Impact of Ambulatory Care Pharmacist-Led Management on Hemoglobin A1c Values among Patients with Uncontrolled Diabetes in a Primary Care Clinic vs Usual Care over Two Years

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ABSTRACT

Background: *Literature has shown the positive impact of ambulatory care pharmacists on diabetes management, yet additional research on clinical outcomes compared to traditional care models is warranted.*

Objective: *The objective of this study is to evaluate the impact of an ambulatory care pharmacist on glycemic control over two years compared to patients who received usual care.*

Methods: *This retrospective cohort study matched patients with a baseline hemoglobin A1c (HgbA1c) ≥8% managed by the ambulatory care pharmacist to patients who received usual care. The primary outcome was the mean change in HgbA1c over two years. The secondary outcomes were to evaluate the difference in (1) the proportion of patients achieving HgbA1c <8%, (2) the proportion of patients achieving blood pressure <130/80 mmHg, (3) mean LDL, (4) the proportion of patients prescribed SGLT2 inhibitors, GLP-1RA, and sulfonylureas, and (5) severe hypoglycemia after two years.*

Results: *Data for 180 patients was analyzed over two years. The mean HgbA1c was 10% at baseline vs 8.2% after two years (adjusted mean change -1.92) among pharmacist-managed patients, compared to 9.9% vs 9% respectively for usual care patients (adjusted mean change -0.98) (p=0.004). Among pharmacist-managed patients, 53.5% achieved HgbA1c <8% compared with 34.2% of usual care patients (p=0.014). There were no statistically significant differences in proportion of patients at goal blood pressure, mean LDL, or hypoglycemia between the two groups. After two years, 18.3% of pharmacist-managed and 5.8% of usual care patients were on an SGLT2 inhibitor (p=0.008), and 46.7% of pharmacist-managed and 9.2% of usual care patients were on a GLP-1RA (p<0.001). No difference was found in sulfonylurea utilization.*

Conclusion: *Patients with HgbA1c >8% managed by an ambulatory care pharmacist had twice the HgbA1c reduction and significantly more utilization of GLP-1RA and SGLT2 inhibitors as compared to controls provided usual care.*

Keywords: diabetes, ambulatory care, pharmacist, pharmacy, interprofessional

BACKGROUND

Type 2 diabetes is a major public health crisis with an estimated 462 million people currently diagnosed worldwide.[1] Uncontrolled diabetes is associated with microvascular and macrovascular complications that are responsible for approximately 5 million deaths per year.[2] Within the United States, there is a shortage of primary care physicians and endocrinologists who can manage patients with diabetes.[3] Patients with diabetes require concerted efforts with the interprofessional team for optimal management, especially for patients who have multiple comorbidities. Suboptimal control of blood glucose has been associated with poor medication adherence, complex regimens, side effects, poor communication, and financial burdens.[4] Achieving a hemoglobin A1c (HgbA1c) less than 7% has been shown to reduce microvascular complications. The Diabetes Control and Complications Trial (DCCT) and UK Prospective Diabetes Study (UKPDS) illustrated a curvilinear relationship between HgbA1c and microvascular complications whereby lower HgbA1c was associated with fewer complications.[5] The UKPDS-35 study has shown that a 1% reduction in HgbA1c is associated with a 37% reduction in microvascular complications and a 14% reduction in the rate of myocardial infarctions. Specific patient factors and comorbidities are used to determine an individualized HgbA1c target, however, many health plan metrics target an HgbA1c less than 8% since patients with multiple comorbidities and factors for hypoglycemia may have this threshold set as their goal.

