Factors Driving Diabetes Care Improvement in a Large Medical Group: Ten Years of Progress

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Abstract

The purpose of this study was to document trends in diabetes quality of care and coinciding strategies for quality improvement over 10 years in a large medical group. Adults with diagnosed diabetes mellitus were identified each year from 1994 (N = 5610) to 2003 (N = 7650), and internal medical group data quantified improvement trends. Multivariate analysis was used to identify factors that did and did not contribute to improvement trends. Median glycosylated hemoglobin A_{1C} (A_{1C}) levels improved from 8.3% in 1994 to 6.9% in 2003 (P <.001). Mean low-density lipoprotein (LDL) cholesterol measurements improved from 132 mg/dL in 1995 to 97 mg/dL in 2003 (P <.001). Both A_{1C} (P <.01) and LDL improvement (P <.0001) were driven by drug intensification, leadership commitment to diabetes improvement, greater continuity of primary care, participation in local and national diabetes care improvement initiatives, and allocation of multidisciplinary resources at the clinic level to improve diabetes care. Resources were spent on nurse and dietitian educators, active outreach to high-risk patients facilitated by registries, physician opinion leader activities including clinic-based training programs, and financial incentives to primary care clinics. Use of endocrinology referrals was stable throughout the period at about 10% of patients per year, and there were no disease management contracts to outside vendors over the study period. Electronic medical records did not favorably affect glycemic control or lipid control in this setting. This primary care–based system achieved A_{1C} and LDL reductions sufficient to reduce macrovascular and microvascular risk by about 50% according to landmark studies; further risk reduction should be attainable through better blood pressure control. Strategies for diabetes improvement need to be customized to address documented gaps in quality of care, provider prescribing behaviors, and patient characteristics.

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The benefits of good glycemic and lipid control in type 2 diabetes mellitus are well known.[1-4] Although wide gaps between recommended and actual levels of care have been reported, recent national reports document little improvement in glycemic control in US adults with diabetes.[5,6] For example, Saydah et al used national data to show little glycosylated hemoglobin A_{1C} (A_{1C}) improvement and moderate low-density lipoprotein (LDL) cholesterol improvement among adults with diabetes from 1994 to 2000.[7] One of the few long-term analyses of glycemic control in type 2 diabetes recently found that control rates dropped from 44.5% in 1994 to 35.8% in 2000, a period of time during which more effective treatment regimens became widely available.[8]

Despite generally discouraging national data, there have been some reports of significant improvement in diabetes care.[9-12] However, most of these reports cover short time periods, and few reports systematically explore the wide range of factors that may affect diabetes care improvement.

In this article, we present 10-year trends in glycemic control (A_{1C} levels) and lipid control (LDL levels) in a well-defined population of adults with type 2 diabetes and address the following questions: (1) What levels of improvement in diabetes care can be achieved and sustained in primary care practice? (2) To what degree is intensification of pharmacotherapy driving improvement in diabetes care quality? and (3) What strategies may be used by medical groups or health plans to accelerate diabetes care improvement? The answers to

these questions may guide medical groups and health plans currently contemplating efforts to improve diabetes care. As at the level of the individual patient with diabetes, success and sustainability in A_{1C} and lipid control at the institutional level may require a renewed commitment of resources to meet changing needs as well as frequent evaluation of results to ensure progress toward goals.

Methods

We evaluated diabetes care delivered from January 1, 1994, to December 31, 2003, at HealthPartners Medical Group (HPMG), a Minnesota multispecialty medical group that at the time of the study provided comprehensive healthcare services to a defined population of 175 000 adult members at 17 clinics. Internists and family physicians delivered most of the adult diabetes care but easily referred patients to subspecialists as needed. From 9% to 12% of adult patients with diabetes saw an endocrinologist each year, most for a single visit to develop a treatment plan that was then jointly implemented with their primary care physician. Diabetes education nurses in each clinic worked closely with primary care physicians to provide patient education and self-management training. A drug formulary facilitated use of sulfonylureas, metformin, insulin, fibrates, and HMG-CoA [hydroxymethyl glutaryl coenzyme A] reductase inhibitors (statins). The use of alpha-glucosidase inhibitors, meglitinides, and thiazolidinediones required special authorization or prior use of alternative agents.

