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Diabetes Disease Management Results in Hispanic Medicaid Patients

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Abstract: **Objectives**. To investigate outcomes of a telephonic nursing disease management program for Medicaid patients with diabetes residing in Puerto Rico. **Study design**. A 12-month, matched-cohort study. **Study population**. Four hundred and ninety (490) intervention group members matched to 490 controls. **Intervention**. Disease management diabetes program. For those in the intervention group, the disease management program customized a self-management intervention plan. **Main outcome measures**. Medical service utilization, including hospitalizations, emergency department visits, physician evaluation and management visits, selected clinical indicators, and financial impact. **Results**. The intervention group showed significant effects compared with the control group, including a 48% reduction in inpatient bed days, and a 23% increase in ACE inhibitor use, resulting in a return on investment estimate of 3.8:1. **Conclusions**. The study demonstrates that a nursing disease management program for diabetes can significantly improve hospitalizations, drug compliance, and vaccinations in a Hispanic Medicaid population.

Key words: Medicaid, diabetes, Hispanic, Puerto Rico, self-management, nursing, nurse-managed, telephone.

In 2007, the direct annual costs of diabetes are estimated at $116 billion, which (when added to indirect costs of $58 billion) results in total expenditures of $174 billion. This substantial cost imposes a great burden on individuals, families, and society.[1] One strategy strongly recommended by the Task Force on Community Preventive Services to help reduce this burden is disease management for people with diabetes.[2–4]

Disease management is an integrated, systematic approach to health care delivery that focuses on a population of patients with specific chronic diseases; approximately $8 billion is spent annually in the domestic U.S. commercial market on disease management, with an additional $12 to $15 billion spent under Medicaid, Medicare, and other government programs.[6]

While the Hispanic community makes up 18.9% of the U.S. population in the 50 states,[7] diabetes disproportionately affects this community. This is reflected in both

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the age-adjusted prevalence of diabetes among Hispanics, which is nearly twice that of non-Hispanic Whites (9.8% versus 5.0%),[8] and in Hispanics of all ages experiencing 41% more age-adjusted years of potential life lost from diabetes than non-Hispanic Whites.[8]

Substantial variations are observed in the prevalence of diabetes among different Hispanic communities. This variation in the U.S. ranges from a low of 0.5% (Seattle and King County Washington Hispanic women) to a high of 13.1% (Lower Rio Grande Valley, South Texas Hispanic women) of Hispanic adults who have ever been told they had diabetes by a health professional (with a median of 5.4%).[9] The prevalence of diabetes in the adult (Hispanic and non-Hispanic) population in the 50 states and the U.S. territories has a median of 6.6%, ranging from 4% in Alaska to 9.8% in Puerto Rico.[10]

Methods

Study population. The eligible population in the intervention or control group included people who met all of the following criteria:

- Inclusion criteria: adult members of a Medicaid health plan residing in Puerto Rico, for whom an ICD-9 code for diabetes (250.xx, 357.2, 362.0, 366.41, or 648.0) was found in any position. Each member had to have one or more diabetes-related pharmacy claim, one or more emergency department visits, one or more hospital admissions, or two or more outpatient visits.
- Excluded: those who were engaged in a local formal diabetes program.
- Excluded: members age 65 or over, resulting in an age range of 18 to 64.
- Excluded: health plan (Medicaid) members with less than three months eligibility prior to their study start date or less than three months eligibility after their study start date.
- Excluded: members residing in long-term skilled nursing facility, participating in a hospice program, or identified as having end stage renal disease, dialysis, transplants, AIDS, claims costs over $100,000, or malignant cancer. (*Long-term skilled nursing facility stay* was defined as greater than 30 days.)
- Excluded: intervention group members with less than three months participation in the disease management program.

Both the intervention group and the control group met the same inclusion, exclusion, and eligibility requirements. There were a total of 7,966 members with diabetes referred for disease management by the health plan, and their claims represented 5.7% of the claims costs for the plan. The total number of members with a claim in the health plan during the analysis was 885,280.

Of the 7,966 diabetics referred, 1,603 enrolled in the disease management program. The age/gender difference between the 1,603 enrolled and the 6,363 not enrolled was less than 2.2% for gender and less than 0.12 years of age.

Of the 1,630 members enrolled in the disease management program, the overlapping exclusions included 569 for not having at least three months of health plan eligibility before and after starting disease management, 84 for having one of the clinical or high

cost exclusions listed above, 677 for not participating for at least three months in the disease management program, and 587 for being over the age of 65.