Pharmacists can provide chronic disease state and diabetes management through collaborative practice agreements (CPA) in primary care settings. It has been shown that patients typically have more frequent follow-up when managed by a clinical pharmacist.[4] Literature has demonstrated the positive impact of their care on clinical outcomes including HgbA1c. A meta-analysis by Pousinho and colleagues reviewed 26 randomized controlled trials with 5,761 patients from different healthcare facilities managed by a pharmacist in comparison with usual care that evaluated changes in HgbA1c. Twenty-four studies reported a greater reduction in HgbA1c in the

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pharmacist-managed group compared with the usual care group ranging from -0.18% to -2.1%.[7] In comparison, a meta-analysis by Fazel and colleagues analyzed 35 comparative studies involving 7,417 patients and found a mean HgbA1c difference of 1.1% among patients who had their diabetes managed by a pharmacist compared to patients managed by usual care.[8] In both meta-analyses, most included studies had a follow-up duration of 3 to 12 months.[7,8] Most patients were also typically seen by the pharmacist only or exclusively in shared co-visits with the pharmacist and a provider.[7,8] An umbrella review of 7 meta-analyses involving over 300,000 patients was conducted by Abdulrhim and colleagues where 6 out of the 7 meta-analyses reported a reduction in HgbA1c values in patients who received pharmacist intervention.[9] A retrospective matched-cohort analysis by Narain and colleagues of 379 patients found that having at least one visit with a clinical pharmacist was associated with a significant reduction in HgbA1c of 0.4% compared to usual care.[10] Overall, multiple studies have provided evidence that pharmacists have a positive impact on effectively lowering HgbA1c levels in patients with diabetes compared with usual care. However, previous literature is limited in its evaluation of the impact of a pharmacist managing patients in a mixed model with face-to-face and telehealth visits with the ambulatory pharmacy team as well as shared interprofessional co-visits over an extended two-year time period.

This study evaluated the difference in outcomes between pharmacist-managed patients as compared to patients managed in a clinic without a pharmacist or interprofessional involvement (usual care group). The pharmacist-managed group patients were seen in an adult internal medicine clinic that is an outpatient training site for the internal medicine residency program. The majority of patients seen with diabetes in the clinic have government-funded insurance. An ambulatory care pharmacist joined the internal medicine clinic in August 2017, at which time an interprofessional approach to the management of diabetes was implemented. The ambulatory care pharmacist serves as a faculty member in the internal medicine residency program and as a co-preceptor for the medical residents. In addition to providing disease state management, the pharmacist also delivers one 2.5 hour annual diabetes education didactic session to all clinic trainees including guideline review and pharmacotherapeutic considerations. Patients are identified for diabetes management by the pharmacist per provider referral and by pharmacist review of electronic medical record (EMR) reports that identify patients with uncontrolled diabetes (HgbA1c >8%). The pharmacy team, which is comprised of the ambulatory care pharmacist and pharmacy trainees (student pharmacists and/or pharmacy residents under pharmacist supervision), participates in interprofessional shared co-visits, one-on-one face-to-face pharmacy visits, and one-on-one pharmacy telehealth visits. Interprofessional collaborative co-visits typically include a pharmacy team member, medical resident, and faculty attending physician seeing the patient together at the same time; in these visits, the pharmacist or pharmacy trainee leads the chronic disease state management discussion, assessment, and plan with the patient and interprofessional team. After the patient is seen in a collaborative co-visit, pharmacy team recommendations for optimizing diabetes management are discussed with the team and implemented. In each of the visit types, the pharmacist can initiate, modify, or discontinue medications per an approved CPA. The CPA allows for pharmacist-management of diabetes and other chronic conditions and encounters are billed according to type of visit and time spent. Telephonic visits are used to assess adherence to the treatment plan, medication access, and to allow for pharmacotherapeutic adjustments necessary to achieve treatment goals. All patients are seen in a combination of each of these visit types, with specific scheduling of each visit type based on factors such as the purpose of the encounter, expected duration of visit, transportation access, and/or anticipated complexity of the encounter. The frequency of the face-to-face collaborative interprofessional co-visits vary between every one to three months, while frequency of pharmacy only face-to-face or telehealth visits vary between every one to four weeks depending on individual patient assessment. The duration of telehealth visits is typically 10 to 30 minutes, while face-to-face visits are typically 30 to 60 minutes. Pharmacotherapeutic changes follow the American Diabetes Association Standards of Medical Care in Diabetes guideline recommendations and are based on the pharmacist's clinical judgment.[5] During each encounter, the pharmacy team counsels the patient about dietary and lifestyle goals and modifications.[11]

