

Impact of Diet, Exercise, and Education in Prediabetic 30-50 year olds in the U.S. to Reduce Progression to Diabetes Compared to Pre-diabetics Lacking Intervention

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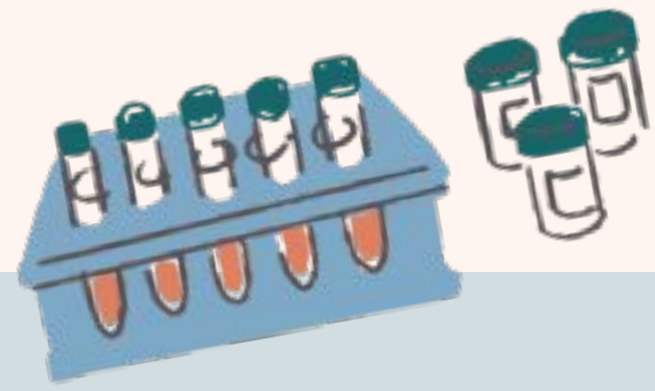
Outcome

Reducing the
Progression of
Prediabetes to
Diabetes

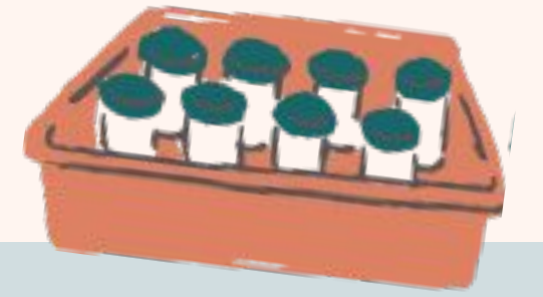


01.

What is Diabetes?



Diabetes



Diabetes is a chronic condition where the body either doesn't produce enough insulin or can't use it properly. Insulin is a hormone that helps regulate blood sugar (glucose) levels. Leading to glucose build up in the blood, leading to high blood sugar.

Prediabetes is a condition where blood sugar levels are higher than normal but not high enough to be diagnosed as diabetes. It's a warning sign that you're at risk of developing type 2 diabetes.



Types of Diabetes:

Type 1 Diabetes: The body doesn't produce insulin.

Type 2 Diabetes: The body doesn't use insulin properly (insulin resistance). Most common form, often linked to lifestyle factors.

Why It Matters:

If not managed, diabetes can lead to serious health problems



**Why must Pre-diabetes be
addressed?**

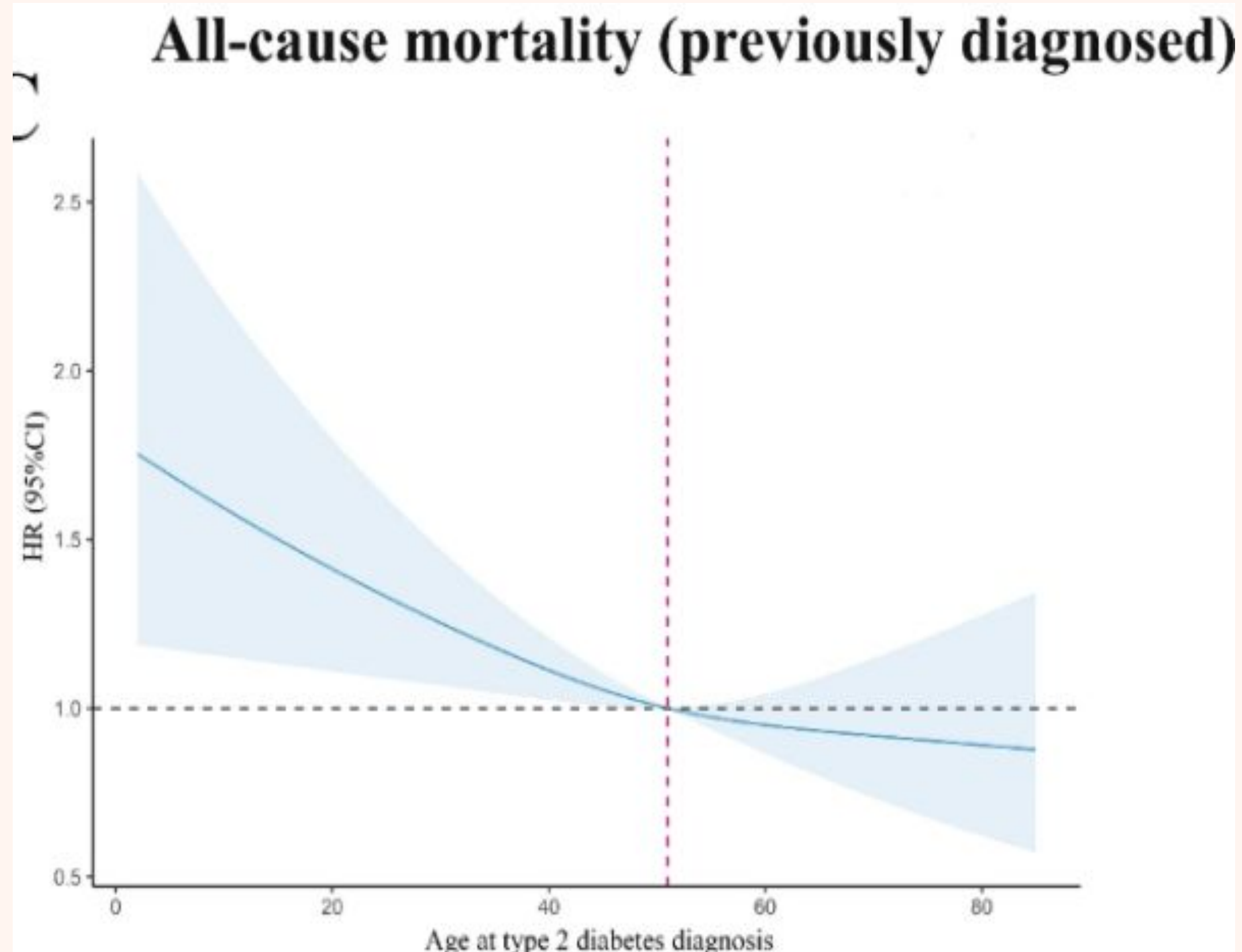


PREVALENCE

- In 2021, approx. 99 million U.S. adults had prediabetes
- Studies show a rise in the number of people younger than 40 years being diagnosed with diabetes over the past 5 years
- Linked to rising obesity rates and changes in lifestyle behavior

EARLY-ONSET & OUTCOMES

- **Younger onset = more aggressive disease**
- Faster onset of complications → shorter life expectancy
- Greater risk of all-cause mortality in adults aged 40 or less



