetes may not have access to proper information about insulin being critical for their survival. The Report of the Governor's Task Force on Reducing Prescription Drug Prices documents multiple stories of the burden of insulin costs on young adults and families.[11] Wisconsin Senate Bill 340 and Assembly Bill 411, introduced in 2019-2020 to place limits on [cap] monthly insulin co-pays at $100, did not pass.

Table 7. Total prescription and medical billable costs by diabetes category and comorbidity for Wisconsin[1] (coverage period January 2019 – June 2020)

| Diagnosis type | Costs | Billed total costs ($ millions)[*] | % Total Cost[2] | Patient count | % of patients[3] | Billed PPC[4] [CCR[5] adjusted lower and upper bounds] |
|---|---|---|---|---|---|---|
| | *Insulin only[7]* | *$8.98* | *2%* | *21,180* | *12.6%* | *$424 [$89, $148]* |
| | *Non-insulin pharmacy* | *$259.00* | *70%* | | | |
| | Total pharmacy[6] | $267.98 | 73% | 70,124 | 41.7% | $3822 [$803, $1338] |
| | Diabetes-related medical[8] | $8.86 | 2% | 42,306 | 25.2% | $209 [$44, $73] |
| | Other medical | $91.03 | 25% | 87,520 | 52.0% | $1040 [$218, $364] |
| Prediabetes[9] N = 168,155 | Totals[14] | $367.87 | 100% | 88,532 | 52.6% | $4155 [$873, $1454] |
| | *Insulin only[7]* | *$25.70* | *22%* | *3,512* | *28.9%* | *$7317 [$1537, $2561]* |
| | *Non-insulin pharmacy* | *$22.45* | *19%* | | | |
| | Total pharmacy[6] | $48.15 | 41% | 3,676 | 30.2% | $13,099 [$2751, $4585] |
| | Diabetes-related medical[8] | $28.99 | 25% | 3,921 | 32.2% | $7394 [$1553, $2588] |
| | Other medical | $38.93 | 34% | 4,064 | 33.4% | $9581 [$2012, $3353] |
| Type 1[10] N = 12,167 | Totals[14] | $116.08 | 100% | 5,637 | 46.3% | $20,593 [$4324, $7207] |
| | *Insulin only[7]* | *$111.49* | *15%* | *25,404* | *14.4%* | *$4389 [$922, $1536]* |
| | *Non-insulin pharmacy* | *$208.46* | *27%* | | | |
| | Total pharmacy[6] | $319.95 | 42% | 28,705 | 16.2% | $11,146 [$2341, $3901] |
| | Diabetes-related medical[8] | $88.10 | 11% | 29,844 | 16.9% | $2952 [$620, $1033] |
| | Other medical | $360.71 | 47% | 32,838 | 18.6% | $10,984 [$2307, $3845] |
| Diabetes type 2[11] (with insulin) N = 176,907 | Totals[14] | $768.75 | 100% | 47,570 | 26.9% | $16,160 [$3394, $5656] |
| | *Insulin only[7]* | *$45.97* | *13%* | *11,854* | *18.5%* | *$3878 [$814, $1357]* |
| | *Non-insulin pharmacy* | *$93.61* | *27%* | | | |
| | Total pharmacy[6] | $139.58 | 41% | 12,948 | 20.2% | $10780 [$2264, $3773] |
| | Diabetes-related medical[8] | $23.13 | 7% | 12,433 | 19.4% | $1860 [$391, $651] |
| | Other medical | $178.96 | 52% | 15,002 | 23.4% | $11929 [$2505, $4175] |
| Diabetes type 2 + hypertension[12] N = 64,133 | Totals[14] | $341.66 | 100% | 15,837 | 24.7% | $21574 [$4530, $7551] |
| | *Insulin only[7]* | *$2.79* | *15%* | *599* | *26.5%* | *$4661 [$979, $1631]* |

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Non-insulin pharmacy* | *$4.62* | *25%* | | | |
| Diabetes type 2 + | Total pharmacy[6] | $7.41 | 41% | 654 | 28.9% | $11324 [$2378, $3963] |
| hypertension + obesity[13] | Diabetes-related medical[8] | $0.83 | 5% | 598 | 26.5% | $1394 [$293, $488] |
| (BMI > 40) | Other medical | $9.99 | 55% | 745 | 33.0% | $13404 [$2815, $4691] |
| N = 2,260 | Totals[14] | $18.22 | 100% | 745 | 33.0% | $24463 [$5137, $8562] |

Source: Wisconsin Health Information Organization. Calculations by WHIO and DHS analysts.

[*]Only millions have decimal places

[1]Billed charges due to diabetes and related comorbidities reported in Table 7 could be up to 70% of all Wisconsin State expenditures due to diabetes because WHIO sample covers 70% of all Wisconsin residents

[2]Percent of Total with categories Prediabetes, Diabetes type 1, Diabetes type 2, Diabetes type 2 with hypertension, and Diabetes type 2 with hypertension and obesity.

[3]Percent of Total observations in diabetes category

[4]Billed charges for treatment when the ICD-10 diagnosis code for a diabetes condition (Prediabetes, type 1 or type 2) is listed as either the Admission diagnosis or Diagnosis 1 on the billing form

[5]Cost to charge ratio (CCR) adjusted allowable costs are provided for average per-patient billed cost in form of lower bound = 21% of billed cost and upper bound = 35% of billed cost. These bounds come from the Wisconsin Hospital Fiscal Survey and are averaged over all of Wisconsin hospital charged

[6]Prescription drug billed charges for insulin, Diabetes-related, and all other prescriptions

[7]Includes insulin costs only

[8]Medical claims spending only for patients with diabetes code in Admission or First Diagnosis field

[9]Primary diagnosis of prediabetes plus all other comorbidities

[10]Primary diagnosis of type 1 diabetes plus all other comorbid conditions

[11]Primary diagnosis of type 2 diabetes plus all other comorbid conditions

[12]Primary diagnosis of type 2 diabetes plus primary diagnosis of hypertension and all other comorbid conditions

[13]Primary diagnosis of type 2 diabetes plus primary diagnosis of hypertension plus primary diagnosis BMI > 40 and all other comorbid conditions

[14]Patient counts not additive; some patients will have multiple encounters and charges in a given coverage period, while others will have none.

Annual billed costs for people with type 1 diabetes are substantial. Insulin alone costs $7,317 PPPY (adjusting these for CCR we get a lower bound of $1537 and upper bound of $2,561), with total pharmacy costs equaling $13,099 (CCR: $2751 to $4,585). These charges make up 22% and 19% of total annual costs, respectively. Strictly diabetes-related medical costs account for 25% of the annual total at $7,394 PPPY (CCR: $1553 to $2588), while the largest cost category is actually non-diabetes-related medical costs, at 34% of annual costs, equaling $9,581 PPPY (CCR: $2,021 to $3,353)[s]. Together, these data show that people with type 1 diabetes face multiple medical bills, so any efforts that improve disease management are likely to reduce costs for both the individual (in terms of OPP charges) and the Wisconsin healthcare system.

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[s] Note: If we want to know the bottom line of what a person with type 1 diabetes would cost we can do the following calculation. Bounds can also be calculated to reflect minimum and maximum expenses associated with disease (including comorbid costs). For example, for type 1 diabetes the lower bound equals strict diabetes related medical costs which is $1,553 (=21% of $7,394) and the upper bound can include medical costs associated with comorbid conditions which is $5,941 (=35% of $7,394 + 35% of $9,581). Calculating the bounds this way answers a query that asks how much could a person with type 1 diabetes cost. Similarly, a person with type 2 diabetes could cost between $620 (= 21% of $2,952 and $4,878 (35% of $1033 + 35% of $3,845) in medical expenses.

People with type 2 diabetes have lower diabetes-related costs than those with type 1, however their non-diabetes-related medical costs are higher. Annual per patient billed pharmacy costs of $11,146 [$2,341, $3,901] which includes $4,389 [$921.61, $1,536.02] for insulin. The diabetes-related for type 2 medical billed costs are $2,952 with allowable amounts between [CCR: $619.90, $1,033.16]. Table 7 also shows people with a primary diagnosis of diabetes type 2, coupled with hypertension, or both hypertension and BMI > 40, face similar diabetes-related costs to people without additional comorbidities, yet non-diabetes-related medical costs continue to rise with additional comorbidities. In our data from WHIO, we show that for many classifications of diabetes, the diabetes-related costs in prescriptions and medical expenses are less than half of the total expenses associated with diabetes. Thus, we largely corroborate Condliffe et al. (2012) estimates that 40% of healthcare costs to treat diabetes come from comorbidities associated with the condition.[10]

Table 8. Per-patient prescription and medical expenditures by diabetes category and age group for Wisconsin (WHIO[1] coverage period January 2019 – March 2020)

| Condition type | Age | Patient count | Per patient billed pharmacy cost $ [CCR adjusted bounds] | Per patient billed insulin$ [CCR[2] adjusted bounds] |
|---|---|---|---|---|
| Prediabetes | Children (0-17) | 3,457 | $51 [$11, $18] | $23 [$5, $8] |
| | Adults (18-44) | 41,373 | $197 [$41, $69] | $87 [$18, $30] |
| | Adults (45-64) | 69,437 | $239 [$50, $84] | $76 [$16, $27] |
| | Adults (65-74) | 29,813 | $130 [$27, $46] | $35 [$7, $12] |
| | Adults (75+) | 17,906 | $350 [$74, $123] | $90 [$19, $32] |
| Diabetes type 1 | Children (0-17) | 1,476 | $4,824 [$1,013, $1,688] | $4,747 [$997, $1,661] |
| | Adults (18-44) | 4,076 | $13,962 [$2,932, $4,887] | $13,565 [$2,849, $4,748] |
| | Adults (45-64) | 3,556 | $8,470 [$1,779, $2,965] | $7,808 [$1,640, $2,733] |
| | Adults (65-74) | 1,103 | $2,793 [$587, $978] | $2,459 [$516, $861] |
| | Adults (75+) | 488 | $3,723 [$782, $1,303] | $3,386 [$711, $1,185] |
| Diabetes type 2 | Children (0-17) | 407 | $1,343 [$282, $470] | $1,114 [$234, $390] |
| | Adults (18-44) | 17,851 | $4,856 [$1,020, $1,700] | $2,776 [$583, $972] |
| | Adults (45-64) | 71,725 | $4,466 [$938, $1,563] | $2,112 [$444, $739] |
| | Adults (65-74) | 43,301 | $1,470 [$309, $515] | $748 [$157, $262] |
| | Adults (75+) | 41,035 | $1,805 [$379, $632] | $997 [$209, $349] |

Source: Wisconsin Health Information Organization (WHIO)
Calculations by: WHIO and Department of Health Services analysts
[1]The expenditures due to diabetes and related comorbidities reported in table above are approximately 70% of all Wisconsin state expenditures due to diabetes.
[2]The cost to charge ratio (CCR) adjustments in the table are based on minimum CCR for lower bound and average CCR for upper bound.

