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# Clinical and Economic Impact of Implementing a Comprehensive Diabetes Management Program in Managed Care*

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**ABSTRACT**

Diabetes mellitus places a significant burden on the U.S. healthcare system. Because of the potential to reduce diabetic complications and costs through intensive management, diabetes has become a primary target for disease management programs. We performed a retrospective analysis of short-term baseline and follow-up clinical, economic, and member and provider satisfaction data from approximately 7,000 people with diabetes being treated through seven managed care plans using Diabetes Treatment Centers of America's Diabetes NetCare[SM], (Nashville, TN), a comprehensive diabetes management program. Our analysis indicates that Diabetes NetCare[SM] achieved gross economic adjusted savings of $50 per diabetic member per month (12.3%), with gross unadjusted savings of $44 (10.9%) per diabetic member per month. Hospital admissions per 1,000 diabetic member years decreased by 18%, and bed days fell by 21%. Patients with diabetes were more likely to get HbA1c tests, foot exams, eye exams, and cholesterol screenings while enrolled in the program. These data suggest that implementation of a comprehensive healthcare management program for people with diabetes can lead to substantial improvements in costs and clinical outcomes in the short-term. It is expected that improvements will increase over time, with continuing improvements in health status and a reduction in the number of future diabetic complications. (*J Clin Endocrinol Metab* **83:** 2635–2642, 1998)

ONE of every seven dollars spent on health care in the United States is spent on behalf of a person with diabetes (1). According to data from the most recent National Health and Nutrition Examination Survey, 5.1% of the U.S. adult population, or 10.2 million Americans, are confirmed diabetics. Moreover, there are believed to be an additional 5.4 million undiagnosed cases (2, 3). People with diabetes are at increased risk of developing numerous micro- and macrovascular complications including renal, ophthalmic, neurological, and circulatory disorders.

In large part because of chronic complications, medical expenditures for people with diabetes are almost four times as high as expenditures for their nondiabetic counterparts (1, 2). In 1992, medical expenditures for people with diabetes were estimated to be $105 billion; however, only 16% of direct medical expenditures for diabetics are attributable to diabetes care and acute glycemic events. The remainder of medical expenditures goes to routine medical care, chronic complications of diabetes, and other significant medical conditions including liver disease, malignant neoplasms, gastritis, and affective disorders (2).

The Diabetes Control and Complications Trial (DCCT) was a landmark multicenter trial, sponsored by the National Institutes of Health, that demonstrated that tight control of blood glucose levels lowers Type 1 patients' risk of developing chronic microvascular complications of diabetes and slows progression of those complications. Over the study period, which averaged 7 years, there was a 50–75% reduction in risk between the intensive treatment group and the standard treatment group in the development of long-term complications of diabetes (4, 5). It is reasonable to expect that therapy achieving such glycemic control will provide similar benefits in terms of reduction in complications to patients with Type 2 diabetes (6).

The two major criticisms of the DCCT treatment protocol are that participants were so highly motivated that their experience cannot be generalized, and that the protocol would be prohibitively expensive to replicate. Additional medical resources of $4,000 to $5,800 per participant were invested annually in the intensively treated population (7). DCCT investigators believe that the reduction in the number of future complications may eventually help defray, but may not offset, the cost of the additional resources consumed in intensive management (4, 8–10).

The organizational and financial structure of managed care organizations (MCOs) makes them well-suited to provide a program of comprehensive preventive care and intensive treatment, similar in approach to that in the DCCT, to people with diabetes. Most plans provide some preventive services to people with diabetes but do not offer comprehensive diabetes management. A recent Gallup survey found that, of health plans available to employees, only a third cover diabetes education classes, half cover annual eye exams, and half cover quarterly glycosylated hemoglobin tests (11).

Diabetes management strategies are more easily accomplished in the integrated setting of the MCO than in a fee-for-service environment. However, because of competitive pressures and member turnover, MCOs must consider short-term financial returns when making program decisions. The

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internal organizational changes that would be required to implement a comprehensive diabetes management program are perceived by many MCOs to be too expensive.

Diabetes NetCare[SM] is a comprehensive health care management program developed and provided by Diabetes Treatment Centers of America (DTCA, Nashville, TN) to improve the clinical outcomes of people with diabetes, while at the same time addressing the concerns of managed care regarding short-term savings. Diabetes NetCare[SM] uses a population-based approach that differs from other disease management programs in that it tracks the entire diabetic population within an MCO, integrating and coordinating all aspects of medical care for the population. The program was designed to replicate the essential elements of the DCCT in a manner that generates savings, improves clinical outcomes, and improves member and provider satisfaction in the short and long term.

