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# Does a Large-Scale Organizational Transformation Toward Patient-Centered Access Change the Utilization and Costs of Care for Patients With Diabetes?

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## Abstract

The authors examined whether Group Health's Access Initiative changed the utilization and costs of care among enrollees with diabetes. Using a single (one-group) interrupted time series design, repeated-measures generalized estimating equation models were used to estimate changes in utilization and costs during the Initiative rollout (2002-2003) and to compare the slopes (annual rates of change) for utilization and costs during the Pre-Initiative period (1998-2002) to the slopes during Full-Implementation (2003-2006) among 9,871 members continuously enrolled from 1997 to 2006 with type 1 or 2 diabetes. Total costs increased in Full-Implementation, but the annual change in total costs did not change. Primary care visits declined, but primary care contacts grew, largely from the Initiative's introduction of secure messaging. Specialty visits did not change; however, the Initiative may have increased emergency visits. To reduce emergency visits, future access initiatives should include proactive and comprehensive outpatient care for patients with diabetes.

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The U.S. health care delivery system is plagued by low-quality care for patients with chronic conditions, and to improve health care the Institute of Medicine (IOM) argues that health care systems must be redesigned to increase safety, effectiveness, equity, timeliness, efficiency, and patient-centeredness (IOM, 2001; McGlynn et al., 2003). The IOM also recommends new care processes guided by "simple rules" (e.g., "patients should receive care whenever they need it and in many forms, not just face-to-face visits"), better information technology, and alignment of provider payment with quality improvement (Berwick & Jain, 2004; IOM, 2001).

Conflicts may exist among the IOM recommendations. For instance, health care organizations that improve patient-centeredness may face increased costs and decreased productivity, eroding their market competitiveness (Charmel, 2003). Few studies have examined the potential trade-offs in service, cost, and effectiveness when health care organizations implement interventions directed at multiple IOM recommendations. In a population of patients with diabetes, our purpose is to examine changes in patient-level utilization and costs associated with a large-scale organizational transformation encompassing several of the IOM recommendations.

## *Group Health Access Initiative*

To reverse trends of declining membership and growing budget deficits, in 2002-2003 Group Health (GH), an integrated health care system based in Seattle, launched a system-wide transformation, known as the Access Initiative (AI), to increase enrollee access to providers and health information (Ralston et al., 2009). The broad goal of the AI was to transform GH from the standard HMO model, with managed care controls restricting access and choice, to a more patient-centered model, where enrollees receive care when and how they want it from their choice of primary or specialty provider. The AI consisted of five components:

1. A patient website, MyGroupHealth (MyGH), that provides patient access to patient–physician secure e-mail, portions of their electronic medical records, and an online health encyclopedia.
2. Advanced access to primary care physicians (same-day appointments or whenever patients preferred, and shorter wait times for services).
3. Direct access to some specialist physicians (removal of primary care physician gate keeping).
4. Change in primary care physician compensation to align with AI objectives through new physician incentives for productivity, patient satisfaction, coding accuracy, and secure messaging with patients.

5. Redesign the delivery of primary care. To increase efficiency and better reflect the lower overall GH enrollment, the Primary Care Redesign reduced the total number of primary care physicians, and changed the composition of primary care teams to improve workflow efficiencies. The redesign also imposed uniform productivity standards across physicians, which was thought necessary to achieve improved access for all enrollees.

In our prior evaluation, the AI was associated with increased patient satisfaction and primary care physician productivity and reduced total costs per member per quarter among the entire GH enrollee population (Conrad et al., 2008; Ralston et al., 2009). The purpose of the current study is to examine changes in patient-level utilization and costs associated with the organizational changes implemented in the AI among a population of patients with diabetes.

## Conceptual Model

Figure 1 presents the conceptual model for evaluating the Group Health Cooperative (GHC) AI. The components of the Initiative are expected to operate "jointly" to change enrollees' utilization of providers and information. In particular, GHC leaders who created the Initiative state that the reforms are synergistic, that is, outcomes will be more than the sum of the parts, or the concept that "1 + 1 = 3" (Ralston et al., 2009). Because the AI is a package of reforms, our evaluation is designed to estimate the effect of the organizational transformation as a whole and does not attempt to disentangle the effects of the individual reforms.

Consistent with IOM (2001) recommendations and Donabedian's (1966) structure–process–outcome model of quality care, the AI is a system redesign, or structural change, that is expected to increase enrollee access to information about their care and to providers, which in turn may influence care processes (utilization and costs), ultimately influencing enrollee satisfaction, care quality, and other outcomes (Barr, 1995; Cretin Shortell, & Keeler, 2004; Whyte, 1991). The process component of the conceptual model introduces new information technologies into medical practice, patient–provider secure messaging, and web-based information. Theory and evidence are unclear about whether the new technologies, working in combination with the organizational efficiency goals of the primary care redesign, may increase or decrease health care costs and in-person utilization (Andersen, 1995; Becker, 1965; IOM, 2001; Landon, Wilson, & Cleary, 1998).

