# Pharmacist Assisted Medication Program Enhancing the Regulation of Diabetes (PAMPERED) study

**Michelle Jacobs, Pamela S. Sherry, Leigh M. Taylor, Mary Amato, Gary R. Tataronis, and Gary Cushing**

## Abstract

***Objectives:*** To demonstrate that pharmacists working with physicians and other providers in an ambulatory care setting can improve glucose, blood pressure, and lipid control for patients with type 2 diabetes and to report patient adherence to screening and general preventive measures.

***Design:*** Prospective, randomized, clinical practice study.

***Setting:*** Burlington, MA, between January 2001 and August 2003.

***Patients:*** 164 patients patients with type 2 diabetes older than 18 years with glycosylated hemoglobin (A1C) greater than 8%.

***Intervention:*** Pharmacist–patient clinic visits included obtaining a comprehensive medication review; performing targeted physical assessment; ordering laboratory tests; reviewing, modifying, and monitoring patients' medication therapy and providing detailed counseling on all therapies; facilitating self-monitoring of blood glucose; and providing reinforcement of dietary guidelines and exercise.

***Main outcome measure:*** Effect of clinical pharmacists working with physicians in an ambulatory setting on health measures (e.g., A1C, blood pressure, cholesterol) of patients with diabetes.

***Results:*** Baseline characteristics were similar between the two groups. After 1 year, significant improvements occurred for A1C and low-density lipoprotein (LDL) cholesterol in the intervention group compared with the control group (A1C, 7.7% vs. 8.4%; LDL, 93.7 vs. 105.1 mg/dL; $P < 0.05$). Systolic blood pressure improved for all study patients without a difference between the two groups. Diastolic blood pressure improved significantly in the intervention group compared with the control group (73.4 mm Hg vs. 77.6 mm Hg, $P < 0.05$). Significantly more intervention patients were screened for retinopathy, neuropathy, and microalbuminuria than control patients ($P < 0.05$).

***Conclusion:*** For all indices measured, this study demonstrated that collaborative diabetes management with a clinical pharmacist can improve overall care.

***Keywords:*** Diabetes, pharmacists, ambulatory care.

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**Michelle Jacobs, PharmD, CDE,** was Clinical Pharmacist Practitioner, Pharmacotherapy Clinic, Lahey Clinic, Burlington, MA, at the time this study was conducted; she is currently Assistant Clinical Professor, School of Pharmacy, Northeastern University, Boston. **Pamela S. Sherry, PharmD,** is Manager and Clinical Pharmacist Practitioner, and **Leigh M. Taylor, PharmD, BCPS, CDE,** is Clinical Pharmacist Practitioner, Pharmacotherapy Clinic, Lahey Clinic, Burlington, MA. **Mary Amato, PharmD, MPH, BCPS,** was Clinical Pharmacist Practitioner, Pharmacotherapy Clinic, Lahey Clinic, Burlington, MA, at the time this study was conducted; she is currently Associate Professor, Massachusetts College of Pharmacy and Health Sciences, Boston. **Gary R. Tataronis, MS,** is Associate Professor of Statistics and Mathematics, Massachusetts College of Pharmacy and Health Sciences, Boston. **Gary Cushing, MD,** is Department Chair Endocrinology, Diabetes and Metabolism, Lahey Clinic, Burlington, MA; Associate Clinical Professor, School of Medicine, Tufts University, Medford, MA; and Clinical Instructor, Harvard Medical School, Boston.

**Correspondence:** Michelle Jacobs, PharmD, CDE, School of Pharmacy, Northeastern University, 140 The Fenway, Room 218, 360 Huntington Ave., Boston, MA 02115. Fax: 617-373-7655. E-mail: m.jacobs@neu.edu

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Diabetes is a leading cause of morbidity and mortality. In the United States, 25.8 million people or 8.3% of the population have diabetes and it is the seventh leading cause of death. Diabetes imposes a high cost burden to the health care system, and in 2007, the total cost attributed to diabetes was estimated to be $174 billion.[1] Evidence indicates that good glycemic control can reduce micro- and macrovascular complications in type 1 diabetes[2,3] and reduce microvascular complications in patients with type 2 diabetes.[4–7] Thus, caring for patients with diabetes involves managing blood glucose as well as cardiovascular risk factors.

