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Original Article

Treat to Goal: Impact of Clinical Pharmacist Referral Service Primarily in Diabetes Management

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Abstract

Purpose: To describe the impact of pharmacist services in a collaborative practice providing care to primarily Medicaid and indigent patients. The practice includes primary care physicians, nurses, a care navigator, and pharmacists. Pharmacy services are provided by pharmacists, including PGY-1 pharmacy residents and pharmacy students.

Methods: A retrospective chart review was conducted to perform a pre-post analysis on all patients referred to pharmacists within an adult medicine clinic. Patients were included if they were more than 18 years old; were referred for type 1 or 2 diabetes mellitus, hypertension, hyperlipidemia, or medication reconciliation; and were seen from August 2010 to March 2011. All charts were reviewed to assess pharmacist impact on adherence to standards of care including hemoglobin A1c; lipids; blood pressure; vaccination status; usage of aspirin, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, and statins; and other criteria. Subgroup analysis was performed on diabetic patients who were not at goal at the time of referral to the pharmacy clinic.

Results: Ninety-three charts were reviewed. In the overall group, rates of influenza and pneumococcal vaccination improved significantly, as did annual foot and eye exams in diabetics. Pharmacists significantly decreased A1c from 9.12% at baseline to 8.13% ($P < .001$), systolic blood pressure (SBP) from 142.6 to 133.5 mm Hg ($P < .001$), and low-density lipoprotein (LDL) from 143.6 to 103.2 mg/dL ($P < .001$) in diabetic patients who were not at goal at baseline.

Conclusions: Pharmacists were effective in improving surrogate outcomes for patients with diabetes and in assisting physicians to address all standards of care.

Key Words—diabetes mellitus, hyperlipidemias, pharmacists, pharmaceutical services, standard of care, vaccination

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Diabetes mellitus (DM) is associated with morbidity and mortality and significant costs to the health care system. It affects an estimated 25.8 million people, or 8.3% of the US population. Diabetes is the seventh leading cause of death and is the leading cause of blindness, kidney failure, and nontraumatic lower extremity amputations. Moreover, diabetes is associated with poorer prognosis in illnesses such as influenza and pneumonia, increased risk for stroke, death due to heart disease, and damage to the nervous system resulting in gastroparesis, neuropathies, and erectile dysfunction. In total, the disease costs the United States $174 billion dollars per year, including direct and indirect costs.[1]

The American Diabetes Association (ADA) publishes guidelines that are updated yearly with recommendations that are known or believed to favorably affect health outcomes in patients with diabetes. The ADA recommends targeting an A1c of <7% to prevent microvascular complications and, if implemented soon after diagnosis, for long-term reduction in macrovascular disease. Blood pressure (BP) is recommended to be lower than 130/80 mm Hg to prevent microvascular and macrovascular outcomes. Lipids, specifically

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low-density lipoproteins (LDL), are recommended to be lowered to <100 mg/dL to prevent macrovascular outcomes.[2]

Most data in the prevention of diabetic complications are from utilization of HMG-CoA reductase inhibitors (statins), angiotensin-converting enzyme inhibitors (ACE-I) or angiotensin receptor blockers (ARBs), and aspirin. Although these drugs are not routinely indicated for all diabetes patients without compelling indications, they are a cornerstone of therapy due to the common frequency of concomitant comorbidities. Patients with type 1 or 2 diabetes who have overt cardiovascular disease or equivalent risk factors, hyperlipidemia, hypertension, varying degrees of albuminuria, who smoke, or who have other indications qualify for these medications.[2]

Smoking worsens macrovascular and microvascular outcomes in patients with diabetes. Thus, diabetes care should include routine counseling on smoking cessation and pharmacologic treatment options to aid in smoking cessation. Among its many detrimental effects, smoking significantly worsens peripheral arterial disease and greatly increases the risk of patients developing ulcers.[2] Smoking inhibits ulcer healing, which may lead to amputation.[3]

