

## **About Irrational Labs**

Irrational Labs is a nonprofit that applies and tests insights from behavioral economics to address product, marketing, and societal problems. We have deep expertise in partnering with companies and organizations to design and test behavioral interventions to increase people's health, wealth and happiness. We also frequently lead workshops with companies to integrate the behavioral science approach into their organizations.

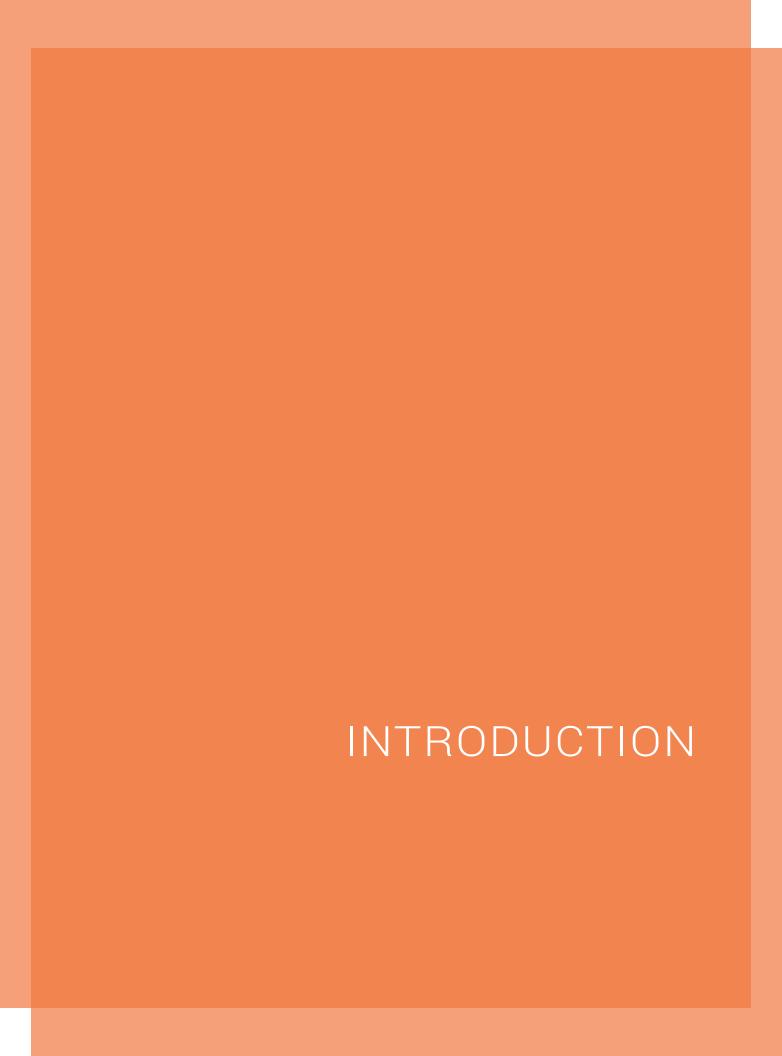
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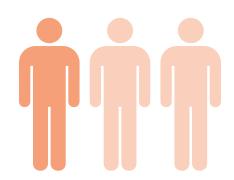
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#### The problem

The impact of unhealthy behaviors on mortality is astonishing. Despite knowing the potentially fatal consequences, we smoke, avoid exercise, overeat, and binge on alcohol. An analysis by the CDC found that up to 40% of premature deaths from the leading five causes (heart disease, cancer, chronic lower respiratory diseases, stroke, and unintentional injuries) in the United States could have been avoided if people had successfully changed their behavior. Just for heart disease, that means behavior change could prolong about 92,000 lives each year. Because of this huge potential to improve lives, many medical professionals are showing an increased interest in behavioral interventions as a treatment option.

In the US, one in three people are estimated to be prediabetic.



In the US, one in three people are estimated to be prediabetic. A person with prediabetes has a blood sugar level higher than normal, but not high enough for a diagnosis of diabetes. He or she is 15-30% more likely than the general population to develop type 2 diabetes within five years if they do not make lifestyle changes to improve their health. They are also at a higher risk of other serious health problems, including heart disease, and stroke.<sup>2</sup>

Diabetes is among the most common and costly of all health problems, despite being preventable. So what can we do to successfully change our behavior in the wake of a prediabetes diagnosis? And as medical practitioners, how can we best support our patients in making behavioral changes happen?

<sup>&</sup>lt;sup>1</sup> Gerstein, H. C., Santaguida, P., Raina, P., Morrison, K. M., Balion, C., Hunt, D., ... Booker, L. (2007). Annual incidence and relative risk of diabetes in people with various categories of dysglycemia: A systematic overview and meta-analysis of prospective studies. *Diabetes Research and Clinical Practice*. http://doi.org/10.1016/j.diabres.2007.05.004

http://www.cdc.gov/diabetes/basics/prediabetes.html

## The behavioral approach

Behavioral economists often study the ways in which we fail to do the things we intend to do. Most people will tell you (and themselves) that they care about their health, yet time and again they skip a dose of medication and fail to exercise regularly. This gap between our actions and intentions can be challenging to close, but there is helpful research that shows us new ways to think about how it can be done. While nudges may not be silver bullets that provide a solution for everyone every time, behavioral economic research has been applied around the world with significant results. A typical approach to help patients make changes to their lifestyle after getting diagnosed with prediabetes is to provide them with information about what they need to change and the consequences of failing to do so. While having the facts is important, it is usually not sufficient. Because research has shown that traditional persuasion messages in healthcare have limited impact on behavior change<sup>3</sup>, we go beyond the idea that the primary barrier to behavior change is a lack of information. Instead, we look at the environment and factors that influence behavior as a whole: How do our biases shape our choices? What is the impact of the environment and people around us on our behavior? And what are the real barriers to behavior change?



How do our biases shape our choices?
What is the impact of the environment and people around us on our behavior?
And what are the real barriers to behavior change?

<sup>&</sup>lt;sup>3</sup> Agha, S. (2003). The impact of a mass media campaign on personal risk perception, perceived self-efficacy and on other behavioural predictors. *AIDS Care*, 15(6), 749–762. http://doi.org/10.1080/09540120310001618603

## How to use this guide

This guide was created to highlight some ways insights from behavioral economics can be applied to stop people who are diagnosed with prediabetes from progressing to type 2 diabetes. The advice offered in this guide is not medical, but rather based on research that investigates ways to facilitate and maintain behavior change. If you are diagnosed with prediabetes or worried that you may be at risk, we strongly advise you to contact your health care provider and work with them to find out what precautions to take. While the advice offered in this report is far from exhaustive, these findings may help make change easier.

**Section 1:** Section one of this guide will look at the causes and risk factors, diagnostic process and treatment of prediabetes.

**Section 2:** The second section of the guide will review ways in which behavioral economic principles can make changes simpler and more likely to stick.

Who should read this guide: This guide is ideal for anyone who has been diagnosed prediabetes or may be at risk, and the health care providers that care for them. The targeted behaviors are based on lifestyle changes that are commonly recommended to patients diagnosed with prediabetes. For ease of use, the content is written in a way that addresses the patient directly.



