

TYPE 2 DIABETES

A LANDSCAPE ANALYSIS

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INTRODUCTION

Finger pricking and meters. Carb counting and logs. Blood sugar highs and lows. Every day in the US, over 29.1 million people juggle any number of these aspects as part of their experience living with type 2 diabetes. The number of people managing this chronic condition has nearly tripled in the past 30 years.¹ Today, well over 100 million people in America are either pre-diabetic or have type 2 diabetes.² Collectively, these individuals cost the US economy upwards of \$245 billion yearly, with over \$176 billion in direct costs to the healthcare system.³ As costs become unsustainable, healthcare stakeholders are scrambling to improve health outcomes for those already diagnosed and stop the diabetes epidemic. The challenge of type 2 diabetes in the 21st century can be attributed to a number of factors, including the aging of the “Baby Boomer” generation and a nationwide struggle to eat healthy and exercise regularly. The root causes of diabetes, however, are still unknown, and the complexities faced at the individual, local, and national level act as immense barriers to any potential solution.

This document, which focuses on type 2 diabetes, provides background information on the condition and identifies underlying themes in the opportunities and challenges encountered by stakeholders. As illuminated by research and anecdotal evidence collected by the 2015-2016 Health for America Fellows in partnership with MedStar Health, these themes include:

CHALLENGES IN CHRONIC CARE COORDINATION

IMPORTANCE OF DIABETES EDUCATION

CHANGING BEHAVIOR AND MANAGING DIABETES

FACING HEALTH DISPARITIES

STRIKING A BALANCE WITHIN SOCIAL SUPPORT

TRENDS AND CHALLENGES IN DIGITAL HEALTH SOLUTIONS

¹ "Rate per 100 of Civilian, Noninstitutionalized Population with Diagnosed Diabetes, by Age, United States, 1980–2011." Centers for Disease Control and Prevention. September 16, 2014. Accessed November 6, 2015. <http://www.cdc.gov/diabetes/statistics/prev/national/figbyage.htm>.

² Centers for Disease Control and Prevention. National Diabetes Statistics Report: Estimates of Diabetes and Its Burden in the United States, 2014. Atlanta, GA: US Department of Health and Human Services; 2014.

³ Frazee, Taressa, Joanna Jiang, and Jacqueline Burgess. "Hospital Stays for Patients with Diabetes, 2008." August 1, 2010. Accessed October 9, 2015.

TYPE 2 DIABETES BACKGROUND

Diabetes is a metabolic condition in which the pancreas does not adequately produce enough insulin. As insulin is necessary for the uptake of glucose by the body's cells, this leads to an elevated blood glucose concentration. There are three main types of diabetes:⁴

Type 1 diabetes is an autoimmune disorder marked by the body's inability to produce insulin. Type 1 diabetes accounts for 5-10% of all diabetes cases in the US.

Type 2 diabetes, which accounts for over 90% of diabetes cases, is caused by insulin resistance, meaning the body does not use insulin efficiently.⁵ Initially, the pancreas attempts to overcome this resistance by producing extra insulin. Over time, the pancreas is unable to overcome the insulin resistance, resulting in elevated blood glucose levels. Type 2 diabetes is a progressive condition, which can range from slight to complete insulin resistance.⁶ Although the specific cause for type 2 diabetes is unknown, there are many risk factors associated with developing the condition. Family history, age, race, physical inactivity and obesity are closely correlated to the risk of developing type 2 diabetes.⁷

Gestational diabetes is marked by insulin resistance in pregnant women, usually around the 24th week of pregnancy. If not properly managed, the condition poses serious health risks to the baby and can lead to an increased risk of type 2 diabetes in the mother.

DEMOGRAPHICS

Fast facts about diabetes in the United States:¹

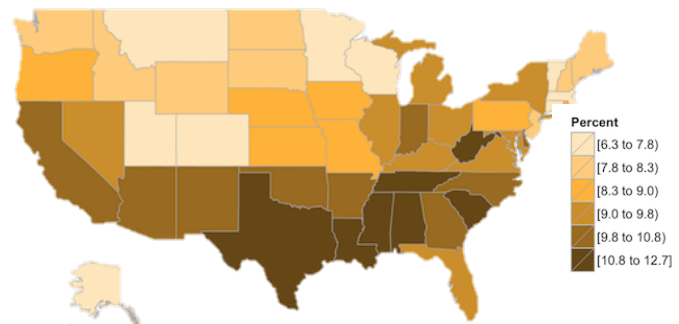
29.1 million people (1 out of 11 people) have diabetes

86 million adults (1 out of 3 adults) have prediabetes

90-95% of all people with diabetes have type 2 diabetes

1 out of 4 people with diabetes remain undiagnosed

PREVALENCE OF TYPE 2 DIABETES IN 2013
PERCENTAGE OF ADULTS PER STATE



⁴ "Diabetes." March 15, 2015. Accessed November 6, 2015. <http://www.cdc.gov/media/presskits/aahd/diabetes.pdf>.

⁵ "Type 1 Diabetes." American Diabetes Association. Accessed November 6, 2015.

⁶ "Type 2 Diabetes." American Diabetes Association. Accessed November 6, 2015.

⁷ "The Diabetes Advisor." American Diabetes Association. Accessed October 15, 2015.

