Evaluation of the Effect of Performance Monitoring and Feedback on Care Process, Utilization, and Outcome

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OBJECTIVE — We evaluated a program of performance measurement and monitoring by assessing care process, utilization of services, and outcomes.

RESEARCH DESIGN AND METHODS — Information on 63,264 diabetic individuals who were continuously enrolled as members of Kaiser Permanente Southern California from 1 January 1994 to 31 December 1997 was used to evaluate the program. Time trends in testing for glycemic test and control and screening for dyslipidemia, use of lipid-lowering drugs, and microalbuminuria were evaluated as measures of care process. Time trends in hospitalization, outpatient appointments, prescriptions, and laboratory tests were evaluated as measures of utilization. Outcomes were hospitalization for myocardial infarction, ischemic stroke, and lower-limb amputation.

RESULTS — Between 1994 and 1997, improvements were evident in the process measures. The mean number of hospitalizations and the mean and median number of outpatients visits did not change. The mean number of laboratory tests increased from 13.2 in 1994 to 23.6 in 1997. The mean number of prescriptions for any medication increased from 19.7 to 24.3. Hospitalization rates for myocardial infarction did not change, but rates increased for ischemic stroke and lower-limb amputation.

CONCLUSIONS — Our findings suggest that measurement and monitoring of clinical performance can bring about modest improvements in measures of the processes of care in the absence of financial incentives, centrally driven interventions, and specialty care for all patients. In our setting, process improvements were associated with higher utilization of laboratory services and more prescriptions without an immediate return in terms of lower hospital utilization.

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Diabetes is an important cause of morbidity and mortality and a major contributor to the cost of medical care (1,2). Randomized trials establish a base of evidence for diabetes management (3–8), and several organizations, including the American Diabetes Association and the Agency for Health Care Policy and Research, have developed diabetes care guidelines. Adherence to these guidelines is now considered to be an indicator of the quality of care. Medicare assesses diabetes processes of care in its Medicare Managed Care Quality Improvement Project, and the National Committee for Quality Assurance will add diabetes process of care measures to its required Health Plan Employer Data and Information Set performance measurement set in the year 2000.

Landon et al. (9) identified four general ways that health care organizations influence the quality of care but focused on the importance of direct influences of health care organizations on physician behavior. The researchers grouped the direct influences on physicians in four dimensions or domains. The first domain is financial incentives. The second domain is management strategies, such as utilization review, referral requirements, guidelines, and physician profiling. The third domain is structural components of care, such as location of practice, staffing, and governance. The final domain is information or normative influences, which encompass the "professional culture of the organization and the nature of professional interactions that help to determine institutional practices or norms, including formal or informal education and feedback" (9). Landon et al. (9) and others (10) have pointed out that the effects of management strategies and information on physician behavior are poorly documented and that guidelines alone have not been especially successful in changing physician behavior.

Herein, we report the results of an evaluation of a program of performance measurement and monitoring for diabetes undertaken in a large health maintenance organization (HMO) that relied on adoption of evidence-based guidelines and group-level performance measurement and monitoring as methods for influencing diabetes care by physicians. The program did not include financial incentives, individual physician profiling, or systematic changes in the structural components of care. The program thus demonstrates the ability of formal group-level performance measurement to influence physician behavior in the context of an integrated care delivery system.

RESEARCH DESIGN AND METHODS

Setting and program description

The Kaiser Foundation Health Plan is a not-for-profit group model HMO that provides

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Abbreviations: HMO, health maintenance organization; ICD-9-CM, *International Classification of Diseases, Ninth Revision*.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Characteristics of 63,264 diabetic patients in the study population*

Characteristic	*n* (%)
Male	33,031 (52)
Age (years)	
<18	456 (1)
19–44	6,442 (10)
45–54	12,354 (20)
55–64	17,798 (28)
65–74	16,677 (26)
≥75	9,537 (15)
Nonuser of insulin	44,264 (70)

comprehensive prepaid medical care to 2.8 million residents of Southern California. Care is delivered in 11 hospitals and medical centers owned by Kaiser Foundation Health Plan and in more than 100 medical offices. The Southern California Permanente Medical Group, a partnership of 3,300 physicians, contracts exclusively with Kaiser Foundation Health Plan to provide professional services to health plan members.

In 1995, diabetes was selected as a focus area in the Kaiser Foundation Health Plan and Medical Group program of strategic goals for clinical care improvement. The choice of diabetes as a clinical strategic goal led to the following actions in 1995: development of a database of members with diabetes, adoption of evidence-based clinical practice guidelines for diabetes care, and implementation of a program of performance measurement and reporting for selected measures of guideline compliance.

