A Detroit Student-Run Free Clinic’s Management of Select Chronic Diseases

Serina B. Beydoun 1, Anna H. Lee 2, Leigh Durudogan 3, Virginia Kaufman 4, Morgan Potter 5, Firas Askar 6, Charles Tsouvalas 7, Brian Reed 8, Robert L. Sherwin 9, 8

1. Pediatrics, Children’s Hospital of Michigan, Detroit, USA 2. Internal Medicine, University of California-Los Angeles Medical Center, Los Angeles, USA 3. Obstetrics and Gynecology, Beaumont Hospital, Royal Oak, USA 4. Department of Obstetrics and Gynecology, Detroit Medical Center, Detroit, USA 5. Emergency Medicine, Icahn School of Medicine at Mount Sinai, New York, USA 6. Internal Medicine, Henry Ford Health System, Detroit, USA 7. Internal Medicine, Kaiser Permanente, Los Angeles, USA 8. Department of Emergency Medicine, Wayne State University School of Medicine, Detroit, USA 9. Department of Emergency Medicine, Detroit Medical Center, Detroit, USA

Corresponding author: Serina B. Beydoun, sbeydoun04@gmail.com

Abstract

Aim: The Cass Clinic is a student-run free clinic in Detroit, Michigan that treats chronic diseases including hypertension (HTN), diabetes mellitus (DM), and obesity. Our study aims to quantify the effectiveness of our clinic in managing chronic diseases.

Subject and methods: This study assessed selected health outcomes for 137 patients who visited our clinic between September 1, 2017 and August 31, 2018 based on initial and most recent surrogate markers including manual blood pressure, hemoglobin A1c (HbA1c), and body mass index (BMI) recorded in the clinic’s medical record system dating back to 2012.

Results: Patients were divided into two groups: occasionally seen patients (OSP) and frequently seen patients (FSP). FSP with HTN had systolic blood pressure (SBP) decreased by an average of 14.1 mmHg and diastolic blood pressure (DBP) decreased by 9.8 mmHg, which were statistically associated with the number of clinic visits. Additionally, all patients treated at Cass Clinic saw a decrease in their HbA1c and BMI. HbA1c in OSP decreased by 0.50%. HbA1c in the FSP decreased by 1.7%. Patients with at least two recorded BMIs (n=73) saw a decrease of 0.13 kg/m².

Conclusion: The data from our analysis support that a student-run free clinic model like Cass Clinic provides long-term value for patients who frequently utilize the clinic. These clinics also act as an important resource for the community by making positive strides toward better health in multiple measurable outcomes, including HTN and DM management.

Categories: Medical Education, Preventive Medicine, Public Health
Keywords: obesity, underserved, diabetes mellitus, hypertension, student-run free clinic

Introduction

This article was previously presented as a poster at the American Medical Association Research Symposium on November 15, 2019. Hypertension (HTN), type II diabetes mellitus (DM), and obesity are highly prevalent in the U.S. and greatly contribute to morbidity and mortality. Data collected by the Center for Disease Control and Prevention (CDC) revealed that approximately 75 million U.S. adults between 2011 and 2012 had HTN, which equates to one in every three adults [1]. In 2015, more than 100 million U.S. adults were living with DM or prediabetes [2]. In 2015–2016, obesity, which affected 93.3 million U.S. adults, was prevalent in 39.8% of the population [3]. Individuals with these chronic diseases are at an increased risk for heart disease and stroke, which are the leading causes of death in the U.S. The estimated combined medical costs of these conditions result in hundreds of billions of dollars each year. These diseases place a significant strain on our economy and the overall health of our society.

Treating these chronic conditions is important in reducing this burden. However, whether a patient can achieve and maintain disease control is dependent on several socioeconomic factors, including their access to affordable healthcare. The U.S. had 15.7% uninsured and 29% underinsured adults in the fourth quarter of 2018, both at their highest level since the first quarter of 2014 [4,5]. Many uninsured and underinsured patients rely on safety-net hospitals, non-profit or faith-based organizations, and free clinics for their medical needs. In 2018, free health care was provided to over 34,044 uninsured patients in Michigan via various free clinics, including student-run free clinics [6]. By managing HTN, DM, and obesity in student-run free clinics, such as the Cass Clinic, there is potential to dramatically improve the health of uninsured and underinsured patients.