## New Contribution

We examine whether implementation of the AI was associated with changes in the utilization and cost of care among patients with diabetes. We chose diabetes because it is a growing public health problem and 76% of individuals with diabetes have one or more comorbid conditions (Egede, 2005; National Institute of Diabetes and Digestive and Kidney Diseases [NIDDKD], 2003; Stagnetti, 2006). Patient-centered

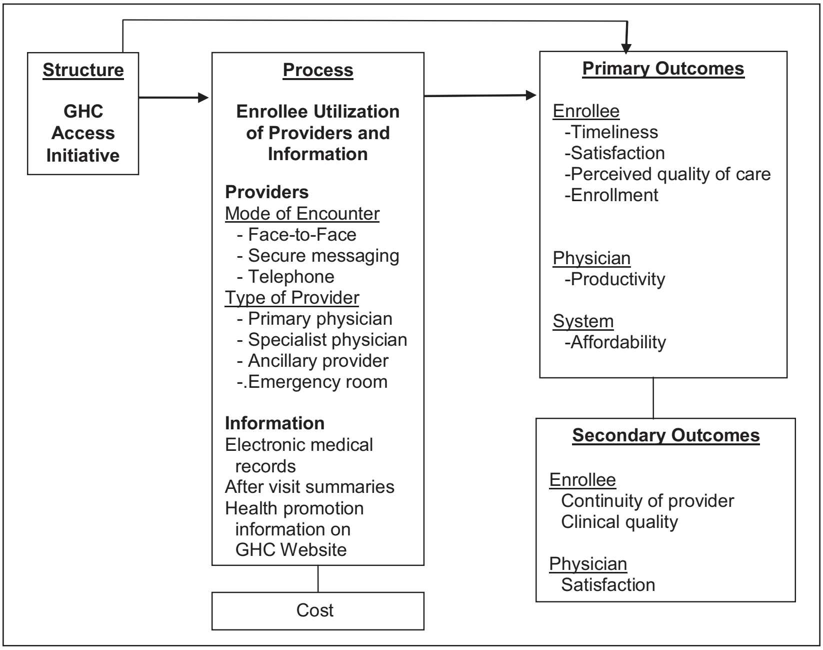


**Figure 1.** Conceptual model for evaluating the Group Health Cooperative (GHC) Access Initiative

access and care is a strategy that may be more effective in addressing the individualized and changing needs of patients with chronic conditions and comorbidity compared with primary care systems designed to address acute conditions (Bayliss, Edwards, Steiner, & Main, 2008; Burton, Anderson, & Kues, 2004; Casalino et al., 2003; Goldberg, Ralston, Hirsch, Hoath, & Ahmed, 2003; Kane, Priester, & Totten, 2005; Noel, Frueh, Larme, & Pugh, 2005; Ralston & Larson, 2005; Ralston, Revere, Robins, & Goldberg, 2004). However, trade-offs may exist between patient-centered access and costs in this patient population: Solberg et al. (2004) report that advanced access was associated with greater costs for patients with diabetes. To our knowledge, no study has examined the utilization and costs associated with blending patient-centered access with organizational efficiency and physician productivity goals for patients with diabetes and comorbid conditions.

# Method

## *Population and Study Design*

Group Health is a mixed-model health care system with more than 675,000 enrollees and a multispecialty group practice of 1,000 physicians who work in its owned and operated facilities mainly with capitation financing. The population for this study consisted of 9,871 members who were continuously enrolled from 1997 through 2006 (or death), on the GH Diabetes Registry in 1997 with prevalent type 1 or 2 diabetes, and who obtained care in 21 GH clinics in western Washington. To enter the registry, enrollees met at least one of the following criteria in the previous 12 months: (a) filled prescriptions for insulin or an oral hypoglycemic agent, (b) $HbA_{1c} > 7.0$, (c) two or more fasting plasma glucose levels ≥126 mg/dL, (d) two or more random plasma glucose levels ≥200 mg/dL, (e) any combination of two fasting plasma glucose and random plasma glucose over the previous limits, or (f) two outpatient diagnoses, or any inpatient diagnoses of diabetes. Enrollees with gestational diabetes or end-stage renal disease were excluded.

The single group interrupted time series design, with the enrollee-quarter as the unit of analysis, was used to test whether the AI was associated with a statistically significant change in health care utilization and costs from the Pre-Initiative period (January 1998-June 2002) to the Full-Implementation period (October 2003-December 2006) of the AI (Shadish, Cook, & Campbell, 2002; Winship & Morgan, 1999).

The single-group interrupted time series design has threats to internal validity, primarily that historical factors and maturation of the cohort could provide alternative explanations for observed effects. Historical factors may be tempered because secure messaging did not exist before the AI, and therefore, growth in secure messaging in Full-Implementation is a direct result of the AI's implementation of an advanced electronic medical record. Although a reduction in primary care visits that was concomitant with growth in secure messaging might be caused by other historical confounders, few plausible rival explanations may exist (Grembowski et al., 2008).