# SECTION 1

Prediabetes at a glance

In a 2010 report, the CDC listed diabetes as the 7th leading cause of death in America, with 69,071 death certificates listing it as the underlying cause of death, and a total of 234,051 death certificates listing diabetes as an underlying or contributing cause of death.<sup>4</sup> It's estimated that one in three Americans currently have prediabetes. Prediabetes, also known as impaired glucose tolerance, is a condition that doesn't have noticeable symptoms, but potentially very serious consequences if it progresses to Type 2 diabetes.

Because prediabetes is usually symptomless, many do not know that they may be prediabetic and don't get tested or diagnosed. Many of these will not even know that they were at risk until they start noticing symptoms and are diagnosed with diabetes. In fact, the CDC has found that only 11% of people with prediabetes are aware of their condition.<sup>5</sup>

The good news is that with proper care and commitment to making lasting lifestyle changes and building positive habits, prediabetes can be kept from progressing to Type 2 diabetes.

## Increasing financial well-being through behavior change

People with diagnosed diabetes incur average out of pocket medical expenditures of about \$13,700 per year, of which about \$7,900 is attributed to diabetes. On average, these patients have medical expenditures that are approximately 2.3 times higher than what it would be in the absence of diabetes (\$13,700 vs. \$5,800). It is also estimated that people with diagnosed diabetes account for more than 1 in 5 health care dollars spent in the US, and more than half of that expenditure is directly attributable to diabetes. Other indirect costs include increased absenteeism (\$5 billion) and reduced productivity while at work (\$20.8 billion) for the employed population, reduced productivity for those not in the labor force (\$2.7 billion), inability to work as a result of disease-related disability (\$21.6 billion), and lost productive capacity due to early mortality (\$18.5 billion).

What these figures show, is that there are ample financial as well as clinical reasons to do what we can to diagnose and treat prediabetes. Keeping diabetes at bay benefits everyone financially. It means less out of pocket expenses for individuals and removing a huge burden from employers and taxpayers.



<sup>&</sup>lt;sup>4</sup> CDC National Diabetes Statistics Report, 2014: http://www.cdc.gov/diabetes/pubs/statsreport14/national-diabetes-report-web.pdf <sup>5</sup> http://www.cdc.gov/features/diabetesfactsheet/

<sup>&</sup>lt;sup>6</sup> Su W, Chen F, Dall TM, Iacobucci W, Perreault L. Return on Investment for Digital Behavioral Counseling in Patients With Prediabetes and Cardiovascular Disease. Prev Chronic Dis 2016;13:150357. DOI: http://dx.doi.org/10.5888/pcd13.150357

<sup>&</sup>lt;sup>7</sup> Yang, W., Dall, T. M., Halder, P., Gallo, P., Kowal, S. L., Hogan, P. F., & Petersen, M. (2013). Economic costs of diabetes in the U.S. in 2012. *Diabetes Care*, *36*(4), 1033–1046. http://doi.org/10.2337/dc12-2625

#### What leads to diabetes?

Type 1 diabetes develops when the pancreas loses its ability to make the hormone insulin. When this happens, the person's own immune system attacks and destroys the cells in the pancreas that produce insulin. This is different from Type 2 diabetes, which develops when the body becomes resistant to insulin or when the pancreas stops producing enough insulin. Instead of the insulin moving into your cells where it's needed for energy, sugar builds up in your bloodstream. Exactly why this happens is unknown, although it is thought that you inherit a predisposition to the disease, then unhealthy behaviors like poor diet and lack of activity can trigger it.

## Type 1 and Type 2 Diabetes

To understand the difference between Type 1 and 2 diabetes, the "lock and key" analogy is helpful: Imagine insulin is the key that opens your cells and allows sugar to enter. If sugar can't enter, it builds up in the blood, makes you hungry and thirsty, and causes your body to turn the sugar in your blood to fat for energy.

In type 1 diabetes, your pancreas stops making keys. You need to put keys in your body (by injecting insulin for example) or sugar can't get into your cells.

In type 2 diabetes, the keyhole is rusty. You have keys, but they have trouble opening the cells. You either need more keys or a way to make the lock work better. You can take a little rust off the lock by exercising, losing weight, or taking medication <sup>8</sup>

Since prediabetes only develops into Type 2 diabetes, this is the focus of the current paper. Type 2 diabetes is also by far the most common, as 90-95% of people with diabetes have it. Type 2 diabetes is also by far the most common, as 90-95% of people with diabetes have it.

<sup>&</sup>lt;sup>8</sup> https://www.diabetesdaily.com/blog/2010/10/which-is-worse-type-1-or-type-2-diabetes/

#### Who is at risk?

Some populations are considered to be at a higher risk for developing prediabetes and type 2 diabetes than others, and should therefore take extra care to be tested at an earlier age. These risk factors include a mixture of genetic and lifestyle factors:

#### Genetic

- 1) Having a family history of diabetes, especially a parent, brother or sister
- Having an African American, Hispanic/Latino, American Indian, Asian American, or Pacific Islander racial or ethnic background
- 3) Having a history of diabetes while pregnant (gestational diabetes) or having given birth to a baby weighing nine pounds or more.
- 4) Having polycystic ovary syndrome (PCOS)
- 5) Having other conditions associated with insulin resistance, such as a condition called acanthosis nigricans, characterized by a dark, velvety rash around the neck or armpits
- 6) Being over 45 years old





#### Lifestyle

- 1) Being overweight or obese (Body mass index over 25)
- 2) Being physically active less than three times a week
- 3) Having high blood pressure, 140/90 mmHg or above, or being treated for high blood pressure
- 4) Having high-density lipoprotein (HDL), or "good," cholesterol, below 35 mg/dL, or a trialyceride level above 250 mg/dL
- 5) Having a history of cardiovascular disease



#### Diagnosing prediabetes

#### When should I get tested?

Monitoring whether you are at risk for developing diabetes is a key part of prevention. If you are at-risk, it is generally recommended that you get tested starting at 20 years old. However, if you are concerned that your child or teenager is at risk, you should get in touch with your healthcare provider to see if getting tested is recommended in your case.

In those who none of these risk factors applies to, it is recommended that testing should begin later, at age 45. If the results of testing are normal, testing should be repeated at least every 3 years. Doctors may recommend more frequent testing depending on initial results and risk status.

#### What does the test involve?

In order to establish prediabetes, patients need to go through one or more of three tests:

- Fasting plasma glucose (FPG) between 100-125 mg/dL: This test is usually done first thing in the morning, after fasting for 8 hours.
- Hemoglobin A1c between 5.7% and 6.4%: This is usually a more convenient test, since blood can be drawn any time of day.
- Two hour post-prandial blood glucose of 140-199 mg/dL following a 75-gram oral glucose tolerance test (OGTT): A two-hour test that checks your blood glucose levels before and 2 hours after you drink a special sweet drink.