Guidelines from the American Diabetes Association (ADA) are aimed at preventing both micro- and macrovascular complications through use of screening tools, medication, and lifestyle modifications.[8] Despite an increase in focus and reporting of standards of medical care for patients with diabetes, one of five patients in the United States is estimated to not have good control of their blood glucose. In addition, two of five patients continue to have poor control of low-density lipoprotein (LDL) cholesterol and one of three patients have poor blood pressure control.[9]

### At a Glance

**Synopsis:** Clinical pharmacists with training and experience in diabetes care can help patients achieve therapeutic goals, as demonstrated by this study of pharmacists working in an ambulatory general internal medicine setting with physicians and other providers during a 1-year period. Glycosylated hemoglobin, low-density lipoprotein cholesterol, and diastolic blood pressure improved significantly in the intervention compared with the control group, and systolic blood pressure improved for all study patients. Significantly more intervention than control patients were screened for retinopathy, neuropathy, and microalbuminuria.

***Analysis:*** *Pharmacists in the current study were able to address overall medication therapy and, upon physician approval, adjust medications to achieve therapeutic goals for blood pressure and lipids as well as glucose control. Because of their extensive training in pharmacotherapeutics of chronic diseases, clinical pharmacists are ideally prepared to assume a role as team members assisting in the care of patients with diabetes. In addition, many pharmacists obtain specialized residency training to prepare for a direct patient care role. Clinical pharmacists practicing in collaborative settings are increasingly working with primary care providers to help manage patients with chronic conditions requiring drug therapy. Most states now have legislation documenting collaborative drug therapy management as an important role for pharmacists.*

An interdisciplinary approach is key to the success of controlling diabetes and its complications. The value of pharmacists producing positive outcomes for patients through disease management has been well documented in the literature.[10–14] Several studies have shown that pharmacist involvement in diabetes care improves glycemic control.[15–18] Studies also have assessed pharmacist management of glycemic control and adherence to ADA guidelines.[19–35] When the current study was being designed, many available studies were retrospective, lacked a randomized control group, had a small study sample, or were short term. Since the conclusion of the current study, more trials have investigated the benefit of pharmacist involvement in managing type 2 diabetes.[36–39] However, we feel that because of its randomized prospective design and larger sample size, our study is unique and adds value to this growing body of evidence.

## Objectives

The primary objective of this study was to demonstrate that pharmacists working with physicians and other providers in an ambulatory care setting can improve glucose, blood pressure, and lipid control for patients with type 2 diabetes. Secondary objectives included whether patients adhered to screening and general preventive measures.

## Methods

The PAMPERED (Pharmacist Assisted Medication Program Enhancing the Regulation of Diabetes) study is a prospective, randomized, clinical practice study examining the impact on care of patients with type 2 diabetes by pharmacists working in an ambulatory general internal medicine setting with physicians and other providers during a 1-year period. The Lahey Clinic Institutional Review Board reviewed and provided approval for the study protocol, which enrolled patients at the Lahey Clinic in Burlington, MA, between January 2001 and August 2003. Consent was required for all intervention patients but waived for control patients to reduce the likelihood of bias from both physicians and patients, thereby maintaining the current standard of practice in the control group. Patients were not matched.

All 66 primary care physicians were educated regarding the study protocol before patient enrollment, and all but two physicians agreed to include their patients in the initial screening. Patients were selected through a query of the Sunquest Laboratory Data System at Lahey Clinic for patients older than 18 years with a documented glycosylated hemoglobin (A1C) value greater than 8% obtained more than 6 months before the data acquisition date. At the time, Lahey Clinic had a combination of electronic and paper records, both of which were reviewed by a pharmacist to determine patients to screen for eligibility. Patients were excluded if they received primary care outside of the Lahey Clinic Burlington campus, were diagnosed with type 1 diabetes, had an A1C less than 8% within 6 months of randomization, were enrolled in any other pharmacist-run or diabetes management study, were receiving diabetes management by an outside endocrinologist, or were unable to adhere to scheduled follow up.