HPMG Diabetes Programs

In 1995, HPMG leaders identified diabetes as 1 of 8 priority areas for clinical quality improvement. This led to a multifaceted diabetes improvement strategy that began with the development of a registry for patients with diabetes and evolved throughout the period of interest to include a variety of initiatives. In each calendar year from 1994 to 2003, HPMG members aged 19 years and older were classified as having diagnosed diabetes if they met 1 or both of the following criteria: (a) 2 *International Statistical Classification of Diseases, 9th Revision* (*ICD-9*) 250.xx diagnostic codes at outpatient or inpatient visits that calendar year, or (b) a filled prescription for a diabetes-specific medication in that calendar year. This validated method of diabetes identification had an estimated sensitivity of 0.91 and an estimated specificity of 0.99; the positive predictive value was 0.94 in 1994[13] and 0.95 when revalidated in 2001. Those plan members identified as having diabetes were listed in diabetes registries first provided to physician/nurse teams in 1997; these registries were progressively expanded to include A_{1C} and LDL data and identification of comorbid coronary heart disease. Nurses used the registries to guide "active outreach" to high-risk patients not in metabolic control or missing recommended tests.

Beginning in 1997, the medical group leadership maintained a commitment to implement the locally accepted diabetes guideline, called Institute for Clinical Systems Improvement (ICSI) Diabetes Guideline (www.icsi.org), and participated in a medical group shared learning initiative to improve diabetes care called the ICSI Diabetes Action Group. HPMG also achieved recognition in the National Committee for Quality Assurance (NCQA)/American Diabetes Association (ADA) Diabetes Physician Recognition Program (DPRP) in 1999, and maintains that standing to date. All basic measures of diabetes care were continuously tracked over the 10-year period, and A_{1C} values were provided as a feedback and improvement tool to clinics and providers starting in 1997. LDL values were added to the feedback around 1999. Starting in 2001, feedback to providers was changed so that the percentage of patients with diabetes who were *simultaneously* at A_{1C} and LDL goal was reported, in an effort to focus diabetes care on both lipid and A_{1C} control. Although a diabetes registry was always available to the clinics, the format evolved as resources committed to this project waxed and waned. In the final year of the study period, financial incentives were made available to clinics for good performance on diabetes measures.

Tracking Trends in Diabetes Care

The proportion of patients with diabetes

Table 1. Trends in A_{1C} and LDL Values From 1994 to 2003 in Adults With Diabetes Receiving Care at HealthPartners Medical Group

Measure	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Number with diabetes	5610	5933	6332	5413	6067	6741	7056	7238	7423	7650
Mean age (yr)	59	59	59	59	59	59	59	61	61	61
% Women	47	48	47	46	46	47	47	47	48	48
% Tested for A_{1C}	85	82	88	90	90	85	90	88	90	89
Mean A_{1C} (%)	8.6	8.2	8	8	7.8	7.5	7.5	7.2	7.3	7.1
Median A_{1C} (%)	8.3	7.9	7.8	7.8	7.5	7.1	7.0	6.9	7.1	6.9
% Tested for LDL	NA	27	27	31	38	43	65	68	75	79
Mean LDL (mg/dL)	NA	132	130	126	120	116	115	110	109	97

A_{1C} indicates glycosylated hemoglobin A_{1C}; LDL, low-density lipoprotein cholesterol; NA, data not available.

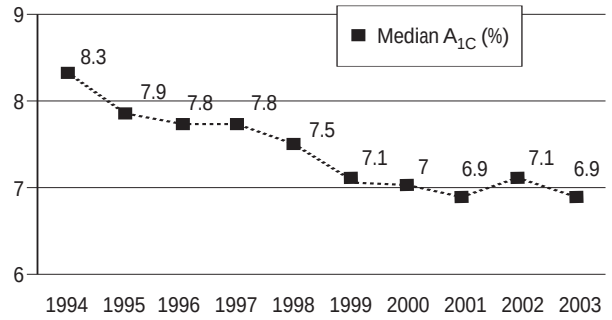
having 1 or more A_{1C} or LDL tests in each calendar year and the mean and median test values were measured for 1994 through 2003. When more than 1 A_{1C} or LDL test was done within a calendar year, the value obtained latest in the year was selected for analysis. A single accredited clinical chemistry laboratory did all tests. A_{1C} was measured by a liquid chromatographic assay, with a normal range of 4.5% to 6.1% and a coefficient of variation of 0.58% at an A_{1C} value of 8.8%.[14] LDL was calculated using standard equations only when blood samples were drawn after a minimum 12-hour fast and when triglycerides were less than 400 mg/dL. Patient age and gender were obtained from medical group administrative data. Age was reported as age in years as of January 1 of each year.