Guidelines were disseminated in written form to primary care physicians and primary care chiefs of service as well as to clinical leaders at each medical center. Beginning in 1996, the guidelines were accessible to physicians via an internal website.

Beginning in 1995, a report on performance measures was prepared and was distributed annually in April and reflected performance in the previous calendar year. Measures were reported at the regional medical service area and medical center levels. Copies were sent to endocrinologists, chiefs of adult primary care (family medicine and internal medicine), area medical directors, and physician and administrative heads of departments of quality at each medical center.

To facilitate outreach efforts and local interim monitoring of performance, the diabetes database was made available to local analytic groups, and selected data elements were placed in the data warehouse.

Within this organizational framework, the clinically and financially accountable units are medical centers, which are aggregated into service areas. Models of care to improve performance for diabetes were developed in the local units and reflected local structural constraints and opportunities. From 1994 to 1997, no financial incentives were associated with diabetes performance, and no other centrally driven changes in the structural aspects of diabetes care were implemented. The organizational structure of Kaiser Permanente was stable during this period.

Identification of individuals with diabetes

Identification of members with diabetes involved a computer record linkage algorithm originally developed by Jonathan Brown and Joe Selby of Kaiser Permanente Northwest and Kaiser Permanente Northern California, respectively (personal communication). Members of the health plan in Southern California are identified as having diabetes based on linkage of data from the program's pharmacy, laboratory, and hospitalization information systems. Individuals are classified as having diabetes when they meet any of the following criteria: members who are taking insulin or an oral hypoglycemic agent, have an HbA_{1c} or equivalent fructosamine test ≥6.7%, or are hospitalized in a Kaiser Foundation hospital with a discharge diagnosis of diabetes (*International Classification of Diseases, Ninth Revision* [ICD-9-CM], code 250). The starting period for identification of individuals with diabetes was mid-1991.

The database is updated annually to identify members who cease enrollment in the health plan, to add newly enrolled members with diabetes, and to add members who newly meet the criteria for having diabetes. A 1995 special study assessed the ability of the database to identify individuals known to have diabetes (sensitivity) and the probability of an individual having a clinical diagnosis of diabetes when identified as having diabetes in the database (positive predictive value). The sensitivity assessment compared the database with a computer file of 4,287 individuals treated in the diabetes clinic at the Harbor City Kaiser Permanente Medical Center. Treatment in the diabetes clinic was considered to be a definite indicator of having diabetes. Positive predictive value was assessed by reviewing the medical records of a random sample of 200 individuals classified as having diabetes by using record linkage. A clinical diagnosis of diabetes recorded in the medical record was considered to be a definite indicator of having diabetes. Sensitivity of the database was 93%, and the positive predictive value was 95%.

Evaluation design

This evaluation was based on information about the 63,264 diabetic individuals who were continuously enrolled as members of the health plan from 1 January 1994 to 31 December 1997. The protocol for the evaluation was reviewed and approved by the Southern California Institutional Review Board for the Protection of Human Subjects.

The performance measures that were part of an ongoing reporting system that were also used in this evaluation were the percentage of members with diabetes who had one or more measurements of glycosylation (HbA_{1c} or fructosamine) during the year; the percentage of members tested whose values were in control (HbA_{1c} or equivalent <8.0%), out of control (HbA_{1c} or equivalent >10.0%), or borderline con-

Table 2—*Performance measures, 1994–1997*

Performance measure	1994	1995	1996	1997
One or more glycosolated tests (%)*	60	57	61	64†
Glycosolated test result (%)‡				
In control	41	44	48	55†
Borderline	37	36	36	29
Out of control	22	20	17	17
Full lipid profile (%)§	36	35	38	42†
Patients taking a lipid-lowering drug if LDL cholesterol >130 mg/dl (%)‖	27	33	34	41†
Screening for microalbuminuria (%)	10	13	20	33†

*HbA_{1c} or fructosamine; †$P < 0.0001$; ‡HbA_{1c} or equivalent, in control <8.0%, borderline 8.0–9.9%, out of control ≥10.0%; §measure of LDL cholesterol, HDL cholesterol, and triglycerides ≥18 years; ‖≥18 years.