A previous study in this clinic evaluated 116 patients two years prior to and two years after the ambulatory care pharmacist was embedded in the clinic.[11] The mean HgbA1c at baseline pre-pharmacist intervention was 8.8% compared to a mean HgbA1c of 7.8% two years post-intervention ($p<0.001$).[11] Additionally, in patients who were more uncontrolled at baseline with an HgbA1c ≥ 8%, there was a significant change in the mean HgbA1c from 9.8% pre-intervention to 8.7% post-intervention ($p<0.001$). However, one of the major limitations of this previous study was that patients served as their own control group. The current study overcomes this limitation by including a matched comparator usual care group. Usual care typically involves a primary care physician who manages the patient's chronic disease states. In this study, the usual care group consists of patients managed in a primary clinic that is comparable to the clinic where the pharmacist practices in that it is also an outpatient training site for 30 medical residents. The clinic does not have interprofessional involvement with a pharmacist and while didactic education on chronic disease states is given to the medical trainees by their medical faculty, no didactic educational sessions are provided by a pharmacist.

The objective of this study is to evaluate the impact of an ambulatory care pharmacist on HgbA1c values, goal blood pressure achievement, LDL cholesterol, utilization of GLP-1RA

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and SGLT2 inhibitors, and severe hypoglycemia among patients with uncontrolled diabetes in a primary care clinic over a two-year period as compared to patients managed via usual care.

METHODS

This was a retrospective matched cohort study. Patients in the pharmacist-managed group were propensity-score matched to patients who received usual care in a 1:2 ratio. A report from the EMR identified patients with HgbA1c ≥8% and had at least one encounter with their provider (pharmacist or physician) within the specified time period. Automated EMR data query was used for data collection (no manual collection).

The primary outcome was the mean change in HgbA1c between the two groups over two years. The secondary outcomes were to evaluate the difference in (1) the proportion of patients achieving HgbA1c <8%, (2) the proportion of patients achieving blood pressure <130/80 mmHg, (3) mean LDL, (4) the proportion of patients prescribed sodium-glucose cotransporter 2 inhibitors (SGLT2 inhibitors), glucagon-like peptide 1 receptor agonists (GLP-1RA), and sulfonylureas, and (5) the occurrence of serious hypoglycemic events between the two groups after two years. Serious hypoglycemic events were defined as any hypoglycemic episode warranting an acute care admission within the healthcare system. For the primary outcome, the mean change in HgbA1c was calculated by comparing the baseline HgbA1c (last HgbA1c on record between August 1, 2016 through July 31, 2017) to the last HgbA1c on record during the pharmacist intervention period (August 1, 2017 to October 31, 2019). For the secondary outcomes including evaluation of mean LDL after two years and proportion of patients achieving goal blood pressure, patients included reflect those who had at least one of each respective value in both time periods.

Inclusion criteria consisted of adult patients 18 years and older who were diagnosed with type 2 diabetes, who had a baseline HgbA1c value ≥8%. Patients must have had at least one encounter with the pharmacy team (pharmacist-managed group) or their physician (usual care group) between August 1, 2017 through October 31, 2019. Patients must have had baseline data available on age, sex, HgbA1c, body mass index (BMI), and insulin use to be included as these parameters were used for propensity score matching. Pregnant patients or patients with gestational diabetes were excluded. This study was reviewed by the Institutional Review Board and deemed to be exempt.