After the above exclusions, the final sample size for the enrolled intervention group was 490 members whose medical and pharmacy claims formed the basis of the analysis for each study period. The age/gender difference between the 1,603 enrolled and the 490 included in the study was less than 0.5% for gender and less than 4.9 years of age.

The control group was drawn from the same referred population eligible for the intervention (7,966) except that the control group did not enroll in the disease management program or could not be contacted for enrollment in the program. The control group was not selected from any of the excluded enrolled members. After matching based on pre-intervention data, the control group consisted of 490 members whose medical and pharmacy claims formed the basis of the analysis for each study period. Matching was conducted using propensity scoring, as described below.

Intervention. In September 2002, registered nurses began calling identified members with diabetes for program enrollment. For those who agreed to enroll, McKesson Health Solutions customized a self-management intervention plan that included risk stratification, formal scheduled nurse education sessions, 24-hour access to a nurse counseling, and sources of symptom advice (a telephone line, printed action plans, workbooks). In addition, enrollees received individualized assessment letters, and reminders (for medication compliance and vaccination). Physicians received alerts about signs and symptoms of decompensation and notification of gaps between patient-reported practice and guideline recommendations.

Risk stratification was determined from direct patient assessment of medical service utilization, self-management practices, medical history, medical management, and psychosocial factors. The tool employed Boolean logic and sorted patients into three categories, which determined the frequency of scheduled calls over the course of the year. The interventions were primarily by telephone, with nurses calling the intervention group members' home residence. The American Diabetes Association guidelines, which are updated and published annually, formed the basis of the intervention.[11]

Initial assessments occurred from September 2002 through December 2003. The control group received usual care from the health plan and providers, which did not include the disease management intervention.

Study design. The intervention was approved by the Quality Management Department at the health plan providing the service. The health plan did not wish to evaluate the impact with a randomized controlled trial design and opted to employ a matched control analysis to evaluate program effects, since study evaluation was designed after the program launch. Therefore, a retrospective, concurrent matched cohort study design was employed.

Heckman argues that four features are needed for a proper evaluation: (1) intervention group members and controls are balanced on unobserved variables, (2) intervention group members and controls are balanced on observed variables, (3) outcomes are defined and measured in the same way for both groups, and (4) both groups are located in the same environment.[12] Features (2)–(4) can be achieved in non-experimental settings, while feature (1) is the principle benefit of randomized studies. This study achieves feature (2) through the use of matching, achieves feature (3) by defining and

measuring outcomes the same way for both groups, and achieves feature (4) by virtue of both groups being located in the same geographic area and belonging to the same health plan.

The control group was generated by matching each intervention group member with a control group member determined by a propensity score.[13,14] Matching on a propensity score is a way of matching on many variables indirectly, as direct matching becomes increasingly difficult with more variables.[15–18] Matching on a propensity score reduces a multivariate matching problem into a simpler univariate matching problem. Baseline matching variables were used in the propensity score estimation; these matching variables include demographic characteristics, comorbidities, utilization of medical services, medications, diagnostic tests, immunization history, and medical and pharmacy costs. Comorbidities were matched according to their presence, rather than severity, which is difficult to ascertain from an administrative database. The propensity score was calculated as the predicted probability from a logistic regression of participating or not in disease management as the dependent variable and the baseline matching variables as the independent variables.

Propensity scores were calculated on the intervention and control groups. The control group was formed by selecting the person with the closest propensity score to each intervention group member using the method of replacement described by Dehejia and Wahba.[19] A baseline time period was used to find matches to the intervention group. The baseline time period for the intervention group is the year before the initial assessment date for the diabetes disease management program. Since the control group did not have a date of initial assessment, the distribution of assessment dates from the intervention group was used for the control group to define a *pseudo* assessment date for the purposes of defining a baseline time period. The intervention time period is the time after each initial assessment date, which yielded a similar distribution of dates between the treatment and control groups from which the baseline was defined, which precluded any seasonality bias between the groups.

Outcomes measured. Medical service utilization, prescription drug use, and procedures performed were determined from administrative medical and pharmacy claims. Both medical and pharmacy costs were also measured (as described below). All of a member's claims were used in the analysis. Medical service utilization included inpatient admissions, inpatient bed-days, emergency department visits, physician evaluation and management visits, and the proportion of people with a readmission within 30 days of a previous admission. Prescription drug use included ACE inhibitor, beta blocker, antihypertensives, diuretics, cardiac glycosides or antiarrhymic, and blood glucose regulator use. Procedures analyzed with their associated procedure codes included hemoglobin A1c tests (83036), lipid panels (80061, 82465, 83718, 84478), influenza vaccines (90657, 90658, 90659, 90660, 90724, G0008), pneumococcal vaccines (90669, 90732, G0009), eye exams (92002, 92004, 92012, 92014), maculopathy (67208–67228), mircoalbumin testing (82043, 82044), echocardiography (93303–93350), cardiac catheterization (93501–93562), and myocardial imaging/perfusion testing (78414–78499).