Diabetes NetCare[SM] employs a multidisciplinary team that works with plan physicians and their patients to effect behavioral changes and to maintain desirable behaviors in the long term. Profiling tools are used to stratify physicians and hospitals based on the volume, costs, and outcomes of their diabetic patients, thereby allowing provider support coordinators to vary their assistance based on each provider's needs. Provider support coordinators call on physicians and hospitals to determine what services they require to provide better diabetes care for their patients (for example, continuing medical education, nurse training seminars, and/or patient care conferences). Diabetes NetCare[SM] also facilitates the formation of a diabetes-focused, medical leadership panel for each plan, composed of primary care physicians and specialists with high volumes of diabetes patients. The panel reviews outcomes and quality issues and provides physician-to-physician interaction to strengthen the message of compliance with accepted practice standards.

To facilitate efficient patient support, Diabetes NetCare[SM] stratifies members with diabetes into one of three levels based on the complexity of their disease. While more resources are invested in the complex level 2 and 3 cases, all members are sent reminders about preventive screenings, physicians' visits, and diagnostic tests, and are encouraged to participate in educational classes and seminars. All patients are also assigned to a diabetes nurse case manager who emphasizes effective self-management behaviors and proactively identifies those at risk for adverse events. Members who have an elevated HbA1c, comorbidities, and/or have been hospitalized (levels 2 and 3) are assigned to a complex case coordinator who works intensively with the physician and patient to alter risk factors including high blood pressure, cholesterol, and HbA1c values.

The nurse case managers are responsible for managing and integrating all the health care needs of their patients, not just those specifically related to diabetes. They manage the inpatient and outpatient resources required in caring for a patient with diabetes who has fractured an arm in a skiing accident, as well as the needs of one hospitalized for ketoacidosis. The member support component of the program provides each member with an advocate, a source of immediate information and support, and a guide through the health care system.

The program is supported by an infrastructure that includes an on-site administrative team, a clinical team, a provider support team, a management team, and an electronic tracking system. The electronic tracking system contains continuously updated patient and provider information. It is used to make resource allocation decisions that support the DTCA goals of quality improvement and efficient use of limited health care resources.

This study analyzes and compares baseline and follow-up clinical, financial, and member and provider satisfaction data from seven sites comprising (at follow-up) approximately 360,000 covered lives and 7,000 diabetic lives (5, 941 diabetic member years) to determine the short-term impact of implementing a comprehensive health care management program for the population with diabetes at managed care plans.

## Materials and Methods

### *Participating plans*

The plans participating in the study are all commercial health maintenance organizations (HMOs). For confidentiality reasons, results have been aggregated across plans, and the plans will only be referred to by number. Table 1 provides an overview of the participating plans. Plans are located in the southeast, midwest, south, and mid-atlantic regions of the United States. Each of the plans reimburses primary care physicians on a capitated basis; specialty physicians are paid per service provided. Six of the plans reimburse hospitals per diem, while one uses the diagnosis-related groups system for payment. Plan membership ranged from 30,000 to 87,500 members, and the plans had between 260 and 887 primary care physicians.

The dates of the baseline and follow-up periods for each plan are shown in Table 1. The beginning of each follow-up period corresponds to the implementation of the Diabetes NetCare[SM] program at each site; there was no phase-in period. The differences in the length of baseline and follow-up periods among the plans were unavoidable due to data availability issues and different program implementation dates. Aggregating the data and evaluating costs and outcomes by member month has minimized the impact of these differences.

### *Data collection*

Electronic tapes containing service utilization, laboratory, and pharmacy claims were collected for the baseline period and for each month of follow-up. Before implementation of the program, members with diabetes were identified from the electronic tapes based on having any of the following characteristics: 1) a record of taking insulin or other oral diabetic agents; or 2) an encounter with the health care system specifically related to diabetes, as indicated by the presence of a diabetes-specific International Classification of Diseases (ICD)-9-CM code [codes 250 (diabetes mellitus); 250.0 (diabetes mellitus without mention of complication); 250.1 (diabetes with ketoacidosis); 250.3 (diabetes with other coma); 250.4 (diabetes with renal manifestations); 250.5 (diabetes with ophthalmic manifestations); 250.6 (diabetes with neurological manifestations); 250.7 (diabetes with peripheral circulatory disorders); 250.8 (diabetes with other specified manifestations); 250.9 (diabetes with unspecified complications); and 362.0 (diabetic retinopathy)]. Each identified diabetic patient was linked to his or her primary care physician. These "identified" patients make up the group of baseline patients.

