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RESEARCH ARTICLE

Initial Impacts of the Patient Care Networks of Alabama Initiative

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Objectives. To estimate the effects of medical home support on the use of clinical services and Medicaid expenditures.

Data Source. Medicaid claims.

Study Design. A difference-in-differences model where changes in utilization and expenditures of the intervention group are compared to changes in the nonintervention group.

Extraction Methods. Using Medicaid claims from October 2010 through September 2013, service use and expenditures are measured for 12 months before and 21 months after implementation. Changes for four health status groups are examined separately.

Principal Findings. The introduction of community-based support was associated with a small reduction in use and no statistically significant overall effect on expenditures. However, among those with chronic and/or mental health conditions, there were modest, statistically significant increases in use of and expenditures for a range of ambulatory and inpatient health care services, while service use for those without these conditions declined. Emergency department use increased for all groups.

Conclusions. Community-based support for medical home practices is associated with a shift in the service mix provided to higher cost, more vulnerable subgroups in Medicaid. Such systems are unlikely to be associated with significant overall cost savings, at least in the short term, but may have other benefits.

Key Words. Managed care techniques (e.g., utilization review), Medicaid, chronic disease, state health policies, managed care organizations (e.g., HMOs/PPOs/IPAs)

Within Medicaid programs, and health plans more generally, there has been considerable interest in establishing patient-centered medical homes. Medical homes are seen as mechanisms for improving the quality and timeliness of care delivered to patients, and potentially lowering overall health care expenditures by treating complicated conditions promptly, effectively and on an ongoing basis. However, physician practices often lack many of the resources needed to establish and maintain medical homes for their patients. In general,

physician practices do not have data systems that allow them to track health care use in their entire patient population. They often do not have the information or resources to follow up with patients who visit the emergency department or the capacity to manage the sometimes complex medical and pharmaceutical needs of patients with chronic conditions. Moreover, they often do not have the capacity to provide care management or social service linkages for their patients.

Enrollees in Alabama Medicaid have access to a basic medical home through the Patient 1st program. This primary care case management program was established in 1997 under a 1915(b) waiver. Patient 1st includes all noninstitutionalized Medicaid enrollees except those receiving maternity care; clients using maternity care are assigned to a separate regional capitated contractor, as established under a separate 1915(b) waiver. The Patient Care Networks of Alabama (PCNA) program was established on a pilot basis by Alabama Medicaid in August–September 2011. The effort was designed to offer primary care physicians serving Patient 1st Medicaid enrollees with support services to facilitate the provision of a medical home. The networks provide population health management through systematic data analysis to identify enrollees and providers for outreach and education, and through monitoring of access, capacity, quality, and effectiveness. In addition, the networks provide case management for high-risk, high-acuity enrollees to ensure that they obtain appropriate care and to help these enrollees with disease-state education and self-management. The networks have in-house clinical pharmacists who can audit patient medication use and advise physicians on treatment protocols. They also conduct public health campaigns such as nutrition and weight management programs and flu shot vaccination campaigns and care sites.

The pilot program began in August–September 2011 in three areas of Alabama: the West Area, based in Tuscaloosa; the East Area, based in Auburn; and the North Area, based in Huntsville. In July 2012, additional counties were added to these areas, and a fourth network, the Gulf Area, was

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[Correction added on 29 June 2015, after first online publication: The author's name "Bhisaka Sen" has been corrected to "Bisakha Sen". Also, the affiliation of Bisakha Sen and Sally Engler has been corrected to School of Public Health, University of Alabama at Birmingham, Birmingham, AL.]

established in Mobile. While the Gulf Area is not included in this analysis because of the truncated time frame, the additional counties in the three original areas are included. Networks are paid approximately \$8 per member per month for those enrollees who have been classified by claims data as having had a chronic disease or mental health diagnosis in the previous 18 months and whose assigned primary care providers (PCPs) are network members. Going forward, state legislation passed in 2013 mandated the creation of risk-bearing regional care organizations (RCOs) that are intended to manage a continuum of health care services for Medicaid beneficiaries under a single capitated rate. Locally based organizations like the Patient Care Networks will facilitate the RCOs in improving care provision and managing expenditures. The RCO concept currently awaits an 1115 Demonstration Waiver from CMS.

This paper estimates the initial effects of the pilot PCNA networks on the utilization of inpatient services, various types of ambulatory services, and prescription drugs together with the associated Medicaid expenditures. The estimates compare use and expenditures for those in PCNA networks with those outside the networks in the 12 months before and 21 months after implementation, allowing for a 3-month transition period, which is not included in the analysis. As such, this is an observational study that uses a difference-in-differences statistical approach to control for area and time level confounders.

