**Remote-Care Interventions for Type 2 Diabetes Patients during the COVID-19 Pandemic**

by

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# Remote-Care Interventions in Type 2 Diabetes Patients at a Free Clinic during the COVID-19 Pandemic

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## Abstract

The COVID-19 pandemic poses increased burden on patients managing Type 2 diabetes. The Birmingham Free Clinic introduced new interventions as a result of the COVID-19 pandemic in efforts to mitigate pandemic burden on patients and to maintain care and diabetic disease management through medication delivery and virtual visitation appointments. Previous research shows diabetic education and lifestyle interventions can help patients with glycemic control in efforts to manage their diabetes. Before the pandemic, the clinic introduced grant-funded interventions focusing on providing glucose and blood pressure monitors as well as a social determinants of health screening during clinic visits.

Of the clinic 300 patient population with Type 2 diabetes, 62 patients were selected for the dataset that had a baseline measurement of HbA1c and controlled blood pressure at 3 months leading up to the pandemic lockdown conditions in March 2020 with follow-up data collected in the 3 months preceding March 2021. Of those 62, 40 patients had complete data to analyze if there was a significant difference in HbA1c in a retrospective analysis. We observed a reduction of 0.39% (SD = 2.53, p-value = 0.1602) in HbA1c, which was not clinically meaningful nor statistically significant in showing an association of HbA1c reduction to the pandemic interventions for diabetes, with negligible differences in blood pressure control. By providing resources such as health screenings, medication deliveries, and telehealth options during the hardships of the pandemic, the clinic strives to maintain quality of care in diabetes management

among the cohort of patients with diabetes that could translate well in a post-pandemic clinical environment with further data collection of HbA1c, blood pressure control, and weight. The overall public health significance of this study is meant to highlight the potential benefits of telehealth options in a clinical setting for an underserved population, specifically with type 2 diabetes, a chronic health condition associated with poor outcomes.

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## 1.0 Introduction

## 1.1 Epidemiology of Type 2 Diabetes

Diabetes is a chronic disease affecting over 420 million people across the world with more than 642 million projected to be diagnosed by 2040.[1,2] In America, 34.2 million people, or 10.5% of the population, have Type 2 diabetes – 26.9 having been diagnosed and 7.3 million that are undiagnosed.[2] Of those who have been diagnosed 57% are non-Hispanic white, 16% are non-Hispanic black, 6% are non-Hispanic Asian, and 18% are Hispanic.[2] However, when looking at each ethnic subset of the American population the discrepancy in diabetes prevalence becomes more apparent, with greater disease burden among black and Hispanic populations. Diabetic onset is typically found in older adults. However, approximately 8% children and about 26% young adults have diabetes mellitus in the world.[5] Adults aged 45 to 64 were most commonly diagnosed in 2015 with about 809,000 cases compared to 355,000 cases in ages 18 to 44 and 366,000 cases in ages 65 and older.[2] In addition to those aged over 45 having a high risk association in diabetic onset, other fixed risk factors include obesity, family history of diabetes, prediabetes, sedentary lifestyle, low high-density lipoprotein (HDL) or high triglycerides, history of cardiovascular disease, and increased risk among minority ethnic groups.[6] Of all the risk factors, obesity poses the greatest potential risk association: 87.5% of those diagnosed with diabetes are overweight/obese.[2] Furthermore, diabetic onset can also be differentiated based on gender differences. Diabetes is often diagnosed in men at younger ages and lower body mass index (BMI) compared to women, as obesity is more commonly diagnosed in women.[3] More global funding

and attention is given toward communicable diseases while diabetes persists as a prevalent chronic disease that can lead to a variety of different health complications.[4]

## 1.2 Social risk factors of Diabetes

Health disparities among racial minorities has been well documented, especially in Type 2 Diabetes. In order to effectively alleviate racial health disparities in people with diabetes, including African Americans, Latinx, and other underserved racial groups, interventions introduced at each stage of care can be beneficial in educating patients in how to manage their chronic disease, including chronic disease management education programs focusing on different lifestyle choices as disease-specific management.

While many of the defined risk factors named earlier are biological in nature, several social risk factors can be attributed to the onset of diabetes. Social determinants such as income, education, housing, and access to nutritious food are key factors in the development of diabetes, as those with lower income and education are 2 to 4 times as likely to develop diabetes than their advantaged counterparts.[7] Thus, addressing equity gaps in diabetes management is essential in providing population-level interventions in reducing incidence of newly diagnosed patients with diabetes.

Disadvantaged individuals are often faced with chronic stress of making ends meet, leading to other behavioral factors that become diabetic risk factors including alcohol use, unhealthy diets, etc. The combination of psychological and physiological stressors contributes to diabetic onset, as well as diabetes management and control in diagnosed individuals.[8] Furthermore, several psychosocial factors, including self-efficacy, depression, social support, and perceived stress have

had profound associations with self-care and glycemic control.[8-9] Other neighborhood factors, such as social cohesion, neighborhood esthetics, and food insecurity have been linked to glycemic control as well.[9]

Social determinants of health are important considerations to make in designing public health interventions and policy changes. The social determinants associated with diabetes have been well documented to show socioeconomic and psychological impacts on diabetes outcomes. In a prospective cohort study conducted by Pantell et al. on 18,133 participants from the Kaiser Permanente Northern California's Adult Member Health Survey without baseline hypertension and 35,788 adults without baseline diabetes, cumulative social and behavioral risk was significantly associated with earlier onset of hypertension and diabetes. Those with 3 or more risk factors had the largest increased risk of developing hypertension and diabetes.[10] Thus, developing personalized healthcare should not only target the medical needs of a patient but also involve lifestyle factors and other social determinants of health.