Second, while the continuous enrollee cohort eliminated the effect of unobserved enrollee-specific, time-invariant characteristics on utilization and costs, continuous enrollment also introduced a potential maturation threat to internal validity (because aging may cause changes in utilization and costs that coincide with the AI; Winship & Morgan, 1999). We performed several sensitivity analyses to investigate the potential maturation effects and strengthen the internal validity of our primary analysis and support causal inference. End-of-life care for older adults may increase costs significantly (Hoover, Crystal, Kumar, Sambamoorthi, & Cantor, 2002); therefore, deaths would be a plausible explanation for significant changes in costs in a continuously enrolled cohort. As a sensitivity analysis, we repeated the primary analysis, limiting to survivors. Similarly, to discount the effects of increased costs prior to death, a second sensitivity analysis censored enrollees during the two quarters prior to death. Finally, a third sensitivity analysis used a dynamic rather than fixed cohort approach, allowing enrollees to enter the cohort when they developed incident diabetes after 1997 and were continuously enrolled between 1998 and 2006. The dynamic cohort approach has different limitations, including lack of control for unmeasured time-invariant confounders; however, if results of these sensitivity analyses mirror those of the primary analysis, maturation in the continuously enrolled cohort is less likely to be a problem affecting the primary results.

Study protocols were approved by Group Health's Human Subjects Review Committee.

## *Comorbid Conditions*

Using diagnosis codes, pharmacy, and registry information, we measured the following key comorbid conditions because they are common among patients with diabetes and are likely to significantly increase health care utilization and costs (Andersen, 2005; Bishop, O'Connor, & Desai, 2010; Fu, Qiu, Radican, & Wells, 2009): depression (Lin et al., 2000; Simon et al., 2001; Solberg et al., 2006), hypertension (Bullano et al., 2006; DiSalvo et al., 2001), coronary artery disease (CAD; GH secondary heart care registry), and congestive heart failure (CHF; Nichols, Gullion, Koro, Uphross, & Brown, 2004; Nichols, Hillier, Erbey, & Brown, 2001). Because of their chronicity, we assumed hypertension, CAD, and CHF persisted for the remainder of the time series after onset. However, because of the relapsing and remitting nature of depression, the condition was defined for each study quarter based on pharmacy fills and diagnoses for that quarter only.

## *Data Sources and Measures*

*MyGroupHealth take-up*. Enrollee utilization of the MyGH patient website was collected from EpicCare® databases (Ralston et al., 2007). In each quarter, we measured whether an enrollee had sent a secure message to a provider and counted the total number of secure message threads (a thread is a set of messages including an original message plus any messages descending from it as replies; an "original" message is one that is not created in reply to another message; Carrell & Ralston, 2005)

*Utilization*. Enrollee face-to-face utilization was collected from the GH Research Institute's data warehouse (Fishman & Wagner, 1998). Enrollees had financial incentives to seek care within the integrated system, and in those instances where care was received from contract providers, utilization was measured through paid claims. Quarterly in-person utilization measures for 1998 to 2006 included primary care visits, primary care contacts (the sum of primary care visits and secure message threads), specialty visits, emergency room visits, inpatient admissions, inpatient days, and prescriptions filled.

*Costs*. The source of cost information was the GH Cost Management and Information System, where each unique patient encounter regardless of setting was assigned an RVU (relative value unit)-driven cost. Costs assigned to GHC enrollees for services received from providers outside GH were GH's claims-based payment to those providers. For each enrollee, quarterly cost measures in 1998 to 2006 were computed for total costs and each service category of utilization listed above as well as laboratory and radiology costs. Costs were adjusted to 2006 U.S. dollars using the Seattle–Tacoma–Everett medical care price index maintained by the U.S. Bureau of Labor Statistics.

*Residual comorbidity*. Residual comorbidity that did not overlap with diabetes and the four comorbid conditions was measured using the Adjusted Clinical Group case mix system (Weiner, Abrams, & Millman, 2005). ADG indicators (Adjusted Diagnosis Groups) were defined for each quarter based on primary and secondary International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes assigned in all settings over the preceding 12 months. Analyses adjusted for eight diagnosis groups selected based on their association with high health care resource use, including injuries, malignancies, arthritis, and other acute, recurrent, and chronic conditions (ADG Diagnostic Indicators 1, 3, 4, 9, 16, 18, 22, and 32).

*Enrollee and health plan characteristics*. Age, gender, type of insurance plan (Medicare, Medicaid, Basic Health Plan of Washington State for low-income residents, federal government, state government, commercial employer), copayments for office visit and pharmacy fills, and whether the enrollee's plan had a "wellcare waiver" (office visit co-pay not charged for well care visits) were collected from automated GH data systems. We included the "wellcare waiver" measure to capture the generosity of a patient's health plan, in terms of cost sharing, which might be associated with utilization of services.

## *Data Analysis*

Descriptive statistics summarized patient demographic and insurance plan characteristics and prevalent disease status of the cohort at baseline (Quarter 1 of 1998). Time series graphs described population–average quarterly utilization and costs from 1998 to 2006.

The main goal of the analysis was to estimate changes in health care utilization and cost associated with the implementation of the AI among patients with diabetes. Calendar time was divided into three periods: (a) Pre-Implementation (January 1998 to June 2002), (b) Rollout (July 2002 to September 2003), and (c) Full-Implementation (October 2003 to December 2006). Generalized linear models were used to estimate changes in cost and utilization outcomes over time. Calendar time was included in the models as a piecewise linear term, parameterized to allow for a change in the level and slope at both the beginning and the end of the Rollout period. We fit models using a log link with Poisson error distribution for count outcomes (e.g., primary care visits) to estimate utilization rate ratios. We used a log link and gamma errors for continuous cost outcomes (e.g., total costs), to estimate cost ratios. A separate model was fit for each utilization and cost measure, using repeated-measures generalized estimating equation models with an independence working correlation structure and robust standard errors to account for correlated observations by patient.

