

Pharmacist-Managed Diabetes Programs: Improving Treatment Adherence and Patient Outcomes

Amanda Wojtusik Orabone¹, Vincent Do¹, Elizabeth Cohen² 

¹Department of Pharmacy, Yale New Haven Health System, New Haven, CT, USA; ²Department of Transplant Services, Yale New Haven Hospital, New Haven, CT, USA

Correspondence: Elizabeth Cohen, Department of Transplant Services, Yale New Haven Hospital, 800 Howard Ave, 4th Floor, New Haven, CT, USA, Tel +1 203-200-5478, Email elizabeth.cohen@ynhh.org

Abstract: The health and economic burden of diabetes mellitus across the United States and the world is such that effective care is crucial to improving outcomes, including macro and microvascular complications, and lowering health care costs. Pharmacists are well placed within communities to provide the critical care necessary for patients with diabetes and have a unique skillset that has demonstrated clear benefits in clinical and non-clinical outcomes. Here, we will provide a narrative review of the literature including the role of the pharmacist in different care models, outcomes associated with pharmacist care, and future directions and opportunities for pharmacist-managed diabetes.

Keywords: diabetes, hyperglycemia, pharmacist, pharmacy

Introduction

Diabetes mellitus is one of the most common disease states, affecting 8.5% of the world's population.¹ In the United States, diabetes is the chronic condition with the highest economic burden, as 1 in every 4 US health care dollars is spent on a person with diabetes.² Good diabetes control is critical in preventing complications contributing to the economic burden. These complications include macrovascular complications like cardiovascular disease and microvascular complications such as retinopathy and neuropathy that significantly affect quality of life. Fortunately, for patients who live with diabetes, appropriate management has demonstrated to be cost-effective and improve outcomes.³

The shortage of primary care providers and endocrinologists along with the extensive time required to provide complex diabetes management makes it difficult to provide all of the necessary care as providers are allotted less time with each patient.⁴ Patients with diabetes can also have comorbidities that require specific considerations such as those with solid organ transplants or pregnancy, which further adds to the complexity of care required. Additional challenges associated with suboptimal diabetes control include poor medication adherence, complex treatment regimens, medication side effects, poor patient-provider communication, and patient financial limitations. Given the frequency and intense follow-up required along with extensive education, pharmacists can play a critical role in the management of diabetes.

The pharmacist's role has changed significantly over the last fifty years. Transitioning from strictly dispensing to providing clinical services that include patient education, direct patient care responsibilities, and chronic disease management through team-based care. Specialized training for pharmacists including residency programs and certificate programs have been crucial to expanding the pharmacist's role. For example, community pharmacists are uniquely positioned to provide greater access to care for patients in their community by dispensing medications, providing education, and, with additional certification, prescribing and administering immunizations, and medications (eg naloxone). Residency-trained clinical pharmacists have more specific training in the direct care of patients and are generally placed within a clinic setting with a team of providers. The American Diabetes Association recognizes the pharmacist as a crucial member of the diabetes care team. There is a particular opportunity for pharmacists as health care transitions from fee-for-service models to value-based care delivered on the quadruple aim of

improving population health, reducing cost of care, enhancing the patient experience, and improving provider satisfaction.⁵ Pharmacist-managed diabetes care has manifested in many different forms.

The purpose of this manuscript is to provide a narrative review of the different models of pharmacist-managed diabetes care, to discuss the impact of the pharmacist within these models, and to highlight future opportunities. Some of the roles that will be discussed are highlighted in Figure 1. Combinations of keywords to find relevant manuscripts and abstracts in SCOPUS and PubMed included: diabetes, diabetes management, hyperglycemia, pharmacist, pharmacy, community, inpatient, managed, transplant.

Pharmacist Care Models

Methods of Pharmacist Management

Pharmacists serve as members of diabetes management teams within a variety of diverse ambulatory practice settings and provide direct patient care through various practice models. Pharmacists provide patient education, therapeutic recommendations, and in many settings have prescriptive authority through collaborative drug therapy management (CDTM) agreements. A CDTM agreement designates the level of clinician (eg MD, DO, APRN) oversight required in the clinical pharmacy service and defines the pharmacist scope of practice.⁶ CDTM agreements vary based on state regulations and specific institutional preferences. They can be limited to a specific disease state and certain medications with strict algorithmic guidelines or can be broad agreements without disease state or medication class restrictions.⁷ Many CDTM agreements permit the pharmacist to assume professional responsibility for performing patient assessments, ordering medication-related laboratory tests, administering medications, and adjusting medication regimens.⁶ Some CDTM agreements allow pharmacists to initiate, discontinue, and modify drug treatment regimens, while others only allow modification of existing treatment.^{8,9} Apart from CDTM agreements, pharmacists can collaboratively manage diabetes through protocols (eg insulin titration protocols) or via therapeutic recommendations made directly to the clinician for implementation.^{10–12} Interventions that allow pharmacists to make medication adjustments, as opposed to providing only drug review and disease education, have reported greater improvements in outcomes.¹³

Pharmacists often provide diabetes management services as embedded resources within a specific clinic location, providing patient management through a combination of onsite visits and telephone follow-up. Alternatively, pharmacists can manage patients via a central location or solely via telehealth. While the majority of pharmacist-managed diabetes services exist within the primary care setting, pharmacists can also provide management via the community or retail



Figure 1 Role of the pharmacist.

setting or within a specialty office (eg endocrinology, transplant). Additionally, transitions of care services provide another opportunity for pharmacists to provide diabetes management services.

