

Diabetes Disease Management in Medicare Advantage Reduces Hospitalizations and Costs

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The Centers for Disease Control and Prevention estimates that 23.6 million people (7.8% of the US population) have diabetes. Like many other health conditions, the prevalence of diabetes increases with age. Among the population age 60 years or older, 12.2 million people (23.1%) have diabetes.¹ Poorly controlled diabetes often is associated with the development and exacerbation of complications such as heart disease, stroke, blindness due to retinopathy, end-stage renal disease, and leg and foot amputations due to peripheral vascular disease and diabetic neuropathy. The prevalence of cardiovascular conditions is particularly high among patients with diabetes, and it increases with age, with a self-reported prevalence of 48.0% among those age 65 to 74 years and 58.0% among those age 75 years or older.²

Diabetes takes its toll in terms of human suffering and in financial cost. The direct and indirect cost of diabetes in 2007 is estimated at \$174 billion.³ As with prevalence, the cost associated with diabetes is especially concentrated in older age groups. The American Diabetes Association reports that 56% of all diabetes-related healthcare expenditures are for those age 65 years and older, with much of this financial burden covered by Medicare.³

Much of the suffering and cost associated with diabetes could be mitigated with appropriate care. However, fewer than 45% of persons with diabetes receive recommended care.⁴ This care gap is due to many factors such as inconsistent quality care from healthcare providers, lack of patient education, and lack of support for self-management such as meal planning, weight control, exercise, glucose monitoring, smoking cessation, and medication adherence.

Disease management is designed to fill many of the care gaps. Disease management interventions typically include patient education, biometric monitoring, reminders for foot exams and lab tests, review of care plans for alignment with evidence-based practices, and patient support for adherence to treatment plans and self-management.

Several studies have shown that diabetes disease management programs effectively reduce hospital utilization and cost in various segments of the population.^{5,6} One study concluded that these programs are associ-

ated with better processes of diabetes care but not with improved intermediate outcomes or level of medication management.⁷ Another meta-analysis conclud-

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Objective: To evaluate the effectiveness of a telephonic diabetes disease management intervention in a Medicare Advantage population with comorbid diabetes and coronary artery disease (CAD).

Study Design: Prospective unequal randomization design of 526 members from a Medicare Advantage segment of one region of a large national health plan from May 2005 through April 2007.

Methods: High-risk and high-cost patients with diabetes and CAD who were enrolled in telephonic diabetes disease management were compared with a randomly selected comparison group receiving usual care. Wilcoxon signed-rank tests were used to compare the groups on all-cause hospital admissions, diabetes-related hospital admissions, all-cause and diabetes-related emergency department (ED) visits, and all-cause medical costs. Changes in self-reported clinical outcomes also were measured in the intervention group.

Results: Patients receiving telephonic diabetes disease management had significantly decreased all-cause hospital admissions and diabetes-related hospital admissions ($P < .05$). The intervention group had decreased all-cause and diabetes-related ED visits, although the difference was not statistically significant. The comparison group had increased ED utilization. The intervention group decreased their all-cause total medical costs by \$984.87 per member per year (PMPY) compared with a \$4547.06 PMPY increase in the comparison group ($P < .05$). All clinical measures significantly improved ($P < .05$) in the intervention group.

Conclusions: A disease management program for high-risk patients with diabetes and CAD was effective in reducing hospital inpatient admission and total costs in a Medicare Advantage population.

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For author information and disclosures, see end of text.

Take-Away Points

A prospective unequal randomization study of a telephonic disease management program for Medicare Advantage patients with diabetes and coronary artery disease indicated that the program was effective.