All study subjects had basic health insurance benefits through HPMG. More than 91% of study subjects younger than 65 years of age and 80% to 82% of those 65 years and older had pharmacy coverage in each year. For these patients, filled prescriptions were enumerated in each calendar year for the following drug classes: insulins, sulfonylureas, biguanides, thiazolidinediones, alpha-glucosidase inhibitors, meglitinides, and statins. Less than 5% of all HPMG members reported using any allopathic medical care services from sources outside HealthPartners.[15]

Results

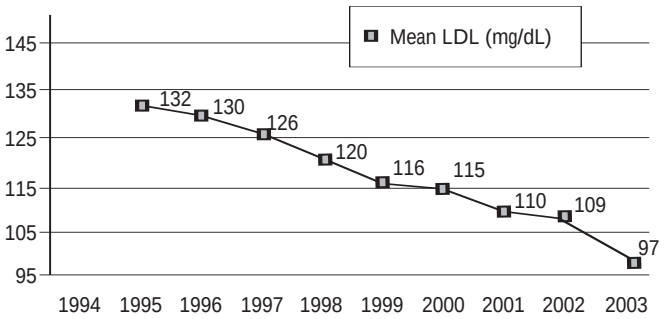
Demographic and clinical information for adults classified as having diabetes in each calendar year from 1994 to 2003 are given in **Table 1.** The number of patients with diabetes in each yearly cross-sectional sample rose from 5610 in 1994 to 7650 in 2003, despite the absence of sustained membership growth. The increased number of patients in the cross-sections over time is consistent with changes in diabetes diagnostic criteria and rising prevalence of diabetes.[16,17] Median A_{1C} fell from 8.3% in 1994 to 6.9% in 2003 (P <.001) and mean LDL fell from 132 mg/dL in 1995 to 97 mg/dL in 2003 (P <.001) across the cross-sectional samples (**Figures 1** and **2**). Previous analysis showed that A_{1C} in this patient population was not a predictor of subsequent death or disenrollment (although better glycemic control was correlated with lower medical care costs[18]). Analysis of the 1994 patients with diabetes as a cohort through 1999 showed similar

Figure 1. Change in Median A_{1C} Levels for Adults With Diabetes Receiving Care at HealthPartners Medical Group From 1994 to 2003



A_{1C} indicates glycosylated hemoglobin A_{1C}.

Figure 2. Change in Mean LDL Levels for Adults With Diabetes Receiving Care at HealthPartners Medical Group From 1994 to 2003



LDL indicates low-density lipoprotein cholesterol.

improvement trends in both A_{1C} and LDL (data not shown), indicating that death or selective disenrollment did not account for the noted improvements.

In unadjusted bivariate comparisons, A_{1C} and LDL improved significantly from 1994 to 1999 in nearly all defined patient subgroups. Multivariate models with change in A_{1C} from 1994 to 1999 as the dependent variable showed that older age (P <.0001), higher baseline A_{1C} (P <.0001), addition of sulfonylurea (P = .006), and addition of metformin (P = .01) were related to greater A_{1C} improvement. Baseline sulfonylurea use (P = .002) and evidence of depression during the study (P <.03) were related to less A_{1C} improvement. Also, younger adults (aged 18-44 years), patients on insulin treatment, and patients with no pharmacy coverage (about 18.3% of patients) had changes in A_{1C} that were less desirable than those achieved by other patients. Patient gender, patient comorbidity, primary care physician variables (age, gender, and specialty), diabetes educator visits, and a limited set of interaction terms were not significantly related to change in A_{1C}.

Patients who were older, had very high baseline A_{1C} scores, or had major comorbidity had the greatest improvement in LDL levels. As expected, those with higher baseline A_{1C} were more likely to receive intensified treatment, and A_{1C} improvement was greatest in those with initiation of insulin or combination therapy. The combination of insulin and metformin was particularly potent, for all patients as well as for patients with baseline A_{1C} greater than 9%, but other combinations (insulin and sulfonylurea, metformin and sulfonylurea) were also effective. Combination therapy using metformin and/or insulin increased substantially during the study period.