## 1.3 Management of Type 2 Diabetes

Diabetic management is founded in proper patient education in targeting the chronic disease from a multitude of lifestyle changes. With cultural competence, a patient can be directed to medications, insulin supplements, diet, and exercise while considering their financial resources, comorbidities, and social support – identifying these barriers and providing helpful mitigation strategies is essential in treating patients diagnosed with diabetes.[20] Ideally, patients are able to work with their healthcare provider in forming a targeted approach to glycemic control, measured by HbA1c levels. This can be achieved through prescribed regimens of metformin in conjunction

with combination therapy of pharmaceutical agents, as well as insulin supplements in those with higher HbA1c levels trying to reach a goal of 7%.[21]

The American Diabetes Association (ADA) has established guidelines in how to properly manage patients with diabetes, which can inform how interventions can be implemented. Treatment decisions should be timely and come as a result of patient-provider collaboration. This applies to underserved populations that require more attention to their level of health literacy and self-efficacy. Patients who may need targeted interventions for health literacy and/or social support can be identified by social determinants of health screenings. The patient must be well-informed and given appropriate recommendations from an active team of health professionals. Team-based care in addition to community involvement is a proposed solution to better engage patient populations. The ADA highlights the multiple factors that contribute to health inequities in diabetic management, such as ethnic/cultural differences, access to health care, system-level interventions, community engagement, food insecurity, language barriers, and homelessness.[11] This paves the way for additional research in each of these areas to determine effective interventions to mitigate health disparities in underserved populations.

While diabetic patients require medical consultation for medication, much of the impactful disease management comes from lifestyle decisions, such as diet and exercise. A study done using data from the National Ambulatory Medical Care Survey sought to determine if there was an association between diet/nutrition, exercise, and weight loss education in socioeconomically disadvantaged patients with diabetes. Of the 3027 patients analyzed in the study, about 36% received diet/nutrition education, 22% received exercise education, and 14% received weight loss education.[12] This lack of health education can be attributed to the pervasive diagnoses across the nation among all at risk individuals. The access to these programs decreases even further in many

underserved populations, adding to their stark disparity in diabetic outcomes. Medicaid patients especially did not have access to these preventative programs[2]. Without proper funding for chronic disease management, a lot of these patients will have worse health outcomes outside of clinical treatment, resulting in further health care expenditure and a need for additional diabetic interventions. Patients must be well-informed of how to give themselves the best chance at a healthy life, and medical professionals require cultural sensitivity and awareness of structural factors that impact patient health outcomes to properly make recommendations at any medical encounter.

While medication therapy is an essential part in managing a patient's diabetes, other educational aspects are vital, including disease process, treatment options, nutritional and exercise plans, glucose monitoring, familiarity of complications, psychosocial issues, and self-efficacy in promoting one's health.[22] When a patient is diagnosed, they need the guidance to make important, sometimes drastic, lifestyle changes to stray away from unhealthy habits and lean towards maintaining glycemic control through these prescribed avenues.

Patient-centric interventions must not only be specific on a societal and cultural level, but also must be tailored for each individual's risk factors, primarily obesity. A study centered around comparing abdominally obese and non-obese individuals among type 2 diabetic patients can provide further insight on this risk factor. The data was obtained from 15 years of (National Health and Nutrition Examination Survey (NHANES) records and was meant to analyze the data for public health advancements. The main finding of the study confers that individuals with abdominal obesity have an increased prevalence of type 2 diabetes, especially those above age 45.[14] This information can be extrapolated to underserved populations and determine which population groups have high prevalence of obesity and can be compared to the prevalence of diabetes as well.

The factor of obesity is a significant contributor to diabetic onset and should be used as a potential target of intervention. Most interventions will have a positive impact in diabetic outcomes, measured by HbA1c or weight loss.

As the COVID pandemic continues, guidance for proper diabetes management education have turned to a mobile approach. New mobile apps and services are being tailored for patients with diabetes in the new technological age of chronic disease medicine. With social distancing in mind, patients are able to upload symptoms, weight, blood pressure, blood glucose, and exercise goals with feedback from healthcare professionals.[23] As more modern approaches develop to help patients manage their diabetes, we are able to see improvements in glycemic control and quality of life but face technological barriers among underserved populations utilizing telehealth options.

## 1.3.1  Personal vs. Group Interventions

Different educational programs have been implemented to target specific racial groups. A clinical trial study implemented a community health worker counseling program to address type 2 diabetes among Latinos as compared to the normal standard of care. The participants were patients in a local Miami hospital and had a HbA1c greater than 8.0. A 1-year community health worker intervention consisted of home visits, telephone calls, and group-level activities to target diabetes self-management skills. Latinos with poorly controlled diabetes saw the largest decrease of HbA1c levels at about a 0.51% decline, while other health outcome markers were not as significant in an association.[15] The main focus in implementing this study was as mentioned: to increase accessibility and cultural sensitivity. New interventions consisted of coming to the patient and visiting them in their home or educating patients with telehealth methods. From reaching a

solution with the community of interest, they were able to see improvements in diabetic health markers.