Prediabetes is established when one of these measurements is present, and patients typically must repeat the test on a second day to confirm it is correct. This is because all laboratory test results can vary from day to day and from test to test. For example, results can vary both within the person being tested (a person's blood glucose levels normally move up and down depending on meals, exercise, sickness, and stress) and between different tests. The tests are usually done at a clinic or a doctor's office.<sup>9</sup>

<sup>9</sup> https://omadahealth.com/assets/pdf/Omada\_Clinical\_Dossier.pdf

#### Good news! It's preventable. Lifestyle changes work.



#### The Diabetes Prevention Program

The Diabetes Prevention Program (DPP) was a large clinical trial that showed that lifestyle intervention to improve diet and physical activity reduced type 2 diabetes onset by 58% over 3 years, with continued clinical benefits observed at 10-year and 15- year follow-up. 10 In the DPP, participants from 27 clinical centers around the United States were randomly divided into different treatment groups.

The first group, called the lifestyle intervention group, received:

- intensive training in diet
- physical activity, and
- behavior modification.

By eating less fat and fewer calories, as well as exercising for a total of 150 minutes a week, they aimed to lose 7 percent of their body weight and maintain that loss.

The second group took 850 mg of metformin, an oral diabetes medicine that helps control blood sugar levels, twice a day.

The third group received placebo pills instead of metformin. The metformin and placebo groups also received information about diet and exercise but no intensive motivational counseling.

A fourth group was treated with the drug troglitazone (Rezulin), but this part of the study was discontinued after researchers discovered that troglitazone can cause serious liver damage. The participants in this group were followed but not included as one of the intervention groups. All 3,234 study participants were overweight and had prediabetes. In addition, 45 percent of the participants were from minority groups: African American, Alaska Native, American Indian, Asian American, Hispanic/Latino, or Pacific Islander. These groups are known to be at increased risk of developing diabetes.

Participants in the lifestyle intervention group reduced their risk of developing diabetes by 58 percent. This finding was true for all participating ethnic groups and for both men and women. Lifestyle changes worked particularly well for participants aged 60 and older, reducing their risk by 71 percent. About 5 percent of the lifestyle intervention group developed diabetes each year during the study period, compared with 11 percent of those in the placebo group.

Participants taking metformin reduced their risk of developing diabetes by 31 percent. Metformin was effective for both men and women, but it was least effective in people aged 45 and older. Metformin was most effective in people 25 to 44 years old and in those with a body mass index of 35 or higher, meaning they were at least 60 pounds overweight. About 7.8 percent of the metformin group developed diabetes each year during the study, compared with 11 percent of the group receiving the placebo.<sup>11</sup>

<sup>&</sup>lt;sup>10</sup> Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med 2002;346(6):393–403

<sup>11</sup> http://www.niddk.nih.gov/about-niddk/research-areas/diabetes/diabetes-prevention-program-dpp/Pages/default.aspx

## Using behavioral economics to drive behavior change

the CDC set up a number of common standards for interventions, called the Diabetes Prevention Recognition Program (DPRP). The purpose of these standards is to track and ensure the quality of lifestyle intervention programs aimed at diabetes risk reduction. It recognizes organizations that have demonstrated their ability to effectively deliver a proven type 2 diabetes prevention lifestyle intervention. 12 Having DPRP recognition of a program is considered essential to its credibility, and most health care professionals and recognized intervention programs follow these standards. That includes popular interventions such as YMCA's Diabetes Prevention Program and Omada Health's Prevent Program.

Given the success of the prevention program,

Most of the DPRP standards focus on education as a means of driving behavior change. For example, it is required that an intervention should consist of a series of sessions, providing information, assigning homework, and offering feedback in stages. Furthermore, the DPRP provides a list of curriculum topics that need to be covered in educational sessions and homework in a set time frame.<sup>13</sup>

From a behavioral economics standpoint the current way the DPRP thinks about interventions may offer an opportunity: We know that traditional approaches such as education and media campaigns is a necessary but rarely sufficient factor to change behavior. The educational approach assumes that people lack

the knowledge of what they should be doing, and if they improve their knowledge they will change their attitude and behavior. However, we think this view is too simplistic. Understanding why someone engages in a certain health behavior is complicated and multifactorial, consisting of internal factors, attitudes, beliefs, motivations, ability, perceived threats, self-efficacy, social norms, socio-cultural contexts and so on.<sup>14</sup> In addition, the amount of information provided is not always helpful: Giving too much information may be overwhelming, making it harder to take the first steps.

Understanding why someone engages in a certain health behavior is complicated and multifactorial.

For healthcare professionals developing new behavior change interventions, success is likely to depend on going beyond DPRP requirements and taking into account what psychologists know about the many complicated factors that influence our behavior.

<sup>&</sup>lt;sup>12</sup> Centers for Disease Control and Prevention Diabetes Prevention Recognition, Program Standards and Operating Procedures 2015. http://www.cdc.gov/diabetes/prevention/pdf/dprp-standards.pdf

<sup>&</sup>lt;sup>13</sup> Centers for Disease Control and Prevention Diabetes Prevention Recognition, Program Standards and Operating Procedures 2015. http://www.cdc.gov/diabetes/prevention/pdf/dprp-standards.pdf

<sup>&</sup>lt;sup>14</sup> Corace, K., & Garber, G. (2014). When knowledge is not enough: Changing behavior to change vaccination results. *Human Vaccines and Immunotherapeutics*, 10(9), 2623–2624. http://doi.org/10.4161/21645515.2014.970076

# SECTION 2 Behavioral Economics

## Part A: Activity Recommendations

Physical activity has a host of benefits that are important for keeping prediabetes from getting worse, and it is usually the first thing the doctor will recommend upon diagnosis. Regular physical exercise, both aerobic exercise and strength training, improves glucose control, lipid levels, and blood pressure, decreases the risk of falls and fractures, and improves functional capacity and sense of well-being.

In 2010, The American College of Sports Medicine and American Diabetes Association issued a joint position statement on Type 2 diabetes and exercise, offering guidelines on the benefits and risks of physical activity for prevention and management of Type 2 diabetes. Among their recommendations was that the physical activity regimen should involve at least 150 minutes per week, or 30 minutes per day, of moderate-intensity exercise such as brisk walking (for example a 15- to 20-minute mile) and strength training. It is worth noting that a study of adult Americans by the CDC found that only 20.6 percent of people met the total recommended amounts of exercise - about 23 percent of surveyed men and 18 percent of surveyed women.

Despite ample reason to exercise, it is something most people struggle to do. Because the benefits of exercise are primarily in the future, it can be easy to find excuses for not being active in the present. This section focuses on how behavioral science can be applied to help remove barriers to getting more active. We show four principles and how to apply them:

- The licensing effect
- · Adding a social element
- Commitment devices
- · Building healthy habits

Below is an outline of key behaviors that are recommended for people diagnosed with prediabetes.