In the follow-up period, each identified member's primary care physician was contacted to confirm that the patient had diabetes. Information for those confirmed as having diabetes was stored in DTCA's proprietary Electronic Medical Record (EMR) on each site's computer server. Data stored in the EMR were updated regularly and included case notes from patient contacts, class attendance records, laboratory tests and results, notification of hospital admissions, specialist visits, and

**TABLE 1.** Overview of participating health plans

| | Plan 1 | Plan 2 | Plan 3 | Plan 4 | Plan 5 | Plan 6 | Plan 7 |
|---|---|---|---|---|---|---|---|
| Plan Membership | 30,000 | 60,000 | 87,500 | 50,000 | 37,000 | 35,500 | 60,000 |
| Baseline diabetic member months | 8,262 | 9,545 | 17,950 | 8,842 | 9,587 | 11,876 | 12,851 |
| Follow-up diabetic member months | 6,144 | 10,405 | 12,529 | 12,325 | 14,476 | 4,051 | 11,365 |
| Total primary care physicians | 700 | 882 | 260 | 513 | 430 | 887 | 400 |
| Hospital payment | Per diem | Per diem | Per diem | Per diem | Per diem | Per diem | DRG |
| Baseline period | 1/96–12/96 | 1/96–12/96 | 1/96–12/96 | 1/96–9/96 | 7/96–11/96 | 1/96–12/96 | 1/95–12/95 |
| Follow-up period | 1/97–9/97 | 1/97–9/97 | 1/97–9/97 | 10/96–9/97 | 12/96–9/97 | 3/97–9/97 | 7/96–9/97 |

Source: Diabetes Treatment Centers of America.

emergency room utilization. These "confirmed" patients make up the group of follow-up patients, along with all new diabetic plan members.

Chart reviews were performed to collect baseline clinical and laboratory data only for members confirmed as having diabetes. Chart reviews were not performed for patients who were identified as having diabetes during the baseline period, but could not be confirmed in the follow-up period.

Member and provider satisfaction data were collected and analyzed by Solution Point (Nashville, TN), a healthcare technology firm. Approximately 6 months after program initiation, Solution Point surveyed a sample of up to 150 physicians at each site who had treated patients in the program. Just before the program initiation, they surveyed a random sample of 300 plan members with diabetes at 6 sites to obtain baseline information. A second random sample of 300 plan members per site was surveyed approximately 9 months after program initiation to obtain follow-up member satisfaction data.

### *Data evaluation*

To quantify baseline costs, medical and pharmacy claims from the baseline period were analyzed for all members identified as having diabetes. Complete financial data were not available for Plans 6 and 7, so they were excluded from the financial analysis. The total number of diabetic member months in the financial analysis is 54,186 in the baseline period and 55,879 in the follow-up period.

All costs have been converted to 1997 dollars using the Medical Care Consumer Price Index (calculated by the Bureau of Labor Statistics). The weighted average cost across plans per member month was calculated using the following formula: diabetic cost per member month = $(\Sigma_i(mm_i \times \text{diabetic costs}_i)/ \Sigma_i mm_i$, where $mm_i$ represents member months in Plan i.

Weighted cost averages were determined in an analogous manner for the following service utilization categories: Inpatient, Outpatient, Physician, Pharmacy, and Other (includes emergency room visits, home health, ambulance, radiology, and laboratory services). Categories were identified by point-of-service codes on the claims data. Physician costs do not include primary care physician visits, which were covered under capitated contracts.

A reinsurance adjustment was made for inpatient stays to prevent the inclusion of costs not actually incurred by the plans. The plans in the financial analysis have reinsurance arrangements that protect them from incurring costs above a fixed ceiling for an individual patient over the course of the year. Any inpatient costs in excess of the ceiling in either the baseline or the follow-up period were excluded from the analysis. The unadjusted costs are reported in the *Results* section, to quantify the magnitude of excluded costs.

Follow-up costs were ascertained for the confirmed diabetic patients using medical and pharmacy claims data. As in the baseline, the number of diabetic member months was calculated, and the costs by service utilization category were weighted and aggregated across plans to determine overall diabetic cost per member month. A reinsurance adjustment was made for inpatient stays. Baseline and follow-up cost data for the nondiabetic population were evaluated in the same manner as for the diabetic population.

