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Are Primary Care Services a Substitute or Complement for Specialty and Inpatient Services?

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Objective. To determine whether strategies designed to increase members' use of primary care services result in decreases (substitution) or increases (complementation) in the use and cost of other types of health services.

Study Setting. Encounter and cost data were extracted from the Department of Veterans Affairs (VA) administrative data sources for the period 1995–1999. This timeframe captures the VA's natural experiment of increasing geographic access to primary care by establishing new satellite primary care clinics, known as Community-Based Outpatient Clinics (CBOCs).

Study Design. We exploited this natural experiment to estimate the substitutability of primary care for other health services and its impact on cost. Hypotheses were tested using ordinary least squares (OLS) regression, which was potentially subject to endogeneity bias. Endogeneity bias was assessed using a Hausman test. Endogeneity bias was accounted for by using instrumental variables analysis, which capitalized on the establishment of CBOCs to provide an exogenous identifier (change in travel distance to primary care).

Data Collection. Demographic, encounter, and cost data were collected for all veterans using VA health services who resided in the catchment areas of new CBOCs and for a matched group of veterans residing outside CBOC catchment areas.

Principal Findings. Change in distance to primary care was a significant and substantial predictor of change in primary care visits. OLS analyses indicated that an increase in primary care service use was associated with increases in the use of all specialty outpatient services and inpatient services, as well as increases in inpatient and outpatient costs. Hausman tests confirmed that OLS results for specialty mental health encounters and mental health admissions were unbiased, but that results for specialty medical encounters, physical health admissions, and outpatient costs were biased. Instrumental variables analyses indicated that an increase in primary care encounters was associated with a decrease in specialty medical encounters and was not associated with an increase in physical health admissions, or outpatient costs.

Conclusions. Results provide evidence that health systems can implement strategies to encourage their members to use more primary care services without driving up physical health costs.

Key Words. Primary care, service substitution, cost, managed care

The Institute of Medicine has defined primary care as the provision of integrated, accessible health care services by clinicians who are accountable for addressing the majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community (Donaldson et al. 1996). Starfield defines primary care as continuous, coordinated, and comprehensive care provided over time to populations undifferentiated by a particular disease, organ system, or gender (Starfield 1996). Both of these definitions stress the importance of focusing on (1) population-based medicine (in contrast to encounter-based medicine), (2) the continuity of care over time, and (3) the integration or coordination of care (Cooke 1995; Thompson 1996; Fontana et al. 1997; Frame, Berg, and Woolf 1997; Hall et al. 1997; Roman and Harris 1997). In an effort to practice population-based medicine and to contain health expenditures, many health maintenance organizations, the Department of Veterans Affairs (VA), and the National Health Service in the United Kingdom have all attempted to shift the locus of care from specialty and inpatient settings to the primary care setting (Manning et al. 1987; Coulter 1996; Kizer 1996).

The value of increasing access to primary care depends on whether primary care services can effectively substitute for more costly specialty and inpatient care. Most studies examining the substitution of primary care for

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specialty/inpatient care have used observational and cross-sectional study designs. Many of these studies have correlated aggregate rates of preventable hospitalizations with aggregate measures of access to primary care services (e.g., providers per capita) across geographic areas. These studies are subject to the limitations associated with analyzing aggregate utilization rates from geographic areas (e.g., ecological fallacy, border crossing, lack of case-mix data, etc.). Findings from analyses of aggregate data have been mixed, with some studies finding a substitution effect (Bindman et al. 1995), while others do not (Goodman et al. 1997; Ricketts et al. 2001). Observational analyses of disaggregate patient-level data could provide stronger evidence for a substitution effect, but again, the empirical findings are mixed, with some finding a substitution effect (Gill and Mainous 1998; Falik et al. 2001), while others do not (Gill and Mainous 1998; Petersen et al. 1998; Gill, Mainous, and Nsereko 2000).

Quasi-experimental and experimental study designs potentially provide the strongest evidence for or against a substitution effect. In a quasi-experimental study, Rubenstein and colleagues found that hospitalizations and specialty outpatient visits at the Sepulveda VA decreased significantly after reorganizing services to increase access to primary care for veterans (Rubenstein et al. 1996). However, a multisite VA experimental study found that veterans with chronic disorders who were randomly assigned to an intensive primary care treatment intervention after hospitalization had a higher probability of being readmitted to the hospital compared with the control group (Weinberger, Oddone, and Henderson 1996). In the RAND Health Insurance Experiment, study participants were randomly assigned to receive different health benefits. Results indicated that the insurance group with free ambulatory care had a nonsignificantly higher number of inpatient admissions than enrollees facing a $150 deductible for ambulatory care, suggesting a trend toward a complementation effect between ambulatory and inpatient care (Phelps 1992).

