Retraction Notice

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☐ yes, date: yyyy-mm-dd
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Correction:
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Comment:
This paper is retracted by the editor handling error.

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The Addition of Pharmacists on a Patient Care Team to Improve Diabetic Patient Outcomes

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Abstract

As diabetes becomes more prevalent throughout the United States, there is an increased demand for healthcare providers and healthcare resources. Pharmacists have started to collaborate with primary care providers, and through this collaboration, pharmacists are able to augment patient care and provide additional resources to diabetic patients. This essay reviews the effect of one clinic that incorporates pharmacist interventions as an addition to established patient care teams, and evaluates the effect that the pharmacist interventions have on patient hemoglobin A1C%. While this essay provides data to show the positive benefits of pharmacist intervention on diabetes patients and A1C% goals, additional data and research are needed to demonstrate how pharmacists are a necessary addition to patient care teams.

Keywords

Diabetes, Pharmacist Intervention, Patient Care Team, Hemoglobin A1C%

1. Introduction: The Growing Need for Healthcare Practitioners in the United States

In the United States, the prevalence of diabetes mellitus is rising [1]. In 2017, The National Diabetes Statistics Report found that 30.3 million people in the United States were diagnosed with diabetes, which was an increase from 29.1 million people reported in 2014 [2] [3]. In addition, the 2017 report indicates that at least 87.5% of this diabetic population is diagnosed with one or more comorbidities related to diabetes [2]. Because diabetes is a chronic illness associated with multiple comorbidities, when this population size increases, the workload burden for primary care providers also increases.

One strategy to disperse the workload burden of primary care providers is to implement a "patient care team" approach to patient care. Members of the pa-

tient care team may include receptionists, nurses, nutritionists, and physicians [4]. These teams are often most effective with the addition of a clinical pharmacist and have shown to provide improved patient outcomes [4] [5].

Health care providers, including pharmacists, use the hemoglobin A1C% as one of the primary methods to determine a diabetic patients' glycemic control [6]. The American Diabetes Association (ADA) recommends a goal of 7.0% for most nonpregnant adult diabetic patients but permits providers to modify this goal based on patient characteristics and risk factors for diabetic complications [6].

The purpose of this essay is to provide data that pharmacists on a patient care team will achieve better patient outcomes and lower A1C% than a patient care team without a pharmacist. The pharmacist will provide interventions through one-on-one educational appointments for the diabetic population through pharmacist-physician collaboration. Throughout this essay, the patients receiving pharmacist intervention at these appointments will be referred to as being enrolled in a "pharmacist diabetes clinic".

2. Methods for the Design of a Pharmacist Diabetes Clinic

The pharmacist diabetes clinic discussed in this essay was designed within a private, closed-door all male institutional setting. In the setting from which the patients were selected, the patients have been previously established into four groups labeled "A", "B", "C", or "D", based on parameters unrelated to health and other factors that are insignificant to this clinic. The patients for this pharmacist diabetes clinic were randomly chosen from group D and all had a hemoglobin A1C% greater than 9.0. Lastly, all patients were asked for their permission to be included in this project and participate in the pharmacist diabetes clinic.

The pharmacist diabetes clinic appointments were held as private, individual sessions with each enrolled patient. This clinic required coordination with the institution's current scheduling system and patient exam room availability. Prior to the patient appointment, the pharmacist reviewed at least one year of relevant patient chart notes and previous and current A1C% trends, and this information determined what type of education or hand-out the patient would receive. There were a total of two pharmacists dedicated to evaluating patients in this clinic.

No funding or resources outside of the institution's normal daily operations were required to implement the pharmacist diabetes clinic project discussed in this essay. The pharmacists that provided patient interventions were asked to participate on a volunteer basis and did not receive compensation outside of their normal pay. The resources used in this pharmacist diabetes clinic were already available to physicians, physician assistants, and nurse practitioners, therefore there were no additional equipment costs were necessary for this clinic.