Costs. All medical and pharmacy costs were inflation-adjusted to equal December 2003 values, using the medical and pharmacy price indices.[20] Medical/pharmacy costs were determined from medical/pharmacy claims costs, divided by total member months

to achieve a per member per month (PMPM) claims cost. Gross PMPM savings was determined in a program period as the difference between the treatment and control group PMPM claims costs. Total disease management services fees during the study period for the intervention group are converted to PMPM fees billed by dividing by the total number of member months for the intervention group during the study period. The return on investment is the division of PMPM gross savings and PMPM disease management services fees.

Statistics. Once a comparison cohort was defined, variables were compared at baseline year to ensure the similarity of the two groups. The Mantel-Haenszel chi-squared test was used for comparison of variables between the treatment and comparison cohorts that were dichotomous. This test was chosen for its ability to test the differences in proportions between two groups. The t-test was used for continuous variables to test differences in group means.

Results

The intensity of the intervention is shown in Table 1, which shows the type of call, the number of calls, and the average duration of the call. The diabetes care support program's 490 intervention group members had a total of 4,138 completed calls for an average of 8.4 per person over the course of the intervention. These 4,138 completed calls represent 46.2% of all calls, with the remaining calls represented as incomplete or unable to contact. Incomplete calls represented 11.2% of total calls and unable to contact calls represented the remaining 42.6% of calls. These calls resulted in an average of 207.2 minutes of nurse contact with each intervention group member. Of the 490 intervention group members, nine were risk-stratified into the lowest risk category, 264 into the medium risk category, and 217 into the highest risk category.

Since this is a two-group matched study design, the two groups (treatment and control) are first determined to be similar on measured variables at baseline (pre-treatment)

Table 1.

INTENSITY OF THE DISEASE MANAGEMENT INTERVENTION FOR THE PROGRAM'S 490 INTERVENTION GROUP MEMBERS

Type of call	Number	Average length (minutes)
Enrollment	491	8.2
Initial assessment	490	55.8
6 month re-assessment	311	43.0
12 month re-assessment	157	40.4
Monitoring	1,908	27.7
Symptomatic	59	8.7
Inbound	255	4.1
Outbound	467	3.7

and then compared with one another in the program period. Any differences in the program period are inferred to result from the intervention.

Table 2 reveals baseline characteristics of the two groups. The two groups were extremely well matched on all variables, showing no significant differences. Average age of the intervention group was 54.5 years. As expected, the comorbidity burden in this group of diabetes patients was high. Over 12% of the intervention group and control group had coronary artery disease and over 14% had hypertension.

Table 2.

BASELINE MATCHING RESULTS BETWEEN THE STUDY AND CONTROL GROUPS

	Study group	Control group	P-value
Demographic and comorbidities			
Number of people	490	490	1.000
Average months of health plan eligibility[a]	11.6	11.6	0.882
Average months of health plan eligibility[b]	11.7	11.5	0.566
Male (%)	37.1	37.3	0.947
Over age 65 (%)	0.0	0.0	1.000
Average age (%)	54.5	53.5	0.102
Coronary Artery Disease (%)	12.7	13.5	0.705
Chronic Obstructive Pulmonary Disease (%)	1.2	1.2	1.000
Hypertension (%)	15.9	17.8	0.443
Stroke (%)	2.4	1.4	0.247
Myocardial Infarction (%)	1.6	2.9	0.196
Peripheral Vascular Disease (%)	3.7	2.9	0.472
Diabetic Retinopathy (%)	12.4	11.0	0.487
Medical service utilization (annualized rate per 1000)			
Inpatient admits	331.9	306.2	0.670
Inpatient bed days	2,213.5	2,339.6	0.790
Emergency Department visits	1,042.3	918.5	0.322
Physician evaluation and management visits	5,027.5	4,875.6	0.685
Pharmacy scripts	38,830.9	38,702.8	0.963
Diabetes inpatient admits	55.0	23.2	0.310
Diabetes inpatient bed days	241.0	67.6	0.138
Diabetes Emergency Department visits	129.0	90.8	0.216
Cardiac inpatient admits	61.3	54.9	0.731
Cardiac inpatient bed days	255.8	232.3	0.785
Cardiac Emergency Department visits	25.4	23.2	0.856
Inpatient 30 day readmits	67.7	35.9	0.326
Inpatient admit[c]	63.4	54.9	0.583
Emergency Department Visit[c]	99.4	92.9	0.742

