THE PATIENT-CENTERED MEDICAL HOME: IMPACT ON RACIAL/ETHNIC DISPARITIES IN QUALITY OF CARE

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ABSTRACT

Karen Elizabeth Swietek: The Patient-Centered Medical Home: Impact on Racial/Ethnic Disparities in Quality of Care
(Under the direction of Marisa Domino)

Objective: The objective of this research is to investigate the effects of the patient-centered medical home (PCMH) model on disparities in quality of care among populations with major depressive disorder (MDD) and comorbid chronic physical conditions.

Methods: Applying instrumental variable techniques to account for differential selection into treatment, we used generalized estimating equations and generalized linear models to determine the probability of receiving eight disease-specific quality measures for adults age 18-64 years with MDD and diabetes. Our independent variables of interest were enrollment in a National Committee for Quality Assurance (NCQA) recognized patient-centered medical home (PCMH), as well as level of NCQA recognition. We used a rank-and-replace method to measure disparities between racial groups, based on the Institute of Medicine definition.

Results: We found that while PCMH enrollment may improve overall quality of care, the effect is inconsistent across racial groups and not always associated with reductions in racial/ethnic disparities in quality. We found no association between level of NCQA PCMH recognition and improvement in quality. Finally, we found that considerable HTE exists among PCMH enrollees, and this heterogeneity is driven by patient race, sex, age, rurality, and number of chronic comorbidities.

Conclusions: Our findings suggest that the PCMH model alone may be insufficient to meet the needs of diverse patient populations. Providers and policymakers should consider racial/ethnic disparities and heterogeneous treatment effects explicitly when designing, implementing, and evaluating PCMH programs.

To my grandmothers, Mary Mattus Fowler and Alice Kufel Swietek

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LIST OF ABBREVIATIONS

2SRI	Two-stage residual inclusion
AHRF	Area Health Resource File
CCNC	Community Care of North Carolina
GEE	Generalized Estimating Equations
GLM	Generalized Linear Models
HEDIS	Healthcare Effectiveness Data and Information Set
HPSA	Health Professional Shortage Area
HTE	Heterogeneity of Treatment Effects
IOM	Institute of Medicine NCQA – National Committee for Quality Assurance
LIV	Local instrumental variable
MAX	Medicaid Analytic Extract
MDD	Major depressive disorder
MSA	Metropolitan Statistical Area
MTE	Marginal treatment effect
NCQA	National Committee on Quality Assurance
NH E&M	Non-hospital evaluation and management
NPI	National Provider Identifier
NPPES	National Plan and Provider Enumeration System
PeT	Person-centered treatment
PCMH	Patient-Centered Medical Home
QIC	Quasi-likelihood under the independence criterion

CHAPTER 1: INTRODUCTION

Overview

Persons with multiple chronic conditions utilize health care services more frequently and access a wider range of services than the general population,[1,2] making coordination of their care more difficult. Because mental health problems also exacerbate the disability associated with physical disorders and complicate their management,[3] these coordination challenges make persons with co-occurring mental illnesses such as less likely to receive recommended services.[1,4] Additionally, racial minorities with psychiatric comorbidities may be particularly vulnerable to low-quality care.

The patient-centered medical home (PCMH) model is an increasingly popular intervention to improve quality of care for this complex population. Several provisions of the Affordable Care Act (ACA) incentivize the use of accredited PCMH models for patients with comorbid mental and physical health conditions.[6] But while the rationale for PCMH transformation is well-documented,[7,8] different patient populations may not benefit equally from this model, and the effect of PCMH on racial disparities in quality of care is unknown.[9]

The overall objective of this study is to investigate the effects of the PCMH model on racial disparities in quality among populations with comorbid depression and chronic physical conditions. The central hypotheses are that the PCMH model will improve overall quality of care and reduce racial/ethnic disparities, and that practices that achieve higher NCQA recognition levels will see greater reductions in disparities. This objective is analyzed through three specific aims:

Aim 1: Estimate the effect of PCMH enrollment on racial/ethnic disparities in quality of care for adults with depression and one or more other chronic medical conditions.

Hypothesis 1.1: PCMHs will provide higher rates of guideline-concordant care compared to other models of primary care.

Hypothesis 1.2: PCMHs will see greater reductions in racial/ethnic disparities in quality of care compared to other models of primary care.

This retrospective cohort study will control for differential selection into the PCMH using county rates of PCMH adoption as an instrumental variable (IV).

Aim 2: Determine whether disparities in quality of care for patients with depression and other chronic conditions vary with level of NCQA recognition (level 1, 2, or 3).

Hypothesis 2.1: PCMHs with higher levels of NCQA accreditation will provide higher rates of guideline-concordant care overall

Hypothesis 2.2: PCMHs with higher levels of NCQA accreditation will see greater reductions in racial/ethnic disparities compared to lower recognition levels.

This study will analyze the same mental and physical health quality indicators as aim 1 to assess variations in quality of care for Medicaid-enrolled adults receiving care from providers with different levels of NCQA PCMH recognition.

Aim 3: Identify the subgroups of adults with depression and other chronic conditions most likely to benefit from PCMH participation.

Hypothesis 3: PCMH enrollment will have heterogeneous effects on quality; individualized treatment outcomes will vary by race, age, gender, rurality, and number of comorbidities.