DELAYED DIAGNOSIS

- Prediabetes is often asymptomatic, causing many to spend years without knowing they're at risk
- In 2021, **4.5% of U.S. adults (~15 million)** had undiagnosed diabetes
- Delayed diagnosis leads to:
 - Missed opportunities for prevention
 - Poorer prognosis

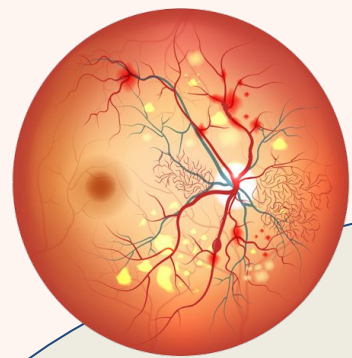


COMPLICATIONS OF DIABETES



Cardiovascular Disease

Damage to cardiac blood vessels increases risk of developing heart disease, heart attack, and stroke



Retinopathy

Damaged blood vessels in the retina become weak, eventually start leaking blood → vision loss or blindness

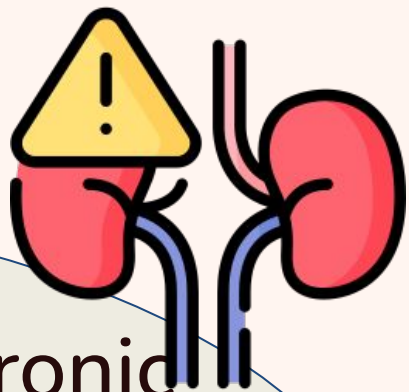
Neuropathy

Nerve damage to the extremities causes tingling and numbness
Increased risk of infection due to unnoticed wounds



Nephropathy

Damage to renal vessels causes chronic kidney disease
Progression to stage 5, requires dialysis several times per week



Total cost of diagnosed diabetes in the U.S. in 2022:

\$412,900,000,000

This figure includes:

\$306.6 billion in Direct Medical Costs

\$106.3 billion in Indirect Costs (cost of workdays missed, work productivity losses, unemployment due to chronic disability, and premature death)





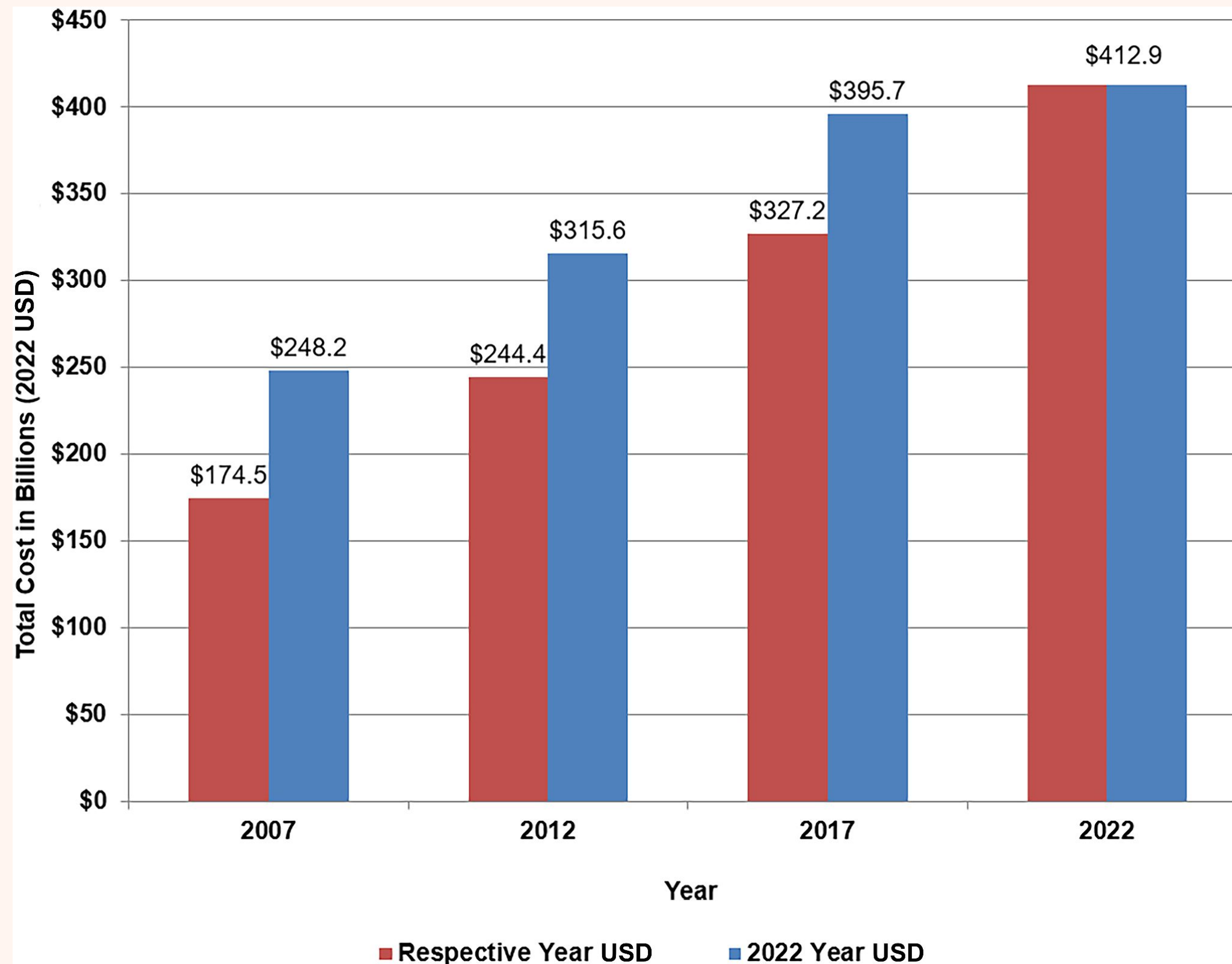
Economic Burden

- Diabetes is responsible for **1 in 4 healthcare dollars** spent in the U.S.
- People with diabetes incur **2.6x higher medical expenditures** than those *without* diabetes
 - Average annual per capita health care costs of \$19,736 vs. \$7,714
- **Average yearly direct medical costs for diabetes treatment is continuously on the rise!**
 - Went from \$11,619 in **2017** to \$12,022 in **2022** (increased by 3.5%)

So what does this mean?