Overall, the introduction of the PCNA was associated with a small reduction in the number of enrollees who interacted with the health care system, and it had no statistically significant effect either on mean expenditures for service users or on net expenditures. The findings, however, are more nuanced. The decline in service utilization was concentrated among the 65 percent of enrollees with no recent history of chronic or mental health conditions, and included declines in inpatient, hospital outpatient, physician office, ancillary and externally contracted care management services, but an increase in physician emergency department services. There was an increase in service utilization, mean expenditures per service user, and net expenditures for the group of enrollees with a combination of chronic and mental health conditions. Utilization of inpatient, outpatient, physician office, physician emergency, mental health outpatient, and pharmacy services all increased in this group, as did mean expenditures for service users for physician office, mental health inpatient, and externally contracted case management services. Enrollees with chronic but without mental health conditions had utilization and expenditures that were unchanged overall, but experienced an increase in out-

patient hospital, physician emergency, and physician office services, along with a decrease in use of pharmacy services. We conclude that adding a community-level support system to a medical home-based delivery system can facilitate a shift in the mix of services provided to the higher cost and more vulnerable subgroups in the Medicaid population. Such medical home support systems are unlikely to be associated with significant overall cost savings, at least in the short term.

BACKGROUND

Currently, eight state Medicaid programs have adopted strategies to care for their high-need Medicaid beneficiaries through the development of local community-based care coordination networks or teams (Takach and Buxbaum 2013). Several more states are looking to adopt this model as part of their State Innovation Model design plan (Hinkle et al. 2013). These networks are designed to provide an array of wrap-around services to share among multiple primary care practices in a community or region so that they can better care for their high-risk patients.

States have found the local community-based care coordination network model appealing. Unlike some traditional disease management strategies that focus on specific chronic diseases and rely on remote, telephonic management of patient care, the networks emphasize patient engagement and care coordination with in-person contact with patients and integration with primary care providers (PCPs) and community resources. Networks emphasize multidisciplinary team care and, as a result, expand the capacity of PCPs to care for chronically ill populations. Evidence does demonstrate that multidisciplinary teams in primary care—providing the information and shared decision making that many PCPs lack the time to offer—can improve care and at times lower costs for patients with chronic diseases (Bodenheimer, Chen, and Bennett 2009). Though core characteristics of community networks exist, states vary widely in how they are developing their community networks or teams (Takach and Buxbaum 2013). Variations among current programs include the composition of network or team members and their roles, referral patterns, targeted population, linkages with community services and hospitals, and approaches to patient and practice education.

In general, research on utilization management offers only limited evidence of success. Preadmission certification linked with concurrent review appears to reduce hospital admissions and/or length of stay, but ambulatory

efforts have shown less success (Morrisey 2014). Research on care coordination in the Medicare population has shown even less success in reducing hospitalizations and expenditures. Peikes et al. (2009) reviewed 15 randomized trials of care coordination programs implemented between 2002 and 2005. They concluded that 13 of the 15 programs showed no significant differences in hospitalizations and none of the programs generated savings above program costs. However, the authors do suggest that the modestly favorable findings for two programs “suggest that the potential exists for care coordination interventions to be cost-neutral and to improve patients’ well-being” (p. 615). The Congressional Budget Office (2012) released its report on the effectiveness of six Medicare demonstrations projects that provided disease management and care coordination. It concluded: “In nearly every program involving disease management and care coordination, spending was either unchanged or increased relative to the spending that would have occurred in the absence of the program, when the fees paid to the participating organizations were considered” (p. 1). However, they also concluded that the programs with much greater direct interaction with physicians and significant in-person interaction with patients were more likely to reduce spending, although not enough to offset program fees.

Research on patient experience and health outcomes for Medicaid patients in networks is limited, and no peer-reviewed evaluations appear to have been done to date (Takach and Buxbaum 2013). Two of the eight community network or team programs—in North Carolina and Vermont—have reported limited findings, suggesting a positive impact on health quality for those enrolled in these programs. North Carolina’s Community Care of North Carolina (CCNC) has the longest standing community network program and has served as the inspiration for most of the states, including Alabama. An evaluation of the quality of care for chronic conditions in the CCNC-enrolled Medicaid population from 2009 to 2012 showed consistent improvement in all the chronic conditions measured (DuBard 2013). Even among heaviest users of health care services, patients enrolled in CCNC over time showed a pattern of lower emergency department use and hospitalization and more frequent use of their PCPs (Hanlon, Thompson, and DeWalt 2013). It should be noted, however, that a 2012 analysis funded by the Agency for Healthcare Research and Quality did not classify the North Carolina studies as meeting the agency’s criteria for rigorous medical home evaluations (Peikes et al. 2012).

The Vermont Blueprint for Health program completed limited assessment of their community health “teams” using interviews and focus groups. Findings indicated patients with chronic conditions were being seen more

frequently and significant decreases were reported in emergency room use and hospital admissions (Bielaszka-DuVernay 2011; Bielaszka-DuVernay 2011). Patients served by the Vermont community health care teams also noted a shift from more episodic care to a whole-person, patient-centered care approach they also reported more positive health care experiences and an increased ability to manage their health care needs (Vermont Child Health Improvement Program [VCHIP] 2011, Department of Vermont Health Access 2012, 2013). Providers reported increased communication between practices and an improvement in the services they were able to provide to their patients.