Moreover, diabetes is recognized as an epidemic and is more prevalent in minority populations, such as Latinx individuals. Instituting large educational programs that are individualized to each patient can be costly. A study by Noya et al. explored whether a behavioral shared medical appointment intervention was effective in improving patients' disease management and health outcomes, which is a potentially more time- and cost-effective intervention. This study included nonrandomized matched control group participants receiving usual care. At 6 months, achieving target A1C goals was greater in the intervention group than in the control group. Furthermore, the results showed 3- and 6-month declines that were greater in the shared medical appointment group than in the control group.[16] This program can be applied to other communities and health care facilities as well. Behavioral shared medical appointments can be effective in reducing disparities in chronic disease management among underserved populations. However, in clinical settings with resource limitations and patient confidentiality concerns, providers may opt for personal-based interventions rather than pursuing the benefits of group-based interventions.

### 1.3.2  Cultural Sensitivity in Diabetes Management Education

These principles of targeting health issues with regards to ethnic-specific issues can be applied to other racial groups as well but may not have a similar impact. Lutes and his team evaluated the effectiveness of a community health worker who delivered lifestyle intervention for African American women with type 2 diabetes. Participants were randomized to either 16 phone-based lifestyle intervention sessions aimed at making small changes in their diet and activity or 16 educational mailings sent across 12 months. Main outcomes included HbA1c, blood pressure, and

weight changes. The phone-based intervention actually resulted in no significant improvements in HbA1c or BP but did demonstrate modest improvements in weight.[17] Women not using insulin, however, showed significant improvements in all primary outcomes.[17] The study did not discuss cultural relevance in determining the intervention and was mainly just focused in targeting this particular racial group. This approach did not see a significant improvement but may prove the need for cultural sensitivity for any intervention, since we cannot assume universal effectiveness if it works only in one underserved group.

Even analyses looking at interventions within similar populations can differ in their effect size and significance. Looking at the Hispanic population, McCurley and colleagues conducted a systematic review of diabetes prevention in American adults to assess the prevalence of diabetes, prediabetes, and metabolic syndrome as well as effective interventions to alleviate the potential health disparity in this population. This was marked by reductions in glucose regulation or weight reduction, both contributors to the chronic disease. Many reported significant weight losses, while two reported glucose regulation as a result of the educational intervention.[27] The most effective interventions were tailored with cultural sensitivity and relevance. Specifically, several trials featured culturally relevant intervention focuses, such as on language, setting, delivery, health literacy, cultural food suggestions, and all derived from community input.

### 1.3.3 Healthcare Provider Trust

More efforts can be taken by health officials and providers with interventions; however, they must establish trust with their patients, a long-standing concern especially among underserved racial minorities. One minority group with significant health inequity are indigenous peoples. A study on indigenous peoples' healthcare experiences in managing their diabetes focused on this

population and its associated unique social determinants of health, including the ongoing impacts of colonization, contribute to increased rates of chronic disease and a health equity gap for indigenous people.[18] Jacklin et al. gathered information from focus groups and interviews from several indigenous communities to understand their unique healthcare experiences and how their clinical encounters may differ from other ethnic groups. Their findings show that health care relationships have a role in mitigating past harms and should be addressed.

Likewise, African Americans and other minority groups have historically distrusted the healthcare system, fearing they would be harmed in misleading medical research as concerns grew that doctors would fail to explain the full significance of participation in a clinical study, such as what happened with the 20th century Tuskegee Syphilis Study.[32] With numerous accounts of failed trust in healthcare treatment among minorities, it continues to be increasingly difficult to establish that trust with effective medical advice and interventions.

For example, Chard and colleagues identified how African Americans over the age of 50 are socially disadvantaged by analyzing subjective measures of well-being among those with Type 2 diabetes. Ethnographers interviewed older adults with diabetes using an adaptation of the McGill Illness Narrative Interview, which seeks information regarding a patient's healthcare experience regarding their illness, adherence, and impact on self-perception and relationships with others. Diabetes self-care was also found to motivate social engagement and care of others. Typically, patients strive to meet the goals set forth by their healthcare providers in managing their diabetes in aims for good health. However, long-founded distrust of the medical institution within the African American community meant that in some viewpoints nonadherence to suggested treatment was classified as well-being.[10] This is important to address when helping minority patients manage their diabetes to promote their trust in a clinician and take on the advice to make key lifestyle

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changes and improve adherence to prescribed medicines. The consistent health inequity and the harm of the healthcare system towards indigenous people and African Americans in these cases across the sites fuel increased mistrust of health care systems in minority populations. Providers should be more cognizant of a patient's health beliefs and cultural experiences when treating their chronic illness.