Table 8 presents diabetes billed costs by age group and in the parenthesis are CCR adjusted lower and upper bounds of billed charges. Per patient billed costs for prediabetes grow with advancing age, except the 65–74 age range, where costs are likely contained due to total allowable amounts imposed by Medicare. Per patient billed costs for those age 75 and older are likely higher due to other comorbidities. For type 1 diabetes, the highest billed costs are $13,962 with allowable amounts between $2,932 and $4,887 for adults 18–44; and for ages 45–64, the billed costs associated with type 1 diabetes are $8,470 with allowable amounts between $1,779 and $2,965. These are fixed costs for people with type 1 diabetes because it is not yet preventable—however, good disease management could keep the costs to the lower end of the cost bounds. Considering that type 1 diabetes onset is usually during childhood, the jump in costs at this age range may indicate loss of parental control of disease, less management during college and early working and parenting years, or other lifestyle or development factors.

For type 2 diabetes, we also see the per-person billed costs highest in the 18–44 age range at $4,856 [$1,020, $1,700], with billed costs dropping substantially at age 65 of $1,470 [$309, $515]. This could be because as people age, they become Medicare eligible and that covers all costs or as people age they naturally regulate their diets and increase their investments in health. The most important take away is that intervening in the prediabetes stage, when costs are low, to prevent progression to type 2 diabetes will be cost-effective.

## Employee Trust Funds

For the ETF sample, the definitions differ slightly than what we have outlined for other groups reported so we define them here to re-orient the reader to classifications. Stage 0 (non-diabetes) includes everyone in the sample without any primary diagnosis of prediabetes, type 1 or type 2 diabetes, or having diabetes-related episode claims. The numbers listed for the stage 0 group are costs associated with managing other non-diabetic conditions. Stage 1 (onset of diabetes) includes all types of diabetes: prediabetes, type 1, and type 2 with a formal diagnosis but no complications associated with the medical condition. Stage 2 (diabetes) includes only type 1 and type 2 diabetes and no prediabetes. Those in stage 2 have both a diabetes diagnosis and local complications associated with the medical condition. Stage 3 (advanced diabetes) includes diagnosed patients with systemic or chronic complications associated with diabetes such as deep circulation problems and renal malfunction. We do not include death in this reporting.

Table 9. ETF Non-Medicare average annual treatment allowable costs (all costs, including diabetes and comorbidities, $ values are per person per year [PPPY])

| Stage | Type | OOP[1] medical[5] + pharmacy[3,4] | Insurance pay medical[5] + pharmacy[3,4] | Third-party medical[5] + pharmacy[3,4] | Allowed cost[2] medical[5] + pharmacy[3,4,6] |
|---|---|---|---|---|---|
| Non-diabetes | Comorbid | $454 | $5,675 | $1,052 | $7,186 |
| Stage 0 (n = 223,010) | Diabetes | - | - | - | |
| Onset of diabetes | Comorbid | $346 | $3,530 | $548 | $4,426 |
| Stage 1 (n = 5,183) | Diabetes | $856 | $12,771 | $3,154 | $16,744 |
| Diabetes | Comorbid | $394 | $4,531 | $1,996 | $6,917 |
| Stage 2 (n = 6,924) | Diabetes | $886 | $13,767 | $6,981 | $21,629 |
| Advanced diabetes | Comorbid | $320 | $13,225 | $7,861 | $21,405 |
| Stage 3 (n = 359) | Diabetes | $999 | $51,367 | $27,279 | $79,657 |

Source: Employee Trust Funds—Derived from analysis provided by IBM-Watson

[1]OOP—out of pocket expenditure.

[2] Allowed amount is the amount for which an insurer contracts with a healthcare provider to pay for a service. It is more commonly a discount value than a set amount. A provider bills an insurance company their stated price for a healthcare service. The health plan applies the negotiated discount or fee schedule to the service billed, and this becomes the allowed amount. From the allowed amount, the insurance company applies cost sharing (copays, coinsurance, etc.), which is paid by the member. The member cost sharing plus the allowed amount is the net paid amount.

[3]National Drug Code list of 2017 diabetes insulin codes.

[4]National Drug Code list of 2017 diabetes non-insulin pharmacy codes.

[5] IBM Watson Methodology

[6]Note: Allowed amounts do not exactly add up to OPP + Insurance pay + third party pay because there are other miscellaneous charges not captured by these three categories.

Table 9 shows the annual PPPY costs associated with non-Medicare members in different stages of diabetes. These include the total costs of managing diabetes and any other comorbidities. We can see from Table 9 that a typical stage 0 (no diabetes) patient incurs the lowest out-of-pocket (OOP) medical and prescription charges, $454 per year, as compared to a person in stage 1 with an average annual OOP of $856 for diabetes plus $346 for comorbid conditions. Even for those without complications, annual OOP doubles with a formal diagnosis of diabetes. For those in stage 2, diabetes-related costs are $886, and $394 for comorbid conditions. While a diagnosis of diabetes adds over $850 in annual OPP expenses, the differences are not as significant from stage 1 to stage 2. There is a modest increase to $999 in annual OPP expenses for those in stage 3 suffering from advanced diabetes. Diabetes-related average annual medical and prescription costs are similar for stage 1 ($12,771) and stage 2 ($13,767). However, costs for stage 3 jump significantly to $51,367 PPPY. These cost differences are stark and give us insights into why employer sponsors like ETF may be interested in providing incentives for participation in Diabetes Prevention Programs to keep costs down[t]. If we could shift a person from stage 1 to stage 0, the annual PPPY medical and prescription cost could go down by a third, from $12,771 to $5,675. It stands to reason that shifting just 10% of patients with stage 1 diabetes to stage 0 could result in appreciable cost savings[u]. We will explore how introducing prevention programs with an adherence rate of 10% - 50% will result in cost savings for insurers using ETF data in the incremental cost effectiveness ratio and economic rate of return section below.

Another significant source of diabetes-related expenditures is third-party (Medicare and other insurances through coordination of benefits) medical and prescription expenses. As noted in Table 9, the PPPY third-party cost in stage 1 is $3,154, and it more than doubles for people with stage 2 disease to $6,981. This result clearly shows that costs rise with increasing disease stage, thus interventions that prevent or slow disease progression will result in cost savings, regardless of whether the insurer, insured person, or a third-party payer is paying those costs.

ETF also has many retired enrollees in their database. Table 10 reports the expenditure structure associated with the retired ETF enrollees with different stages of diabetes. The OOP costs for retirees are $371 for those without diabetes, $475 for those with onset of diabetes, and $766 for members with type 1 diabetes. Those with advanced diabetes face $770 per person OOP costs. Notably, OOP costs are lower than for non-retirees, which is typical for Medicare beneficiaries. Net medical and prescription costs for those in stage 0 without diabetes, stage 1 (includes prediabetes, type 1, and type 2), stage 2 (includes type 1 and type 2), and stage 3 (includes advanced type 1 or type 2) are $5,266, $6,262, $11,890, and $32,437 respectively.

Table 10. Medicare average annual treatment allowable costs (all costs, including diabetes and comorbidities, $ values are per member per year [PPPY])

| Stage of disease | Inclusion criteria | OOP[1] medical[5] + pharmacy[3,4] | Insurance pay medical[5] + pharmacy[3,4] | Third-party medical[5] + pharmacy[3,4] | Allowed cost[2] medical[5] + pharmacy[3,4,6] |
|---|---|---|---|---|---|
| Stage 0: No diabetes | | $371 | $5,226 | $7,440 | $13,058 |
| Stage 1: Onset of diabetes | Prediabetes & type 2 | $475 | $6,263 | $8,835 | $15,572 |

[t] Note: There are no known prevention programs for type 1 diabetes. In the IBM-Watson staging breakdown, people with type 1 diabetes are included in the sample, however at each disease stage they only represent 1.7% of the total diabetes universe, so removing them would not change the PPPY cost in each category.[16]

[u] Note: Cost savings do not directly accrue to ETF but help keep the pool dynamics stable.

| | | | | | |
|---|---|---|---|---|---|
| Stage 2: Diabetes | Type 1 | $766 | $11,890 | $15,096 | $27,696 |
| | Type 2 | $603 | $7,285 | $12,793 | $20,668 |
| | Types 1 or 2 undefined | $608 | $7,310 | $12,826 | $20,729 |
| Stage 3: Advanced diabetes | Types 1 & 2 | $770 | $32,437 | $35,433 | $68,659 |

Source: Employee Trust Funds—Derived from tables provided by IBM Watson
[1]OOP—out of pocket expenditure.
[2]Allowed amount is the amount for which an insurer contracts with a healthcare provider to pay for a service. It is more commonly a discount value than a set amount. A provider bills an insurance company their stated price for a healthcare service. The health plan applies the negotiated discount or fee schedule to the service billed, and this becomes the allowed amount. From the allowed amount, the insurance company applies cost sharing (copays, coinsurance, etc.), which is paid by the member. The member cost sharing plus the allowed amount is the net paid amount.
[3]National Drug Code list of 2017 diabetes insulin codes
[4]National Drug Code list of 2017 diabetes non-insulin pharmacy codes
[5]IBM Watson Methodology
[6]Note: Allowed costs do not exactly add up to OPP + Insurance pay + third party pay because there are other miscellaneous charges not captured by these three categories.

Among the retiree group, it is striking to note the higher third-party payments in each category. It is typical for retirees to hold two insurance plans simultaneously. For this group, Medicare covers less than half of the total costs for each category. One central theme emerges, which is average medical costs for caring for members with diabetes is comparable for retirees and non-retirees. This means the annual costs associated with diabetes are costs carried with someone until death. It makes sense, therefore, from both an insurer and member perspective, to make the needed investments for lifestyle and self-management of disease as early as possible.

We also asked ETF to create cost profiles for enrollees with diabetes who can be categorized in the bottom 25%, average, median, and top 90% of costs. While being in a high cost category doesn't imply poor self-management, because the rate of disease progression is individual-specific and dependent on factors out of the scope of this analysis, we can still make inferences of what annual costs could look like for a person with presumed good self-management of disease versus someone with presumed poor self-management. The hypothetical inference argues that those who have the support and environment enabling them to make conscious choices about their health will keep costs lower than for those who may not be able to make such choices. Numbers comparing individuals in the different cost categories are provided in Table 11.

Table 11 illustrates that a person with stage 1 diabetes faces a median annual cost of $1,245 as compared to $445 for those in the bottom 25$^{th}$ percentile. This is 2.8 times the annual costs for pre-diabetes or early onset of diabetes. When the disease progresses to stage 2, the annual costs for those in the bottom 25$^{th}$ percentile jumps to $756, which is 1.7 times of costs from the onset stage. Clearly, the cost differential between those in the lowest and highest cost categories is substantial. From a purely cost perspective, there is inherent value in efforts that shift the percentage of the insured population to the lower cost categories. While multiple influencing factors are outside a person's control, such as genetic background and the socio-economic conditions of early life, other factors, such as self-management post-diagnosis are within one's control. We cannot assign the cost contributions of each of these mitigating factors, however we can argue that teaching life-style changes and good self-management could potentially reduce annual costs, driving more insured people with diabetes into lower cost categories.

Table 11. Non-Medicare treatment allowable costs (only costs from episodes of diabetes), bottom 25th, average, median, and top 90th percentile cost profiles

| Stages | | 25th percentile | Average[1] | Median | 90th percentile |
|---|---|---|---|---|---|
| Stage 1: Onset of diabetes | Prediabetes & type 2 | $445 | $5,471 | $1,245 | $15,706 |
| Stage 2: Diabetes | Type 1 | $7,956 | $16,758 | $14,239 | $31,058 |
| | Type 2 | $756 | $7,722 | $2,964 | $19,037 |
| | Types 1 & 2 (unknown) | $812 | $8,468 | $4,117 | $21,624 |
| Stage 3: Advanced diabetes | Types 1 & 2 (aggregated) | $1,111 | $30,594 | $7,238 | $98,011 |

Source: ETF, derived from tables provided by IBM-Watson
[1]Cost used for ICER calculation

## Gestational Diabetes and Costs

Table 12 provides a breakdown of hospital cost-adjusted charges by insurance payer for births from mothers with: No diabetes, gestational diabetes, or type 1 or type 2 diabetes.