- **Each person with diabetes now costs more in medical care and treatment than they did five years ago. This shows that the longer we delay intervention efforts, the more expensive diabetes becomes for everyone.**

Economic Burden

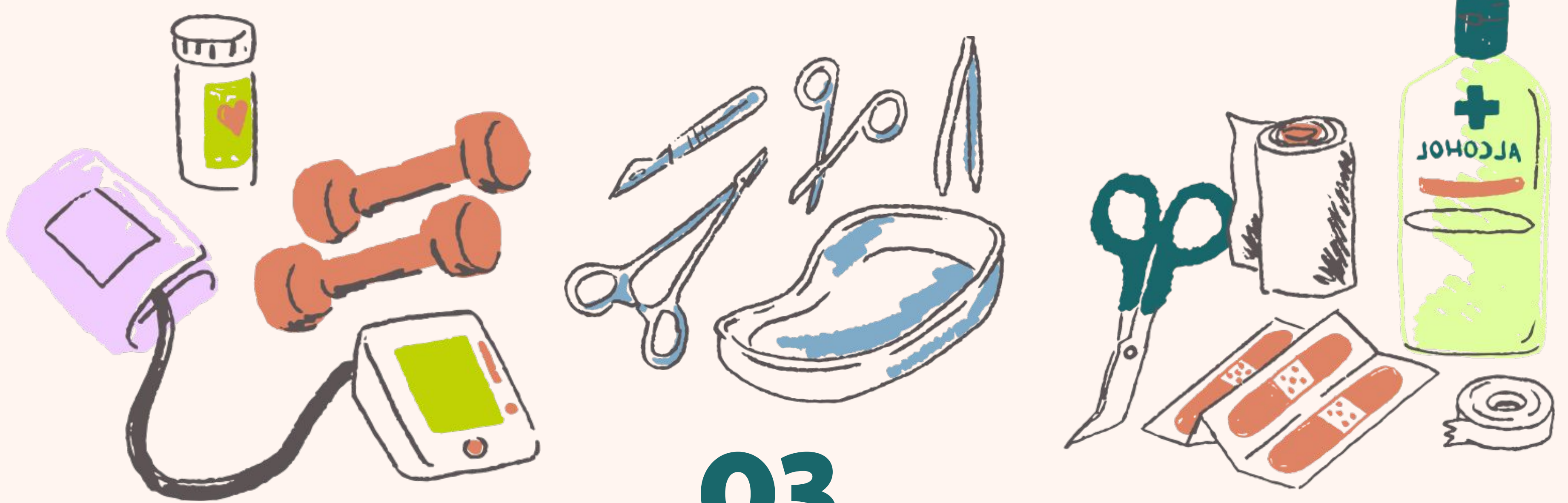


**Inflation-adjusted total economic burden of diabetes in the U.S. increased from \$395.7 billion in 2017 to \$412.9 billion in 2022
→ aka. 4.3% growth (has been a consistent positive trend!)**

Therefore, intervening during prediabetes can help flatten this upward cost trend and save the nation money!

Diabetes is Preventable!

- **A systematic review conducted based on 20 studies show that:**
 - **Type 2 diabetes is largely preventable, especially in the prediabetes stage**
 - **Lifestyle interventions at the prediabetes stage have proved successful at reducing the incidence of T2D by 28.5% to 58%, in China, India, Finland, and the United States**
 - **Diet and exercise interventions were found to be cost-effective or cost-saving for preventing type 2 diabetes**
 - **Cost per QALY (quality-adjusted life year) gained was below accepted thresholds**
 - Tells you how much it costs to gain one extra year of life in perfect health, meaning these intervention programs provided good value for money



03.

Population

Why Focus on 30-50-year-old Prediabetics?

Justification: High Disease Levels in Target population

- Sharp rise in Diabetes Incidence with Age
 - 7.7% (age 30–39) and 8.6% (age 40–50) vs. only 1.6% at 18–29
 - Per 1,000 person-years:
 - 4.3 (30–39), 3.9 (40–50) vs. 1.6 (18–29)
- Higher-Risk Period for onset:
 - Prediabetes progressing to T2D commonly occurs after the age of 35 (Mayo clinic, 2025)
 - Global prediabetes expected to affect 1 billion by 2045

Why Focus on 30-50-year-old Prediabetics?

Justification: Low Activity Levels = Higher Risk

- Low Physical Activity Prevalence:
 - 66% of participants (ages 36–69) had low physical activity
 - Majority of the group included 30-50-year-olds (Yang et al., 2024)
 - 43% higher T2D risk with low vs. moderate activity
 - FBG increased +0.20 mmol/L in low activity vs. –0.27 mmol/L decrease in moderate group
 - Highest T2D incidence:
 - 55.83/1,000 person-years (low) vs. 35.14 (moderate) & 39.61 (high)

Why Focus on 30-50-year-old Prediabetics?

Justification: Modifiable Risk Factors & Need for Early Intervention

- Elevated BMI, glucose, and TG/HDL-C ratio identified as strongest predictors in 30-50-years-olds
- Stronger protective effect of physical activity found in adults <60 ($P = 0.02$)
- Risk factors are modifiable and still reversible with early intervention
- Lifestyle interventions such as weight loss and increased physical activity are effective in this age group at preventing or delaying the onset of T2D
 - Reduced diabetes incidence by 58% compared to placebo and metformin over 2.8 years in adults (mean age 51)
 - Placebo: 11.0 cases per 100 person-years, Metformin: 7.8 cases per 100 person-years, Physical activity: only 4.8 cases per 100 person-years)

Why Focus on 30-50-year-old Prediabetics?

Justification: Younger Diagnosis → Worse Prognosis

- **Based on an international cohort study**
 - Each decade of earlier diagnosis of diabetes was associated with about three to four years of lower life expectancy (Kaptoge et al., 2023).
 - After adjusting for age, a direct association between earlier age at diagnosis and higher all-cause mortality, mortality due to CV disease and other causes was observed
- **Hazard Ratios (risk of death) is highest in younger groups**
 - Of the following age at diagnosis groups (30-39, 40-49, 50-59, 60-69, & ≥ 70), it was observed that ages 30-39 & 40-49 had HR's of 2.69 & 2.26 respectively (Kaptoge et al., 2023).

Why Focus on 30-50-year-old Prediabetics?

Priority Group Behaviors Increasing Risk

- **Higher baseline A1c in younger adults**
 - Younger adults (age 21-44) had mean A1c values of 8.9% vs. 8.4% in older adults (age 45-64) = worse glucose control = insufficient lifestyle management
- **Lower odds of achieving A1c <7% at year 1**
 - Suggestive of challenges in sustaining diet and exercise changes
- **Identifiable Barriers**
 - Earlier age at diagnosis has been associated with higher rates of depression, stress, poorer diet and lower medication adherence

Why Focus on 30-50-year-old Prediabetics?