Statistical Analysis

Patients meeting inclusion criteria in the pharmacist-managed group were matched to patients meeting criteria in the usual care group according to a 1:2 ratio. Matching was done using the estimated propensity score modeled on age, sex, baseline HgbA1c, BMI, and insulin use. Baseline characteristics of the two groups were reported as frequencies and percentages for categorical variables and means and standard deviations for continuous variables. Study groups were compared using Chi-squared tests (or Fisher's exact test, where sparse cells existed) for categorical variables, and either t-tests or Wilcoxon tests for continuous variables depending on whether data were normally distributed. The primary outcome was analyzed using an analysis of variance model adjusting for baseline age, gender, race, BMI, HgbA1c, and insulin usage status. Secondary outcomes were analyzed using Chi-squared tests (or Fisher's exact as needed). A sample size of 183 (61 cases + 122 controls) was estimated to achieve power of 86% to detect an absolute mean group difference in change in HgbA1c of 1%, assuming a 2-sided test and a significance level (alpha) of 0.05. All tests with p value <0.05 indicate statistical significance. All statistical analyses were performed with SAS v9.4 (SAS Institute, Inc., Cary, NC).

RESULTS

Baseline Patient Characteristics

Table 1 shows the baseline patient characteristics. A total of 180 patients were included in this study, 60 of which were patients in the pharmacist-managed group matched to 120 patients in the usual care group (61 pharmacist-managed patients were initially available however 1 was excluded due to missing baseline BMI needed for matching). The mean age was approximately 53 years old in both groups, with about 53% of both groups being male. Forty-five percent of pharmacist-managed patients and 30% of usual care patients self-identified as African American, while 53.3% and 65.8% of patients self-identified as white, respectively. Approximately 61% of patients in both groups were on insulin therapy at baseline. The mean baseline HgbA1c was approximately 10% in both groups. Mean baseline LDL was 83.8 mg/dL in the pharmacist-managed group as compared to 101.1 mg/dL in the usual care group. Mean systolic and diastolic blood pressure at baseline was 136.3 mmHg and 79.9 mmHg in the pharmacist-managed group as compared to 134.7 mmHg and 77.5 mmHg in the usual care group, respectively.

Primary Outcome Results

Table 2 shows the change in HgbA1c from baseline to two years in the pharmacist-managed group as compared to the usual care group. Among the pharmacist-managed group, mean baseline HgbA1c was 10%, which improved to a mean of 8.2% after two years (unadjusted mean change of -1.81). Among the usual care group, mean HgbA1c was 9.9%, which improved to a mean of 9% after two years (unadjusted mean change of -0.93). After adjusting for age, sex, race, BMI, baseline HgbA1c, and baseline insulin status (i.e. whether or not the patient was managed on insulin at baseline), the mean change in the pharmacist-managed group was -1.92 as compared to -0.98 in the usual care group (p=0.004).

Secondary Outcome Results

Hemoglobin A1c of less than 8% was achieved in 53.3% of patients in the pharmacist-managed group as compared to 34.2% in the usual care group (p=0.014) (Table 2). Table 3

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shows the secondary outcome results including the proportion of patients achieving systolic blood pressure (SBP) <130 mmHg and diastolic blood pressure (DBP) <80 mmHg and mean LDL cholesterol levels in the pharmacist-managed group as compared with usual care over two years. SBP of <130 mmHg was achieved in 53.3% of patients in the pharmacist-managed group as compared to 46.2% in the usual care group (p=0.369). DBP of <80 mmHg was achieved in 21.7% of patients in the pharmacist-managed group as compared to 21.8% in the usual care group (p=0.978). There was no statistically significant difference in the mean LDL after two years between the groups (p=0.145).

Table 4 shows the evaluation of the use of SGLT2 inhibitors, GLP-1RA, and sulfonylureas as well as the occurrence of serious hypoglycemia requiring acute care utilization in both groups. In both the pharmacist-managed and usual care groups, GLP-1RA medication use was 3.3% at baseline which increased to 46.7% after two years in the pharmacist-managed group and 9.2% in the usual care group (p<0.001). In both the pharmacist-managed and usual care groups, SGLT2 inhibitor medication use was 5% at baseline which increased to 18.3% after two years in the pharmacist-managed group and 5.8% in the usual care group (p=0.008). There was no statistically significant difference in the use of sulfonylureas after two years. There was no statistically significant difference in the occurrence of serious hypoglycemia requiring acute care admission between the two groups.