Diabetics, especially those with cardiac and chronic kidney disease, are more prone to infections, such as influenza and pneumonia, due to abnormalities in immune system function.[4,5] Vaccination with the annual influenza vaccine in diabetes patients 6 months of age and older is recommended to prevent hospitalization and complications from influenza. Studies have shown that vaccination can decrease hospital admissions by as much as 79% during flu epidemics.[4] The pneumococcal polysaccharide vaccine is indicated for patients 2 years of age and older, and it is to be repeated when patients turn 65 (unless previous vaccine was ≤5 years ago) or in other conditions such as nephrotic syndrome or post organ transplantation.[2,5] The booster dose of pneumococcal vaccine at age 65 is recommended due to increased risk of morbidity and mortality in patients older than 64 years.[5]

Screening for disease progression and prevention of complications is necessary for optimal diabetes management. Hemoglobin A1c should be obtained every 2 to 3 months for persons who have A1c >7% or are not at their personalized goal. Lipid panel, comprehensive foot check, and dilated eye exam should be completed annually. Annual spot urine albumin excretion tests are recommended by the ADA, but the test and treatment options based on extent of albumin per gram of creatinine are now under controversy.[6] BP should be checked at every routine diabetes visit.[2] These measures can result in earlier detection of diabetes complications at a time when intervention may prevent further damage.[2]

Despite the evidence, rates of accomplishing standards of care are low. National rates derived from data from 1999 to 2006 for diabetic patients who are at goal for A1c, BP, and cholesterol are just 57.1%, 45.5%, and 46.5%, respectively. Only 12.2% of patients achieve all 3 targets simultaneously.[7] National data from 2009 reveal that annual foot exams and eye exams are performed in 67.3% and 62.7% of diabetics and that vaccination rates for influenza and pneumonia are 49.5% and 43.0%, respectively. Routine labwork, such as the minimum requirement of A1c tests twice a year (assuming controlled diabetes), is performed in only 72% of patients.[8]

Control of diabetes and other chronic disease states presents a major challenge to the indigent patient population. This population has difficulty accessing primary and specialized medical care, prescription drugs, and healthy food choices such as fresh fruits and vegetables. With health care costs on the rise, a physician shortage,[9] and the limited time and resources physicians have to comprehensively manage chronic disease states, there is the need for increased efficiency in the health care system. There is also difficulty translating guidelines for diabetes into clinical practice in areas with a high prevalence of indigent patients.[10]

In 2005, a pharmacy resident–based clinic was established at an adult medicine outpatient clinic. Uncontrolled diabetes is the primary reason for referrals, and many of these patients have concurrent hypertension and hyperlipidemia. Other reasons for referrals are smoking cessation and medication reconciliation for complicated regimens. The objective of this study was to determine the effect of pharmacist interventions on adherence to the ADA guidelines for diabetes and on control of diabetes, hypertension, and hyperlipidemia.

METHODS

A retrospective medical chart review to conduct a pre-post analysis of data was approved by the ProMedica Health System Institutional Review Board. Inclusion criteria for charts to be reviewed were patients older than 18 years who were referred to and seen by a pharmacist between August 1, 2010, and March 1, 2011, for type 1 or type 2 DM, hyperlipidemia, hypertension, smoking cessation, or medication reconciliation. If a patient was referred for medication reconciliation, he or she also had to have one of the aforementioned chronic disease states for

inclusion into the study. Data were then retrospectively collected from the most current visit back to 2005 or the earliest date the patient was seen by a pharmacist. Patients referred for all other reasons were excluded from the chart review. All possible interventions and/or referrals for interventions were performed by the pharmacists when needed as determined by the physician/pharmacist/patient team. The potential interventions by a pharmacist are included in **Table 1**.