METHODS

The analysis used all Alabama Medicaid claims data for Patient 1st enrollees over the period October 1, 2010, through September 30, 2013. These data were sorted into quarterly (i.e., 3 months) time periods based on the date of service recorded on the claim. January 1, 2012, is treated as the effective date of the pilot networks. The quarter including October through December 2011, the period when the networks were hiring staff and building initial relationships with local Medicaid PCPs, is excluded from the analysis. This allowed seven quarters of claims experience after the commencement of the PCNA networks and four quarters prior. The precommencement data are included to take into account any baseline differences in utilization in these populations. Medicaid enrollees in Patient 1st were assigned to networks based on the county location of their assigned PCP in Medicaid eligibility files. All claims data for Patient 1st enrollees in the remainder of the state and not enrolled in the PCNA pilot were also included so that the change in their utilization and expenditures could serve as a comparison. Thus, the analytic approach uses a difference-in-differences model where changes in the utilization and expenditures of the intervention group are compared to changes in the nonintervention group.

Utilization and Medicaid expenditures were grouped into 11 mutually exclusive categories: inpatient hospital and inpatient physician claims (combined), outpatient hospital claims, physician office claims, physicians' emergency department claims, mental health inpatient service claims, mental health outpatient service claims, pharmacy claims, externally contracted case management services from the state public health department, other social service agency case management services, dental care claims, and an ancillary

category that included durable medical equipment, transportation, and diagnostic services.

Clearly, health care use and expenditures depend in large part on the health status of the enrollees. The presence of chronic and disabling mental health conditions in particular tend to shift individuals into predictably higher utilization/expense groups, although even within these categories, care use tends to be skewed so that a small number of individuals account for a larger portion of the costs (Kronick et al. 1996). In each analytic quarter, enrollees were categorized into four groups based on the diagnoses on claims incurred in the preceding 12 months: (1) those with chronic conditions, (2) those with mental health conditions (includes substance abuse diagnoses), (3) those with both chronic and mental health conditions, and (4) those without either of those conditions. Health status was used in two ways in the analysis. First, it was used as a control measure in the overall analysis of utilization and expenditures. Here, we also included as a control the count of how many of 10 common chronic conditions (asthma, elevated BMI, COPD, cancer, diabetes, heart disease, HIV infection, chronic kidney disease, sickle cell disease, and transplant survivor) were recorded for the enrollee in the previous 12 months. Second, utilization and expenditure changes were analyzed separately for each health status category.

The primary empirical approach involves estimating multivariate regression models and the difference-in-differences framework to examine the effect of pilot PCNA network on health expenditures. The general functional form of the difference-in-differences model is as follows:

$$\text{Exp}_{iat} = f(\text{Network}_{at}, X_{iat}, Z_{at}, A_a, T_t)$$

where Exp_{iat} represents expenditures for Medicaid enrollee ' i ' in area ' a ' and quarter ' t '. Network_{at} is a binary indicator of an active network in that area and quarter. X_{iat} represents individual characteristics of the enrollee. Z_{at} represents time-variant area-specific characteristics that may influence access to and utilization of care. A_a is a vector of binary indicators for each area, included to capture time-invariant area-specific characteristics that could lead to variations in expenditures between the areas at the baseline. T_t is a vector of quarter specific binary indicators that help capture time series variation in expenditures unrelated to the activation of networks. The vector of enrollee characteristics, X_{iab} includes age and age squared, race, gender, and health status (chronic conditions, mental health/substance use, both, neither). The rurality of the residence county was included (measured in terms of the U.S. Department of Agriculture Rural-Urban Continuum [RUCA] codes for 2010)

as additional control factors in the utilization and expenditure analyses. Additionally, two measures of the relative accessibility of an enrollee's PCP were included to account for potential issues of availability of providers over time. The first was the number of enrollees per active PCP located in an enrollee's residence county in the quarter. This was calculated as the number of PCPs with a Patient 1st caseload in the quarter, divided by the number of enrollees residing in the county in the quarter. Some enrollees use PCPs in counties other than their residence county, but measuring the residence county is a better assessment of the local availability of physician resources. The second measure was the decile volume of the Patient 1st caseload of the enrollee's assigned PCP. This measure is calculated as the number of enrollees assigned to each PCP in the quarter, and then arraying the PCPs into 10 categories, from lowest to highest volume.

