Implementation of an Interprofessional Diabetes Management Clinic in the Rural Primary Care Setting

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Abstract
Background: Access to a primary care provider is not guaranteed for many living in rural settings. Notably, rural populations experience a higher degree of burden from chronic diseases compared to urban-dwellers. For example, diabetes can go undiagnosed and undertreated with lack of primary care. To address these care gaps at a large, rural family medicine practice in western North Carolina, a multidisciplinary pharmacist-led diabetes clinic was developed. *Objectives*: This article describes the implementation, evolution, and impact of the diabetes management clinic and explores future directions for improving the experience of patients and health care providers. *Practice Description and Innovation*: The diabetes management clinic at Mountain Area Health Education Center (MAHEC) is a pharmacy resident-led interdisciplinary clinic incorporating nutrition and pharmacy learners to provide patient care in both telehealth and in-office settings. Since its inception in 2018, the clinic has facilitated meaningful learning opportunities for students and residents and helped patients manage their diabetes in a multifaceted approach. *Evaluation Methods*: A retrospective, cross-sectional study evaluated diabetes-related outcomes for 80 patients seen in the diabetes management clinic during twelve months of appointments. The primary outcome measure was change in A1c from baseline. *Results*: Among patients with a follow-up A1c during the study (n=64), there was a mean reduction in A1c by 0.79% from baseline. Additionally, among those with a second follow-up A1c available (n=32), there was a mean reduction from baseline in A1c of 1.42%. *Conclusion*: The utilization of pharmacy residents as part of an interdisciplinary diabetes management clinic can extend access to care for underserved patients. The clinic also serves as a structured teaching clinic for interdisciplinary learners, and it has contributed to positive clinical outcomes, strong interprofessional collaboration, and expansion of experiential education opportunities since its inception in 2018.

Keywords: Diabetes management; Rural; Primary Care; Interprofessional

Background

Having timely access to medical care is something that some may take for granted; however, readily obtainable health care services are not a given for many Americans. When comparing urban-dwelling to rural-dwelling Americans, it is estimated that the number of primary care providers (PCPs) per 100,000 people for the former is 79.3 and for the latter is 55.1.[1] Specialists are even more difficult to come across in rural areas, with the difference in physicians per 100,000 increasing to 263 in urban environments versus only 30 in rural areas.[1] Transportation can be a significant barrier to receiving medical care, with one study reporting approximately one-third of respondents as having experienced transportation barriers within a one-year period; major concerns included cost of travel and lack of driver or car availability.[2] Such disparities are especially important when considering the unique impact of chronic disease on rural populations. One cross-sectional study comparing urban to rural populations determined that rural populations had prevalence rates of diabetes and coronary heart disease that were higher than their urban counterparts (8.6% and 38.8% higher, respectively).[3] A separate study found a positive correlation between patients' distances to PCPs and their disease burden and overall health care utilization in all settings.[4]

Differences in health care between urban and rural communities become more significant when considering how chronic disease states, such as diabetes, are managed. Estimates from 2022 indicate that over 37 million American adults (11.3% of the population) have diabetes but 23% of those with diabetes have not yet been diagnosed.[5] One study projected a 46% increase in the prevalence of diagnosed diabetes in the U.S. between the years 1987 and 2050,[6] indicating that diabetes is a growing public health issue. Studies have also shown a correlation between rural environments and increased risk of mortality from diabetes. In one analysis, the diabetes mortality rate per 100,000 inhabitants of a large central metro (cities of at least one million people) between 1999 and 2015 was 21.8 whereas the rate for those living in "noncore" areas (i.e. the most rural living classification) had a rate of 34.2 diabetes deaths per 100,000 people.[7] Additionally, when rurality increased (moving from large metro areas to medium metro areas, to "micropolitan" areas and finally to noncore areas), a clear trend emerged for increased diabetes mortality rate.[7]

Health care providers must think creatively in extending their reach to patients in rural settings. One method to address health disparities between those who can access a PCP's

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physical office and those who cannot is telemedicine. Telemedicine is defined by the World Health Organization as "the delivery of health care services, where distance is a critical factor…using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries."[8] The beginning of the COVID-19 pandemic in early 2020 quickly propelled telemedicine into the center of the health care sector. The nation's experience with the pandemic, and the years beyond, has demonstrated that telemedicine is suitable and sustainable for many aspects of primary care.