DISCUSSION

In this study, we found that HgbA1c reduction in the clinic with an embedded ambulatory pharmacist was nearly twice that of the usual care group, with a mean HgbA1c reduction of approximately 2%. A similar retrospective matched cohort study conducted in a primary care clinic found a mean reduction in HgbA1c of 2.1% in the pharmacist-led group and 0.5% in the usual care group (p<0.001). However, that study was only over a six-month time period and the patients in the pharmacist intervention group had a higher baseline HgbA1c than those in the usual care group (10.1% vs. 9.3%, respectively).[12] Another retrospective cohort study at a federal health center also found that the HgbA1c in patients managed by a clinical pharmacist decreased by twice as much as patients managed by usual care (1.6% vs. 0.9% respectively), but patients in that study were more uncontrolled at baseline than patients in our study (mean HgbA1c 10.9% in pharmacist group and 10.6% in usual care group) and results were also only collected over a six month period.[13]

The previous pre-post study conducted at our clinic found a mean reduction in HgbA1c of 1% for patients managed by the ambulatory care pharmacist.[11] In contrast, the current study found a mean reduction in HgbA1c of 1.92% for patients managed by the ambulatory care pharmacist. The difference in the reduction of HgbA1c could be due to the inclusion criteria of the current study including patients who had a baseline HgbA1c ≥ 8%, while the previous study included patients with a baseline HgbA1c ≥ 7%. This suggests that the pharmacist may have a more significant impact on glycemic control when patients have higher HgbA1c at baseline.

The current study also found that more patients managed by the ambulatory care pharmacist were able to achieve a HgbA1c ≤ 8% compared to patients managed by usual care. A previous retrospective, propensity scored cohort study found that patients with pharmacist-managed care were more likely to reach their goal HgbA1c ≤ 8% than patients managed by usual care. While these results were significant, there was overall a lower percentage of patients who reached HgbA1c ≤ 8% compared to our current study (34.4% vs. 53.3% respectively).[14]

While the proportion of patients achieving goal blood pressure after two years between the groups was not statistically significant, patients in our study were referred to the pharmacist for diabetes disease-state management and therefore blood pressure control may not have been a primary emphasis based on the provider referral. At baseline, LDL was statistically different between the groups, with LDL being higher in the usual care group. Despite this, no difference was found between the groups after two years. Other studies have shown that pharmacists can significantly reduce blood pressure and LDL when that is one of the primary objectives of the intervention.[15,16] A meta-analysis of randomized controlled trials examined the impact of pharmacist intervention on blood pressure control.[15] The study found improved blood pressure control after the intervention, however, the interventions had differential effects ranging from very large impact to no effect. The analysis could not identify which interventions were most effective at improving blood pressure control, and our data suggests that improving blood pressure control requires a more focused pharmacist intervention. Other studies have found that pharmacist interventions such as medication counseling, individualized care plans, education on lifestyle modifications, and frequent follow-up have been shown to be beneficial on blood pressure control.[17,18]

In this study, there were more patients on a GLP-1RA or SGLT2 inhibitors in the pharmacist intervention group compared with the usual care group after two years compared to baseline. Fink and colleagues reviewed pharmacotherapy approaches in patients managed by a pharmacist as compared to usual care in a retrospective cohort study.[13] They found that clinical pharmacists were more likely to start a patient on a GLP-1RA and SGLT2 inhibitor while usual care providers more likely added metformin, sulfonylureas, and thiazolidinediones. The 2023 American Diabetes Association guidelines state that first line treatment should be guided by patient-specific risk factors and comorbidities and usually include metformin.[5] SGLT2 inhibitors and GLP-1RA are now preferred agents due to weight loss, cardiovascular, and nephroprotective benefits. Older agents such as sulfonylureas and thiazolidinediones are no