The pharmacists participating in the pharmacist diabetes clinic met one on one with the enrolled diabetic patients between May 2017 and October 2017, for

a six month period. Frequency of intervention and pharmacist appointments was subjectively determined by patient's characteristics and willingness to participate in the interventions recommended by the pharmacists. Patient treatment plans and educational information was also tailored specific to each patient using ADA guidelines. Interventions related to oral medications and/or insulin were based on the 2017 ADA guidelines and the specific algorithms used by the pharmacists in this project are available in Figure 1 and Figure 2 of this essay [7]. The plans for each patient included patient education, hand-outs, and/or recommendations to the patient's primary care provider.

The enrolled patient's A1C%'s were measured at least every 90 days and reviewed by the pharmacist in the pharmacist diabetes clinic. The A1C% goals for each patient were derived from the 2017 ADA guidelines are summarized in Figure 3 [7]. Patients receiving insulin injections had their blood glucose level taken prior to the administration of the insulin and also reviewed by the pharmacist,

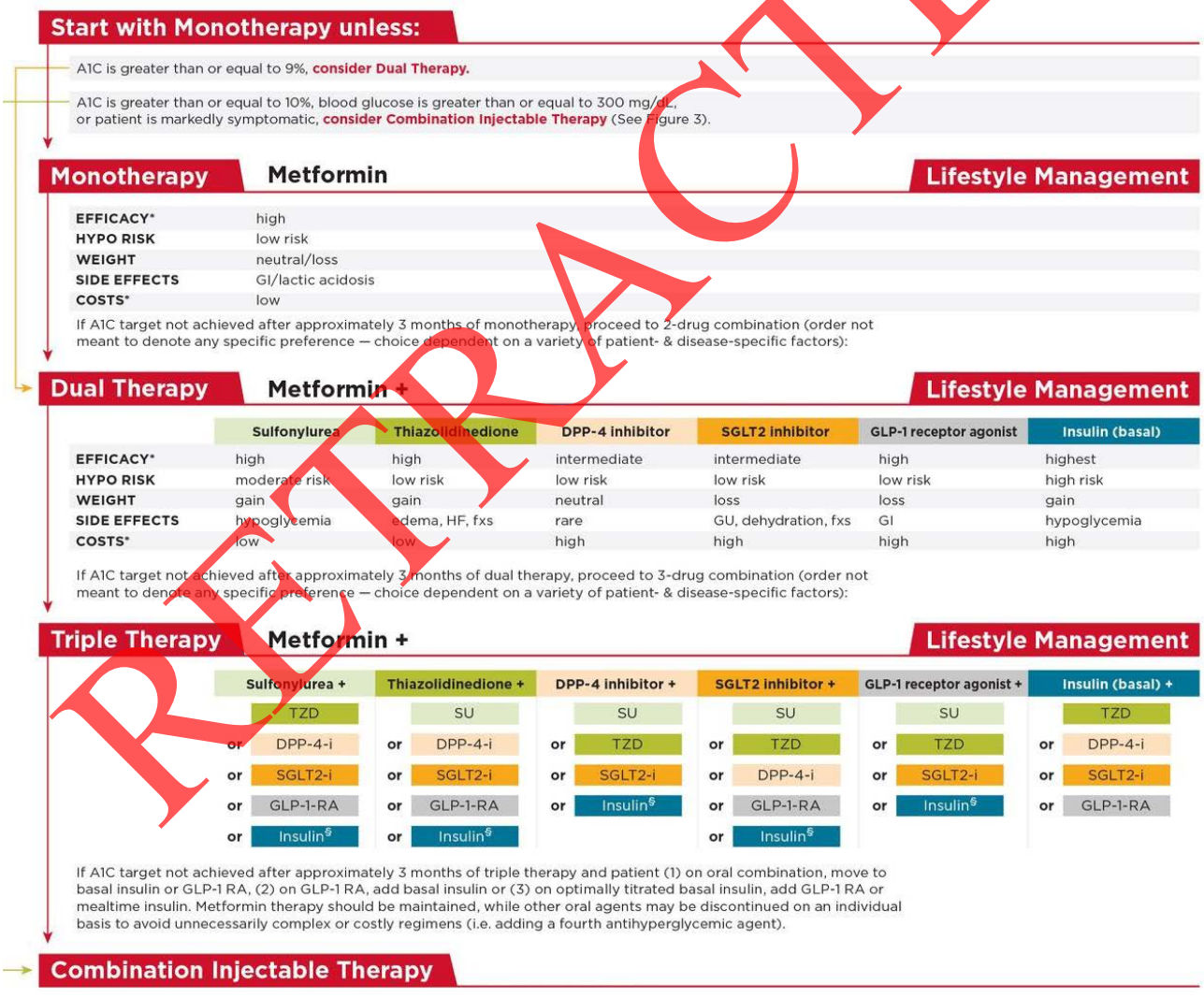

Figure 1. "Antihyperglycemic therapy in type 2 diabetes: general recommendations" taken from the 2017 ADA guidelines. [Source: Reference 7]