Each year, **5,000** children and nearly **1.7 million** adults will be diagnosed with type 2 diabetes

The mean and median age of type 2 diagnosis is **54**

Men are **15% more likely** to be diagnosed with diabetes than women

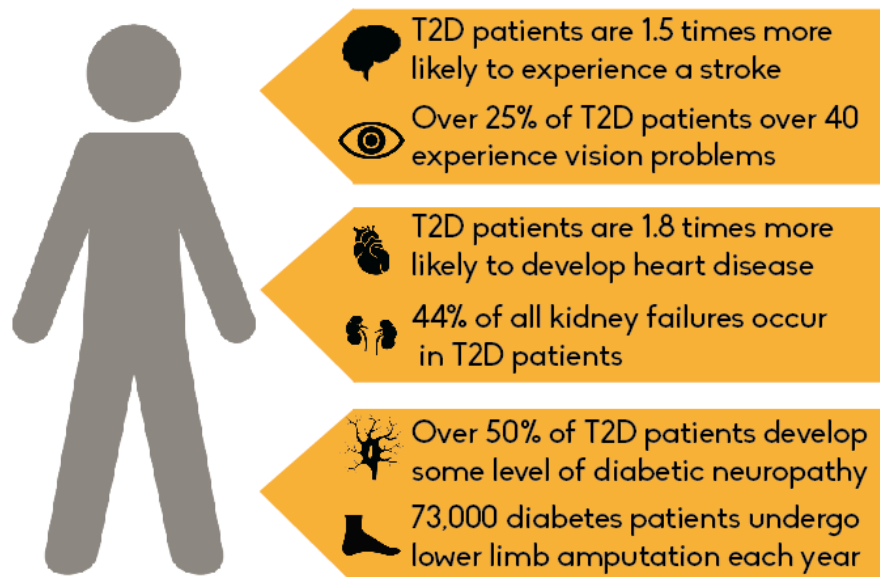
Incidence of diabetes varies by racial/ethnic group: 7.6% in non-Hispanic whites, 9.0% in Asian Americans, 12.8% in Hispanics, 13.2% in non-Hispanic blacks, and 15.9% in American Indians

The Center for Disease Control (CDC) has identified 644 counties in 15 states that have a higher risk of patients with type 2 diabetes (8.5% vs. 11.7% incidence)

HEALTH OUTCOMES

Currently, there is no cure for type 2 diabetes. The progressive nature of diabetes requires increasingly stronger treatments to control blood glucose levels over time. 69,000 people die every year with diabetes listed as the cause of death; however, diabetes is listed as a contributing factor in over 230,000 deaths annually. The CDC estimates that only 35-40% of diabetes-related deaths are reported as such, making the scope of the disease far wider than publicly documented.¹

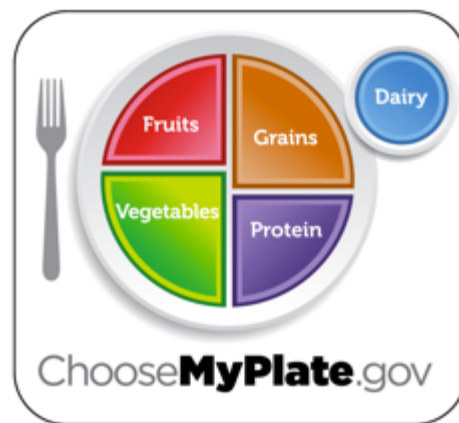
People living with type 2 diabetes are also at risk for developing numerous comorbidities. While anecdotal evidence speaks to the intense, compounding burden of these comorbidities on patients, caregivers, and healthcare providers, the national statistics are perhaps even more striking:¹



TREATMENT

Successful diabetes management plans are created via collaboration between providers and patients. After diagnosis, the start of a treatment plan should align with diabetes self-management education (DSME), which builds skills in self-monitoring, maintaining a healthy diet, leading a physically active lifestyle, and properly managing medications.

Diet is a critical component of diabetes management, yet many patients cite maintaining a healthy diet as a significant challenge. Barriers include accessing and understanding accurate information as well as adopting and maintaining dietary changes in lieu of “one size fits all” recommendations. For all individuals living with prediabetes or type 2 diabetes, the American Diabetes Association (ADA) emphasizes the importance of consistent, balanced meals, which include appropriate portions of nutritionally dense foods. A common method for balancing meals is the United States Department of Agriculture (USDA)'s My Plate framework, pictured below.



Physical Activity is also a key part of diabetes management. Whether it is walking, swimming, gardening, or heading to a Zumba class, adults living with type 2 diabetes are encouraged to engage in moderate physical activity for thirty minutes, five days per week. In the absence of contraindications, resistance training is recommended twice per week.⁸ For many patients, lifestyle changes can be part of more intensive weight loss counseling.

Medication is often required in a diabetes management plan, as diet and exercise are commonly not enough to lower blood glucose levels to the target range. These levels are measured in clinical settings by the hemoglobin A1C test, which is an indicator of blood glucose control over a 2-3 month period. For people living with type 2 diabetes, a target goal of A1C less than 7% reduces the incidence of diabetes-related complications.⁷

Oral medication is common when lifestyle changes alone are not enough to reach A1C goals of less than 7%. Metformin monotherapy is a common first step. If A1C is greater than 9% or if A1C goals are not met within three months of monotherapy, dual therapy is recommended (metformin and one of six options: sulfonylureas, thiazolidinedione, DPP-4 inhibitors, SGLT2 inhibitors, GLP-1 receptor agonists, and basal insulin).⁷