(Continued on p. 438)

Table 2. *(continued)*

	Study group	Control group	P-value
Prescription drugs (% of people who have)			
ACE inhibitor (%)	32.4	28.2	0.145
Beta blocker (%)	26.1	22.0	0.135
Antihypertensives (%)	48.0	47.1	0.798
Diuretics (%)	37.1	38.4	0.693
Cardiac Glycosides (%)	4.7	7.1	0.104
Blood Glucose Regulators (%)	92.9	92.7	0.902
Procedures performed (% of people who have)			
Hemoglobin A1c (%)	20.6	22.4	0.485
Lipid panel (%)	30.0	34.7	0.117
Eye examination (%)	6.5	5.7	0.594
Maculopathy (%)	3.7	2.9	0.472
Microalbumin (%)	0.0	0.0	1.000
Echocardiography (%)	5.9	7.3	0.369
Cardiac Catheterization (%)	3.1	2.7	0.702
Myocardial imaging/ perfusion (%)	2.0	2.4	0.666
Influenza immunization (%)	5.7	5.1	0.672
Pneumococcal immunization (%)	1.2	2.0	0.314
Average costs			
Monthly medical costs ($)	154.65	163.26	0.737
Monthly pharmacy costs ($)	76.68	73.85	0.505
Monthly total costs ($)	231.34	237.11	0.825

[a]baseline
[b]program period
[c]60 Days prior to Program Period

Table 3 provides a comparison of measured outcomes between the study group and the control group in the program period. The diabetes program appears to have had a marked favorable impact on study group members' utilization of acute medical services. Compared with the control group, the intervention group showed a pronounced significant reduction in inpatient bed days (reduced by 48.0%), and in cardiac inpatient bed days (reduced by 74.6%).

There were no significant differences between the two groups for beta blocker use although the intervention group had higher use by 7.1% over the control group. Compared with the control group, the intervention group did however have a pronounced significant higher rate of ACE inhibitor use and diuretics use (higher by 23.0% and 25.4%, respectively).

Recommended procedures showed statistically significant differences between the intervention and control groups with hemoglobin A1c testing higher in the interven-

Table 3.

PROGRAM PERIOD RESULTS AND DIFFERENCES BETWEEN THE STUDY AND CONTROL GROUPS

	Study group	Control group	P-value	Change (%)
Medical service utilization (annualized rate per 1000)				
Inpatient admits	174.0	268.4	0.112	35.2
Inpatient bed days	920.3	1,770.0	0.021[a]	48.0
Emergency Department visits	773.6	758.3	0.778	2.0
Physician evaluation & management visit	5,153.0	4,651.8	0.649	10.8
Pharmacy scripts	39,530.4	40,932.9	0.704	−3.4
Diabetes inpatient admits	39.8	14.9	0.437	167.2
Diabetes inpatient bed days	148.8	108.6	0.699	37.0
Diabetes Emergency Department visits	81.8	95.8	0.603	−14.7
Cardiac inpatient admits	25.2	98.0	0.001[b]	−74.3
Cardiac inpatient bed days	134.2	528.2	0.002[b]	−74.6
Cardiac Emergency Department visits	16.8	12.8	0.591	31.2
Inpatient 30 day readmits	29.4	42.6	0.635	−31.1
Prescription drugs (% of people who have)				
ACE inhibitor (%)	31.6	25.7	0.041[a]	23.0
Beta blocker (%)	27.6	25.7	0.516	7.1
Antihypertensives (%)	54.9	49.8	0.110	10.2
Diuretics (%)	45.3	36.1	0.004[b]	25.4
Cardiac glycosides (%)	5.1	6.3	0.409	−19.4
Blood glucose regulators (%)	90.4	90.4	1.000	0.0
Procedures performed (% of people who have)				
Hemoglobin A1c	21.2	16.5	0.061[c]	28.4
Lipid panel	28.0	23.7	0.126	18.1
Eye examination	16.3	13.9	0.285	17.6
Maculopathy	3.9	3.5	0.734	11.8
Microalbumin	1.4	1.2	0.780	16.7
Echocardiography	4.9	7.6	0.086[c]	−35.1
Cardiac catheterization	1.2	5.7	0.000[b]	−78.6
Myocardial imaging/ perfusion	1.8	2.0	0.817	−7.1
Influenza immunization	7.1	2.4	0.001[b]	191.7
Pneumococcal immunization	2.9	1.0	0.037[a]	180.0
Average costs				
Monthly medical costs ($)	74.50	154.66	0.001[b]	−51.8
Monthly pharmacy costs ($)	79.25	80.11	0.848	−1.1
Monthly total costs ($)	153.75	234.78	0.002[b]	34.5

[a]Significant at 5%
[b]Significant at 1%
[c]Significant at 10%

tion group by 28.4%, influenza immunization higher by 191.7%, and pneumoccocal immunization higher by 180.0%.