The scope of chronic disease state management in collaboration with the physician and patient included counseling on lifestyle factors affecting the disease(s); medication initiation, discontinuation, or dosage adjustments; and point-of-care testing (blood glucose, blood pressure) and other key components of diabetes education. Members of the collaborative practice care team included 4 physicians, a nurse practitioner, 2 PGY-1 pharmacy residents, 2 clinical pharmacist preceptors, pharmacy students, a nurse care navigator, registered nurses, and medical assistants. Pharmacy residents conducted face-to-face patient visits with occasional phone calls to monitor drug therapy adjustments such as insulin titration. The residents would then meet with the clinical pharmacist preceptor and primary care physician to determine the treatment plan.

Data were collected using patient charts located at the adult medicine clinic and an electronic clinical data repository. Data collected included patient demographic information (age, height, insurance status, etc), information about allergies, and information related to appropriate use of medications and interventions recommended in ADA standards of care. Data included chronic disease states, A1c, BP, lipid panel, adherence to annual foot and eye exam, and recommended drugs or vaccinations per appropriate guidelines. If a patient referred to the clinic did not have diabetes but had hypertension, hyperlipidemia, or other conditions, the appropriate national guidelines were used and applied.[11-15]

Table 1. Potential pharmacist interventions and referrals

Interventions	Diabetes management
	Hypertension management
	Smoking cessation
	Hyperlipidemia management
	Medication reconciliation
	Vaccination (pneumococcal, influenza)
	Labwork recommendations (albumin/creatinine ratio, lipid panel, A1c)
Referrals	Annual diabetic comprehensive foot check
	Annual diabetic eye exam

All patients were evaluated for the overall adherence rate on recommended medications (ACE-I/ARBs, statins, and aspirin). Data were evaluated to determine diabetic patients who had not yet received an annual comprehensive foot check and eye exam, as well as for appropriate candidates for vaccination against influenza and pneumonia. Subgroup assessment included the pre-post analysis of all patients seen in the pharmacy clinic for a minimum of 3 months for the following: smoking status, mean pre-post A1c, BP, and LDL, and pharmacy visits per patient per year (PPPY). Patients were further analyzed to include only uncontrolled diabetic patients seen for 3 months or longer for pre-post changes with a baseline A1c $\geq$ 6.5%, BP $\geq$ 130/80 mm Hg, or LDL $\geq$ 100 mg/dL.

Data were collected and analyzed independently. Descriptive statistics were analyzed in a pre-post analysis using a 2-sided paired Student *t* test. Dichotomous data were compared using the chi-square test. An a priori significance level of .05 was used for all statistical tests.

RESULTS

A total of 93 patients' charts were reviewed and included in the overall analysis. Baseline characteristics are provided in **Table 2**.

Patients who were seen in the pharmacy clinic for at least 3 months utilized pharmacy services an average of 7.8 times PPPY, including face-to-face visits and phone consultations. Pharmacists had no significant impact on smoking cessation, as only 1 of 13 smokers quit in the group that had at least 3 months' follow-up with pharmacists ($P = .82$).

A mean reduction in A1c of 0.99% was seen in the group that was seen by pharmacists for 3 months or more, representing a change from 9.12% at baseline to 8.13% (95% CI, 0.23 to 1.75; $P < .001$). Forty-six patients were further analyzed to include only uncontrolled diabetics with a baseline A1c of $\geq$6.5%. A mean reduction of 1.17%, representing a change from 9.42% to 8.25%, was found (95% CI, 0.39 to 1.95; $P < .001$). The number of patients at goal A1c increased from 4 (9%) to 13 (28%) ($P = .016$).

