Pharmacist-Provided Diabetes Education and Management in a Diverse, Medically Underserved Population

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Diabetes prevalence continues to rise in the United States, affecting more than 30 million people (9.4% of the population) in 2015 (1). Diabetes is expensive in terms of both direct medical costs and indirect costs of disability, lost work productivity, and premature death. The estimated cost of diabetes in the United States was $245 billion in 2012 (2). Optimizing care by facilitating glycemic control, patient education, preventive health screenings, and adherence to the treatment regimen have been suggested as methods to decrease the cost of this disease (3).

There are inequalities in the disease burden of diabetes in the United States. The prevalence, incidence, and complications rates of diabetes are higher in non-Hispanic black, Hispanic, and American Indian/Alaska Native populations (4,5). Minority, low-income, and uninsured people have a higher risk for omissions of recommended diabetes prevention services (6). Furthermore, people who are non-English–speaking may experience barriers to effective diabetes medication management, including prohibitive costs of medications, hindered communication, knowledge deficits, and difficulties in understanding (7). The American Diabetes Association consistently identifies the promotion of health equity for populations disparately affected by diabetes as an advocacy priority (8).

Federally Qualified Health Centers (FQHCs) provide primary care, behavioral health services, dental care, and other health care services to medically underserved populations. These safety-net clinics work to reduce barriers to health and health care in low-income populations disproportionately affected by chronic disease by increasing access to health care providers and medications (9,10). In 2016, FQHCs provided care to more than 26 million patients, more than half of whom had an income below the federal poverty level. The Health Resources and Services Administration (HRSA) reported in its 2016 health center data report that 32.1% of the more than 2 million patients with diabetes receiving care at FQHCs had an A1C >9% or no A1C measurement that year (11).

Pharmacists have been successful in managing diabetes, including at community health centers, where studies have demonstrated improved outcomes (12–14). Project IMPACT: Diabetes, a multisite study in 25 communities disproportionately affected by diabetes, found improved clinical outcomes, including diabetes control, preventive care, and management of comorbidities, with interprofessional care that included a pharmacist (15). Additional documentation of outcomes, specifically in medically underserved patients with barriers to care, may catalyze the expansion of pharmacist integration in diabetes management and its reimbursement by payers.

At Heart of Ohio Family Health, in Columbus, OH, the clinical pharmacy team provides diabetes management services to patients referred by their primary care provider (PCP). The pharmacy team consists of two clinical pharmacists, one postgraduate year 1 pharmacy practice resident, fourth-year student pharmacists completing advanced pharmacy practice experiences, and third-year student pharmacists completing introductory pharmacy practice experiences from The Ohio State University College of Pharmacy. The team works to improve diabetes outcomes for each patient by holding face-to-face visits, providing patient education, managing medications, addressing medication access concerns, ensuring appropriate monitoring, and providing follow-up in collaboration with each

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patient's PCP. The patient population served by the clinics is predominantly black/African American (63%), low-income (61% are below the federal poverty level), and best served in a language other than English (34%) (16). The objective of this study was to evaluate the impact of pharmacist-led, face-to-face clinic visits on A1C in patients seen at a network of two FQHCs.

Design and Methods

This study was a retrospective, descriptive study that examined change in A1C in patients with diabetes managed by the pharmacy team. The Office of Responsible Research Practices designated this study exempt from review by the institutional review board at The Ohio State University.

Population

A report from the electronic health record (EHR) system identified patients seen by the pharmacy team between 1 July 2013 and 30 June 2017 for diabetes education and management. Adult patients were included if they had a diagnosis of diabetes, at least one visit with the pharmacy team for diabetes during the study period, at least one A1C value in the time frame from 6 months before to 6 weeks after the first diabetes visit with the pharmacy team, and at least one follow-up A1C value no more than 6 months after their most recent visit with the pharmacy team. Exclusion criteria were no follow-up A1C after their visit with the pharmacist, no diabetes education or management documented in the EHR by the pharmacy team, or age <18 years.

Outcomes

The primary outcome was change in A1C among patients seen by the pharmacy team for diabetes management. Secondary outcomes included the percentage of patients reaching an A1C <9% (a metric required by the Healthcare Effectiveness Data and Information Set and Uniform Data System), the difference in A1C lowering among English-speaking compared with non-English–speaking patients, and the difference in A1C lowering among insured versus uninsured patients. A1C was chosen as the primary end point because it is a generally reliable clinical marker indicative of glycemic control (17). Other data collected included the number of diabetes medications (antihyperglycemic agents) taken at the first and last visits, age, sex, race/ethnicity, language spoken, insurance status, number of visits with the pharmacy team, and whether each patient was seen by an endocrinologist.