Even prior to the increase in telehealth's popularity, pharmacists were proven to be valuable members of the clinical care team. One study evaluating a pharmacist-led diabetes program in a primary care setting found that patients who interacted with clinical pharmacists through the program experienced an average reduction in A1c of 1.9% over an average of 6 months.[9] Incorporation of residents into clinic workflows was also shown to be successful, with one pharmacy resident-led transitions of care clinic demonstrating lower rates of 30-day readmissions and emergency department visits versus a comparator group.[10] Another assessment of a pharmacy student and resident-led discharge counseling initiative among heart failure patients prevented 34 medication errors or discrepancies among 86 patients and led to patients having a better understanding of their medications.[11] While multiple care models have shown positive impact, there is a lack of research supporting pharmacy resident-led clinics for diabetes management. Incorporating learners such as residents and students helps expand opportunities for patients to receive care and for learners to gain valuable experience managing this chronic disease in a diverse patient population.

Objectives

This paper primarily aims to describe a sustainable and impactful example of an interprofessional, pharmacy resident-led diabetes management service in a large, rural family medicine practice in order to serve as a guide for other practices that hope to establish similar resources. In addition to this implementation framework, an evaluation of the clinic service was conducted as a retrospective chart review to investigate improvement in diabetes-related outcomes.

Practice Description and Innovation

Mountain Area Health Education Center (MAHEC) is a large family medicine practice in Asheville, North Carolina, serving the sixteen westernmost counties of the state. MAHEC Family Medicine is a Patient-Centered Medical Home (PCMH) and is part of a regional Accountable Care Organization (ACO). Since 2001, clinical pharmacy services have been integrated into MAHEC's practice model as independent clinic visits and co-visits during PCP appointments. As part of the ACO, MAHEC strives to meet certain metrics related to health screenings and chronic disease state management, including diabetes. As MAHEC was investigating ways to improve attainment of the diabetes-specific ACO measure related to proportion of patients with A1c at goal in 2018, a formal pharmacist-led phone clinic was created. Up until that point, most telephone follow-up calls made by pharmacists were completed as administrative tasks outside of clinic schedules. At that same time, the pharmacy team was also looking for opportunities to incorporate the services of two post-graduate year 1 (PGY1) pharmacy residents and provide a more robust diabetes-focused learning experience. Beginning in August 2018, each PGY1 resident was given one half-day of "diabetes clinic time" where they could discuss cost barriers with patients, adjust medications, and review lifestyle recommendations over the phone. Longitudinal follow-up was also offered during each call to ensure that patients were meeting their goals. The team utilized ACO metric reports to generate lists of patients not meeting the A1c goal who needed enhanced follow-up and diabetes care.

Since its origins in fall 2018, the diabetes management clinic has undergone significant changes to meet patient needs, enhance the learning and practice management experiences of PGY1 residents, and ensure sustainability over time. Originally, the telehealth clinic was not organized into distinct appointment time slots like other pharmacotherapy clinic days at MAHEC. PGY1 residents utilized the half-days of clinic time to "cold call" patients identified from the metric reports. If a patient was contacted, the PGY1 resident would explain the purpose of the call to "pitch" the benefits of the telehealth program and assess their willingness to participate. While some patients were immediately interested in the service, others were more hesitant. One reason for this may have been a lack of PCP involvement toward the start of the program. This began to change in spring 2019 after an explanation of the clinic and its outcomes was presented at MAHEC's Annual Research Day. These clinical outcomes have been subsequently published.[12] With greater awareness of the clinic, physicians began referring more patients to the pharmacy team, who would then reach out to the patient. With their PCP's input, telehealth patients were more likely to be accepting of changes recommended by the PGY1 resident compared to when patients were "cold called." As it operates today, patients are primarily referred to the clinic by their PCP. The provider can give the patient a description of pharmacy services, so they know what to expect prior to their diabetes management clinic appointment.

A second area of evolution for the clinic includes scheduling and billing. Rather than PGY1 residents having a half-day to call patients in any order (and spend any amount of time), the clinic is now organized into distinct time slots that allow for a 40-minute appointment per patient. On most clinic half-days, one resident speaks with four to five patients throughout the afternoon. This incorporation of scheduled slots allows for better continuity of care as the residents can schedule follow-up with a patient on a specific date and time, and patients are

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able to plan for their visit. Patients can be scheduled as in-person or telehealth depending on transportation barriers or the need for in-house services like labs. Under a collaborative practice agreement, pharmacists can order labs as well as prescribe and change medications relating to patients' diabetes care. Billing has also evolved with the expansion of telehealth prompted by COVID-19. Pharmacists utilized new opportunities to bill insurance companies for services provided via phone or video chat platforms. This new billing structure contributed to sustainability of the telehealth clinic over time. The team has also been able to contribute to the attainment of diabetes-related ACO metric goals. Therefore, a secondary benefit of the clinic is to increase reimbursement rates for value-based care from insurers.