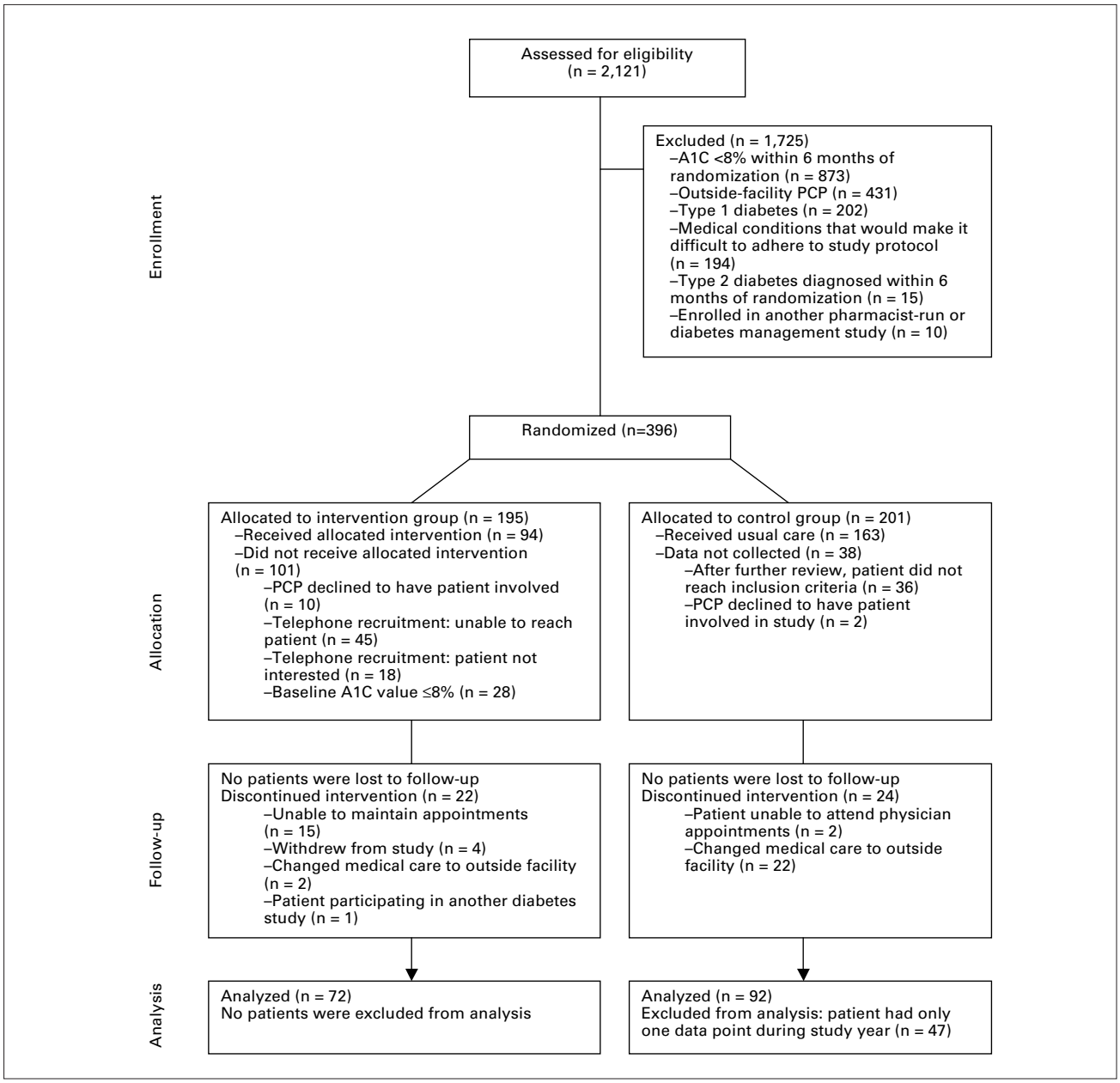


**Figure 1.** Flow diagram of patient progress in the PAMPERED study

Abbreviations used: A1C, glycosylated hemoglobin; PAMPERED, Pharmacist Assisted Medication Program Enhancing the Regulation of Diabetes; PCP, primary care provider.

