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# Digging deep into diabetes: achieving better glycemic control in diabetic patients in a resident-run clinic

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**ABSTRACT**

**Background**: Diabetes mellitus (DM) affects over 30 million Americans with an estimated annual cost of $327 billion in 2017. Patients with diabetes, especially with financial and/or social hardships, pose challenges in achieving target hemoglobin A1c (HbA1c) values. Understanding patient-specific barriers offer opportunities to improve outcomes in patient care.

**Objective**: We aimed to improve a patient's glycemic control by reducing barriers to care. Furthermore, we evaluated the impact that a resident quality improvement effort had on providing high value diabetic care.

**Methods**: We performed a retrospective cohort study of patients with HbA1c >9.0% in an underserved, resident-run clinic. Patients were surveyed on their knowledge of diabetes and reported obstacles to achieve diabetic control. We then implemented a 12 -month customized, patient-directed, multi-modal, multidisciplinary intervention.

**Results**: Ninety-four patients with HbA1c >9.0% were identified, 65 surveyed, and 51 included in the intervention phase. After the intervention phase, re-evaluation of HbA1c in a paired sample comparison showed that the average HbA1c had decreased by 1.41% (11.28% vs. 9.87%, $p < 0.01$). Among the patients included in the intervention group, approximately 8% had their HbA1c reduced by ≥50% from their baseline, 23% had their HbA1c reduced by ≥25% from their baseline and 49% had their HbA1c reduced by ≥10% from their baseline.

**Conclusions**: A strategically designed, a patient-centered customized intervention can have a positive impact on a patient's diabetic control.

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**KEYWORDS**
Diabetes; glycemic control; quality improvement; resident-run clinic

## 1. Introduction

Diabetes mellitus is one of the fastest growing epidemics of the twenty-first century and the seventh leading cause of death in the US. According to the Centers for Disease Control and Prevention, as of 2015, 30.3 million Americans or 9.4% of the US population has diabetes[1]. Poor glycemic control causes a significant increase in diabetes-related complications including retinopathy, nephropathy, neuropathy and increased risk of cardiovascular disease. With an estimated direct and indirect expenditure of $327 billion in 2017, diabetes and its complications continue to pose a significant societal burden due to associated morbidity, mortality, and healthcare cost[2].

The challenge for optimal diabetic care is complex with management requiring both the patient and provider to be invested and involved in decision-making, availability of resources, affordability of diabetic supplies and medication, implementation of complicated treatment plans, and monitoring of treatment outcome. Treatment of diabetes requires regular clinic visits, frequent laboratory tests, glucose monitoring, and an annual office visit for preventative measures and health maintenance. Successful management requires health literacy, compliance with treatment and medical advice, and availability of transportation to and from outpatient/inpatient health-care settings.

Disparities in diabetes care among US populations are well documented. Multiple barriers to care have been recognized in underserved clinics [3]. These obstacles include impoverished and less educated patient populations, increased diabetes disease burden among various racial and ethnic minorities, limited financial resources, and lack of integrated health-care teams [4,5]. Ineffective communication between patients and providers in the public healthcare system may contribute to suboptimal diabetic care [6]. Providers have reported time constraints, challenges to the continuity of care with patients, and limitations with staffing and resources [7,8]. Community partnerships with

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Supplemental data for this article can be accessed here.

academic settings can be an effective model to improve communication in healthcare and help address disparities for diabetic care in populations that are more vulnerable or underserved [7,9].

This resident-run quality improvement project aims to address the barriers in providing care to patients with poorly controlled diabetes according to ADA treatment guidelines at a publicly funded clinic in St. Louis, MO [10]. The clinic provides medical care to a predominantly African-American population of low socioeconomic status with average health literacy at the third-grade level. Approximately one-fourth of these patients have diabetes mellitus, and 29% of them had a HbA1c >9.0% in 2016. Our goal was to customize care plans according to the specific barriers faced by our patient population to help improve glycemic control.