Priority Group Behaviors Increasing Risk

- **Differences in ideal care/educational platform**
 - Younger adults tend to prefer online portals as opposed to in-person visits, as a result traditional approaches may not sufficiently meet the needs of this population.
- **Adherence Issues**
 - Despite having higher odds of beginning metformin upon diagnosis, about 50% of young adults did not adhere to its proper usage
 - Explanations for this finding include: difficulty coping with the diagnosis, preferences for “natural approaches” and present-future bias (valuing the “costs” of a task over long term benefit)

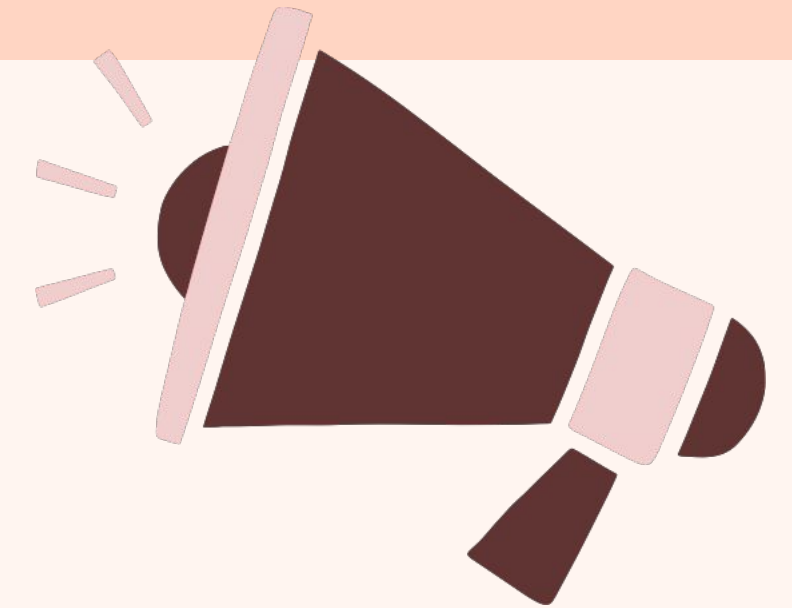


05.

Intervention



INTERVENTION



DIET

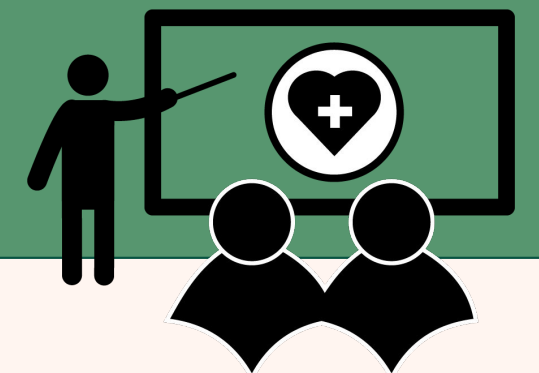
A balanced diet rich in whole grains, lean proteins, and fiber helps regulate blood sugar and prevent diabetes.

EXERCISE

Regular physical activity improves insulin sensitivity and supports healthy weight management.

EDUCATION

Education provides the knowledge and motivation needed to adopt and maintain diabetes-preventing lifestyle habits.



DIET



YOU ARE
WHAT YOU
EAT

Does Diet really help?

Over 50% of interventions improved glucose, insulin, lipids, BMI, and weight.

Eight studies (57.1%) showed reduced diabetes progression or reversal.

One study found complete remission with a high-protein diet and Curcumin improved β -cell function and insulin resistance with few side effects.



Key Foods Improving Glucose and Insulin Parameters:



Whole grains

superior to refined grains, better glucose and insulin outcomes



Kimchi

Improved glucose metabolism and BMI post-intervention



Vinegar

Increased insulin sensitivity and glucose metabolism



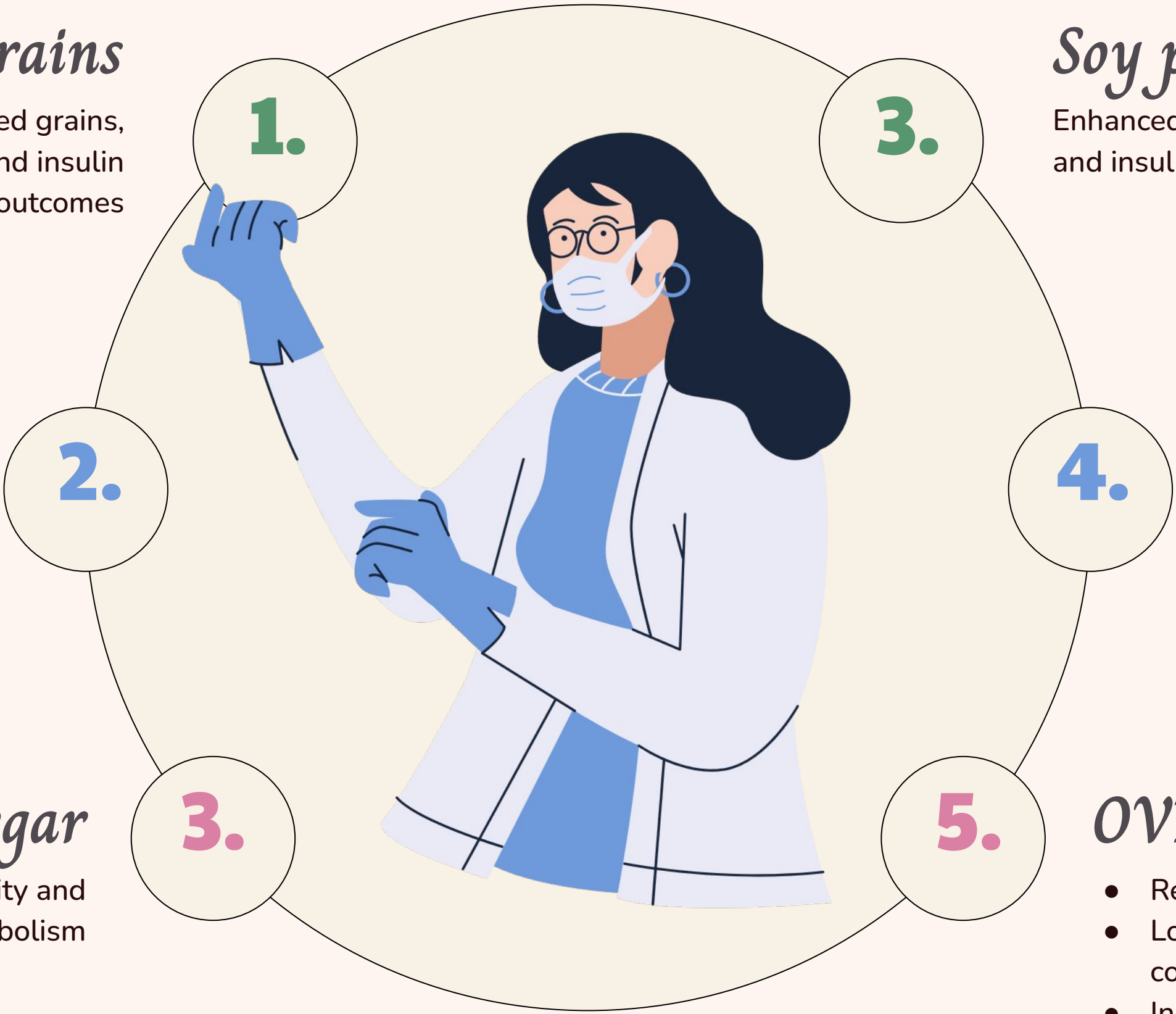
Soy protein

Enhanced glucose levels, BMI, and insulin parameters



Pistachios

Positively correlated with glucose and insulin-related improvements



OVERALL

- Reduced daily caloric intake
- Lower fat and alcohol consumption
- Increased dietary fiber