Table 3—*Category of glycemic control in 1997 and earlier*

Category*	Earliest year	1997
In control	14,461 (38.7)	20,642 (55.3)
Borderline	14,251 (38.2)	10,752 (28.8)
Out of control	8,631 (23.1)	5,949 (15.9)
All	37,343 (100)	37,343 (100)

Data are *n* (%) and are for continuously enrolled members with HbA_{1c} test in 1997 and at least one test in an earlier year. *HbA_{1c} or equivalent, in control <8.0%, borderline 8.0–9.9%, out of control ≥10.0%.

trolled (HbA_{1c} or equivalent 8.0–9.9%); the percentage of members with diabetes aged ≥18 years who had a lipid profile that included measurement of LDL cholesterol, HDL cholesterol, and triglycerides during the year; the percentage of members with values of LDL cholesterol >130 mg/dl who were taking a lipid-lowering drug; and the percentage of members with diabetes who had a screening test for microalbuminuria.

In addition, for this evaluation, we assessed the level of glycemic control for all members who had a glycemic test in 1997 and who also had at least one test in an earlier year and the time trend in the percentage of members taking a lipid-lowering medication among those with an LDL cholesterol value >130 mg/dl according to the year in which LDL cholesterol >130 mg/dl was first identified. We did not include data on retinal screening or patient education, which are also components of the diabetes guidelines because these measures require chart review and/or survey.

Measures of utilization used in this evaluation were the mean and median number of outpatient appointment visits, laboratory tests, and prescriptions per member with diabetes; the mean number of hospitalizations; and the number of hospital days per 1,000 members with diabetes.

Outcome measures included in annual reports and in this evaluation were hospitalization for acute myocardial infarction, ischemic stroke, and lower-limb amputation.

Data sources

All HbA_{1c}, fructosamine, lipid, and microalbumin testing was done at a single laboratory for the entire Southern California region of Kaiser Permanente. Computer-stored information regarding these tests and their results was used to calculate measures of glycemic, lipid, and microalbuminuria testing and the results of glycemic and lipid testing. The conversion factor for fructosamine to HbA_{1c} (HbA_{1c} = fructosamine/40.0) was based on a study of split specimens performed in the Southern California regional laboratory (R. Evans, personal communication).

Computer-stored information on outpatient visits was used to calculate the number of outpatient visits. Computer-stored information on filled prescriptions was used to calculate the number of prescriptions.

Computer-stored hospital discharge data was the source of information on hospital utilization and rates of hospitalization for myocardial infarction (ICD-9-CM codes 410.xx–411.xx), ischemic stroke (432.xx–433.xx), and lower-limb amputation (ICD-9-CM procedures codes 84.10–84.17).

Statistical analysis

We used the χ^2 statistic to assess the significance of changes in performance measures, glycemic control, percentage of members with LDL cholesterol >130 mg/dl while taking a lipid-lowering drug, and rates of hospitalization for myocardial infarction, ischemic stroke, and lower-limb amputation. We assessed the statistical significance of changes in hospital days, outpatient visits, prescriptions, and laboratory tests by using repeated-measures analysis of variance.

Because of the large sample size, interpretation of statistical tests should be cautious. Clinically meaningless differences are sometimes highly significant statistically.

RESULTS

Table 1 shows the age and sex of the 63,264 diabetic patients in this evaluation. We do not have information on other demographic characteristics of the study population.

For all of the performance measures, improvements occurred in performance between 1994 and 1997 (Table 2).

A total of 37,343 people had a glycemic test in 1997 and also had a test in an earlier year. Table 3 shows the distribution of HbA_{1c} values for these individuals in 1997 and the earliest year tested. In 1997, 55.3% were in control compared with 38.7% in the earliest prior year. We also performed an analysis that assessed differences in mean values of HbA_{1c} for these 37,343 people and found that 65.6% improved (change in HbA_{1c} >0.0%), whereas 34.4% did not change or worsened (data not shown).

Among the 13,434 continuously enrolled members who were first identified as having an LDL cholesterol level >130 mg/dl in 1994, the percentage taking a lipid-lowering drug increased progressively through 1997 (Table 4). Similar increases were evident in the use of lipid-lowering medication for members whose first elevated LDL cholesterol level occurred in later years.

The changes in the mean number of hospitalizations and the mean and median number of outpatient visits between 1994 and 1997 were not great (Table 5), although all changes were statistically significant. The number of hospital days per 1,000 people with diabetes fluctuated but did not increase or decrease by much, even though the changes were statistically significant. The mean number of laboratory tests increased significantly from 13.2 in 1994 to 23.6 in 1997; the median number of laboratory tests increased from 8 to 12. The mean number of prescriptions for any medication increased significantly from 19.7 to 24.3; the median number of prescriptions increased from 15 to 20.

From 1994 to 1997, the rates of hospitalization for myocardial infarction did not change significantly ($P > 0.05$), whereas the rates of hospitalization for ischemic stroke or lower-limb amputation increased (Table 6).