In overall BP, there was a mean SBP reduction of 1.3 mm Hg (95% CI, -5.1 to 7.7; $P = .57$) and a mean DBP increase of 0.4 mm Hg (95% CI, -3.67 to 4.47; $P = 0.79$), representing changes of 131.2 to 129.9 mm Hg and 80.5 to 80.9 mm Hg in the SBP and DBP,

Table 2. Baseline characteristics for overall study population

Characteristics	Average ± SD[a]
Total patients, n	93
Age	50 ± 13.5 years (range, 24-92)
No. of chronic medications	9 ± 4
Uninsured patients, n (%)	28 (30)
BMI[b]	34.52 ± 9.85 kg/m^2
Length of follow-up	327 days
No. of smokers (%)	38 (41)
A1c[c]	8.91 ± 2.14% (range, 5.8%–14.5%)
SBP[d]	128 ± 18 mm Hg (range, 90-172)
DBP[d]	80 ± 11 mm Hg (range, 58-118)
LDL[e]	110 ± 47 mg/dL (range, 10-341)
Reason for consult	**No.**
DM type 1	3
DM type 2	79
HLD	3
Smoking cessation	4
Medication reconciliation	4

Note: BMI = body mass index; DBP = diastolic blood pressure; DM = diabetes mellitus; HLD = hyperlipidemia; LDL = low-density lipoprotein cholesterol; SBP = systolic blood pressure.
[a]Unless otherwise indicated.
[b]23 patients without either baseline height or weight.
[c]7 patients without baseline A1c.
[d]5 patients without baseline blood pressure.
[e]11 patients without baseline LDL.

respectively. Of the 93 patients, 33 (all of whom had also been diagnosed with diabetes) had either uncontrolled SBP or uncontrolled DBP or both with a baseline BP of ≥ 130/80 mm Hg at the time of referral. In this group, the mean SBP decreased from 142.6 to 133.5 mm Hg, yielding a decrease of 9.1 mm Hg (95% CI, 3.15 to 15.09; $P < .001$). DBP decreased from 86.5 to 82.9 mm Hg, a decrease of 3.6 mm Hg (95% CI, -0.7 to 7.9; $P = .07$). The number of patients at goal SBP and DBP increased from 4/33 (12%) to 13/33 (39%) ($P = .011$) and 2/33 (6%) to 9/33 (27%) ($P = .020$), respectively.

Mean LDL was reduced by 21 mg/dL in the overall group seen by pharmacists for 3 months or longer, dropping from 111.4 to 90.4 mg/dL (95% CI, 4.8 to 37.2; $P = .001$). Of the 27 diabetic patients with uncontrolled LDL, the average LDL decreased from 143.6 to 103.2 mg/dL, a total of 40.4 mg/dL (95% CI, 17.4 to 63.4; $P < .001$). By default, no patients in this group were at goal to start. However, 17 patients were at goal LDL after seeing a pharmacist (63%).

Rates of vaccination against influenza and pneumonia were significantly improved after a patient was seen by a pharmacist. Recommended annual eye exams and foot checks revealed improvement that was statistically significant, whereas the only improvement in adherence to recommended therapies was use of statins in appropriate candidates (see **Table 3**).

DISCUSSION

Pharmacist intervention significantly reduced patients' A1c. Current diabetes medications that are US Food and Drug Administration (FDA)–approved lower A1c by 0.5% to 2.5%. Moreover, for every 1% increase in A1c, there is an associated 14% increase in mortality and 21% increase in diabetes-related mortality.[16] The finding that A1c lowered nearly 1% in the overall group and more than 1% in the uncontrolled group is clinically significant.

The average BP values of patients referred to pharmacy at baseline were at or near goal. Although it was not a goal of the pharmacists' interventions to significantly decrease the SBP in patients at the time of referral, the average still was above the goal SBP of <130 mm Hg and pharmacists were ineffective in lowering DBP to <80 mm Hg. Pharmacists set their

Table 3. Standards of care adherence rates per ADA or other appropriate guidelines

	Before n/N(%)	After n/N(%)	Difference	*P* value[a]
ACE or ARB use	52/82 (63%)	63/82 (77%)	+11 (14%)	.061
Aspirin use	30/80 (38%)	41/80 (51%)	+11 (14%)	.080
Statin use	46/85 (54%)	59/85 (69%)	+13 (15%)	.040
Influenza vaccine	28/92 (30%)	41/92 (44%)	+13 (14%)	.048
Pneumonia vaccine	27/86 (31%)	45/86 (52%)	+18 (21%)	.005
Foot check	21/82 (26%)	40/82 (49%)	+19 (23%)	.002
Eye check	11/82 (13%)	22/82 (27%)	+11 (14%)	.032