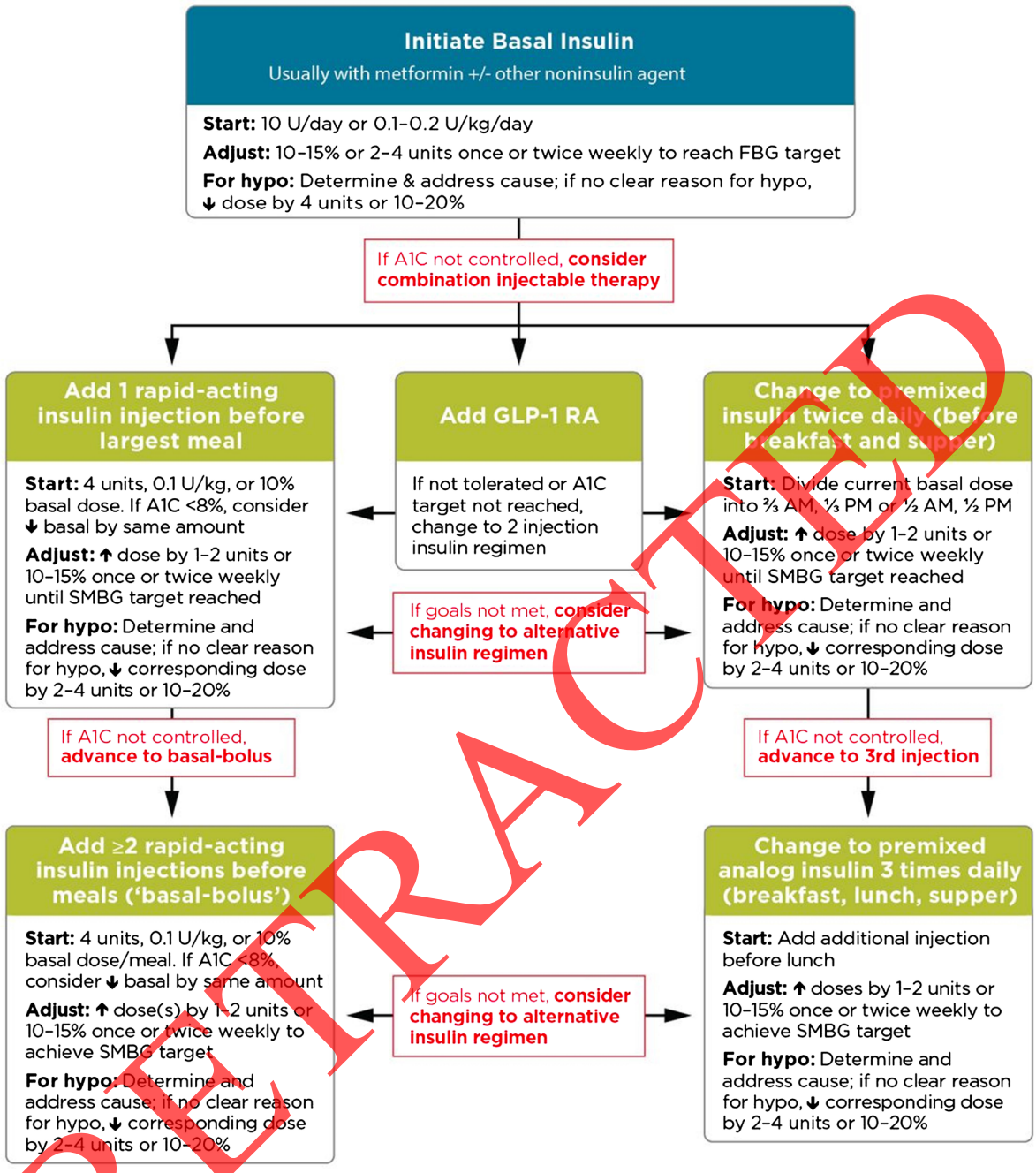

Figure 2. "Combination injectable therapy for type 2 diabetes" taken from the 2017 ADA guidelines. [Source: Reference 7]

A1C	<7.0% (53 mmol/mol)*
Preprandial capillary plasma glucose	80–130 mg/dL* (4.4–7.2 mmol/L)
Peak postprandial capillary plasma glucose†	<180 mg/dL* (10.0 mmol/L)

**More or less stringent glycemic goals may be appropriate for individual patients. Goals should be individualized based on duration of diabetes, age/life expectancy, comorbid conditions, known CVD or advanced microvascular complications, hypoglycemia unawareness, and individual patient considerations. †Postprandial glucose may be targeted if A1C goals are not met despite reaching preprandial glucose goals. Postprandial glucose measurements should be made 1–2 h after the beginning of the meal, generally peak levels in patients with diabetes.*

Figure 3. Summary of glycemic recommendations for many nonpregnant adults with diabetes. [Source: Reference 7]

with patient goals derived from Figure 3 as well [7]. Although lifestyle modifications, medication recommendations, and A1C% goals were derived from the current ADA guidelines, each patient's goal and plan were discussed and agreed upon between the pharmacist and patient. Follow-up appointments were based on the patient's specific disease characteristics and the range of time for the pharmacist follow-up varied between 1 to 6 weeks. Pharmacist education to the patient and recommendations to the providers were based on these values in addition to patient's history and self-reported symptoms.

3. Observations and Patient Outcomes

The observations for this essay were obtained by comparing data between the patients enrolled in the pharmacist diabetes clinic and a control group or patients who were not enrolled in the pharmacist diabetes clinic. The control group patients were selected from group "C" based on A1C% and all patients were male, aged over 18 years old, and had a starting A1C% of 9.0 or greater. The starting data point for all patients was an initial A1C% obtained in May 2017 and the final data point for all patients was the most current A1C% as of October 2017.