#### Key behaviors:

- 1) Get at least 30 minutes a day, 5 days a week (150 minutes per week) of physical activity such as brisk walking
- 2) Go to the gym at least twice a week

and Mortality Weekly Report, 62(17), 326-30. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/23636025

<sup>&</sup>lt;sup>16</sup> Colberg, S. R., Albright, A. L., Blissmer, B. J., Braun, B., Chasan-Taber, L., Fernhall, B., ... Sigal, R. J. (2010). Exercise and type 2 diabetes: American College of Sports Medicine and the American Diabetes Association: joint position statement. Exercise and type 2 diabetes. *Medicine and Science in Sports and Exercise*, 42(12), 2282–303. http://doi.org/10.1249/MSS.0b013e3181eeb61c

<sup>16</sup> Report, M. W. (2013). Adult participation in aerobic and muscle-strengthening physical activities - United States, 2011. *MMWR. Morbidity* 

## Principle: Licensing effect

#### Allowing yourself to do something bad because you just did something good.

### Research background:

Our behaviors and decisions can vary a lot depending on how information is presented to us. This has been studied in many areas, from politics, economics and consumer choice to health. In the area of exercise, one problem is that people who work out often also "reward" themselves more afterwards. Researcher Brian Wansink wanted to address this issue, and found that when exercise is seen as a fun activity rather than something they have to get through, participants will engage less in hedonic behaviors afterwards.

One of his studies illustrates this: He split up two groups and took them on a walk around campus. One group was told it was an exercise walk, and the other group was told it was a scenic walk. After the walk, the group that was told it was an exercise walk ate 35% more chocolate pudding than those who were told it was a scenic walk. These findings were replicated in two other studies, showing that perceiving exercise as fun lead to healthier food choices. These studies show that engaging in a physical activity seems to trigger the search for reward when individuals perceive it as exercise but not when they perceive it as fun.

## $\searrow$ Using this finding:

- Make it fun. Find a way to be active in a way that is engaging to you. It may mean getting creative and joining a group or team or taking lessons to learn something new.
- Be aware that you may want to overindulge after a tough workout.
   Prepare portions of healthy, lowcalorie snacks that are easier to grab than sweets or pastries. Reward yourself with a healthy snack that works with your diet.

After the walk, the group that was told it was an exercise walk ate

35%

more chocolate pudding than those who were told it was a scenic walk.

<sup>&</sup>lt;sup>17</sup> Werle, C., Wansink, B. and Payne, C. (2014). Is it fun or exercise? The framing of physical activity biases subsequent snacking. *Marketing Letters*. 10.1007/s11002-014-9301-6

## Principle: Add a social element

#### People do more exercise and enjoy it more when doing it with others.

## Research background:

Not only do people report enjoying exercise more when they do it with friends, research has also found that for moderate and vigorous exercise, the duration of exercise was shorter when people exercised alone rather than with others. 18 In a study looking at the effects of working out with a partner, participants were divided into groups and asked to ride an exercise bike. One group rode alone, and the second had a single partner (note that the partner in this study was actually virtual via Skype). The researchers found that those who rode alone did so for an average of 10.6 minutes before stopping. Those with a partner kept going for 19.8 minutes - 87% longer!19

In 2015, the fitness tracker Jawbone introduced a feature called Duels to their app "UP" which applies this principle. Duels allow participants to challenge one or more friends to a competition where whoever has the most steps after a set period wins. The company has found that the more people we exercise with, the more active we are. In fact, those who have two teammates in the UP app move, on average, 7% more than those who used the step counters without teammates.<sup>20</sup>

- Enlist a friend. Work with one or more friends who have similar fitness goals to you to find a time and place where you can work out together. You can go to the gym, start a new activity together or just go for a walk.
- Take advantage of the social aspect of your fitness apps. If you use a fitness tracker or app that has a social element built into it, use it! It may feel uncomfortable to share the details of your workouts so publicly with friends, but it will help you get and stay active.



Users of the app "UP" by Jawbone take more steps the more teammates they have.

<sup>&</sup>lt;sup>18</sup> Dunton, G. F., Berrigan, D., Ballard-Barbash, R., Graubard, B. I., & Atienza, A. A. (2009). Environmental influences on exercise intensity and duration in a U.S. time use study. *Medicine and Science in Sports and Exercise*, 41(9), 1698.

<sup>&</sup>lt;sup>19</sup> Irwin, B. C., Scorniaenchi, J., Kerr, N. L., Eisenmann, J. C., & Feltz, D. L. (2012). Aerobic exercise is promoted when individual performance affects the group: A test of the kohler motivation gain effect. *Annals of Behavioral Medicine*, 44(2), 151–159. http://doi.org/10.1007/s12160-012-9367-4

<sup>&</sup>lt;sup>20</sup> https://jawbone.com/blog/introducing-duels-ultimate-step-competition/

## Principle: Commitment devices

#### Making us accountable to our future selves.

#### Research background:

The simple act of agreeing to do something actually makes you much more likely to do it. This idea comes from Robert Cialdini's influential work on influence, and it's called a commitment device. A commitment device is a choice that an individual makes in the present which restricts his or her own choices in the future, often as a means of controlling future impulsive behavior and limiting choices to those that reflect long-term goals. In his book "Influence", Cialdini explains that once we have made a choice or taken a stand, we will encounter personal and interpersonal pressures to behave consistently with that commitment. In fact, the more public our commitment is, the more likely we are to behave in accordance with the commitment.



Once we have made a choice or taken a stand, we will encounter personal and interpersonal pressures to behave consistently with that commitment.

They are not a new idea. In literature, Ulysses knew that the sirens' enchanting song could lead him to follow them, but he didn't want to do that. At the same time he also did not want to deprive himself from hearing their song — so he asked his sailors to tie him to the mast of the ship and fill their ears with wax to block out the sound — and so he could hear the song of the sirens but resist their lure. Since then, there are countless modern ways to increase commitment.

Research has shown that commitment devices have helped people lose weight, improve their diets, exercise more, and quit smoking. One randomized experiment, for example, found that access to a commitment device increased the rate at which smokers succeeded in quitting after 6 months by 40%. In the study, smokers got a savings account in which they put their money for 6 months, after which they took a urine test. If they passed, their money was returned without interest. If they failed, the money went to charity.<sup>22</sup>

<sup>&</sup>lt;sup>21</sup> Cialdini, R. (1984). *Influence: The Psychology of Persuasion*, New York: Quill

<sup>&</sup>lt;sup>22</sup> Giné X, Karlan D, Zinman J. Put your money where your butt is: a commitment contract for smoking cessation. Am Econ J Appl Econ. 2010;2(4):213-235



- The more public your commitment is, the more likely you are to follow through with it. Tell your friends about your goal! Bonus points for committing to get active together!
- Use one of the apps that get you to commit to and stick with your goals, such as:
  - Pact gets you to commit to a weekly goal, like exercising a certain number of times or eating certain servings of vegetables. It keeps you accountable by using your phone's GPS tracker, as well as asking you to log meals and provide photographic evidence of your healthy behaviors. If you meet your goal, you get a small cash reward for each day committed, paid for by those who didn't make it.<sup>23</sup>
  - o Jawbone's app "UP" applies the concept of commitment and consistency to help users stick to their goals. When you sign up for the app, it asks you about your goals for steps, sleep and weight. After you've set your goals, the app tracks your behavior and gives you feedback about whether or not you've accomplished them.
  - UP also offers the feature "Today I Will", which suggests actionable behaviors that users can agree to. For example, when UP notices you've recently had a few late nights compared with your normal sleep habits, it will ask you, "Hey it looks like you haven't been getting enough sleep recently. Why don't you try to get to bed by 10:50 pm tonight?" Because of our desire to be consistent with our previous commitment, we are more likely to comply later. Their research found that this works well: Users get to bed 23 minutes earlier on average and it makes them 72% more likely to get to bed early enough to get at least 7 hours of sleep.<sup>24</sup>

<sup>&</sup>lt;sup>23</sup> http://www.gym-pact.com/#

<sup>&</sup>lt;sup>24</sup> https://jawbone.com/blog/how-your-brain-is-wired-to-help-you/

## Principle: Triggers and rewards help us take action

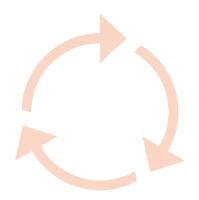
## Supporting long-term change through building healthy habits and getting rid of bad ones.