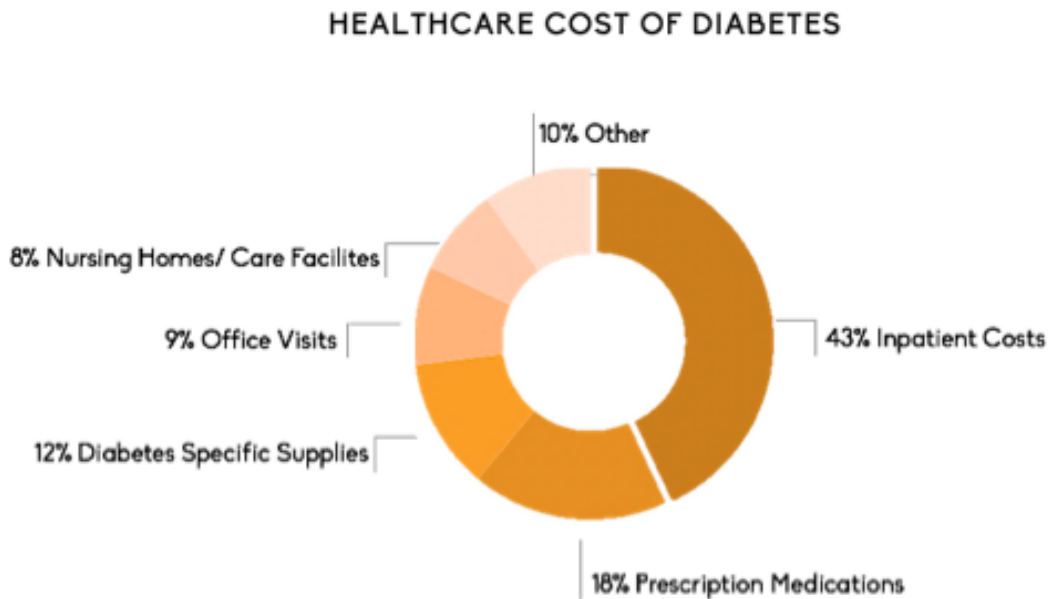
⁸ Standards of Medical Care in Diabetes--2015." Diabetes Care 38 (2015). doi:10.2337/dc15-S001.

Insulin is strongly recommended for patients with an A1C measurement between 10% and 12%. Long-acting or basal insulin is often prescribed initially and can be supplemented by rapid-acting or bolus insulin if A1C levels remain elevated. Although insulin eventually becomes necessary for many patients given the natural progression of type 2 diabetes, there are multiple factors that act as barriers to patients switching to insulin therapy (discussed later).⁷

Patients often receive a mix of best practice treatment alongside plans which are composites informed by not only patient literacy, lifestyle, and insurance but also healthcare providers' knowledge and experience in treating diabetes. The themes discussed later in this document address major barriers to the delivery of ideal care.

COST

At the national level, the ADA estimates diabetes costs the US economy \$245 billion each year, with \$69 billion attributed to missed days of work, lowered productivity and early deaths.⁹ The \$176 billion of costs that burden the national health system are as follows:



At the individual level, diabetes costs a person living with the condition an average of \$7,900 each year.⁸ 95% of people who seek treatment for type 2 diabetes are covered by insurance, which offsets much of the cost to the patient. Of patients admitted to hospitals for treatment of diabetes, 70% receive insurance coverage through Medicare or Medicaid.¹⁰

⁹Fraze, Taessa, Joanna Jiang, and Jacqueline Burgess. "Hospital Stays for Patients with Diabetes, 2008." August 1, 2010. Accessed October 9, 2015.








¹⁰ Brandle, M., H. Zhou, B. R.k. Smith, D. Marriott, R. Burke, B. P. Tabaei, M. B. Brown, and W. H. Herman. "The Direct Medical Cost of Type 2 Diabetes." *Diabetes Care*, 2003, 2300-304.

The range of monthly spending for an individual managing type 2 diabetes is as follows:



STAKEHOLDERS




The sheer number of communities, industries, and systems affected by diabetes brings together a large and diverse group of stakeholders. Over the past couple months, Health for America has interviewed many of these stakeholders. These interviews have illuminated both the unique opportunities for meaningful collaboration as well as the deeply rooted diverging opinions, which further complicate the management of diabetes .

-  **Primary care physicians (PCP)** are often the first line of defense in diabetes prevention, diagnosis, and treatment, caring for 90% of the patients with diabetes in the US.¹¹
-  **Endocrinologists** can also act as the primary manager of a patient's diabetes care or can provide clinical recommendations to support the PCP.
-  **Interdisciplinary specialists**—dietitians, ophthalmologists, dentists, psychologists, social workers, and more—can act as indispensable partners the PCP, given the rise of team-based care models.
-  **Certified Diabetes Educators**, extensively trained professionals who provide diabetes self-management education, can be key members of a care team, though access and reimbursement present significant challenges.
-  **Health systems and hospitals**, which house these teams, must manage the time and costs of diabetes care while simultaneously shifting practices and procedures in accordance with emerging health policies.
-  **Informal caregivers** provide significant support outside clinical settings, with some estimates valuing this care at upwards of \$3 billion per year in the US alone.¹²
-  **Communities** provide both formal and informal education and support to patients and families while simultaneously shouldering significant economic and

¹¹ Davidson, Jaime A. "The Increasing Role of Primary Care Physicians in Caring for Patients With Type 2 Diabetes Mellitus." Mayo Clinic Proceedings.