## 1.4 Screening for Type 2 Diabetes

Racial health disparities exist in virtually every health outcome. One study looks at how African Americans, Latinx, and Asian Americans are disproportionately affected by diabetes. Cross-sectional data was analyzed from the Medical Expenditure Panel survey. It was found across the board that several of the screening procedures, including HbA1c tests, foot exams, eye exams, cholesterol tests, and flu vaccinations, were all significantly lower in minority population when compared to Whites.[13] Some of these disparities existed even when controlling for health insurance status, poverty, and education. This calls attention to the need for not only addressing economic concerns in healthcare management and resource allocation, but also addressing the gaps in care that minority patients receive as well. While lack of insurance coverage and education explained some of the racial disparities observed in diabetes quality of care, improving quality of diabetes care through effective interventions could help reduce rates of diabetes complications, healthcare costs, and mortality in these patients.

**1.5 Telehealth Interventions in Underserved Populations**

Developments in technology-based interventions have been fruitful in assisting patients manage their diabetes by increasing accessibility to provider assistance and care. Patients are able to stay in touch with their provider via live video, chat, and mobile app options. A patient-centered telehealth program could potentially meet the needs of patients in a underserved populations as a mitigation tool to address socioeconomic disparity.[34] While telehealth can help to remove barriers to receiving healthcare during the COVID-19 pandemic, such as transportation and in-person exposure concerns, a focused concentration on health behaviors and practices in diabetes management is essential.

Technology-based programs are accepted by both patients and providers, can reduce healthcare costs, and alleviate inequalities in healthcare access – furthermore, technology-based care can improve disease management, promote patient-centered care, enhance patient self-efficacy.[35] In the pandemic, these options can help patients get the care that they are seeking without having to risk exposure to COVID-19 by traveling and visiting a clinical site.

A meta-analysis from Fitzner and Moss shows that the delivery of diabetes self-management and training through telehealth platforms is effective in supporting underserved minorities and others in improving their management and diabetic outcomes. However, patients and providers can face barriers in establishing efficient and affordable ways to implement these technological interventions in a clinical setting.[36] It is also important to consider that technology should be appropriate to the patient's age, abilities, and sensitivities to be the most effective for those patients with access to computers or smartphones.

However, underserved minorities are less likely to have internet access. Per Pew Research Center data, 79% of White individuals are home broadband users, compared to 66% of Black and

61% of Hispanic individuals; therefore 25% of Hispanic and 23% of Black individuals are reliant on smartphones for internet access, compared to only 12% of White individuals.[39] Although this digital divide provides a barrier to telehealth options, community mitigation strategies, such as portable hotspots or access to internet at community centers, are able to bridge the divide. With increased accessibility for those who have personal or community access to internet, telehealth options can be beneficial in improving access to healthcare in underserved populations.

### 1.6 Patients Likely to be Uninsured/Underinsured

Uninsured patients are widespread in many communities – in 2018, over 30 million Americans were uninsured; most were low-income, Latino, and under the age of 35.[24] Declines in overall population coverage has been exacerbated by not only downtrends in Medicaid coverage but also by the COVID pandemic bringing new hardships for struggling families. In 2019, 74% of uninsured adults said the cost of healthcare coverage was too high for the reason they were uninsured.[25] People are often faced with mounting medical debt when they turn to costly healthcare options.

Patients with diabetes require access to diabetes self-management education in order to achieve their health goals and avoid detrimental complications. Shaw et al. explain how free clinics can help to mitigate those challenges for people in seeking quality healthcare.[26] Free clinics play an important role in providing a medical safety-net that can care for those with barriers to seeking traditional care options. A study on free clinic populations in Syracuse, NY showed that 45% of their clients were unemployed, 78% were uninsured, and 43% cite cost as their primary barrier to insurance.[33] These patients would otherwise turn to care at a hospital emergency room if free

clinics were not an available option. The accessibility of free clinics in underserved populations can help to increase access to medical care and decrease morbidity/mortality rates as well.[33]

## 1.7 Birmingham Free Clinic

The Birmingham Free Clinic (BFC) in Pittsburgh, PA primarily serves individuals who are uninsured, under-resourced, and look to the free clinic in meeting their health needs. The clinic is essential in assisting those who need help in managing their chronic illness, especially diabetes. As the COVID-19 pandemic continues to weigh stress on healthcare systems around the world, those who lack access to affordable healthcare bear the greatest burden in navigating their ongoing chronic health concerns. To support chronic disease patients in the community, the BFC facilitates access to high-quality care among those in need. For over 26 years, the PHCUP has delivered comprehensive primary and specialty care, medication access, and social service care, at no cost to any patient. A total of 42% percent of BFC patients are homeless as per Federal McKinney Act Criteria, which includes individuals in residential facilities, at-risk for homelessness, or those who rely on friends or family for shelter. 80% have incomes at or below 200% of the federal poverty level. Many patients are under-resourced and uninsured, including many representing minority groups and non-English speaking communities. BFC conducts interventions for chronic disease patients, specifically with diabetes, hypertension, asthma, and COPD, to improve their personal disease management through social determinants of health screening, preventative care, medication access, and other methods specific to each patient. During the pandemic, these patients have been facing obstacles in supporting themselves and receiving their necessary medications and

personalized healthcare. The clinic aimed to mitigate these barriers through guided telehealth support and medication delivery to those in need.