Based on the interrupted time series design, we summarized model estimates of changes in health care costs and utilization during the study period by reporting the following: (a) the annual rate of change (slope) during the Pre-Initiative period, (b) the annual rate of change during the Full-Implementation period, and (c) estimated change in the level of utilization and costs during the five-quarter Rollout period. A comparison of the slopes during the Pre-Initiative period to the Full-Implementation period is of primary interest, particularly for costs, because changes in slope for costs reflected financial viability, which is driven by the rate of cost growth (Chernew, 2010/2011; Gruber, 2010). The absolute change in level during the Rollout period also is of interest, because this estimates any immediate or short-term impact the AI may have had on care costs and utilization. The estimated change in level during the Rollout period is a summary of overall change from the beginning to the end of Rollout, estimated as a linear combination of model parameters, capturing the immediate change in level (intercept) at the beginning and end of Rollout and the linear change during the Rollout period.

To control for other determinants of utilization and costs, models adjusted for enrollee and insurance plan characteristics, including age, gender, and time-varying measures of outpatient and pharmacy copayment amounts, insurance type, "wellcare waiver." Models also adjusted for the four comorbid conditions (hypertension, CAD, CHF, depression) and residual comorbidity (ADGs). Because past studies report that proximity to death is associated with higher utilization and costs (Hoover et al., 2002), models also included indicators for the last two quarters of life. Enrollees were excluded from the time series when they developed end-stage renal disease ($n$ = 158), indicated by the first occurrence of a diagnosis. Finally, we performed the three sensitivity analyses to examine potential threats to internal validity as described earlier. Models were estimated using Stata version 10.0 statistical software.

## Results

Table 1 presents baseline characteristics of the cohort. On average, enrollees were older adults, evenly divided by gender, and most were insured through a commercial health plan. Most enrollees had a "wellcare waiver" and had outpatient and pharmacy copayments of $10 or less. About 33% ($n$ = 3,245) of the enrollees died during the time series. Enrollees contributed an average of 7.4 (*SD* 2.7) years of follow-up (minimum 1 quarter, maximum 9 years).

At baseline in 1998, 43% of enrollees had diabetes only, and hypertension was the most common of the four comorbid conditions. At the end of the time series (2006), only 19% of enrollees had diabetes only.

### *Descriptive Utilization and Cost Results*

By the last quarter of 2006, 32% of the enrollees ($n$ = 3,127) had signed-up and were authenticated to use the MyGH website. About 25% of all enrollees secure messaged providers in this quarter.

Figure 2 shows that unadjusted primary care visits declined in Full-Implementation. In contrast, primary care contacts (primary care visits and secure message threads) increased with the introduction of secure messaging with primary care providers. Specialty visits increased slightly. Figure 3 indicates that

**Table 1.** Enrollee Characteristics at Baseline (First Quarter of 1998)

| Characteristic | Number of Enrollees (%) (*N* = 9,871) |
|---|---|
| Age, mean (*SD*) | 63 (13) |
| Gender | |
| Male | |
| Female | 4,971 (49.6) |
| Outpatient co-payment | |
| <$10 | 6,073 (79.1) |
| $10 | 1,552 (20.2) |
| >$10 | 52 (0.7) |
| Missing | 2,194 |
| Pharmacy co-payment | |
| No co-payment | 1,226 (13.9) |
| <$10 | 4,048 (45.8) |
| $10 | 3,556 (40.2) |
| >$10 | 16 (0.2) |
| Missing | 1,025 |
| Well care waiver | |
| No | 1,339 (13.9) |
| Yes | 8,294 (86.0) |
| Missing | 238 |
| Insurance type | |
| Commercial | 8,330 (86.5) |
| Medicare | 1,206 (12.5) |
| Other | 97 (1.0) |
| Missing | 238 |
| Prevalent comorbidity at baseline | |
| Hypertension | 4,351 (44.1) |
| Current depression | 359 (3.6) |
| Coronary artery disease | 1,707 (17.3) |
| Congestive health failure | 1,593 (16.1) |

emergency visits were infrequent but increased from an average of 0.05 visits per person per quarter in Pre-Initiative to more than 0.10 in Full-Implementation. Enrollees with diabetes and none of the four comorbid conditions consistently had the lowest utilization rates across years for all types of utilization (data not shown). Average total costs per quarter adjusted only for inflation increased steadily from $1,946 in 1998 (Quarter 1) to $3,295 in 2006 (Quarter 4). Similar trends exist for primary care and emergency costs, while specialty costs decline in Rollout and then remain relatively flat in Full-Implementation (data not shown and available from lead author on request).