This analysis will use a person-centered treatment (PeT) effects model to understand heterogeneity of individual-level treatment effects among diverse subpopulations of PCMH enrollees by examining the intersection of patient characteristics including age, gender, rurality, and number of comorbidities. Using county rates of PCMH adoption as an IV, this model will identify the marginal distributions of individual treatment effects based on different combinations of individual characteristics.

These studies have important policy implications and will contribute to a more detailed understanding of how the PCMH model affects quality of care for diverse populations. Specifically, these analyses will produce empirical evidence on the potential of the PCMH model to reduce racial/ethnic disparities in quality of care, determine whether level of NCQA recognition plays a role in the receipt of quality care, and provide insight into which subpopulations benefit the most from PCMH enrollment.

Significance

The relationship between race, depression, and chronic disease outcomes is complex,[5,10] and concurrent mental and chronic physical illness is an area in which outcomes are known to be poor.[2] Moreover, racial/ethnic disparities have been well-documented among persons with chronic disease and mental illness;[11] a higher proportion of individuals in minority communities have unmet mental and physical health needs.[11,12] Although minorities experience mental illness at approximately the same rate as the white population, minority patients are less likely to receive timely and appropriate treatment. The factors driving disparities in quality of care are not completely understood, but cost of care, social stigma, and the fragmented organization of services have been identified as barriers that may disproportionately prevent racial minorities with mental illnesses from accessing quality care.[11]

Given that minorities are more likely to seek mental health services in primary care than from a mental health specialist,[12] understanding the potential for primary care models to address the intersection between race, depression, and chronic disease is critical to reduce health disparities in this population.[5,10,13] The PCMH is a model of primary care transformation that aims to improve outcomes, safety, system efficiency, and patient and provider experiences by offering enhanced care coordination and disease management.[7,14,15] Multiple organizations certify PCMH status, but the most widely used recognition program was developed by the National Committee on Quality Assurance (NCQA) in 2008.[16] The NCQA offers three possible recognition levels, based on the number of PCMH elements adopted by a practice.[6] Practices can obtain the required number of points for each recognition level from a flexible set of criteria, although there are certain "must-pass" elements required of all practices.[17]

A growing body of literature demonstrates that this model is effective and that PCMH transformation is associated with improved clinical outcomes and patient experience of care.[6] Research also suggests that the populations that can most benefit from this model are those that require long-term management of their conditions such as chronic disease and behavioral health patients.[18] However, empirical evidence about the effects of this model on racial disparities in quality of care is limited.

Because the PCMH is being widely adopted, assessing the potential of the PCMH model to reduce disparities has significant policy implications. Several provisions of the ACA encourage PCMH models for populations with multiple chronic conditions and behavioral health needs, including enhanced federal funds for states implementing a variant of the model in their Medicaid programs.[6] Thanks in part to these incentives, adoption of the

PCMH model is growing quickly; between 2009 and 2013 the number of PCMH initiatives in the U.S. increased from 26 to 114.[19,20] By 2012, half of all states had implemented payment reforms encouraging expansion of the PCMH model for their Medicaid populations.[20] However, racial/ethnic disparities are not well-documented or widely evaluated in PCMH initiatives.[7,9] Despite the limited evidence, policymakers and providers largely believe that the PCMH has the potential to reduce racial disparities.[9]

Innovation

This project addresses a significant gap in the literature by generating new knowledge about the impact of the PCMH model on the delivery of equitable, high-quality care. This topic is understudied; only a limited number of empirical studies have examined the effect of the PCMH on disparities in healthcare and results have been mixed.[21–25] This study adds to the knowledge base by generating an empirical analysis of the association between the PCMH model and disparities in receipt of quality care.

This project is innovative in two important ways. First, this research leverages a novel dataset, leading to substantial increases in the knowledge base on the PCMH model and racial disparities in quality. This work constructs a unique dataset by combining five sources of data: 1) Medicaid claims from three states (North Carolina, Georgia, Texas); 2) NCQA PCMH recognition data; 3) physician and practice-level data from the National Plan and Provider Enumeration System (NPPES) Downloadable File; 4) county-level socioeconomic status (SES) data from the U.S. Census Bureau's Small Area Income and Poverty Estimates; and 5) county-level mental health provider supply variables from the Area Health Resource File. Both the NCQA recognition data and the NPPES file are only recently available for research. This is an innovative and relevant contribution to the field because many existing PCMH initiatives utilize incentive structures that base payments on NCQA recognition