Sugary Beverages



Sugar-sweetened beverages increases the risk of DM type II

Leads to weight gain and obesity, which increases risk of DM type II

Promote metabolic mechanisms that contribute to DM type II

Decreasing consumption of sugary beverages promotes decreased risk of DM type II development



Exercise

Does exercise really help?

Meta-analysis study showed participants exercised 3–4 times/week with activities like walking, treadmill, or aerobic dance.

Significant improvements observed:

- BMI ↓ 1.44 kg/m²
- Fasting blood glucose ↓ 0.51 mmol/L
- 2-hour post-load glucose ↓ 0.76 mmol/L
- HbA1c ↓ 0.34%.



Aerobic exercise alone reduces Type 2
diabetes risk by:

46%

Longer programs show greater benefits.

Aerobic exercise is a low-cost, non-drug method to
prevent diabetes.



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Intervention: Prescribing Wellness for Prediabetes Prevention

Prescribing Wellness is a comprehensive lifestyle prescription program aimed at preventing type 2 diabetes in prediabetic patients.

Healthcare providers prescribe a bundled intervention that includes:

- A list of pre-approved healthy foods (e.g., whole grains, soy, kimchi, vinegar, pistachios)
- Access food and activity tracking, culturally tailored recipes, and lifestyle education via patient portal/MyChart
- Simple home-based aerobic exercise routines
 - Potential partnerships with community gyms and community center activities
- Optional coaching and digital reminders

Food prescriptions are redeemable at pharmacies, grocery stores, and farmers' markets.

Pharmacies create a clearly labeled “Prediabetes Section” to make food access easier.

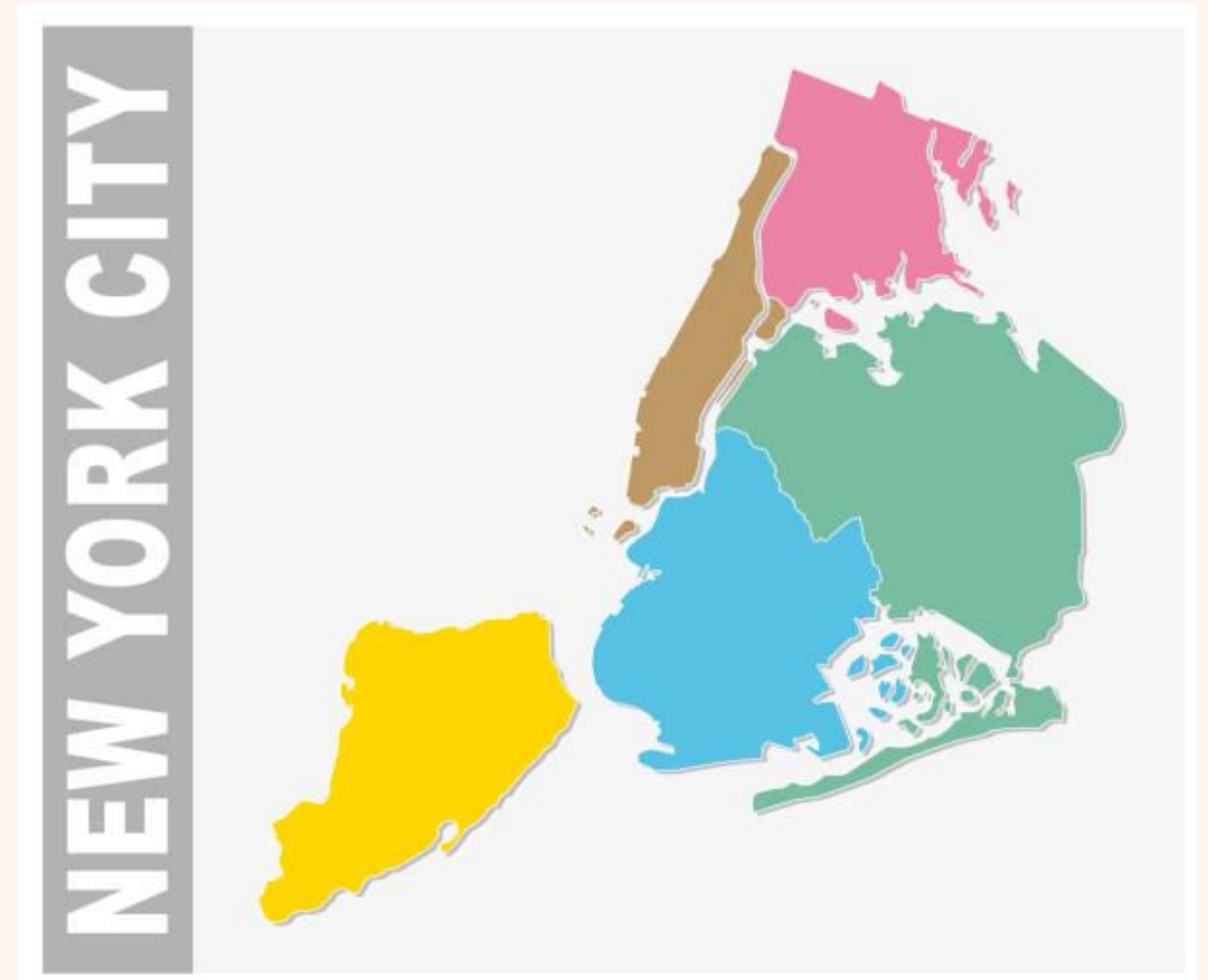
Intervention: Prescribing Wellness for Diabetes Prevention

- Should be implemented when patient's A1C reaches the pre-diabetic range (between 5.7 and 6.4)
- Should be maintained until A1C downtrends to no longer being in the pre-diabetic range (under 5.7)
- All primary care providers should be aware of this program to see if it is a good match for their patients