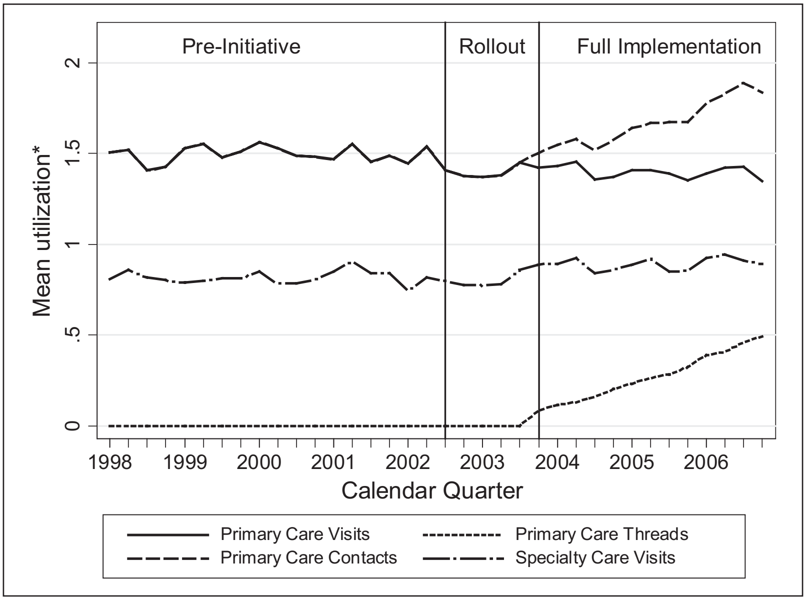


**Figure 2.** Unadjusted average quarterly rates for primary visits and contacts, specialty care visits, and secure message threads during Pre-Initiative, Initiative Rollout, and Full-Implementation, 1998-2006
*Mean utilization per person per quarter.

## *Regression Utilization and Cost Results*

Tables 2 and 3 present utilization incidence rate ratios (IRR) and cost ratios (CR) that (a) compare the annual rates of change (slopes) for the Pre-Initiative versus Full-Implementation periods and (b) compare utilization and costs at the start and end of the AI's Rollout, incorporating both changes in intercept and linear trend during the Rollout, and controlling for personal and plan characteristics, ADGs, and proximity to death.

*Total costs*. Implementation of the AI had no impact on total health care costs among this diabetic population. The change in total costs between the start and end of Rollout (CR = 1.014) was not significant (see Table 3), and the annual rate of change in total costs in Pre-initiative and Full-Implementation was the same (CR = 1.057).

*Primary care*. The AI had an immediate impact on the number of face-to-face primary care visits, with a decrease of 10% (IRR = 0.895; see Table 2) in the mean number of visits during the Rollout period. However, there was no significant effect on the annual rate of change primary care visits, with an annual decline of 2% to 3% estimated in both the Pre- and Post-Initiative periods. In contrast, there was no significant change in primary care costs, but there was an increase in the annual rate of change from 3.5% in Pre-Initiative to 6.2% Post-Initiative.

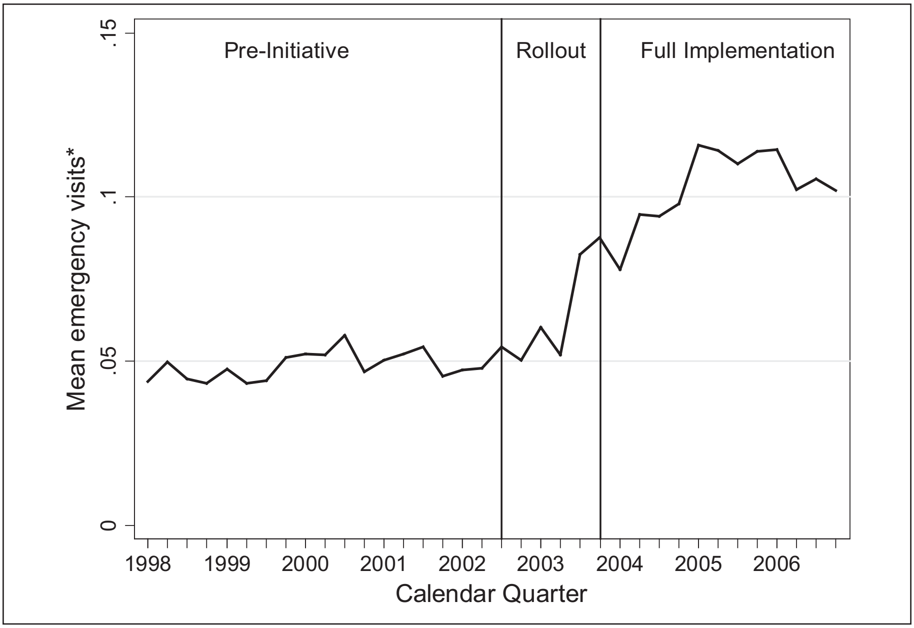


**Figure 3.** Unadjusted average quarterly rates for emergency care visits in 1998-2006}
*Mean emergency visits per person per quarter.

There was no significant change in primary care contacts (secure messages and in-person visits; IRR = 1.009) during Rollout. However, while primary care contacts decreased annually in Pre-Initiative by 2%, primary care contacts increased annually by 8% in Full-Implementation due to growth in secure messaging (see Figure 1).