Table 12. Diabetes hospital costs for pregnant persons, cost to charge-adjusted, 2016 – 2019

| | Diabetes status during pregnancy | | | | | |
|---|---|---|---|---|---|---|
| Payer | No diabetes | | Gestational | | Type 1 or type 2 | |
| | N (% within) | Mean | N (% within) | Mean | N (% within) | Mean |
| Unknown | 1,827(1%) | $4,643 | 172(2%) | $5114 | 19 (1%) | $565 |
| Medicaid or BadgerCare Plus | 56,661(37%) | $4,859 | 4,284(38%) | $5965 | 934 (52%) | $8,128 |
| Private insurance | 92,397(60%) | $4,739 | 6,588(58%) | $5762 | 796(45%) | $7,467 |
| Self-pay | 1,304(1%) | $4,683 | 60(1%) | $5635 | 4(0%) | $5,545 |
| Other | 2,999(2%) | $4,627 | 220(2%) | $5180 | 27(2%) | $5,563 |

Source: Wisconsin Hospital Birth Records, 2016-2018. Note: Hospital-to-charge-ratio adjusts hospital charges to hospital of delivery (not for individual patient). N = number of observations

The Wisconsin hospital birth records data does not differentiate mothers with type 1 diabetes from mothers with type 2 diabetes, so this report groups them together. Table 12 shows that 61,879 (=56661+4284+934) mothers are on Wisconsin Medicaid or BadgerCare Plus, and of these, 6.9% have gestational diabetes. For comparison, an approximately equivalent 6.6% of mothers on private insurance have gestational diabetes.

Table 13. Cost of births by method of delivery, 2016 - 2019

| Pregnancy Type | Statistic | C-Section | Vaginal | Other* |
|---|---|---|---|---|
| No diabetes | N | 40,145 | 104,732 | 10,311 |
| | Mean cost | $7,553 | $3,759 | $4,341 |
| Gestational diabetes | N | 4,091 | 6,539 | 694 |
| | Mean cost | $8,358 | $4,319 | $4,952 |
| Diabetes types 1 & 2 | N | 1,013 | 689 | 78 |
| | Mean cost | $9,260 | $5,693 | $6,561 |

*Other includes forceps and suction. N = number of observations
Note: The costs are adjusted for hospital charges.

Because hospital charges for births vary by the method of delivery and the mother's age, this report considers hospital cost-to-charge adjusted deliveries within the categories of delivery in table 13. Vaginal deliveries for mothers who have gestational diabetes cost on average 14.9% more than for mothers who do not have gestational diabetes, and vaginal deliveries for mothers who have diabetes costs 51.4% more than to mothers who do not have diabetes. Similarly, C-section and other assisted births cost more for mothers with gestational diabetes than those without, and still more for those with diabetes.

The literature argues that Black people who are age 20 or older are twice as likely to have type 2 diabetes and that Black mothers are particularly vulnerable to chronic disease.[12-15] The literature suggests that this could be, in part, because systemic racism causes multiple stressors in many domains of life, and chronic stress over time takes a physical toll. We therefore look at hospital-cost-to-charge adjusted charges associated with birth by race.

In Wisconsin, we find the highest rate of gestational diabetes to be among people of Asian descent (13%), followed by those of Hispanic ethnicity (9%) and American Indians (8%). Yet, the costs of delivery with gestational diabetes are highest for Black people and lowest for Asian individuals. Gestational diabetes with hypertension rates are also highest among Asian people (24%), followed by American Indian (17%) and Hispanic (15%) individuals. Again, we see costs discordant with prevalence, with Black and Hispanic people with gestational diabetes and hypertension experiencing the highest costs, and American Indian and Asian people experiencing the lowest costs. The highest rates of type 1 or type 2 diabetes plus hypertension are experienced by expectant American Indian people (12%), followed by Asian and Hispanic individuals (7%), with Black people experiencing the highest costs.

Table 14. Costs by race and diabetes status for a delivery, 2016-2019

| | | Diabetes | | | Hypertension + diabetes | | |
|---|---|---|---|---|---|---|---|
| Race | Diabetes type | N | Within % | Hospital charge | N | Within % | Hospital charge |
| Hispanic | Non-diabetes | 12,094 | 90% | $4,701 | 745 | 77% | $7,180 |
| | Gestational | 1,148 | 9% | $5,554 | 147 | 15% | $8,477 |
| | type 1 or 2 | 188 | 1% | $6,751 | 72 | 7% | $8,517 |
| White | Non-diabetes | 101,733 | 94% | $4,557 | 9,057 | 86% | $6,750 |
| | Gestational | 6,129 | 6% | $5,373 | 1,199 | 11% | $7,606 |
| | type 1 or 2 | 630 | 1% | $6,742 | 306 | 3% | $9,413 |
| Black | Non-diabetes | 13,898 | 94% | $4,995 | 2,121 | 85% | $7,893 |
| | Gestational | 642 | 4% | $6,568 | 228 | 9% | $9,659 |
| | type 1 or 2 | 170 | 1% | $7,217 | 160 | 6% | $10,634 |
| AIAN[1] | Non-diabetes | 1,428 | 90% | $4,856 | 133 | 71% | $6,810 |
| | Gestational | 133 | 8% | $5,870 | 31 | 17% | $7,090 |
| | type 1 or 2 | 26 | 2% | $7,153 | 23 | 12% | $9,263 |
| Asian | Non-diabetes | 6,814 | 86% | $4,178 | 275 | 68% | $7,728 |
| | Gestational | 1,056 | 13% | $4,871 | 98 | 24% | $7,346 |
| | type 1 or 2 | 73 | 1% | $6,342 | 29 | 7% | $8,493 |
| Other | Non-diabetes | 5,905 | 92% | $4,701 | 485 | 79% | $7,328 |
| | Gestational | 424 | 7% | $5,554 | 89 | 15% | $7,589 |
| | type 1 or 2 | 64 | 1% | $6,751 | 39 | 6% | $8,353 |

Source: Wisconsin Hospital Birth Records, 2016-2019 [1]AIAN = American Indian or Alaskan Native.

When reviewing hospital charges adjusted by hospital (not shown), we also find systematic differences by race:

- On a non-diabetes delivery, the mean charge for Black people is 9% higher than for White people.
- For a Black person who has gestational diabetes, the charges for delivery are 22% higher than for a White person who has gestational diabetes, and the charges for delivery are 7% higher for a Black person who has diabetes than for a White person who has diabetes.
- Expecting Native American people who have type 1 or type 2 diabetes face 6% higher cost-adjusted hospital charges than White people.
- While Asian people tend to have a higher incidence of gestational diabetes, their hospital cost-adjusted charges tend to be lower than all other groups (Table 14).

In Wisconsin, certain cities like Green Bay, Racine, Beloit, Milwaukee, and Kenosha have higher concentrations of Black people. Thus, a potential confounding factor could be that the higher charges are reflective of the hospitals where Black people seek care. We do not condition for hospital and regional fixed effects when analyzing hospital charges.

### Programmatic Costs

For this analysis, we were not able to secure detailed programmatic costs associated with HLWD. It costs $30 per person to participate in HLWD. Costs of organizing workshops, follow ups and dedicated staff time are not included in this analysis. The programmatic costs associated with the NDPP are built into the diabetes impact tool provided through the Centers for Disease Control and Prevention (CDC).

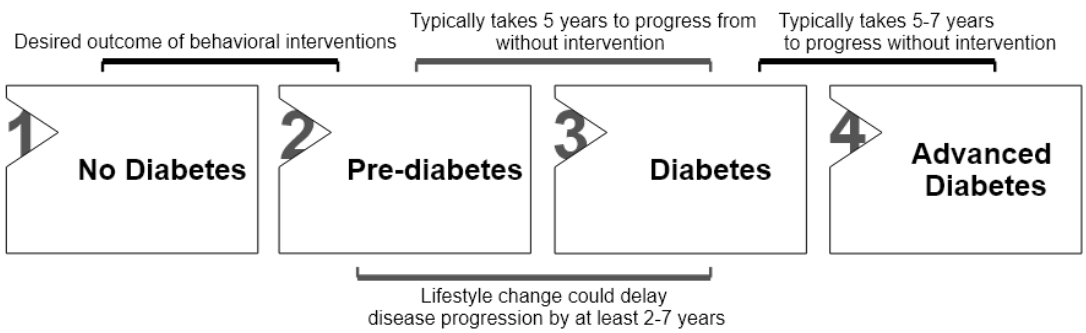
### Department of Corrections

For this round of cost data collection, we were not able to identify an incarcerated population with diabetes because of the significant proprietary data collection required. We hope to acquire this information in the next reporting cycle.

## V. Modeling Disease Progress for Estimating Costs of Disease

Usually, each disease progresses to severe states or recovery states. For some diseases like diabetes, it is possible and desirable to intervene before the disease is even diagnosed.[16-17] For example, implementing supported behavioral changes among persons with prediabetes can successfully avert the disease state of type 2 diabetes. This can be conceptualized in two ways: one, the benefits to a healthy population in reducing the economic burden of disease to the state; two, the benefits to an individual in terms of quality of life, and reduced healthcare expenditures. Figure 4 illustrates how disease progresses from prediabetes to type 2 diabetes, and it also shows the benefits of intervention to either reverse the course of disease or to slow down disease progression.

Figure 4. Diabetes mellitus disease progression diagram



As can be seen in Figure 4, a behavioral intervention can send a person with prediabetes to a state without diabetes. Alternatively, a behavioral intervention can delay progression to type 2 diabetes. Similarly, disease management interventions can delay progress from a symptomatic diabetes stage to an advanced diabetes stage. There are scant few scientific journal articles that address disease progression in diabetes—and the articles in print do not offer standardization.[16-21] In type 2 diabetes staging, the considerations and focus are on the type of complication for which to model progression, such as retinopathy, myocardial infraction, cardio-vascular complications, and in more advanced stages, renal failure. Our focus here is to demonstrate, using ETF grouper methodology, how costs can change with disease staging. The purpose here is not to validate a disease staging methodology.

To model disease progression, it is important to see how an individual versus a population progresses over time. For instance, at a given time period ‘t,’ a person may be normal but develop prediabetes or gestational diabetes at time ‘t+1’, and further at some time ‘t+j’, progress into a formal diagnosis of diabetes. The question that prevention programs such as NDPP typically ask is: can we prevent people with pre-diabetes or gestational diabetes from progressing to a diabetic state? Diabetes self-management programs are directed at keeping the population with diabetes from developing complications that are costly both for personal health and to the healthcare system.