¹² Langa, Kenneth, Sandeep Vijan, Rodney A. Hayward, Michael E. Chernew, Caroline S. Blaum, Mohammed Kabeto, David Weir, Steven J. Katz, Robert J. Willis, and A. Mark Fendrick. "Informal Caregiving for Diabetes and Diabetic Complications Among Elderly Americans." SSRN Electronic Journal SSRN Journal.

psychosocial impacts of diabetes (often disproportionately across divides of socioeconomic status, race, and ethnicity).

-  **Pharmaceutical companies and device manufacturers** work to develop and commercialize new therapies and technologies for diabetes treatment and management, while providing significant funding for research and education.
-  **Public and private insurance industries**, like Medicare which spends \$1 in \$3 on diabetes care, play a major role in driving change as the standards of diabetes management shift due to the requirements of the Affordable Care Act.¹³
-  **Advocacy groups** are also creating impact by funding diabetes research, advocating for best practices in diabetes care, providing access to accurate information, and acting as patient and family support networks.

CONTROVERSIES

Are we actually searching for a cure?

A major controversy surrounding type 2 diabetes is the notion that pharmaceutical companies are not interested in curing diabetes. The premise is that there is more money to be made in treating diabetes symptoms than in finding a cure. United Healthcare estimates that the U.S. will spend \$3.4 trillion over the next decade treating diabetes.¹⁴

Whose fault is it?

For decades, there has been a widespread misconception that people living with type 2 diabetes are solely at fault for their condition. While lifestyle choices play a significant role in the disease, a number of genetic, environmental, and social factors have an immense, often under acknowledged, impact. Although a person may exacerbate their diabetes symptoms with poor habits, many develop diabetes while trying to lead a healthy lifestyle. This misconception is pervasive at all levels of healthcare and have generated significant stigma around type 2 diabetes. The shame and guilt therein create substantial barriers to the proper and timely diagnosis and treatment of the disease.

Is medication really necessary or is diet and exercise enough?

Another common misconception is that type 2 diabetes can be reversed and cured through diet and exercise. There is anecdotal evidence that suggests that, with proper exercise and diet, people living with type 2 diabetes can manage the condition without medication. However, since type 2 diabetes is a chronic condition, the function of the pancreas will continue to deteriorate over time. Eventually, the pancreas will not be able to produce enough insulin for the body's demand and will require the patient to administer insulin. Therefore, while it is true that people can manage their blood sugar through lifestyle changes, nearly all will require medication at some point.

¹³ "The Staggering Cost of Diabetes." American Diabetes Association. Accessed November 6, 2015.

¹⁴ "Is Big Pharma Really Trying to Cure Diabetes? We're Seeking Profits and Debunking Myths." Seeking Alpha. Accessed November 6, 2015.

EMERGING THEMES IN TYPE 2 DIABETES

CHALLENGES IN CHRONIC CARE COORDINATION

Many challenges faced in the delivery of care to people living with type 2 diabetes arise from its nature as a chronic disease. Past reimbursement models, such as fee-for-service, have built a healthcare infrastructure that is not well equipped to handle chronic conditions. The interaction of a system focused on the delivery of acute care with the growing prevalence of chronic conditions has exposed systemic inefficiencies and inertia.

Managing Comorbidities

Current research and anecdotal evidence underscore the challenge people with type 2 diabetes face in managing multiple comorbidities. The average adult with type 2 diabetes has an average of 2.5 comorbidities, with at least 88% having at least one comorbidity.¹⁵ These conditions increase the burden on patients, caregivers, and healthcare providers. Comorbidities make it harder to treat diabetes by compounding dietary restrictions and medication regimens. The complexities of these comorbidities manifest in the increased rate of physician visits and 30-day readmissions.¹⁶

As chronic diseases and comorbidities progress, the burden of care is cumulative and thus increases an individual's cost to the healthcare system over time. With the average age of type 2 diabetes diagnosis at 54 years old, it is of little surprise that the doubling of the number of US adults over age 65 by 2050 coincides with a predicted doubling or tripling of the number of people with diabetes.¹⁷

Diabetes and Aging

Beyond a rise in the national prevalence of type 2 diabetes, the increasingly elderly population in the US will also increase the number of individuals managing multiple comorbidities. Aging affects everyone—decreasing the ability to exercise, reducing cognitive abilities, and slowing recovery times. This trend is already beginning to further burden providers, as communication, engagement and adherence can be constrained. Caregivers also experience significant challenges in the face of an aging population, in particular the “sandwich generation” which is tasked with providing care to both aging parents and growing children. Similar to comorbidities, age complicates and constrains the care and disease management of individuals with diabetes.

¹⁵ Lin, Pei-Jung, David Kent, Aaron Winn, Joshua Cohen, and Peter Neumann. "Multiple Chronic Conditions in Type 2 Diabetes Mellitus: Prevalence and Consequences." *American Journal of Managed Care* 21, no. 1 (2015).

¹⁶ Garrison, G. M., M. P. Mansukhani, and B. Bohn. "Predictors of Thirty-Day Readmission Among Hospitalized Family Medicine Patients." *The Journal of the American Board of Family Medicine*, 2013, 71-77.

¹⁷ "Age-Adjusted Rate per 100 of Civilian, Noninstitutionalized Population with Diagnosed Diabetes, by Sex, United States, 1980–2011." Centers for Disease Control and Prevention. September 16, 2014. Accessed November 6, 2015. <http://www.cdc.gov/diabetes/statistics/prev/national/figbysex.htm>.