Finally, over the last two and a half years, the clinic has evolved to include larger involvement of an interdisciplinary team. Collaboration between pharmacists and physicians is a common occurrence at MAHEC, and since the beginning of the clinic, the pharmacy residents have shared diabetes medication decisions with clinic patients' providers. This relationship has grown stronger with time, and as of fall 2020, nutrition services were incorporated into the clinic workflow. The American Diabetes Association recognizes the importance of Medical Nutrition Therapy in diabetes management, and by integrating dietary recommendations into the clinic, the team can address blood glucose control in a multifactorial manner that is convenient for the patient. Typically, a nutritionist or nutrition intern joins the pharmacist's visit in a co-visit model, listening in for the pharmacotherapy portion of the visit. The pharmacy resident, upon wrapping up, stays with the patient to listen to the nutritionist's recommendations as well. This way, the visit also serves as an opportunity for interprofessional education. In addition to nutrition learners, the clinic also began to welcome fourth-year pharmacy students on rotation, making the prospect of interprofessional education even more pertinent.

Evaluation Methods

The clinic's impact on diabetes-related outcomes was evaluated through a retrospective, cross-sectional chart review that included patients seen in the clinic between January 1st, 2021 and December 31st, 2021. Patient information was gathered from the MAHEC electronic health record (EHR). Date of initial diabetes clinic visit, age, sex, race and/or ethnicity, type of diabetes, number of years with diabetes (Type 1 or Type 2 were both included), number of diabetic medications, insulin use, and statin use were collected from the EHR. The primary outcome measure was change in A1c from baseline. Secondary outcomes included change in BMI, weight, and blood pressure from baseline, as well as assessments on the type of interventions made and the mean number of diabetes clinic appointments. The study was reviewed by the local IRB and deemed exempt. Descriptive statistics were used to analyze the data. Additionally, a paired-samples t-test (α=0.05) was conducted to compare baseline A1c to follow-up A1c measurements.

Results

Eighty patient charts were reviewed and included in the final evaluation. Most patients were female (61.3%) and Caucasian (60.0%), with a mean age of 56 years at the time of chart review. At baseline, patients had been diagnosed with diabetes for a mean of 7.2 years. The mean number of diabetic medications per patient was 2.4, with 57.4% of patients being on insulin as a part of their management regimen. There was a mean baseline A1c of 8.9% in the total patient population, BMI of 36.6 kg/m^2, weight of 227.5 pounds, and blood pressure of 132/81 mmHg (Table 1). The mean number of encounters per patient was two visits during the study period, with many of the appointments occurring via telehealth (41%). Among patients with one follow-up A1c during the study (n=64), there was a significant reduction in A1c by 0.8% when comparing baseline (M=9.2, SD=2.1) and first follow-up (M=8.4, SD=1.8); 95%CI (-0.3,-1.3), p = 0.003. Additionally, among those with a second follow-up A1c available (n=32), another significant reduction in A1c by 1.4% was seen when comparing baseline (M=9.3,SD=2.0) with second follow-up A1c (M=7.9,SD=1.8); 95%CI (-.5,-2.3), p = 0.003 (Table 2).

In terms of key secondary endpoints observed, for those with follow-up weight, BMI, and blood pressures available (n=59), there was a mean reduction in weight by 5.3 pounds, a mean reduction in BMI by 0.9 kg/m^2, and a mean reduction in systolic and diastolic blood pressures by 4 and 1 mmHg, respectively (Table 3). During diabetes management clinic appointments, 95% of the patients received general education, 87.5% received a nutritional intervention, 42.5% had a medication dose adjusted, 47.5% had labs ordered or scheduled, 31.3% had their insulin titrated, and 40% had a new medication added to their regimen. Continuous glucose monitors (CGM) teaching and initiations were completed in 26.3% of patients and 16.3% of patients received an intervention regarding help with medication access or prescription assistance programs (Table 4). It is worth noting that these interventions were not mutually exclusive; one patient may have experienced both a medication change and an insulin titration during their follow-up period while another might have discussed only lifestyle interventions.