Table 15. Transition matrix showing disease progression across stages (conceptual)[16-17]

| State population movement | t + 1<br>No diabetes | <br>Prediabetes | <br>Diabetes |
|---|---|---|---|
| No diabetes | $Normal_t$ + Expected $Normal_{t+1}$ | New cases = (Diagnosed prediabetes + undiagnosed prediabetes in $Wisconsin)_{t+1}$ with presumed normal $HbA_{1}c$, FPG, OGTT in period t | New cases = (Diagnosed $diabetes)_{t+1}$ with presumed normal $HbA_{1}c$[1], FPG[2], OGTT[3] in period t |
| Prediabetes | Plausible and desirable outcome of DPP: (Diagnosed prediabetes + undiagnosed prediabetes in $Wisconsin)_t$ with normal $HbA_{1}c$, FPG, OGTT in period t+1 | Diagnosed prediabetes + undiagnosed prediabetes in Wisconsin in period t | New cases = $Diabetes_{t+1}$ with prediabetes levels of $HbA_{1}c$, FPG, OGTT in period t |
| Diabetes | RARE close to 0: (Diagnosed $diabetes)_t$ with normal $HbA_{1}c$, FPG, OGTT | RARE close to 0 and desirable: (Diagnosed $diabetes)_t$ with prediabetes ranges of $HbA_{1}c$, FPG, OGTT in period t+1 | (Diagnosed $diabetes)_t$ with diabetes ranges of $HbA_{1}c$, FPG, OGTT in period t |

[1]The $HbA_{1c}$ test measures the average resting blood glucose levels over a period of time, typically three months.
[2]The fasting plasma glucose test (FPG) is administered after abstaining from food or sugar beverages for a period of 8 hours.
[3]An oral glucose tolerance test (OGTT) is done over a two-hour period, where a physician takes a baseline measurement, asks the patient to consume a sugary beverage, and takes a blood glucose measurement again after two hours.

(light shading) Observed cases + undiagnosed cases in the population
(dark shading) Desired outcome of DPP

Using the logic of Table 15, we create a plausible scenario for the Wisconsin population of people with pre-diabetes and diabetes. We start with simple macro-variables: the Wisconsin population estimate in 2019 (5,822,434), the growth rate of Wisconsin’s population (about

2.4%), the percent of Wisconsin's population with known diabetes diagnoses (8.7%), the estimated Wisconsin population with diagnosed or undiagnosed prediabetes (30%), and an annual growth rate of disease progression of 3% (potentially an under-estimate) and reconstruct Table 15 with these macro-values.[v]

Table 16. Crude calculation of diabetes stage progression from 2019 to 2020 using metadata[1,2,3]

| State diabetes population movement | | Wisconsin 2020 | | |
|---|---|---|---|---|
| | | No diabetes | Prediabetes | Diabetes |
| Wisconsin 2019 | No diabetes | 3,768,431 | 34,224 | 7,770 |
| | Prediabetes | 0 | 1,584,048 | 48,991 |
| | Diabetes | 0 | 0 | 518,709 |

Source: Wisconsin population statistics.
[1]Wisconsin population growth 2.4%
[2]2019 population = 5,822,434
[3]Disease progression rate 3%

Table 16 then shows that annually we potentially add 34,224 Wisconsinites to the prediabetes pool, a projected 7,770 (at 8.7 prevalence rate) Wisconsinites are newly diagnosed with diabetes, and a projected 1,148 Wisconsinites with prediabetes progress to a formal diagnosis of diabetes (not shown).

Table 17. Hypothetical benefits of prediabetes cases averted with NDPP intervention in disease progression

| Participants | Fully successful NDPP | Partial success rate NDPP |
|---|---|---|
| | Goal = 10% | Goal = 50% |
| Cases averted | 161,827 | 24,496 |

Source: Wisconsin Department of Health Services calculations

Table 17 offers a scenario where 10% of participants are fully successful in implementing NDPP, and 50% are partially successful in implementing NDPP. In such a scenario, 161,827 Wisconsinites would move from prediabetes stage 1 to a non-diabetes stage 0, and 24,496 Wisconsinites would stay in prediabetes stage 1 without progressing to diabetes. Several factors have to be in place to yield such results: mandatory testing for prediabetes at routine annual check-ups, offering of diabetes prevention training to all Wisconsin residents with prediabetes through insurance, and making available evidence-based programs like the NDPP to all people with prediabetes.

We use these hypothetical scenarios to form assumptions of how programs like the NDPP or HLWD yield a higher economic rate of return (ERR; or return on investment) for the State of Wisconsin. For calculating the ERR we also need to take into consideration disease progression. We next present disease progression using ETF data to illustrate transitions across different stages of disease. Ideally, we would be able to illustrate these stages over 5 years, because that is typically how long it takes for a person to progress to more advanced stages of diabetes. In this next section, we show the transitions over two consecutive time periods.

[v] Another way to present this example would have been to start with the diagnosed diabetes group. For example, an estimated 346,190 adults in Wisconsin have been diagnosed with diabetes and an additional 128,900 adults are estimated to have diabetes that has not yet been diagnosed, for a total of 475,090 adults (10.1%).

## Transition Table Example Using ETF Data

The main purpose of this section is to illustrate disease progression because it is commonly used to calculated ICERs and ERRs. Ideally, we would have a long panel to show these transitions over five to ten years of a patients' life, however, two period tables also illustrate the subtle nuances and data considerations a state, institution, or researcher needs to pay attention to before requesting an ICER-ERR calculation that relies on disease progression.

Table 18. Transition matrix for disease progression (follows individual with continuous enrollment)

| | Stages of disease | 2019 Stage 0: No diabetes | 2019 Stage 1: Onset of diabetes | 2019 Stage 2: Diabetes | 2019 Stage 3: Advanced diabetes |
|---|---|---|---|---|---|
| 2018 | Stage 0: No diabetes | 182,671 | 2,057 | 1,222 | 69 |
| 2018 | Stage 1: Onset of diabetes | | 1,954 | 756 | 28 |
| 2018 | Stage 2: Diabetes (type 1 or 2)[1] | | | 4,295 | 127 |
| 2018 | Stage 3: Advanced diabetes | | | | 72 |

Source: Employee Trust Funds data and derived table from IBM-Watson Analysis.
Note: Disease staging via IBM-Watson includes both type 1 and type 2 in Stage 2. It would be ideal to have this population separated out, but we would run into small numbers for reporting.

Table 18 shows the classic transition matrix of enrollees in ETF and the stages of disease. In this transition matrix we follow the individual 'i.' For example, of the total enrollees in 2018 without diabetes, 182,671 enrollees remained at stage 0 without diabetes, 2,057 enrollees were diagnosed with prediabetes, 1,222 enrollees were diagnosed with type 1 or 2 diabetes with localized symptoms, and 69 were diagnosed with advanced diabetes. Of the 2018 enrollees with stage 1 diabetes, 1,954 enrollees remained in that disease state, 756 transitioned to stage 2 diabetes with localized symptoms, and 28 transitioned to advanced diabetes from the onset of diabetes in 2018. Of the 2018 enrollees with stage 2 diabetes of type 1 or type 2, the vast majority (4,295) remained at stage 2 with localized symptoms, while 127 enrollees progressed to stage 3 with advanced diabetes.

Table 19. Transition table for disease progression with diabetes (no continuous enrollment requirement)

| | Stage of disease | 2019 Stage 0: No diabetes | 2019 Stage 1: Onset of diabetes | 2019 Stage 2: Diabetes | 2019 Stage 3: Advanced diabetes |
|---|---|---|---|---|---|
| 2018 | Stage 0: No diabetes | 240,617 (=182,671+57,946) | 2,444 (=2,057+387) | 1,522 (=1,222+300) | 96 (=69+27) |
| 2018 | Stage 1: Onset of diabetes | | 2,132 (=1,954+178) | 804 (=756+46) | 33 (=28+5) |
| 2018 | Stage 2: Diabetes (type 1 or 2) | | | 4,506 (=4,295+211) | 157 (=127+30) |
| 2018 | Stage 3: Advanced diabetes | | | | 89 (=72+17) |

Source: Employee Trust Funds data and derived table from IBM-Watson Analysis.
+= new cases

In contrast to table 18, table 19 shows disease progression as cases are added. In table 19, we are not following individual enrollees but are looking at the ETF member population as a whole. Of the enrollees in 2018 without a formal diagnosis of diabetes, 240,617 stage 0 enrollees remain undiagnosed with diabetes in 2019 and we add 57,946 new enrollees[w] because we relax the continuous enrollment requirement in table 18. Stage 1 cases increase by 387 newly diagnosed cases to a total of 2,444. For stage 2 diabetes, 300 new cases are added for a total of 1,522. Lastly, stage 3 cases increase by 27 new cases for a total of and 96. Of cases existing in the 2018 stage 1 population, they increased by 178 new cases in 2019. For stage 2, 46 new cases were added in 2019, and 5 new stage 3 diabetes cases. Similarly, from the 2018 population, 211 new stage 2 cases were added in 2019, and 30 new stage 3 diabetes cases. Existing stage 3 cases grew by 17 new cases in 2019.

The distinction between table 18 and 19 is important when analyzing disease growth rates. For example, it is estimated in Wisconsin 1 in 3 people have prediabetes[2] but do not have a formal diagnosis. If that is true, then our real 2019 ETF count of enrollees with onset of diabetes would be 81,847 (240,617(0.33) + 2,444). We make our assumptions of disease progression modeling based on ETF data for cost, which affects our calculation of the economic rate of return.

# VI. Incremental Cost Effectiveness Ratio (ICER) and Economic Rate of Return (ERR)

In this section we report on the financial impact of diabetes on the state of Wisconsin. We analyze this with two distinct metrics: incremental cost effectiveness ratio (ICER) and the Economic Rate of Return (ERR). The ICER evaluates the cost effectiveness of two treatments with the understanding that treatments vary across the population and that any treatment will benefit people differently. ERR, on the other hand, measures the net benefit to the whole population if a treatment were to be implemented widely.

## Notes on Calculating ICER and ERR:

- We calculate ICER only for NDPP. CDC provides a toolkit to perform standard evaluation of the economic impact of a type 2 diabetes prevention program. HLWD is offered to type 1 and type 2 patients, thus we include an ERR calculation on the impact of HLWD on disease progression.
- The underlying economic model incorporates parameters such as: results from statistical studies of diabetes disease progression, macroeconomic conditions, estimated costs, and estimated or predicted quality of life years gained, as well auxiliary sources such as program documents.
- Once all assumptions in the model are clear, an economic model that calculates the net present value and net costs is used to develop the ICER and ERR calculations.

## Programs Evaluated

### National Diabetes Prevention Program (NDPP)

In 2010, the U.S. Congress authorized the Centers for Disease Control and Prevention (CDC) to implement the National Diabetes Prevention Program (NDPP) aimed at preventing type 2 diabetes. This year-long program teaches healthy lifestyle changes through diet modification and exercise. The NDPP brings together community organizations, private insurers, employers, health care organizations, faith-based organizations, and government agencies. According to CDC, three distinguishing features make NDPP appealing. First, it offers a certified lifestyle coach for the duration of the training. The coach teaches new skills, encourages participants to

[w] More accurately, the increase is a result of new enrollees and members who were not continuously enrolled during the prior enrollment year.

set and meet goals, and keep participants motivated. The coach also facilitates discussions and helps make the program fun and engaging. Second, it offers a CDC-approved curriculum with lessons, handouts, and other resources to help participants make healthy changes. Third, participants have group support during the course from peers with similar goals and challenges. Together, participants can share ideas, celebrate successes, and work to overcome obstacles. In some programs, the participants consistently stay in touch with each other. Participants may find it easier to make lifestyle changes when supported by a group.