For the total expenditure variables for the entire population, the subset of enrollees under age 19, as well as each of the four health status categories, we estimated two-part models, with the first part using logistic models for any expenditure, and the second part using gamma GLM with log-link. Natural log of expenditures was preferred as expenditures tend to be right-skewed among health service utilizers (Duan 1983; Polsky and Glick 2009). Gamma GLM with log-link was preferred over a linear regression model as it helps circumvent challenges of retransformation and smearing (Duan 1983), which can be problematic in the presence of heteroscedasticity due to repeated observations from each patient (Belotti et al., 2015). For these models, we calculated the aggregate marginal effect of an active network that takes into account both changes in the probability of any expenditure and changes in expenditure level conditional on any expenditure. Subsequently, for total expenditures as well as each of the 11 categories of expenditures, we separately modeled the effect of being included in an active network on the probability of any health expenditures using linear probability models, and on the amount of expenditure among the subsample of service utilizers using gamma GLM with log-link. Robustness checks on a large subset of models verified that linear probability models and logistic models for any health expenditures yielded very similar results. In all models, standard errors are clustered to account for repeated observations from the same member. The statistical software *STATA* (Version 13, StataCorp, College Station, TX, USA) is used for all statistical estimation, and the "tpm" routine is used for estimating the two-part models for total expenditure.

We start by presenting descriptive statistics on characteristics of individuals in the PCNA pilot areas before and after the networks became active and

characteristics of individuals outside of networks (i.e., the remainder of the state) for the same periods. Subsequently, we present a simple difference-in-differences analyses by comparing the portion of enrollees with *any* of each type of expenditure, and quarterly mean of expenditure, for enrollees in PCNA areas and for their counterparts outside the network area. For those outside the network area, this translates into a change in each of these measures between time period 1 (October 2010 – September 2011) and time period 2 (January 2012 – September 2013). For those in the network areas, the former time period is the pre-network active period and the latter is the post-network active period, with the exception of a small number of counties that entered in July 2012. Those enrollees are not included in the post period until that date. We follow this up with the multivariate difference-in-differences models that were described above in detail. The multivariate analyses are presented for the full sample, for enrollees under 19 years, and for enrollees by health status category.

FINDINGS

Table 1 presents an overview of the populations included in the analysis. Over 80 percent of the Patient 1st enrollees are children aged 18 and younger, approximately 45 percent of the enrollees are African American, with a slightly lower percentage of whites. Hispanics make up 7–8 percent of the enrollees. Approximately 14 percent of children and 22 percent of adult enrollees have a chronic condition; some 10 percent of children and 14 percent of adults have had a mental health or substance abuse diagnosis in the prior 12 months; and 4 percent of children and 35 percent of adults have both. A large portion of this population in both time periods, in both the PCNA Pilot areas and in the rest of the state, were not continuously enrolled in the Medicaid program. The PCNA Pilot Areas have a slightly younger population, and a slightly larger proportion of African Americans. A larger portion of the PCNA population lives in metropolitan areas. The PCPs in the PCNA Areas also have a somewhat larger Patient 1st enrollee panel than do providers in the remainder of the state, and network counties have more enrollees per PCP.

Table 2 provides a simple comparison of the Medicaid utilization and expenditures before and after the establishment of the PCNA pilot networks for both the Network Areas and the remainder of the state. The portion with any utilization of care and utilization of each type of services was fairly similar between the PCNA areas and the rest of the state before network activation,

Table 1: Characteristics of the Patient 1st Enrollees in the PCNA Areas and the Rest of the State

	<i>Remainder of State</i>		<i>PCNA Pilot Areas</i>	
	<i>Preperiod</i>	<i>Postperiod</i>	<i>Prenetwork</i>	<i>Postnetwork</i>
Number of individuals	443,106	518,701	149,923	176,548
% continuously enrolled	68.8	48.8	66.0	45.8
Percentage of observations				
Age <1	5.7	5.8	6.2	6.4
Age 1–18	75.0	74.6	75.9	76.0
Age 19–64	19.0	19.5	17.6	17.5
Age >64	0.2	0.1	0.3	0.1
White	44.3	45.4	42.5	43.3
African American	44.1	42.7	46.0	44.4
Hispanic	7.5	7.4	7.2	7.3
Other	4.0	4.5	4.4	5.0
Male	47.5	47.6	48.0	48.4
Female	52.5	52.4	52.0	51.6
Mean (SD) number of chronic conditions	0.38 (0.77)	0.56 (0.93)	0.37 (0.75)	0.51 (0.90)
For enrollees <19 years old				
Chronic diagnosis	14.4	15.1	14.2	14.8
H/SA diagnosis	10.0	10.7	10.3	10.4
Chronic and MH/SA diagnosis	4.2	4.8	4.0	4.4
No chronic or MH/SA diagnosis	71.3	69.4	71.5	70.3
For enrollees ≥19 years old				
Chronic diagnosis	22.7	21.0	23.2	21.6
MH/SA diagnosis	13.8	14.3	14.3	14.6
Chronic and MH/SA diagnosis	34.9	38.7	33.8	36.7
No chronic or MH/SA diagnosis	28.6	25.9	28.7	27.2
County type metro (RUCA codes 1–3)	64.3	65.2	74.3	75.2
County type adjacent to metro (RUCA codes 4–6)	27.3	26.6	20.5	20.0
County type rural (RUCA codes 7–9)	8.3	8.2	5.2	4.8
Mean (SD) number of enrollees per PCP in county	594.4 (209.5)	583.7 (228.1)	601.9 (183.0)	609.5 (193.0)
Decile distribution of patient volume of assigned PCP				
1	0.1	0.1	0.1	0.1
2	0.6	0.7	0.7	0.6
3	1.8	1.8	1.9	1.5
4	3.2	3.1	2.3	2.0
5	4.6	4.8	4.8	3.9
6	6.6	6.4	6.6	8.1
7	8.7	9.5	10.4	9.8
8	13.4	13.1	12.3	13.2
9	18.6	18.0	22.9	22.7
10	42.5	42.4	37.9	38.0