From a theoretical standpoint, there are a number of possible mechanisms for the substitution of primary care for inpatient and specialty outpatient services. First, the prevention, or early detection, of illnesses that can be treated in the primary care setting, may avert the need for specialty or inpatient care (Starfield 1994; Donaldson et al. 1996). This substitution mechanism is likely to have both short-term effects (e.g., prevention of hospitalization for asthma by prevention and early treatment of exacerbations) and long-term effects (e.g., prevention of stroke by treatment of hypertension). The second possible mechanism for substitution is the prevention, or delay, of the need for specialty

or inpatient care by the management of chronic health conditions (e.g., control of blood sugar to avert kidney failure in patients with diabetes mellitus) (Starfield 1994). This substitution mechanism includes routine monitoring/testing, medication management, and patient education that promotes self-management. The second substitution mechanism is likely to be more pronounced for patients with serious chronic illnesses and worse health status, although this mechanism will only be applicable for disorders that can be managed in the primary care setting effectively. The third substitution mechanism is gatekeeping (Starfield 1994). Gatekeeping policies require enrollees to obtain a referral from their primary care provider before their health plan will provide access to or pay claims for specialty visits. If primary care providers receive financial or other incentives from the health plan to maintain low referral rates, gatekeeping policies should reduce visits to specialists, although recent empirical evidence indicates that gatekeeping policies do not necessarily reduce the utilization of specialty services (Forrest et al. 2003).

Alternatively, there are several possible mechanisms by which primary care could be a complement with other types of health services. Complementary health services are those that tend to be delivered/consumed together (e.g., surgery and anesthesia). The first complementation mechanism is the utilization of services that are truly supplemental or ancillary to primary care treatments, such as diagnostic laboratory tests. For example, screening for diabetes mellitus in primary care requires a laboratory test, which is a complementary service. The second complementation mechanism is the detection of illnesses (e.g., cancer, serious mental illness, etc.) that are not appropriately treated in primary care settings or that should be comanaged with a specialist. For example, a patient with a prostate nodule and positive fecal occult blood tests discovered on routine screening in primary care will require further testing (prostate biopsy and colonoscopy, respectively) by nonprimary care specialists. This second mechanism is likely to be particularly salient for patients who have not used primary care services for a long period of time and who have a greater number of undetected illnesses. The third complementation mechanism is the identification (through close monitoring of chronic illnesses) of acute episodes that the primary care provider believes require specialty or inpatient treatment. This mechanism is likely to be particularly relevant for disorders with symptoms that may fluctuate in severity over time (e.g., angina or major depressive disorder).

Because theory does not necessarily support the substitution hypothesis over the complementation hypothesis and because the literature reports contradictory findings, it is not clear whether increased use of primary care

services decreases or increases the use of specialty and inpatient care or its impact on costs. Thus, additional research into this policy relevant issue is critically needed. Using data from the VA's natural experiment of increasing geographic access to primary care by establishing new Community-Based Outpatient Clinics (CBOC), we examined whether increased use of primary care results in decreases (substitution) or increases (complementation) in the use of other types of health services. We also examined whether increased use of primary care increases or decreases health care expenditures. To control for the endogeneity bias resulting from unmeasured severity of illness and heterogeneous preferences, we conducted a difference-in-differences analysis of longitudinal data and used instrumental variables techniques.

METHODS

In February 1995, the Department of Veterans Affairs began establishing CBOCs in order to increase access to primary care services for veterans living in underserved areas, and to facilitate the substitution of primary care for more costly inpatient and specialty care. The impact of establishing CBOCs on service utilization patterns and costs has been previously reported (Fortney et al. 2005). In this analysis, a quasi-experimental, pre–poststudy design was used to estimate the impact of increased use of primary care services resulting from improved geographic access to care on changes in the utilization of specialty and inpatient services, and changes in health expenditures.

Fifteen CBOCs offering primary care from 11 Veterans Integrated Service Networks (VISNs) were included in the analysis. CBOCs were included in the analysis if they were established between March 29, 1997 and September 30, 1997, which was the first-year diagnostic data that were available in the outpatient files. All veterans living within a catchment area of a new CBOC were included in the study if they had used any VA medical services in the 6-month period before the establishment of the CBOC. The definition of a CBOC catchment area was any zip code that was closer to that CBOC than to any other VA facility. Veterans were excluded if they had an extended care admission (e.g., nursing home or domiciliary stay) during the 6 months prior to the establishment of the CBOC, or if they moved out of the catchment area during the 6 months prior to CBOC establishment. Movers were defined as those veterans who had an inpatient admission or outpatient encounter record with a corresponding zip code outside the catchment area.