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longer recommended first-line due to side effects such as hypoglycemia and weight gain. During the follow up period in this study (between August 2017 and October 2019), the American Diabetes Association guidelines were still emerging over each year with strengthened recommendations regarding addition of GLP-1RA and SGLT2 inhibitors.[19] Local health plan coverage was also limited for these agents during that time period. In spite of this, our data showed an increase in the number of patients on these preferred medications in the pharmacist intervention group, suggesting that the pharmacist was more mindful of emerging literature and access support for these medications. In contrast, there was no statistically significant difference in the number of patients on a sulfonylurea between the pharmacist and usual care groups. In fact, there was a non-statistically significant increase in the number of patients on a sulfonylurea in the pharmacist-managed group compared to the usual care group. This could be because the pharmacist may have been utilizing less preferred medication classes to lower HgbA1c at a time when insurance formularies were restrictive in terms of newer medication classes such as SGLT2 inhibitors or GLP-1RA. It is unknown how many of the patients on sulfonylureas were also on SGLT2 inhibitors or GLP-1RA in the post-intervention period.

There was no difference in the occurrence of severe hypoglycemia found between patients managed by the pharmacist compared to usual care. Overall, there was a very low rate of serious hypoglycemia during the study period, with only 1 patient having an emergency department admission for hypoglycemia. It has been estimated that the rate of a serious hypoglycemic events in a patient with type 2 diabetes is about 35 episodes per 100 patient-years.[20] The current study duration follow up was only two years and data collection was limited to only our health system, potentially underestimating the rates of hypoglycemia if patients presented with hypoglycemia outside of the system.

This study has many strengths. Patients in the pharmacist-managed group were matched to two controls via propensity scores, while most previous literature only matched one case to one control patient. The matched cohort design eliminates some sources of potential bias and confounding variables given the retrospective study design. Our study is also unique in that it examines the differences in diabetes pharmacotherapeutic management between pharmacists and usual care. Both study groups were managed at clinics that utilized very similar primary care models, with both serving as training settings for medical residents and students. The study outcomes were also followed over a two-year time period, compared to most studies that had limited follow-up to a 6 to 12 month duration.

While our study showed significant improvement in HgbA1c in patients managed by a pharmacist, some limitations do exist. This was a retrospective review, limiting the ability to draw casual inferences. The sample size was limited to patients managed by the ambulatory care pharmacist during the study period and matched to usual care comparators. Selection bias was also a risk in the pharmacist-managed group as patients were referred to the pharmacist by clinic physicians or identified by EMR reports. Patients managed by the pharmacist may also be more likely to be engaged in their health as compared to patients managed in the usual care group. Furthermore, while the two clinics studied used similar care models, the clinics have some differences and are staffed by different physicians and medical residents. Socioeconomic status of patients from both clinics were not formally evaluated although presumed to be similar due to geographical locations of the clinics. The baseline differences between the pharmacist-managed and usual care groups were accounted for by the propensity score matching, but it does not account for any potential systemic differences in practice between the two clinics. Additionally, as this was a retrospective chart review, we were limited by the information that was available in the electronic medical record. For the secondary outcomes, the sample size was further limited for some outcomes due to missing information for comparison across both data collection periods.

CONCLUSION

Patients managed by an ambulatory care pharmacist in an adult internal medicine clinic demonstrated a significant reduction in HgbA1c among patients with uncontrolled diabetes over two years of follow up when compared with usual care. An approximate 2-point reduction in HgbA1c was demonstrated over two years and was nearly twice that of the usual care group. While no significant difference was found between blood pressure, LDL, and hypoglycemia outcomes, patients in the pharmacist-managed group had significantly higher utilization of GLP-1RA and SGTL2 inhibitors compared to patients managed by usual care. Future studies may further highlight the benefit of innovative models including ambulatory care pharmacists on HgbA1c and additional outcomes such as blood pressure and LDL cholesterol.

Conflicts of Interest: We declare no conflicts of interest or financial interests that the authors or members of their immediate families have in any product or service discussed in the manuscript, including grants (pending or received), employment, gifts, stock holdings or options, honoraria, consultancies, expert testimony, patents, and royalties.