Baseline and follow-up diabetic hospital utilization (admissions and bed days) was tabulated per 1,000 member years. Utilization measures were calculated by tabulating the inpatient utilization at each plan, weighting each plan's utilization by the number of diabetic member years, then averaging weighted utilization across plans, and multiplying by 1,000 to determine utilization per 1,000 diabetic member years. The following formula was used for this purpose:

Hospital utilization per 1,000 member years = $1{,}000 \times \Sigma_i(my_i \times \text{utilization}_i)/\Sigma_i my_i$, where $my_i$ represents member years in Plan i. Hospital utilization data were not available for Plan 7, so it is excluded from this analysis. The total number of diabetic member months in the hospital utilization analysis is 66,062 in the baseline period and 59,930 in the follow-up period. All inpatient days were included in these estimates, regardless of whether or not they were covered by reinsurance.

Baseline and follow-up clinical data from the EMR were evaluated to determine the number of eye exams, HbA1c exams, foot exams, and cholesterol exams performed per member year. The numerator for these measures was the unique number of members receiving the exam of interest (*e.g.* if a member received two eye exams during the time frame, only one eye exam was counted), and the denominator was the number of member years represented in the time frame. For those who received at least two HbA1c tests in the follow-up period, a comparison was made between the numerical results of the first test and the numerical results of the second test. Multiple tests were not analyzed for foot exams, eye exams, or cholesterol screenings, because these tests are generally performed annually. The total number of diabetic member months in the clinical analysis is 50,328 in the baseline period and 71,295 in the follow-up period.

## Results

### *Clinical results*

As indicated in Fig. 1, the percentage of members with diabetes per member year receiving at least one HbA1c test rose from 34% in the baseline period to 76% in the follow-up. The American Diabetes Association's 1998 Standards of Care recommends HbA1c testing at least twice a year in patients who are meeting treatment goals and more frequently (quarterly assessment) in patients whose therapy has changed or who are not meeting glycemic goals (12).

The percentage of diabetics per member year receiving an eye exam rose from 23% in the baseline to 40% in the follow-up. The American Diabetes Association recommends that comprehensive dilated eye and visual examinations be performed annually for all people ages 10 years and older who have had diabetes for 3–5 years, for all those diagnosed after age 30, and for anyone with visual symptoms and/or abnormalities (12). In addition, one of the National Committee for Quality Assurance's (NCQA) Health Plan Employer Data and Information Set (HEDIS) measures is the percentage of continuously enrolled members with diabetes aged 31 and older who have had a retinal exam in the previous reporting year. According to the National Committee for Quality Assurance (NCQA), the national average for people with diabetes receiving retinal exams in 1996 was 38.4% (13). This number is overstated compared with the findings in this study because of NCQA's restrictions on age and continuous enrollment.

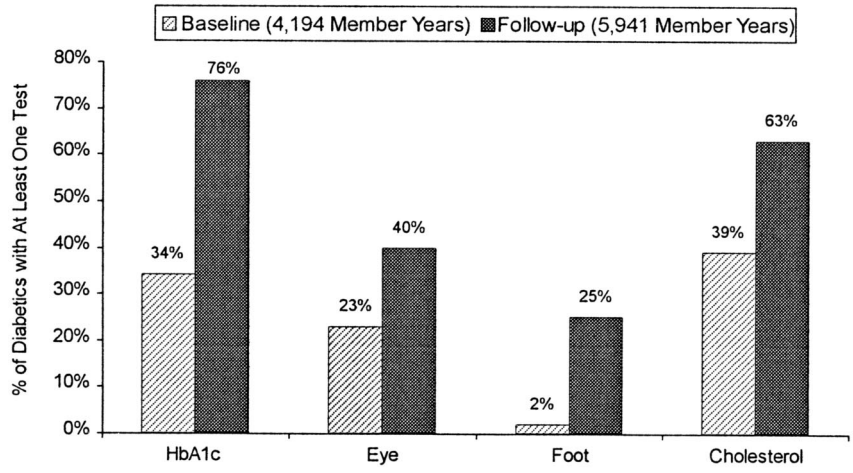


FIG. 1. Percent of diabetics per member year with at least one test. Source: DTCA's Electronic Medical Record.