The total costs of the intervention were $1,769 for the lowest-risk group, corresponding to 7.9 months of program enrollment; $61,727 for the medium-risk group, corresponding to 9.4 months of program enrollment; and $58,810 for the high-risk group, corresponding to an average of 10.9 months of program enrollment. The total costs of the intervention were $122,306; the average costs were $249.60 per intervention group member during the entire time period of program enrollment, or $24.82 per month of program enrollment.

Total medical and pharmacy costs per person in the intervention group, inclusive of program fees, were $2,046 during the study period of approximately one year, compared with $2,699 in the control group during the same time period. Thus, the intervention group had 34.5% lower claims costs than the control group; with the costs of the program included, the intervention group had 24.2% lower costs than the control group. Another metric to evaluate financial impact is a return on investment calculation. All dollar metrics have been converted to December 2003 using the medical and pharmacy consumer price index.[20] Total intervention costs of $122,306 generated gross savings of $463,814 ($341,508 in net savings for a net savings percent of 25.8) resulting in a return on investment of 3.8:1.

Discussion

Diabetes disease management programs have penetrated managed care plans, with 75% of managed care plans in a recent survey offering comprehensive diabetes disease management programs with at least six of eight program elements as defined by the Disease Management Association of America.[21] Hispanic populations in a managed care organizations appear to make significantly less use of preventive services,[22] which could be addressed by disease management. There is also evidence of a Spanish-language disease management program having a favorable impact on diabetics' health behaviors, health status, and self-efficacy[23] and the need to support culturally sensitive diabetes education programs.[24] Hispanic populations suffer disproportionately from diabetes, in terms of both prevalence and severity. Innovations that improve health status and reduce avoidable costs are critically important to serving the needs of this vulnerable population. This study has the strength of being conducted in a community setting rather than restricted to an academic health center or a few clinic sites, which allows for wider generalization.

It is important to note that the patients included in the study were neither healthy nor free of significant disease. The patients' average age was 54.5 years, they had hospitalization rates greater than 300 per 1,000, and they had significant comorbidities (with more than 12% having coronary artery disease, over 15% having hypertension, and over 12% having diabetic retinopathy).

Limitations. Although matching on a propensity score tends to balance observed variables (as is done in this retrospective study) it does not balance unobserved variables (such as motivation for deciding to participate in an intervention). It is unknown which variables may be important in influencing a person's decision to participate in a disease

management program. So, important unobserved variables might have led to selection bias, although the bias magnitude or direction cannot be known. However, evidence suggests that propensity score adjustment for selection bias is possible, as in a study of women who either self-selected into epidural treatment or who did not self-select into epidural treatment,[25] and in another study of people who self-selected into taking aspirin or not.[26] Further evidence suggests that selection bias is controlled for, as in a study of people who used intravenous heparin, which was left to the discretion of the treating physician,[27] or who had a right heart catheterization.[28] The accuracy of controlling for selection bias is predicated on the assumption that the variables associated with selection are both observable and used in the matching process.[29] If the variables associated with selection are unobserved, then the only study design capable of controlling for selection bias is random trial, although Heckman has found that having applied the three of the four features described in the study design section produces results that are "fairly close to those produced from an experimental evaluation."[12, p. 646]

Further limitations include the use of administrative claims data, which lack lab values for specific tests and do not give information on the severity of comorbidities, or provide access to telephone numbers for control group patients. The availability of lab values or complete telephone access to the control group might have allowed for a better match between the intervention and control groups. The impact of these limitations is unknown.

In summary, this community-based, concurrent trial of a commercial diabetes disease management intervention in Hispanic Medicaid members demonstrated significant reductions in medical services, resulting in a 24.2% reduction in the costs of care. The control group was extremely well matched on a wide set of variables, and though the study design is still subject to possible selection bias, the approach does address temporal bias and provides a methodology for researchers to evaluate private health care service innovations without a randomized trial design to infer causality from the measurement of treatment effects of a disease management program.

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