### 1.1. Methods

We performed a retrospective cohort study of patients with HbA1c >9.0% treated at Betty Jean Kerr People's Health Center St. Luke's Continuity Clinic in Saint Louis, Missouri between January 2016 to December 2016. We included English-speaking patients with type 2 diabetes, who were 18 years or older, with their most recent HbA1c value of >9.0%. Patients who had changed their primary care providers, did not have working telephone numbers, or died prior to the intervention phase were excluded. Qualified patients' electronic health records (NextGen EHR, NextGen Healthcare Inc, Irvine, CA) were reviewed. Data collection included demographic background information (age, sex, race, contact information) as well as clinical data, including associated diagnoses, current medications, last recorded blood pressure, laboratory results (HbA1c values, microalbumin levels, lipid panels, and calculated ASCVD risk scores), preventative/screening examinations, and smoking status. Subsequently, a survey questionnaire was created and completed via a telephone conversation or during in-person clinic visits. This survey assessed a patient's knowledge and understanding of their disease, medication adherence, and patient-reported barrier for their diabetic care (Supplement 1).

A total of 94 patients with HbA1c >9.0% were identified. Six patients with Type 1 diabetes and one non-English speaking patient were excluded. Eighty-seven patients were initially interviewed; however, two patients died, 23 were not reachable, 6 changed primary care providers, and 5 had non-working phone numbers. Fifty-one patients qualified for the intervention phase.

Our goals were to improve patient knowledge of the disease, increase self-control of disease management, increase adherence to a treatment plan by addressing patient-reported barriers to diabetic management, and improve HbA1C values. We implemented a multimodal intervention plan from June 2017 to May 2018, which was directed at a patient's self-reported barriers to diabetes control. Didactic education sessions were provided to Internal Medicine residents. These sessions included review of treatment options of diabetes, medication and dosing instructions, how to identify and treat symptoms of hypoglycemia, how to perform a diabetic foot examination, as well as information on how to schedule appointments for follow up, refill medications and diabetic supplies, refer to ophthalmology, podiatry, dietician/nutrition services, and information on how and when to contact social services.

Patients were monitored with regular telephone calls every 5 weeks to ensure access to physicians, medications, diabetic supplies, and to address any questions or concerns. Additionally, patients were encouraged to adhere with scheduled clinic visits where they were provided with diabetic education cards that included their health information (last HbA1c value, medications, date of last eye and foot examination) and tips on how to reduce HbA1c values as well as diet recommendations (Supplement 3). Annual referrals to ophthalmology and podiatry departments were made as needed. Social services addressed issues related to the cost of medication and diabetic supplies, insurance coverage, and need for transportation. The study was approved by the St. Luke's Hospital Institutional Review Board and Risk Management department of the clinic. Data analysis was done with SPSS Statistics. HbA1C values before and after intervention were expressed as mean with the variability of changes. Paired t-test was used to determine if the mean difference between pre – and post-intervention is zero.

#### 1.1.1. Results

A total of 51 patients with HbA1c >9.0% were included in the study for intervention and post-intervention analysis. The average age of the patients was 52 ± 8.9 years. Ninety-two percent of the patients were African-American with a female predominance of 53% (Table 1). A majority of patients were overweight to obese with average body mass index (BMI) of 33.3 ± 7.7 kg/m$^2$. The average pre-intervention HbA1c was 11.28 ± 1.73%, and the distribution of HbA1C among these patients is shown in Figure 1. During the pre-intervention phase, among patients surveyed/interviewed, 98% of patients were aware that they had DM, 82% knew what a HbA1c was, but only 31% knew their last HbA1c value; 86% of patients reported medication compliance (Table 2). For the treatment of DM, 64% of patients were treated with long-acting insulin (40.6% on insulin detemir and 22.9% on insulin glargine), and 67% of patients were on metformin. Major barriers to adherence to treatment included difficulty in following a diabetic diet (35%), inability to afford medications (33%), inadequate supply of medications