Cass Clinic is a student-run free clinic organization operating two sites in Detroit. It has served uninsured and underinsured patients since the late 1970s. The clinic primarily treats chronic diseases, including HTN, DM, and obesity. During a typical patient visit, medical students conduct an interview, perform a focused physical exam, and, when appropriate, obtain certain laboratory tests, including glycosylated hemoglobin A1c (HbA1c), lipid panel, and blood glucose readings. The student team then
presents the case to an attending physician and, together, they come up with a treatment plan, which includes medications, lifestyle modifications, patient education, and referrals.

All Cass Clinic patients have their vital signs, height, and weight checked at every visit. BMI calculation allows for proper nutrition and exercise counseling. Cass Clinic patients with HTN have their blood pressure manually checked by either a medical student or a volunteer nurse practitioner. Medications are then adjusted accordingly, and they are subsequently given a one-month refill on their antihypertensive medications. During the visit, they will also receive counseling on improving their nutrition, smoking cessation, and the importance of exercise. Cass Clinic patients with DM are provided glucometers and asked to measure their blood glucose at least twice a day, which is then reviewed at each visit. A fasting or random glucose test is checked, and patients receive a one-month refill on their insulin, needles, syringes, and glucometer test strips, in addition to access to a diabetes nurse educator. Cass Clinic also hosts several other student organizations, including FreshRx, which provides patients with a prescription to eat more fruits and vegetables, which can be filled at partnering farm stands or markets, and Sight Savers, which provides free eye exams, glaucoma screenings, and prescription glasses. In addition to chronic disease management, patients receive care for acute illnesses, allergies, and asthma. In 2017, Cass Clinic facilitated over 650 patient encounters provided by over 1,688 volunteer hours from undergraduate, medical, and other healthcare-associated graduate students.

Nearly, 38% of Detroit’s approximate 670,000 residents lived below the poverty line in 2017, with 13.8% of the population under 65 being uninsured [7]. It is well documented that health outcomes and chronic disease management are negatively affected by poverty and lack of insurance coverage, making our clinic an important resource for patients who would otherwise go untreated. While providing free medical care for this population seems valuable, the impact of Cass Clinic on chronic disease management has never been formally quantified. There have been several studies showcasing that HTN management in student-run free clinics is on par with national data [8,9]. However, limited research exists concerning the treatment and outcomes of DM in these clinics, and studies regarding counseling and improvements among the obese populations are rare. Our methodology is unique in that we were able to individually assess the HTN, DM, and obesity management of Cass Clinic patients.

The study aims to confirm whether Cass Clinic improved selected health outcomes for its patients with chronic diseases including HTN, DM, and overweight/obesity based on surrogate markers including manual blood pressure, HbA1c, and body mass index (BMI), respectively, that have been recorded in the clinic’s electronic medical record (EMR) system. We also looked for differences in outcomes based on visit frequency; that is, whether a patient was a frequently seen patient (FSP) or an occasionally seen patient (OSP) in the clinic. This study will help Cass Clinic and other student-run free clinics better understand the Detroit population that utilizes our clinics and how to best provide care to our patients.

**Materials And Methods**

Cass Clinic has student teams document all patient encounters in an EMR system that has been in use since 2012, PracticeFusion©, and patient charts are subsequently reviewed by the clinic EMR coordinator and signed as a quality control measure. This study was conducted by the Cass Clinic coordinators. There were no exclusion criteria for this study. Patients were included if they had been treated in our clinic between September 1, 2017 and August 31, 2018. This time period was chosen as it was before the COVID-19 pandemic caused a temporary shutdown of the clinic. After selecting patients, patient data including patient date of birth, age, gender at birth, ethnicity/race, current or history of smoking, diagnosis of DM or HTN, first encounter date, most recent encounter date, medication for DM or HTN at any time as a Cass Clinic patient, the total number of days between first and most recent encounters, the total number of visits documented in the EMR, first and most recent documented blood pressure, first and most recent documented HbA1c, and first and most recent documented BMI were collected via chart review (Table 1). These variables were all chosen as they are consistently documented in each patient’s chart and can act as valid surrogate markers for the management of chronic diseases. The Cass Clinic EMR does not have a designated area for HbA1c documentation. Instead, the result of an HbA1c lab test is written in the encounter note. The patient’s first encounter date may have occurred as early as 2012, when the Cass Clinic transitioned to the current EMR system from paper-based documentation. Data from 2012 to the end of the study period on August 31, 2018 was included. Patients who were only seen once were excluded.
| Variable                        | Data collected                                      |
|--------------------------------|-----------------------------------------------------|
| Date of birth                  | Month/day/year (age)                                |
| Gender at birth                | Male or female                                      |
| Ethnicity/race                 | African American, White, Hispanic/Latino, Native American, Asian American, other |
| Smoker at anytime              | Yes or no                                           |
| Type 2 DM diagnosis            | Yes or no                                           |
| HTN diagnosis                  | Yes or no                                           |
| First encounter date           | Month/day/year                                      |
| Most recent encounter date     | Month/day/year                                      |
| At any time DM medication      | Yes or No                                           |
| At any time HTN medication     | Yes or No                                           |
| Total number of days between first encounter and last encounter | Total number of days |
| Total number of visits         | Total number of visits                               |
| First documented blood pressure| Systolic BP/diastolic BP                             |
| First documented HbA1c         | HbA1c number                                        |
| First documented BMI           | BMI number                                           |
| Most recent documented blood pressure | Systolic BP/diastolic BP                             |
| Most recent documented HbA1c   | HbA1c number                                        |
| Most recent documented BMI     | BMI number                                           |