While other similar programs are available through various private and public institutions, the appeal of the CDC running a program like this is its scalability. As more stakeholders provide NDPP as a covered benefit to their employee or membership base, the standardization permits scientific measurement across the U.S. It is the overarching goal of this federally-funded program to reduce the incidence of type 2 diabetes by 50%. This goal will be realized as the NDPP is more widely promoted as a covered benefit.

Why take such dramatic steps at a governmental level? In the U.S., 86 million people are said to have prediabetes and nine out of ten people with prediabetes are not aware of it.[19] Approximately one third of people with prediabetes will progress to type 2 diabetes within 5 years.[1-2, 9-10,18-22] Obviously, this is a pressing health care concern. Diabetes is associated with numerous comorbid conditions with two prominent culprits: hypertension and obesity. These top three co-occurring medical conditions are highly preventable with behavioral interventions. Any reductions in disease progression or prediabetes cases averted could potentially reduce the global disease burden by 40%.[1-2,9-10, 12-15, 18-21]

### Healthy Living with Diabetes (HLWD)

HLWD is an evidence-based workshop for people who have diabetes. The six-week course is run by the Wisconsin Institute for Healthy Aging (WIHA). It is also available in Spanish in Wisconsin as *Vivir Saludable con Diabetes*. In 2014 (the most recent year for which HLWD data are available), an estimated 475,000 Wisconsin adults had diabetes, and an estimated 1.45 million had prediabetes; diabetes was the leading cause of blindness, heart disease, stroke, and lower extremity amputations; and diabetes cost Wisconsin $4.07B in direct health costs and $2.7B in indirect costs. Instituted in 2013, HLWD reached 639 participants during 91 HLWD workshops in 26 counties through 2014. [22]

Nationally, the results for people with diabetes participating in HLWD showed a 53% reduction in ED visits and statistically significant improvements in Hemoglobin A1c (HbA1c), a critical measure of blood sugar levels over time. Participants also experienced reductions in health distress, symptoms of hypo- and hyper-glycemia, reported improved health, and reported better communications with physicians.[23, 24-26] In Wisconsin, results showed that HLWD participants had 24% fewer encounters with the healthcare system six months after participating in the HLWD program than during the six months prior to participation.[23, 24-26] The HWLD runs currently and offers programs throughout Wisconsin.

## Incremental Cost Effectiveness Ratio

To calculate the Incremental Cost Effectiveness Ratio (ICER) for the NDPP, we use the Diabetes Prevention Impact Toolkit from the Centers of Disease Control and Prevention (CDC). The toolkit is designed to predict the health and economic effects of NDPP on a state, employer, and insurer's population of people who are at risk for type 2 diabetes. Through this toolkit, it is possible to calculate program costs, diabetes-related medical costs, and return on investment from NDPP to a group or state.

## Data Assumptions Underlying the ICER

The data for ICER comes predominantly from meta sources available through the CDC. The biggest data challenge for an ICER calculation is getting true costs associated with the two programs (NDPP and HLWD). While the CDC diabetes impact toolkit allows us to calculate the ICER for NDPP, there is no such tool available for HLWD, and it would be beyond the scope of this report to develop one.

The underlying CDC model for determining the ICER for NDPP in Wisconsin calculated detailed opportunity costs along the dimensions of: direct medical costs, employer costs, absenteeism costs, productivity costs, and mortality costs (see Table 20 metadata provided in the diabetes impact toolkit for Wisconsin.)

Table 20. Wisconsin per person diabetes type 2 costs in ICER calculation in 2013 dollars

| Sex | Direct medical costs | Costs incurred by employers (all payers) | Costs to Medicaid | Absenteeism cost per worker | Cost of productivity loss | Inability to work attributable to diabetes | Mortality costs |
|---|---|---|---|---|---|---|---|
| Total | $ 15,780 | $ 9,750 | $ 3,490 | $ 305 | $ 210 | $ 2,925 | $1,235.2 |
| Male | $ 17,070 | $ 10,116 | $ 3,788 | $ 359 | $ 117 | $ 3,796 | $ 837.2 |
| Female | $ 14,552 | $ 9,337 | $ 3,312 | $ 252 | $ 298 | $ 2,076 | $ 398.0 |

Source: Center for Disease Control Diabetes impact toolkit data assumptions default values.

The toolkit relies on estimates from National Health and Nutrition Examination Survey 2011 – 2014, the Behavior Risk Factor Surveillance System BRFSS (2014), and the National Health Interview Survey (2014) to characterize at risk groups. The costs of implementation of the program, productivity losses resulting from advancing disease, and health costs are calculated through a detailed survey on economic costs of prediabetes.[27,-28] We input updated population characteristics and cost structures.

We rely exclusively on built-in programmatic costs, and costs associated with the program in the form of fees are explicitly modeled. As Table 20 shows, costs in the model include employer costs, costs accruing due to inability to work, absenteeism, hospitalization costs, mortality costs, medical costs, costs due to productivity losses, and direct medical costs attributable to diabetes.

The toolkit allows for states and researchers to customize the population characteristics for employer and insurer modules. Wisconsin's 2019 Diabetes Care and Prevention Action Program[29] requires us to report on the diabetes-related programs for ETF, the Department of Public Instruction, and the Department of Corrections. While we do not have enough information to conduct a thorough evaluation for the Department of Corrections or Department of Public Instruction, we are able to evaluate NDPP for Wisconsin Medicaid and ETF using the Diabetes Prevention Impact Toolkit user input dashboard.

We used the diabetes impact tool kit dashboard to perform two customizations. For ETF, we could theoretically choose to use the insurer input, or employer input dashboard page to evaluate the effect of NDPP. Because productivity costs are captured in the employer dashboard, we chose to use the employer dashboard for the ETF calculations to obtain a more relevant ICER calculation. We customized the employer dashboard input page for ETF members to reflect current data on age, sex, and cost. We used state employee demographic data for race and ethnicity in ETF customization.

For Medicaid, there is no employer relationship, thus no productivity costs are captured, and the insurer input dashboard page is appropriate.[27, 28] The underlying data in the default dashboard is from 2014, but we had more updated data, so we input 2019 information on age, sex, ethnicity, BMI, and cost numbers for the Medicaid ICER calculation.

## ICER Calculation

The decision to implement a program like the NDPP depends fundamentally on how an intervention benefits an individual as compared to the counter-factual (leaving individuals untreated or following the status quo treatment). Incremental cost-effectiveness analysis is a formal decision framework for making treatment decisions based on the benefit of the treatment to the patient population. In economics, this calculation of net benefits is grounded in expected utility theory because the decision hinges on the expectation of returns on monetized health gain minus costs incurred to acquire the health benefit.

Table 21. Medicaid population distribution (ages 18 and over) at risk for prediabetes input for CDC diabetes impact dashboard, 2019

| Parameter | Number | % of total |
|---|---|---|
| Total Medicaid enrollees ages 18+ | 873,300 | |
| ***Sex*** | | |
| Male | 354,389 | 41% |
| Female | 518,911 | 59% |
| ***Age*** | | |
| 18–44 | 460,041 | 53% |
| 45–64 | 218,882 | 25% |
| 65–74 | 108,313 | 12% |
| 75+ and other | 86,064 | 10% |
| ***Race and ethnicity*** | | |
| Hispanic (all races) | 159,014 | 8% |
| White, non-Hispanic | 526,541 | 60% |
| Black, non-Hispanic | 138,894 | 16% |
| Asian | 24,236 | 3% |
| Other | 115,971 | 13% |
| ***BMI***[1] | | |
| BMI 18.5–24.9 | - | 42% |
| BMI 25–29.9 | - | 30% |
| BMI > 30 | - | 28% |
| ***Wisconsin prediabetes at-risk population*** | 1 in 3 | 33% |
| ***Program costs***[2] | DPP program costs default value from CDC | |
| Program cost per person[a] | $417 | - |
| Screening cost per person[b] | $12.50 | - |
| Other screening costs[c] | $20 | - |
| Number of screenings per case detected | 2 | - |
| ***Individual costs***[3] | | |
| Costs incurred in the year of prediabetes diagnosis[a] | $5,435[3d] | |

| | | |
|---|---|---|
| Costs incurred per year after prediabetes diagnosis[b] | $3,253[3e] | |
| Discount rate[c] | | 3% |
| ***Productivity costs***[4] | | |
| Days of work missed per year due to diabetes[a] | 3.3 days | |
| Daily earnings for persons with diabetes[b] | $134 | |

Source: Wisconsin Medicaid data [1]BMI BRFSS estimate of Medicaid/BadgerCare distribution
[2a,b,c]CDC default values where we didn't have any updated values
[3a]Medicaid 2019 per person estimated values used for first year from Table 5, page 16
[3b]After diagnosis is discounted by 1.67 (CDC recommendation $year1 = 1.67*year2)
[3c]Default discount rate = 3%
[3d]Sensitivity analysis default value $3,300 lowest range in Diabetes Impact Toolkit
[3e]Sensitivity analysis default value $2,000 lowest range in Diabetes Impact Toolkit
[4a]Default days lost
[4b]Wisconsin Medicaid family of 4 daily eligibility rate

In table 21, we present the data assumptions used for the Medicaid population in Wisconsin. As shown in Table 21, the total number of enrollees who were age 18 or older in 2019 was 873,000. Within the Medicaid population, 59% were female and 41% were male. Looking at race and ethnicity, 60% were White, 18% were Hispanic, and 16% were Black, as compared to the overall Wisconsin population, which is 81% White, 8% Hispanic and 7% Black (Census, 2020).[30] Regarding the age distribution, 52% of the Medicaid population were between 18 and 44 years old, 25% were aged 45 to 64, 12% aged 65 to 74, and 10% were 75 years old or more.

We used data from the 2019 BRFSS results to estimate the Medicaid/BadgerCare distribution for BMI. We estimate that 30% of the Medicaid population had a BMI between 25 and 40, and 28% had a BMI of 40 or higher. In Wisconsin, 1 in 3 people are presumed to have prediabetes. We used CDC default values for programmatic costs. This lifestyle education model costs $417 per person, screening for prediabetes costs $12.50, and CDC estimated the administration costs to be $20 per person. For individual costs, we estimated Medicaid values using 2019 data. For the first year per person Medicaid costs we use the higher end of Medicaid expenditures presented in Table 5 with comorbid conditions because we want to run a simulation where we focus on the higher risk Medicaid population with one or more comorbid conditions. We also wanted to stay within the CDC recommended range of costs per person. For our example, we summed estimated pharmacy costs, insulin costs, in-patient costs and out-patient costs, which are calculated to be $5435 (Table 4, page 15) per person. The CDC algorithm predicts that costs for the first year are 167% of the subsequent year costs, or $3253 (=$5435÷1.67) per person[27]. We also run a simulation for Medicaid where we focus on the lower end of the cost structure to illustrate these tradeoffs. Finally, for productivity costs, we used the CDC default of 3.3 days of work lost due to prediabetes, and for lost wages we used the daily rate for a family of four, which is $134 [(1.35 × Federal Poverty Line)/(52 × 5)] per day.[x]

Next, we report the results from the CDC diabetes impact for incremental cost effectiveness. In tables 22-25 we present the results of ICER for Medicaid. As inputs, we enter the projected participants in WDDP-Medicaid, which are 9.6% (of 873,300) of the Medicaid population, or 84,067 adults participants enrolled in Medicaid. The results presented in Table 23 and 24 compares two scenarios. Scenario 1 assumes that 10% of the population has prediabetes, of which 100% are eligible to participate in Wisconsin's NDPP. In scenario 2, 100% of the people

[x] In the spirit of standardized reporting, we use CDC defaults on lost productivity days and daily income rate. This estimate is based on their extensive survey in 2012.

with prediabetes participate. We do not model any program costs other than the $417, $12.5 and $20 (between 2-3 screening per person) incurred by the person to enroll in the program and pay for screening costs. The net costs for the individual participating in the program are given in Table 25. We can see by the eighth year that participating in NDPP becomes cost saving for Medicaid given our underlying data assumptions. This model is sensitive to number of screenings per person, the initial values for cost, and percentage of people we allocate for screening. For example, if we use the lower bound values for Medicaid simulation, NDPP becomes cost-effective in year 10.