- Medical costs were significantly reduced.
- All-cause and diabetes-related hospital admissions were significantly decreased, with a large increase in members having no hospital admissions.
- The intervention group had significant improvement on all clinical goals.

ed that among quality improvement initiatives to improve diabetes care, nurse care management interventions had the most robust effect on measures of quality.⁸ Further, a report by the Cochrane Collaboration found some support for improved outcomes associated with patient-oriented interventions that are analogous with disease management.⁹ However, other recent publications have questioned the effectiveness of disease management, particularly citing difficulties in establishing meaningful comparators and a lack of rigorous evaluation methods.^{10,11}

There is agreement that additional studies addressing the effectiveness of disease management programs in applied settings would be valuable in helping decision makers address healthcare delivery and policy issues.^{12,13} The Centers for Medicare & Medicare Services (CMS) has been exploring new interventions to improve the quality of care and reduce cost in the growing and aging Medicare population.¹⁴ Because of this, studies evaluating the effectiveness of disease management in Medicare populations are particularly timely and relevant.

STUDY DESIGN

This study evaluated a telephonic diabetes management program using a Medicare Advantage population in one region of a large national health plan. We used a prospective unequal randomization design. All patients identified as eligible for the study were enrolled with the health plan for at least the full 24 months spanning the study. The baseline period ran from May 2005 through April 2006, and the study period ran from May 2006 through April 2007.

METHODS

Member Identification and Enrollment

This disease management program focused on medium-risk and high-risk patients with comorbid diabetes and coronary artery disease (CAD). Patients were identified as having diabetes through medical claims containing any *International Classification of Diseases, Ninth Revision (ICD-9)* diagnosis code of 250.xx, 316.00, or 362.0x and were identified as having

CAD through medical claims containing any ICD-9 diagnosis code of 414.xx. To be eligible, patients also had to have 1 or more distinct claim dates for an emergency department (ED) visit, urgent care visit, or hospital admission with a diabetes-related diagnosis during the 12-month baseline period. Patients were excluded for any of the following

conditions: severe cognitive impairment without a caregiver, end-stage renal disease, AIDS/HIV, entry into hospice, nursing home requirement, or pregnancy.

A total of 526 CAD patients with documented medium-risk or high-risk diabetes were selected by the participating health plan to be considered for the study. The 526 patients were unequally randomized into either the disease management program or into usual care without a disease management program. Unequal randomization was selected because the health plan wanted to maximize the number of members offered the disease management program while still having a sufficient comparison group. A random sample of 64 patients from the study group was selected as a control group to continue with their usual care without a disease management program. The remaining 462 patients were offered the disease management program. Of these patients, 356 consented and enrolled in the program; 106 did not consent to participate and therefore continued with their usual care.

A registered nurse conducted a comprehensive telephonic clinical assessment among the patients enrolled in disease management. The nurse documented the patient's health history and relevant clinical information including:

- Diabetes symptoms and self-monitoring adherence.
- Knowledge of diabetes care, including sick day plan, foot care, nutrition, and physical activity.
- Collection of biometric results.
- Assessment of compliance and adherence to physicians' treatment plan and preventive exams.
- Medications and adherence.
- Utilization of hospital and ED.
- Psychosocial indicators, including assessment of depression with the Patient Health Questionnaire-2.¹⁵

Nursing interventions included sending patients an educational and assessment packet containing materials developed by the Joslin Diabetes Center. Patients also were sent a quarterly newsletter on diabetes. The nurse care manager called each patient every 14 to 30 days to conduct an assessment and provide coaching and health education. Patients were reminded about vaccinations, annual eye and foot exams, and the importance of medication adherence. Key

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biometric values, such as glycosylated hemoglobin (A1C), low-density lipoprotein cholesterol (LDL-C), and blood glucose were monitored via self-report. Some of the highest-risk patients received a DLM112 Daylink home biometric device to transmit blood glucose levels and symptom data to their nurse care manager so they could be closely monitored.

Communication with the patients' physicians to support their treatment plans was an important element of the intervention. Physicians were notified when patients enrolled in the program, and they were sent periodic clinical progress reports and alert reports. The program had the added feature of timing the reports to be received by the physician a few days prior to a scheduled patient visit, so the information could be most efficiently used by the provider. These previsit reports contained a one-page summary of key clinical indicators. In addition, the nurse called the physicians when situations emerged requiring their urgent attention. The patients were discharged according to program protocols, and many continued in the program beyond the study period.