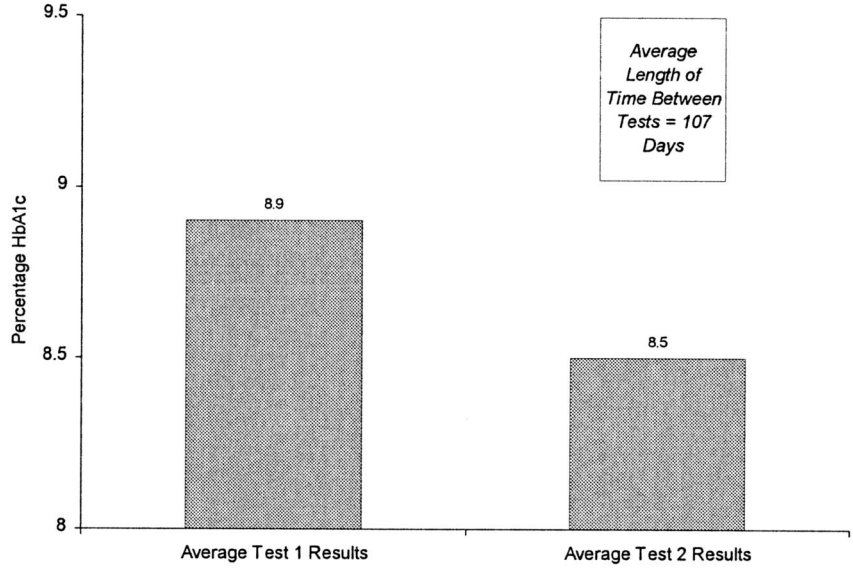


FIG. 2. Members with at least 2 HbA1c tests (1,603 members). Source: DTCA's Electronic Medical Record.

The percentage of diabetic patients per member year receiving a foot exam rose from 2% in the baseline to 25% in the follow-up. The American Diabetes Association recommends that patients at risk be given a foot exam as part of their quarterly physical evaluation. They advise that patients with diabetes who are not at risk be routinely evaluated (12).

The percentage of diabetic patients receiving cholesterol tests also increased between baseline and follow-up. The percent of patients receiving a yearly cholesterol screening rose from 39% to 63%. The American Diabetes Association recommends that adult patients with diabetes be tested annually for lipid disorders, and that children within accepted risk levels be tested every 5 years (12).

For patients who received at least two HbA1c tests in the follow-up period, a comparison was made between the results of the first test and the results of the second test. As Fig. 2 indicates, the average time between tests was 107 days, and a drop in HbA1c from 8.9% to 8.5% was observed. These results do not account for potential variation in HbA1c values between labs. Given the lack of standardization across laboratories, confidence intervals around these HbA1c measures would not be meaningful.

Hospital utilization was measured via admissions and bed days per 1,000 diabetic member years. Admissions per 1,000 diabetic member years decreased from 239 in the baseline period to 196 in follow-up. Bed days fell from 1,336 days in the baseline to 1,047 days in follow-up. These findings translate into an average length of stay of 5.6 days in the baseline period, and 5.3 days in the follow-up period.

### *Economic results*

Figure 3 compares per member per month health care costs for the diabetic population in the baseline and the follow-up periods. Total costs are subdivided into five service utilization categories: Inpatient, Outpatient, Physician, Pharmacy, and Other.

Total costs decreased by $44 per diabetic member per month or 10.9%. Using the average plan size in this study of 1,000 people with diabetes, this would translate into gross savings of $528,000 in the first year of operation of

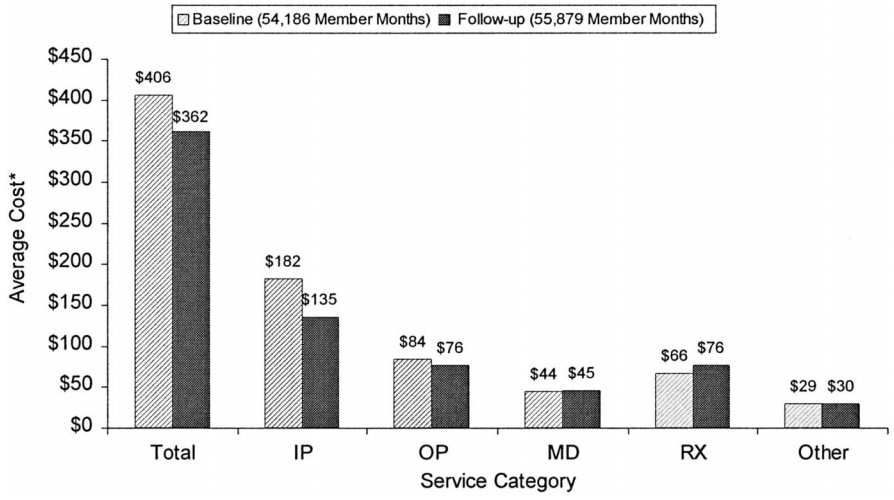


FIG. 3. Per member per month health care costs in the diabetes population. Source: claims data from each of the participating plans. * Average costs do not include Plans 6 or 7.