#### Research background:

Part of why getting regular exercise is so hard is that taking an action repeatedly is more difficult than just doing it once. Regular exercise involves not only creating the habit of being physically active, but also intentionally overcoming an existing habit of being sedentary. Bad habits are hard to change, but the good news is that so are healthy habits: Once they are formed, they provide the most resilient and sustainable way to maintain a behavior. In order to support ourselves in building habits that stick, it's important to know how they work.

A habit is a repeated behavior that is triggered by cues in our environment. In order to save time and effort, our brain creates strong associations between cues and routines that we do regularly.<sup>25</sup> Because habits become deeply ingrained and often automatic, we may not even notice them. In fact, researchers have estimated that habits account for as much as 40% of our behavior on a given day.<sup>26</sup>

In addition to the cue and routine, adding a reward can help drive us forward and give us a reason to repeat a new behavior. Rewarding experiences make us want to come back and do it again. Over time, the cue gets associated with the reward, encouraging us to perform the routine even after we've stopped actually getting rewarded for it.<sup>27</sup>



To illustrate this "habit loop", let's look at a an example: Putting out our exercise clothes in the morning (cue) can lead us to go for a run (routine) which fills us with endorphins, makes us feel good about ourselves (reward). Then, when we see the exercise clothes again the next morning, we are reminded of the reward which motivates us to do the routine

<sup>&</sup>lt;sup>25</sup> Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological Review, 114*(4), 843–863. http://doi.org/10.1037/0033-295X.114.4.843

<sup>&</sup>lt;sup>26</sup> Neal, D. T., Wood, W., & Quinn, J. M. (2006). Habits - A repeat performance. Current Directions in *Psychological Science*, *15*(4), 198–202. http://doi.org/10.1111/j.1467-8721.2006.00435.x

<sup>&</sup>lt;sup>27</sup> Wendel, S. (2014) Designing for behavior change

- Get in the habit of tracking your exercise. Wearables like Fitbit, Jawbone or the Nike+ FuelBand build the habit of checking how many steps you are taking throughout the day. They give you a cue (the tracker itself), routine (checking your steps), and reward (seeing the points increase).
- To change existing bad habits, there are five main strategies that can be used<sup>28</sup>:
  - Avoid the cue: If the best time to exercise is after you get home from work, but you have a tendency to get on the couch in front of the TV the moment you get back, it may be a good idea to remove the TV or go straight to the gym from work.
  - Change the habit into something else: It is possible to "hijack" bad routines and turn them into good ones. Using the same example, a treadmill or exercise bike in front of the TV would get you active despite the old cue (the TV) still being present.
  - Use conscious interference: Consciously disrupting our bad habits can be difficult but useful. In order to do this, we need to carefully think about our bad habits: What is the cue that triggers it? What is the routine? Am I doing this because of an anticipated reward? Once you know what your habits are and what triggers you to do it, it is easier to recognize and avoid them.
  - *Use mindfulness to avoid acting on the cue*: Similarly to thinking about our habits, practicing mindfulness has been shown to help us increase focus and reduce impulsivity in several domains. Being mindful of the cues and routines of unwanted habits helps us increase control and resist their pull.
  - Crowd out the old habit with new behavior. There is only so much time in one day. If your problem is sitting at home watching TV too much, consciously creating new habits that keep you out of the house (going to the gym, attending a cooking class, meeting a friend for a walk after work) will decrease the amount of available TV-time.

<sup>&</sup>lt;sup>28</sup> Wendel, S. (2014) Designing for behavior change



## Part B: Diet and Lifestyle Recommendations

The CDC recommends activity and losing 5 to 7% of your body weight as the most effective way to keep prediabetes from progressing. Exercise alone is not sufficient to achieve this: You have to also make diet and lifestyle adjustments. A common mistake is to start working out, but also increase food and alcohol intake. This concept is called moral licensing, and it is the tendency to allow ourselves to "misbehave" in one area because we are being good in another. There are many examples of this: One study found that participants who believed multivitamin pills provided significant health benefits exercised less and were less likely to choose healthy food.<sup>29</sup>

Exercise alone is not sufficient to achieve this: You have to also make diet and lifestyle adjustments.

Although there are some variations in the recommendations about what constitutes the best diet for prediabetics, it is usually recommend that those who are diagnosed or at risk should lower caloric intake and keep a diet low in saturated fat, sugars, and refined carbohydrates, as well as limited sodium. The American Association for Clinical Endocrinologists (AACE) recommends that all patients should strive to attain and maintain an optimal weight through a primarily plant-based diet high in polyunsaturated and monounsaturated fatty acids, with limited intake of saturated fatty acids and avoidance of trans fats. In addition, patients with prediabetes should also be consistent in day-to-day carbohydrate intake, limiting sucrose containing or high-glycemic-index foods.

<sup>&</sup>lt;sup>29</sup> Chiou, W.-B., Yang, C.-C., & Wan, C.-S. (2011). Ironic effects of dietary supplementation: illusory invulnerability created by taking dietary supplements licenses health-risk behaviors. *Psychological Science*: A *Journal of the American Psychological Society / APS*, 22(8), 1081–1086. http://doi.org/10.1177/0956797611416253

Dietary guidelines are sometimes confusing and the disagreement about what the guidelines mean and what changes you should make can be discouraging. Although this is partially because of a lack of knowledge about the long term effects of specific diets on diabetes, it will serve patients best if health care professionals make an effort to reduce this barrier by providing clear instructions and meal plan suggestions to anyone who is diagnosed with prediabetes.

To illustrate how complicated these guidelines can seem, consider these. The American Diabetes Association (ADA) recommends that a healthy diet should consist of a daily energy intake of 15 - 20% protein, at least 130 g/day of healthy carbohydrates, less than 7% saturated fatty acids, limit cholesterol to less than 200 mg/day, and individually tailor intake of monosaturated fatty acids. In contrast, the European Association for the Study of Diabetes (EASD) recommends 10-20% protein, 35% fat, 45-60% healthy carbohydrates and less than 10% transfat and saturated fatty acids. Monosaturated fatty acids should be individually tailored. Another study showed that a ketogenic diet (very low carb) was best at improving glycated hemoglobin (HbA1c) levels in individuals with prediabetes and Type 2 diabetes.