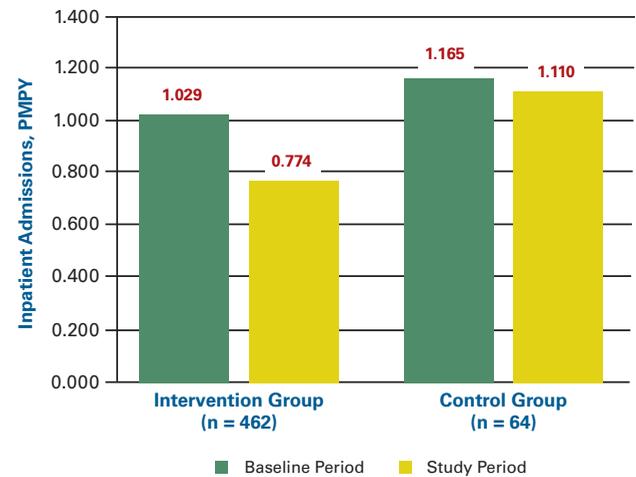
Data and Analysis

Medical claims data provided by the health plan were used to estimate utilization and cost outcomes, measured in a baseline period (May 2005 through April 2006) and during the study period (May 2006 through April 2007). All-cause utilization was measured by identifying inpatient hospital admissions and ED visits in both periods. Diabetes-related utilization was measured by identifying the inpatient hospital admissions and ED visits with 1 of the above-mentioned diabetes ICD-9 codes in the first 5 diagnosis code positions on the claim. All-cause total medical costs were measured using total paid amounts for all claims, including ED visits, inpatient hospital admissions, inpatient and outpatient procedures, outpatient office visits, and laboratory tests.

Disease management programs have traditionally been evaluated on the outcomes of all members identified as having the condition, whether or not they are enrolled in the disease management program. Accordingly, an intention-to-treat analysis was used to compare the outcomes of the intervention-eligible group (intervention group) with the outcomes of the control group. The primary advantage of the intention-to-treat analysis design is that it helps control the influence of program selection bias and supports a more conservative assessment of program impact.

Changes in utilization and cost from the baseline period to the study period were compared for the intervention group and the control group. Total utilization and cost changes are presented as per member per year (PMPY). Per patient utilization and cost differences between the baseline and study periods were calculated for each patient. Initial analysis showed

■ **Figure 1.** All-Cause Inpatient Admissions per Member per Year (PMPY)^a



^aWilcoxon test result comparing the change from baseline to study period for the intervention group and the control group was significant at $P \leq .05$.

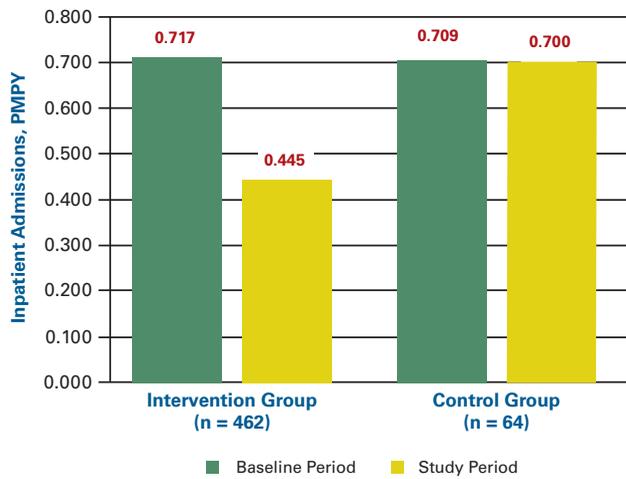
that none of the dependent variables were normally distributed and the groups had unequal variance; therefore, non-parametric 1-sided Wilcoxon signed-rank tests were used to determine whether the intervention group had significantly greater reductions in utilization and cost than the comparison group.

A pre-post design was used to assess the clinical impact of the intervention on the intervention group. The change in the percentage of members meeting self-reported clinical outcome goals between the first and last assessment within the study period was evaluated. The self-reported clinical outcomes, reflecting the clinical goals of the program, included examination of the feet performed annually, A1C level, LDL-C, urine microalbumin test performed within the past year, a dilated retinal exam, use of an angiotensin-converting enzyme inhibitor or angiotensin receptor blocker, and daily aspirin if over age 40 years. For every clinical measure, change between the baseline period and the study period was assessed with the McNemar χ^2 test. All analyses were conducted using SAS 9.1 software (SAS Institute Inc, Cary, NC).