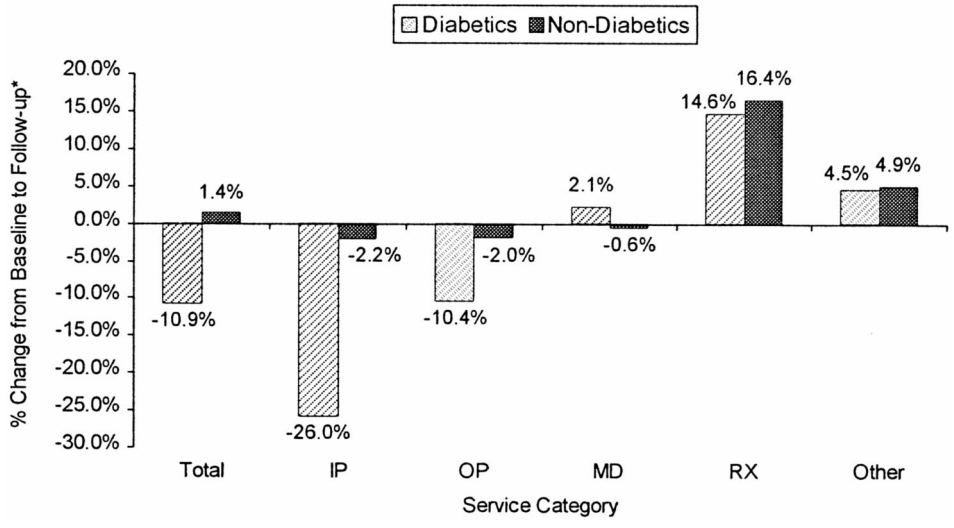


FIG. 4. Percent change in per member per month health care costs. Source: claims data from each of the participating plans. *Baseline and follow-up costs do not include Plans 6 or 7.

the population management program. The largest decrease in costs for people with diabetes was attributable to the reduction in inpatient hospitalizations and bed days. Inpatient hospital costs fell by $47 per diabetic member per month.[1]

Figure 4 examines percentage changes in costs between the baseline and follow-up periods and compares these percentage changes in the diabetic population to those in the nondiabetic population. This figure indicates that, as total health care costs were falling for the diabetic population, they were rising for the nondiabetic population. There was a 10.9% decrease in costs for diabetics, compared with a 1.4% increase in costs for nondiabetics. If it were assumed that without Diabetes NetCare[SM] diabetics would have experienced the same cost changes as nondiabetics, then the actual economic effect of Diabetes NetCare[SM] would be a 12.3% decrease in costs, or $50 per diabetic member per month. This captures the combined effect of the 1.4% increase for nondiabetics and the 10.9% decrease for diabetics. In a plan with 1,000 members with diabetes, this would translate into savings of $600,000 over the course of a year.

*Member and provider satisfaction results*

Approximately 27% of physicians contacted responded (ranging from 234 to 281 respondents per question) to the Provider Satisfaction survey instrument. Of those physicians who responded, 90% thought the overall quality of the program was good to excellent, 85% thought the program provided better care to patients, 80% thought the care manager staff was good to excellent, 82% thought the information provided was good to excellent, and 83% of physicians would recommend the program to others. The standard errors for these responses range from 4.7 to 5.1. These results are depicted in Fig. 5.

Approximately 34% of plan members contacted responded (547 respondents) to the follow-up Member Satisfaction survey. When asked if they would recommend Di-

[1] The unadjusted inpatient hospitalization costs were $202 per diabetic member per month in the baseline period and $145 per diabetic member per month in the follow-up period.


FIG. 5. Physician satisfaction. Source: Solution Point survey data.

abetes NetCare's[SM] diabetes services to others needing similar care, 45.3% strongly agreed and 29.1% somewhat agreed. The standard error for this response was 3.8.

## Discussion

Diabetes disease management initiatives can be divided into basic and comprehensive programs. Basic programs are more common and consist of patient education materials with some accompanying services and/or products. The Diabetes NetCare[SM] program described in this article is a comprehensive program that generated substantial gross cost savings in the short-term. Unlike basic disease management programs, DTCA's population based approach tracks the entire population with diabetes with a managed care organization and manages all aspects of their care, rather than focusing solely on glycemic control.