Discussion

The diabetes management clinic has experienced many successes that may serve as examples for others developing pharmacy resident-led clinics with rural patient populations. First, patient participation in the diabetes management clinic was associated with modest reductions in A1c, BMI, weight, and blood pressure outcomes. A1c reductions proved to be statistically significant, and while reductions may appear modest (-0.8% on average at first follow-up and –1.4% on average for those with a second follow-up measurement), small A1c changes may mean the difference between meeting or not

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meeting an A1c target for an individual patient. Those with two follow-up A1c measurements saw a larger decrease in mean A1c values. Because second follow-up A1c measurements generally occurred over one hundred days following initial follow-up A1c measurements, a possible explanation is that continued involvement in the diabetes management clinic over a longer period allowed for additional A1c improvements as patients continued to implement lifestyle changes with nutritionist and pharmacist support, adjust medications as directed, and participate in close follow-up.

The breadth of interventions demonstrates the value that pharmacy resident involvement can bring to diabetes management within the primary care setting, echoing earlier studies evaluating pharmacist-led diabetes care. One retrospective case-control study done within a rural primary care site compared patient outcomes for those treated in a pharmacist diabetes clinic along with standard care versus those treated by a non-pharmacist PCP alone and found that the pharmacist-managed patients were significantly more likely to experience an A1c reduction.13 Similar to our study, others have investigated the role of a pharmacist on an interdisciplinary diabetes care team; one care team comprised of a pharmacist, a dietitian, and a family medicine resident, among others, demonstrated significant A1c decreases in their patients over a 6-month period. From a baseline average of 10.25%, one-third of patients achieved an A1c of below 8%.14 Lastly, another retrospective cohort study investigating impact of clinical video telehealth (CVT) versus face-to-face (FTF) clinical pharmacy services on improvement in A1c for those with poorly controlled diabetes demonstrated that at 6 months, diabetes care provided via CVT was as effective as FTF. This study also quantified average travel distances (99.5 miles) and times (1.6 hours) averted per patient by utilizing telemedicine.15 While the current study was too small to attribute specific interventions to the benefits seen, the improvements across multiple clinical outcomes over time suggests a positive impact on patient care that supports the joining of pharmacy residents and nutritionists in collaborative care models. Additionally, no other literature to date has supported the innovative use of PGY1 pharmacy residents to provide care for patients with diabetes in the primary care setting.

Throughout their time leading Diabetes Management clinic, pharmacy residents have enjoyed opportunities to build relationships with patients. This model creates an innovative, longitudinal rotation where residents take full ownership of the patients who they see. The ease of being able to connect with patients virtually, over the phone, or in clinic allows a variety of different settings for pharmacy residents to meet the needs of individual patients. Through these relationships, the resident gets to know a patient's background and addresses barriers to care including lack of PCP appointment availability, medication access, and other social determinants of health. This allows them to thoroughly manage all aspects that may be contributing to a patient's uncontrolled diabetes. Residents may also easily schedule follow-up with the patient in the form of another diabetes clinic encounter or a PCP visit. The clinic model allows relationship-building over time, with patients receiving more frequent encounters than they would with standard care due to limited availability of primary care provider schedules. This close follow-up gives the team opportunities to assure patients have timely access to the care they need.

Utilizing pharmacy residents to lead the clinic half-day and including fourth-year pharmacy students and nutrition interns are other unique aspects of the clinic model. The incorporation of nutrition education empowers the patient to reach their goals via lifestyle interventions and gives pharmacy students and residents the chance to participate directly in interprofessional teaching and learning. Utilizing students in clinic also allows pharmacy residents to practice their precepting skills while still being fully supported within MAHEC's layered-learning model. Students work directly with PGY1 pharmacy resident preceptors to review the day's clinic patients, discuss potential interventions, and see patients independently or with preceptor support depending on the student's comfort level. Ambulatory care pharmacy rotations ideally give students ample experience caring for patients with diabetes, and incorporating them into the diabetes management clinic gives them valuable insight into CGM, complex insulin regimens, and social determinants of health that they may not otherwise see as frequently.