#### Key behaviors:

- 1) Lose 5 to 7% of your body weight
- 2) Eat regular meals to keep your blood glucose levels stable
- 3) Lower caloric intake and keep a diet low in saturated fat, sugars, sodium and refined carbohydrates
- Include at least five portions of fruits and vegetables each day
- 5) Avoid excess alcohol
- 6) Stop smoking

<sup>30</sup> https://www.aace.com/sites/all/files/enduring\_materials/5359\_Hamdy\_Wed\_AACE\_dyslipidemia\_Nutrition.pdf

<sup>&</sup>lt;sup>31</sup> Saslow, L. R., Kim, S., Daubenmier, J. J., Moskowitz, J. T., Phinney, S. D., Goldman, V., ... Hecht, F. M. (2014). A randomized pilot trial of a moderate carbohydrate diet compared to a very low carbohydrate diet in overweight or obese individuals with type 2 diabetes mellitus or prediabetes. *PLoS One*, *9*(4), e91027. http://doi.org/10.1371/journal.pone.0091027

## Principle: Implementation intentions

#### Using "if-then" plans to stick to goals and form better habits.

### Research background:

Changing eating and lifestyle habits is hard. In all likelihood, you will come across many situations where you will be tempted to forget all about your diagnosis and do what feels good in the moment. One way to mitigate this is to anticipate situations where there will be temptations and develop a strategy to deal with it. A study by Stadler, Oettingen and Gollwitzer (2010) tested an intervention called "mental contrasting with implementation intentions", which was aimed at providing women not only with information, but better strategies to self-regulate in order for them to maintain a healthy diet containing more fruit and vegetables.<sup>32</sup> This self-regulation strategy has two key components: Mental contrasting and implementation intentions. Mental contrasting creates strong goal commitments, whereas implementation intentions facilitate the implementation of the goal.

Mental contrasting has a specific sequence of three steps:

- 1) Identify an important wish that is directed towards behaviour change that you expect to be able to attain (for example "I want to stick to my new diet!")
- 2) Identify and imagine the most positive outcome of successfully changing your behaviour (for example "losing 5 to 7% of my body weight" or "being happy and proud of my body at the beach"); and
- 3) Identify and imagine the most critical obstacle that stands in the way of your wish fulfilment (i.e. chocolate craving), and events and experiences associated with this obstacle (i.e. chocolate at the register in shops).

Mental contrasting creates strong goal commitments, whereas implementation intentions facilitate the implementation of the goal.

<sup>&</sup>lt;sup>32</sup> Stadler, G., Oettingen, G., & Gollwitzer, P. M. (2010). Intervention effects of information and self-regulation on eating fruits and vegetables over two years. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, 29(3), 274–283. http://doi.org/10.1037/a0018644

Even though people are strongly committed to goals, they do not always implement them. This is where implementation intentions can be helpful. Goal realization becomes more probable when people supplement a strong goal commitment (i.e. "I want to eat more fruit and vegetables") with an implementation intention that details when, where, and how the person wants to act (i.e. "If the waiter asks me about dessert I'll order a fruit salad"). Mental contrasting helps identify and specify obstacles that hinder behaviour change. We can then address these with "if-then" plans that link the obstacle with an action to overcome or circumvent the obstacle.

In the study, implementation intentions were formed through the following questions:

- 1) "When and where does the obstacle occur, and what can I do to overcome or circumvent the obstacle?";
- 2) "When and where is an opportunity to prevent the obstacle from occurring, and what can I do to prevent it from occurring?"; and
- 3) "When and where is a good opportunity for me to act in a goal-directed way, and what would the goal-directed action be?"

The 2010 study was a randomised controlled trial with three groups, one information-only group (leaflet about eating healthy, diet guidance, and advantages), one information + self-regulation group and one control group. The researchers found that participants in the first two groups ate more fruits and vegetables during the first four months after the intervention. Two years later, participants in the information + self-regulation group maintained the higher intake, whereas participants in the information group returned to the baseline level.

Goal realization becomes more probable when people supplement a strong goal commitment.

- Hold yourself accountable to your goals and consciously shape healthier habits by using selfregulation techniques like mental contrasting and implementation intentions.
- Write out your goals and critical obstacles using the mental contrasting sequence, and discuss with a friend or family member if possible.
- Shape your implementation intentions by writing out your answers to the obstacle questions, and discuss with a friend or family member if possible.

#### Principle: Loss aversion

#### People are typically more motivated to avoid losses than to seek gains.

### Q

#### Research background:

We tend to overvalue things that we own. In a famous study, Daniel Kahneman, Jack Knetsch and Richard Thaler showed participants a mug, and then asked how much they would be willing to pay for it. They then gave the participants the mug but gave them a chance to sell it or trade it for a pen of equal value. In the study, they found that the amount participants required as compensation for the mug once their ownership of the mug had been established was about twice as high as the amount they were willing to pay to get the mug before they owned it.<sup>33</sup>

This phenomenon can be explained by something behavioral economists call loss aversion. What researchers have found is that people strongly prefer avoiding losses to acquiring gains. This means that the potential of losing a reward is a more powerful motivation than getting one.

Loss aversion can be leveraged to help us stick to our diet and exercise goals. In a study looking at how different reward structures influenced

People strongly prefer avoiding losses to acquiring gains.

physical activity, Mitesh Patel and his colleagues asked participants to walk 7,000 steps per day for 26 weeks. For the first 13 weeks of the study, the participants were split into four groups where the only difference was the type of reward they received: One group got no reward, another got the chance of winning \$1.40 per day, another received a definite \$1.40 per day they successfully reached their step goal, and finally a last group received a set amount at the beginning of the month but lost \$1.40 for each day they failed to reach their goal. In the study, the group that lost money when they didn't reach their goal came out as a clear winner, with people achieving their 7,000 step goal about 50% more often than any of the other groups.34

- Use a friend as a referee
  - oThere are several apps that uses the concept of loss aversion to help us stick to our goals. The startup StickK allows you to choose a goal and a referee, then risk money to make sure that you follow through.<sup>35</sup> The reason this works so well is because we will go to great lengths to avoid the sting of a loss.
  - •You don't have to use an app to get motivated by a potential loss. Let your trusted referee know about your goal, and give them an amount of money you'd rather not lose. If you meet your goal, they give it back. However, if you fail to meet your goal, they give the money away to their favorite charity.

<sup>&</sup>lt;sup>33</sup> Kahneman, Daniel, Jack L. Knetsch, and Richard H. Thaler. "Experimental tests of the endowment effect and the Coase theorem." *Journal of political Economy* (1990): 1325-1348.

<sup>&</sup>lt;sup>34</sup> Patel, M. S., Asch, D. A., Rosin, R., Small, D. S., Bellamy, S. L., Heuer, J., ... Volpp, K. G. (2016). Framing Financial Incentives to Increase Physical Activity Among Overweight and Obese Adults: A Randomized, Controlled Trial. *Annals of Internal Medicine*, *164*(6), 385–394. http://doi.org/10.7326/M15-1635

<sup>35</sup> http://www.stickk.com/

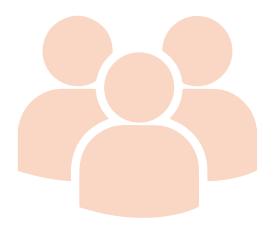
#### Principle: Social norms

Assuming the actions of others in an attempt to reflect correct behavior for a given situation.