Like the DCCT treatment protocol, the Diabetes NetCare[SM] protocol ensures that people with diabetes have access to frequent interaction with their care coordinator, effective lines of communication with their physician, involvement in their own care planning, and access to substantial educational opportunities. However, unlike the DCCT, the Diabetes NetCare[SM] protocol provides for the efficient use of limited health care resources by stratifying members and providers based on costs and utilization, and by employing electronic medical records to track trends and outcomes and to redirect medical resources. While the DCCT protocol involved frequent and prolonged interaction with an array of health professionals including endocrinologists, diabetologists, nurses, dietitians, and behavioral scientists, the Diabetes NetCare[SM] protocol stresses using the lowest level of health professional necessary to accomplish objectives (7). Additionally, the Diabetes NetCare[SM] protocol provides for a high level of support for the primary care physician through the physician support coordinator.

Members with diabetes from the seven sites participating in this diabetes program showed substantial improvement in all of the clinical measures collected. Members were more likely to receive HbA1c tests, foot exams, eye exams, and cholesterol screenings while enrolled in the program. These tests are important elements of the American Diabetes Association's Standards of Care for management of people with diabetes. In addition, there was a decrease in HbA1c levels for those patients who had at least two HbA1c exams in follow-up. Over an average period of 107 days, patients' HbA1c levels fell from 8.9% to 8.5%. Research has demonstrated that HbA1c levels are closely linked both to costs and to development of complications. A recent study examining the relationship between HbA1c levels and medical care charges for adults with diabetes enrolled in an HMO found that medical charges increased significantly for every 1% increase in HbA1c above an HbA1c of 7% (9).

The Diabetes NetCare[SM] results are conservative and likely understated. This results from the fact that the follow-up period for five of the plans was less than 12 months; therefore, many patients were not scheduled to receive their annual exams during the study timeframe. If all plans had been followed for 12 months, it is reasonable to assume that the clinical results would improve.

Despite impressive headway, there is still opportunity for improvement in each of the clinical measures. Ideally, HbA1c values would be below 8%, and there would be 100% compliance with the American Diabetes Association's Standards of Care. In a 2-year retrospective study of 378 people with Type 2 diabetes treated at a Kaiser Permanente staff-model HMO clinic, 48.4% had at least two HbA1c tests, 60% had a cholesterol screening, 60.8% had two foot exams, and 79.9% had an ophthalmology visit over the 2-year study period (14). Although the two studies are not comparable because of Kaiser's small sample size, different delivery system, and longer evaluation time, both Kaiser and Diabetes NetCare[SM] fall short of total compliance with the various Standards of Care. While 76% of patients in the Diabetes NetCare[SM] program received annual HbA1c tests, only 25% received foot exams. In contrast, only 48.4% of Kaiser patients received annual HbA1c exams, while 60.8% received foot exams. Theoretically, a foot exam (and a cholesterol screening) could be performed in the same visit as the HbA1c test, so the dis-

crepancies are notable. Increased physician and patient education and monitoring may prove beneficial in increasing compliance with these prevention measures and in decreasing testing disparity.

Hospital utilization decreased dramatically for each plan's diabetic population. Admissions per 1,000 diabetic member years decreased by 18% between baseline and follow-up, and bed days decreased by 21%. There is no reason to believe that these findings are a function of denied access to inpatient care. DTCA had 12 years experience providing inpatient diabetes management and outpatient education before implementing Diabetes NetCare[SM]. The knowledge and experience gained through their hospital endeavors were invaluable in the creation of the inpatient management piece of the program, and are probably responsible for their success in decreasing hospital utilization.

Short-term cost outcomes from this program were also positive. Total gross costs decreased by $44 per diabetic member per month, or 10.9%. This would translate into gross savings of $528,000 per 1,000 diabetic members in the first year. The gross savings are even greater when an economic adjustment is made for the increasing costs observed in the nondiabetic population, resulting in savings of $50 (12.3%) per diabetic member per month. This translates into $600,000 in gross savings in the first year per 1,000 diabetic members.

It is likely that the savings realized in the first year of operation of the program will be greater than the 10.9% savings achieved by the plans in the financial analysis. The program had only been in operation for 9 months at three of the five plans analyzed, and 10 months at a fourth plan, when the analysis was conducted. Only Plan 4 had a full year of follow-up data and can therefore offer some insight into expected first-year savings for the other plans. At 9 months, Plan 4 had achieved 8.7% gross savings over baseline costs, and at 12 months gross savings had risen to 11.5%. Costs in the nondiabetic population for Plan 4 had fallen 0.1% at 9 months and had risen 0.8% at 12 months, resulting in economic adjusted gross savings of 8.6% and 12.3%, respectively.