## 1.8 Gaps in Knowledge

There is a great deal of understanding diabetes education programs effect on improving health outcomes. A study from Perreault et al using Diabetes Prevention Program data found that not only does prediabetes pose higher risk for diabetes, but reversion to normal glucose regulation is also associated with a significant risk reduction of future diabetes. From adherence to diabetic education, patients are able to control their risk from diabetes from an early stage of chronic disease progression.[30] The Look AHEAD (Action for Health in Diabetes) study, focused on reduction in mortality and morbidity of cardiovascular disease from weight loss in overweight type 2 diabetes patients, showed that clinicians can help patients focus on losing weight and improving glucose management which can result in long-term positive health outcomes and improved quality of life.[31]

While we understand the benefits of diabetic education and intensive lifestyle intervention, ongoing and future research can provide more insight on the feasibility and benefits of telehealth advancements and new interventions can have in assisting people manage their diabetes. TheCOVID-19 pandemic presented a time of high demand to meet those solutions to see the same appreciable improvements in health outcomes in remote-based care.

## 1.9 Public Health Significance

Diabetes continues to be a major public health problem that poses personal and societal costs from uncontrolled diabetes from complications, quality of life, and health care resources. Population based approaches to targeting diabetes from several levels from personal to community scale issues is essential to identify mitigation strategies in controlling diabetes.[28] Additionally, the focus on diabetes care should shift from not only those with acutely uncontrolled diabetes but those that showing early signs of increasing risk for developing uncontrolled diabetes. Therefore, a population-based approach in chronic disease management would be most effective in controlling diabetes.[28] By understanding that strictly following medical advice should be supplemented by a multilevel epidemiological systems approach in personal behavioral care, a great impact in health outcomes and economics could be seen in a community or clinical setting, for example.

As the COVID-19 pandemic poses barriers to patients with diabetes, the health care system necessitates the need for mitigation strategies, such as medication delivery and virtual appointments. In the coming future in the wake of the pandemic, healthcare professionals strongly believe that technology will play a greater role in delivering the support necessary for patients to effectively manage their diabetes.[29] Telehealth options can promote disease management and self-efficacy for patients utilizing those options from their provider. The interventions developed during the pandemic will provide increased healthcare access and support moving forward. Interventions that have seen success in improving health outcomes during the pandemic will prove to be effective in a post-pandemic climate.[29] As healthcare professionals continue to improve valued support options for patients with diabetes through technological advancements, patients with access to telehealth options can take hold of better control of their chronic disease.

## 2.0 Objective

The Birmingham Free Clinic introduced mitigation strategies in the face of the challenge of in-person visit restrictions due to the pandemic. Patients with type 2 diabetes were provided with resources that included medication delivery, virtual visitation, and a focus on social determinants of health. The aim of this paper was to explore the diabetes interventions introduced early in the COVID-19 pandemic and the effect on type 2 diabetes health outcomes, primarily changes in HbA1c as a result of these interventions.

## 3.0 Methods

### 3.1 Grant-Funded Interventions for Chronic Disease Patients

Prior to the pandemic, the clinical team at Birmingham Free Clinic worked to develop a manual for incoming students and clinicians to get acquainted with the PA Department of Health funded project for chronic disease patients. We had outlined the entire workflow process with interventions specific to each of the most common chronic diseases in the clinic. Before the onset of the pandemic, the clinical team worked to introduce new screening measures to help address chronic disease patients' illness management, such as social determinant screening, asthma and COPD control screening, and giving patients blood glucose and pressure monitors to help them manage and monitor their health at home. We began a new social determinants of health screening tool (Appendix A).

The social determinants health screening tool was designed to assess a patient's barriers to improving their health, such as identifying their health beliefs, self-efficacy in disease management, and prohibiting barriers like cost and transportation. The questionnaire targets different topics such as health beliefs, barriers to care, and especially, perceived level of efficacy to manage their health issues. The goal of this information will help to inform us how to better manage patients' care as well as improve the clinic's overall care by targeting common issues in our patient population. However, this was an intervention introduced as a part of the grant project initiated a year prior to the pandemic. As a part of maintaining funding from the Department of Health for our chronic disease project at the clinic, we needed to report quarterly on health

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indicators, such as HbA1c and blood pressure goals, for our patient population using SAS reporting.

Once a patient indicated interest for enrollment in our diabetic education program, we have a certified registered nurse practitioner student that is conducting individual counseling sessions as a part of a separate project by a Pitt nursing student. The nursing student met with patients monthly to discuss how to effectively manage their diabetes. This patient-provider interaction focused on enhancing self-efficacy and introducing lifestyle changes, such as diet and exercise. The patients were educated more on their disease – from how they developed it to how they can live with it and lead a healthy lifestyle with diabetes. Other health behaviors such as glucose monitoring and medication adherence were emphasized as well.

## 3.2 Pandemic Interventions for Chronic Disease Patients

While the previous year to the pandemic was focused on improving health outcomes, the pandemic necessitated interventions that could continue that progress and mitigate the negative effects of pandemic burdens on patients with diabetes. New interventions introduced at the outset of the COVID pandemic included medication delivery and telehealth appointments. Patients were able to receive care remotely via virtual visitation options by appointment and also opt into medication delivery services. This allowed patients to have quality access to the healthcare they need as well as avoiding in-person visits that would be restricted by the risk of COVID-19 spread.