Patients were seen by one of five clinical pharmacist practitioners who had PharmD degrees and, at minimum, postgraduate residency training with emphasis in ambulatory care practice and experience in directly caring for patients with chronic diseases. Four of the five pharmacists worked at least 10 years in ambulatory care practice at the time of study. The lead investigator was paid by the study sponsor, and the other pharmacists were paid by the institution.

Patient progress is outlined in Figure 1. Eligible patients were randomized to either an intervention or control group using a computer randomized sequence of ones and zeros. Primary care physicians were unaware of which patients were randomized to the control group but were informed of which patients were in the intervention group because any therapy and monitoring recommendations required approval by the patient's physician and because all notes and visits were documented in the medical record. Patients randomized to the

intervention group were contacted by telephone and asked to participate. No financial incentive was offered to patients for participating. Those interested were required to sign an informed consent form that provided an appraisal of the potential risk and benefit of participation in the study. Patients receiving intervention were required to attend a minimum of three clinic visits with a clinical pharmacist at baseline, 6 months, and 12 months for focused preventive and secondary diabetes management. Additional visits were arranged as clinically appropriate for therapeutic drug monitoring.

Pharmacist–patient clinic visits included obtaining a comprehensive medication review (i.e., review of medications, including prescription, over-the-counter [OTC] products, herbal remedies, and dietary supplements); performing targeted physical assessment including weight, height, blood pressure, pulse, and foot exam; educating on diabetes pathophysiology and importance of control; ordering laboratory tests; reviewing, modifying, and monitoring patients' medication therapy and providing detailed counseling on all therapies; facilitating self-monitoring of blood glucose; and providing reinforcement of dietary guidelines and exercise. Referrals were facilitated to other clinicians when indicated, including ophthalmology, podiatry, nutrition, and primary care for follow up of acute or other chronic issues or when requested by patients.

The pharmacists' recommendations for initiation, discontinuation, or adjustment of medications, laboratory monitoring, and referrals were based on the most recent guidelines and clinical trial evidence and communicated via chart note, telephone, e-mail, or face-to-face interaction with primary care physicians. Chart notes followed a standardized format for all patients followed by a pharmacist. Any adjustment in therapy, laboratory testing, or referral to other services required approval by the referring physician before being implemented by the pharmacist. A1C, lipid, and blood pressure values were collected at baseline, 6 months, and 12 months (±1 month) prospectively during the 12-month study period for intervention patients.

Control patients received usual care directed by their physician, and the same data were gathered from chart review during the 12-month study period. All laboratory measures were collected through the centralized laboratory at the clinic. A minimum of two results were required for A1C, lipid, and blood pressure values for the 12-month study period for patients to be included in data collection. Patient data collected included patient age at the time of study, comorbid diseases (e.g., hypertension, dyslipidemia, cardiovascular disease), medication history (for the control group, limited to history documented in the medical record), smoking status, weight, height, body mass index (BMI), urine microalbumin, evidence of retinopathy, evidence of neuropathy, and number of diabetes-related visits.

Primary outcomes included achieving targets for A1C (≤7%), LDL cholesterol (≤100 mg/dL) and blood pressure (≤130/80 mm Hg).

**Table 1.** Baseline characteristics of patients in the PAMPERED study

| Characteristic | Intervention group No. (%) | Control group No. (%) | *P* |
|---|---|---|---|
| n | 72 | 92 | |
| Age (years), mean ± SD | 62.7 ± 10.8 | 63.0 ± 11.2 | 0.86 |
| Men | 49 (68) | 51 (55) | 0.15 |
| White race/ethnicity | 59 (82) | 66 (72) | 0.21 |
| Current smoker | 9 (13) | 9 (10) | 0.62 |
| Family history of premature heart disease | 21 (29) | 16 (17) | 0.09 |
| Comorbid diseases | | | |
| Hypertension | 50 (69) | 54 (59) | 0.19 |
| Coronary heart disease | 25 (35) | 30 (33) | 0.87 |
| Dyslipidemia | 60 (83) | 71 (77) | 0.43 |
| **Evidence of:** | | | |
| Retinopathy | 23 (32) | 31 (34) | 0.87 |
| Nephropathy | 29 (40) | 32 (35) | 0.52 |
| Neuropathy | 31 (43) | 29 (32) | 0.14 |

Abbreviation used: PAMPERED, Pharmacist Assisted Medication Program Enhancing the Regulation of Diabetes.