MH/SA, mental health and/or substance abuse; PCNA, Patient Care Networks of Alabama; PCP, primary care provider.

Table 2: A Comparison of the Medicaid Quarterly Utilization and Expenditures before and after the Establishment of the PCNA Pilot Networks among Those with Any Use

Network Status	PCNA Pilot Areas			Remainder of State		
	Preperiod		Change in Any Use (%)	Preperiod		Change in Mean Exp. Any Use (%)
	Any Use (%)	Use (%)		Any Use (%)	Use (%)	
Study Period	Preperiod	Postperiod	Preperiod	Postperiod	Preperiod	Postperiod
Variable	Any Use (%)	Change in Any Use (%)	Difference in Differences %	Mean Exp. Any Use (\$)	Change in Mean Exp. Any Use (%)	Difference in Difference %
Total	73.6	-1.2	-0.5	\$1,013	-5.3	-0.5
Inpatient	2.6	-9.2	-8.2	\$5,848	-0.6	-2.0
Outpatient	12.0	-2.6	-3.1	\$387	-35.9	+7.8
Hospital						
MD in office	46.7	-1.9	-0.9	\$200	3.3	0.0
MD in ED	14.5	-2.2	-1.5	\$99	-1.1	-3.0
MH Inpatient	0.0	30.7	+21.1	\$10,645	-6.1	+4.9
MH Outpatient	6.3	-1.2	-0.3	\$1,141	-0.6	+0.7
Pharmacy	50.6	-2.3	-1.1	\$371	2.2	+1.2
Other	39.9	0.6	-0.7	\$275	-5.5	-2.4
Public	2.5	2.8	-29.6	\$224	11.8	+15.4
Health CM						
Other CM	2.3	-14.3	-3.4	\$2,383	5.1	+13.2
Dental	17.7	4.5	+2.7	\$199	-6.3	-2.1

ADPH CM, Alabama Department of Public Health case management; ED, emergency department; Exp., expenditures; MD, medical doctor; MH/SA, mental health and/or substance abuse; PCNA, Patient Care Networks of Alabama; Other CM refers to case management provided by other state agencies.

with slightly higher outpatient mental health care use and slightly lower pharmacy use in PCNA areas. Outside of the network area, change over time in the use of services was minimal, with substantial increases only in inpatient mental health care and public health case management, and decreases in other types of case management. Within networks, inpatient mental health care use also increased and other case management decreased, but public health case management increased to a much lower extent, and use of inpatient care decreased by 9 percent.

Mean quarterly total expenditures for those with any service use were lower and declined more in PCNA areas than in the rest of the state but only by a modest 0.5 percent. The categories with the largest differences in change over time in mean expenditures per user were the two categories of case management. Both increased more in PCNA than in non-PCNA areas. Mean costs for inpatient mental health episodes and outpatient hospital care also decreased less over time in PCNA than in non-PCNA areas. According to state Medicaid personnel, the change in costs of outpatient care was largely the effect of changes in Medicaid pricing policies which disproportionately affected the largest metropolitan area of the state, which is in a non-PCNA area.

While these unadjusted difference-in-differences comparisons are a useful means of examining relative changes across the pilot sites and the rest of the state, they are potentially confounded by differences in the characteristics of the enrollees in each geographic area and by the availability of primary care resources. To account for this, a series of quarterly regression models were estimated that control for individual age, gender, race, and health status characteristics.