The net savings realized by an HMO using this program would be a function of the financial arrangements between DTCA and the HMO. The program has both fixed and variable costs that include: salaries and benefits, supplies, satisfaction surveys, physician advisory committee costs, purchased services, member and provider communications, travel, liability insurance, depreciation, taxes and licenses, and rent. Total program costs would vary by the number of people with diabetes in the HMO. The actual program implementation costs are proprietary and could not be reported in this paper. We did analyze these costs, however, and found that the program breaks even at approximately 1,265 diabetic members. Net savings increase as the number of diabetic members increases and the fixed costs are spread out over a larger denominator.

As in previous studies on HMO costs, hospital utilization represented the greatest cost component for diabetic patients enrolled in the Diabetes NetCare[SM] program (15). Hospital costs accounted for 45% of overall diabetic patient costs in the baseline, but only 37% of diabetic patient costs in the follow-up. Hospital costs decreased by $47 per diabetic plan member per month, or $564 per year between baseline and follow-up. When an economic adjustment is made for the 2.2% decrease in hospital costs in the nondiabetic population, these results translate into savings of $43 per diabetic member per month and $516 per diabetic member per year.

The only component of care demonstrating a substantial increase in cost was pharmacy. Some of the increase in pharmacy costs may be attributable to the program's success in increasing patient compliance with their pharmaceutical regimens and in advocating aggressive risk factor management. However, it is more probable that the rising diabetic pharmacy costs represent an industry-wide trend, and are not attributable to the program. In fact, over the course of the study pharmacy costs for nondiabetic plan members rose by a higher percentage than pharmacy costs for diabetic plan members. When an economic adjustment is made for the 16.4% increase in pharmacy costs in the nondiabetic population, the result is a pharmacy savings of 1.8% for the population with diabetes. Rising pharmacy costs stem from a number of factors, including an increase in the average price per prescription above the rate of inflation, higher pharmacy utilization resulting from the shift from inpatient to outpatient care, and the introduction of new, more expensive products (16, 17).

DTCA has created a pharmacoeconomic model to predict the increasing yearly cost savings achievable through their program. The model predicted gross economic-adjusted cost savings of 10% in the first year of the program, 17% in the second year, 23% in the third year, 28% in the fourth year, and 31% in the fifth year. Diabetes NetCare[SM] exceeded the predicted cost savings for the first year, achieving actual gross economic-adjusted cost savings of 12.3%. Using the average baseline member month charges of $406, the program could be expected to achieve gross economic-adjusted cost savings per 1,000 diabetic members of $828,240 in year 2, $1,120,560 in year 3, $1,364,160 in year 4, and $1,510,320 in year 5, based on DTCA's model. Given Plan 4's average economic-adjusted savings rate of 27.4% over the fourth quarter, and cumulative economic-adjusted savings rate of 12.3% at the end of the first year, Diabetes NetCare[SM] appears to be well positioned to achieve its second-year savings goal of 17%.

Dr. Richard Eastman of the National Institutes of Diabetes, Digestive and Kidney Diseases developed a model (18) that predicts an average discounted lifetime cost per person of $62,769 for standard care, and $76,922 for comprehensive care. Rather than the net diabetic cost savings predicted by the DTCA model, the Eastman model predicts a $14,153 increase in lifetime costs for comprehensively treated diabetics. One reason for the discrepancy between the DTCA model and the Eastman model is that Eastman assumes that glycemic control will have no impact on macrovascular complications. Additionally, his model assumes that comprehensive diabetes treatment will cost $1,983 more per diabetic per year than standard diabetes treatment (*i.e.* standard treatment - $890/year; comprehensive treatment - $2,873/year) (18, 19).

The International Diabetes Center's Staged Diabetes Management program recently evaluated approximately 300 patients at five clinical sites. Over the course of the 6–12 month study period, patients with a mean starting HbA1c of 9.2%

showed a mean decrease of 1.8 percentage points in HbA1c levels. A pharmacoeconomic analysis predicted net lifetime cost savings of $27,000 per patient resulting from the program; however, the breakeven period for costs was 6–7 years (20).

For a disease management program to be successful, it must address the concerns of all the stakeholders—the patient, the physician and the MCO. The satisfaction survey results indicate that this program has successfully addressed member and provider needs. Three of four members enrolled in Diabetes NetCare[SM] would recommend the program to others needing similar care, and 85% of physicians believe that the program improves care for their patients with diabetes.

A comprehensive diabetes disease management program should, in the short term, improve patient outcomes, decrease costs, and ensure member and provider satisfaction. It appears that Diabetes NetCare[SM] meets these criteria, and it will be interesting to follow the Diabetes NetCare[SM] experience to track the magnitude of cost savings and improved clinical outcomes over time.

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