RESULTS

At baseline, the intervention and control groups were similar. The intervention group had an average age of 74.0 years and was 43.5% female, and the comparison group had an average age of 74.9 years and was 43.8% female. Two sample t tests indicated that the age and sex of the groups were not significantly different ($P = .39$ and $P = .85$, respectively). In addition, Wilcoxon 2-sample tests indicated that the groups

■ **Figure 2.** Diabetes-Related Inpatient Admissions per Member per Year (PMPY)^a

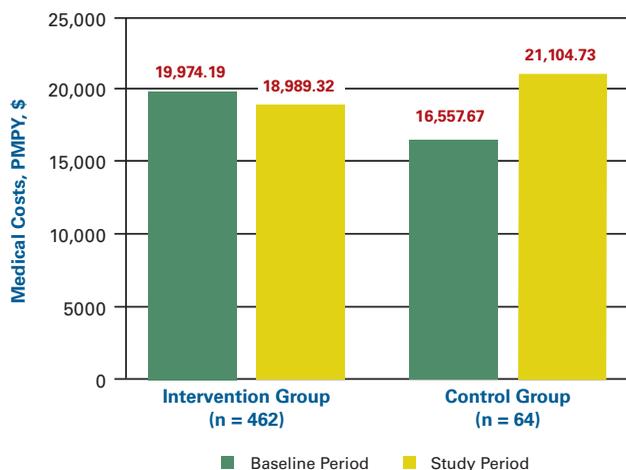


^aWilcoxon test result comparing the change from baseline to study period for the intervention group and the control group was significant at $P \leq .05$.

were not significantly different at baseline on any of the dependent variables (all-cause admissions, $P = .49$; diabetes-related admissions utilization, $P = .40$; all-cause ED visits, $P = .18$; diabetes-related ED visits, $P = .29$; and all-cause medical costs, $P = .14$).

As a result of the disease management intervention, the intervention group had significantly greater reductions in both all-cause and diabetes-related admission rates than the comparison group ($P \leq .05$) (Figure 1 and Figure 2). Moreover, in the intervention group all-cause medical costs were decreased

■ **Figure 3.** All-Cause Medical Costs per Member per Year (PMPY)^a



^aWilcoxon test result comparing the change from baseline to study period for the intervention group and the control group was significant at $P \leq .05$.

by \$984.87 PMPY, whereas in the comparison group all-cause medical costs were increased by \$4547.06 PMPY ($P \leq .05$) (Figure 3).

The large reduction in the all-cause admissions rate for the intervention group was exemplified by the change in the frequency of patients with no admissions. At baseline, 48.4% of the comparison group and 41.8% of the intervention group had zero admissions. However, during the study period, those with zero admissions in the comparison group decreased to 43.8%, while those with zero admissions in the intervention group increased to 63.1%.

The intervention group also had directionally greater reductions in all-cause and diabetes-related ED visits than the control group. For all-cause ED visits the intervention group decreased utilization from 0.814 to 0.729 visits PMPY, while the comparison group increased utilization from 0.535 to 0.683 visits PMPY. The difference between the intervention group and comparison group appeared even greater for diabetes-related ED visits; the intervention group decreased utilization slightly from 0.148 to 0.146 visits PMPY, whereas the comparison group greatly increased utilization from 0.095 to 0.171 visits PMPY. However, the difference in these changes is not statistically significant ($P = .18$ for all-cause ED visits and $P = .23$ for diabetes-related ED visits).

Clinical Measures

The 181 intervention group patients who engaged in the disease management program and had 2 complete assessments during the study period demonstrated significant improvement on all clinical measures. The mean length of time from first to last assessment was 11.4 months. The Table shows the percentage of members who met clinical goals in the baseline and study periods. The table also presents the results from the McNemar χ^2 test. The largest improvements were seen in rates of microalbuminuria tests (27.1%), annual A1C tests (23.2%), annual LDL-C tests (13.2%), and annual foot exams (11.6%).