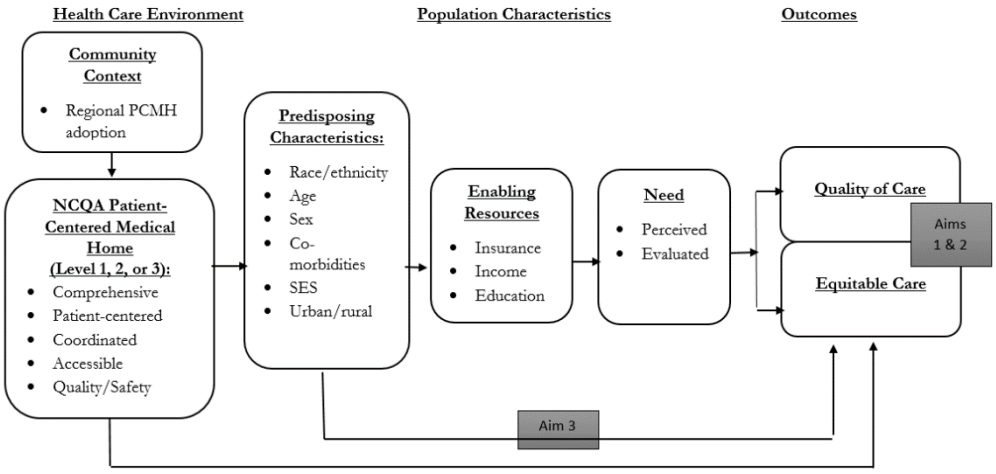
level,[26] yet research examining the association between of NCQA recognition level and quality outcomes is limited.

Second, this study assesses heterogeneity of treatment outcomes related to PCMH enrollment using a person-centered treatment (PeT) effects model. This is a relatively new statistical method is based on local instrumental variable (LIV) techniques.[27,28] While IV methods are frequently used in the health economics literature to address selection bias, less attention has been paid to the appropriate use of IV methods if treatment effects are heterogeneous.[28] The PeT approach assesses individual-level heterogeneity in an observational data setting by taking individual treatment choices into account to predict individualized treatment effects.[27] Using LIV methods, PeT models can explore treatment effect heterogeneity across both observable characteristics and unobserved confounders.[27] The PeT model is particularly relevant to disparities research, because documentation of health inequalities is often done with a focus on a single category of difference (e.g. race/ethnicity, sex, rurality).[29] Analyses such as this one have the potential to improve population health research by providing greater detail on both heterogeneity of treatment effects within racial groups and the complex causal processes that result in health disparities.[29] By examining individual-level heterogeneity, the results of this study will provide more precise insight into who most (and least) benefits from the PCMH intervention. These results can guide policymakers in both in targeting PCMH outreach to specific populations and inform efforts to identify specific groups in need of enhanced or additional care.

Conceptual Model

The conceptual model for this study (Figure 1) is adapted from the Andersen and Aday behavioral model for health service use.[30] This model represents the quantity and quality of services accessed as a function of both the health care environment and population characteristics (predisposing characteristics, enabling resources, and need).This model represents how the key components of the PCMH will affect outcomes related to both quality and equity of care, an effect which is moderated by population characteristics. The key intervention in this conceptual model is the PCMH, which is composed of five core elements: comprehensiveness, affordability, accessibility, patient-centeredness, and focus on quality and safety. This model is designed to address barriers to receipt of high quality care including fragmented care, stigma towards mental health treatment, lack of knowledge, poor treatment adherence and self-management, and poor physician-patient communication. Because these barriers disproportionately affect racial/ethnic minorities, many believe that the PCMH should reduce disparities in quality of care.[9,31] Finally, this model demonstrates that regional rates of PCMH adoption are not hypothesized to have any direct effect on quality or equity of care except via access to treatment in a PCMH. This assumption allows for the use of county PCMH adoption rates as an IV to control for selection bias.

Figure 1: *Conceptual Model*



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CHAPTER 2: EFFECT OF PATIENT-CENTERED MEDICAL HOME ENROLLMENT ON RACIAL/ETHNIC DISPARITIES IN QUALITY OF CARE FOR ADULTS WITH DEPRESSION AND MULTIPLE CHRONIC CONDITIONS

Overview

Objective: Estimate the association between National Committee for Quality Assurance recognition of patient-centered medical homes (PCMHs) and racial/ethnic disparities in the quality of care for adults age 18-64 years with major depressive disorder (MDD) and comorbid medical conditions.

Data sources: Secondary Medicaid claims data from 2008-2011 from Georgia, North Carolina, and Texas.

Study design: Applying instrumental variables to account for differential selection into treatment, we used generalized estimating equations to determine the probability of receiving eight disease-specific quality measures for adults age 18-64 years with MDD and diabetes. We used a rank-and-replace method to measure disparities between racial groups, based on the Institute of Medicine definition.

Data collection: Medicaid data merged with provider- and area-level data.

Principal findings: PCMH enrollment was associated with an increase in the overall likelihood of receiving six of eight recommended services and a decrease in the likelihood of receiving any psychotherapy (4.94 percentage points, $p<0.01$) and retinal exams (5.51 percentage points, $p<0.05$). Black-white and Hispanic-white disparities were each reduced for two measures. Although both groups improved, we also found that PCMH enrollment

exacerbated the Black-white disparity in adequate antidepressant use by 4.20 percentage points ($p<0.01$).

Conclusions: While PCMH enrollment may improve overall quality of care, the effect is inconsistent across racial groups and not always associated with reductions in racial/ethnic disparities in quality.