Educational interventions delivered by pharmacists who manage patients with diabetes typically include diabetes self-management education with a focus on healthy eating, physical activity, self-monitoring, taking medication, problem solving, healthy coping, and reducing risks.^{11,14} Pharmacists are also well positioned to provide tailored education specific to medication timing, administration, and adherence, which is especially important considering the complex nature of medication regimens for patients with diabetes and the risk of polypharmacy and poor medication adherence. The clinical pharmacist is able to provide evidence-based recommendations for medication selection including dose, adverse reaction prediction, and interventions. Clinical interventions made by pharmacists address medication effectiveness, safety, tolerability, adherence, and affordability.¹⁵ Patients managed by pharmacists usually have follow-up at frequent intervals, more often than they would otherwise see their physician. For this reason, pharmacists are able to modify medication regimens in a timely fashion, often reducing the time needed to attain treatment goals.^{8,16} As patients with diabetes require a variety of important health maintenance screenings, pharmacists involved in diabetes management programs are able to ensure patient completion of annual retinal exams, monofilament testing for neuropathy, urine microalbumin testing, and administration of recommended immunizations. Pharmacist-managed diabetes programs also routinely include motivational interviewing with a focus on patient goal setting and identification of barriers to improved control.^{17–19} Along with diabetes, pharmacists also routinely provide management for a variety of other chronic diseases including hypertension and dyslipidemia, which are often present along with diabetes.

It is common for pharmacists who are providing diabetes management services to have completed post-graduate residency training, along with attainment of board certification in pharmacotherapy or ambulatory care (eg BCPS, BCACP), advanced certification in diabetes management (BC-ADM), or credentialing as a certified diabetes educator (CDE).^{18,20}

The next sections will discuss how pharmacists utilize these tools to develop models in primary care, telemanagement, transitions of care, and special populations.

Pharmacists in Primary Care

There is an abundance of published literature describing pharmacist-managed diabetes within the primary care setting. Primary care settings that have pharmacist-managed diabetes programs include private practices, academic health centers, federally qualified health centers (FQHCs), and the Veterans Affairs (VA). These settings span rural and urban areas across the United States. Most pharmacist-managed diabetes programs within primary care target patients with type 2 diabetes because it is significantly more prevalent and because those with type 1 diabetes are often referred to an endocrinologist.

Pharmacist-managed diabetes within primary care is routinely delivered via a team-based model.^{21,22} Pharmacists collaborate closely with primary care providers (PCPs) including physicians, advanced practice registered nurses (APRNs), and physician assistants (PAs). It is common for pharmacists to identify patients requiring referral to a registered dietitian or other care team members who include podiatrists, exercise physiologists, and ophthalmologists, among others. Many pharmacist-managed diabetes clinics within the primary care setting also incorporate pharmacy learners of various levels into patient care delivery, and in many settings the pharmacist is responsible for providing education to physician residents and other medical learners.^{10,19}

Pharmacist-managed diabetes clinics within primary care operate through voluntary physician referrals, via proactive patient identification, or through a combination of both.^{16,22} Many clinics have suggested referral criteria, and although referrals can be limited to patients with poorly controlled diabetes (eg A1c >9%), more often patients are referred to the pharmacist across the continuum of diabetes care. This includes patients with newly diagnosed diabetes, long-standing diabetes, and those with controlled to severely uncontrolled disease.²³ Reasons for referral to the pharmacist include the need for medication adjustment, initiation of insulin or other injectable therapy, diabetes education, or the need for close monitoring and follow-up for high-risk patients. Outside of voluntary clinician referrals, patients can also be enrolled in a pharmacist-managed diabetes clinic through proactive identification by the pharmacist or their support staff based on specific enrollment criteria.²³