Note: ACE = angiotensin-converting enzyme; ADA = American Diabetes Association; ARB = angiotensin receptor blocker.
[a]*P* value was calculated using chi-square test (significance level at $< .05$).

priorities on the most significant problems first (such as a significantly elevated baseline A1c), and then targeted other parameters not at goal in follow-up visits. It should also be noted that ADA recommendations for BP are largely based on the ACCORD trial, whose only primary outcome with a significant decrease was stroke and nonfatal stroke, with a number needed to treat to prevent 1 stroke over 5 years of 89 patients.[17] As such, guidelines acknowledge that the greatest benefit comes from decreasing SBP to <140 mm Hg, and goals may be less stringent.[2]

Pharmacists' interventions were consistently effective in lowering LDL. Sixty-three percent of diabetic patients with elevated LDL at baseline achieved goal LDL. Pharmacists' interventions lowered the LDL 28% from baseline. This is in line with the recommendation that all patients should have at least a 30% to 40% reduction in LDL if goal LDL cannot be achieved.[2] The TNT-DM trial lowered LDL 22% from baseline, resulting in a 4.7% absolute risk reduction[18]; the CARE-DM trial lowered LDL 27% from baseline, resulting in a 5.4% absolute risk reduction.[19] Even though patients were not lowered to goal, their risk for cardiovascular events was reduced.

Healthy People 2020 set high goals for vaccinations and diabetic standards of care, but these goals are more likely to be reached when adequate time and resources are made available to physicians to provide such care. The current goal target for influenza vaccination is set at 90% for all high-risk adults (ie, diabetes) regardless of age. Pneumococcal vaccination has the same target for adults 65 years old and older, but it is lower at 60% of all high-risk adults who are 18 to 64 years old.[20] Although the clinic rates were far below national goals, pharmacists had a significant effect in reaching these goals. This was especially evident for the pneumococcal vaccine that was commonly missed in the primary care practice.

By design, this study was limited by its retrospective analysis and not controlling for confounding factors, such as patients often seeing multiple health care practitioners. The study was also limited by the high percentage of indigent patients and the associated difficulties of these patients in obtaining medications and other diabetes-related supplies and traveling to clinic appointments. Another weakness was that patient referrals were primarily for type 2 diabetics, so there were no reliable data on pharmacist interventions in persons with only hypertension, hyperlipidemia, smoking cessation, or any combination of these.

Although national standards were used in our study, patient-centered care that focuses on the needs, preferences, and tolerances of each patient is being emphasized in more recent guidelines.[2,21,22] Short-term disease-oriented outcomes were measured rather than patient-oriented outcomes such as progression to dialysis or retinopathy and mortality, which would require longer follow-up. Even so, this study further demonstrates how pharmacists can improve disease state management primarily in diabetes.

The current health care problems of inflated costs and patients' lack of accessibility to currently recognized health care providers illustrate the need to reevaluate the role of pharmacists in disease management. State laws and billing methods need to be modernized to facilitate rather than hinder collaborative practices between pharmacists and physicians. Pharmacists have extensive medication knowledge for managing disease and, with the proper pharmacist-physician communication, they can positively impact overall care.

CONCLUSION

This study showed that pharmacists were effective in lowering A1c, LDL, and SBP in diabetes patients who were in need of intervention. Other standards of care were significantly improved, including pneumococcal

and influenza vaccination rates. Pharmacists can have a significant impact within the health care team and are accessible health care professionals who can help to promote high rates of adherence to standards of care for chronic disease states, especially diabetes. By improving surrogate outcomes using evidence-based medicine, pharmacists can decrease health costs, morbidity, and mortality.

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