Table 22. Cumulative projected Medicaid cases of diabetes/cumulative years with diabetes averted for 84,067[1] projected NDPP-Medicaid participants

| Year | Incidence with no NDPP | Incidence with NDPP | Cases averted[2] | Years of diabetes averted[3] | Risk reduction[4] (%) |
|---|---|---|---|---|---|
| 1 | 2,873.4 | 1,854.9 | 1,018.5 | 1,018.5 | 35.4% |
| 2 | 5,599.3 | 4,089.1 | 1,510.2 | 2,528.7 | 27.0% |
| 3 | 8,184.4 | 6,332.9 | 1,851.5 | 4,380.2 | 22.6% |
| 4 | 10,634.7 | 8,870.3 | 1,764.4 | 6,144.6 | 16.6% |
| 5 | 12,956.2 | 11,275.1 | 1,681.1 | 7,825.7 | 13.0% |
| 6 | 15,154.6 | 13,553.3 | 1,601.3 | 9,427.0 | 10.6% |
| 7 | 17,235.3 | 15,710.2 | 1,525.1 | 10,952.1 | 8.8% |
| 8 | 19,203.5 | 17,751.4 | 1,452.1 | 12,404.2 | 7.6% |
| 9 | 21,064.2 | 19,681.9 | 1,382.3 | 13,786.5 | 6.6% |
| 10 | 22,822.1 | 21,506.6 | 1,315.5 | 15,102.0 | 5.8% |

[1]The number of projected participants is part of the results the diabetes impact tool kit gives after running through the ICER algorithm.
[2]The "Cases averted" column is the difference between the cases in the "Incidence with no NDPP" in scenario 1 and the "Incidence with NDPP" in scenario 2.
[3]"Years of diabetes averted" is a cumulative calculation of the "Cases averted" column. It represents the number of person-years with diabetes that are averted with intervention.
[4]The "Risk reduction" column is equal to the "Cases averted" divided by the "Incidence with no intervention" column.

Table 23. Medical, productivity cost, and net cost of offering NDPP

| | Medical Costs | | | Productivity Costs[3] | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | No NDPP | NDPP | Savings[1] | No NDPP | NDPP | Savings | Program Cost[2] | Net Cost[4] |
| 1 | $5,815 | $5,744 | $71 | $16 | $11 | $6 | $517 | $440 |
| 2 | $11,596 | $11,463 | $134 | $47 | $33 | $14 | $517 | $369 |
| 3 | $17,326 | $17,125 | $201 | $91 | $67 | $24 | $517 | $293 |
| 4 | $22,993 | $22,742 | $251 | $146 | $113 | $33 | $517 | $233 |
| 5 | $28,691 | $28,389 | $302 | $212 | $170 | $42 | $517 | $174 |
| 6 | $34,316 | $33,962 | $354 | $286 | $236 | $50 | $517 | $114 |
| 7 | $39,878 | $39,470 | $408 | $368 | $311 | $57 | $517 | $53 |
| 8 | $45,376 | $44,913 | $462 | $456 | $393 | $63 | $517 | -$9 |
| 9 | $50,800 | $50,282 | $518 | $551 | $481 | $70 | $517 | -$71 |
| 10 | $56,158 | $55,583 | $575 | $650 | $575 | $75 | $517 | -$133 |

Source: CDC State DPP Tool Kit Medicaid population simulation results

Note: All costs are discounted back to year 0. The default discount rate (3%) or user-entered rate is used to discount costs.

[1]The "Medical Cost savings" column is the cumulative difference between costs in the "Medical Costs with No NDPP" column and the "Medical Costs with NDPP" column. Numbers may not add up due to rounding.

[2]Program Cost includes the cost of screening if you have chosen to do a screening program. The cost of screenings that do not detect cases of prediabetes are accounted for in the program cost.

[3]The "Productivity Cost Savings" column is the cumulative difference between costs in the "Productivity Costs with No NDPP" column and the "Productivity Costs with NDPP" column. Numbers may not add up due to rounding.

[4]The "Net Cost" column is the difference between the "Program Cost" column and the "Medical Cost-savings" column. Numbers may not add up due to rounding.

Table 24. Medicaid incremental cost-effectiveness ratio (ICERs) for NDPP in Wisconsin (in 2013 dollars)

| Year | Net cost[1] | QALYs gained[2] | Incremental cost-effectiveness ratio[3] | Cost per case averted |
|---|---|---|---|---|
| 1 | $440 | 0.0005 | $842,024 | $32,700 |
| 2 | $369 | 0.0013 | $279,054 | $18,498 |
| 3 | $293 | 0.0023 | $125,263 | $11,948 |
| 4 | $233 | 0.0034 | $69,333 | $9,978 |
| 5 | $174 | 0.0044 | $39,648 | $7,826 |
| 6 | $114 | 0.0054 | $21,001 | $5,376 |
| 7 | $53 | 0.0065 | $8,198 | $2,624 |
| 8 | -$9 | 0.0075 | Cost Saving | Cost Saving |
| 9 | -$71 | 0.0085 | Cost Saving | Cost Saving |
| 10 | -$133 | 0.0095 | Cost Saving | Cost Saving |

Source: CDC State DPP Tool Kit Medicaid population simulation results
ICER = incremental cost-effectiveness ratio; QALYs = quality-adjusted life years;
[1]The "net cost" column is the cumulative difference between the discounted program costs and the medical cost-savings. Productivity cost-savings are also included if you are using the employer module.
[2]The "QALYs Gained" column represents the QALYs gained for each participant in the program. One QALY or "quality-adjusted life year" is equal to one year of life with a perfect quality of life.
[3]The ICER is equal to the "Cumulative Net Cost" column divided by the "Cumulative QALYs Gained" column. It is stated as dollars spent per QALY gained. When net costs are negative, the ICER is listed as "cost-saving," because the intervention saves money and improves QALYs.

In table 25, we present the data assumptions used for the ETF population. As shown in the table, the total number of enrollees 18+ years of age in 2019 was 186,379. The ETF population was 53% female[y], with age distribution among the ETF population as follows: 45.08% were between the ages of 18 and 44, 35.50% were ages 45 to 64, 12.54% were ages 65 to 74, and 6.88% were ages 75 and older.

[y] Please note that the sex variable in this study is a binary classification, male or female, which is not accurate for all people. Because the data sources we used do not have information on gender identity in addition to legal sex, we are unable to reflect on the incidence or prevalence of diabetes among transgender, nonbinary, or intersex people.

Table 25. ETF-ICER data assumptions for (ages 18 and over) at risk for prediabetes, 2019

| Parameter | Number | % of total |
|---|---|---|
| Total ETF Enrollees ages 18+ | 186379 | |
| Sex | | |
| Male | 87907 | 47% |
| Female | 98472 | 53% |
| Age | | |
| 18-44 | 84018 | 45% |
| 45-64 | 66158 | 36% |
| 65-74 | 23372 | 13% |
| 75+ and other | 12831 | 7% |
| Race and ethnicity[1] | | |
| Hispanic (all races) | - | 3% |
| White, non-Hispanic | - | 86% |
| Black, non-Hispanic | - | 7% |
| Asian | - | 3% |
| Other races/ethnicities | - | <1% |
| BMI* | | |
| BMI 18.5 – 24.9 | - | 42% |
| BMI 25 – 29.9 | - | 30% |
| BMI > 30 | - | 28% |
| Wisconsin prediabetes at-risk population | 1 in 3 | 33% |
| No. prediabetes screened (counter-factual = 0) | 3 | - |
| Program costs[2] | ETF Value | - |
| Program cost per person[a] | $417 | - |
| Screening cost per person[b] | $12.50 | - |
| Other costs[c] | $20 | - |
| Individual costs[3] | | |
| Costs incurred in the year of diagnosis[3a] | | $5,471 |
| Costs incurred per year after diagnosis[3b] | | $3,218 |
| Discount rate[3c] | | 3% |
| Productivity costs[4] | | |
| Days of work missed per year due to diabetes[4a] | 3.3 days | |
| Daily earnings for persons with diabetes[4b] | $272 | |

Source: Wisconsin Employee Trust Fund (ETF) data
[1]Race data comes from State of Wisconsin Workforce Report
[2]BMI BRFSS estimate of state distribution
[3a,b]ETF customized values see table 11 page 25
[3a]ETF 2019 per person estimated values used for costs after the first year of diagnosis
[3b]Cost is discounted by 1.67 (CDC recommendation $Year 1 = 1.67*Year 2)
[3c]Default discount rate = 3%
[4a]Default days lost
[4b]Default wage rate

Again, we used 2019 BRFSS data for the distribution of BMI and race, which showed that 3% of Wisconsin residents are Hispanic, 6.9% are Black, 2.9% are Asian, and 86% are White. The data also showed that 30% have BMI between 25 and 40, and 28% have BMI 40 or over. BMI measurements meet the CDC criteria for defining obesity, which is highly correlated with diabetes. In Wisconsin, 1 in 3 people are presumed to have prediabetes. The NDPP lifestyle education model costs $417 per person, screening for prediabetes costs $12.50, CDC estimates the administration costs to be $20 per person, and we used the CDC default values for programmatic costs. For individual costs, we used ETF values from 2019 data. For the first year per person costs, we sum estimated non-insulin pharmacy costs, insulin costs, in-patient costs, and out-patient costs for diabetes patients in stage 1, which was $5,471 (= 1.67* 3530 Table 11, page 24) per person. The CDC algorithm predicts that costs for subsequent years are 67% of the total first year cost, or $3,530 per person. Finally, for productivity costs, we used the CDC default of 3.3 days of work-loss due to prediabetes, and for lost wages, we used the daily rate for a family of four, which is $272 (median income family of 4 $70,720) per day.

In Tables 26-28, we present the results of ICER for ETF. As inputs, we enter the projected participants in NDDP-ETF are 18%—or 33,796 ETF adult enrollees.