Many primary care practices have a pharmacist embedded within their clinics. Embedded pharmacists may be physically located onsite five days a week or less often, depending on the size of the primary care office and the other responsibilities of the pharmacist in providing care via other disease management clinics or teaching requirements for those with faculty

appointments at a college of pharmacy.^{24,25} It is now common for embedded pharmacists to manage patients with diabetes through independent prescribing based on CDTM agreements, however there are other successful patient care models that have been described. These models include joint pharmacist-physician appointments in which both professionals evaluate the patient and develop a treatment plan at the point of care, pharmacist-patient appointments in which the pharmacist discusses each patient with the PCP to develop a treatment plan at the point of care, or pharmacist appointments where recommendations are provided via the EHR (electronic health record) to the PCP for implementation by the PCP or for implementation by the pharmacist following PCP authorization.¹⁸ Alternative models described have utilized pharmacists solely for the delivery of diabetes education, while others have tiered approaches to management based on the scope of the referral. Within these diabetes management programs pharmacists may provide 1) diabetes education and counseling, 2) diabetes education and counseling plus diabetes management and monitoring, or 3) education and diabetes management along with management and monitoring of other comorbid conditions.^{26,27} Tiered referral approaches acknowledge the varied degrees of comfort that PCPs may have with pharmacist-managed diabetes. There are also described reports of pharmacist-managed insulin titration programs within primary care that focus specifically on insulin titration to achieve pre-specified blood sugar goals.^{10,11}

When primary care clinics have an embedded pharmacist, it allows for routine face-to-face contact with PCPs and other clinic staff. This facilitates team-based care and promotes a level of trust in the pharmacist.¹⁵ It also allows the pharmacist to easily consult with the clinician in the instance of abnormal findings identified during a pharmacist appointment or when other special circumstances arise that require consultation with the PCP.^{11,19,27} Alternatively, some primary care offices refer patients to a centralized pharmacist for diabetes management.¹⁴ In this model, pharmacists are usually physically located in a setting other than the primary care office due to geographical constraints or to help standardize care delivery and management practices. When pharmacist managed diabetes programs are centralized, pharmacist interaction with the PCP team may be exclusively via the EHR. In all settings where pharmacists provide diabetes management services, it is routine practice for the pharmacist to document all patient care activities and treatment decisions within the EHR for communication with the PCP.

Most pharmacist-managed diabetes programs within primary care deliver services via a combination of face-to-face visits and telephone follow-up. Pharmacists also utilize secure messaging systems to communicate with patients in-between scheduled visits. The frequency of appointments with the pharmacist varies based on patient needs from weekly to every 12 weeks or longer. Appointment durations range from 45 to 90 minutes for initial visits and are typically shorter (15 to 30 minutes) for follow-up appointments. Many patients managed by pharmacists within the primary care setting are referred back to the PCP for management once they meet their metabolic targets, with the option to re-refer to the pharmacist if needed.²⁷ Patients may also be discharged from pharmacist-managed services if they miss consecutive appointments, decide themselves they no longer wish to receive care from the pharmacist, or if they cannot be contacted to schedule or re-schedule follow-up.²⁸

Descriptions of primary care pharmacist-managed diabetes programs do not routinely discuss methods for billing and reimbursement, likely because pharmacists are not universally able to bill for their services. Additionally, the setting that a pharmacist works in can also dictate the billing opportunities with differences in facility-fee billing in a hospital-based clinic and incident-to billing in a physician-based clinic.²⁹ Pharmacists who are also CDEs can bill Diabetes Self-Management Training and Education codes if their program is recognized by the American Diabetes Association (ADA) or the American Association of Diabetes Educators (AADE). As many diabetes care measures, including Hemoglobin A1c (A1c) control, are core metrics of pay-for-performance programs, pharmacist-managed diabetes services can help generate revenue via increased reimbursement from quality-based payment pathways.^{23,29} For health systems like the VA, which serve as both the payer and the provider, particular attention is paid to cost savings that result from decreased hospitalizations and emergency department utilization and reduced disease state complications – all tied to improved diabetes control.¹⁶

As health maintenance is a cornerstone of primary care, pharmacists practicing within the primary care setting support PCPs in meeting preventative care measures, including those recommended by the ADA and those described in the Healthy People 2030 objectives.²³ Additionally, as PCPs are responsible for whole person care, pharmacists who are part of primary care teams often manage chronic conditions outside of diabetes, most commonly hypertension, dyslipidemia, asthma, chronic obstructive pulmonary disease (COPD), and nicotine cessation. It is well accepted that a comprehensive approach targeting control of multiple cardiovascular risk factors is beneficial in lowering morbidity and mortality among

patients with diabetes. Thus, pharmacist-managed diabetes programs that include management of hypertension, hyperlipidemia, and nicotine cessation are commonly found within primary care settings.^{24,26,30} Given the unique barriers that many PCPs face in caring for patients with diabetes along with the growing shortage of available PCPs, primary care is an ideal environment for pharmacists to assist with care delivery.