As depicted in Table 1, there were unremarkable age and language differences between patients who received pharmacist intervention compared to the patients that did not receive pharmacist intervention. The median age for the patients who received pharmacist intervention was 56 years and the group that did not

Table 1. Clinic population demographics and diabetes comorbidities. The number (and percentage) of patients with each characteristic is reported. Note that biological sex was male for all patients.

Characteristics	All Patients (n= 27)	Pharmacist Intervention Group (n = 15)	Control Group (n = 12)
Median Age (Range)	57 (33 - 73)	56 (33 - 69)	58 (47 - 73)
Ethnicity			
Black or African American	14 (52%)	8 (53%)	6 (50%)
Hispanic or Latino	5 (19%)	5 (33%)	0 (0%)
White or Caucasian	6 (22%)	2 (13%)	4 (33%)
Unknown Ethnicity	2 (7%)	0 (0%)	2 (17%)
Comorbidities			
Hypertension	23 (85%)	13 (87%)	10 (83%)
Hyperlipidemia	18 (67%)	10 (67%)	8 (67%)
BMI > 30	16 (59%)	6 (40%)	10 (83%)
Native Language			
English	22 (81%)	11 (73%)	11 (92%)
Spanish	4 (15%)	4 (27%)	0 (0%)
Other	1 (4%)	0 (0%)	1 (8%)

receive pharmacist intervention was 58. Any non-English speaking patient was provided an interpreter for all pharmacist appointments and any education materials. The majority of the enrolled patients reported their ethnicity as Black or African American and all patients had a previous diagnosis of diabetes mellitus with an A1C% of 9.0 or greater at the beginning of data collection. There were notably less non-white patients in the control group compared to the intervention group, with a percentage of 67 and 86, respectively. Comorbidities were comparable between groups, except for BMI > 30. There were more patients with a BMI greater than 30 in the control group compared to the patients in the intervention group, with a percentage of 83 and 40, respectively.