Over 300 patients with type 2 diabetes come to the clinic for regular healthcare and treatment. In efforts to improve their health, we introduced a comprehensive intervention to seek improvement in specifically their HbA1c level and blood pressure.  HbA1c is a reliable biomarker

for diabetes diagnosis and prognosis by representing long-term glycemic control during the preceding two to three months. HbA1c not only provides a reliable measure of chronic hyperglycemia but also correlates well with the risk of long-term diabetes complications. Controlled blood pressure is defined as having a systolic blood pressure (SBP) under 140 and a diastolic blood pressure (DBP) under 90.

We have developed analysis tools via Microsoft Excel and SAS to help monitor improvements in HbA1c levels in patients over time. We also have access to their health information collected at other medical sites as well, such as UPMC locations using the same electronic health system, EpicCare. While these measures were set before the pandemic, this paper examines difference in HbA1c measures and blood pressure control at two time points: the baseline measurements were collected from January-March 2020 before the start of the pandemic lockdown, and a follow-up measurement was collected from patients who had on-site measurements of HbA1c and controlled blood pressure and on-site measurement one year later during January-March 2021. Data for this paper were collected for 62 patients in a retrospective chart review, approved by the UPMC QI Committee.

The pandemic interventions were focused on medication delivery and virtual visitation. Medication delivery was facilitated by student volunteers from the Pitt School of Medicine to deliver essential diabetes medications to the homes of patients in order to overcome the pandemic restriction on in-person visits and to ensure the fewest gaps in medication access and adherence. Students worked on-call shifts to deliver medications in the Pittsburgh area by car, sometimes including food support. Virtual visitation options were also offered in lieu of in-person visits via phone or video call by appointment to assist patients with medical consultation in conjunction with

self-measured blood glucose and pressure readings to substitute in-person follow-up visits. Patients would have their HbA1c measured on-site in 3-month intervals.

The patients were monitored over time and compared to their assessment of diabetic control from before the COVID-19 pandemic to a year after pandemic conditions. Specifically, the cohort was analyzed periodically to measure a change in average HbA1c to track the effectiveness of the intervention. Patient feedback is periodically collected to improve the health education program.

# 4.0 Results

This study examined data from 62 patients with type 2 diabetes before the pandemic and one year later to assess the effects of interventions introduced by the clinic in order to maintain a continuity of care as a result of the obstacles created by the pandemic. The data included patients seeking treatment for type 2 diabetes at BFC and had available data from selected time intervals: a baseline within 3 months before the March 2020 beginning of the COVID-19 pandemic and within 3 months of March 2021 for the follow-up metrics. The average age of the cohort was 55 years old, with patients ranging from 35 to 76 years of age. Over half were male (55%). Patients who identify as white comprised 45% of the cohort, while Black and Asian patients comprised 40% and 10%, respectively. A total of 77% of patients did not identify as Hispanic/Latino, while 19% of patients identified as Hispanic/Latino.

BFC typically has a cohort of type 2 diabetes patients estimated at 300 individuals, however, this pilot study limited that population to those who had available data points at the defined baseline and follow-up time periods and who have utilized telehealth and medication delivery services during the pandemic. Of those 62 patients that met these criteria, 44 patients had complete data to compare changes in HbA1c and blood pressure. The 18 patients with missing data were spread evenly across demographic groups, unlikely to cause a significant shift in the demographic makeup of the analyzed cohort. At time of baseline, 26 individuals had uncontrolled blood pressure and 20 individuals had controlled blood pressure. At time of follow-up, 24 individuals had uncontrolled blood pressure and 20 individuals had controlled blood pressure.

**Table 1. Baseline Demographic Characteristics of Study Cohort (N=62)**

|  | Mean (SD) |
|---|---|
| Age | 55.3 (9.83) |
| Blood Glucose (mg/dL) | 185.4 (117.3) |

|  | n (%) |
|---|---|
| Gender, Male | 34 (54.8) |
| Asian | 6 (9.7) |
| Black | 25 (40.3) |
| White | 28(45.2) |
| Not Reported | 3 (4.8) |
| Hispanic/Latino | 12 (19.4) |
| Not Hispanic/Latino | 48 (77.4) |
| Not Reported | 2 (3.2) |
| Patients with controlled blood pressure at baseline | 20 (43.5) |
| Patients with controlled blood pressure at follow-up | 20 (44.5) |

**Table 2. Changes in HbA1c and Controlled Blood Pressure (N=44)**

| Measurement | HbA1c% (SD) [p-value] | Patients with uncontrolled blood pressure, SBP >140 DBP >90, n (%) | Patients with controlled blood pressure, SBP <140 DBP <90, n (%) |
|---|---|---|---|
| Baseline | 8.41 (2.13) | 26 (56.5) | 20 (43.5) |
| Follow-up | 7.85 (1.82) | 24 (54.5) | 20 (44.5) |
| Mean Difference | -0.39 (2.53) [0.16] | 2 (2%) | 0 |

The follow-up data collection for average HbA1c among patients with diabetes was calculated as 7.85%, which is a reduction of 0.39% compared to the baseline average, 8.41%. While there was a noticeable improvement among patients in their HbA1c, the number of patients with controlled versus uncontrolled blood pressure stayed relatively constant.