Background

Persons with multiple chronic conditions (MCC) utilize health care services more frequently and access a wider range of services than the general population,[1,2] making coordination of their care more difficult. Because mental health problems also exacerbate the disability associated with physical disorders and complicate their management,[3] these coordination challenges make persons with co-occurring mental illnesses particularly vulnerable to suboptimal quality of care.[1,4]

Further, racial/ethnic disparities in quality have been well-documented among persons with chronic disease and mental illness.[5,6] Racial and ethnic minorities have less access to mental health services, are less likely to receive needed care, and are more likely to receive poor-quality care than their white counterparts.[6] Although minority patients experience mental illness at approximately the same rate as whites, they are less likely to receive timely and appropriate treatment and are more likely to have unmet mental and physical health needs.[6–9] One study examining the unmet need for mental health services among minorities found that for persons with major depressive disorder (MDD), 64% of Latinos, 69% of Asians, and 59% of African Americans did not access any past-year mental health treatment, compared with 40% of non-Hispanic whites.[8]

The factors driving racial disparities in quality of care for this population are not completely understood, but cost of care, social stigma, provider discrimination, and

fragmented organization of services have been identified as barriers that may disproportionately prevent minority patients with mental illnesses from accessing quality care.[6,10] Given that minority patients are more likely to seek mental health services in primary care than from a mental health specialist,[7] understanding the potential for primary care models to these barriers and reduce health disparities in this population is critical.[5,11,12]

The patient-centered medical home (PCMH) is a model of primary care that uses enhanced care coordination and disease management to improve outcomes, safety, system efficiency, and patient and provider experiences.[13–15] The PCMH has been endorsed by a broad coalition of healthcare stakeholders, including all major national health plans, patient groups, and every major national physician organization.[16,17] Several provisions of the Affordable Care Act also encourage PCMH models for populations with MCC and behavioral health needs, including enhanced federal funds for states implementing a variant of the model in their Medicaid programs.[18] Thanks in part to these incentives, adoption of the PCMH model grew quickly; between 2009 and 2013 the number of PCMH initiatives increased from 26 to 114.[19,20] By 2012, half of all states had implemented payment reforms encouraging expansion of the PCMH model for their Medicaid populations.[20]

A growing body of literature demonstrates that the PCMH is effective for chronic care and that PCMH transformation is associated with improved clinical outcomes, overall quality of care,[14,21] and patient experience of care.[18] However, the literature also shows that the interventions classified as "medical homes" are heterogeneous.[22] In an effort to standardize the definition of "medical home," many organizations use a recognition program developed by the National Committee on Quality Assurance (NCQA) in 2008,[23] which offers three recognition levels based on the number of PCMH elements adopted by a practice.[18]

Practices can obtain the required number of points for each recognition level from a flexible set of criteria, although there are certain "must-pass" elements required of all practices.[24] This variation in operational definition and changes in PCMH requirements over time make defining the PCMH challenging.

Because the PCMH is being widely adopted and incentivized in Medicaid programs, assessing its effect on disparities is critical. This model is designed to address barriers to receipt of high quality care including fragmented care, lack of knowledge, poor treatment adherence and self-management, and poor physician-patient communication. Because these barriers disproportionately affect racial/ethnic minorities, the PCMH has the potential to reduce disparities in quality of care.[25,26] Policymakers and providers involved in four state-based PCMH initiatives in 2012-2013 reported in believing that the PCMH could reduce racial disparities by directly addressing the challenges faced by disadvantaged populations, a group that likely has the most room for improvement.[26] Notably, the same study found that most respondents said that disparities were not part of the considerations that motivated the design of the PCMH initiative.[26]

There is some evidence to suggest that overall quality improvement initiatives like the PCMH will improve outcomes for racial minorities and potentially reduce racial/ethnic disparities even if they are not specifically designed to do so.[10] In a large trial of quality improvement for depression in older adults, a collaborative care intervention significantly improved care for Black, Hispanic/Latino, and white patients similarly.[27] A study of two quality improvement interventions for depression found that improvements in quality were greater for Hispanic/Latino and Black patients than they were for whites.[28] These studies suggest that racial/ethnic minority patients may benefit from quality of care interventions,

even in the absence of substantial cultural adaptations of the intervention, and that some interventions may disproportionately benefit minority patients.[27]

Several studies have documented disparities in access to the PCMH.[29–31] For example, the Commonwealth Fund 2006 Health Care Quality Survey found that among all adults with a chronic condition, Hispanics were the least likely to have medical homes (20%) compared with whites (32%), Asian Americans (32%), and African Americans (34%).[31] However, empirical evidence about the effects of this model on racial disparities in quality outcomes is limited; racial/ethnic disparities in quality are not well-documented or widely evaluated in PCMH initiatives.[14,26,32] Those studies that do examine the effect of the PCMH on racial disparities report mixed results.[22] Some studies have found that the PCMH model reduces or eliminates racial disparities in quality of care metrics such as preventive care reminders, cholesterol testing, and cancer screenings.[31] However, other studies found varying effects among racial/ethnic groups[17,29,33,34] and some found no effect on disparities.[35]

This study investigates the effects of NCQA-recognized PCMH practices on racial disparities in quality among patients with comorbid depression and chronic physical conditions. The present study focuses on how the key components of the PCMH will affect outcomes related to both quality and equity of care, an effect that is moderated by predisposing characteristics such as race/ethnicity, socioeconomic status, age, and sex.