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Table 1. Baseline Demographics and Patient Characteristics			
	Pharmacist-Managed	**Usual Care**	**p-value**
n	60	120	
Age, yrs (mean ± SD)	53.1 ± 11.8	53.5 ± 12.0	0.842
Gender (n, %)			1.00
Female	29 (48.3)	56 (46.7)	
Male	32 (53.3)	64 (53.3)	
Patient-Identified Race (n, %)			0.123
African American	27 (45.0)	36 (30.0)	
White	32 (53.3)	79 (65.8)	
Other	1 (1.7)	2 (1.7)	
BMI (mean ± SD)	34.7 ± 8.7	34.9 ± 9.0	0.750
HgbA1c, % (mean ± SD)	10.0 ± 1.6	9.9 ± 1.5	0.821
SBP, mmHg (mean ± SD)	136.3 ± 18.8	134.7 ± 18.9	0.714
DBP, mmHg (mean ± SD)	79.9 ± 10.6	77.5 ± 10.7	0.339
LDL, mg/dL (mean ± SD)	83.8 ± 33.5	101.1 ± 40.8	0.014
Insulin Use (n, %)			0.914
Yes	37 (61.7)	73 (60.8)	
No	23 (38.3)	47 (39.2)	

Baseline patient characteristics including patient demographics and disease-state measures.
Legend: hemoglobin A1c (HgbA1c); systolic blood pressure (SBP); diastolic blood pressure (DBP)

Table 2. HgbA1c Outcomes			
	Pharmacist-Managed	**Usual Care**	**p-value**
n	60	120	
HgbA1c, % (mean ± SD)			
Baseline	10.0 ± 1.6	9.9 ± 1.5	
After Two Years	8.2 ± 2.0	9.0 ± 2.2	
HgbA1c Change, mean			
Unadjusted	-1.81	-0.93	0.004
Adjusted*	-1.92	-0.98	
HgbA1c <8% Achieved (n, %)	32 (53.3)	41 (34.2)	0.014

Mean change in HgbA1c in the pharmacist-managed as compared to the usual care group and proportion of patients achieving HgbA1c <8% after two years
*adjusted for age, sex, race, BMI, baseline HgbA1c, and baseline insulin usage status

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Table 3. Blood Pressure and LDL Outcomes*			
	Pharmacist-Managed	**Usual Care**	**p-value**
n	59	115	
SBP <130 mmHg Achieved (n, %)	32 (53.3)	55 (46.2)	0.369
DBP <80 mmHg Achieved (n, %)	13 (21.7)	26 (21.8)	0.978
n	56	111	
LDL, mg/dL (mean ± SD)	83.8 ± 33.4	91.5 ± 31.1	0.145

Mean LDL after two years and proportion of patients achieving goal SBP (<130 mmHg) and goal DBP (<80 mmHg) in the pharmacist-managed as compared to usual care group after two years
*n represents patients who had at least 1 value for each parameter in each time period

Table 4. Medication Use and Occurrence of Serious Hypoglycemia			
	Pharmacist-Managed	**Usual Care**	**p-value**
n	60	120	
Medication Use			
GLP-1RA (n, %)			
Baseline	2 (3.3)	4 (3.3)	1.000
After Two Years	28 (46.7)	11 (9.2)	<0.001
SGLT2 inhibitor (n, %)			
Baseline	3 (5.0)	6 (5.0)	1.000
After Two Years	11 (18.3)	7 (5.8)	0.008
Sulfonylurea (n, %)			
Baseline	16 (26.7)	28 (23.3)	0.624
After Two Years	21 (35.0)	36 (30.0)	0.497
Occurrence of Hypoglycemia (n, %)			
Baseline	0 (0.0)	0 (0.0)	-
After Two Years	1 (1.7)	0 (0.0)	0.333

Proportion of patients prescribed GLP-1RA, SGLT2 inhibitor, or sulfonylurea and occurrence of hypoglycemia in the pharmacist-managed as compared to the usual care group after two years

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