TABLE 1 Demographic Information

Age (years)	54.5 (11.7)
Sex	
Male	193 (39.9)
Female	291 (60.1)
Language	
English	305 (63.0)
Spanish	81 (10.5)
Nepali	41 (8.5)
Somali	20 (4.1)
Tigrinya	8 (1.7)
Amharic	7 (1.4)
Other	22 (4.5)
Insurance	
Medicaid	219 (45.2)
Private	106 (21.9)
Uninsured	85 (17.6)
Medicare	74 (15.3)
Diagnosis	
Type 2 diabetes	478 (98.8)
Type 1 diabetes	5 (1.0)
Uncertain	1 (0.2)
Race/ethnicity	
Black	244 (50.4)
White	90 (18.6)
Hispanic	83 (17.1)
Asian	53 (11.0)
Other	14 (2.9)
Had seen an endocrinologist	
No	438 (90.5)
Yes	46 (9.5)
Number of visits with a pharmacist	
1	129 (26.7)
2-3	168 (34.7)
≥4	187 (38.7)
Number of diabetes medications before first visit	1.7 ± 1.0
Number of diabetes medications after last visit	1.9 ± 1.1

Values are *n* (%) or mean ± SD.

Statistical Analysis

A1C values before and after pharmacy intervention were analyzed using a paired Student *t* test. Potential associations between the change in A1C with pharmacist intervention and other clinical and socioeconomic factors (e.g., patients' language and insurance status) were analyzed using a one-way ANOVA for normally distributed data or a Kruskal-Wallis rank test for data that were not normally distributed. Associations between the incidence of an A1C <9% and other factors were analyzed using logistic regression. The incidence of patients reaching an A1C <9% before and after pharmacy intervention was analyzed using a Fisher exact test. All statistical tests were two-sided, and significance was set at $P < 0.05$. SAS v 9.4 statistical software (SAS Institute, Cary, NC) was used for the analyses, all of which were performed with assistance from a biostatistician.

TABLE 2 Change in A1C for Different Language, Insurance, and Initial A1C Categories

	n	Initial A1C, %	Post-Intervention A1C, %	Change in A1C, %	*P**
All included patients	484	9.0 ± 2.3	8.1 ± 1.9	−0.95 ± 2.23	<0.001
Preferred language					
English	305	9.0 ± 2.49	8.0 ± 1.9	−0.96 ± 2.24	<0.001
All non-English	179	9.1 ± 2.1	8.2 ± 1.8	−0.94 ± 2.24	<0.001
Spanish	81	8.8 ± 2.1	8.2 ± 2.0	−0.62 ± 1.96	0.006
Nepali	41	9.2 ± 2.2	8.1 ± 1.9	−1.14 ± 2.23	0.002
Somali	20	8.7 ± 1.9	8.1 ± 1.5	−0.60 ± 2.00	0.20
Tigrinya	8	10.9 ± 2.1	8.3 ± 1.4	−2.53 ± 3.03	0.050
Amharic	7	10.1 ± 2.5	9.2 ± 2.2	−0.86 ± 2.10	0.32
Other	22	9.2 ± 2.3	7.7 ± 1.5	−1.49 ± 2.91	0.026
Insurance status					
All insured	399	8.9 ± 2.2	8.0 ± 1.8	−0.91 ± 2.14	<0.001
Medicaid	219	9.0 ± 2.3	8.0 ± 1.9	−0.98 ± 2.26	<0.001
Private	106	8.9 ± 2.1	7.9 ± 1.7	−0.97 ± 2.23	<0.001
Medicare	74	8.6 ± 2.1	8.0 ± 1.8	−0.58 ± 1.57	0.002
Uninsured	85	9.5 ± 2.5	8.3 ± 1.9	−1.16 ± 2.64	<0.001
Initial A1C value					
>12%	61	13.5 ± 1.2	9.0 ± 2.3	−4.52 ± 2.67	<0.001
9–12%	148	10.2 ± 0.9	8.9 ± 1.9	−1.27 ± 1.84	<0.001
<9%	275	7.4 ± 0.9	7.4 ± 1.4	0.013 ± 1.27	0.86

A1C data are mean ± SD. *Two-sided paired Student *t* tests with significance level of P <0.05.

Results

The EHR report yielded 886 patients to be screened for inclusion. Of those, 484 were included for data analysis; 98 were excluded for having no face-to-face visit with a pharmacist, 15 for having only a prediabetes visit with a pharmacist, 19 for having no initial A1C, and 270 for having no follow-up A1C. Demographics and baseline data for the patients who were included are shown in Table 1.

Overall, patients' A1C values decreased significantly after pharmacist appointments (mean change −0.95%, P <0.001). There was no difference in A1C lowering when comparing preferred language (English vs. non-English–speaking, P = 0.92) or insurance status (insured vs. uninsured, P = 0.83). A1C reduction was significant for all non-English speakers overall, but when looked at for individual language groups, it was only significant in those who identified their preferred language as Nepali, Spanish, or other. Statistically significant A1C lowering was seen among patients in all insurance categories.

The number of visits with the pharmacy team was not associated with A1C control (P = 0.70). The incidence of an A1C <9% increased after meeting with the pharmacist from 57.2 to 71.9% of the study population (P <0.001). Mean A1C was significantly lower after visiting with a pharmacist in those who had an initial A1C >12% (mean change −4.52%, P <0.001) and in those with an initial A1C between 9 and 12% (mean change −1.27%, P <0.001,); however, A1C reduction was not significant for those with an initial A1C <9% (P = 0.86). Additional data on change in A1C are summarized in Table 2. Table 3 presents the number of patients with an A1C <9% in each category.