**Table 1.** Patient characteristics and relevant medical information.

| | |
|---|---|
| Age (average, in years) | 52 ± 8.9 |
| Body mass index (kg/m$^2$) | 33.3 ± 7.7 |
| Gender: | |
| Male | 24 (47%) |
| Female | 27 (53%) |
| Race/Ethnicity | |
| African-American | 47 (92%) |
| Caucasian | 1 (2%) |
| Others | 3 (6%) |
| Hypertension | 26 (51%) |
| Current smoker | 16 (31%) |
| On statin therapy | 44 (86%) |
| On aspirin therapy | 39 (76%) |
| Diabetic foot examination in past 12 months | 13 (25%) |
| Documented eye examination in past 12 months | 11 (22%) |
| Urine microalbumin checked in past 12 months | 40 (78%) |
| Medication used | |
| Metformin | 34 (66%) |
| Glipizide | 8 (11.7%) |
| Glimepiride | 5 (10%) |
| Glyburide | 3 (6%) |
| Lantus insulin | 12 (23%) |
| Levemir insulin | 21 (41%) |
| Humalog insulin | 7 (14%) |
| Novolog insulin | 4 (8%) |

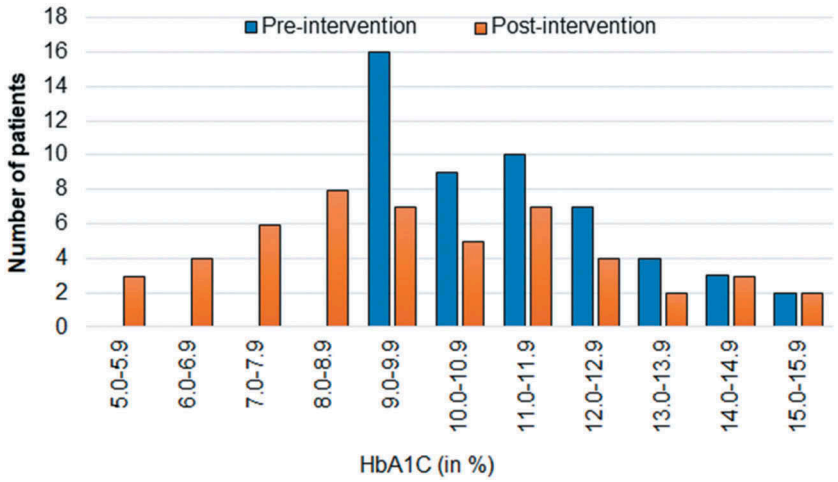


**Figure 1.** Distribution of HbA1C among patients before and after intervention.

**Table 2.** Patient's self-reported knowledge and compliance with physician-advised management of diabetes mellitus.

| Questions | Response (percent) |
|---|---|
| Aware of their diagnosis of diabetes | 50 (98%) |
| Knows about HbA1C | 42 (82%) |
| Remembers the value of last measured HbA1C | 15 (29%) |
| Received diabetic education after the diagnosis | 40 (78%) |
| Watchful of diet/knows about diabetic diet | 39 (76%) |
| Exercises to control diabetes | 33 (64%) |
| Checks blood sugar as advised by physician | 29 (56%) |
| Taking medication as prescribed | 42 (82%) |

(27%), and forgetting to take medication as prescribed (24%) (Figure 2).

Analysis of the HbA1c (pre- and post-intervention) showed that the average HbA1c was decreased by 1.41% (11.28% vs 9.87%, $p< 0.001$) (Figure 3). Among the patients included in the intervention group, approximately 8% had HbA1C reduced by ≥50% from their baseline, 23% had HbA1C reduced by ≥25% from their baseline, and 49% had HbA1C reduced by ≥10% from their baseline. However, approximately 10% of the patients did not have any change of HbA1c from their baseline, and 23% had their HbA1c increased from their baseline (Figure 4). The