Inefficiencies in Care Models

Challenges in chronic care coordination are also compounded by inefficiencies in care models. The United States spends more on healthcare than any other country in the world, accounting for 17.4% of GDP in 2014.¹⁸ In spite of its large expenditures on health, the US performs poorly when compared to the rest of the developed world.¹⁹ With a system geared more towards specialists and acute care, patients with chronic diseases are not provided with adequate primary care services to manage their health until it requires emergency medical intervention. With many of the most expensive patients in the healthcare system being adults with multiple chronic diseases, time and money are inefficiently spent trying to chase these patients, as opposed to preventing them from falling to poor health status in the first place.

Clinical Inertia

Clinical inertia is defined as “the lack of treatment intensification in a patient not at evidence-based goals for care.” Clinical inertia is viewed as a multifactorial problem, with the Agency for Healthcare Research and Quality estimating that 50% of clinical inertia results from physician factors, while patient factors and office system factors account for 30% and 20%, respectively.²⁰

It is a well-reviewed phenomenon that physicians underestimate the need for or intentionally avoid intensifying medications in chronic conditions.²³ In some cases, this stems from a lack of physician education or experience in treating diabetes. During interviews with HFA Fellows, physicians commonly remarked that their training in diabetes care was largely experiential and occurred beyond their formalized education. The HFA Fellows also encountered instances in which the prescription of insulin therapy did not align with clinical guidelines due to the physician’s fear of patient hypoglycemia or doubt in the patient’s ability to manage such a treatment plan.

Patients may contribute to clinical inertia by denying the diagnosis and its severity, resisting lifestyle changes, or refusing insulin therapy because of personal fears, cultural stigma, or widespread misinformation. Finally, the complexity and rigidity of healthcare system administrations contributes to clinical inertia by limiting treatment options at the expense of customizing the patient experience and being reactive vs. proactive in the care agenda. In many cases, patients are initially denied access to diabetes education or certain therapeutic devices, such as insulin pumps or continuous glucose monitors, because of conflicts with insurance companies. Often, these barriers require providers to spend unreimbursed time and energy advocating on the patient’s behalf for extended coverage.

Solution Examples

Locally, MedStar’s community health worker outreach program provides consistent and substantial care management to patients, many of whom have multiple comorbidities. At

¹⁸ “Historical.” Centers for Medicare & Medicaid Services. September 12, 2014. Accessed November 6, 2015.

¹⁹ “Mirror, Mirror on the Wall, 2014 Update: How the U.S. Health Care System Compares Internationally.” The Commonwealth Fund. Accessed November 6, 2015.

²⁰ O’connor, Patrick J., Joann M. Sperl-Hillen, Paul E. Johnson, William A. Rush, and George Biltz. “Clinical Inertia and Outpatient Medical Errors.” PsycEXTRA Dataset.

the Lucile Packard Children's Hospital at Stanford, a platform known as GluVue sends patient's real time blood glucose data remotely to their EMR to improve the accessibility of the data and support provider supervision and management of their patient populations.

IMPORTANCE OF DIABETES EDUCATION

The absence of a "one size fits all" roadmap for the type 2 diabetes experience presents significant challenges during the journey through diagnosis, treatment, and management. Patients, caregivers, and healthcare providers are often not equipped to effectively and efficiently navigate the system due to challenges in education, engagement, and access.

Ranging Disease Trajectories

Some patients are first diagnosed during routine blood tests, while others experience acute complications that lead to a diagnosis in an emergency room or urgent care setting. After diagnosis, individual disease trajectories are similarly diverse. Type 2 diabetes is not treated in a manner similar to a cold or broken arm. There is no singular treatment that can "cure" diabetes. Instead, there is a plethora of management options, ranging from blueberry-agave smoothies to insulin injections, all in pursuit of the same goal: keeping blood sugars under control. Yet for patients and providers, navigating these potential treatment plans requires high levels of engagement and diabetes literacy from both sides.

Challenges within the System

The healthcare ecosystem has responded to this challenge of a diverse population with diverse outcomes by encouraging patients with type 2 diabetes to seek care from a wide variety of specialists. In this model, a patient may see a dietician for nutrition counseling, a primary care physician for a standard oral medication, or an endocrinologist if a more aggressive treatment plan is necessary. While patient success is widely defined by the standard measurement of blood glucose levels, treatment plans vary based upon issues of individual patient health status and needs, access to care, challenges in behavior change, clinical inertia, and more.

As it stands, the system does not currently provide enough educational support to empower patients to navigate those diverse treatment trajectories. Approximately 90% of type 2 diabetes patients receive care from their primary care physician.²¹ As this clinician is likely juggling a significant caseload, some aspects of patient health go completely unaddressed. This includes not only components of diabetes care, like self-management education, but also treatment of the mental health disorders and psychological stress experienced by 45% of people living with type 2 diabetes. Additionally, between 15% and 20% of diagnosed cases of type 2 diabetes receive no

²¹ Balhara, Yatan. "Diabetes and Psychiatric Disorders." *Indian Journal of Endocrinology and Metabolism*. Accessed November 6, 2015. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3193776/>.

pharmaceutical treatment,²² due in part to clinical inertia and to low numbers of endocrinologists nationwide, with some estimates at only 1,000 of these specialists nationwide.²³

As a result of these systemic challenges of access, engagement, and education, many patients receive the most hands-on treatment from nurses. While some patients receive substantial diabetes self-management education from these nurses, many do not. While the HFA Fellows have had the opportunity to shadow highly-skilled educators facilitating truly meaningful education experiences, the team has also encountered countless stories of patients who received very limited education and, as a result, feel they are “winging it” when it comes to their own care. With over 25 million people already living with type 2 diabetes, some of these individuals are provided over-standardized care despite the unique manifestations of their diabetes. More personalized care often does not occur due to current reimbursement models which do not incentivize or adequately reimburse clinicians for patient education or chronic care management. This is exacerbated by diabetes education within the medical school system, in which, outside of those specializing in endocrinology, most physicians receive only limited education and experience in diabetes care.