Veterans residing in the catchment areas of these 15 CBOCs were matched to veterans residing outside of the catchment area of any new VA facility. Veterans were matched according to prior utilization, VISN of residence, and distance to closest VA outpatient clinic prior to CBOC establishment. To generate a sample of matched veterans, the CBOC catchment area sample was divided into 15 subsamples according to their residence within each of the 15 study CBOC catchment areas. For each of the 15 CBOC subsamples, 15 reference subgroups were populated with veterans who used VA services in the 6 months prior to CBOC establishment, and who resided in the same VISN as the CBOC, but not in the catchment area of a VA facility established at anytime during the study period. Next, veterans were sampled from each of these 15 reference subgroups according to their travel distance in the preperiod to help ensure that veterans in the matched subsamples had similar geographic access to VA services (prior to the establishment of the CBOC) as veterans in the CBOC subsamples. Specifically, for each of the 15 CBOC subsamples, the median preperiod travel distance was calculated, and the number of veterans with preperiod travel distances less than and greater than this median were determined. Veterans from the reference subgroups were randomly sampled until the same number of veterans in the matched subsample had preperiod travel distances less than and greater than this median. The 15 matched subsamples were then combined to generate the final sample of matched veterans.

The pre–postperiod ranged from October 1995 to September 1999. The preperiod was defined as the 18 months before the establishment of each CBOC, and the postperiod was defined as the 18 months after the establishment date of each CBOC. Utilization and costs in the first 6 months of the postperiod were excluded to minimize the bias associated with start-up effects. As a result, the postperiod was defined as months 6–24 following the establishment of the CBOC. Based on experiences with CBOC start-up at our VA Medical Center, it was expected that fewer primary care services would have been provided to veterans in the catchment area during the start-up period because of (1) a lag time in enrolling patients, (2) inadequate capacity resulting in long appointment waiting times, and (3) inefficiencies in operations. Consequently, it was expected that inclusion of the first 6 months of data in the analysis would result in a much smaller increase in observed primary care services resulting in less statistical power to detect a substitution effect.

The dependent variables were defined as *post* minus *pre* changes in utilization and costs. Outpatient utilization (taken from the SE files in the VA Austin Automation Center) was divided into five categories according to the

clinic code: (1) primary care encounters, (2) specialty medical encounters, (3) specialty mental encounters, (4) ancillary (not analyzed), and (5) other (not analyzed). Inpatient utilization (taken from PM and PB files) was categorized into physical health admission or mental health admission based on the primary diagnosis. Outpatient encounter costs were calculated using a VA Health Economics Resource Center (HERC) algorithm (Phibbs et al. 2003), which assigned costs to specific clinic codes based on data from the Cost Distribution Report. The Cost Distribution Report defined average clinic costs based on workload estimates by service chiefs at each VA facility. The number of clinic encounters made by each veteran was then multiplied by the appropriate average costs for each clinic encounter. These values were summed to calculate the total outpatient costs for each patient. Inpatient encounter costs were calculated using an algorithm developed by the HERC, which generated patient-specific costs based on age, sex, discharge disposition, bedsection(s), length of stay, and Medicare DRG weights (Wagner, Chen, and Barnett 2003). Costs were logged before calculating post minus pre differences in expenditures, in order to generate more normal distributions.

The covariates included VISN (represented by fixed effects), age, sex, race, marital status, percent service connected, means test category, and Diagnostic Cost Groups (DCGs). Service-connected disability (0–100 percent) reflects the proportion of a veteran's disability related to a disorder contracted during active military service. Means test categories reflect a veteran's eligibility and priority to receive VA services based on their service-connected disability rating, and/or income. The DCG values were based on the inpatient and outpatient diagnoses recorded in Fiscal Year 1997 (FY97), the year the 15 CBOCs were established. Diagnostic risk was defined by the Medicare Hierarchical Coexisting Conditions (HCC) Prospective Risk Score and calculated using Version 3.0 of the DCG software (Ash et al. 2000). The DCG–HCC model organized closely related conditions into hierarchies, and a person was assigned a score in one of 23 diagnostic categories based upon the most serious condition in that hierarchy. Multiple conditions were allowed in the DCG–HCC, to account for comorbidities. A DCG value of 1 represented the average risk category for Medicare patients, and a value of 0.5 represented half the average risk.