Use of Telemanagement

Telehealth provides patients with the ability to communicate with healthcare clinicians through telephonic or video means. Although the advent of COVID-19 has rapidly brought this tool into wide popularity, use of telehealth has been around since the 1900s. Pharmacists have utilized telehealth strategies to provide remote patient monitoring (RPM) services or to facilitate easier and more frequent follow-up. The Centers for Medicare and Medicaid Services (CMS) defines RPM as “the collection and analysis of patient physiologic data that are used to develop and manage a treatment plan related to a chronic and/or acute health illness or condition.”³¹ In addition to this, advancement in technology has assisted in facilitating the ease of delivering telehealth services through the development of patient-friendly video-based platforms and applications that allow for RPM.

Pharmacists have used telehealth in combination with in-person visits to facilitate frequent follow-up visits that help reduce the transportation burden and related indirect costs to the patient. Studies have found that both in-person and virtual visits have similar outcomes.³² The majority of published pharmacist models generally focus on scheduled telephone visits with interventions focused on pharmacist-led telephonic clinics, post-discharge follow-up, laboratory monitoring, and medication counseling.³³

Pharmacists have integrated technology into their visits through different means. In one model, the pharmacist performed electronic visits, sometimes in combination with in-person visits, through the use of video or telephonic means. Pharmacists in this state were authorized to provide drug therapy management under the supervision of a licensed clinician and were guided by a protocol specific to the practice site. Pharmacists additionally offered and educated on the use of a glucose flowsheet through their EHR to allow the patient to input their blood sugars for the clinician to later review.³⁴ In another model, pharmacists educated patients on a phone application that provided daily prompts to remind patients to take their medications and complete daily diabetes self-care tasks.³⁵ RPM devices like continuous glucose monitoring (CGM) have also gained wide popularity to improve accessibility to health care resources and transparency in clinical information. CGM is a revolutionary tool that provides important trends to allow for efficient and effective blood glucose monitoring. Some CGMs have compatible applications that allow real-time data to be sent to the clinician’s office. Pharmacists are positioned in a role where they can utilize CGM to improve patient care and/or facilitate transitions of care through interpretation and management of diabetes regimens and/or education on the device itself. One model implemented an eConsult program as a new referral opportunity for clinical pharmacists. Interventions completed by the pharmacist included education, CGM device placement, and retrieval of CGM data. Endocrinologists reviewed the data and pharmacist documentation to develop a plan.³⁶ Another study looked at the integration of CGM into an established outpatient pharmacist managed diabetes program at the VA. Pharmacists at the VA had prescriptive authority to manage patients’ diabetes regimens. In addition to their usual care, they would also download CGM data and review to make therapeutic adjustments. They found that patients in this program were able to achieve improved A1c reduction likely due to improved self-monitoring.³⁷

Through these studies, it is clear that telehealth remains a strong and reliable tool to extend pharmacy services to patients to improve care outcomes and medication adherence.

Pharmacists in Transitions of Care

A crucial point of time in health care is during the transition from one phase of care to another, particularly during the transition between a hospital admission back to care in the community. This time point is important given the number of changes that a patient may have to their medication regimen and poor education regarding these changes. The pharmacist is well placed to provide education to patients during this transition to avoid medication errors and possible readmission and to help improve adherence.

In a randomized controlled trial assessing pharmacist education at hospital discharge, it was found that detailed education from the pharmacist can have a significant impact on medication adherence, diabetes follow-up, and ultimately

diabetes control.³⁸ A pharmacist provided a 30 to 45-minute counseling session prior to discharge on medications and adherence to medications and follow-up visits along with self-care instructions. Adherence to diabetes medications 150 days after discharge using a proportion of days covered (PDC) was significantly improved in patients who received pharmacist education. Even more importantly, however, patients who had education with the pharmacist had increased adherence to follow-up visits and decreased hemoglobin A1c.

Another study reviewed the impact of pharmacist diabetes education during hospital admission for high-risk diabetes patients on 30-day readmission.³⁹ Given the high costs associated with hospital admissions, this could have a significant impact on the economic burden of diabetes care.

These two studies are great examples of the importance of extensive diabetes education during the transition between inpatient hospital stay and discharge to home. The pharmacist impact during this phase of care can have a large impact on diabetes outcomes.

Alternative Care Models

Outside of the primary care setting, pharmacists have positioned themselves to manage diabetes in various special populations. This section will review some of these examples.