Table 2 shows the difference between the patients enrolled in the pharmacist diabetes clinic and received pharmacist intervention compared to the patients who did not receive pharmacist intervention as it relates to their starting A1C% and their ending A1C%. The median A1C% for all patients at the start of the pharmacist diabetes clinic was 10.0 and the ending A1C% was 8.1. The average improvement of A1C% percentage points for all patients was 2.3 (SD = 1.96). The patients who received pharmacist intervention started with a median A1C% of 10.1 and the ending median was 8.3, and the average improvement of A1C percentage points for these patients was 2.6 (SD = 1.88). Patients who did not receive pharmacist intervention started with a median A1C% of 9.6 and ended with 8.0, and the average improvement of A1C percentage points for these patients was 2.1 (SD = 1.96). The group patients who received pharmacist intervention through the pharmacist diabetes clinic had an average of 0.5 A1C percentage point improvement higher than the group of patients that did not receive pharmacist intervention, but this difference was not statistically significant (P = 0.78).

The statistical analysis used to compare the data in Table 2 was done with a nonparametric calculation due to the small sample sizes in this project. The Mann-Whitney U Test was chosen to compare the group of patients that received

Table 2. Hemoglobin A1C% for patients who received pharmacist intervention in a pharmacist diabetes clinic and for patients that received no pharmacist intervention. The patients starting A1C%, ending A1C%, and average percentage point improvements are represented within the table below. The pharmacist intervention group had a 0.5 A1C% point improvement versus the control group (P = 0.78).

A1C% Results	All Patients (n = 27)	Pharmacist Intervention Group (n = 15)	Control Group (n = 12)
Median, Mean (Rage) at Start	10.0, 10.2 (9.0 - 12.7)	10.1, 10.4 (9.1 - 12.7)	9.6, 9.9 (9.0 - 12.2)
Median, Mean (Rage) at End	8.1, 8.2 (5.9 - 12.0)	8.3, 8.3 (5.9 - 11.5)	8.0, 8.3 (6.8 - 12.0)
Patients with an Overall Improvement	23 (85%)	13 (86%)	10(83%)
Median, Mean (Rage) Points of Improvement	2.0, 2.3 (0.2 - 6.5)	2.0, 2.6 (0.2 - 6.5)	1.55, 2.1 (0.6 - 4.8)

pharmacist intervention to the group that did not receive pharmacist intervention and it was calculated assuming a 2 tailed hypothesis with significance at $p < 0.05$. The "points improved" between the two groups of patients was calculated and the differences were not significant ($P = 0.78$; z-score = 0.28). Therefore, although there was an overall improvement in A1C% for each group, there is no statistically significant difference between the improvements.

4. Challenges and Opportunities

This pharmacist diabetes clinic was designed with the primary goal of decreasing diabetic patient's hemoglobin A1C%'s while evaluating the value of added by pharmacist interventions. Although the sample sizes for these data were small, there was enough information to show that pharmacists may cause positive changes in patient's disease process. The most important finding was that the group of patients that received pharmacist intervention, on average, had a larger hemoglobin A1C% percentage point decrease than the patients that did not receive interventions. Interventions varied from patient to patient and were based on the ADA guidelines and recommendations.

There were some challenges faced by the pharmacists performing the interventions. Some of the challenges were patient-specific, provider-specific, and due to pharmacists' scope of practice within the particular institution for this pharmacist diabetes clinic. Some patients were not interested in any lifestyle or medication modifications, regardless of the potential long-term and short-term health outcomes. These patients were still followed and included in the reported data. In addition, some primary care providers did not want to make medication changes based on pharmacist recommendations. In these scenarios, recommendations were still made and the patients were still enrolled in the pharmacist diabetes clinic. Lastly, pharmacists at this institution did not directly make changes to patient medications, rather, they only made suggestions to the patients' primary care provider. The pharmacist interventions suggested to the providers were not always implemented into the patients' care plan, however, pharmacists still assisted with ordering labs and monitoring patients' blood pressure, complete metabolic panel, A1C% and blood glucose.