Solution Examples

The American Diabetes Association supports newly diagnosed people by mailing actionable education materials through its program “Living with Type 2 Diabetes.” Programs also exist in some healthcare facilities in which patients receive bedside education on iPads during inpatient stays after emergency room admissions.

CHANGING BEHAVIOR AND MANAGING DIABETES

The field of behavioral change abounds with models that promise to change behavior by addressing factors believed to influence decision-making. Despite these models, lifestyle behavior changes stand as a significant barrier to positive health outcomes in type 2 diabetes. As such, it is clear that a better understanding of the requirements and stresses of behavioral change should inform personalized diabetes care solutions.

Models of Behavior Change

Behavior change models such as the Transtheoretical Model of Change, the Health Belief Model, and others provide strong frameworks for behavior change but lack the flexibility to be personalized for the myriad of people living with type 2 diabetes. Managing type 2 diabetes requires a breadth of touch points, since the condition affects so many aspects of an individual's life. As a result, there are many different stages and mindsets that need to be taken into consideration when trying to encourage behavior and lifestyle changes. Traditional models of behavior change are linear and thus do not account for the chaos and complexity of human nature that is amplified in managing chronic conditions.

²² "Crude and Age-Adjusted Percentage of Adults with Diabetes Using Any Diabetes Medication, United States, 1997–2011." Centers for Disease Control and Prevention. November 20, 2012. Accessed November 6, 2015. <http://www.cdc.gov/diabetes/statistics/meduse/fig3.htm>

²³ "US Endocrinologist Shortage Affects Access to Care, Physician Satisfaction." US Endocrinologist Shortage Affects Access to Care, Physician Satisfaction. Accessed November 6, 2015.

Motivation and Engagement

Behavior change experts agree that behavior change is most likely to stick if it is rooted in positivity and self-motivation. Positive reinforcement and incentives encourage good behavior and can take many forms, from words of encouragement to monetary rewards. As mentioned previously, there is no "one size fits all" for treating and managing diabetes; the effectiveness of incentives will largely depend on the motivation and mindset of an individual and should be tailored accordingly.

One of the largest challenges in health behavior change is getting and keeping patients engaged in actively managing their health. Patient engagement has proven to be vital to successfully managing chronic conditions but difficult to attain. Patient engagement is important because it leads to improved health outcomes and greater patient self-efficacy. Strategies for patient engagement include gameification, social interaction, and education among others.

Fitting Within Daily Life Ecosystems

In diabetes care, one of the largest deterrents to patient engagement is that many interventions do not fit into a patient's natural ecosystem. A great illustration of this is the failure of food diary apps to maintain users. While some patients may engage with such apps initially, many stop logging their calorie and carbohydrate intake after a couple months. This is because manually recording each food item falls outside of their natural ecosystem.

Managing chronic conditions is a challenge because it requires drastic lifestyle changes. There are many useful models and frameworks that can serve as a general guide for encouraging the desired behavior change. Because of the variety of people living with type 2 diabetes, interventions targeting behavior change in this population should be targeted and personalized to the individual while simultaneously fitting within their natural ecosystem. There are, however, several attributes that can influence positive health behavior change such as self-motivation, positive reinforcement and patient engagement.

Solution Examples

Omada Health, a well-respected digital health company, provides users with a digital scale and social platform to support them in completing the Diabetes Prevention Program. Similarly, Noom is a new coaching application provides feedback on users' dietary choices and then provides personalized support in making healthier choices in the future.

FACING HEALTH DISPARITIES

The prevalence of type 2 diabetes is associated with disparities related to accessing basic needs and services, such as healthy food, safe neighborhoods, and affordable medical care. These disparities, which disproportionately affect low-income, minority, and rural populations, hinder the success of both prevention strategies and disease management.

Food Deserts

Recent research has disproved the belief that low-income populations lack access to supermarkets and healthy food options.²⁴ However, though the original notion of food deserts might be inaccurate, low-income populations still experience significant challenges in accessing and consuming healthy foods. It is not uncommon for a patient to report that eating healthy is too expensive, too time-consuming, or too hard to balance against the needs of an entire family. While these challenges may be manageable with education and practice, many people with type 2 diabetes never receive the support they need, leaving them at an increased risk for poor health outcomes.

Safe Spaces to Exercise and Play

Adding to this risk are barriers in accessing safe spaces to be physically active. In neighborhoods where safety is a concern for residents, community members may experience decreased health outcomes due to the challenge of coordinating their diabetes care and lifestyle management around times when they feel safe outside their homes. Safe neighborhoods have also been demonstrated as an indicator in improved medication adherence in type 2 diabetes populations.²⁵ The HFA Fellows have encountered numerous individuals who assert that access to safe places to exercise as well as safe modes of travel to clinics and pharmacies would improve their self-management.