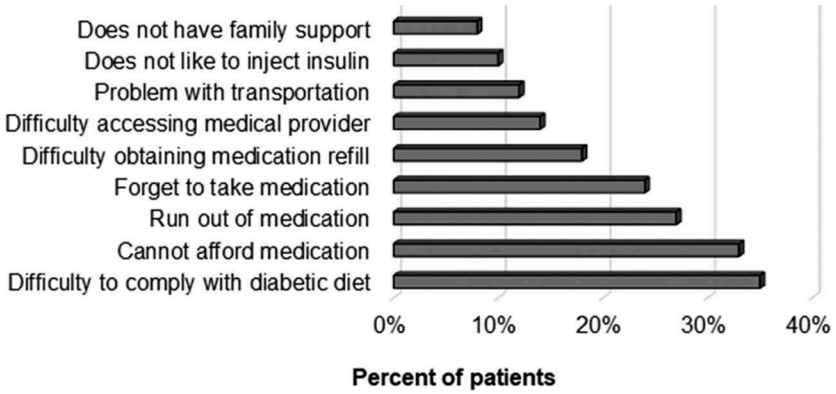


Figure 2. Patient reported barriers to optimum control of diabetes.

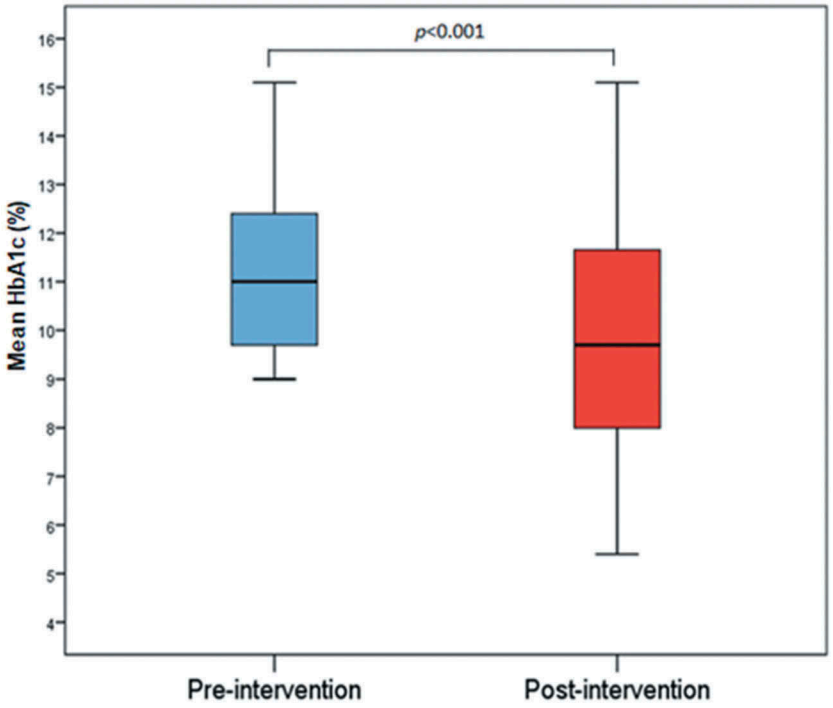


Figure 3. HbA1C before and after the intervention.

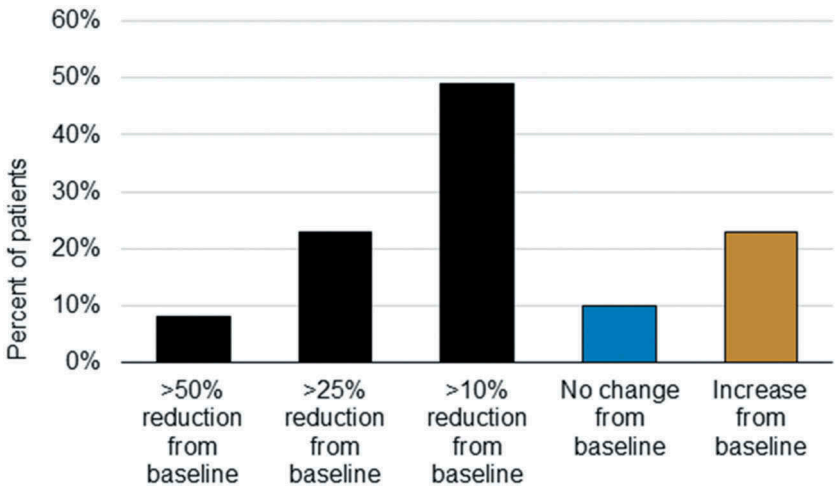


Figure 4. Changes of HbA1C from baseline (pre-intervention HbA1c) after the intervention.