**TABLE 1: Variables and data collected**

DM: diabetes mellitus, HTN: hypertension, HbA1c: hemoglobin A1c, BMI: body mass index

Patients were considered to have HTN if they reported a prior physician diagnosis of HTN, previous use of HTN medication, or if they had two separate readings of either systolic blood pressure (SBP) >140 mmHg or diastolic blood pressure (DBP) >90 mmHg, which is consistent with the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure guidelines in 2012, when our EMR was first introduced and many of our frequently seen patients' first blood pressure readings were recorded. Similarly, patients were considered to have DM if they reported a prior physician diagnosis of DM, previous use of DM medication, or HbA1c >6.5%. A unique patient identification number identified each patient, and all information was input into an Excel spreadsheet (Microsoft Excel, Microsoft® Corp., Redmond, WA). The difference (referred to as Delta in the results section) in the patient's initial and most recent measurements for systolic blood pressure and diastolic blood pressure, BMI, and HbA1c were then calculated to determine the change in each surrogate marker as a reflection of chronic disease management.

Initial screening found 252 patients who were seen during our study period. Patients who were only seen once were excluded from the analysis (n=115). Charts were reviewed for the remaining 137 patients. The patients were then analyzed based on overall clinic use rate, diagnosis of HTN, and diagnosis of DM. Based on the overall clinic use rate, they were divided into "OSP" and "FSP" based on how many total visits to the clinic they made. The median number of visits for all patients included in the analysis was nine visits. This served as our cut-off, establishing OSP as those with a total of two to nine visits and FSP as those who have more than nine visits. Patients were also separated by a diagnosis of either HTN or DM and again stratified by utilization of the clinic. There were 110 patients diagnosed with HTN. The median visit count was 15 for patients diagnosed with HTN and this served as our cut-off with OSP having a total of two to 15 visits and FSP having more than 15 visits. There were 43 patients diagnosed with DM. The median visit count was 13 for patients diagnosed with DM, and this served as our cut-off, with OSP having a total of two to 15 visits and FSP having more than 15 visits.

Analysis was performed with statistical analysis systems (SAS) and included the use of a t-test, Wilcoxon Rank Sum t-test approximation, Chi-Squared test, and Fisher’s Exact test to determine the statistical significance of all data points. Statistical significance was set at p<0.05.

**Results**

OSP demographics include an average age of 49.4 years old, 49.3% female, 50.7% male, 61.8% current or
have a history of smoking, 26.1% diagnosed with DM, 63.8% diagnosed with HTN, 23.2% treated with DM medication, and 58% treated with an antihypertensive (Table 2). On average, an OSP visited the clinic four times (Table 3). Demographics of FSP include average age of 60.1 years old, 33.8% female and 66.2% male, 52.9% are current or have a history of smoking, 36.8% were diagnosed with DM, 97.1% with HTN, 35.3% with DM medication, and 97.1% were treated with an antihypertensive (Table 2). On average, an FSP visited the clinic 31.2 times, and an OSP visited an average of 4 times (Table 3). There was a statistically significant difference between the number of OSP and FSP with HTN (p<0.0001) and treated with anti-hypertensives (p<0.0001). There was no statistically significant difference between FSP and OSP with DM (p=0.1781) or taking medication for DM (p=0.1192).