Inpatient management of glucose control by pharmacists is also important to consider. This patient population may be receiving medications that increase their blood glucose, not on traditional diets, and are at risk for adverse outcomes with poorly managed blood glucose. Through consultation and protocol development, improved hyperglycemia management by pharmacists is possible.^{40,41}

Solid organ transplantation (SOT) has seen many successes with the addition of the pharmacist into the care team. Post-transplant, up to 90% of patients can experience transient hyperglycemia that often requires short-term treatment with anti-hyperglycemic agents, while others may go on to develop post-transplant diabetes.⁴² Pharmacists have developed various types of clinic models in order to cater to the dynamic glycemic requirements of this patient population. One model established a transition of care (TOC) clinic where they followed patients immediately post-transplant on a weekly to bi-weekly basis until the patient could be seen by their PCP or an endocrinologist.⁴³ They found that implementation of a TOC clinic was associated with a reduction in emergency department visits and hospitalizations. Alternatively, another model established a post-transplant diabetes clinic to care for those with transient hyperglycemia and long-standing post-transplant diabetes and was able to significantly reduce A1c in their patient population.⁴⁴

Pharmacists have also established practices to assist underserved populations. One example is incarcerated individuals who are more likely to have chronic conditions than the general population.⁴⁵ Oftentimes patients will have unpredictable durations of incarceration, which may hinder their ability to control their disease state. One study piloted a pharmacist-led clinic that cared for male incarcerated individuals on oral anti-hyperglycemic medications and was able to improve A1c and increase the frequency of statin usage.⁴⁶

A very specific group of patients requiring diabetes care is those patients experiencing hyperglycemia during pregnancy. As high blood glucose during pregnancy is a risk factor for future diabetes and cardiovascular diseases, in addition to harm to the fetus, it is critical that it is well controlled. In a study reviewing the impact of a pharmacist on hyperglycemic care during pregnancy, the pharmacist provided education to patients at five time points: at diagnosis, 1-month post-diagnosis, at the beginning of the 9th month of pregnancy, before delivery, and 6 weeks after delivery.⁴⁷ The clinical pharmacist provided recommendations in a team-based care approach to adjust medications based on clinical response and adverse effects. These interventions led to improved glycemic control and reduced maternal complications.

Pharmacist expertise should be used when caring for patients with diabetes in very specific populations given their specialized training and ability to provide additional and enhanced patient care.

Outcomes

Diabetes Outcomes

Most studies evaluating the impact of diabetes care by pharmacists are retrospective in nature. There are very few published randomized controlled trials.¹⁵ In many of the reviewed studies, authors used patients as their own controls for

pre- and post-pharmacist intervention or compared two cohorts of patients, those who interacted with a pharmacist as part of their diabetes care team compared to those who were managed solely by their non-pharmacist clinician.

The majority of studies evaluating the impact of diabetes care by pharmacists primarily reported A1c outcomes that include A1c change and percentage of patients achieving a specified A1c goal. The reported change in A1c varied from study to study with an average decrease of 1% to 2%. A meta-analysis of 35 studies looking at pharmacist interventions in the ambulatory care setting found a mean difference of 1.1%.⁴⁸ One of the most significant impacts reported was a 2.8% decrease in A1c in patients who were referred to a pharmacist managed diabetes program.²⁸ Several studies reported that patients with poorer glycemic control at baseline received the most benefit from pharmacist intervention.^{9,15,18} Studies that looked at the use of telehealth-based visits saw similar improvements in A1c.^{49,50} Other diabetes-specific outcomes reported on include time to treatment intensification,²⁵ time needed to reach A1c goal,²² number of daily insulin injections, daily units of insulin injected,¹¹ diabetes-related interventions made per patient per year,⁸ reduction in fluctuation of blood glucose, hypoglycemia reduction,⁴⁰ appropriate deprescribing,⁵¹ and patient and clinician reported barriers to achieve glycemic control.¹⁸

Comprehensive Care and Preventative Care Measures

Studies also routinely reported on change in systolic and diastolic blood pressure, change in LDL-C, change in weight or body mass index (BMI), and patient use of HMG-CoA reductase inhibitors, angiotensin-converting enzyme (ACE) inhibitors, angiotensin II receptor blockers (ARBs) and aspirin. Reported change in blood pressure control is mixed in studies, with fewer reports of significant change in either systolic or diastolic blood pressure, possibly because pharmacists were predominantly focused on blood sugar control.^{9,12,21,27,28,30} Several studies reported significant improvement in lipid panel results, with the most notable improvement usually in triglyceride levels.^{7,12,21,27,28,30} There have been several meta-analyses and systematic reviews that have looked at the outcomes of pharmacist interventions related to comprehensive care. A meta-analysis of diabetes care by pharmacists in the ambulatory care setting found a modest impact on systolic blood pressure and LDL-C.⁴⁸ Reviewing 14 studies, pharmacists had a statistically significant impact on systolic blood pressure with an improvement of 4.3 mmHg. Impacts on LDL-C were also significant. In 19 studies, the impact of pharmacist intervention led to a reduction in LDL-C by 10.6 mg/dL. Another meta-analysis reviewed 24 studies and found that there was an overall positive impact on blood pressure (−5.20 mmHg) and lipids (−0.16 mmol/L).⁵² A systematic review evaluated pharmacist interventions on blood pressure and lipid profile. Seven of 20 studies showed statistical significant improvements in blood pressure ranging from +3.45 to −10.6 mmHg. Seven of the 21 studies showed improvements in LDL-C ranging from +2.1 mg/dL to −27 mg/dL.⁵³ A second review similarly looked at pharmacist interventions, where they found that 10 of 12 studies showed improvements in blood pressure and 9 of 13 studies showed improvements in lipid panel.⁵⁴ This data demonstrates the importance of comprehensive care when managing diabetes.