This essay's data has limitations. The first limitation is the small sample sizes and the length of time the patients were reviewed. If a future clinic were to perform a similar review of pharmacist intervention and the effect of these interventions on patient's A1C%, it would be ideal to use a larger sample size and review these patients over a longer period of time. The sample for the project only included men, even though diabetes can affect both men and women. Not only should the future project have a larger sample size, it should be executed at an institution that has women patients so the entire population of the United States is better represented. Another limitation is the data's lack of statistical significance in this essay. While the group of patients who received pharmacist intervention had an A1C% improvement compared to the group without pharmacist

intervention, this improvement was not significant (P = 0.78). Larger sample sizes would be required to determine if these interventions are truly statistically significant. Potentially contributing to the project's statistically not significant findings, this essay was based on a clinic that was not originally designed for data collection and analysis. This project should be repeated with a clinic that is designed specifically collect and analyze data in a statistically significant method.

5. Discussion and Conclusions

The residual lifetime risk for diabetes in the male population at age 40 years is reported to be as high as 1 in 3 individuals [6]. Many studies suggest that the incident of diabetes will continue to increase and may especially increase in younger populations [6]. When more people are being diagnosed with diabetes, more healthcare resources and more providers will be necessary to keep up with the demand for patient care. As the population of the United States continues to grow older and the number of diabetic patients increases, there will be a greater and greater demand for primary care physicians. As demonstrated in this pharmacy diabetes clinic, pharmacists can play an integral role in the care for diabetic patients while decreasing the workload of the primary care providers.

Pharmacists are an emerging field of health care practitioners that are expanding their scope of practice, and pharmacists have the opportunity to augment diabetes care by contributing medication expertise and knowledge about pharmacotherapeutic decisions [8]. There is an increasing demand for the interpretation and application of drug and disease information, and pharmacists have the unique skillset to assist with this demand [9]. By using these unique skillsets, pharmacists can be a great addition to diabetes education and medication knowledge, especially because team-based healthcare outcomes are shown superior to the delivery systems that do not provide team-based healthcare [10].

While the results of this project were not statistically significant due to small sample sizes, the patient outcomes for the pharmacist intervention group were positive and overall these patients had improvement for their A1C% (P = 0.78). The main goal of this clinic is to have pharmacists perform clinical tasks that relive some of the burden for primary care providers, provide better diabetes care, and also investigate the logistics of creating a pharmacist diabetes clinic. Statistically significant data will be required to determine whether or not patient care teams have better patient outcomes, however, this clinic alleviates workload for the primary care providers. The pharmacists alleviate the workload by following up with patients in between primary care provider appointments, ordering laboratory tests, and reviewing patient charts.

To improve the effect of pharmacist interventions in future projects and clinics, there needs to be a shift in the way patients and other health care providers view pharmacists and their scope of practice. Previously, pharmacists were less involved with the clinical aspect of patient care, but as the profession progresses, more and more pharmacists are trained to manage complex patient cases and

assist primary care providers. More recently, pharmacists in some states have been trained to evaluate patients, execute a physical exam, make dosage changes, order labs, and make specialist referrals based on their own knowledge. Pharmacists need to exercise this training and utilize their scope of practice to the highest degree so the profession can continue to grow and augment the current model of healthcare.

In addition to exercising the expanded scope of practice for pharmacists, research and clinical trials with positive patient outcomes are necessary to increase to utilization of pharmacists within health care teams. These types of studies and essays will provide concrete evidence to support the addition of pharmacists on a patient care team. Overall, open communication among pharmacists, patients, and providers, appropriate recommendations, and positive patient outcomes will be necessary for the successful integration of pharmacists into primary care clinics [11].

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Conflicts of Interest

The author has no conflicts of interest to disclose.

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