Methods

Setting

This analysis includes Medicaid claims from 2008-2011 in North Carolina, Georgia, and Texas. This study focuses on NCQA-recognized PCMHs because many existing Medicaid PCMH initiatives utilize incentive structures that base payments on NCQA recognition and over 50 payers nationwide offer enhanced reimbursement for NCQA-

recognized practices.[36] The NCQA's PCMH recognition standards were first implemented in 2008, therefore these data reflect the early stages of the program. During the study period, North Carolina was the only state in our sample with a state-developed medical home program.[37] The state's Medicaid PCMH program, Community Care of North Carolina (CCNC), does not require participating providers to attain NCQA recognition, but does offer resources and support for practices seeking recognition. During this period, medical home initiatives in Georgia and Texas were largely supported by private partnerships.[38,39]

Data/sample

This study uses a novel dataset constructed from several administrative data sources. First, 2008-2011 Medicaid Analytic eXtract (MAX) claims data from three states (NC, GA, TX) were merged with the data from the National Plan and Provider Enumeration System (NPPES) which contains National Provider Identifiers (NPIs) from practicing providers and organizations, including deactivated NPIs. The NPPES contains information on several provider characteristics, including gender, provider type, state, and Medicaid billing identifiers. These data were then combined with NCQA PCMH recognition data, which contain information on PCMH characteristics such as date, duration, and level of recognition. County supply of mental health professionals was measured using data from the Area Health Resource File.[40] Finally, socioeconomic status variables were measured at the county level using the U.S. Census Bureau's Small Area Income and Poverty Estimates.[41]

The study population includes Medicaid beneficiaries who are not dually enrolled in Medicare, ages 18-64 years, with MDD and at least one other chronic condition. MDD was identified using ICD-9 codes 296.2, 296.3, 300.4, and 311. Subgroup analyses were conducted for individuals with diabetes (Type I or Type II) because it a condition that is highly prevalent in Medicaid populations.[42,43] Additionally, clear evidence indicates that

comorbid depression interferes with diabetes self-management, [44]and studies have shown that MDD is also an independent risk factor for Type II diabetes.[45] To avoid "rule-out" diagnoses and/or errors in coding we used strict definitions of MDD and diabetes, defined as having at least one inpatient diagnosis or at least two outpatient or emergency department diagnoses during a single year in the study period, and at least one claim for the condition in the current year. We excluded individuals with serious mental illnesses such as schizophrenia or bipolar disorder because specialty providers are more likely to serve as the primary point of contact with the healthcare system for this population.[46]

Key Measures

Key outcomes included disease-specific quality indicators for MDD and diabetes derived from Medicaid claims (see Table 1 for full definitions). Quality measures were selected based on recommended core quality measures for the PCMH,[47] the Centers for Medicare and Medicaid Services 2016 core set of adult quality measures for Medicaid,[48] and the 2011 Healthcare Effectiveness Data and Information Set (HEDIS).

Any antidepressant use, receipt of any psychotherapy, and all four diabetes measures were measured at the person-year level. Clinical guidelines specify that use of antidepressants or psychotherapy should be based on clinical circumstances such as severity and complex psychosocial situations.[49] Because this information was not available in claims data, we measured the likelihood that beneficiaries with MDD received any psychotherapy or any antidepressant prescription. While either treatment modality would be considered guideline-concordant, these measures represent a minimum quality standard.[50,51]

Given the episodic nature of MDD, we also constructed an episode-level variable for minimally adequate antidepressant use in addition to the calendar-year depression measures. In episodic analyses, we assessed the HEDIS antidepressant management measure for

effective acute phase treatment, defined as the likelihood that beneficiaries received at least 84 days of antidepressants during an acute episode.[52] We focused on the acute phase of treatment because it is typically the period of most intensive treatment,[50] and there are clear guidelines for antidepressant usage during this phase.[52] An acute episode was initiated by two MDD outpatient services on different dates or by initiation of an antidepressant prescription. We required a period of at least three months without MDD claims before the initiation of a new episode. The acute phase of an episode was considered to have ended after either 90 days of no MDD services or antidepressants or 120 days after the start of the episode.[50] Because we were unable to observe prescriptions received during inpatient hospitalizations, we adjusted for inpatient episodes by assuming that patients received dispensed medication during their hospitalization and resumed their outpatient medications upon discharge.

The primary explanatory variable was a binary indicator of yearly engagement in an NCQA-certified PCMH. In 2008, NCQA PCMH recognition criteria consisted of nine standards: access and communication; patient tracking and registry functions; care management; self-management support; electronic prescribing; test tracking; referral tracking; performance reporting and improvement; and advanced electronic communications. Additionally, there were five "must-pass" elements to achieve level 1 recognition and ten required for levels 2 and 3.

We identified primary care providers using provider taxonomy codes for internal medicine, family medicine, pediatrics, general practice, ambulatory clinics, nurse practitioners, and physician assistants. Patients were attributed to a primary care provider using the "plurality rule" commonly applied by the Centers for Medicare and Medicaid Services, especially for attributing beneficiaries to Accountable Care Organizations.[53] Under

this method, a beneficiary's primary care provider is defined as the provider that delivers the plurality of the beneficiary's non-hospital evaluation and management (NH-E&M) visits.[54] In the event that a beneficiary received the same number of services from two providers, they were attributed to the most recent provider.[54] Because this study is focused on a population with MDD, we modified this method by attributing beneficiaries first to the primary care provider where they received the plurality of depression-related NH E&M claims. If a beneficiary did not have a depression-related NH E&M claim with a primary care provider, they were then attributed to the primary care provider where they received the plurality of general NH E&M services. For example, if a beneficiary had NH E&M claims from three providers but saw only one of these providers for claims related to depression, the beneficiary was attributed to the provider whom they saw for a depression-related concern. We conducted sensitivity analyses defining PCMH enrollment as having any claim with an NCQA recognized PCMH provider during a given year. A provider's PCMH status was determined using NCQA recognition data.