Intervention: Location

- Pilot in New York City- Possibility to Expand
- 11% of New Yorkers with DM
- Larger, more robust social service infrastructure
- Innovation hub



Intervention: Financial Requirements

Initial Investment

- Grant applying team
- Software creation and implementation
- Content creation
 - Educational content, culturally-tailored food recipes, ect
- Partnership building
 - Providers willing to participate
 - Insurance companies willing to cover
 - Stores that accept the food prescriptions
 - Gyms/community centers

Support & Follow-up

- IT for software glitches and updates
- Staff to continue investing in the partnerships and update content



Intervention: Sources for Funding

Nonprofits and Foundations

- Can provide grants
- Kresge Foundation, Robert Wood's Foundation, American Diabetes Association

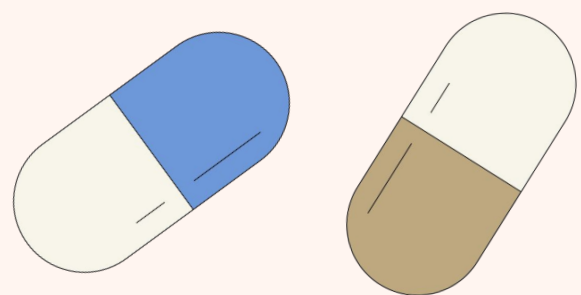
Insurance Companies

- Preventive care is less expensive than DM care

Government funding

- CDC and state-specific funding
- The Gus Schumacher Nutrition Incentive Program (GusNIP) of the USDA- Provides grants to improve health and nutritional status





Stakeholder

Primary Care Providers, Hospitals, and Clinics

Role:

- Screen and identify prediabetic patients
- Prescribe Prescribing wellness and track progress via the integrated platform

Benefits:

- Improved patient outcomes and satisfaction
- Eligible for value-based reimbursement incentives
- Supports preventive care targets and quality reporting (e.g., HEDIS measures)

Public Health Departments

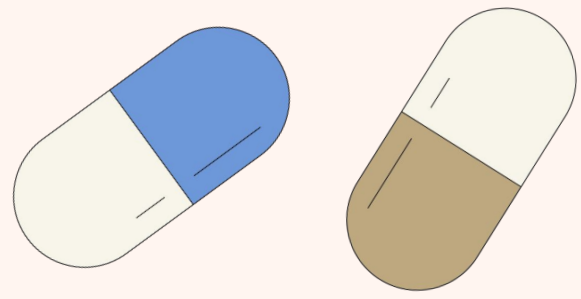
Role:

- Promote the program in at-risk areas
- Support outreach, education, and evaluation efforts

Benefits:

- Advance chronic disease prevention goals
- Reduce disparities in diabetes outcome
- Leverage partnerships to improve community health





Stakeholder

Insurance Companies (Public and Private)

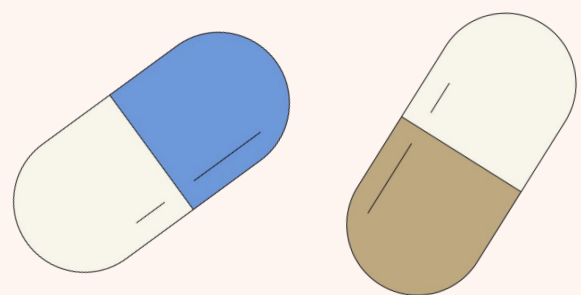
Role: Fund the entire Prescribing Wellness program, including:

- Prescribed foods
- App maintenance
- Nutrition coaching
- Community gym/exercise access
- Bonus payments to providers for patient enrollment and health outcome improvements

Benefit:

- Reduce long-term costs by preventing T2DM and expensive complications
- Improve HEDIS and Star Ratings, leading to bonus payments and competitive advantages
- Increase member retention and satisfaction through personalized, preventive care
- Align with value-based care, chronic disease prevention, and ROI-focused health strategies





Stakeholder



Pharmacies

Role: Support access and education

- Dispense shelf-stable food prescriptions (e.g., vinegar, oats, soy snacks)
- Create a clearly labeled “Prediabetes Section” in-store for easy access to recommended foods
- Offer recipe guides and basic nutrition info

Benefits:

- Increased foot traffic and sales of wellness-focused products
- Expanded role in chronic disease prevention and public health
- New revenue opportunities through value-based partnerships with insurers



Grocery Stores & Farmers’ Markets

Role:

Accept vouchers for prescribed healthy foods

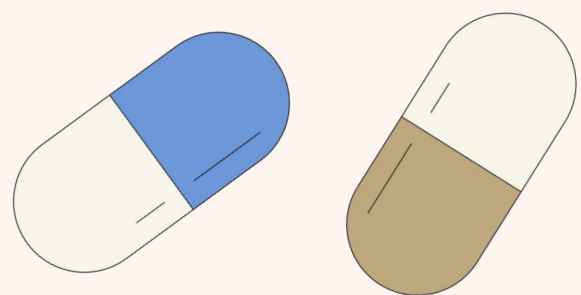
Offer pre-packaged "Prescribing Wellness" bundles

Benefits:

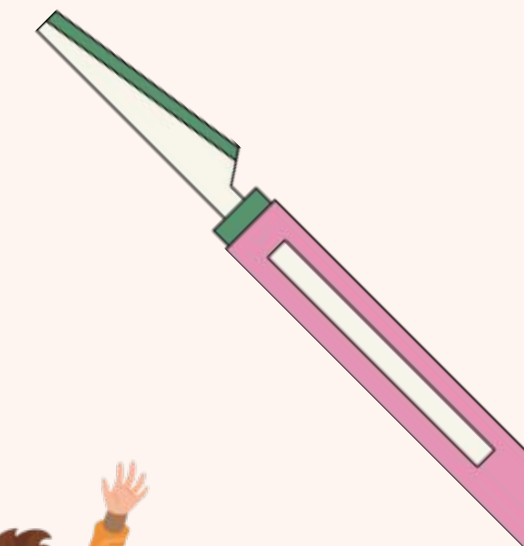
Boost sales of targeted food products

Build trust and visibility in local communities

Participate in health-focused retail innovation



Stakeholder



- Community Centers, Local Gyms & Fitness Instructors

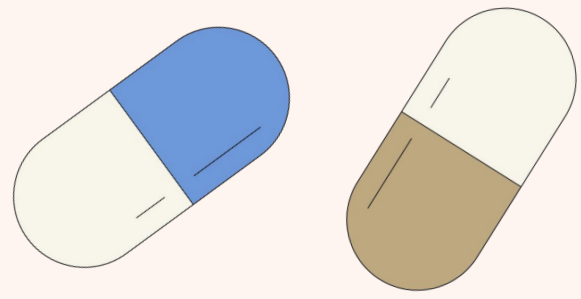
Role:

- Provide access to affordable or free aerobic classes (e.g., walking groups, dance, treadmill programs) if patient have a Prescribing Wellness prescription
- Partner with insurers to offer Prescribing Wellness specific exercise sessions

Benefits:

- Increase program attendance and visibility
- Attract new members through health partnerships
- Position themselves as local hubs for chronic disease prevention





Stakeholder

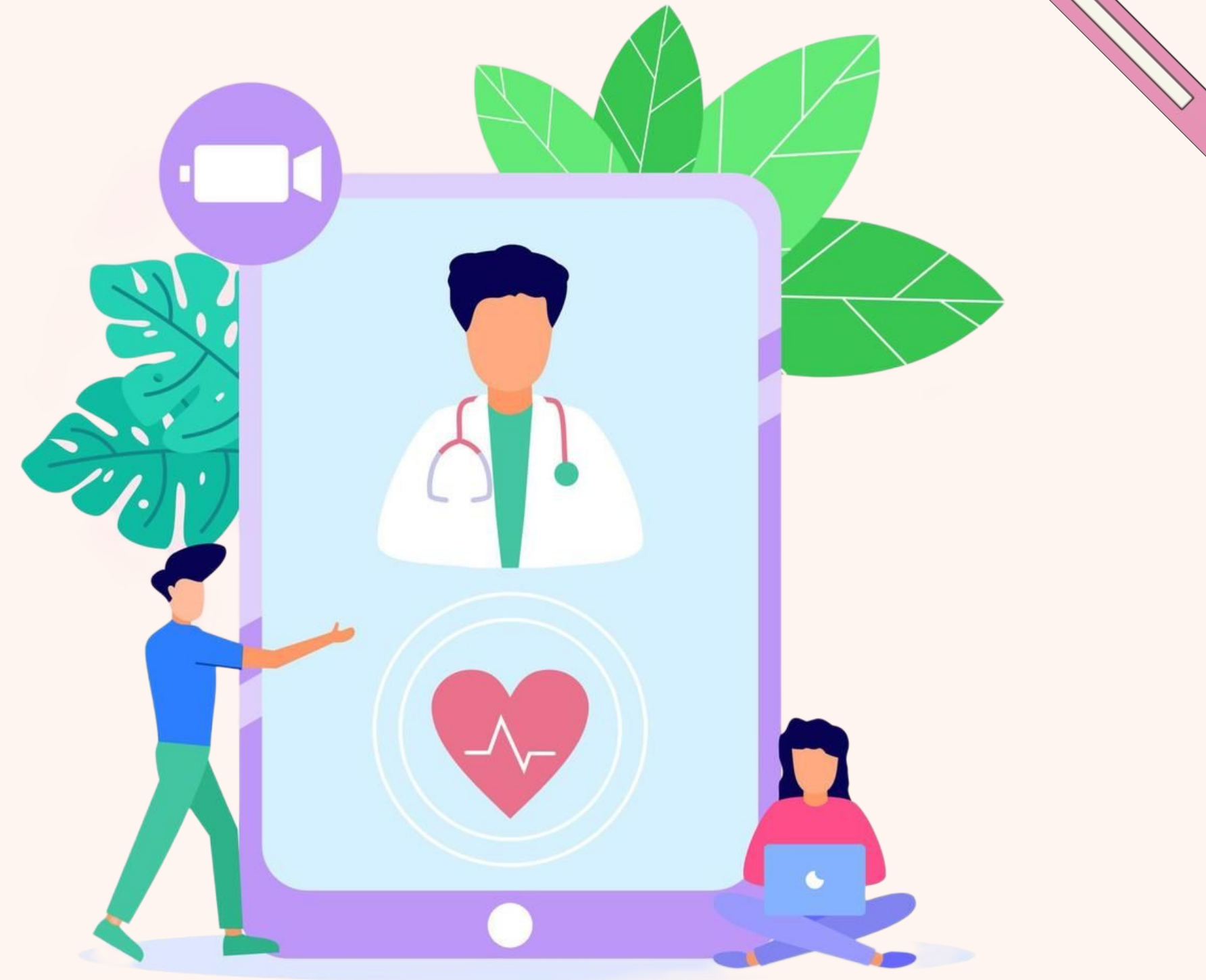
Digital Health Vendors

Role:

- Build and manage the mychart add on for food tracking, exercise logging, and educational modules

Benefits:

- Form long-term contracts with insurers
- Expand reach in value-based care tech
- Demonstrate platform effectiveness in chronic disease prevention





Measures of Success

Measures of Success

Data to be collected:

- Clinical Data

- HbA1c levels: lower average levels correlates with better glycemic control
- Fasting glucose levels
- Trends in progression from pre-diabetes to T2DM (expecting downtrends)

- Behavioral Data

- Medication adherence (self-reported)
- Quality improvements in diet (self-reported)
- Exercise frequency (measured in minutes of activity per week)

- Education Effectiveness

- Knowledge of steps and measures to prevent progression

Measures of Success

Data collection methods:

- Clinical Data

- Baseline blood work with interval follow-ups scheduled at 3 month increments (e.g. 3, 6, 9 & 12).
- EHR (to track patient outcomes)



- Behavioral Data

- Intervention entry and exit surveys (e.g., IPAQ) to assess for changes in diet and exercise routines

- Education Effectiveness

- Surveys to assess understanding of steps and measures to prevent progression



Measures of Success

International Physical Activity Questionnaire (IPAQ)

- Self-reported data on:
 - Frequency (days per week)
 - Duration (minutes per day)
 - Types of activity (eg., walking, moderate, vigorous)

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

☐ No vigorous physical activities ➔ **Skip to question 3**

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

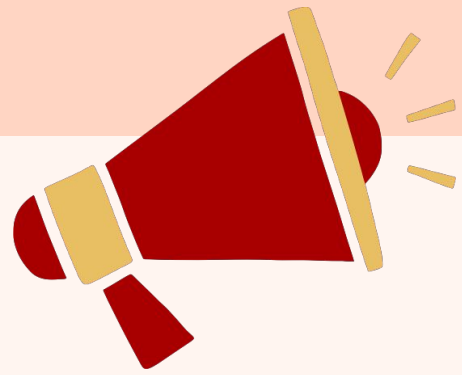
3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