Table 3 reports the multivariate difference-in-differences estimates for the relative change in utilization and conditional expenditures; these are analogous to the simple difference-in-differences values reported in Table 2. The analysis for the subset of enrollees under age 19 are also shown. The table reports the parameter estimates for the intervention on utilization and expenditures conditional on use for each category of service. The full regression results which include the impact of demographic and provider factors on utilization and expenditures are available from the authors. The estimates of the impact of the intervention on utilization are shown in two ways: as the net overall change, based on the coefficient from the regression, and the percent change in use, which applies the net overall change to the percent with any use as shown in Table 2. Thus, the overall net change in the likelihood of outpatient hospital use was 0.556, which represents a 4.6 percent increase in the 12.0 percent rate of quarterly outpatient hospital use in the population. The

Table 3: Medicaid Utilization and Expenditures—Any Use and Mean Use, Whole Population, Controlling for Age, Sex, Race, Disease Category, Residence in Network Area

Expenditure Category	Change in Likelihood of Use			Change in Mean Expenditures Conditional on Use				
	Whole Population		Children	Whole Population		Children		
	Active Network Overall Change	Net % Change in Use	Active Network % Overall Change	Net % Change in Use	Active Network Coefficient on Log of Use	\$ Difference in Mean Expenditure	Active Network	\$ Difference
Total expenditures	−0.183*	−0.25	−0.426 [‡]	−0.59	0.001	\$1.00	0.004	\$1.00
Inpatient	−0.002	−0.08	−0.065*	−4.43	−0.017	−\$0.98	0.035	\$1.04
Outpatient hospital	0.556 [‡]	4.64	−0.162*	−1.80	0.077 [‡]	\$1.08	0.146 [‡]	\$1.16
MD in office	0.141	0.30	−0.134	−0.30	−0.010	−\$0.99	−0.032 [‡]	−\$0.97
MD in ED	0.497 [‡]	3.42	0.269 [‡]	2.12	−0.001	−\$1.00	0.009	\$1.01
MH inpatient	0.004	8.92	0.006	11.08	−0.040	−\$0.96	−0.035	−\$0.97
MH outpatient	0.335 [‡]	5.30	0.253 [‡]	5.86	−0.008	−\$0.99	−0.054	−\$0.95
Pharmacy	−0.800 [‡]	−1.58	−1.209 [‡]	−2.65	0.013	\$1.01	0.015	\$1.01
Other	−1.069 [‡]	−2.68	−1.181 [‡]	−3.07	0.018*	\$1.02	0.025*	\$1.03
ADPH CM	−0.314 [‡]	−12.60	−0.257 [‡]	−12.13	0.123 [‡]	\$1.13	0.064 [‡]	\$1.07
Other CM	−0.009	−0.39	0.066	4.34	0.076*	\$1.08	−0.039	−\$0.96
Dental	0.0870	0.49	0.097	0.45	−0.020 [‡]	−\$0.98	−0.018 [‡]	−\$0.98

*Statistically significant at the 90% confidence level, two-tailed test.

[‡]Statistically significant at the 95% confidence level, two-tailed test.

*Statistically significant at the 99% confidence level, two-tailed test.

ADPH CM, Alabama Department of Public Health case management; ED, emergency department; MD, medical doctor; MH, mental health; Other CM refers to case management provided by other state agencies; PCNA, Patient Care Networks of Alabama.

estimates of the intervention on mean expenditures conditional on use are shown as the coefficient for the log of expenditures from the linear regression, and the log-transformed average dollar difference that this represents.

Controlling for age, gender, race/ethnicity, comorbidity, rural residence, and primary care physician panel size, overall the introduction of the Pilot PCNA networks decreased utilization by a quarter of a percent, and slightly more than half a percent for children relative to the change in the rest of the state. For both the overall population and the subset of children, this decline was driven by larger reductions in use of pharmacy, ancillary, and public health case management services, but partially offset by increases in the use of outpatient hospital services, emergency physicians, and mental health outpatient services. The category of expenditure with the largest decline in use in the PCNA areas after the introduction of networks was public health department case management services, although this represents a very small portion of overall service use. Overall expenditures for those with any utilization were unchanged as a result of the introduction of the PCNA Pilot program. This was because increased emergency department and case management spending was offset by reductions in dental service expenditures and, for children, reductions in expenditures on office visits.

Table 4 shows the large differences in expenditures and utilization across the four health status categories used in this study. Average expenditures for individuals with chronic or with mental health conditions are more than double expenditures for individuals without those conditions, while average expenditures for individuals with both chronic and mental health conditions are nearly double that. Differences between the PCNA network areas and the rest of the state were minimal, as were differences in changes in utilization or expenditures on services before and after the initiation of the networks.

Table 5 examines changes in utilization and expenditures by health status category, adjusting for other factors and comparing changes for enrollees in networks to changes for enrollees outside of networks. This deconstruction provides considerable insight into the effects of the program. It is clear that the reduction in the use of health services reported in Table 3 results from reductions in service use among those with neither chronic nor mental health diagnoses. Within this group, the reductions were largely in use of inpatient, office physician, outpatient hospital, ancillary, and case management services. In contrast, enrollees with chronic, mental health, and both chronic and mental health conditions used more outpatient hospital services; the two groups with chronic conditions used more office services, the two groups with mental health conditions used more outpatient mental health services, and those with

Table 4: Medicaid Utilization and Expenditures Pre- and Postestablishment of PCNA Networks among Those with Any Use—By Major Health Status Categories