CONCLUSIONS

A program of performance monitoring and feedback conducted in a large group model HMO was associated with modest improvements in

Table 4—*Percentage of patients taking lipid-lowering medication among those with LDL cholesterol levels >130 mg/dl by the year of first identification of an LDL cholesterol level >130 mg/dl*

Year first identified	Patients identified in that year (*n*)	Patients taking a lipid-lowering medication (%)			
		1994	1995	1996	1997
1994	13,434	26.7	31.4	35.3	47.1*
1995	6,397	—	20.9	24.8	34.7*
1996	4,041	—	—	18.2	28.4*
1997	2,767	—	—	—	22.0

*$P < 0.05$.

Table 5—*Utilization of services, 1994–1997*

	1994	1995	1996	1997
Hospitalizations				
Mean/person	0.93 ± 0.02	0.86 ± 0.01	0.96 ± 0.02	1.1 ± 0.02*
Median	0	0	0	0
Days/1,000	928 ± 15	856 ± 14	962 ± 16	1,114 ± 17*
Outpatient appointment visits				
Mean/person	11.7 ± 0.05	11.4 ± 0.05	12.0 ± 0.05	12.4 ± 0.05*
Median	9	9	9	9
Prescriptions for any medication				
Mean/person	19.7 ± 0.07	21.4 ± 0.08	23.4 ± 0.08	24.3 ± 0.08*
Median	15	17	19	20
Laboratory tests				
Mean/person	13.2 ± 0.09	15.5 ± 0.10	20.2 ± 0.14	23.6 ± 0.17*
Median	8	9	11	12

Data are means ± SEM or medians. *$P < 0.0001$.

several measures of better process of care. No clinically important changes were evident in hospital utilization. Use of laboratory services and prescriptions, but not outpatient visits, increased substantially.

The program relied on group-level versus individual physician-level performance reporting. Improvement in care processes occurred in the absence of financial incentives and without prespecified structural changes in the organization or the delivery system. Keen (11) suggested that systematic audit of processes and outcomes in diabetes care could result in continuous quality improvement. Our findings support this contention. However, any conclusion that the program caused the observed improvements in processes of care must be tempered because of the lack of a comparison group. Our results may be secular due to changes in diabetes care brought about by publicity about the results of the Diabetes Control and Complications Trial and randomized trials showing the benefits of blood pressure control in preventing or the promulgation of guidelines by the Agency for Health Care Policy and Research and the American Diabetes Association.

Most prior research on diabetes care has focused on comparing specialist versus primary care physicians and generally shows better processes and outcomes for patients with diabetes managed by specialists in the context of organized programs (12–15). Whether these findings are a result of specialist care or the organized system in which care was delivered is not clear. Levetan et al. (16) reported that diabetic patients managed by both primary care physicians and a diabetes center had lower mortality rates compared with diabetic patients managed exclusively by primary care physicians. Recent research suggests that organized and targeted efforts to improve diabetes care can improve generalist care (17–19).

A population-based approach to diabetes management in the Group Health Cooperative of Puget Sound reportedly resulted in major improvements in processes of care (18) and included the development of a registry of patients with diabetes and the adoption of evidence-based guidelines, as in our program. Unlike our program, a continuously updated diabetes registry was available on-line. Guideline implementation included not only traditional continuing education and print dissemination but also individual and small group education, provider-specific reporting of compliance, and on-line availability of guidelines. In addition, an expert consultant team traveled to primary care clinics to meet with the primary care team, and explicit redesign occurred in primary care practice, including group visits.

In the similarly comprehensive multifaceted Episodes of Care program for primary care management of diabetes reported by Friedman et al. (19), improvements in processes of care were great. That program, like the Group Health Cooperative program, included on-line access to computerized medical information about patients with diabetes, integration of diabetes practice guidelines into forms and patient profiles, provider-level reporting of performance and feedback, and several patient interventions (e.g., diabetes-focused interventions, patient education, and reminders).

Our findings suggest that measurement and monitoring of clinical performance alone has the potential to bring about modest improvements in measures of the processes of care in the absence of financial incentives and physician-specific profiling. In our setting, increased utilization of laboratory services and more prescriptions during the same time period were evident. In this setting, no immediate return was evident in terms of lower overall hospital utilization or lower rates of hospitalization for myocardial infarction, stroke, or lower-limb amputation.

Table 6—*Diabetes outcome measures, 1994–1997*

Outcome measure	1994	1995	1996	1997
Acute myocardial infarction	11.6	10.9	12.8	12.0*
Ischemic stroke	7.3	7.7	9.6	10.2†
Lower-limb amputation	3.7	4.1	4.8	5.6†

Data are hospitalization rates per 1,000. *$P > 0.05$; †$P < 0.05$.

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