*Specialty and emergency care*. Between the start and end of Rollout, specialty care visits did not change significantly (IRR = 1.014), although specialty costs decreased 17%. Specialty visits declined 1% to 2% per year in the Pre-Initiative and Full-Implementation periods, and the difference in the rates between the periods was not significant. The rate of growth in specialty costs declined significantly from about 7% in Pre-Initiative to 1% in Full-Implementation.

Between the start and end of Rollout, emergency care visits increased unexpectedly by 36%, and costs increased 33%. In Pre-Initiative, emergency visits and costs changed little year-to-year, but in Full-Implementation emergency visits increased annually 9%, while annual emergency care costs increased annually 13%.

*Inpatient care*. During the Rollout period no significant changes were detected for inpatient admissions, length of stay (days), or costs. There was no difference in the annual rate of change in inpatient admissions between the Pre-Initiative and Full-Implementation periods. Inpatient days decreased annually about 2% in Pre-Initiative; however, in Full-Implementation inpatient days increased annually about 11%.

**Table 2.** Incidence Rate Ratios (IRR) Comparing Slopes (Annual Rates of Change) for the Pre-Initiative Years Versus Full-Implementation Years, and Comparing Utilization at the Start and End of the Access Initiative's Rollout

| | Annual Rate of Change in Utilization | | | Short-Term Change in Level of Utilization |
|---|---|---|---|---|
| | Pre-Initiative Q1 1998 to Q2 2002 | Full-Implementation Q3 2003 to Q4 2006 | | Start versus End of Rollout Period Q3 2002 vs. Q2 2003 |
| | IRR[a] (95% CI) | IRR[a] (95% CI) | *p* Value[b] | IRR[c] (95% CI) |
| Primary care visits | 0.983 (0.977, 0.990) | 0.974 (0.962, 0.987) | .22 | 0.895 (0.866, 0.924) |
| Primary care contacts[d] | 0.983 (0.977, 0.989) | 1.078 (1.064, 1.094) | <.001 | 1.009 (0.976, 1.043) |
| Specialty visits | 0.986 (0.978, 0.994) | 0.985 (0.969, 1.000) | .88 | 1.014 (0.975, 1.054) |
| Emergency visits | 0.991 (0.966, 1.016) | 1.090 (1.040, 1.114) | .001 | 1.363 (1.175, 1.581) |
| Pharmacy fills | 1.053 (1.047, 1.058) | 0.993 (0.986, 1.000) | <.001 | 1.010 (0.995, 1.024) |
| Inpatient admits | 0.979 (0.961, 0.998) | 0.971 (0.931, 1.012) | .72 | 1.107 (0.986, 1.241) |
| Inpatient days | 0.976 (0.953, 0.999) | 1.112 (1.028, 1.218) | .003 | 1.046 (0.901, 1.214) |

Note: CI = confidence interval; CAD = coronary artery disease; CHF = congestive heart failure; HTN = hypertension. Generalized estimating equation models with Poisson error distribution, log link, and robust standard errors. Models adjusted for age, gender, end of life quarters, CAD, CHF, HTN, current depression, pharmacy co-pay, outpatient co-pay, insurance type, well-care waiver, and ADGs (1, 3, 4, 9, 16, 18, 22, 32).
a. IRR for annual change in utilization
b. *p* Value for comparing the annual rate of change (slope) in the Pre-Initiative period to the annual rate of change in the Full-Implementation period.
c. IRR comparing utilization at the end of the Rollout period (Q2 2003) relative to the start of the Rollout period (Q3 2002).
d. PC Contacts = primary care visits + threads.

Consequently, in Pre-Initiative there was no statistically significant annual change in inpatient hospital costs, but in Full-Implementation these costs increased annually 18%.

*Pharmacy dispenses, laboratory, radiology*. Although pharmacy fills did not change between the start and end of Rollout, pharmacy costs decreased about 4% (CR = 0.961). In Pre-Initiative, both prescription fills and costs were increasing annually, but in Full-Implementation there was no statistically significant annual trend.

Laboratory and radiology costs declined between the start and end of Rollout. There was no annual change in laboratory costs in Pre-Initiative, but costs increased annually 4% in Full-Implementation. Radiology costs grew in both periods, but the difference in growth rates was not significant.

*Sensitivity analyses*. Sensitivity analyses included re-estimating the models for the following: (a) survivors only, (b) censoring enrollees in the two quarters prior to death, and (c) adding enrollees who entered the GH Diabetes Registry after 1997