Travel distances to the closest VA facility offering primary care services in both the preperiod and the postperiod were calculated using the ArcInfo/ArcView Geographic Information System (GIS). Each patient was assigned to the closest VA facility in both the preperiod and the postperiod based on Euclidean distance. Euclidean distance was calculated using the longitude and

latitude of each VA facility and the longitude and latitude of the centroid of the zip code in which the patient resided. Two studies have verified that Euclidean distance explains virtually all (e.g., 94–98 percent) of the variation in actual travel time (Fortney, Rost, and Warren 2000; Phibbs and Luft 1995). By definition, veterans in the catchment areas of newly established CBOCs experienced a decrease in travel distance to primary care services, while the matched veterans experienced no change in travel distance.

ANALYSIS

The explanatory variable of interest was the change (post minus pre) in the number of primary care clinic encounters. Ordinary least squares (OLS) regression analysis was used to estimate the relationship between the change in primary care encounters over time and the change in specialty and inpatient service utilization categories over time. The standard errors of the OLS parameter estimates were corrected for clustering at the VISN level using a modification of the Huber–White sandwich estimator of variance, as implemented in the *STATA* software package. This specification yields a "difference-in-differences" analysis that controls for first-order endogeneity bias, which is a potentially important methodological problem in this context. First-order endogeneity bias refers to the impact of unobserved time-invariant case-mix factors, that may be correlated with both the dependent and explanatory variables. The difference-in-differences analysis controls for first-order endogeneity if the impact of the unobserved factors is the same in both the preperiod and the postperiod. However, the difference-in-differences approach does not control for second-order endogeneity bias. Second-order endogeneity bias refers to the impact of unobserved time-variant case-mix factors. Second-order endogeneity bias is a potentially important methodological problem because patients with deteriorating health status are likely to have greater increases in the utilization of all types of health care services. The presence of second-order endogeneity may lead to positive correlations among all types of service use categories, and bias results toward concluding that primary care is a complement with other types of health services.

Instrumental variables analysis is a widely used econometric technique designed to control for endogeneity bias. In an instrumental variables analysis, an exogenous variable is used as an instrument for an endogenous explanatory variable (e.g., change in primary care encounters). The instrument must meet two main conditions: (1) it must significantly and substantially predict

variation in the endogenous explanatory variable (Staiger and Stock 1997) and (2) it must not be directly associated with the dependent variable or correlated with other unobserved variables that affect the dependent variable. The first condition is empirically testable using *t*-statistics and *F*-statistics to determine whether the instrument predicts a significant amount of variation in the endogenous explanatory variable. The second condition is not empirically testable, and thus, this condition should be examined from a theoretical perspective. The exogenous instrument used in this analysis was the change in travel distance to the nearest VA facility offering primary care services. Veterans in the CBOC catchment areas (half the sample) experienced a decrease in travel distance in the postperiod, while the matched veterans outside of the CBOC catchment areas experienced no change. From a theoretical perspective, change in geographic access to CBOC-based primary care should have a direct impact on use of primary care services, but not a direct impact on the use of other types of services not offered at the CBOC. There have been numerous health services research studies that have used travel barriers as an instrumental variable successfully to control for endogeneity bias (McClellan, McNeil, and Newhouse 1994; Fortney et al. 1998, 2001; Newhouse and McClellan 1998; Lu 1999).

Assuming an appropriate instrument has been identified, instrumental variables analysis uses the predicted value of the endogenous explanatory variable (using the instrument and other covariates as the predictors) instead of the actual value of the endogenous explanatory variable. One can think of the natural experiment of establishing CBOCs as a way to parse the variation in primary care encounters into an exogenously determined component (resulting from improved geographic access) and an endogenously determined component (resulting from changes in unmeasured health status), and then using only the exogenously determined component to estimate the relationship between primary care and the other types of health services. The instrumental variables regression was estimated in two stages, as implemented in *STATA*, and the standard errors of the parameter estimates were corrected for clustering at the VISN level using a modification of the Huber–White sandwich estimator of variance. Note that there is a substantial loss of statistical power associated with instrumental variables regression analysis, resulting in larger standard errors for the parameter estimate. A Hausman test was used to determine whether the OLS parameter estimates were significantly different from the instrumental variables parameter estimates (Greene 1993). If the Hausman test was significant, it indicated that there is sufficient power to show that the OLS estimates are biased because of endogeneity effects (assuming the

instrumental variables specification is the correct model). Note that the Hausman test is well known to be a relatively low-powered test.

Because five of the 15 CBOCs offered some mental health services on site, change in travel distance may not meet the necessary conditions for being an exogenous identifier at these sites. Specifically, the change in travel distance for veterans in the catchment area of these five CBOCs may directly impact changes in mental health services utilization. Therefore, a sensitivity analysis was conducted for specialty mental encounters that excluded patients from the catchment areas of these five CBOCs along with the corresponding matched patients.