Completion of preventative care measures is also commonly reported in studies that evaluate pharmacist managed diabetes programs. These measures include completion rates for annual retinal exams, monofilament testing for neuropathy, urine microalbumin testing, and administration of influenza and pneumococcal vaccinations. Studies consistently reported high attainment of core preventative care measures when a pharmacist is included on the patient's care team.^{7,10,15,17,18,21,23,27}

Patient Satisfaction

There are also studies that reported on patient quality of life, patient experience and satisfaction, and provider satisfaction. The pharmacist's training allows them to take into account multiple patient factors to select a medication to enhance patient satisfaction. In one study, patients who received pharmacist-managed diabetes care demonstrated improved quality-of-life measures.¹² Quality-of-life measures were assessed using the Diabetes Quality of Life (DQOL) questionnaire, which includes five different components: health level, satisfaction, impact, worry about disease, and worry about social and vocational issues. Patients in the pharmacist managed cohort were more satisfied, had a higher impact score, had less worry about their disease, and had a higher perceived health level compared with the control group.

Three studies evaluated patient satisfaction with pharmacist services. In the first study, patient satisfaction was evaluated via a 21-question survey adapted from the Diabetes Disease State Management Questionnaire (DDSM-Q) and a two-hour conversational-approach patient focus group to capture feedback regarding interactions with the pharmacist.¹⁹ The survey

assessed four areas of patient satisfaction: services received, the pharmacist, self-management, and diabetes education. Thirteen of the 21 questions had more than half of patients answer strongly agree, signaling strong satisfaction across all four areas. All focus group participants described positive relationships with their pharmacists. Focus group participants valued the ability to meet one-on-one with the pharmacist, speak with the pharmacist on a regular basis in between provider appointments, and described the pharmacist as person-centered because they were available, willing to talk on the phone, meet one-on-one, developed positive relationships, and provided true medication education. The second study assessed patient satisfaction through an abbreviated Clinicians and Group Consumer Assessment of Healthcare Providers and Systems (CG-CAHPS) survey.²⁹ Based on the abbreviated CG-CAHPS survey, patients were highly satisfied with pharmacist services. Pharmacist services were rated as “always” >90% of the time and were rated a 9/10 or a 10/10 in 97.4% of cases. The final study assessed patient satisfaction through the Satisfaction with Pharmacists (SWiP) scale. The scale included seven questions to assess satisfaction with the pharmacist services and three questions to assess satisfaction with telehealth services. Each response was based on a 5-point Likert scale with a maximum total score of 40. The investigators found an overall high median patient satisfaction score of 39.5 (IQR 36–40).⁵⁰

When pharmacists provided intensive diabetes care and education, pregnant patients had higher diabetes knowledge and higher quality of life scores than those patients who did not receive clinical pharmacist services. This was in addition to better clinical diabetes outcomes.⁴⁷

Provider Satisfaction

One study reported on provider satisfaction with pharmacist-managed diabetes services.¹⁹ Provider satisfaction was evaluated via a validated 11 question survey that measures provider satisfaction with pharmacists co-managing patients. Eleven out of 29 providers (38%) responded to the survey. The providers answered 73% of the questions with strongly agree. No providers responded strongly disagree, disagree or neutral for any question. In addition, it is important to take into account how pharmacist-led programs are implemented and communicated to the provider. In a study that reviewed how a new pharmacist CDTM was communicated to providers and the subsequent referrals, providers were more likely to refer patients when they were provided an individualized report card of their patients indicating who would benefit from a referral.⁵⁵ This led to high provider satisfaction (96%) with the overall program.

Pharmacist Comfort with Complex Care

Pharmacists are also capable of taking care of high-risk patients and providing patient education in community settings. In a survey of Sudanese community pharmacists caring for patients during Ramadan, most pharmacists felt comfortable identifying patients who had to break their fast and were able to make recommendations for meals to avoid hypoglycemia and prevent post-prandial hyperglycemia.⁵⁶ In a survey of community pharmacists in Norway, pharmacists were very willing to provide diabetes risk-assessment services, but wanted some guidance on how to recruit and identify patients.⁵⁷ In two focus groups of community pharmacists in the United Kingdom in conjunction with surveys of primary care physicians and nurses, researchers found that participants were very comfortable transitioning aspects of diabetes care to the community pharmacist. Thoughts on ways to enhance the program included increased education for technicians and enhanced education back to the primary provider.⁵⁸ These studies demonstrate the importance of pharmacist comfort-level while taking care of complicated patient populations.