Beneficiary-level covariates derived from claims included age, sex, number of additional chronic comorbidities, number of Medicaid-enrolled months and rurality. Chronic conditions were identified using the Agency for Healthcare Research and Quality's Chronic Condition Indicator software, which defines chronic conditions as lasting at least 12 months and causing limitations on self-care or resulting in need for ongoing medical intervention.[55] Rurality was measured in three categories (metropolitan, metropolitan-adjacent, and rural) using simplified county-level Rural-Urban Continuum Codes.[56] Provider-level covariates included Federally Qualified Health Center or Rural Health Center status, and sex. County-level supply of mental health professionals was measured using county supply of

psychiatrists and Mental Health Professional Shortage Area (HPSA) status (full or partial). Finally, county-level socioeconomic characteristics were measured using percent of the population under poverty and median income.

Because of concerns about the endogeneity of participating in a PCMH, we constructed two instrumental variables based on county rates of PCMH adoption. First, the ratio of county PCMH adoption was defined as the number of unique PCMH providers in a county divided by the total number of Medicaid primary care providers, as measured by NCQA PCMH recognition data and the Area Health Resource File. The second instrument was a similar county-level rate of NCQA medical home practices to all primary care providers, but both the numerator and denominator were conditional on the provider NPI appearing in Medicaid MAX claims during the study period.

Defining & Measuring Disparities

This study employs the definition of disparities described in the 2002 Institute of Medicine (IOM) report "Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care." The IOM defines a racial disparity in health care as "racial or ethnic differences in the quality of health care that are not due to access-related factors or clinical needs, preferences, and appropriateness of intervention.''[57] Under this definition, the simple unadjusted difference in means or rates between racial groups does not constitute a healthcare disparity.[57,58] Rather, measuring a disparity requires separating out "differences" that are driven by underlying health status or preference from those that represent true "disparities" that are driven by healthcare systems factors or discrimination.[57] Another distinguishing feature of this definition is that it includes the effects of mediating factors (other than health status and preferences), such as variables associated with geography or

socioeconomic status.[57] Therefore, implementing this definition requires adjusting for health status, but not other factors explaining differences in service use or expenditures.[58]

While measuring differences in outcomes can be accomplished by comparing the observed sample means between whites and minority groups, measuring disparities under the IOM definition requires generating counterfactual predictions of the outcomes that minority groups would experience *if their health status were identical to their white counterparts.* To implement this counterfactual, we estimate racial disparities as follows: 1) with non-Hispanic whites as a reference group, fit a model describing relationships between quality/utilization and health status, race, and other characteristics, 2) using a rank and replace method, transform the distributions of health status variables (age, gender, and number of comorbidities) for minority groups to be the same as those of non-Hispanic whites, while leaving other variables unchanged, creating a counterfactual minority subgroup with distributions identical to the white subgroup 3) calculate predictions using the coefficients from the initial models and the transformed/counterfactual health status variables for minority groups, and 4) aggregate predictions by racial group to estimate disparities.[58] Variance estimates for these aggregated predictions were obtained via 500 bootstrap iterations.

Analytic Methods

This analysis uses generalized estimating equations (GEE) with a binomial family and logit link function selected based on the probability distributions of the dependent variables. We examined independent, exchangeable, and unstructured correlation structures; an independent correlation structure was selected based on the quasi-likelihood under the independence model criterion (QIC).[59] The functional form of the covariates was also selected based on QIC. We examined age as a quadratic variable and interactions between

race and medical home status, median income, percent under poverty, and gender. Only the quadratic form of age improved model fit.

Because PCMH enrollment is non-random and therefore likely subject to selection bias, we used an instrumental variable (IV) approach. To address this differential selection, we used two-stage residual inclusion (2SRI). The first stage 2SRI model uses a logit model to regress PCMH enrollment on the instruments and other covariates:

$$Equation\ 1:\ PCMH\_enrollment_{it} = \beta_0 + \beta_1 * PCMH\_rate_{ct} + \beta_2 * X_{ipct} + \varepsilon_{ipct}$$

where X represents a vector of covariates and i, p, and c represent individual, provider, and county level variables and t is the time-period (year). The residuals (*predicted_residuals)* from this model were included in the second stage GEE equation:

$$Equation\ 2:\ Y_{it} = \beta_0 + \beta_1 * PCMH\_enrollment_{it} + \beta_2 * X_{ipct} + \beta_3 * (predicted\_residuals) + \varepsilon_{ipct}$$

Where Y represents a set of binary dependent variables, defined as the receipt of each quality indicator.

Average marginal effects for the overall estimates were obtained using predictive margins. Because the second stage of the 2SRI model does not account for the estimated residuals included from the first stage, we used bootstrapping (500 replicates) to obtain the most precise standard errors. Bootstrap replicates were clustered at the beneficiary level to account for repeated observations over time. In the disparities models, predicted probabilities were obtained using the methods described above and standard errors were obtained via bootstrapping (500 replicates) clustered at the beneficiary level. 2SRI models yield estimates that should be interpreted within a Local Average Treatment Effect (LATE) context. All analyses were performed using Stata (Version 13).