Thiazolidinediones, alpha-glucosidase inhibitors, and meglitinides were used in the aggregate by less than 2% of all patients through 1999. Thiazolidinedione use increased from about 2% in 1999 to about 9.5% of patients with diabetes by 2003.

Statin use accounted for most of the observed improvement in LDL; statin use was less than 20% in the mid-1990s, but reached 36% in 2001, and further increased to 50% in 2003. From 1995 to 1999, those patients taking statins had LDL decreases averaging about 30 mg/dL, whereas those not taking statins saw LDL drops of only about 7 mg/dL. In multivariate models, LDL improvement from 1995 to 1999 was significantly related to higher baseline LDL (P <.0001), older age (P = .03), higher comorbidity score (P = .05), taking a statin at baseline (P <.0001), or initiating statins during the study (P <.0001).

Table 2 provides an overview of diabetes care measurement trends coupled with care

Table 2. Factors and Strategies Contributing to Improved Diabetes Care at HPMG From 1994 to 2003

Study Period	Impact	Contributing Factors
1994-1997	Substantial improvement	1. Diabetes became a leadership priority 2. Improvement is easier at higher baseline A_{1C} levels 3. Participation in local Diabetes Guideline and Action Groups 4. Registry development
1997-1999	Relatively little improvement	1. Improvement is more difficult in lower A_{1C} range 2. No new strategies developed
1999-2001	Substantial improvement	1. Renewed priority: start of the Diabetes Improvement Project with paid champions 2. Participation in national initiatives, such as IHI and NCQA/ADA DPRP 3. Diabetes training for physicians provided at the clinics 4. Registry enhancements and support of clinic-based multidisciplinary resources
2001-2002	Measurement decline	1. Competing priorities for leadership 2. Cuts in multidisciplinary resources 3. Registry use waned 4. Nondisease-based strategies to transform care (eg, EMR implementation)
2002-2003	Regained the losses	1. Change in leadership structure with financial accountability to diabetes measurement performance 2. Redesigned registry and measurement tracking using EMR data (real-time) 3. Provider "pay for performance" financial incentives for diabetes quality measures 4. Prepared practice teams are more established

HPMG indicates HealthPartners Medical Group; A_{1C}, glycosylated hemoglobin A_{1C}; IHI, Institute for Healthcare Improvement; NCQA, National Committee for Quality Assurance; ADA, American Diabetes Association; DPRP, Diabetes Physician Recognition Program; EMR, electronic medical record.

improvement strategies implemented from 1994 to 2003. The table summarizes learnings from 6 federally funded research grants that collected data within the HPMG patient population during these years, as well as qualitative data from interviews with HPMG and HealthPartners leaders, providers, clinic staff, and quality improvement staff. The relative contributions of specific improvement strategies to observed trends in diabetes care quality are discussed next along with general observations about the ongoing HPMG efforts.

Additional data on attitudes of patients toward diabetes and diabetes care providers were obtained in surveys sent in 2001 to 1900 randomly selected HPMG adults with diabetes. Analyses of these data have been previously published, and reference to these survey results and trends is made in the Discussion that follows.[19-21]

Discussion

1. Primary care clinics can successfully improve diabetes care in the absence of carve-out disease management. Primary care physician continuity of care is significantly related to better diabetes care. This medical group implemented many common disease management tools, such as registries with ongoing monitoring of patients and active outreach to high-risk patients and those missing necessary tests. Previsit planning and case management often occurred in a multidisciplinary fashion among the diabetes nurses, dietitians, and

physicians at each clinic. These activities were done within the clinic and medical group, rather than being contracted out to a commercial disease management vendor. In seeking to improve access to primary care visits, we discovered a strong relationship between higher primary care continuity of care and quality of diabetes care. The HPMG diabetes care strategy is to invest available resources to develop chronic disease care infrastructure within the medical group, rather than siphoning off resources to outside vendors.