ED Visits and Hospitalizations

The impact of pharmacist managed diabetes programs on emergency department (ED) visits, hospitalizations, and cost savings has also been assessed. One study compared the change in number of all-cause ED visits and hospitalizations for 12 months before and 12 months after the study entry between pharmacist-collaborative care and usual care groups. Both ED visits ($P = 0.0162$) and hospitalizations ($P = 0.0225$) decreased significantly after entry into the pharmacist-collaborative care group, resulting in a total savings and cost avoidance of \$633,015 for the 12-month follow-up period.⁷

Two other studies evaluated diabetes-related hospitalizations and diabetes-related ED visits for usual care compared to pharmacist-managed patient cohorts. In the first study, diabetes-related hospitalizations (10 vs 6, $p = 0.104$) and ED visits (27 vs 8, $p = 0.049$) decreased in the pharmacist managed cohort compared to the usual care group.⁸ In the second

study, there was a decrease in the number of hospitalizations in the pharmacist managed cohort, while those in the usual care group had an increase in the number of hospitalizations ($p = 0.06$).²⁰ Both the pharmacist managed and the usual care groups had increases in the number of ED visits, although the pharmacist managed cohort had an increase of four ED visits, while the usual care cohort had an increase of 16 ED visits ($p = 0.28$).

Transition of care studies related to diabetes management have reported similar outcomes. In one study, a 20-minute educational session during the hospital admission was found to reduce 30-day readmissions from 20.5% to 13.2%.³⁹ A second study found that establishing a pharmacist visit early post-transplant discharge for diabetes management was associated with a reduction in 30-day (17 vs 28) and 90-day (30 vs 37) all-cause readmission rates.⁵⁹ Another study found that a transplant diabetes-related transitions of care program was associated with a reduced hyperglycemia-related readmission rates (9 vs 1).⁴³

Cost Effectiveness

In a study by Anaya et al, average costs for inpatient hospitalizations and ED visits were compared with pre- and post-entry into a pharmacist managed diabetes service.²⁶ For patients with diabetes as the primary or secondary diagnosis, the combined average costs for inpatient hospitalizations and ED visits were significantly higher in the pre- versus the post-intervention period (\$2434 versus \$636, respectively; $p = 0.015$). Pre-intervention costs were higher than post-intervention costs for patients with a primary diagnosis of diabetes, but this difference was not significant (\$3082 versus \$696, respectively; $p = 0.100$). The lack of statistical significance was likely due to the small sample size ($n = 15$).

The economic impact of pharmacist-managed diabetes programs has been calculated based on published cost estimates that correlate improved A1c control with expected cost savings. Cost estimates come from a published study by Wagner et al which found an annual cost savings of \$685–\$950 per patient per year (1997 dollars) in total health care costs for patients with $\geq 1\%$ decrease in A1c.⁶⁰ The first study calculated cost avoidance using a savings estimate of \$1118 per patient for each patient who had a decrease of $\geq 1\%$ in HbA1c value.³⁰ Authors used the medical care component of the Consumer Price Index to inflate the average \$820 per year in 1997 dollars to \$1118 per year in 2011 dollars. Sixty-seven patients were included in the cost-avoidance analysis equating to an expected savings of \$74,906 - per year. The second study did not consider cost inflation in their analysis.⁹ Seventy-five patients (53%) experienced a 1% or greater reduction in A1C. Based on an estimated savings of \$820, total cost avoidance was calculated at \$61,500.

Implementation of an intensive diabetes program by an endocrinology-pharmacist was also largely cost-effective. Improving A1c in the pharmacist-led program versus primary care led to a 3-year cost-avoidance of \$5287 and a return on investment of \$9 per \$1 spent on the pharmacist program. In addition to the cost-effectiveness of lowering A1c, estimated medical costs were lower and quality adjusted life years (QALYs) were gained with the pharmacist-led program and predicted 10-year benefits in diabetes-related complications and all-cause mortality.⁶¹

Another study looked at total inpatient, outpatient, and pharmacy costs for patients enrolled in a pharmacist-led diabetes medication management program that was part of an integrated health system with its own health plan.¹⁴ Costs were evaluated from the perspective of the health plan and were compared from the year before enrollment to the second year of enrollment in the program. Patients in the pharmacist managed cohort had lower inpatient costs compared to the usual care patients, while outpatient costs were similar. Overall, pharmacy costs were significantly higher for patients in the pharmacist managed cohort, likely due to increased drug costs associated with expensive brand name diabetes medications. The authors noted a limitation of their study is that typically a time period of at least 3 to 5 years is needed to achieve a financial benefit from pharmacist-managed diabetes programs.⁶²