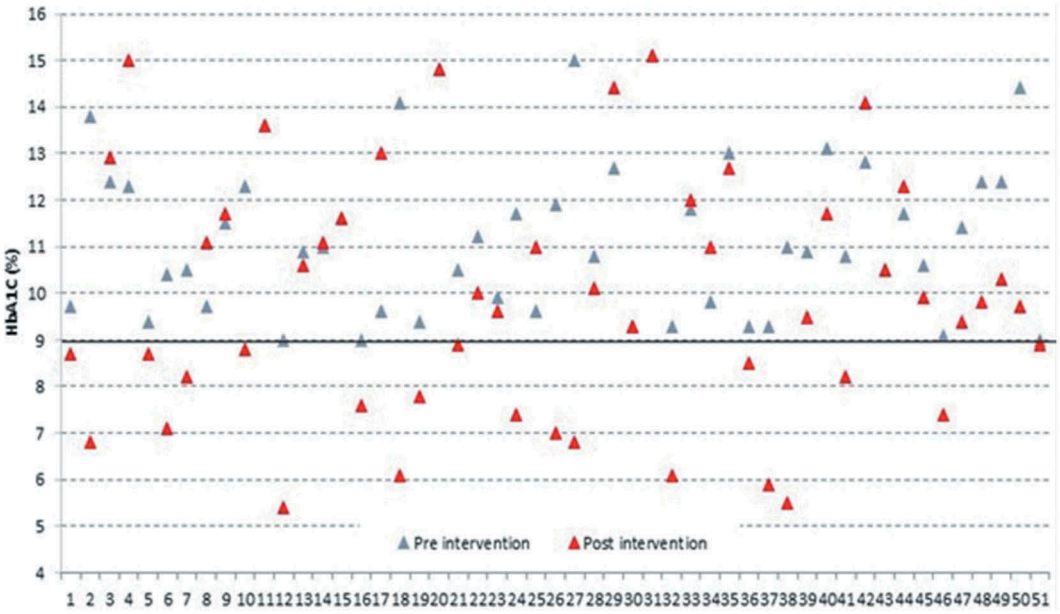


Figure 5. HbA1C value for each patient before and after intervention.

scatter plot shows HbA1C for each individual patient during their pre- and post-intervention phase (Figure 5).

*1.1.1.1. Discussion.* Diabetes management is a challenge for both patients and health-care providers. The disease itself can be difficult to understand, especially for patients with low health literacy, and can become overwhelming in the setting of limited resources. While the substantial effort was made by providers to improve HbA1c in this poorly controlled patient population, the results were mixed. Barriers to care included medication non-compliance, low health literacy, lack of resources, inadequate insurance coverage, and timely access to health-care providers. With the understanding of patient-specific barriers, we were able to offer more customized efforts to improve diabetic care. By offering regular follow-up visits and phone calls every 5 weeks, we were able to improve access to providers and ensure uninterrupted supplies of medications.

One of the frequently underestimated issues for our patients was low health literacy. We found that patients' knowledge about diabetes and its management was inconsistent. Although many patients were aware that they have diabetes, they did not fully understand the disease process including the cause and ramifications of inadequate glucose control, the meaning of HbA1c and why it was being checked, and their HbA1c target goals. We addressed these deficiencies by introducing diabetes education during clinic visits and phone conversations. When patients were provided with adequate diabetes education in a simplified way, diabetes control improved.

One limitation to our study is a small sample size. Selection of patients was limited due to accessibility via phone. Many of our patients used pre-paid phone services; as a result, follow-up calls were inconsistent. Additionally, in a resident-run clinic, the continuity of care between provider and patient is somewhat affected by resident availability. We tried to minimize the impact of this shortcoming by requiring residents to have follow-up telephone calls with their groups of patients every 5 weeks.

Our study shows that a strategically designed, patient-centered, customized intervention can contribute significant benefit to individualized diabetes control. We identified several barriers to care where more sustained attention is needed for the successful management of patients with diabetes.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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