RESULTS

The sample included 52,801 veterans using VA services prior to the establishment of the CBOCs. Descriptive statistics for the sample are presented in Table 1. The distributions of the covariates for the veterans in the CBOC catchment areas were very similar to those for the matched veterans, although there were some differences. The travel distance in the preperiod was significantly ($p<.01$) and substantially greater for veterans in CBOC catchment areas (42.9 miles) compared with the matched veterans (31.2 miles). In addition, compared with matched veterans, veterans in the CBOC catchment areas had significantly ($p<.01$), but not substantially, greater percent service connection and a somewhat higher proportion were married, male, category A service connected, and caucasian.

Veterans in the catchment areas of CBOCs experienced a decrease in Euclidean travel distance from an average of 42.9 miles to the closest VA facility in the preperiod to 19.1 miles in the postperiod (post–pre mean = -23.8 miles). The minimum change was 0.1 mile and the maximum change was 73.3 miles. Matched veterans experienced no decrease in travel distance. The first-stage instrumental variables regression results are reported in Table 2. The change in travel distance was a significant and substantial predictor of change in primary care encounters. In fact, change in travel distance was the most significant predictor ($p<.0001$) in the first-stage regression equation of the instrumental variables analysis. The difference in *F*-values for the regression models predicting change in primary care encounters with and without travel distance was 5.3. Thus, travel distance meets the first condition needed to be an appropriate instrumental variable, although the strength of the instrument does not meet the "rule of thumb" criteria of having an *F*-value >10.0 (Staiger and Stock 1997).

Table 1: Descriptive Statistics

	Mean (SD)/Proportion	
Variable	*Veterans in CBOC Catchment Area n = 29,770*	*Matched Veterans n = 23,031*
Post–pre utilization/costs		
Primary care encounters	0.66 (4.70)	0.14 (4.81)
Specialty medical encounters	− 0.05 (8.56)	0.22 (8.25)
Specialty mental encounters	0.26 (15.71)	− 0.32 (19.60)
Physical health admits	− 0.09 (1.05)	− 0.08 (1.05)
Mental health admits	− 0.02 (0.40)	− 0.03 (0.53)
Outpatient cost	94.58 (3,089.91)	24.65 (3,602.79)
Inpatient cost	− 439.43 (32,377.04)	− 608.81 (33,340.73)
Case-mix		
Age	58.91 (14.59)	58.84 (14.90)
Male gender	94.30	92.35
Married	58.84	52.66
Race		
Caucasian	52.92	46.07
African American	7.12	9.52
Hispanic	3.58	2.30
Other	0.19	0.63
Unknown	36.19	41.48
Percent service connected	18.4 (30.3)	17.0 (29.5)
Means test		
Cat A, NSC	41.97	43.37
Cat A, SC	47.41	44.01
Cat C	4.60	4.76
Cat NA	6.02	7.85
DCG97 risk score	1.06 (0.86)	1.05 (0.86)
Instrumental variable		
Change in distance (miles)	− 23.8 (17.3)	0.0 (0.0)

The OLS regression results are reported in Table 3. All of the OLS parameter estimates for primary care encounters are significantly positive, which indicates that primary care appears to be complementary to all of these other types of health services. Over an 18-month period, results indicated that an increase of one primary care encounter would result in an 8.4 percent increase in specialty medical encounters, a 7.4 percent increase in specialty mental encounters, a 12.5 percent increase in physical health admissions, and a 2.6 percent increase in mental health admissions.[1] The sensitivity analysis for specialty mental encounters was quite similar to the main analysis. The coefficient in the sensitivity analysis was 0.239 compared with 0.238 in the main

Table 2: First-Stage Instrumental Variables Regression Parameter Estimates Predicting the Effect of Distance and Covariates on the Number of Primary Care Encounters

Variables[†]	*Coefficient*
Intercept	−2.90***
Change in distance	0.17***
Age	0.11***
Age squared	−0.00***
Male gender	0.26**
Married	−0.03
Race	
Caucasian (ref.)	
African American	−0.09
Hispanic	0.05
Unknown race	−0.70*
Percent service connect	−0.01
Means test	
Cat A, NSC (ref.)	
Cat A, SC	0.07
Cat C	−0.40***
Cat NA	−0.25**
DCG risk score	1.06***
DCG risk score squared	−0.72***
DCG risk score cubed	0.07***

[†]Parameter estimates for VISN fixed effects are not displayed.

*$p<.05$; **$p<.01$; ***$p<.001$.

DCG, Diagnostic Cost Group; VISN, Veterans Integrated Service Networks.

analysis. For health expenditures, OLS results indicated that increased use of primary care services is associated with a significant increase in both outpatient costs and inpatient costs.