2. The final common pathway to A_{1C} and LDL improvement is intensification of pharmacotherapy. In this medical group, drug therapy with combinations of insulin, metformin, and sulfonylureas led to the greatest improvement in A_{1C}. The improvements noted through 1999 do not reflect benefits from widespread use of thiazolidinediones, alpha-glucosidase inhibitors, or nonsulfonylurea secretogogues, because use rates of these classes of drugs were low prior to year 2000. Clinical inertia is also a major barrier to better diabetes care. Clinical inertia is defined as failure to intensify therapy at a visit when A_{1C}, LDL, or blood pressure are not at evidence-based goals, and is reported to occur at about 60% of all diabetes visits.[22-24] However, our data suggest that HPMG physicians who participated in clinic-based Staged Diabetes Management training sessions were more likely to intensify medications than physicians who did not receive this training. Intensification of pharmacotherapy appears to be the "final common pathway" to successful control of both A_{1C} and LDL over long periods of time.

3. Certain groups of patients have had less improvement in A_{1C} and LDL than other groups. Those with the most difficulty included younger adults and those with a current or former diagnosis of depression. In addition to the willingness of physicians and patients to increase doses or use combination therapy, there were also a number of additional variables that emerged as independent predictors of A_{1C} or LDL control. For example, LDL change was robust in older, sicker patients—perhaps a reflection of current lipid control guidelines[25] that recommend targeting this population. Alternatively, the lesser degree of A_{1C} improvement in younger adults may indicate problems with access to care for younger patients who are more often employed. Age-based attitudinal differences toward diabetes may also account for the observed relative weakness in glycemic control in younger patients.[26] Data from the 2001 HPMG survey of adults with diabetes indicated that appreciation of the serious risk of diabetes (which patients with asymptomatic diabetes often fail to perceive) also independently predicts improvement in A_{1C}.[17,27] Tailoring of diabetes care improvement strategies to the needs of particular subgroups of patients may well be the engine needed to drive future improvement in diabetes care.[27]

4. As overall care improved, the "recidivism vector" became an increasingly important drag on further improvement. Each year, the net small incremental improvement in A_{1C} was the sum of 2 vectors. The improvement vector (roughly 35% of diabetes patients had better A_{1C} values than the year before) was largely offset by the recidivism vector (roughly 30% of diabetes patients had worse A_{1C} values than the year before). As overall A_{1C} values improve, the recidivism vector increases and acts as an increasingly prominent brake on further population-level improvements in A_{1C} levels. Thus, in addition to focused efforts to target high-A_{1C} patients with education and support, more aggressive "proactive" or "feed-forward" care also needs to be sustained across the entire population to continue the observed trends in A_{1C} improvement.[27] For example, results from diabetes prevention trials provide clinical justification of aggressive management of insulin resistance among patients with prediabetes. This supports the proposition that those with near-normal A_{1C} values should receive continued lifestyle support and ongoing aggressive pharmacotherapy as needed to preempt deterioration in A_{1C}.[28,29]

5. The benefits of patient education could be enhanced by more careful targeting of this resource. The presence of

diabetes educators in clinics has been associated with improved A_{1C} levels.[30] Payment for such services by Medicare has recently improved; however, significant barriers still remain to self-management support. For example, nurse and dietitian encounters cannot be reimbursed if services are provided on the same day, even if this is more convenient for the patient. In addition, the amount of time per year that will be reimbursed is limited and bears no relationship to the actual needs of the patient. The value of diabetes educators to medical groups may be greatly enhanced if educators collaborate with physicians to improve blood pressure and lipid control, as well as glycemic control. Additional efficiencies may be obtained by allocating educator time in a way that is consistent with a given patient's readiness to change.[19]

6. Participation in national and local long-term care improvement activities facilitated improvements, but competing priorities were sometimes a barrier. The medical group participated in both local and national quality improvement initiatives, including initiatives sponsored by the ICSI, the Institute for Healthcare Improvement (www.ihi.org), and the Minnesota Department of Health. However, the impact of these and other activities (such as participation in a national physician recognition program—see **Sidebar,** "The Diabetes Physician Recognition Program [DPRP] at HealthPartners Medical Group [HPMG]") on quality of care may be attenuated if there are many improvement initiatives competing for the physician's attention and priority. A primary example in the HPMG setting was an improvement initiative funded by a private foundation designed to address clinic systems globally, without any disease-specific focus.