We conducted several tests on our instruments, including tests of exogeneity using the Durbin and Wu–Hausman tests,[60] tests of instrument strength,[61] and over-identification.[62] The instruments were uniformly strong, with F-statistics of the joint significance of the two instruments ranging from 1048.92 to 4029.4. The correlation between the instruments was 0.44, suggesting that although the two measure similar constructs, they are capturing different information and are both appropriate for inclusion in these models. PCMH enrollment was determined to be endogenous in all 8 models. The instruments pass the overidentification test for 5 of the 8 models; the calendar-year psychotherapy, antidepressant, and combined psychotherapy/antidepressant models did not pass. However, there is some controversy about overidentification tests in recent literature; while they are generally discussed as tests of excludability, they are in fact joint tests of excludability and homogeneity of treatment effects. Therefore, instruments that are excludable may be rejected due to local average treatment effects.[63,64]

Results

The final sample (Table 2) consisted of 310,906 person-years contributed by 191,565 unique individuals. Approximately 1.6% of person-years were accounted for by PCMH enrollees. PCMH enrollees were more likely to be Black (39.2% versus 30.1% among non-enrollees, $p<0.001$), and less likely to live in rural areas ($p<0.001$). In unadjusted comparisons (Table 3), PCMH enrollees were significantly ($p<0.01$) more likely to receive all recommended services except for yearly psychotherapy and retinal exams.

Major Depression Outcomes

In the calendar-year depression analyses (Table 4), we found that PCMH enrollment was associated with a 4.88 percentage point increase in the overall receipt of any depression treatment, whether psychotherapy or antidepressants, among beneficiaries with MDD

($p<0.01$). This improvement was driven primarily by antidepressant use; PCMH enrollees saw a 5.94 percentage point higher rate of receipt of any antidepressants ($p<0.01$), but also a 4.94 percentage point overall lower rates of psychotherapy ($p<0.01$). In the acute episodic depression analyses, PCMH enrollment was associated with a 2.85 percentage point higher probability of receiving minimally adequate antidepressants ($p<0.05$). In fully adjusted models, Black and Hispanic/Latino beneficiaries were 3.31 and 3.69 percentage points more likely to receive psychotherapy than their white counterparts ($p<0.01$), but 14.30 and 5.46 percentage points less likely to receive antidepressants ($p<0.01$).

In disparities models for depression outcomes (Table 5), Black and Hispanic/Latino beneficiaries had slightly higher predicted probabilities of receiving annual psychotherapy than white beneficiaries in both the non-PCMH and PCMH groups (50.9% and 41.1% respectively, compared to 39.6% for whites), and this pattern persisted among PCMH enrollees. However, this effect was heterogeneous across racial groups: PCMH enrollment was associated with a lower predicted probability of receiving any psychotherapy for white and Black enrollees, and a small increase for Hispanic/Latino enrollees. PCMH enrollment significantly reduced Black-white and Hispanic-white disparities in calendar-year antidepressant use by 0.90 percentage points ($p<0.05$) and 9.72 percentage points ($p<0.01$), respectively. PCMH enrollment was also associated with a 6.81 percentage point reduction in Hispanic-white disparities ($p<0.01$) in receipt of either calendar-year measure. Finally, in acute episodic analyses, PCMH enrollment was associated with a 4.20 percentage point increase in Black-white disparities ($p<0.01$) and had no statistically significant association with Hispanic-white disparities.

Diabetes Outcomes

Among patients with diabetes(Table 6), PCMH enrollment generally increased overall receipt of recommended diabetes services: an 11.70 percentage point increase in the overall probability of receiving of a lipids panel ($p<0.01$), a 14.00 percentage point increase in the probability of an A1c test ($p<0.01$), and a 7.53 percentage point increase in the likelihood of receiving attention for nephropathy ($p <0.01$). Being a PCMH enrollee was associated with a 5.51 percentage point decrease in the likelihood of receiving a retinal exam ($p<0.05$). Before rank-and-replace adjustment, Hispanic/Latino beneficiaries were significantly more likely to receive all diabetes services than their white counterparts. Black beneficiaries were more likely to receive eye exams and attention for nephropathy, but slightly less likely to receive lipids testing. There was no significant association between Black race and A1c testing in the fully-adjusted models.

In IOM-adjusted disparities models for diabetes (Table 7), Black beneficiaries not enrolled in a PCMH were 2.27 percentage points less likely to receive A1c testing ($p<0.01$), and this disparity was eliminated among PCMH enrollees. Statistically significant black-white disparities also existed for both receipt of lipids testing and retinal exams. Among PCMH enrollees, the disparity in lipids testing was reduced from 7.36 percentage points to 3.71 percentage points and the disparity in retinal exams was reduced from 6.45 percentage points to 5.70 percentage points, however the reduction was not statistically significant for either measure. There were no statistically significant Black-white disparities in attention for nephropathy. Hispanic/Latino beneficiaries had higher rates of A1c testing and this advantage persisted among PCMH enrollees. There were no statistically significant Hispanic-white disparities for either treatment group in receipt of lipids panels or attention for nephropathy. A statistically significant Hispanic-white disparity existed in the PCMH group

for retinal exams, but not for the non-PCMH group, suggesting that disparities were exacerbated among PCMH enrollees.