DISCUSSION

The results of this study indicate a disease management intervention involving telephonic nurse care management, diabetes education, and telemedicine to transmit blood glucose data in a Medicare population with diabetes and CAD led to a substantial reduction in hospital admissions and healthcare costs. Patients receiving disease management interventions experienced significant improvement in a range of quality measures related to diabetes care.

These are important findings given the recent concerns of CMS regarding the efficacy of disease management interven-

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■ **Table.** Percentages of Members Who Met Clinical Goals in Baseline and Study Periods (n = 181).

Goal	Percentage		% Change	P
	Baseline	Study		
Foot exam	82.3	93.9	11.6	<.0001
A1C test	26.0	49.2	23.2	<.0001
LDL-C test	14.4	27.6	13.2	<.0001
Microalbuminuria	7.7	34.8	27.1	<.0001
Retina exam	82.3	92.3	10.0	<.0001
ACE inhibitor or ARB	61.3	70.2	8.9	.0009
Daily aspirin	60.8	68.5	7.7	.0043

A1C indicates glycosylated hemoglobin; ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; LDL-C, low-density lipoprotein cholesterol.

tions with Medicare-eligible participants,¹⁶ as all of the individuals in this study participated in a Medicare Advantage program.

The findings are especially important because the cost reductions were achieved within a sample that included members not receiving disease management. When offering a disease management program to any population, one will always find a small group of patients who do not want to participate. So these results would be consistent with what one would likely see in a general population.

It is important to note that all of the subjects in this study were high-risk and high-cost patients with coexistent diabetes mellitus and CAD. From the data we have shown, total costs were reduced, but it is not clear how much of the cost reduction was due to a decrease in CAD-related morbidity and hospitalizations. In addition to glycemic control, a major component of our diabetes disease management program included interventions to control blood pressure and hyperlipidemia, along with proper use of angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and aspirin. All of these factors are important in the reduction or amelioration of CAD risk, and are proper components of a diabetes disease management intervention. We do not know whether a similar diabetes disease management program in a population of patients with diabetes and without CAD would achieve comparable cost reductions. It is likely that such an intervention would require risk stratification, so that more intense care management would be targeted to the most severely affected patients with diabetes and its associated complications.

This approach to disease management is noteworthy in that it utilized high-intensity telephonic intervention by skilled nurse care managers who were trained in the care of diabetes and delivered diabetes education and behavioral interventions to the subjects involved in the study. Substantial efforts were made to provide timely communication with the

medical care providers and to make sure that these providers were able to use the information obtained by the care managers during their visits with their patients to make clinical decisions and retain control of the care of their patients.

A methodologic limitation of this study was the relatively low number of patients in the control group, which contributed to a loss in statistical power and difficulty in achieving statistical significance with regard to ED visits. The large imbalance in the randomization procedure also may have introduced potential bias in the balance of covariates across the groups. Even though there were no significant differences among the measured covariates, there could be differences among other unmeasured covariates. Equal randomization of the study group was not feasible due to the disease management vendor's contractual obligation to the health plan involved to provide appropriate intervention to the eligible population. The health plan suggested an arbitrary range of 60 to 70 patients to serve as a random control group; the final number selected was 64 control patients. Despite the small control group, this study showed significant and substantial reductions in costs and hospitalization rates with this disease management intervention. Another limitation of the study was that only 181 of the 356 enrolled had 2 complete assessments during the study period. Additional research with larger sample sizes and full randomization is warranted based on this study's findings.

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Authorship Information: Concept and design (JLR, GKN, TJM); acquisition of data (TJM, PT); analysis and interpretation of data (JLR, MST, GKN, TJM, WT, PT); drafting of the manuscript (JLR, MST, GKN, TJM,

WT); critical revision of the manuscript for important intellectual content (JLR, GKN); statistical analysis (MST, WT, PT); provision of study materials or patients (JLR, TJM), and supervision (JLR, GKN).

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