Disease Status	Utilization						Expenditures					
	Remainder of State			PCNA Pilot Areas			Remainder of State			PCNA Pilot Areas		
	Preperiod		Postperiod	Prenetwork		Postnetwork	Preperiod		Postperiod	Prenetwork		Postnetwork
	Any		Change	Any		Change	Mean		Change in	Mean Exp.		Change in
	Use (%)	Use (%)	Any	Use (%)	Any	Any	Exp. Any	Any	Mean Exp.	Any Use (\$)	Any Use (%)	Any Use (%)
			Use (%)			Differences						Differences
						(%)						(%)
No Chronic or MH conditions	68.2	−2.7	66.5	−3.2	−0.6	−13.2	\$597	−14.7	\$537	−13.2	−13.2	+1.5
Chronic conditions	86.2	−3.0	86.2	−2.8	0.2	−22.4	\$1,441	−20.8	\$1,371	−22.4	−22.4	−1.6
MH conditions	88.4	−4.3	88.6	−4.5	−0.2	−16.0	\$1,525	−16.0	\$1,460	−14.4	−14.4	+1.6
Both chronic & MH conditions	94.6	−2.3	94.7	−2.4	−0.1	−11.7	\$2,896	−11.7	\$2,932	−11.2	−11.2	+0.5

PCNA, Patient Care Networks of Alabama; Exp., expenditures; MH/SA, mental health/substance abuse.

Table 5: Any Use and Mean Use by Disease Category, Controlling for Age, Sex, Race, Disease Category and Residence in Network Area

	Likelihood of Any Use			Log Expenditures for Those with Use			
	Active Network for No Problems (Net % Change)	Active Network for Chronic	Active Network for MH/SA	Active Network for Both	Active Network for No Problems (\$ Change)	Active Network for Chronic	Active Network for MH for Both
Total	-0.726 [‡] (-1.09)	0.319 (0.37)	0.221 (0.25)	0.796 [‡] (0.84)	-0.003 (\$1.00)	-0.139 (\$0.99)	-0.018 (\$0.98)
Inpatient	-0.0833 [‡] (-6.03)	0.086 (2.05)	-0.130 (-4.26)	0.500* (4.70)	0.016 (\$1.02)	-0.057 (\$0.94)	0.138 (\$0.87)
Outpatient	-0.149* (-1.84)	1.040 [‡] (5.34)	0.969 [‡] (7.00)	3.931 [‡] (12.60)	0.127 [‡] (\$1.14)	0.051 (\$1.05)	-0.010 (\$0.99)
hospital							
MD in office	-0.518 [‡] (-1.28)	0.895 [‡] (1.48)	0.428 (0.82)	1.668 [‡] (2.32)	-0.038 [‡] (-\$0.96)	-0.007 (\$0.99)	-0.001 (\$1.00)
MD in ED	0.238 [‡] (2.01)	0.388* (2.08)	0.886 [‡] (5.55)	1.888 [‡] (6.45)	0.004 (\$1.00)	-0.006 (\$0.99)	0.009 (\$1.01)
MH inpatient	0.004 (76.53)	-0.002 (-35.29)	0.040 (13.51)	0.018 (3.24)	-0.512* (-\$0.60)	-1.023* (\$0.36)	-0.095 (\$0.91)
MH	-0.018 (-2.04)	-0.094 (-7.36)	0.731* (2.19)	0.808* (2.81)	0.087 (\$1.09)	0.010 (\$1.01)	0.006 (\$1.01)
outpatient							
Pharmacy	-1.440 (-3.67)	-0.640* (-0.89)	-0.052 (-0.07)	0.719 [‡] (0.82)	-0.008 (\$0.99)	0.024 (\$1.02)	-0.008 (\$0.99)
Other	-1.296 [‡] (-3.65)	-1.235 [‡] (-0.02)	-1.069 [‡] (-2.47)	0.673 (1.17)	0.007 (\$1.01)	0.051* (\$1.05)	0.009 (\$1.01)
expenditure							
ADPH CM	-0.373 [‡] (-18.64)	0.157 (5.12)	-1.083 [‡] (-33.56)	-0.058 (-1.17)	0.030 (\$1.03)	0.148 [‡] (\$1.16)	0.112 [‡] (\$1.12)
Other CM	-0.046 [‡] (-8.95)	-0.007 (-0.04)	-0.296 (-2.96)	0.048 (0.52)	0.047 (\$1.05)	0.097 (\$1.10)	0.021 (\$1.02)
Dental	-0.111 (-0.59)	0.006 [‡] (0.04)	0.539* (2.86)	0.105 (1.16)	-0.016* (-\$0.98)	-0.040 [‡] (-\$0.96)	-0.027 (\$0.97)

Note *Statistically significant at the 90% confidence level, two-tailed test.

†Statistically significant at the 95% confidence level, two-tailed test.

‡Statistically significant at the 99% confidence level, two-tailed test.