**Table 2.** A1C, LDL cholesterol, and blood pressure values of patients in the PAMPERED study

| Characteristic | Intervention group Mean ± SD | Control group Mean ± SD | *P* |
|---|---|---|---|
| n | 72 | 92 | |
| **A1C (%)** | | | |
| Baseline | 9.5 ± 1.1 | 9.2 ± 1.0 | 0.070 |
| 6 months | 8.1 ± 1.2 | 8.2 ± 1.2 | 0.597 |
| 12 months | 7.7 ± 1.3 | 8.4 ± 1.6 | 0.003[a] |
| **LDL cholesterol (mg/dL)** | | | |
| Baseline | 121.5 ± 31.8 | 115.1 ± 34.8 | 0.227 |
| 6 months | 107.4 ± 29.9 | 116.9 ± 39.0 | 0.079 |
| 12 months | 93.7 ± 21.2 | 105.1 ± 34.3 | 0.010[a] |
| **SBP (mm Hg)** | | | |
| Baseline | 142.5 ± 15.2 | 134.8 ± 16.9 | 0.003[a] |
| 6 months | 132.8 ± 15.6 | 135.4 ± 18.3 | 0.337 |
| 12 months | 132.5 ± 16.3 | 135.4 ± 14.0 | 0.223 |
| **DBP (mm Hg)** | | | |
| Baseline | 79.4 ± 9.9 | 78.3 ± 10.4 | 0.493 |
| 6 months | 73.4 ± 9.0 | 77.6 ± 10.5 | 0.008[a] |
| 12 months | 72.0 ± 8.5 | 77.6 ± 8.4 | 0.001[a] |

Abbreviations used: A1C, glycosylated hemoglobin; DBP, diastolic blood pressure; LDL, low-density lipoprotein; PAMPERED, Pharmacist Assisted Medication Program Enhancing the Regulation of Diabetes; SBP, systolic blood pressure.
[a]Statistically significant ($P < 0.05$).

## Statistical analysis

Descriptive statistics consisting of frequencies, percentages, or means (±SD) were generated from patient data collected in each study group. Two data points were required for a patient

to be included in analysis. Statistical differences in baseline measures (such as age and comorbid diseases) and study variables (e.g., A1C, LDL cholesterol, blood pressure, medication use) for the two study groups at 0, 6, and 12 months were assessed using unpaired *t* tests or Fisher's exact tests. All analyses were conducted with NCSS 2007 (version 7.1.12; NCSS, Kaysville, UT). Results were considered statistically significant if the observed level of significance was $P < 0.05$.

## Results

Baseline characteristics were similar between the two groups and reflect an obese white population of patients with diabetes, with a large percentage having comorbid medical conditions and existing microvascular complications (Table 1). Mean BMI values for the intervention group were slightly larger at baseline than those for the control group (32.8 vs. 31.8 kg/m$^2$, $P < 0.05$). BMI values within each group did not change significantly during the course of the study but were significantly different between intervention and control groups at the conclusion of the study (33.2 vs. 31.6 kg/m$^2$, $P < 0.05$). Intervention patients had an average of 6.5 office visits with the pharmacist during the study period.

### A1C

A1C values were similar for the intervention and control groups at baseline (Table 2). At 6 months, A1C values for the two groups were significantly improved and similar between groups. At 12 months, A1C in the intervention group continued to decrease significantly, whereas it increased in the control group. The absolute percent change in A1C from baseline for the intervention group was greater than that for the control group (–1.8 vs. –0.8 percentage points, $P < 0.05$), and a greater percentage of patients in the intervention group reached A1C goal during the study period (Table 3).

### LDL cholesterol

Mean LDL cholesterol reached the designated goal for the intervention group but not for the control group (Table 2). At baseline, more patients in the control group than in the intervention group were at LDL cholesterol goal, but at 12 months, more patients in the intervention group than in the control group were at LDL goal (Table 3). Use of statins increased only slightly in the control group, whereas the percent of patients taking statins increased from 35% to 68%. Negligible use of other antilipemic agents other than statins occurred in both groups (Table 4).