Discussion

Overall, patients seen by the pharmacy team for diabetes management experienced a reduction in their A1C levels. Additionally, on a population level, the percentage of patients with an A1C <9% significantly increased. These results provide further evidence that pharmacist interventions are effective at improving glycemic control in adults with diabetes. No difference was found in the degree of improvement in glycemic control based on whether patients spoke English or on their insurance status. No clear relationship was identified between the number of medications or the number of visits with a pharmacist and reduction in A1C; further studies exploring such potential relationships may be helpful in determining efficiencies in a pharmacist diabetes service.

The results of this study add to existing literature that pharmacist diabetes services are capable of significantly lowering A1C levels of patients who receive care in FQHCs. At an FQHC in Texas, medically underserved patients with uncontrolled diabetes managed by a pharmacist had a

TABLE 3 Patients With an A1C <9% Before and After the Intervention, by Category

	Initial A1C, %	Post-Intervention A1C, %	*P**
All included patients	275 (56.8)	348 (71.9)	<0.001
Preferred language			
English	173 (57)	221 (72)	<0.001
All non-English	104 (58)	127 (71)	0.015
Spanish	50 (62)	54 (67)	0.62
Nepali	24 (59)	31 (76)	0.16
Somali	13 (65)	16 (80)	0.48
Tigrinya	1 (13)	5 (63)	0.12
Amharic	3 (43)	3 (43)	1
Other	13 (59)	18 (82)	0.19
Insurance status			
All insured	231 (58)	291 (73)	<0.001
Medicaid	125 (57)	162 (74)	<0.001
Private	59 (56)	77 (73)	0.015
Medicare	47 (64)	52 (70)	0.48
Uninsured	46 (54)	57 (67)	0.12
Initial A1C			
>12%	0 (0)	31 (51)	<0.001
9–12%	0 (0)	80 (54)	<0.0001
<9%	275 (100)	237 (86)	<0.001

A1C data are *n* (%). *χ^2 and Fisher exact tests, where appropriate, with significance level of *P* <0.05.

greater decrease in A1C and a decrease in diabetes-related hospital visits compared with individuals who received usual care (18). A multisite, pilot, prospective, descriptive study in Ohio demonstrated how pharmacists in FQHCs improved diabetes and hypertension control through medication therapy management (19). A recently published study also identified similar improvement in diabetes control when comparting outcomes in Hispanic and Spanish-speaking patients compared with non-Hispanic and English-speaking patients who received clinical pharmacy services (20). Although these studies were also conducted in FQHCs, our study was unique in that it also examined how change in A1C differed based on language spoken and insurance status. Our data demonstrate that pharmacists improve equitable diabetes care for underserved populations for whom known disparities in health and health care exist.

FQHCs annually report clinical quality measures to HRSA to provide data on how they are improving the quality of care provided and closing the gap on a variety of health outcomes. One such outcome used to evaluate FQHCs is the percentage of patients 18–75 years of age with diabetes who had an A1C >9% in the measurement period (21). Rodis et al. (19) showed that pharmacist interventions increased the number of patients with an A1C <9%. Overall, our study also demonstrated pharmacists' ability to increase the number of patients with an A1C <9%. However, 38 patients whose initial A1C was <9% (14%) experienced an increase in their A1C to >9% after meeting with a pharmacist. Additionally, among uninsured patients, there was not a significant increase of the number of patients with an A1C <9%. Both of these findings may be the result of patients encountering barriers to medication and health care, making achieving this level of glycemic control more challenging. Defined models of incorporating pharmacists into the practice environment of FQHCs are available; however, barriers to further integration of pharmacists into FQHCs may include minimal reimbursement options, physical space limitations, and the concerns of other health care providers (21–23).

Limitations

This study was a retrospective chart review; therefore, only trends can be identified. Additionally, this study examined the work of only one pharmacy team, which limited the sample size and possibly the generalizability of the study. Applying this model and study type to other pharmacist diabetes management programs could provide more data to support the relationships found in this study. This study also predominately included patients with type 2 diabetes; additional studies looking at populations with type 1 or gestational diabetes would better define the impact of pharmacist clinical services in those populations. Finally, comparing patients seen by clinical pharmacy teams to a matched group receiving usual care would provide more powerful study results; however, this type of data would have likely introduced compliance bias in our study population given that referral to the clinical pharmacy team is a consistent part of usual diabetes care in these two clinics.

Conclusion

Pharmacists can be used in an expanded role to treat diverse groups of patients with diabetes. Pharmacy services should also consider targeting patients with higher A1C values (i.e., >9%), which may maximize pharmacist influence on diabetes control. The results of this study add to existing literature providing evidence that pharmacists can provide effective treatment of diabetes, even in populations that may experience barriers to achieving improved health outcomes.

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DUALITY OF INTEREST

No potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

K.W.N. oversaw the study design and wrote the manuscript. A.S.F. contributed to discussion, aided in planning the study design, and reviewed/edited the manuscript. G.M.L. developed the study design, collected the data, and reviewed/edited the manuscript. K.W.N. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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