The mean difference in HbA1c was low and had a p-value of 0.16, which would not suggest a significant difference in HbA1c among the 40 patients with available HbA1c data due to the pandemic interventions for remote care over the course of the 1-year follow-up time period. The standard deviation was also greater than the mean difference in HbA1c, further denoting the findings are not statistically significant to determine a positive or negative change in HbA1c among the cohort.

## 5.0 Discussion

This study aimed to capture the impact of remote-based care in chronic disease management by conducting a retrospective analysis of current patient data compared to data points prior to the start of the COVID-19 pandemic. The patients included in the cohort benefited from virtual visits to bolster their diabetes management education through personalized guidance via phone or virtual calls. Although there was an observable reduction in HbA1c levels among the cohort over the course of the pandemic, the reduction of 0.39 in HbA1c was neither statistically significant (p= 0.16) nor clinically meaningful, but trended towards an overall reduction, nonetheless. It is widely accepted that a 0.5% change in HbA1c would be considered a clinically meaningful.[37]

Although this result does not show that the new pandemic interventions introduced by the clinic significantly lowered HbA1c, a key finding is that health screenings, medication delivery, virtual visitation, and social determinant questionnaires that were integrated into the routine clinical care options were able to help patients maintain glycemic control–even with the pandemic challenges posed on patient-centered care at the Birmingham Free Clinic. While the goal of the pre-pandemic grant-funded interventions was to seek improvement in the cohort of chronic disease patients, the pandemic interventions were focused on maintaining that quality of care with the increased burden of the pandemic on the lives of patients and clinic practices. There was a continuity in the number of those who had controlled blood pressure as well, a virtually net zero change in the number of patients with controlled blood pressure from baseline to follow-up. While this could be attributable to the new interventions, one would have to consider the numerous burdens to chronic disease management and their possible negative affect on these measured health

outcomes when comparing the baseline to the follow-up data. We would look to these interventions during the pandemic as mitigation strategies to uphold the quality of care rather than seeking improvements in health measures when our clinical climate is strained by the risk of COVID-19. Perhaps, this could have had a contrary effect to the interventions and muted the positive improvement in an environment without the constraints of the ongoing pandemic.

There are a few limitations to this study to note. The initial cohort of patients with diabetes at the Birmingham Free Clinic was approximated to 300 patients, although our team was only able to gather data based on patient information from 62 individuals who are typical patients that were able to attend appointments for HbA1c measurements. Additionally, select patients have missing info in certain HbA1c and blood pressure data points that flaws the validity of the findings, limiting the cohort to 40 individuals in the analysis of HbA1c change. However, this was meant to be a pilot study of patient data in a pandemic situation which hindered our efforts to collect data effectively and accurately. Notably, many of the patients in our cohort face socioeconomic struggles that can contribute to the barriers in achieving improved health goals. Nevertheless, we were able to see an observable change in HbA1c which can indicate an overall improvement among patients in their glycemic control.

By interviewing patients with the social determinant health screening tool, I was able to see what was preventing them from controlling their disease and leading a healthy life, and unsurprisingly, the health beliefs that prevent that were shared by many patients and could be properly addressed. When I made recommendations to the rest of the clinical team, we adjusted our patient plans for managing their healthcare in the clinic but also advised them how to lead healthier lives at home by promoting patients' self-efficacy.

Interventions in raising awareness of disease prevention and management is extremely valuable in engaging individuals at all levels of health literacy. When targeting interventions at specific racial group, a great deal of cultural sensitivity is required, and that comes from community engagement and working with people from that population in figuring out solutions. Diabetic educational programs have been shown to decrease weight and HbA1c levels, and they need to become more widespread and credible. The dataset used in this study did not include weight measurements, which could also be an additional metric to show improvement among diabetes patients striving to improve their health. Medication delivery and telehealth options have made diabetes education more accessible and helps patients to improve their grasp on glycemic control, even in under-resourced patients with access to computers and smartphones. While we can learn from interventions from one racial group, we need to acknowledge the various issues that surround the healthcare of individuals of different racially underserved populations and their own set of risk factors. By targeting individuals' lifestyle choices and disease management, we can help people of diverse backgrounds lead healthier lives.

## 5.1 Future directions

The team will be continuing to analyze patient population data to assess areas of improvement and new potential interventions for hopefully an increased rate of improvement of diabetes indicators since the last quarter. The data available for this pilot work was was particularly limited and I hope to develop more analyses on changes in HbA1c, blood pressure control, and weight among a larger cohort of patients that could potentially confer a statistically significant result with the increased sample size. Additionally, it would be beneficial to compare these

changes to a set of timepoints before the pandemic as a control group to assess the grant intervention effects aside from the additional pandemic intervention effects.

Also, as time moves forward with more community members receiving vaccinations, we can hope to see a change in the clinical environment similar to pre-pandemic conditions. We can apply the same interventions to continue to gather data on whether this produces a meaningful and beneficial improvement in health markers for type 2 diabetes, a major public health problem, across a larger cohort.