The diabetes management clinic has already positively impacted the lives of many patients; however, limitations in sample size and the nature of retrospective chart review makes generalizability for diabetes-related outcomes difficult. Missing follow-up data and a one-year study period also limits knowledge of the true impact of this innovative practice model. As patient needs continue to evolve and telehealth increases in popularity, the clinic will also need to change. One adjustment involves the creation of a streamlined referral process that could allow for a more organized booking process for patients and providers. The new schedule arrangement would also provide reliable appointment reminders to patients. Another solution for increasing access to clinical services would be to expand the number of half-days on which the clinic is offered. Welcoming more students could allow for more than five patients on each half-day of clinic; however, this may put more burden on the pharmacy resident preceptor. A third clinic aspect that may be further streamlined is turnover upon the end of the residency year. Currently, residents discuss the upcoming transition with their patient panel and provide a "warm hand-off" in the form of chart messages to the incoming resident for particularly complex patient cases, but a more systematic approach may be favorable. Finally, the pharmacy team also plans to create a "graduation" process by which

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patients will be referred back to their PCP after reaching their A1c goal (and other personal goals as applicable). By standardizing this process, new patients can use the clinic service as established patients graduate.

Conclusion

Improving access to care for patients with diabetes can be challenging, especially in rural areas. Even prior to its surge in popularity during the COVID-19 pandemic, telehealth had already proven itself an efficient and effective means of meeting the needs of patients with uncontrolled chronic disease – especially in rural populations. MAHEC saw the beginning of its diabetes management clinic in 2018, and since that time, it has demonstrated positive clinical outcomes, streamlined strong interprofessional collaboration, and fostered close patient-provider relationships. Additionally, this study builds upon previous literature showcasing the positive impact of pharmacists in diabetes management and other studies demonstrating successful resident-led patient care initiatives; no other published assessment has supported the use of PGY1 pharmacy residents to provide care for patients with diabetes in the primary care setting. The incorporation of pharmacy residents and students to lead clinic visits has provided teaching opportunities, encouraged interdisciplinary discussion among learners, and increased access to care for patients with diabetes via expanded appointment availability. As the landscape of health care continues to change, the MAHEC pharmacy team looks forward to opportunities to build upon the clinic's success and continue to positively impact patient health outcomes.

Disclaimer: The statements, opinions, and data contained in all publications are those of the authors.

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Table 1: Baseline characteristics of patients included in the chart review

Characteristic	Value (N = 80)
Age, mean yrs.	56
Sex, no. (%) Female Male	 49 (61.3) 31 (38.8)
Race/Ethnicity, no. (%) White African American Hispanic Other/Unidentified	 48 (60.0) 16 (20.0) 7 (8.8) 9 (11.3)
Years with diabetes, mean yrs.	7.2
Type 2 diabetes, no. (%)	77 (96.3)
Diabetic medications, mean no.	2.4
On insulin, no. (%)	31 (57.4)
On statin, no. (%)	36 (66.7)
Mean A1c (%)	8.9

Table 2: Primary endpoint results demonstrating decrease from baseline A1c in patients after one follow-up lab check and after two follow-up lab checks.

	Mean Baseline A1c (%)	Mean Follow-up A1c (%)	Difference (%)	Median (Min;Max) Days Between A1c Measurements
Patients with one follow-up A1c (n=64)[a]	9.2	8.4	-0.8[b]	118 (27;329)
Patients with two follow-up A1cs (n=32)[a]	9.3	7.9	-1.4[c]	229 (159;441)

[a]Of note, not all patients reviewed had a follow-up A1c available within the time frame of this study. Sixty-four patients had 1 follow-up A1c and 32 patients had a second follow-up A1c within the year.
[b]95% CI (-0.3,-1.3); p=0.003
[c]95% CI (-0.5,-2.3); p=0.003

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Table 3: Results of clinical secondary endpoints showing change from baseline in patients' weight, BMI, and systolic and diastolic blood pressures

Outcome	Baseline	Follow-up (n = 59)	Difference
Weight, lb.	227.5	222.2	-5.3
BMI, kg/m^2	36.6	35.7	-0.9
BP, mmHg	132/81	128/80	-4/1

Table 4: Types of interventions made within the diabetes management clinic visits and the frequency with which these interventions occurred

Intervention	Patients Who Received: n (%)
General education	76 (95)
Nutrition	70 (87.5)
Order/schedule labs	38 (47.5)
Changed medication dose	34 (42.5)
Added medication	32 (40.0)
Insulin titration	25 (31.3)
CGM	21 (26.3)
Changed medication type	14 (17.5)
Medication access	13 (16.3)
Med compliance	12 (15.0)