| Variable                  | All patients N(N%) | OSP* N(N%) | FSP** N(N%) | p-value  |
|---------------------------|--------------------|------------|-------------|----------|
| Number of patients        | 137                | 69         | 68          |          |
| Age                       | 54.7 ± 12.56       | 49.4 ± 13.66 | 60.1 ± 8.51 | <0.0001  |
| Sex                       | 0.0666             |            |             |          |
| Female                    | 57 (41.6)          | 34 (49.3)  | 23 (33.8)   |          |
| Male                      | 80 (58.4)          | 35 (50.7)  | 45 (66.2)   |          |
| Race                      | 0.6795             |            |             |          |
| African American          | 87 (87.9)          | 38 (66.4)  | 49 (89.1)   |          |
| White                     | 12 (12.1)          | 6 (13.6)   | 6 (10.9)    |          |
| Ever smoker               | 0.2082             |            |             |          |
| Yes                       | 78 (57.4)          | 42 (61.8)  | 36 (52.9)   |          |
| No                        | 58 (42.6)          | 26 (38.2)  | 32 (47.1)   |          |
| Diabetic                  | 0.1781             |            |             |          |
| Yes                       | 43 (31.4)          | 18 (26.1)  | 25 (36.8)   |          |
| No                        | 94 (68.6)          | 51 (73.9)  | 43 (63.2)   |          |
| Hypertension              | <0.0001            |            |             |          |
| Yes                       | 110 (80.3)         | 44 (63.8)  | 66 (97.1)   |          |
| No                        | 27 (19.7)          | 25 (36.2)  | 2 (2.9)     |          |
| Patient takes DM medication| 0.1192             |            |             |          |
| Yes                       | 40 (29.2)          | 16 (23.2)  | 24 (25.3)   |          |
| No                        | 97 (70.8)          | 33 (76.8)  | 44 (64.7)   |          |
| Patient takes HTN medication| <0.0001            |            |             |          |
| Yes                       | 106 (77.4)         | 40 (58)    | 66 (97.1)   |          |
| No                        | 31 (21.6)          | 29 (42)    | 2 (2.9)     |          |

TABLE 2: Summary of Cass Clinic patients

*2-9 visits; **>9 visits; p<0.05 is statistically significant

OSP: occasionally seen patient, FSP: frequently seen patient, DM: diabetes mellitus, HTN: hypertension
Among all patients, SBP decreased by an average of 12.1 mmHg (95% CI [-15.57, -8.63]) and DBP decreased by 8.7 mmHg (95% CI [-11.25, -6.15]) between the first and most recent visit. OSP had an average SBP decrease of 5.5 mmHg (95% CI [-10.34, -0.65]) and a DBP of 3 mmHg (95% CI [-6.38, 0.38]). FSP had an average SBP decrease of 18.3 mmHg (95% CI [-22.81, -13.79]) and a DBP decrease of 14.2 mmHg (95% CI [-17.53, -10.87]). There was a statistically significant difference in the decrease in SBP and DBP between OSP and FSP (p<0.0001 and p=0.0002, respectively) (Table 3). There was no statistically significant difference in decreased HbA1c (p=0.0794). Patients with at least two recorded BMIs (n=73) saw a decrease of 0.13 kg/m$^2$ (95% CI [-0.608, 0.348]). OSP had a decrease of 0.18kg/m$^2$ (n=42) (95% CI [-0.842, 0.482]) and FSP had a decrease of 0.06kg/m$^2$ (n=31) (95% CI [-0.752, 0.632]). The average BMI change stratified by OSP and FSP was not statistically significant (p=0.4637) (Table 3).

Patients were separated by a diagnosis of either HTN or DM and then further stratified by utilization of the clinic. The median visit count was 15 for patients diagnosed with HTN; the median visit count was 13 for patients diagnosed with DM; and the median visit count was 17.5 for patients diagnosed with DM and HTN. Disease-specific median visit counts were used to further analyze disease modification for patients with HTN or DM by once again classifying patients as OSP or FSP.

Overall, patients diagnosed with HTN (n=110) had SBP decreased by 14.1 mmHg (95% CI [-17.95, -10.26]) and DBP decreased by 9.8 mmHg (95% CI [-12.67, -6.94]). OSP (two to 15 visits) with HTN had an average SBP decrease of 10.2 mmHg (95% CI [-14.24, -6.16]) and DBP of 5.5 mmHg (95% CI [-8.13, -2.47]), while FSP (>15 visits) with HTN had an average SBP decrease of 18.2 mmHg (95% CI [-21.70, -14.70]) and DBP of 14.8 mmHg (95% CI [-17.42, -12.18]). The difference in the decrease in SBP and DBP in OSP and FSP with HTN was statistically significant (p=0.0426 and p=0.0010, respectively) (Table 4). Furthermore, the average age of FSP’s diagnosed with HTN was 60.4 years old; for OSPs, the average age was 55.2 years old (p=0.0025) (Table 4).