This program, which had strong buy-in from health plan and medical group leaders, led to temporary discontinuation of ongoing disease-specific efforts to improve diabetes care, and likely accounted for the temporary worsening of A_{1C} levels in the period from 2001 to 2002. A second example was implementation of the electronic medical record (EMR), which many thought would solve the problems of poor quality care through best practice reminders. However, the process of EMR implementation diverted time and attention from clinical care and disrupted established chronic disease care routines for about 6 to 12 months. In clinics where the EMR was first implemented, EMR-related improvements in process measures, such as increased A_{1C} or cholesterol testing, did not translate to better levels of A_{1C} or LDL relative to similar clinics without EMRs.[31-33]

7. Financial accountability and performance incentives for diabetes performance may facilitate improvement. It was not until 2003 that HPMG established explicit financial incentives for better diabetes care. The impact of these incentives on diabetes care quality began to be felt almost immediately and continued through 2004. Incentives were initially directed to

The Diabetes Physician Recognition Program (DPRP) at HealthPartners Medical Group (HPMG)

HPMG achieved recognition in the National Committee for Quality Assurance (NCQA)/American Diabetes Association (ADA) Diabetes Physician Recognition Program (DPRP) in 1999, and has maintained that standing to date. The NCQA/ADA DPRP (www.ncqa.org/dprp) recognizes quality diabetes care provided by individual physicians or large group practices. Achieving recognition of excellent diabetes care through DPRP recognition has the potential benefit of providing greater visibility and credibility to a provider or medical group. However, in the Twin Cities market, such recognition has not led to major incremental marketing advantages for HPMG. The cost of participating in the DPRP program and the cost of required data collection are substantial. The attractiveness of the DPRP program to medical groups or physicians could perhaps be substantially increased if it were linked to financial incentives, such as a slightly higher reimbursement rate for care delivered by DPRP-recognized providers. This could be done through payers (such as the Centers for Medicare & Medicaid Services or major health plans) or employers, because the nonprofit organizations that administer the DPRP program are not well positioned to provide or administer financial incentives.

clinics and to practicing physicians in leadership positions rather than to individual physicians.

Thus, the improvements noted in diabetes care from 1994 to 2003 cannot be attributed to positive financial incentives. However, HPMG leaders plan to amplify the role of positive financial incentives to clinics as a strategy to further improve diabetes care and other care in the future. The EMR facilitates detailed tracking of diabetes care performance at the patient, provider, and clinic levels. A comprehensive diabetes "optimal care measure" is used to reward clinics in the system for the number of patients with diabetes who simultaneously meet all of the following standards:

- A_{1C} tested and result <7%;
- LDL tested and result <100 mg/dL;
- Systolic blood pressure <130 mm Hg;
- Aspirin use (for ages >40 years); and
- Nonsmoker status.

Another financial incentive program was offered by HealthPartners health plan to contracted medical groups other than HPMG for many years. Data suggest that this financial incentive program, referred to as the Outcomes Recognition Program, did have a positive impact not only on glycemic control in patients with diabetes, but also on lipid control in patients with heart disease and in overall rates of appropriate preventive care. These incentives were condition-specific and were provided to medical groups rather than to individual clinics or physicians.

Summary and Future Directions

The 10-year trends presented here indicate that widespread and sustained improvement in diabetes care can be achieved within a primary care–oriented delivery system. The magnitude of improvement in diabetes care from 1994 to 2003 was sufficient to reduce cardiovascular risk by about 50% in adults with diabetes. In addition to the noted improvements in A_{1C} and LDL levels, the rate of major cardiovascular events in adults with diabetes has decreased over time, and rates of patient-reported blindness among those with diabetes decreased from 1995 to 2001 (P = .052).

These results question conventional wisdom that EMRs, disease management contracts with outside vendors, and widespread use of expensive new classes of pharmacologic agents are necessary to improve diabetes care. An alternative strategy—to invest resources in enhanced primary care delivery systems and to increase primary care physician continuity of care—appeared quite effective in this report. It is clear that even the major 10-year improvement trend observed in this group leaves much to be desired. In settings such as this, with median A_{1C} levels already below 7%, higher priority should be given to better blood pressure control while maintaining gains achieved in A_{1C} and LDL levels.

Important future directions include the need to reduce clinical inertia and increase patient activation.[34] There is strong evidence that improved primary care physician continuity of care is a driver of diabetes care improvement, and efforts to maintain continuity of care will likely continue to be a priority. HPMG will also give more attention to external accountability and to physician or clinic financial incentives, which have demonstrated potential to induce care improvements in several clinical domains. A major need is to develop the potential of our recently implemented EMR system to provide more sophisticated decision support to physicians (and perhaps ultimately to patients as well) in a customized and timely fashion.

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