**Table 3.** Cost Ratios (CR) Comparing Slopes (Annual Rates of Change in Costs) for the Pre-Initiative Years Versus Full-Implementation Years, and Comparing Costs at the Start and End of the Access Initiative's Rollout

| | Annual Rate of Change in Costs | | | Short-Term Change in Cost |
|---|---|---|---|---|
| | Pre-Initiative Q1 1998 to Q2 2002 | Full-Implementation Q3 2003 to Q4 2006 | | Start Versus End of Rollout Period Q3 2002 vs. Q2 2003 |
| | Cost Ratio[a] 95% CI) | Cost Ratio[a] 95% CI) | *p* Value[b] | Cost Ratio[c] (95% CI) |
| Total costs | 1.057 (1.048, 1.067) | 1.057 (1.039, 1.076) | .99 | 1.014 (0.969, 1.061) |
| Primary care costs | 1.035 (1.027, 1.043) | 1.062 (1.046, 1.078) | .004 | 0.982 (0.944, 1.022) |
| Specialty care costs | 1.065 (1.050, 1.080) | 1.014 (0.988, 1.041) | .002 | 0.833 (0.782, 0.888) |
| Emergency care costs | 1.027 (0.991, 1.064) | 1.132 (1.051, 1.219) | .027 | 1.333 (1.056, 1.683) |
| Inpatient costs | 1.031 (0.985, 1.078) | 1.183 (1.062, 1.319) | .023 | 0.914 (0.677, 1.233) |
| Pharmacy costs | 1.111 (1.101, 1.122) | 1.008 (0.993, 1.024) | <.001 | 0.961 (0.933, 0.989) |
| Lab costs | 0.993 (0.984, 1.002) | 1.040 (1.019, 1.062) | <.001 | 0.959 (0.919, 1.000) |
| Radiology costs | 1.060 (1.040, 1.081) | 1.050 (1.016, 1.086) | .64 | 0.805 (0.733, 0.884) |

Note: CI = confidence interval; CAD = coronary artery disease; CHF = congestive heart failure; HTN = hypertension. Generalized estimating equation models with gamma error distribution, log link, and robust standard errors. Models adjusted for age, gender, end of life quarters, CAD, CHF, HTN, current depression, pharmacy co-pay, outpatient co-pay, insurance type, well-care waiver, and ADGs (1, 3, 4, 9, 16, 18, 22, 32).

[a] Cost ratio for annual change in costs.

[b] *p* Value for comparing the annual rate of change (slope) in the Pre-Initiative period to the annual rate of change in the Full-Implementation period.

[c] Cost ratio comparing costs at the end of the Rollout period (Q2 2003) relative to the start of the Rollout period (Q3 2002).

and were continuously enrolled from 1997 to 1998. There were no appreciable differences between the main analysis and the results from the three sensitivity analyses. Point estimates were similar, and there were only two differences in the significance of effect estimates. The difference in annual rates of change in inpatient costs in the Pre-Initiative compared with the Post-Initiative was significant in the primary analysis, but not significant when limiting to survivors. Also, pharmacy fills had a marginally statistically significant increase during the Rollout-period among survivors (IRR = 1.016, 95% confidence interval [CI] = 1.002, 1.030) in the analysis limiting to survivors, which was not significant in the main analysis (IRR = 1.010, 95% CI = 0.995, 1.024). Sensitivity analysis results are available from the lead author on request.

## Discussion

What are the utilization and cost consequences for patients with diabetes when an integrated delivery system launches a large-scale organizational transformation, blending patient-centered access with the potentially conflicting goals of organizational efficiency and physician productivity? Patient-centered access has the potential to grow both utilization and costs, threatening the organization's financial viability. Among GH enrollees with diabetes and continuously enrolled from 1997 to 2006, the AI was associated with changes in utilization and costs but sometimes in unexpected ways.

### *Utilization*

The introduction of a new service, secure messaging, increased annual primary care contacts and the annual rates of change for primary care contacts. The annual rates of change for emergency visits and costs also increased, an unexpected finding given the Initiative's focus on improving access to primary care, and evidence that proactive primary care is related to lower emergency visits (Gruneir, Silver, & Rochon, 2011). While inpatient admissions did not change, annual rates of change for inpatient days and costs increased in the Full-Implementation period.

Why did emergency visits increase for patients with diabetes? National trends in emergency room visit rates for older adults between 1995 and 2005 cannot account for the increase in emergency room visits following the AI (Nawar, Niska, & Xu, 2005; Stussman, 1997), nor can visits to urgent care centers, which are located in GH primary care facilities and are counted as primary care utilization. Another possible explanation is that the introduction of advanced access inadvertently created barriers to primary care that detoured enrollees to emergency rooms by changing the appointment system. However, advanced access introduced same-day appointments (Subramanian et al., 2009), and enrollees still had the option of traditional "prebooked" scheduling up to 3 months for regular monitoring in the AI; therefore, this change should have reduced, rather than introduced, barriers to primary care.

The emergency room findings may be a negative consequence of the Initiative's primary care redesign components, which decreased staffing of primary care teams, shortened average visit lengths, and dismantled some chronic care components, such as designated diabetes care nurses working in primary care (Ralston et al., 2009). GH also shifted from a focus on physician panel–based care management to physician productivity, which increased the burden on primary care physicians and reduced the time spent with patients and attention to management of diabetes and comorbid conditions that otherwise might have diverted some visits to emergency departments (Tufano, Ralston, & Martin, 2008). Primary care physician turnover and closure of some medical centers may have disrupted continuity of care and contributed to more emergency visits (Gruneir et al., 2011; McCusker et al., 2010). Advanced access available 24/7 may create provider discontinuity and may have contributed to greater emergency visits (Ferris, 2004; Gladstone & Howard, 2011; Haggerty et al., 2003). Future initiatives to improve access should implement policies, such as the medical home model, to reduce the number of emergency visits among patients with diabetes and comorbid conditions (Reid et al., 2009).