The Hausman test indicated that the OLS results were significantly biased for specialty medical encounters ($\chi^2 = 46.52$, $p<.0001$), and physical health admissions ($\chi^2 = 8.55$, $p = .0035$), but not for specialty mental encounters ($\chi^2 = 2.98$, $p = .09$) or mental health admissions ($\chi^2 = 0.61$, $p = .44$). The Hausman test also indicated that OLS results were significantly biased for outpatient costs ($\chi^2 = 31.69$, $p<.0001$), but not inpatient costs ($\chi^2 = 0.71$, $p<.40$). When the Hausman test indicates that OLS results are not biased, both the OLS and IV results are consistent, although the OLS results are more efficient. Therefore, because of the loss of statistical power associated with instrumental variables analysis, the OLS results are less likely to be subject to Type II error.

Table 3: Results of the Ordinary Least Squares Regression Analysis Estimating the Effect of Primary Care Encounters on Other Types of Service Use and Costs

Variables[†]	*Specialty Medical Encounters*	*Specialty Mental Encounters*	*Physical Health Admits*	*Mental Health Admits*	*Outpatient Cost*	*Inpatient Cost*
Intercept	−3.61***	0.57	−0.02	0.01	−6.82***	−0.41
Primary care encounters	0.47***	0.24***	0.04***	0.002***	0.24***	0.05***
Age	0.11***	0.01	−0.00*	−0.000	0.16***	0.00
Age squared	−0.00***	0.00	0.00*	0.000**	−0.00***	0.00
Male gender	0.05	0.14	0.01	−0.016	−0.32*	−0.05
Married	0.10	−0.14	−0.1*	0.023***	0.21***	0.09
Race						
Caucasian (ref.)						
African American	−0.17	0.15	−0.02*	−0.027***	0.25**	−0.18
Hispanic	−0.22	0.27	−0.03	−0.025*	0.35**	−0.18*
Unknown race	−0.68	−0.69	−0.04	−0.050	−0.48	−0.24
Percent service connect	−0.12	−0.08	0.00	−0.000	0.03***	−0.00
Means test						
Cat A, NSC (ref.)						
Cat A, SC	0.15	0.29	0.01	−0.001	0.41***	0.05
Cat C	−0.30	0.16	−0.03	−0.000	−0.68***	−0.08
Cat NA	0.12	−0.65	0.04**	−0.002	−1.64***	−0.05
DCG risk score	2.22***	−2.07***	0.28**	−0.150***	2.29***	−0.43*
DCG risk score squared	−1.23***	0.77***	−0.20***	0.044***	−0.96***	0.05
DCG risk score cubed	0.10***	−0.08***	0.01*	−0.004***	0.09	−0.01

[†]Parameter estimates for VISN fixed effects are not displayed.

*$p<.05$; **$p<.01$; ***$p<.001$.

DCG, Diagnostic Cost Group; VISN, Veterans Integrated Service Networks.

The second-stage instrumental variables regression results, which adjust for endogeneity bias, are reported in Table 4. Reduced form results are given in Table 5. The parameter estimate for specialty medical encounters switched from significantly positive in the OLS regression to significantly negative in the instrumental variables regression, indicating that primary care is a substitute rather than a complement for this type of service category. The parameter estimate for physical health admissions switched signs from significantly positive in the OLS regression to insignificantly negative in the instrumental variables regression. Over an 18-month period, the instrumental variables results indicated that an increase of one primary care encounter would result in a 7.1 percent decrease in specialty medical encounters. For specialty mental encounters and mental health admissions, the instrumental

Table 4: Results of the Instrumental Variables Regression Analysis Estimating the Effect of Primary Care Encounters on Other Types of Service Use and Costs

Variables[†]	*Specialty Medical Encounters*	*Specialty Mental Encounters*	*Physical Health Admits*	*Mental Health Admits*	*Outpatient Cost*	*Inpatient Cost*
Intercept	−6.00***	1.88	−0.14	0.026	−7.56***	−0.55*
Primary care encounters	−0.40***	0.71	−0.01	0.008	−0.03	0.00
Age	0.21***	−0.05	0.00	−0.001	0.19***	0.01
Age squared	−0.00***	0.00	0.00	0.000*	−0.00***	0.00
Male gender	0.29*	0.01	0.02*	−0.018*	−0.25	−0.03
Married	0.09	−0.13	−0.01	0.023***	0.21***	0.08*
Race						
Caucasian (ref.)						
African American	−0.26*	0.20	−0.03*	−0.027***	0.22**	−0.18
Hispanic	−0.13	0.22	−0.03	−0.026*	0.38***	−0.17*
Unknown race	−1.44*	−0.28	−0.08	−0.045	−0.72*	−0.28
Percent service connect	−0.13*	−0.07	0.00	−0.000	0.03**	−0.00
Means test						
Cat A, NSC (ref.)						
Cat A, SC	0.22**	0.25	0.01	−0.002	0.43***	0.05
Cat C	−0.65**	0.35*	−0.05**	0.002	−0.79***	−0.10
Cat NA	0.12	−0.52	0.03	−0.001	−1.17***	−0.06
DCG risk score	3.15***	−2.58**	0.33***	−0.156***	2.58***	−0.37
DCG risk score squared	−1.86***	1.11*	−0.23***	0.048***	−1.16***	0.01
DCG risk score cubed	0.177***	−0.12*	0.02***	−0.004***	0.11***	−0.01