**Table 3: Statistical summary for all clinic patients by the use rate**

|                      | All patients | All patient’s mean + SD | OSP* N | OSP* mean + SD | FSP** N | FSP** mean +SD | p-value |
|----------------------|--------------|-------------------------|--------|---------------|---------|----------------|---------|
| Initial visit SBP (mmHg) | 130          | 147.3 + 19.48           | 64     | 141.5 + 19.76 | 66      | 152.8 + 17.64  | 0.0008  |
| Initial visit DBP (mmHg) | 129          | 90.9 + 13.11            | 64     | 87.2 + 12.55  | 65      | 94.5 + 12.71   | 0.0017  |
| Initial visit BMI     | 84           | 31.7 + 7.56             | 49     | 30.68 + 7.48  | 35      | 33.14 + 7.54   | 0.1405  |
| Initial A1c           | 32           | 9.3 + 2.71              | 10     | 9.12 + 3.41   | 22      | 9.38 + 2.41    | 0.4816  |
| Most recent visit SBP (mmHg) | 134         | 135.2 + 16.4            | 66     | 135.9 + 15.93 | 68      | 134.5 + 16.93  | 0.5983  |
| Most recent visit DBP (mmHg) | 134         | 82.3 + 10.71            | 66     | 84 + 11.04    | 68      | 80.7 + 10.2    | 0.0816  |
| Most recent visit BMI  | 109          | 31.25 + 7.346           | 51     | 31.5 + 7.65   | 58      | 31.03 + 7.13   | 0.8701  |
| Most recent A1c       | 25           | 7.65 + 1.90             | 5      | 6.84 + 0.063  | 20      | 7.86 + 2.07    | 0.5881  |

SBP: systolic blood pressure, DBP: diastolic blood pressure, BMI: body mass index, A1c: hemoglobin A1c

*2-9 visits; **>9 visits; p<0.05 is statistically significant

Among all patients, SBP decreased by an average of 12.1 mmHg (95% CI [-15.57, -8.63]) and DBP decreased by 8.7 mmHg (95% CI [-11.25, -6.15]) between the first and most recent visit. OSP had an average SBP decrease of 5.5 mmHg (95% CI [-10.34, -0.659]) and a DBP of 3 mmHg (95% CI [-6.38, 0.38]). FSP had an average SBP decrease of 18.3 mmHg (95% CI [-22.81, -13.79]) and a DBP decrease of 14.2 mmHg (95% CI [-17.53, -10.87]). There was a statistically significant difference in the decrease in SBP and DBP between OSP and FSP (p<0.0001 and p=0.0002, respectively) (Table 3). There was no statistically significant difference in decreased HbA1c (p=0.0794). Patients with at least two recorded BMIs (n=73) saw a decrease of 0.13 kg/m$^2$ (95% CI [-0.608, 0.348]). OSP had a decrease of 0.18kg/m$^2$ (n=42) (95% CI [-0.842, 0.482]) and FSP had a decrease of 0.06kg/m$^2$ (n=31) (95% CI [-0.752, 0.632]). The average BMI change stratified by OSP and FSP was not statistically significant (p=0.4637) (Table 3).

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Overall, patients diagnosed with HTN (n=110) had SBP decreased by 14.1 mmHg (95% CI [-17.95, -10.26]) and DBP decreased by 9.8 mmHg (95% CI [-12.67, -6.94]). OSP (two to 15 visits) with HTN had an average SBP decrease of 10.2 mmHg (95% CI [-14.24, -6.16]) and DBP of 5.5 mmHg (95% CI [-8.13, -2.47]), while FSP (>15 visits) with HTN had an average SBP decrease of 18.2 mmHg (95% CI [-21.70, -14.70]) and DBP of 14.8 mmHg (95% CI [-17.42, -12.18]). The difference in the decrease in SBP and DBP in OSP and FSP with HTN was statistically significant (p=0.0426 and p=0.0010, respectively) (Table 4). Furthermore, the average age of FSP’s diagnosed with HTN was 60.4 years old; for OSPs, the average age was 55.2 years old (p=0.0025) (Table 4).
There were 43 patients with documented DM. Only 25 had at least two HbA1c recordings for analysis. Among those 25 patients, there was a decrease of 1.4% in HbA1c. OSP (two to 13 visits) with DM had an HbA1c decrease of 0.50% (n=5) and FSP (>15 visits) with DM had a decrease of 1.7% (n=20). The average HbA1c decrease between OSP and FSP was not statistically significant (p=0.1733) (Table 5). However, the SBP decrease among DM patients was significant. Among all patients with DM, SBP decreased by 12.7 mmHg (95% CI [−19.21, −6.19]) and DBP decreased by 6.4 mmHg (95% CI [−11.12, −1.66]). OSP with DM had an average SBP decrease of 5.2 mmHg (95% CI [−14.54, 4.14]) and DBP of 4 mmHg (95% CI [−11.77, 3.77]), while FSP with DM had an average SBP decrease of 20.9 mmHg (95% CI [−28.65, −13.15]) and DBP of 9.1 mmHg (95% CI [−14.11, −4.09]). The difference in the decrease in SBP between OSP and FSP was statistically significant (p=0.0162), but was not for DBP (p=0.2867) (Table 5). The difference in BMI between OSP with DM, which decreased 0.73 kg/m², and FSP with DM, which decreased by 0.67 kg/m² was not statistically significant (p=0.4285) (Table 5).
TABLE 5: Statistical summary for Cass Clinic patients with diagnosis of type II diabetes mellitus