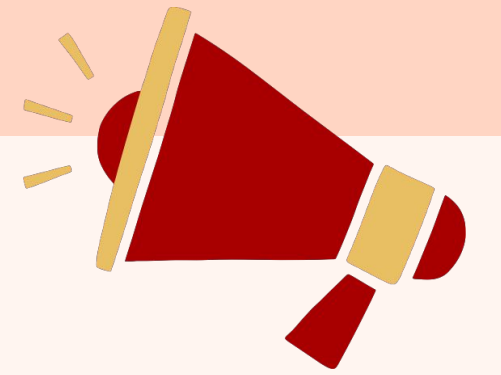
☐ No moderate physical activities ➔ **Skip to question 5**



Limitations/Barriers



LIMITATIONS



ACCESS

For those with lower socioeconomic status, nearby pharmacies & stores may be limited in healthier food options

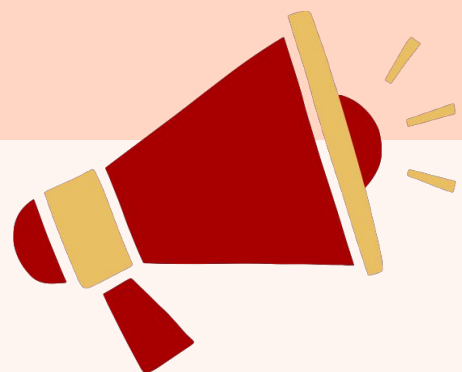
TIME

Younger adults (age 30–40) may face:

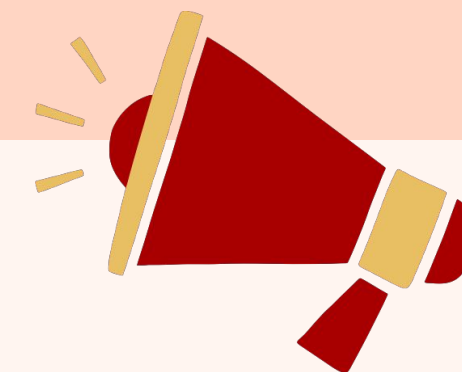
- Busy schedules
- Work demands
- Childcare responsibilities

EDUCATION

Short primary care appointments mean limited time for counseling on lifestyle changes



LIMITATIONS



Low Health Literacy

Patients with poor health literacy face a barrier in the development of self-management skills needed for effective glycemic control

- **Linked to several negative health outcomes, such as poorer overall health, higher hospitalization and mortality rates, reduced ability to manage chronic illnesses, and increased patient expenses**

→ highlights the need for health literacy-driven interventions

Limited Insurance Coverage or Reimbursement

Lack of insurance coverage for lifestyle change programs statewide is most often cited as a reason for why providers are not diagnosing and referring patients to diabetes prevention programs and why patients are not attending them

Ex. Even CDC's National Diabetes Prevention Program faced this setback

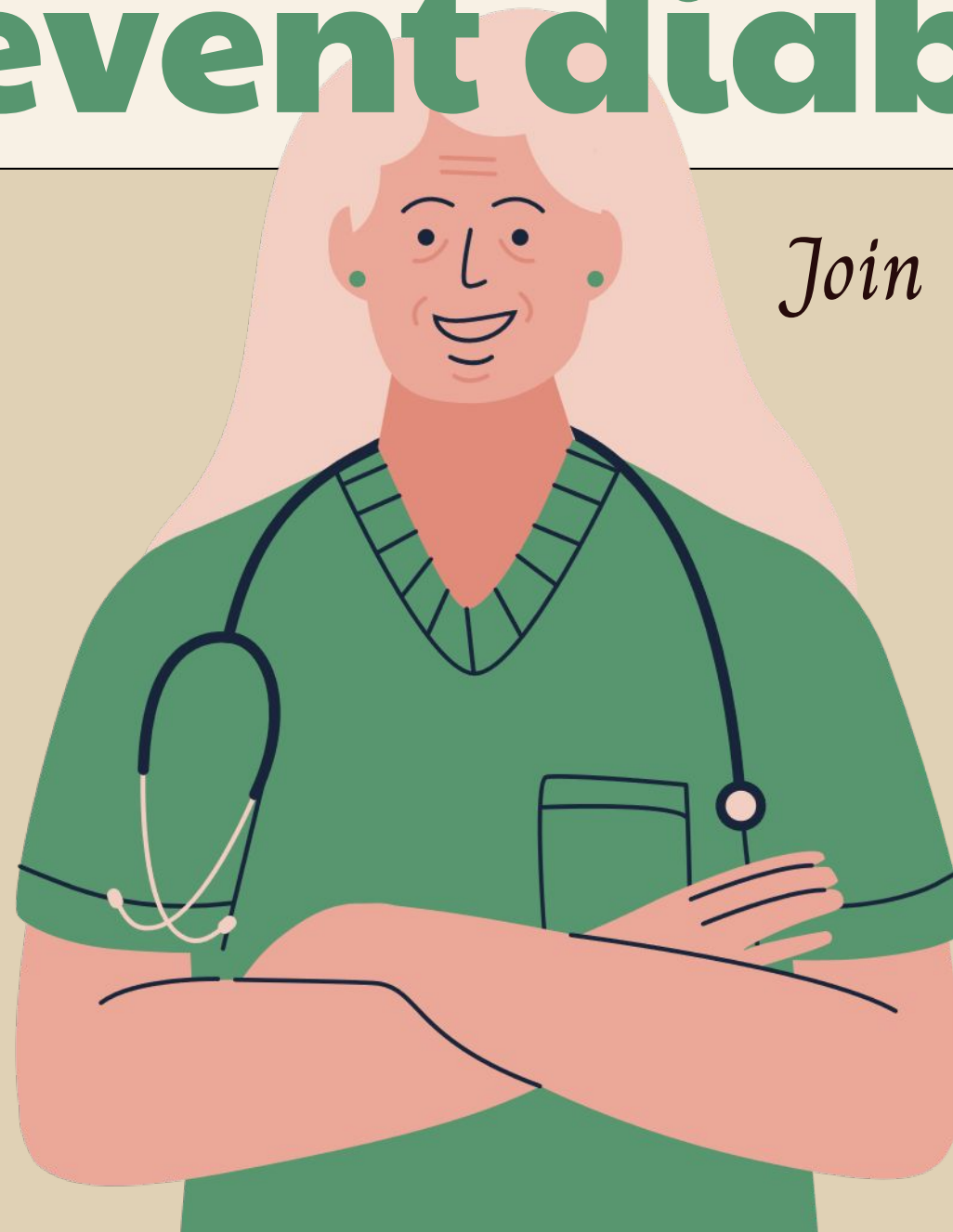
Socioeconomic Factors

Low SES and unstable housing makes it more difficult to engage in self-care, follow self-management routines, afford diabetes medications and supplies, and eat healthy foods

- **Large price differences between healthy and unhealthy foods lead to differences in purchasing patterns and resulting diets**

**With the right resources
and right people we can
prevent diabetes!**

Join our cause



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