Access to Care

With successful management of type 2 diabetes requiring comprehensive lifestyle changes, as well as a high number of touch points between patients and their providers, ensuring that these connections occur is critical. Many patients attribute missed or late appointments to travel time, overlapping appointments, or trouble taking time off of work. This seems to be especially true for low-income patients, who may depend on public transportation, reside in rural areas, or work multiple jobs. Many healthcare providers who have shared their experiences with the HFA Fellows cite missed visits as a culprit in both decreased health outcomes for their patients and in clinical workflow challenges.

Affording Care

Beyond the barriers to reaching medical care, patients also experience challenges in affording proper care. While the Affordable Care Act has reduced the number of uninsured Americans from 14.4% to 9.2% in the past two years, 32 million Americans remain without insurance coverage.²⁶ Even for individuals who are receiving some form of financial support for their care, the complete cost of medications and doctor visits is often not fully defrayed. Increasing attention has also been paid to warning consumers about signing up for low cost, high deductible plans, as they pose serious financial risks to low-income patients who may end up spending significantly more on medication and

²⁴ Wilde, Parke, Joseph Llobrera, and Michele Ploeg. "Population Density, Poverty, and Food Retail Access in the United States: An Empirical Approach." *International Food and Agribusiness Management Review* 17, no. Special Issue A (2014).

²⁵ Billimek, John, and Dara H. Sorkin. "Self-reported Neighborhood Safety and Nonadherence to Treatment Regimens Among Patients with Type 2 Diabetes." *J GEN INTERN MED Journal of General Internal Medicine*, 2011, 292-96

²⁶ Pear, Robert. "Number of Uninsured Has Declined by 15 Million Since 2013, Administration Says." *New York Times*, August 12, 2016, Politics sec.

emergency hospitalizations than they save in premiums. Finally, while Medicare covers ten hours of diabetes self-management training, a copay is still assessed, requiring elderly patients to pay for their education.²⁷

Solution Examples

Within MedStar Health, community programs have existed which bring chronic disease screening to community spaces such as barber shops to improve access to diagnosis and care. Similarly, the Nemours Children's Hospital in Delaware connects with school nurses, allowing them to administer insulin, give oral medications and help the student make healthy lunch choices. The "Fruit and Veggies Prescription Program," facilitated by a local organization known as DC Greens, allows physicians to write prescriptions for fruits and veggies redeemable at local "farmacies."

STRIKING A BALANCE WITHIN SOCIAL SUPPORT

Type 2 diabetes is not solely a disease of the individual, but a disease of the family and of the community as well. Social support systems play a complex role in type 2 diabetes and its management. While these caregivers, families, and communities are positioned to dramatically improve health outcomes in the best of scenarios, they are also positioned to shoulder significant burdens and suffer major damages.

Caregiving

Informal caregivers are the primary support mechanism in type 2 diabetes management across the US. Unlike clinicians, who only see patients for mere minutes out of the year, these caregivers provide care in a variety of settings outside of the health system. These spouses, adult children, siblings, friends, coworkers, and others are not compensated for their time and energy but act as a major anchor of support both in medical settings and everyday life. During interactions with healthcare providers, the HFA Fellows have watched caregivers assist their loved ones in understanding and integrating new information while also providing valuable information to the provider (including bringing logs and meters to appointment). These same caregivers have shared stories of the significant roles they play at home by supporting blood glucose testing, medication management, meal planning, and physical activity.

There are, however, significant challenges inherent in this role. The HFA Fellows have also seen examples of informal caregiving that is detrimental because it is misinformed, poorly executed, or conflict inducing. This caregiving, whether beneficial or detrimental, comes at a high cost. Some estimates place the value of informal caregiving at upwards of \$3 billion dollars annually in the US.²⁸ These costs are compounded by caregiver absenteeism, decreases in productivity, or loss of employment as well as psychosocial challenges such as interruption of daily activities and burnout.

²⁷ Your Medicare Coverage." Diabetes Self-management Training. Accessed November 6, 2015.

²⁸ Langa, Kenneth, Sandeep Vijan, Rodney A. Hayward, Michael E. Chernew, Caroline S. Blaum, Mohammed Kabeto, David Weir, Steven J. Katz, Robert J. Willis, and A. Mark Fendrick. "Informal Caregiving for Diabetes and Diabetic Complications Among Elderly Americans." SSRN Electronic Journal SSRN Journal 57B, no. 3 (2002).

Community Support Systems

Similar opportunities and challenges exist with regard to the relationship between type 2 diabetes and community support systems at large. The social, psychological, and financial support provided by these systems leads to better adherence and self-management, decreased depression, and improved health outcomes.²⁹ Many communities around the country have rallied in response to the increasing prevalence of type 2 diabetes by creating opportunities for community members to share information, build healthy lifestyles, and support one another. People living with diabetes are finding these support systems in their schools, workplaces, churches, barbershops, and recreation centers as well as through online social networking sites and message boards.

While community contexts can offer a tremendous amount of support, they can also create challenges and barriers for people living with type 2 diabetes. So often, struggles with community misperceptions, stigma, cultural beliefs, and values create immense barriers to proper and timely prevention, diagnosis, and treatment of diabetes. Furthermore, for many of the people whom the HFA Fellows have encountered, the healthy choice is not always the most convenient or most popular choice, leading to challenges in adhering to care plans and lifestyle changes. For many of these individuals, type 2 diabetes is also an intergenerational disease; diet, physical activity, health literacy, and more can be passed from generation to generation—as can a sense of diabetic fatalism (i.e. “It’s bound to happen to me too. There’s nothing I can do.”).