In a 5-year program of enhanced diabetes care by a pharmacist provided as part of an insurance benefit, the authors assessed total medical and pharmacy costs for patients 12 months before and after enrollment. Despite an increase in medication costs of \$603, medical costs decreased by \$1321 or 26% for a total savings of \$717 per patient per year for the employer.⁶³

One study reported on the financial viability of a pharmacist-managed diabetes service.²⁹ Assuming a no-show rate of 21–31%, authors calculated the average reimbursement for pharmacist appointments, which were predominately billed at 99213 (level 3) or 99214 (level 4). This was multiplied by the average number of patients seen per pharmacist for one year and then the pharmacist's salary and indirect costs were subtracted. Based on the revenue received by the health system, approximately 75% of each PharmD's salary and benefits were covered by the calculated revenue. This estimate

did not include additional income sources generated by the PharmD, such as quality-based outcome reimbursement payments from CMS.

Medication Adherence

The positive impact of the pharmacist on medication adherence has been well published and is no different in diabetes management. Interventions for medication adherence include medication education, device education, adherence calls and pillbox filling. One study evaluated the impact of the pharmacist through the use of telephonic interventions and medication adherence as measured by PDC. PDC is a common measure of adherence that looks at the proportion of days in which a patient is covered based on the prescription fill date and day supply. Patients with a PDC less than 80% were contacted by a pharmacist. After the intervention, 69% of patients on anti-hypertensives and 64% of patients on oral anti-diabetics were able to achieve a PDC greater than 80% within 3 months.⁶⁴

Education at the time of transition from inpatient hospital stay back to the outpatient setting can also impact medication adherence. In a randomized controlled trial of patients with an A1c >8% who had their diabetes medications filled at a pharmacy within the health system, education on discharge led to an improved PDC of 55.2% versus 34.8% ($p = 0.002$) and better follow-up visit adherence (60.5% vs 43.9%; $p = 0.01$).³⁸ This demonstrates the high impact pharmacists can have at the time of discharge, especially within a health system that manages all of the care for the patient.

In another study, personalized calls by the pharmacist were completed to patients who were overdue for refills of oral diabetes prescriptions by 6 days or more. The pharmacist provided personal calls to identify key challenges by refilling their prescriptions followed by completing an intervention. The investigators found that the most common patient reported adherence challenges were difficulty taking medications (27.1%), remembering the dose (24.6%), and forgetting to order a refill (26.3%). Interventions performed by the pharmacist included medication education (35.6%), glucose meter education (28%), and adherence support strategy implementation (40.7%). When compared to the standard of care, the intervention group had a significantly greater medication possession ratio (MPR).⁶⁵

Next Steps for the Role of the Pharmacist

Pharmacist-led diabetes management models have evolved over the course of the past few years. Early practices originated in the development of programs to enhance medication counseling opportunities with the ultimate goal of improving adherence. Now, models have evolved to incorporate traditional counseling with overall disease state management. Depending on the area, pharmacists may also have prescriptive authority or enter into a CDTM agreement with a licensed clinician to expand their scope. Each of the models that were reviewed has shown overall success in clinical outcomes, medication adherence measures, and more. Additionally, the integration of technology, such as telemedicine and RPM, has provided greater tools for the pharmacist to expand their reach and help bridge gaps in care. So what does the future role of the pharmacist look like in diabetes care?

Gaps in healthcare remain as the shortage of PCPs continues.⁶⁶ Pharmacists remain positioned in an opportune place to bridge this gap and to provide services at an expedited time. Some studies have suggested that more frequent follow-up visits can be beneficial to improving rates of attaining diabetes goals. Therefore, by working with available PCPs, pharmacists can act as extenders to provide high-quality care for at risk individuals between their other clinician appointments. Pharmacists may also continue to expand their services into different patient populations. Currently, the majority of embedded pharmacists who help manage diabetes care exist within the primary care setting. However, specialty populations, such as pregnancy, incarcerated individuals, indigent persons, and so on, require greater access to care or different levels of care that the pharmacist can help bridge. Widespread implementation of these services and models will be dependent on changes in the legislature to expand the scope of pharmacy practice and present opportunities for billing.

As technology continues to advance, more patients will become adopters of medical devices to enhance their care. In this manner, the pharmacist is able to combine their existing services of providing disease state management and medication education with medical device education. CGM can also be utilized to increase access to patient data ahead of the visit to allow for more quality discussion and disease state education during a patient visit. However, this remains not readily available to all patients based on insurance restrictions. Use of smart insulin pens has also been on the rise. Many of these pens are able to provide real-time feedback to patients on how much bolus insulin to inject by

calculating insulin requirements based on inputted information. This type of technology may become more prevalent and could impact the quality of diabetes care.

Overall, as legislature changes, services are developed, and technology evolves, the integration of the pharmacist into the ambulatory setting becomes imperative to the delivery of high-quality care.

Disclosure

The authors report no conflicts of interest in this work.

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