|                                  | All patients N | All patients mean + SD | OSP** N | OSP** mean + SD | FSP** N | FSP** Mean + SD | p-value |
|----------------------------------|---------------|------------------------|--------|----------------|--------|----------------|--------|
| Initial visit SBP (mmHg)         | 42            | 147.8 ± 20.44          | 22     | 143.3 ± 20.88  | 20     | 152.7 ± 19.29  | 0.1415 |
| Initial visit DBP (mmHg)         | 42            | 88.2 ± 11.09           | 22     | 87.3 ± 13.72   | 20     | 89.3 ± 7.43    | 0.5607 |
| Initial visit BMI                | 29            | 34.42 ± 8.29           | 18     | 35.38 ± 8.89   | 11     | 32.85 ± 7.32   | 0.4364 |
| Initial A1c                      | 30            | 8.99 ± 2.71            | 12     | 8.42 ± 2.78    | 18     | 9.37 ± 2.29    | 0.1604 |
| Most recent visit SBP (mmHg)     | 43            | 135 ± 15.72            | 22     | 138.1 ± 14.64  | 21     | 131.7 ± 16.46  | 0.1803 |
| Most recent visit DBP (mmHg)     | 43            | 81.8 ± 9.97            | 22     | 83.3 ± 11.23   | 21     | 80.2 ± 8.46    | 0.3244 |
| Most recent visit BMI            | 35            | 32.97 ± 8.03           | 17     | 16.9 ± 2.61    | 18     | 31.18 ± 7.81   | 0.1785 |
| Most recent A1c                  | 24            | 7.47 ± 1.71            | 8      | 6.68 ± 0.534   | 16     | 7.87 ± 1.96    | 0.2434 |
| Visit count                      | 43            | 19.5 ± 17.25           | 22     | 5.2 ± 3.62     | 21     | 34.5 ± 12.99   | <0.0001 |
| SBP Delta                        | 42            | −12.7 ± 21.53          | 22     | −5.2 ± 22.34   | 20     | −20.9 ± 17.68  | 0.0162 |
| DBP Delta                        | 42            | −6.4 ± 15.62           | 22     | −4 ± 18.59     | 20     | −9.1 ± 11.43   | 0.2867 |
| A1c Delta                        | 24            | −1.4 ± 1.37            | 8      | −0.9 ± 1.22    | 16     | −1.7 ± 1.4     | 0.1733 |
| BMI Delta                        | 26            | −0.14 ± 2.278          | 15     | −0.73 ± 1.995  | 11     | −0.67 ± 2.48   | 0.4285 |

**2-15 visits; ***>15 visits; p<0.05 is statistically significant

SBP: systolic blood pressure, DBP: diastolic blood pressure, BMI: body mass index, A1c: hemoglobin A1c

Discussion

Cass Clinic primarily treats patients with chronic diseases, including HTN, DM, and obesity. A majority of patients in our study had been diagnosed with HTN, DM, or both. Our study demonstrates that patients overall saw a decrease in their systolic and diastolic blood pressures. Among all patients, SBP decreased by an average of 12.1 mmHg and DBP decreased by 8.7 mmHg between the first and most recent visit. This finding is clinically relevant as studies have shown a 5 mmHg reduction in systolic blood pressure reduces the risk of major cardiovascular events by about 10%, irrespective of previous diagnoses of cardiovascular disease and even at normal or high-normal blood pressure values [10]. Patients who were seen more frequently had a greater reduction in both SBP and DBP, compared with those less frequently seen in the clinic. This finding was confirmed when patients with a formal diagnosis of HTN were analyzed separately. The more significant decrease in blood pressure in FSP may be attributed to a number of factors. First, the average age of FSP was higher than OSP by 10.7 years overall, and by 5.2 years in those diagnosed with DM. Patients with uncontrolled HTN have a substantially higher risk of developing coronary artery disease, retinopathy, stroke, and renal disease, compared with those only diagnosed with diabetes [15]. Lowering BP in diabetic patients resulted in a decreased risk of cardiovascular events, coronary heart disease, stroke, albuminuria, and retinopathy, ultimately improving the mortality of these patients [16,17].