Another possible explanation for the increase in emergency visits is cohort aging, including greater diabetes severity and numbers of comorbid conditions, and mortality. Greater need for care over time may account for some but not all the increase in emergency visits for the following reasons (Gruneir et al., 2011). First, emergency visits increased 36% from the start to the end of Initiative Rollout, but we found no similar increase in diabetes complications, comorbid conditions, or deaths in this 1.25 year period (Shadish et al., 2002). Second, sensitivity analyses that excluded deaths, or excluded enrollees in the two quarters prior to death, or added enrollees who entered the GH Diabetes Registry in the time series produced results similar to the primary analysis. Third, the AI also was associated with increased emergency visits and costs among all GH enrollees, not just those with diabetes (unpublished findings).

There was little change in specialty visits. One possible explanation is that the continuously enrolled patients with diabetes are likely to have established relationships with their primary care physicians and may be less likely to seek specialty care directly. Also, while enrollees had direct access to nephrologists and neurologists, the Initiative did not allow direct access to endocrinologists and nutrition counselors—a referral from the primary physician was still required.

## *Costs*

The AI was a system-wide intervention that resulted in lower average total costs among all GH enrollees (Conrad et al., 2008). In the Pre-Initiative period, average total costs per quarter for *all* GH enrollees drifted upward and remained at historically high levels during Rollout (about $800 per member per quarter) before declining in the second quarter of Full-Implementation (to about $600 per member per quarter) and remaining relatively flat thereafter.

In contrast, there was no change in total costs for study participants with diabetes: the average total cost was unchanged from the beginning to end of the Rollout period, and the annual rate of increase in total costs was unchanged at 5.7% in both the Pre- and Post-Initiative periods. These findings are partly consistent with Solberg et al. (2004), who found Advanced Access increased costs for patients with diabetes but not the rate of cost growth. Data from the American Diabetes Association (ADA) on U.S. national trends in health care costs among diabetics indicate that per capita health care costs declined from 1997 to 2007. Average per capita costs are reported as $10,071 in 1997, $13,243 in 2002, and $11,744 in 2007 (ADA, 1998, 2003, 2008), and adjusting for inflation results in per capita costs of $15,076, $16,249, and $11,744, respectively (2007 dollars). The continued annual growth in total health care costs among diabetic patients at GH is inconsistent with national secular trends.

The lack of a significant effect on total costs probably occurred because utilization and costs decreased for some services but increased for other services, which offset each other. The AI was associated with greater emergency visits, which increased emergency costs. In contrast, there was an immediate reduction in specialty care costs during the Rollout period, and the annual rates of change for specialty care costs also declined between Pre- and Full-Implementation. This pattern might have occurred for several reasons: (a) the Initiative may have resulted in higher use of lower cost specialties and lower use of higher cost specialties, (b) improvements in the shared medical record may have increased the efficiency of primary-specialty care referrals and care coordination, and (c) with its emphasis on primary care, the Initiative may have increased lower-cost specialty consult visits and reduced higher-cost specialty treatment visits without changing the volume of specialty visits.

In proposing its six aims for quality improvement, the IOM saw these aims as chiefly being complementary and synergistic (IOM, 2001). However, the IOM's main strategy for reducing costs was eliminating waste and reducing administration and production costs, while GH's focus was reducing costs to solve a financial crisis. These are vastly different contexts. The IOM did recommend improvements in chronic care that could result in efficiency gains, and building on the AI, GH has implemented the patient-centered medical home in its medical clinics to reduce cost growth and improve quality outcomes (Sandy, Bodenheimer, Pawlson, & Starfield, 2009).

Our study has several noteworthy limitations. First, our findings are for enrollees with diabetes who are continuously enrolled for 10 years in an integrated delivery system, which limits the generalizability of our findings. While the continuously enrolled cohort may be different from other enrollees, the common attribute of diabetes in both continuously and noncontinuously enrolled members may reduce this concern. Our results may not apply to health care organizations implementing access reforms with different components or a surplus of funds to implement them. Next, the AI was introduced throughout GH, thus precluding the use of a randomized study design. Therefore, our estimates of the associations between AI and changes in health care costs and utilization may not be causal. From a practical perspective, however, Solberg (2011) notes that randomizing organizational practices is difficult in the United States and that much can be learned from rigorous observational studies. Finally, measures of telephone contacts did not exist for all years of the time series; therefore, our analysis of primary care contacts was limited to in-person and secure messaging encounters.

Our findings yield insights about how health care organizations balance trade-offs between service, cost, and quality and how a focus on service and costs may have unintended consequences for some subgroups of patients, such as those with chronic conditions. The AI was a large-scale organizational transformation designed to increase access for all enrollees and improve efficiency. In our sample of established patients with diabetes and comorbid conditions, we found that increasing access to primary care paradoxically did not prevent growth in emergency room visits and costs for some services. To reduce emergency visits and costs, future initiatives targeting access should include proactive and comprehensive outpatient care for patients with diabetes, for example, through nurse case managers, medical homes, or accountable care organizations (Reid et al., 2009; Von Korff et al., 2011).

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