ADPH CM, Alabama Department of Public Health case management; ED, emergency department; MD, medical doctor; MH, mental health; Other CM refers to case management provided by other state agencies; PCNA, Patient Care Networks of Alabama.

chronic or mental health conditions alone used more dental services in network areas after network implementation. We observed declines in pharmacy use for those with chronic conditions, but an increase in inpatient and pharmacy use for those with chronic combined with mental health conditions. Use of public health case management services by those with mental health diagnoses declined. All four health condition groups experienced an increase in use of emergency care physician services.

Table 5 shows fewer statistically significant changes in expenditures per service user than changes in utilization rates. In terms of overall expenditures, there was a modest increase for the group of enrollees with both chronic and mental health conditions. This group also had increases in expenditures for physician office, mental health inpatient, and public health case management services. Average case management service costs increased for those with chronic and mental health conditions. Those with chronic conditions also had a decrease in expenditures for mental health inpatient and dental care. The group of enrollees without chronic or mental health conditions had a decrease in average expenditures for office visits, mental health inpatient services, and dental services.

Finally, the combined marginal effect of active networks on total expenditures from the two-part models—which were estimated for the overall population, the subset of children under 19 years, and for each health condition category—found that the only statistically significant effect was an average increase of \$1.10 in expenditure per enrollee per quarter for the group with both chronic and mental health conditions.

DISCUSSION

Although the creation of local networks to support the physician practices serving as medical homes for Medicaid enrollees is an appealing intervention with popular support from Medicaid participating providers, states, the Federal Government, and advocacy groups, there has been little rigorous evidence of its effect on care use in Medicaid populations. This study has reported on the first 21 months of the PCNA pilot initiative to assist Medicaid providers in the Patient 1st program with medical and social service care coordination and care management for high-risk and high-acuity Medicaid recipients. It was implemented in three areas of the state. This analysis examined changes in utilization and Medicaid spending on those enrollees whose PCPs had access to support relative to changes among

enrollees in other parts of the state that were not part of the pilot program. It also assessed whether any changes over time were different across enrollee groups in different health status categories.

Across the entire Medicaid enrolled population, we found that the network intervention had at best modest aggregate effects in reducing utilization and no statistically meaningful effects on Medicaid payments for those receiving services. However, we did observe differences across health status groups in the nature of utilization and expenditure shifts. For enrollees with neither chronic conditions nor mental health conditions in the preceding 12 months, several types of service utilization, including inpatient, outpatient hospital, and office physician services declined. It is possible that the network intensified case finding, identifying people with chronic and mental health conditions who were not previously diagnosed, and moving them into the other enrollee health status categories, leaving only the least frequent care users in this group, compared to the rest of the state. However, we have no independent verification that this occurred.

For those with chronic conditions, outpatient hospital use, office physician use, and dental care use increased, but pharmacy and ancillary service use declined. Mean expenditures for mental health inpatient care and dental care declined, while expenditures for public health case management increased. This pattern suggests a shift toward more frequent ambulatory care use, perhaps indicative of increases in surveillance visits for this chronically ill population.

The most changes over time in service use and expenditures were observed for those diagnosed with a mental health condition, and particularly those with chronic comorbidities. For this group, inpatient, hospital outpatient, office and emergency department physician, dental care, pharmacy, and mental health outpatient use increased. Mean expenditures for case management, mental health inpatient, and office physician services increased. This pattern suggests improved linkage of this group of enrollees with health and mental health services, resulting in expenditure increases that were larger than individuals with the same diagnoses outside of the networks, but very modest in relation to the high base cost of services for this group.

Overall, we conclude that it appears to be extremely difficult to drive expenditures for this Medicaid population downwards. In fact, we observed increased costs rather than expenditure savings for the \$8 per month per enrollee with chronic or mental health conditions which was expended to support the PCNA activities. Instead of savings, we observed altered patterns of care use with improved infrastructure to support medical homes. Primary effects observed are increased use of outpatient mental health care for those with

mental health diagnoses and an increased use of physician services for those with chronic conditions. We observed an increase rather than a decline in use of physician services in emergency departments for the entire population and all subgroups with network coverage, suggesting that the medical home infrastructure in this initial implementation period did not act to shift use of this site of care. The high enrollee turnover rates (fewer than half of individuals were enrolled for the entire postintervention period) might help explain the limited impact of PCNA interventions on this type of care utilization.

Thus, overall there are two themes that emerge from this pilot study. On one hand, the care utilization effects, at least over the initial 21 months, are modest but real. One can legitimately ask whether these modest changes in utilization and spending are worth the cost, if the primary goal of enhancing a medical home-based intervention in a Medicaid program is to lower expenditures on care. On the other hand, the program does appear to be directing resources toward those with substantial medical needs. Unfortunately, our study does not include measures of quality of care or patient satisfaction, which would be important additional aspects of improvements which might be associated with enhanced medical homes. A longer term evaluation of this and other ongoing interventions, incorporating such measures, along with measures of health status and quality of life, is warranted.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.