[†]Parameter estimates for VISN fixed effects are not displayed.

*$p<.05$; **$p<.01$; ***$p<.001$.

DCG, Diagnostic Cost Group; VISN, Veterans Integrated Service Networks.

variables parameter estimates were substantially more positive than in the OLS parameter estimates, although they were not statistically significant because of the loss of statistical power associated with the instrumental variables estimation. For mental health, the OLS parameter estimates and significance tests should be considered more accurate than the results of instrument variables analysis. For outpatient costs, the parameter estimate switched from significantly positive in the OLS regression to insignificantly negative in the instrumental variables regression. For inpatient costs, the instrumental variables parameter estimate was smaller than the OLS parameter estimate and not significant. Although the Hausman test did not indicate that the OLS parameter estimate for inpatient cost was significantly biased, the Hausman test did indicate that the OLS estimate for physical health admissions was

Table 5: Results of the Reduced Form Regression Analysis Estimating the Effect of Change in Distance to Primary Care on Other Types of Service Use and Costs

Variables†	*Specialty Medical Encounters*	*Specialty Mental Encounters*	*Physical Health Admits*	*Mental Health Admits*	*Outpatient Cost*	*Inpatient Cost*
Intercept	−4.84***	−0.18	−0.12	0.003	−7.49	−0.56
Change in distance	−0.67**	0.12*	−0.00	0.001	−0.00	0.00
Age	0.16***	0.03	0.00	−0.000	0.19***	0.01
Age squared	−0.00***	−0.00	0.00	0.000**	−0.00***	0.00
Male gender (-)	0.19	0.19	0.02	−0.016	−0.26	−0.03
Married	0.10	−0.16	−0.01	0.023***	0.21***	0.08*
Race						
Caucasian (ref.)						
African American	−0.22*	0.14	−0.03*	−0.027	0.22**	−0.18
Hispanic	−0.15	0.26	−0.03	−0.026*	0.38***	−0.17*
Unknown race	−1.16*	−0.78	−0.07	−0.051	−0.70*	−0.28
Percent service connect	−0.13**	−0.08	0.00	−0.000	0.03***	−0.01
Means test						
Cat A, NSC (ref.)						
Cat A, SC	0.20*	0.30	0.01	−0.001	0.43***	0.05
Cat C	−0.48*	0.06	−0.04**	−0.001	−0.78***	−0.10
Cat NA	−0.01	−0.70*	0.03*	−0.003	−1.71***	−0.06
DCG risk score	2.73***	−1.83***	0.32***	−0.148***	2.55***	−0.37*
DCG risk score squared	−1.57***	0.60***	−0.23***	0.043***	−1.14***	0.01
DCG risk score cubed	0.14***	−0.07***	0.02**	−0.004***	0.11***	−0.00

†Parameter estimates for VISN fixed effects are not displayed.

*$p<.05$; **$p<.01$'; ***$p<.001$.

DCG, Diagnostic Cost Group; VISN, Veterans Integrated Service Networks.

significantly biased, and physical health admissions comprise the vast majority of inpatient costs. The same unobserved variables correlated with primary care encounters and physical health admissions are also likely be correlated with inpatient costs. Therefore, it may be that the instrumental variables results for inpatient cost are more accurate than the OLS results.

DISCUSSION

A quasi-experimental pre–poststudy design was used to determine whether increased use of primary care results in decreases (substitution) or increases (complementation) in the use of other types of health services as well as its impact on cost. Using longitudinal data from the VA's natural experiment of

increasing geographic access to primary care by establishing new CBOCs, we tested the substitution hypothesis using a difference-in-differences analysis in conjunction with OLS and instrumental variables regression techniques.