It is also worth noting that in those diagnosed with DM, FSP saw a statistically significant decrease in SBP compared to OSP. However, OSP still had a clinically significant decrease of 5.2 mmHg in SBP. Diabetic patients with uncontrolled HTN have a substantially higher risk of developing coronary artery disease, retinopathy, stroke, and renal disease, compared with those only diagnosed with diabetes [15]. Lowering BP in diabetic patients resulted in a decreased risk of cardiovascular events, coronary heart disease, stroke, albuminuria, and retinopathy, ultimately improving the mortality of these patients [16,17].

The Cass clinic primarily manages obesity through counseling and its partnership with FreshRx and local
frequent medication adjustments and better control of the disease. In those not formally diagnosed with HTN and DM, patient clinic visits, which has been shown in national data to translate to a higher likelihood of BP control and is likely a combination of patient education, fewer available medication options, possibly translating to simpler regimens, and ease of access with a clinic model that is free for the patient and does not require insurance or appointments. Improved access may be contributing to increased options, possibly translating to simpler regimens, while other interventions such as motivational strategies and complex adherence interventions including home visits, work-site care, and telecommunication reminders have shown varied success [21]. Though it is unclear why Cass Clinic is demonstrating success in lowering BP in both OSP and FSP hypertensive patients, it is likely a combination of patient education, fewer available medication options, possibly translating to simpler regimens, and ease of access with a clinic model that is free for the patient and does not require insurance or appointments. Improved access may be contributing to increased patient clinic visits, which has been shown in national data to translate to a higher likelihood of BP control in hypertensive patients [20]. Future studies should be pursued to better elucidate the cause of these meaningful outcomes at the Cass Clinic.

This research was limited by the short study time period and the fact that we considered only two values for each surrogate marker in assessing the management of chronic diseases. Additionally, missing HbA1c recordings for DM patients limited our ability to make stronger conclusions about our data. At Cass Clinic, a standardized pre-volunteering meeting to train students on the EMR would likely help to alleviate inconsistent recording of data. Given our lack of statistically significant findings on BMI changes between the FSP and OSPs, additional training on effective counseling techniques regarding diet, exercise, and other lifestyle changes would not only be beneficial in lowering BMI but also BP and HbA1c. A controlled study comparing different counseling methods may be conducted to look for improvement in our surrogate markers. Finally, we believe that administering satisfaction surveys to all patients would help to improve the clinic experience, which may in turn be associated with better health outcomes for patients.

These encouraging findings support the notion that a student-run free clinic like Cass Clinic provides meaningful value for patients locally and serves as a community resource for managing BP, DM, and obesity. Literature exists on the importance of creating continuity of care for managing chronic disease states like HTN, especially the need for improved collaboration on the transition of care from emergency departments (ED) to primary care providers [22].
Conclusions

Student-run free clinics like Cass Clinic may play a meaningful role, especially since Cass Clinic’s model is targeted toward patients who are uninsured, without a primary care physician, and may not be able to afford their medication. The population most likely to have undiagnosed or uncontrolled HTN and be reliant on ED resources for chronic disease management may be the same population targeted by a student-run free clinic. Moving forward, a retrospective cohort study of Cass Clinic patients and their utilization of ED resources for chronic disease management may provide further insight into this theory. Additionally, the proximity of Cass Clinic to a major hospital system, its accommodation of walk-ins, and its referral system to higher levels of care may further support the clinic’s role in this continuity of care.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. Wayne State University issued approval 121717MP2X. The study was given a concurrence of exemption. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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References