#### Research background:

Simply making people aware of how they compare with others can be an effective way of influencing behavior. A study by Zimmerman (2009)<sup>36</sup> looks at ways behavioral economics can be used to promote physical activity. The author argues that changing people's perceptions about the social norms surrounding an active lifestyle, for example by communicating the average exercise habits of the peers, can encourage people to adopt similar lifestyles. A key finding is that people's preferences for actions are not absolute, but rather relative to some anchor point, and can therefore be influenced by changing the anchor. Using the activity of co-workers as an anchor would therefore encourage behaving in a similar way. Note that this could work in favor of a more sedentary lifestyle as well, so make sure that the anchored activity levels are not too low!

People's preferences for actions are not absolute, but rather relative to some anchor point, and can therefore be influenced by changing the anchor.



The prediabetes prevention app "Prevent" by Omada Health cleverly applies a social element to their platform. When signing up, members are placed in a small support group of 11 - 15 similarly situated peers. The product begins with what can be conceptualized as a fourmonth social game, where people engage in a friendly competition among their small group to get 100% of the way towards their goal weight through proper exercise and diet tracking. Weekly lessons on diabetes prevention are mixed in with the program, and web and mobile apps provide notifications and positive peer pressure. A dedicated health coach (something like a virtual personal trainer meets nutritionist) keeps everyone on track, checking in via text messages and voice calls with participants as needed to bolster their motivation.37

<sup>&</sup>lt;sup>36</sup> Zimmerman, F. J. (2009). Using behavioral economics to promote physical activity. *Preventive Medicine*, 49(4), 289–291. doi:10.1016/j. ypmed.2009.07.008

<sup>&</sup>lt;sup>37</sup> http://a16z.com/2014/04/09/omada-health-behavior-change/

- Comparing ourselves to others can be a good thing. Find a group of likeminded peers with similar goals: It can be friends, members of a weight loss group, a nutrition class, or an online forum. Follow each other's' progress and engage in friendly competition to get to your goals.
- Consider enrolling in a dedicated program for those diagnosed with prediabetes, for example through your local YMCA or the Prevent program, to meet people who are in the same position as you.
- Think about who you spend your time with. Are your friends and family always eating junk food? We are likely to be influenced by the people around us and think that everyone behaves in a similar way. For example, if we spend more time at the gym, we might start thinking that most people exercise. If our friends think that eating a healthy diet is important, we might start thinking so too. If you feel like you're fighting an uphill battle trying to change your diet to something different from what everyone around you are eating, it's especially helpful to seek out new acquaintances through an organized group of likeminded peers.



# Part C: Medical Treatment and Monitoring Recommendations

Monitoring whether you are at risk for developing diabetes is a key part of prevention. If you are at-risk, it is recommended that you get tested starting at 20 years old. In those who do not have any risk factors, it is recommended that testing should begin at age 45. If results of testing are normal, testing should be repeated at least every 3 years. Doctors may recommend more frequent testing depending on initial results and risk status.

Although it is rarely prescribed to patients with a prediabetes diagnosis, about 3.7% of people use the drug metformin to prevent type 2 Diabetes.<sup>38</sup> Specifically, it is prescribed for people under age 60 with a very high risk of developing diabetes, for people who are very obese (BMI of 35 or higher), and for women with a history of gestational diabetes. Metformin is an oral drug that should be taken 2-3 times per day depending on the dosage.

In a 2011 study of Iranian patients with type 2 Diabetes, the researchers showed that the non-adherence rate to metformin was as high as 39.7%. When asked why they didn't take their medication, participants most commonly reported forgetfulness, confusion, fasting, adverse effects, complexity of medication regimen and disruption of routines.<sup>39</sup> Other studies of Metformin adherence has suggested similar rates, for example one UK study that suggested the non-adherence rate could be improved from 38% with regular metformin 2-3 times a day to 19% if only one pill a day was required.<sup>40</sup>

Below is an outline of key behaviors that may be recommended if you are diagnosed with prediabetes. This section focuses on how you can apply behavioral science to make sure you get the most out of your medical treatment.

#### Key behaviors:

- 1) Go to regular check-ups
- 2) Monitor blood glucose levels using home tests if your levels are high
- 3) Take metformin regularly as prescribed

<sup>&</sup>lt;sup>38</sup> Moin, T., Li, J., Duru, O. K., Ettner, S., Turk, N., Keckhafer, A., ... Mangione, C. M. (2015). Metformin prescription for insured adults with prediabetes from 2010 to 2012: A retrospective cohort study. *Annals of Internal Medicine*, *162*(8), 542–548. http://doi.org/10.7326/M14-1773

<sup>&</sup>lt;sup>39</sup> Farsaei, S., Sabzghabaee, A. M., Zargarzadeh, A. H., & Amini, M. (2011). Adherence to glyburide and metformin and associated factors in type 2 diabetes in Isfahan, Iran. *Iranian Journal of Pharmaceutical Research*, 10(4), 933–939.

<sup>&</sup>lt;sup>40</sup> Donnelly, L. A., Morris, A. D., & Pearson, E. R. (2009). Adherence in patients transferred from immediate release metformin to a sustained release formulation: A population-based study. *Diabetes, Obesity and Metabolism, 11*(4), 338–342. http://doi.org/10.1111/j.1463-1326.2008.00973.x

#### Principle: Present bias

#### Using small, frequent, and immediate rewards to encourage treatment adherence.

## $\bigcirc$

#### Research background:

Present bias is the tendency to value immediate rewards more than our long-term intentions. This can have huge implications on our future health and well-being. However, researchers have found that we can also leverage this bias to help us stick to our goals.

In one study, researchers tested the effectiveness of voucher based reinforcement therapy to motivate abstinence from smoking by pregnant women. The program incorporated a number of features, most importantly, frequent and mounting payments for documented abstinence from smoking. The program significantly increased smoking cessation rates at the end of pregnancy (41% vs 10%) and the benefit was still evident 12 weeks postpartum (24% vs 3%).<sup>41</sup>

Present bias does not only help with smoking cessation, it can also be used to encourage adherence to other treatments such as remember taking your medication. Mango Health is a free medication manager and pill reminder app that has used this principle to get their users to stick to their health regimen. Users get reminded and earn points by taking their medication on time, which can be used on rewards such as gift cards or donations to a charity. These small, immediate rewards helps users stay on track with their dosages.<sup>42</sup>

Another way of helping us move past doing only what makes us feel good in the moment is a technique Katherine Milkman, a behavioral economist at the Wharton School, calls temptation bundling. Temptation bundling is about pairing the immediate satisfaction of guilt inducing "want" experiences with "should" behaviors that have delayed rewards. In her study, Milkman used indulgent, page-turner audio books as the "want" experience and working out at the gym as the "should" experience. One group of participants in the experiment were allowed access to the audiobooks only when they attended the gym. The other group also got access to the audiobook, but were allowed to listen to it whenever they wanted. The research found that the group of people who could only listen to the audiobook attended the gym 51% more frequently than the control group, which did not have any restriction on the audio books.<sup>43</sup>

## $\searrow$ Using this finding:

- Emphasize the immediate positive effects of adhering to your treatment goals rather than later benefits. For example, working out or remembering to take my pills gives me a confidence boost today.
- Tie your daily medical routine with something you enjoy. For example, if you take your pills in the morning, always do it while you brew your morning coffee. If you take them after dinner, take the pills while treating yourself to a new episode of your favorite show on Netflix.