# Appendix A - Social Determinants of Health Screening Tool

This is a standard questionnaire we ask all patients to identify ways to best personalize your care and identify any gaps in care. The information you provide to us is voluntary and will be completely confidential. If you feel uncomfortable with any of these questions, feel free to say: "skip".

| Z-CODES | | PATIENT RESPONSE | NEXT STEPS |
|---|---|---|---|
| Z78.9: Language barrier Z60.3: Impaired ability to use community resources due to language barrier | **1. CULTURAL/LANGUAGE** | | |
| | Do you speak a different language at home? | ☐ Yes ☐ No    Language: | A. Use Cyracom to facilitate visit <br> B. Ensure all printed materials are in patient's preferred language; cultural competency training? |
| | What is your preferred language? | | |
| Z91.11: Dietary noncompliance Z72.4: Inappropriate diet and/or eating habits E63.4: Poor diet | **2. HEALTH BELIEFS** | | |
| | What medical condition (illnesses) do you have? | ☐ DM ☐ HTN ☐ Asthma ☐ COPD <br><br> Other: | C. Provide home monitoring device <br> D. Suggest pharmacist phone follow-up between monthly visits (focus: health beliefs-use "Belief about Medicines Screening Questionnaire" and "Brief Illness Perception Questionnaire") <br> E. For DM: Refer to Elisa for diabetes education and support for lifestyle management |
| | What do you think causes this condition? | | |
| | What do you think is the best way to treat your medical conditions? (Prompt: Natural remedies, non-traditional, lifestyle, other forms of healing, etc.) | | |
| | What main problems have your medical conditions caused? | | |
| | **3. SELF-EFFICACY** | | |
| | What is your plan for managing your health? | | C. Provide home monitoring device <br> D. Suggest focused pharmacist phone follow-up between monthly visits (For DM: utilize diabetes self-management record sheet for initial intake) |
| | How likely do you think your health will improve? | | |
| | How much do you agree with the following statement: <br><br> I believe I can succeed with improving my health | ☐ Strongly Disagree ☐ Disagree ☐ Neither Agree nor Disagree ☐ Agree ☐ Strongly Agree | |

| Codes | 4. MONEY & RESOURCES | | |
|---|---|---|---|
| Z59.0: Lack of housing; Z59.1: Inadequate housing; Z59.6: Low income; Z59.8: Economic hardship, Inadequate material resources; Z59.8: No health insurance; Z56.0: Unemployment; Z57.9: Adverse effects of work environment; Z57.9: Occupational exposure to unspecified risk factor; Z59.4: Food deprivation, food insecurity; Z55.9: Problems related to education and literacy; lack of edu | What are your current living arrangements? | | F. Refer to AmeriCorps and Connections 4 Health |
| | What is your current employment? | ☐ Unemployed ☐ Employed:_____ | |
| | In the past 3 months, have you worried about:<br>• Food running out before you had the money?<br>• Paying the heat/electric bills?<br>• Paying hospital bills?<br>• Affording your medications<br>• Finding childcare | ☐ Yes ☐ No<br>☐ Yes ☐ No<br>☐ Yes ☐ No<br>☐ Yes ☐ No<br>☐ Yes ☐ No | F. Refer to AmeriCorps and Connections 4 Health |
| | How often do you need help you when you read instructions, pamphlets, or other written materials? | ☐ Never ☐ Rarely ☐ Sometimes ☐ Usually ☐ Always | G. Utilize visuals for educational materials<br>H. Help patient identify caregiver |
| **5. TRANSPORTATION** | | | |
| Z91.89: Lack of access to transport, travels to PCP by public transport Z59.8: Inability to acquire transport; Z74.8: Assistance needed with transport | How do you currently go to appointments/errands? | ☐ Drives: self ☐ Drives: other ☐ Public transp ☐ Paratransit ☐ Uber/taxi ☐ Other:_____ | C. Provide home monitoring device<br>D. Suggest focused pharmacist phone follow-up between monthly visits<br>F. Refer to AmeriCorps/C4H for resources |
| | Have you had to put off going to the doctor because of transportation? | ☐ Yes ☐ No | |
| **6. SOCIAL SUPPORT** | | | |
| Z60.2: Person living alone; Z74.2: Need for assistance at home, no other household member able to render care; Z59.3: Person living in residential institution; Z63.8/9: Family disruption, family relationship problem | Are you a member of a church or spiritual community? | ☐ Yes ☐ No | I. Provide culturally competent care |
| | In the past month, how often did you have someone around to help you if you needed it? | ☐ Never ☐ Rarely ☐ Sometimes ☐ Usually ☐ Always | J. Help patient identify support system – support group |
| | Who helps you manage your health conditions? | | |
| | If you need help with day-to-day activities, do you get the help you need? | ☐ Yes ☐ No | F. Refer to AmeriCorps and Connections 4 Health for resources |
| **7. EMOTIONAL HEALTH** | | | |
| F43.9: Psychological stress; Z92.49: History of psychological trauma; F40.9: Fear for personal safety; Z63.6: Caregiver burden, stress | Stress is when someone feels tense, nervous, anxious, or can't sleep at night because their mind is troubled. How stressed are you? | ☐ Not at all ☐ A little ☐ Sometimes ☐ Very much | K Refer to Psych appointment for specialist care if appropriate |
| | Caregiver stress is when the emotional and physical strain of caregiving affects time with other family members and friends or causes feelings of being overwhelmed. How much caregiver stress do you have? | ☐ Not at all ☐ A little ☐ Sometimes ☐ Very much | |

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