1. CDC: High blood pressure fact sheet . (2019). Accessed: January 1, 2020: https://www.cdc.gov/dhfs/data/statistics/fact_sheets/fs_bloodpressure.htm.
2. New CDC report: more than 100 million Americans have diabetes or prediabetes . (2016). Accessed: January 1, 2020: https://www.cdc.gov/media/releases/2017/diabetes-report.html.
3. Adult obesity facts | Overweight and Obesity | CDC . (2019). Accessed: January 31, 2020: https://www.cdc.gov/obesity/data/adult.html.
4. U.S. uninsured rate rises to four-year high . (2019). Accessed: January 31, 2020: https://news.gallup.com/poll/246134/uninsured-rate-rises-four-year-high.aspx.
5. Underinsured rate rose from 2014-2018, with greatest growth among people in employer health plans. Commonwealth Fund. (2019). Accessed: January 31, 2022: https://www.commonwealthfund.org/policy-research/issue-briefs/underinsured-2019/uninsured-rate-rise-2014-2018-greatest-growth-among-people-emp....
6. Final free clinic report - State of Michigan. Michigan Department of Health and Human Services . (2018). Accessed: January 31, 2022: https://www.michigan.gov/documents/mdhsa/FINAL_Free_Clinic_Report_FY2018_AM_Edit_w_correct_phone_number_660825.
7. U.S. Census Bureau QuickFacts: Detroit City, Michigan . (2019). Accessed: January 31, 2020: https://www.census.gov/quickfacts/fact/table/detroit,mi/USMI.
8. Zack S, Gillen J, Ackrivo J, Schroeder R, Keller S: Hypertension management in a student-run free clinic: meeting national standards?. Acad Med. 2011, 86:239-45. 10.1097/ACM.0b013e31820465e0.
9. Wahi B, Meyer K, Faller M, Kochhar K, Sevilla J: Assessment of hypertension management and outcomes at an Indianapolis student-run free clinic. J Health Care Poor Underserved. 2017, 28:694-706. 10.1353/hcp.2017.0068.
10. Pharmacological blood pressure lowering for primary and secondary prevention of cardiovascular disease across different levels of blood pressure: an individual participant-level data meta-analysis. Lancet. 2021, 397:1625-36. 10.1016/S0140-6736(21)00959-0.
11. Standards of medical care in diabetes–2010. Diabetes Care. 2010, 33 Suppl 1:S11-61. 10.2539/diabetesonline.comancestors/2010/10501010.
12. National Institute for Health and Clinical Excellence: Newer Agents for Blood Glucose Control in Type 2 Diabetes. Centre for Clinical Practice at NICE, London; 2009. https://www.nice.nhs.uk/guidance/NBK618422.
13. Selvin E, Naripouros S, Burkenbitt G, Rami T, Brancati FL, Powe NR, Golden SH: Meta-analysis: glycosylated hemoglobin and cardiovascular disease in diabetes mellitus. Ann Intern Med. 2004, 141:421-35. 10.1097/00000188-200409100-00007.
14. Stratton IM, Adler AI, Neil HA, et al.: Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 55): prospective observational study. BMJ. 2000, 321:405-12. 10.1136/bmj.321.7258.405.
15. El-Atat F, McFarlane SI, Sowers JR: Diabetes, hypertension, and cardiovascular derangements: pathophysiology and management. Curr Hypertens Rep. 2004, 6:215-23. 10.1007/s11906-004-0072-y.
16. Emdin CA, Rahimi K, Neal B, Callender T, Perkovic V, Patel A: Blood pressure lowering in type 2 diabetes: a systematic review and meta-analysis. JAMA. 2015, 313:605-15. 10.1001/jama.2014.18574.
17. de Boer IH, Bangalore S, Benetos A, et al.: Diabetes and hypertension: a position statement by the American Diabetes Association. Diabetes Care. 2017, 40:1273-84. 10.2337/dc17-0026.
18. Heart disease and stroke | Healthy People . (2020). Accessed: August 25, 2019: https://www.healthypeople.gov/2020/topics-objectives/topic/heart-disease-and-stroke/objectives.
19. Oceans K, Mills RT, Liu Y, He J: Trends in prevalence and control of hypertension according to the 2017 American College of Cardiology/American Heart Association (ACC/AHA) Guideline. J Am Heart Assoc. 2018, 7:10.1161/JAHA.118.008888.
20. Ostchega Y, Zhang G, Hughes JP, Nwankwo T: Factors associated with hypertension control in US adults
using 2017 ACC/AHA guidelines: National Health and Nutrition Examination Survey 1999-2016. Am J Hypertens. 2018, 31:886-94. 10.1093/ajh/hpy047

21. Schroeder K, Fabey T, Ibrahim S: How can we improve adherence to blood pressure-lowering medication in ambulatory care? Systematic review of randomized controlled trials. Arch Intern Med. 2004, 164:722-32. 10.1001/archinte.164.7.722

22. Brody A, Janke A, Sharma V, Levy P: Public health, hypertension, and the emergency department. Curr Hypertens Rep. 2016, 18:50. 10.1007/s11906-016-0634-5