<sup>&</sup>lt;sup>41</sup> Higgins, S. T., Heil, S. H., Solomon, L. J., Bernstein, I. M., Lussier, J. P., Abel, R. L., ... Badger, G. J. (2004). A pilot study on voucher-based incentives to promote abstinence from cigarette smoking during pregnancy and postpartum. *Nicotine Tob Res*, *6*(6), 1015–1020. http://doi.org/10.1080/14622200412331324910

<sup>42</sup> https://www.mangohealth.com/

<sup>&</sup>lt;sup>43</sup> Milkman, K. L., Minson, J. A., & Kevin G M Volpp. (2014). Holding the hunger games hostage at the gym: An evaluation of temptation bundling. *Management Science*, 60(2), 283-299. doi:10.1287/mnsc.2013.1784

#### Principle: The Ostrich Effect

#### The avoidance of intimidating situations by pretending they don't exist.

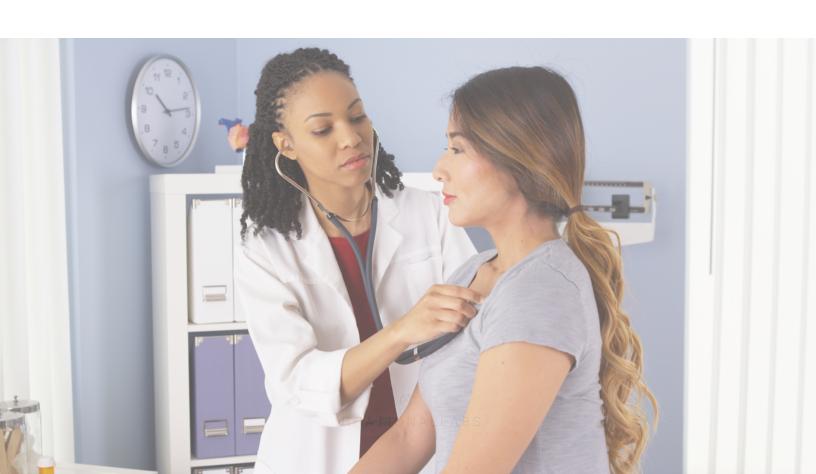
## Research background:

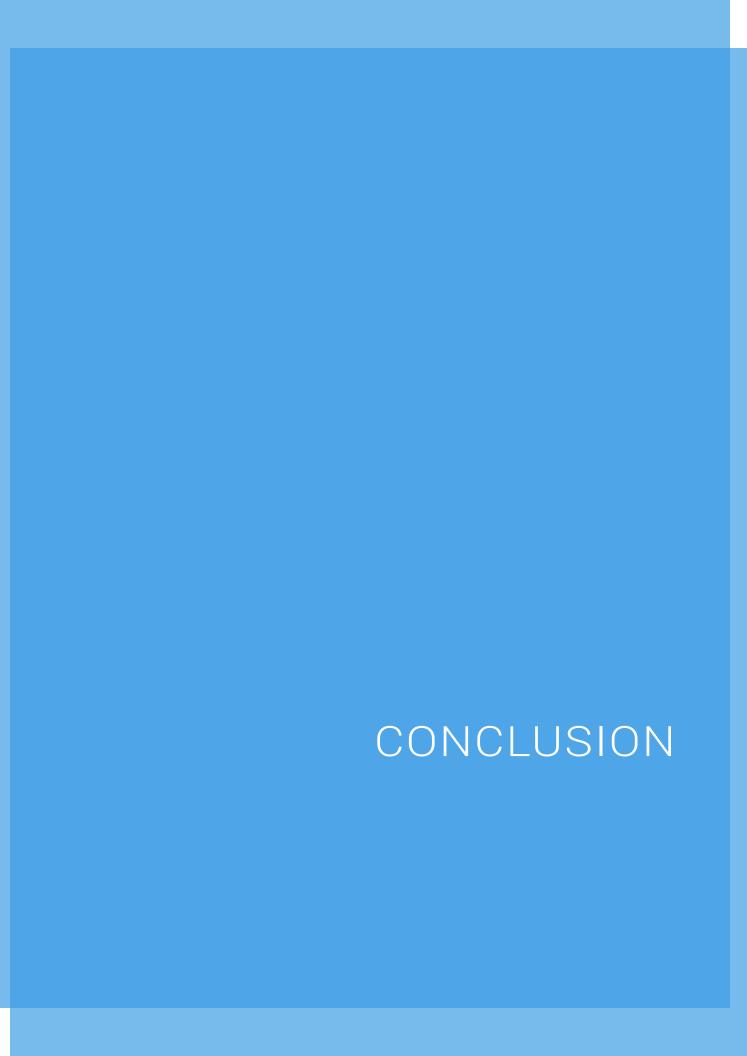
Have you ever been so worried about how much is in your bank account, yet you dread checking it so much that you don't do it? This is called the Ostrich Effect. We want to avoid getting bad news. One study examined this effect, and found that 20% of people who enrolled in weight-loss programs reported they didn't weigh themselves prior to the program. The people who did weigh themselves more often were people who were less worried about the results: They were older, had a lower fat intake, didn't smoke, had a greater history of dieting to lose weight, and lower current body mass index.<sup>44</sup>

In the treatment of prediabetes, it is important to monitor your blood glucose levels at home and to get regular check-ups. Although this might be unpleasant in the short term, burying your head will likely lead to worse outcomes down the road.

- Discuss the possibility of setting up regular and frequent check-up appointments in advance with your doctor. The more automated this is, the less willpower you need to have to get checked.
- If you end up getting negative news: Remember that despite experiencing disappointment from not getting the results you would have liked, those updates are key to prevent worse results later on.

<sup>&</sup>lt;sup>44</sup> Linde, J. A., Jeffery, R. W., French, S. A., Pronk, N. P., & Boyle, R. G. (2005). Self-weighing in weight gain prevention and weight loss trials. *Annals of Behavioral Medicine*, *30*(3), 210-216.





Changing our behavior is hard, even when we have good intentions and the consequences of failing to do so are severe. Our willpower is limited, and with busy schedules, so is our time: Sometimes, it can seem impossible to fit in a run or cooking a healthy meal. Despite doctors and experts in behavior change knowing this, it is easy to feel guilty when we fail to take the necessary steps to improve our health. The guilt can be counterproductive and lead to discouragement and inertia.

Most of the behavior change interventions proposed by behavioral economists focus on how we make decisions and what the barriers to making the choices we want are. By making it simpler, for example by automating decisions or increasing our motivation to do something, it requires less willpower to meet our goals. The good news about receiving a prediabetes diagnosis is that it is not too late to change. Hopefully, some of these insights will make it simpler to do so.



The good news about receiving a prediabetes diagnosis is that it is not too late to change.