### Blood pressure

In the intervention group, systolic and diastolic blood pressure values and the percent of patients who reached blood pressure goal significantly improved during the study period. Essentially no change occurred in blood pressure values for control group patients during the study (Tables 2 and 3).

**Table 3.** Percent of patients reaching primary end points in the PAMPERED study

| Characteristic | Intervention group No. (%) | Control group No. (%) | *P* |
|---|---|---|---|
| n | 72 | 92 | |
| **A1C ≤7%** | | | |
| Baseline | 0 | 0 | 0.999 |
| 6 months | 19/70 (27) | 14/78 (18) | 0.236 |
| 12 months | 19/55 (35) | 14/67 (21) | 0.105 |
| **LDL cholesterol ≤100 mg/dL** | | | |
| Baseline | 19/62 (31) | 20/46 (43) | 0.224 |
| 6 months | 27/66 (41) | 19/42 (45) | 0.693 |
| 12 months | 32/52 (62) | 24/44 (55) | 0.537 |
| **SBP ≤130 mm Hg** | | | |
| Baseline | 19/69 (28) | 40/81 (49) | 0.008[a] |
| 6 months | 32/66 (48) | 42/74 (57) | 0.397 |
| 12 months | 29/57 (51) | 30/70 (43) | 0.378 |
| **DBP ≤80 mm Hg** | | | |
| Baseline | 43/69 (62) | 54/81 (67) | 0.610 |
| 6 months | 50/66 (76) | 53/74 (72) | 0.701 |
| 12 months | 48/57 (84) | 54/70 (77) | 0.374 |

Abbreviations used: A1C, glycosylated hemoglobin; DBP, diastolic blood pressure; LDL, low-density lipoprotein; PAMPERED, Pharmacist Assisted Medication Program Enhancing the Regulation of Diabetes; SBP, systolic blood pressure.
Different denominators reflect patients needing at least two data points to be included in analysis.
[a]Statistically significant ($P < 0.05$).

### Medication use

The increase in the number of medications taken during the study period was similar between the two groups (intervention group, increase of 1.2; control group, increase of 0.9). Intervention group patients had a notably higher use of antiplatelet therapy, angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, and insulin-sensitizing and statin agents (Table 4).

### Microvascular screening parameters

Intervention group patients obtained significantly more recommended screening parameters than control group patients for retinopathy (97% vs. 83%, $P = 0.002$), neuropathy (93% vs. 77%, $P = 0.009$), and nephropathy (96% vs. 62%, $P = 0.001$). No adverse events were caused by the study protocol.

## Discussion

Clinical pharmacists working with physicians in an ambulatory clinic had a positive effect on patients' A1C, blood pressure, and cholesterol values. Data from the Diabetes Control and Complications Trial, U.K. Prospective Diabetes Study, and Heart Protection Study showed that improving control of these parameters decreases microvascular disease and cardiovascular events for patients with diabetes.[2–4,40] More recently published studies (ACCORD [Action to Control Cardiovascular Risk in Diabetes], ADVANCE [Action in Diabetes and Vascu-