Table 26. Cumulative projected cases of diabetes / cumulative years with diabetes averted for 33,796[1] projected participants in DPP

| Year | Incidence with no NDPP | Incidence with NDPP | Cases averted[2] | Years of diabetes averted[3] | Risk reduction[4] (%) |
|---|---|---|---|---|---|
| 1 | 1,284.2 | 829.1 | 455.2 | 455.2 | 35.4% |
| 2 | 2,502.6 | 1,827.6 | 675.0 | 1,130.2 | 27.0% |
| 3 | 3,658.0 | 2,830.5 | 827.5 | 1,957.7 | 22.6% |
| 4 | 4,753.2 | 3,964.6 | 788.6 | 2,746.3 | 16.6% |
| 5 | 5,790.8 | 5,039.4 | 751.4 | 3,497.7 | 13.0% |
| 6 | 6,773.3 | 6,057.6 | 715.7 | 4,213.4 | 10.6% |
| 7 | 7,703.3 | 7,021.7 | 681.6 | 4,895.0 | 8.8% |
| 8 | 8,583.0 | 7,934.0 | 649.0 | 5,544.0 | 7.6% |
| 9 | 9,414.6 | 8,796.8 | 617.8 | 6,161.8 | 6.6% |
| 10 | 10,200.3 | 9,612.3 | 588.0 | 6,749.8 | 5.8% |

Source: CDC diabetes impact tool kit ETF population results

[1]Results of ETF simulation

[2]The "Cases averted" column is the difference between the cases in the "Incidence with no NDPP" column and the "Incidence with NDPP" column. Numbers may not add up due to rounding.

[3]"Years of diabetes averted" is a cumulative calculation of the "Cases averted" column. It represents the number of person-years with diabetes that are averted with NDPP. Numbers may not add up due to rounding.

[4]The "Risk reduction" column is equal to the "Cases averted" divided by the "Incidence with no NDPP" column. Numbers may not add up due to rounding.

In Table 27, we present the net cost for those with intervention and those without intervention. We can see medical cost savings increase every year. However, after adjusting for program costs, it becomes a savings per participant around year nine. The weight loss-gain assumptions underlying this model assume 50% of weight lost is regained in Year 2, and another 20% is presumed to be regained by year 3.[27] Weight loss is limited to 10% to keep the model credible. We maintain that assumption across the 10-year calculation period. We also assumed excess medical costs to be $5,471 in the first year of diagnosis, and $3,218 (Table 11 page 25) in all subsequent years thereafter. By assumption, 3.8% is the annual probability of developing diabetes from prediabetes (CDC diabetes toolkit default), and only a fraction of these projected diabetes cases will be averted with the projected participation in NDPP.

Table 27. Net costs (program costs minus medical cost savings) per participant

| Year | Medical costs with no NDPP | Medical costs with NDPP | Medical cost savings[1] | Program cost[2] | Net cost[3] |
|---|---|---|---|---|---|
| 1 | $5,817 | $5,745 | $72 | $417 | $345 |
| 2 | $11,598 | $11,464 | $134 | $417 | $283 |
| 3 | $17,327 | $17,126 | $201 | $417 | $216 |
| 4 | $22,993 | $22,742 | $251 | $417 | $166 |
| 5 | $28,688 | $28,388 | $300 | $417 | $117 |
| 6 | $34,310 | $33,958 | $352 | $417 | $65 |
| 7 | $39,868 | $39,463 | $405 | $417 | $12 |
| 8 | $45,362 | $44,902 | $459 | $417 | -$42 |
| 9 | $50,781 | $50,266 | $514 | $417 | -$97 |
| 10 | $56,133 | $55,563 | $570 | $417 | -$153 |

Note: All costs are discounted back to year 0. The default discount rate (3%), or user-entered rate, is used to discount costs.

[1]The "Medical cost savings" column is the cumulative difference between costs in the "Medical costs with no NDPP" column and the "Medical costs with NDPP" column. Numbers may not add up due to rounding.

[2]Program cost includes the cost of screening if you have chosen to do a screening program. The cost of screenings that do not detect cases of prediabetes are accounted for in the program cost.

[3]The "Net cost" column is the difference between the "Program cost" column and the "Medical cost-savings" column. Numbers may not add up due to rounding.

Net costs decrease over time, so by year seven the program is cost saving. The net costs fall because program cost is charged only once, but medical costs occur every year. The cost-benefit does not reflect health benefits to the program participants. Furthermore, since ETF membership includes state and local employees, it captures the effect of a sponsor negotiating on behalf of a large pool, instead of small businesses contracting on their own with the insurer. Having a large pool potentially makes expanding coverage to include NDPP attractive. In this analysis, using ETF data, we exclude productivity costs associated with work loss due to diabetes for members.

Table 28 shows the ICER is a measure of the cost-effectiveness or “return on investment” associated with the NDPP. The ICER is equal to the sum of net costs divided by the sum of quality-adjusted life years (QALYs) gained. A lower ICER means that the QALYs are gained at lower cost. As ICER becomes negative, it means the NDPP is cost-saving. Similarly, as the cost per case averted becomes negative, it actually results in savings for offering the program to the whole affected population.

Table 28 presents the ICER for ETF employees. We can see clearly that by year seven it becomes cost saving to offer the NDPP to enrollees who are at risk for diabetes. Quality-adjusted life years increase by 321for the 33,796 projected participants.

Table 28. Incremental cost effectiveness ratio (ICER) for EFT for 33,796 projected participants

| Year | Net cost | QALYs gained | ICER = Net cost/QALYs gained | Cost per case averted |
|---|---|---|---|---|
| 1 | $345 | 0.0010 | $660,451 | $25,649 |
| 2 | $283 | 0.0013 | $213,674 | $14,164 |
| 3 | $216 | 0.0023 | $92,581 | $8,831 |
| 4 | $166 | 0.0034 | $49,523 | $7,127 |
| 5 | $117 | 0.0044 | $26,566 | $5,243 |
| 6 | $65 | 0.0054 | $11,980 | $3,067 |
| 7 | $12 | 0.0065 | $1,850 | $592 |
| 8 | -$42 | 0.0075 | Cost Saving | Cost Saving |
| 9 | -$97 | 0.0085 | Cost Saving | Cost Saving |
| 10 | -$153 | 0.0095 | Cost Saving | Cost Saving |

ICER = Incremental cost-effectiveness ratio;
QALYs = Quality-adjusted life years
Note: All costs and QALYs are discounted back to year 0. The default discount rate (3%) or user-entered rate is used to discount costs and QALYs.

We do not explicitly derive an ICER for WHIO data. In theory, we would modify the insurer page on the diabetes toolkit for the privately insured population in the WHIO database. There are a couple of caveats in that exercise: WHIO data does not explicitly give us race distribution, BMI distribution, or salary range for the privately insured. However, the calculations are likely to be similar to ETF, so we conclude that offering NDPP to the privately insured population in the WHIO database would be cost-effective in approximately seven years.

## ICER for Healthy Living with Diabetes

For HLWD program participants, we calculated a simple ICER based on metadata available. According to studies within Wisconsin, the HLWD reports a reduction in number of medical encounters from five to four.[22-23, 25-26] This means that the per-patient medical savings from participating in a diabetes self-management program like HLWD is bounded between $188 and $1,355, where the lower bound comes from Medicaid, and the higher bound comes from WHIO private insurance data (Table 29 presents the calculation).

Table 29. Incremental cost effectiveness on medical encounters from participating in Healthy Living with Diabetes intervention

| Type of insurance | HLWD | Per patient per year (PPPY) cost | Medical encounters | ICER PPPY cost savings |
|---|---|---|---|---|
| Medicaid | Intervention | $608 | 4 | = ($796 - $608) / |
| | No intervention | $796 | 5 | (5-4) = $188 |
| Employee Trust Fund | Intervention | $3,177 | 4 | $580 |
| | No intervention | $3,757 | 5 | |
| Private insurance | Intervention | $8,737 | 4 | $1,355 |
| | No intervention | $10,092 | 5 | |

Source: Wisconsin Department of Health Services calculations

## Economic Rate of Return[z]

The economic rate of return (ERR) is an estimate of total increase in benefits attributed to an intervention relative to its total costs. Evidence suggests that there is a strong relationship between the total amount of benefits generated by a health intervention and total amount of benefits gained by individual households. The ERR cannot fully identify the impact on any particular sub-group within the project. Generally, high economic rates of returns may also reduce health inequities and enhance the overall impact on the healthcare system.

### The Diabetes Prevention Program Infrastructure

Some features of NDPP lend themselves easily for an ERR analysis. The NDPP program recognizes the need for a public-private partnership between insurers, physicians and government to offer an alternative to reduce the risk of progressing to type 2 diabetes. The results of a clinical study in 2013 led to Medicare coverage expansion to include NDPP.[27] This means that system-wide, American adults aged 65 and over became eligible to participate in NDPP. According to the National Diabetes Statistics Report 2020, the prevalence rate for Medicare beneficiaries with prediabetes is 24.2 %, and Ritchie et. al. 2020 report that 24.5 million Medicare beneficiaries have prediabetes.[31, 32]

The high level of governmental commitment and dissemination via the Centers for Disease Control and Prevention for widespread adoption make this case perfect for an ERR calculation. We explore whether Medicaid and ETF would benefit from expanding their coverage to include NDPP.

### Data Assumptions and Methodology Motivating the ERR Model

Our modeling of ERR also includes some key assumptions, presented in Table 30, made using meta-analysis and, where possible, current Wisconsin-specific data. Calculation of the ERR includes several components: macro-economic data, programmatic goals, disease prevalence and growth rates, disease progression, and cost of treatment at each stage. Macro-economic data used in this model include the gross domestic product per capita, life expectancy, and Wisconsin population by sex. For programmatic goals, we used both Wisconsin-specific data from the Wisconsin Institute for Healthy Aging (WIHA), when available, and National data from meta-studies. For the state of Wisconsin, we evaluate the ERR for two programs: The National Diabetes Prevention Program (NDPP) and Healthy Living with Diabetes (HLWD). NDPP was instituted nationally in 2010, and HLWD was instituted nationally in 2013. For disease prevalence and progression, we used metadata from well-known diabetes studies.[5-7] The costs modeled for the population enrolled in NDPP or HLWD come from multiple sources, depending on availability: directly from the relevant program, meta-analysis of the programs, hospital discharge data, Wisconsin Health Information Organization (WHIO), Medicaid claims, and the Employee Trust Funds (ETF).

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[z] Note: ROI is a simple calculation that measures the return on an investment without time value or the duration of a project. ERR is typically calculated over a long horizon and takes into account the time value of money, compounds interest rate over time, and results in a net zero returns minus investment when all cash flows are calculated to present value. In the context of statewide or program wide adoption of NDPP and HLWD where returns are realized many years downstream ERR is more appropriate to calculated than ROI. Another related note, ERR is an economic concept not an accounting concept.

Table 30. Wisconsin-specific initial values for economic rate of return calculation

| Data assumptions | Prevalence |
|---|---|
| 2018 coverage (over age 18) | 439,230* |
| Wisconsin diabetes prevalence estimate | 8.7% |
| Wisconsin diabetes prevalence estimate | 445,087 |
| National est. # of cases not registered | 1,566,000 |
| Wisconsin est. # of cases not registered | 142,000 |
| Costs by disease stage[1] | |
| Stage 1: Onset of prediabetes, type 1, or type 2 | $ 5,471.00 |
| Stage 2: Disease type 1 or type 2 with local symptoms | $ 16,758.00 |
| Stage 3: Disease type 1 or type 2 with chronic symptoms | $ 30,594.00 |
| Years until transition (not treated) | Years |
| Stage 1 to stage 2 | 5 |
| Stage 2 to stage 3 | 10 |
| Years until transition (treated) | Years |
| Stage 1 to 2 | 7 |
| Stage 2 to 3 | 12 |
| Offering diabetes programs to qualifying (targets)[2] | Minimum |
| Pre-screen and offering NDPP to Stage 1 | 45% |
| Pre-screen and offering HLWD to Stage 2 | 20% |

Source: Own meta-analysis; Wisconsin Behavioral Risk Factor Surveillance System
[1]Employee Trust Funds Table 11 data page 25
[2]NDPP target of 50% and wishful target of 50% for HLWD
*9% of Wisconsin population

Methodology: The ERR calculation takes macro-economic data such as gross domestic product (GDP) and population growth to adjust for the number of projected people with prediabetes, and the number of people with diabetes. The next important set of parameters are years until transition to next stage of disease, which are shown in Table 30. For this version of ERR we assume that 20% of the prediabetes patients in the not treated group transition to type 2 diabetes in 5 years to transition, and 14% of prediabetes patients in the treated group will transition to type 2 diabetes in 7 years. Then the ERR calculation is simply the net present value calculation of the benefits minus the costs of being in the NDPP and HLWD programs.