Because of endogeneity bias, the results of the OLS and the instrumental variables analysis were dramatically different for specialty medical encounters and physical health admissions. The OLS analysis results indicated that primary care encounters complement specialty medical encounters and physical health admissions. In contrast, the instrumental variables analysis results indicated that primary care was a substitute for specialty medical encounters and that increases in primary care utilization have no significant impact on physical health admissions. The policy interpretation of the biased OLS results is that organizational innovations and strategies designed to promote the use of primary care will increase specialty medical encounters and physical health admissions. The policy interpretation of the instrumental variables results is that such organizational innovations will decrease specialty medical encounters and will not impact physical health admissions, at least in the short run (18 months). The substitution effect is likely being driven by the primary care management of chronic health conditions that prevents or delays the need for specialty care and the prevention and early detection of illnesses that can be treated in the primary care setting. For specialty medical encounters, the substitution effect may also be driven by gatekeeping. Veterans cannot self-refer to specialists within the VA health care system, and although there are no direct financial incentives associated with referrals, organizational incentives can be put into place when specialty care resources reach capacity.

Both the OLS and instrumental variables analysis results suggested that primary care and mental health were complementary services. For specialty mental encounters, the complementation effect was likely driven by the detection of illnesses not typically treated in primary care. Because the VA systematically screens for behavioral health disorders (e.g., smoking, at-risk drinking, and depression), and provides relatively easy access to specialty mental health services, primary care providers in the VA often refer patients to mental health specialists. For mental health admissions, the complementation effect was likely being driven by the identification of acute psychiatric episodes through the close monitoring of symptoms associated with mental health disorders already known to the primary care provider.

In terms of costs, the OLS analysis results indicated that increases in primary care service utilization were associated with significantly higher outpatient and inpatient costs. However, in the instrumental variables analysis, the parameter estimate for outpatient cost was insignificantly negative. The

policy interpretation of the biased OLS analysis of outpatient costs is that organizational innovations designed to increase use of primary care services will drive per member per month costs higher. The policy interpretation of the instrumental variables analysis of outpatient costs is that such organizational innovations are likely to be cost neutral for outpatient services. It appears that the higher outpatient costs resulting from the complementary relationship between primary care and mental health are offset by the substitution of primary care services for specialty medical services. Although the OLS analysis of inpatient costs was not demonstrated to be biased, the IV analysis indicated that increased use of primary care services had an insignificant impact on inpatient costs. The finding that increased use of primary care does not result in lower costs is incongruent with the results of two observational cross-sectional studies. One international comparative study found that countries with a greater primary care orientation had lower per capita health expenditures (Starfield 1994). Likewise, a U.S. study found that health care expenditures among Medicare recipients are lower in counties where a greater proportion of physicians are primary care providers (Welch et al. 1993).

An important caveat is that the results reported here should be considered context dependent because health care system characteristics are likely to moderate the substitution and complementation effects between primary care and other types of health services. As previously mentioned, gatekeeping policies linked with financial incentives for primary care providers could impact the substitution/complementation effect. Similarly, performance measures targeting routine screening for disorders predominantly treated in primary care settings (e.g., hypertension) could impact the substitution/complementation effect. The strong integration between physical health and mental health services in the VA and the specialized mission of the VA regarding mental illness related to military service are likely to be conducive to the complementary relationship observed between primary care and mental heath. In contrast, complementation effects are likely to be diminished in nonintegrated systems where there is poor compliance with referrals to specialty care because of barriers such as long appointment waiting times, long travel distances, and high patient cost-sharing levels.

A limitation of the instrumental variables analysis was that change in travel distance was not a particularly strong instrument. Analyses using weak instruments are known to generate biased results (Bound, Jaeger, and Baker 1995). Although we did not consider change in travel distance to be a particularly weak instrument, the strength of the instrument did not meet the "rule

of thumb" criterion. Consequently, the results of the Hausman tests and instrumental variables regressions should be interpreted somewhat cautiously. Another important caveat associated with instrumental variables analyses is that the estimated effect is only generalizable to the "marginal patient" defined as a patient whose value for the endogenous explanatory variable was affected by the instrumental variable (Harris and Remler 1998). In the context of this study, marginal patients are those veterans whose increased use of primary care services was influenced by the change in travel distance resulting from the establishment of a new CBOC. Results are not generalizable to patients whose increased use of primary care services was because of some other reason.

The increased use of primary care services by veterans in this sample may have resulted in improved health outcomes as well as a greater satisfaction with care, although we were not able to address these outcomes in our analysis. If these VA data are generalizable to other health care systems and enrollee populations, this study provides evidence that managed care organizations should continue to implement organizational innovations that encourage enrollees to use more primary care services. Our findings suggest that the benefits of organizational innovations and strategies promoting use of primary care services may come at no additional cost to the payer beyond the initial implementation cost.

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NOTE

1. Percent changes were calculated using the mean value of the dependent variable in the preperiod (i.e., before CBOC establishment).

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