**Table 4.** Medication use of patients in the PAMPERED study

| Characteristic | Intervention group No. (%) | Control group No. (%) | *P* |
|---|---|---|---|
| n | 72 | 92 | |
| **No. of medications (mean ± SD)[a]** | | | |
| Baseline | 5.9 ± 2.9 | 5.1 ± 3.2 | 0.116 |
| 12 months | 7.1 ± 2.7 | 6.0 ± 3.5 | 0.031[b] |
| **Taking antiplatelet agent** | | | |
| Baseline | 40 (56) | 31 (34) | 0.007[b] |
| 12 months | 56 (78) | 37 (40) | 0.001[b] |
| **Taking ACE inhibitor** | | | |
| Baseline | 24 (33) | 29 (32) | 0.867 |
| 12 months | 41 (57) | 39 (42) | 0.083 |
| **Taking ARB** | | | |
| Baseline | 8 (11) | 4 (4) | 0.133 |
| 12 months | 14 (19) | 6 (7) | 0.016[b] |
| **Taking sulfonylurea** | | | |
| Baseline | 40 (56) | 54 (59) | 0.751 |
| 12 months | 47 (65) | 53 (58) | 0.338 |
| **Taking metformin** | | | |
| Baseline | 31 (43) | 47 (51) | 0.346 |
| 12 months | 43 (60) | 49 (53) | 0.432 |
| **Taking thiazolidinedione** | | | |
| Baseline | 13 (18) | 16 (17) | 0.999 |
| 12 months | 27 (38) | 24 (26) | 0.129 |
| **Taking insulin** | | | |
| Baseline | 14 (19) | 14 (15) | 0.533 |
| 12 months | 19 (26) | 21 (23) | 0.714 |
| **Taking statin** | | | |
| Baseline | 25 (35) | 35 (38) | 0.744 |
| 12 months | 49 (68) | 37 (40) | 0.001[b] |
| **Taking fibrate** | | | |
| Baseline | 4 (6) | 6 (7) | 0.999 |
| 12 months | 4 (6) | 5 (5) | 0.999 |
| **Taking niacin** | | | |
| Baseline | 1 (1) | 0 | 0.999 |
| 12 months | 0 | 0 | 0.999 |
| **Taking beta blocker** | | | |
| Baseline | 26 (36) | 28 (30) | 0.504 |
| 12 months | 26 (36) | 31 (34) | 0.869 |
| **Taking calcium channel blocker** | | | |
| Baseline | 13 (18) | 10 (11) | 0.257 |
| 12 months | 14 (19) | 9 (10) | 0.112 |
| **Taking diuretic** | | | |
| Baseline | 22 (31) | 22 (24) | 0.377 |
| 12 months | 29 (40) | 24 (26) | 0.065 |

Abbreviations used: ACE, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; PAMPERED, Pharmacist Assisted Medication Program Enhancing the Regulation of Diabetes.

[a]Pharmacist obtained a detailed medication history, including prescription, over-the-counter (OTC) medications, herbal therapies, and dietary supplements at each visit. The control group medication use was collected by chart review only and may be been incomplete.

[b]Statistically significant ($P < 0.05$).

lar Disease], and VADT [Veterans Affairs Diabetes Trial]) [5–7] showed benefits in lowering A1C for microvascular disease and neuropathy but not for macrovascular disease, although long-term data on cardiovascular outcomes are forthcoming.

Several other studies demonstrating the positive effect of pharmacists on diabetes control have been published; however, most were nonrandomized studies, and many were of short duration, followed fewer patients, or used pharmacists providing only a consultative or educational role. Results of a systematic review of the effects of pharmacist interventions on adults with diabetes noted overall improvement in A1C for patients with diabetes, with greater benefits seen when pharmacists were afforded prescriptive authority. The authors encouraged future studies addressing pharmacist improvement of diabetes outcomes through provision of self-management education and pharmacologic management.[41] Our study was randomized and used pharmacists in a direct patient care role. They addressed overall diabetes therapy, including hypertension and lipid control, and worked with other team members to monitor and implement optimal therapy.

Jaber et al.[23] conducted a study in urban black patients with type 2 diabetes. Patients were randomized to a pharmacist disease management group or a usual care group. The study demonstrated a significant decrease in A1C and fasting plasma glucose. However, only a small number of patients (n = 39) were randomized and followed for a 4-month period, and pharmacists were only able to adjust hypoglycemic medications. Improvements in blood pressure and lipid profiles were not seen in this study. This is in contrast to the current study, in which pharmacists were able to address overall medication therapy and, upon physician approval, adjust medications to achieve therapeutic goals for blood pressure and lipids as well as glucose control.

In another study, pharmacists in a university clinic setting randomized 77 patients with poorly controlled type 2 diabetes to pharmacist intervention compared with usual care.[18] The pharmacists in the study developed a diabetes care plan and communicated recommendations to providers but were not authorized to implement the recommendations. The study did not demonstrate a greater decrease in A1C in the treatment group compared with the control group.