We then impose an ambitious 50% adoption rate to people pre-screened for pre-diabetes—this is a strong assumption. The ERR is extremely sensitive to the initial composition of the population with prediabetes, and disease progression transition probabilities.

With a strict 50% adoption rate of DPP and HLWD, we could expect a return on investment (ROI) of 16% by 2025. Note, imposing this level of adoption is not entirely unreasonable, because in 2016, Medicare started offering NDPP as part of its expanded coverage. Similarly, if state governments make NDPP and HLWD as part of expanded coverage we could potentially see ROIs close to 16%.

To sum up, we estimate an ERR value of 16% for the state of Wisconsin for implementing NDPP and HLWD. This is above the minimum threshold of a 10% ERR benefit to justify statewide implementation of the program. NDPP has a goal of enrolling 50% of the eligible population into the program. If we impose this assumption strictly, offering NDPP to eligible people with prediabetes would be an effective statewide adoption goal.

## Conclusions

We attempted to delineate the cost structure for the different types of diabetes in this report. Diabetes is a complicated medical condition because it is often comorbid with other chronic conditions. This means the best we could do is establish lower and upper bounds for the cost structure and take a step towards standardization. Each entity contributing data to this project had data at different levels of quality and complexity, making it hard to create a standard for reporting. Thus, we have reported costs by data source. We hope to use these analyses to report results more efficiently in the future.

We have looked at the cost of diabetes by type: prediabetes, type 1 diabetes, and type 2 diabetes. We have also reported hospital charges associated with births from mothers with gestational diabetes and type 1 or 2 diabetes. We also report costs by stage of disease, where available. The more advanced stages include costs associated with renal failure or other advanced complications associated with diabetes.

We calculated an economic rate of return of 16% for the National Diabetes Prevention Program and Healthy Living with Diabetes if they were to be widely adopted by the State of Wisconsin. We also reported the incremental cost-effectiveness ratio associated with the National Diabetes Prevention Program. While there are limitations associated with both metrics, it our hope this technical brief be used to understand the cost structure behind diabetes expenditures. Diabetes is comorbid with other conditions, so it is important to become aware of what kind of information is available from different data sources so researchers and state policy makers can effectively request the right kind of information.

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# Economics Appendix

## Definition

We use precise definitions and economic concepts to make clear the scope of this analysis. We are modeling disease progression from prediabetes to diabetes, so we use the American Diabetes Association (ADA) cutoff points, and explain any data limitations that prevent full identification of the prediabetes or diabetes sample. While we do include hospital (cost-adjusted) charges in our descriptive analysis for gestational diabetes, the programs evaluated here do not focus on gestational diabetes.

## Prediabetes and Diabetes

According to the American Diabetes Association (ADA), prediabetes is a condition that shows higher glucose levels than the person registering normal glucose levels, and yet low enough that they are not officially diagnosed with diabetes. Two population studies seek to assess prediabetes prevalence: the National Health Interview Survey (NHIS), which is conducted in person, asks "Has a doctor or other health professional EVER told you that you had prediabetes or borderline diabetes", and the Behavioral Risk Factor Surveillance System (BRFSS), which is conducted by phone, asks: "Have you ever been told by a doctor or other health professional that you have pre-diabetes or borderline diabetes?" However, this identification is done without glucose measurements. It is generally agreed upon that a population with prediabetes is at high risk for developing type 2 diabetes and there are significant economic gains to targeting preventive interventions to this sub-population.

Appendix Table 1. Clinical diagnosis guidelines

| Results | Glycated hemoglobin ($HbA_{1c}$) | Fasting Plasma Glucose (FPG) | Oral Glucose Tolerance Test (OGTT) |
|---|---|---|---|
| Normal | less than 5.7% | less than 100 mg/dl | less than 140 mg/dl |
| Prediabetes | 5.7% to 6.4% | 100 mg/dl to 125 mg/dl | 140 mg/dl to 199 mg/dl |
| Diabetes | 6.5% or higher | 126 mg/dl or higher | 200 mg/dl or higher |

Source: The American Diabetes Association

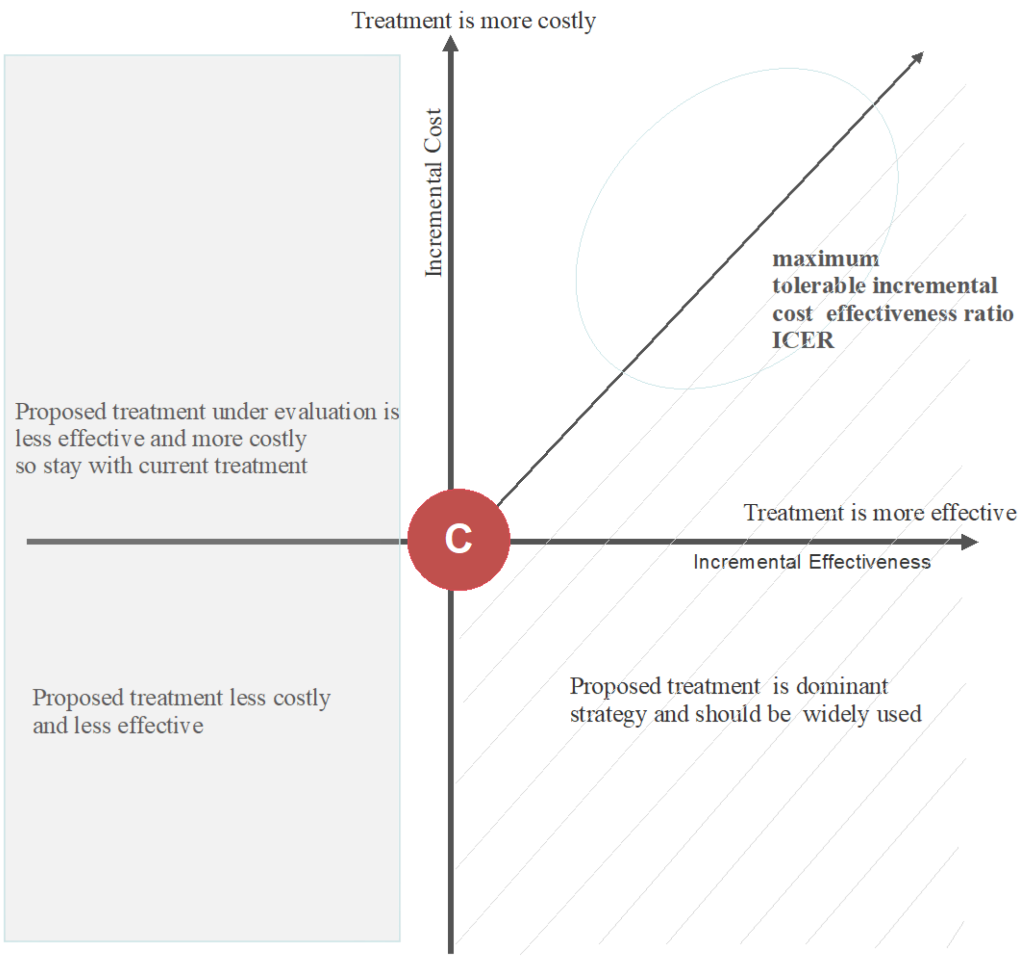
There are three common clinical tests for diabetes: $HbA_{1c}$, fasting plasma glucose (FPG), and oral glucose tolerance test (OGTT). The $HbA_{1c}$ test measures the average resting blood glucose levels over a period of time, typically three months. It is reported as a percentage, and persons with an $HbA_{1C}$ score between 5.7% and 6.4% are considered to have prediabetes, and those with scores higher than 6.5% are considered to have diabetes. Although this is a diagnostic tool, $HbA_{1C}$ numbers typically vary by age, race, and the health status of a person.

The fasting plasma glucose test (FPG) is administered after abstaining from food or sugar beverages for a period of 8 hours. Typically, this test is done first thing in the morning. If a persons' FPG falls between 100 mg/dl to 125 mg/dl then they are considered to have prediabetes; all persons with 126 mg/dl and over are considered to have diabetes. An oral glucose tolerance test (OGTT) is done over a two-hour period, where a physician takes a baseline measurement, asks the patient to consume a sugary beverage, and takes a blood glucose measurement again after two hours. If the blood glucose measurement is above 200 mg/dl then a person is diagnosed with diabetes.

Results that indicate prediabetes do not necessarily mean an eventual diagnosis of type 2 diabetes. Most people with prediabetes can return to normal results by losing 7% of body weight and exercising for 30 minutes a day. Implementing just these two changes will reduce progression to diabetes by 58% percent. Typically, interventions come in two forms: behavioral interventions that help prevent disease, and behavioral interventions that promote self-management of disease.

## Mathematical Representation of ICER

Appendix Figure 1. Incremental Cost Effectiveness Plane




Mathematically this problem is stated as

$$\text{Maximize } NMB_g(j, \theta) = e_{gj}k - c_{gj}$$

Where
j = NDPP, HLWD
NMB = net monetized benefit
θ = people specific uncertain parameters.
g = sub-group (age groups, prediabetes, diabetes)
And NMB are computed as the difference between the monetized health gains from an intervention minus monetized costs.
$e_{gj}$ = effectiveness of treatment j in subgroup g
$c_{gj}$ = costs in subgroup $g$ using treatment $j$
$k$ = a decision makers willingness to pay per unit of clinical effectiveness.

The optimal treatment for a given subgroup is the one that maximizes expected NMBs,

$$j \times g = \text{argmax } j \times E\theta[NMB_g(j,\theta)]$$

In practice, new interventions are usually compared to a counterfactual (pre-existing in the market) treatment often referred to as the comparator. In these cases, a new treatment in a given subgroup is preferred to the comparator if the expected incremental net monetary benefit (INMB) of the new treatment is positive; that is, treatment 1 is preferred to treatment 0 in subgroup $g$ if $E\theta[INMBg]>0$ where the INMB in a particular subgroup is given by

$$INMB(\theta) = NMBg(j = 1,\theta) - NMBg(j = 0,\theta)$$

Equivalently, treatment 1 is preferred to treatment 0 in subgroup $g$ if the incremental cost-effectiveness ratio (ICER) is greater than the willingness to pay threshold k,

$$k > cg_1 - cs_0 eg_1 - eg_0 = ICER_g$$

In the simplest scenario, we consider an evaluation where we do not take into consideration age but evaluate incremental cost effectiveness ratio for the NDPP. The ICER would then be:

$$ICER = \frac{Cost_{NDPP} - Cost_{no\ NDPP}}{Effect_{NDPP} - Effect_{no\ NDPP}} = \frac{\Delta Cost}{\Delta Effect}$$