Similar to caregivers across the country, US communities do not are positioned not only to influence positive health outcomes—they also stand to shoulder much of the burden of negative health outcomes. The ADA estimates that diabetes costs the US upwards of \$69 billion in indirect costs such as absenteeism, decreased productivity, and inability to work due to disability or death³⁰. These disabilities and deaths have an enormous, unmeasured impact on the psychosocial health of communities as the disease affects generations upon generations of individuals, disproportionately represented among racial/ethnic and socioeconomic lines.

Solution Examples

A new online platform for in-home caregivers, Honor, allows families who need a caregiver for a loved one to connect with professional caregivers in their area for support with medications, cooking, cleaning, and other daily activities. In the community setting, Fabulous You! is a 16 week program sponsored by the ADA through which middle-aged women get educational material on healthy habits as well as a community support system to help reach a healthier weight.

²⁹ Kadirvelu, Amudha. "Social Support in Type II Diabetes Care: A Case of Too Little, Too Late." *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy* DMSO, 2012, 407.

³⁰ Brandle, M., H. Zhou, B. R.k. Smith, D. Marriott, R. Burke, B. P. Tabaei, M. B. Brown, and W. H. Herman. "The Direct Medical Cost of Type 2 Diabetes." *Diabetes Care*, 2003, 2300-304.

TRENDS AND CHALLENGES IN DIGITAL HEALTH SOLUTIONS

The complex nature of type 2 diabetes and its manifestation in the US provide unique opportunities for the expansion of digital health solutions. With varying degrees of success, these solutions are attempting to collect actionable data, deliver impactful diabetes education, expand care management support, and better connect patients to their provider.

Decreasing the Friction of Data Collection

The aim of many mobile health interventions for type 2 diabetes is to facilitate the data collection process. A chief complaint by many clinicians is the lack of actionable data about patients' blood glucose control. Given that clinicians generally cannot spend more than a few minutes with each patient, approaches seeking to smooth the data collection process are focused on improving the quality of that limited time. Some leaders in this approach are Blue Loop, powered by MyCareConnect, as well as the Diabetes App by BHI Technologies. Some of these types of applications focus on delivering the data to the clinician before the appointment, while others are focus on creating efficient ways to present the data during the appointment. In recent years, while some blood glucose meters have begun interfacing with smart phones to ease data collection, patients without such technology are still asked to record the data manually. Further complicating this challenge is the reality that providing patients access to their own data may not be enough if they lack the proper diabetes education or health literacy to understand such information. As such, applications like this may serve as tools for clinical use but may not necessarily improve patient efficacy or promote positive lifestyle change.

Turning Data into Education and Action

Many emerging applications, however, are pursuing the goal of improving patient self-efficacy through data collection paired with education. Patients now have the ability to track their blood glucose and receive support that is highly personalized. WellDoc, a Baltimore-based company, is pursuing this with demonstrated success. The company's application, BlueStar, is prescribed by the physician, records blood glucose data, and provides relevant feedback to the patient on blood glucose values and trends. BlueStar also allows patients the opportunity to ask questions to medical professionals through the application. Applications like BlueStar add value by empowering the patient with the information and guidance they need to manage their diabetes between physician visits. WellDoc is, however, not immune to the same challenges in adoption and sustained engagement that other such companies are facing.

High-Touch Hospital-Based Solutions

Although there are thousands of applications focused on diabetes care, many of the positive health outcomes are currently being driven by hospital systems implementing mobile health diabetes interventions. Within MedStar Health, the Pathways program, run by Dr. Michelle Magee allows a Certified Diabetes Educator to closely monitor over thirty patients' blood glucose data for three months. The CDE is able to contact a patient if a high blood glucose level is recorded or if no testing has been done for an extended period of time. This program is a good example of a hybrid solution that blends the

efficacy of personal, high-touch care with the efficiency of a mobile health solution. Human and financial resource constraints stand as barriers to the scalability and sustainability of these kinds of interventions, given that nurses and educators can only intensely manage a few dozen patients at a time.

Improving Access Through Telehealth

A multitude of telehealth providers are currently aiming to increase patient access and decrease the cost of the patient-provider interaction. Hospitals and private companies alike are piloting and expanding telehealth programs that allow patients to have appointments with their primary care physician or a consultation with a specialist through online video chat platforms. Examples of significant success in this arena can be found in Doctor on Demand as well as many telestroke initiatives.

Creating Digital Trust

With the rise of these kinds of digital interventions come the challenges of building trust with potential users. While patients may feel comfortable receiving treatment and advice from experts in brick and mortar medical facilities, they may not feel as comfortable doing so through mobile applications or other digital technologies. In order to address this concern, some companies collaborate with physicians who are viewed as experts, capable of advising their patients on the use of the product or service. Some applications build upon this trust of the patient-provider relationship by seeking to become a prescribable therapy

As the ecosystem surrounding diabetes continues to grow and shift, care solutions are focusing on becoming more personal, whether through mobile or service-based solutions, while maintaining scalability and sustainability.

CONCLUSION

The shifting landscape surrounding type 2 diabetes in the US has created significant pain points within chronic care management, and health disparities rooted in access and availability of resources are major barriers to alleviating these pain points. A solution that will improve management and outcomes related to diabetes must be multifaceted and take into account the range of stakeholders affected by the condition. Although generally moving in the right direction, current approaches do not focus enough on the basic motivations behind behavioral change, as well as the importance of sufficient diabetes education. By working to understand the perspective of all of the players and systems in type 2 diabetes care, the Health for America Fellows are positioning themselves within a movement that is leading toward the creation of highly impactful solutions that have the power to transform lives.