Recently published randomized trials have shown benefit of pharmacist involvement in the management of diabetes therapy. Rothman et al.[42] conducted a randomized controlled trial in 217 patients with type 2 diabetes and A1C level above 8% at an academic general medicine practice that included management by clinical pharmacists and a diabetes care coordinator to help address barriers to care and remind patients about appointments. The clinical pharmacist practitioners provided intensive education and medication management. This study demonstrated improvement in blood pressure, A1C, and use of aspirin therapy. A randomized controlled trial in 149 patients in a community health center who were assigned to a pharmacist-managed diabetes care program for 9 months compared with standard diabetes care also showed improvement in A1C, systolic blood pressure, LDL cholesterol, and quality of life

measures.[43] Additional recently published studies have demonstrated benefit of pharmacist management of diabetes therapy in smaller populations[36,37] or retrospective analyses,[38] and an employer-based pharmacist education and consultation model improved A1C, blood pressure, and acute care visits.[39]

A systematic review studying different types of quality improvement strategies for glycemic control in patients with type 2 diabetes showed that adding team members, including pharmacists, was more effective in improving disease control than other methods such as clinician reminders, clinician education, or patient reminder systems. The benefit was seen especially when these team members were able to adjust medications.[44] Clinical pharmacists are ideally prepared to assume a role as team members assisting in the care of patients with diabetes because of their extensive training in pharmacotherapeutics of chronic diseases. In addition, many pharmacists obtain specialized residency training to prepare for a direct patient care role. Clinical pharmacists practicing in collaborative settings are increasingly working with primary care providers to help manage patients with chronic conditions requiring drug therapy. Most states now have legislation documenting collaborative drug therapy management (CDTM) as an important role for pharmacists.[45,46] CDTM in Massachusetts was not passed into law until 2010 and is just beginning to be implemented. Despite this, the clinical pharmacists in this study were able to adjust therapy with physician approval.

In addition to achieving glucose, blood pressure, and cholesterol control, pharmacist promotion of adherence to practice guidelines and screening in the current study resulted in more patients receiving optimal pharmacotherapy with agents such as antiplatelet medications, inhibitors of the renin–angiotensin system, and statins (Table 4), as well as obtaining ophthalmology screening, neuropathy screening, urine screening for microalbuminuria, and nutritional counseling.

Quality in health care has been a key issue in the United States for the past several years, and health care systems recognize the importance of achieving goals for health care quality. The Healthcare Effectiveness Data and Information Set (HEDIS) reports data on measures of comprehensive diabetes care screening, eye exams, and screening for microalbuminuria. These data are reported for commercial health plan members and Medicaid and Medicare recipients. Our study site has very few Medicaid recipients; therefore, HEDIS data for commercial and Medicare patients are most applicable. Commercial and Medicare data from 2003, during our study period, reported that 85% and 88% of patients had A1C testing, respectively, 88% and 91% had lipid screening, 49% and 65% had routine eye exams, and 48% and 54% were monitored for diabetic nephropathy.[47] All intervention patients in our study obtained A1C and LDL measures. Although the control group in the current study achieved higher rates of screening than HEDIS averages for retinopathy and nephropathy (83% and 67%, respectively), the intervention group had significantly more patients screened for these conditions (97% and 96%). Intervention group screening rates were also higher compared with current HEDIS data.[48]

## Limitations

A limitation of the current study was that costs, such as the cost of offering the pharmacist-run disease management service and administrative costs, were not assessed to determine whether the program was cost-effective overall. However, targeting and improving specific measures such as A1C and LDL impact pay-for-performance bonus and recognition programs, which may outweigh the costs of administering such a program. Future studies should look at overall costs and feasibility of expanding these similar programs to larger populations of patients with diabetes.

Patients in this study were recruited by telephone after identification of lab results by the screening program, and they had already been randomized. Patients who agreed to participate in the study were likely more motivated to adhere to a diabetes treatment program. Although the control patients had to have obtained a minimum number of laboratory tests to be included, some patients in this group may not have participated in the study and may have been a less motivated group than the intervention group. However, this is also true of actual practice, in that some patients accept the services of a clinical pharmacist and others decline. This study suggests that patients who allow a pharmacist to work with them and their primary care provider to help manage their diabetes are more likely to achieve therapeutic goals than a control group of patients receiving usual medical care.

## Conclusion

This study demonstrates that clinical pharmacists with training and experience in diabetes care can help patients achieve therapeutic goals.

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