Sensitivity Analyses

For most measures, including annual receipt of antidepressants, minimally adequate episodic antidepressant use, A1c testing, and retinal exams, sensitivity analyses defining PCMH attribution as any claim with an NCQA-recognized provider produced results similar to the primary analyses in direction and significance, though the effect sizes were generally smaller in magnitude. An exception to this trend was the annual receipt of psychotherapy, where the effect of PCMH enrollment was almost twice as large as the primary analyses. Due to the larger decrease in receipt of psychotherapy, this definition of PCMH enrollment was also associated with a 2.02 percentage point decrease in receipt of either psychotherapy or antidepressants ($p<0.01$).

Discussion

We found that PCMH enrollment increased the likelihood of receiving six of eight recommended services. This finding is consistent with the literature, which suggests that the PCMH model improves quality of care in Medicaid populations.[18,21] The two exceptions to this trend were psychotherapy and retinal exams (for beneficiaries with diabetes). These exceptions may exist because unlike the other quality measures, these two services cannot be provided in primary care. However, both psychotherapy and antidepressants are considered appropriate treatments for antidepressants and we found that despite the decrease in receipt of psychotherapy, receipt any calendar-year depression treatment increased among PCMH enrollees.

However, in IOM-adjusted disparities analyses, the effects of the PCMH varied across racial groups. Some providers and policymakers believe that the PCMH should

improve outcomes for all racial groups, but that minority groups will benefit more because they have the most room for improvement.[26] Overall, our findings do not support this belief; we only see this pattern in Black-white disparities in any antidepressant use and A1c testing and Hispanic-white disparities in any antidepressant use and use of either psychotherapy or antidepressants; each reflecting only two of eight possible quality measures. In other cases (e.g., Black-white disparities in adequate episodic antidepressant use), PCMH enrollment improves the outcome for both the white and minority groups, but the disparity between the two is slightly exacerbated.

Notably, we found that minority patients received better quality of care on several measures, especially for Hispanic/Latino beneficiaries. In most cases these advantages persisted between the non-PCMH and PCMH groups. One possible explanation for this trend is the fact that this sample is limited to individuals enrolled in Medicaid; previous studies have found that Hispanic-white disparities are driven in large part by significant disparities in health insurance coverage.[9,66] Another possible factor is that these analyses do not control for English fluency or language concordance between patient and provider.[67]

Limitations

This study has several limitations. First, individual-level SES data are not available in Medicaid claims data; these analyses instead use county-level measures of SES. Although individual-level SES data is preferable for studying racial/ethnic disparities, area-based measures are often used to adjust for SES in studies using administrative data and perform as well as more complex composite measures of area-level economic deprivation.[68] Second, PCMH recognition level is not necessarily indicative of the services that a practice provides. Non-PCMH primary care practices may be engaging in many of the same activities as NCQA-recognized PCMHs but may not seek recognition due to financial or other concerns.

Third, Medicaid claims may underreport retinal exams because communities often offer free eye exams that do not appear in claims. However, this underreporting would not differentially affect enrollees linked to PCMH and non-PCMH practices. Finally, there are no measures of patient perspective or experience of care are not available in administrative data. Given that patient preference is a crucial aspect of the IOM definition of disparities, future research on the effect of the PCMH on racial disparities should take detailed patient preference variables into account, perhaps using survey data.

Conclusions

These findings show that while the PCMH model may improve overall quality of care, the effect is not necessarily consistent across racial groups. Further, PCMH enrollment not always associated with a reduction in racial/ethnic disparities in quality of care. This suggests that while the PCMH has potential to reduce disparities, implementing a PCMH model alone may not be sufficient to reduce racial inequities in quality of care. Providers or policymakers should consider racial/ethnic disparities explicitly when designing, implementing, and evaluating PCMH programs.

Table 1: *Disease-Specific Dependent Variables*

Variable	Definition	Calendar-Year	Acute Episode
Depression			
Antidepressant use	Receipt of any antidepressant prescriptions	X	
	Receipt of at least 84 days of antidepressants during a 120-day episode.		X
Psychotherapy	Receipt of any group/individual psychotherapy	X	
Any MDD treatment	Receipt of any antidepressant prescriptions or group/individual psychotherapy	X	
Diabetes			
A1C Testing	Percent of diabetic patients receiving A1C testing	X	
LDL-C Testing	Percent of diabetic patients receiving an LDL–C test	X	
Retinal exam	Percent of diabetic patients receiving a retinal exam	X	
Nephropathy screening	Percent of diabetic patients screened for nephropathy	X	

Table 2: *Summary Statistics*

	N(%) or Mean(SD)		
	Total	**Non-PCMH**	**PCMH**
N (Person-Years)	310,906	306,040 (98.40%)	4,866 (1.60%)
Diabetes	82,501 (26.50%)	81304 (26.60%)	1,197 (24.60%)
Race/ethnicity			
White	156,039 (50.20%)	153,529 (50.20%)	2,510 (51.60%)
Black	94167 (30.30%)	92259 (30.10%)	1908 (39.20%)
Hispanic/Latino	37516 (12.10%)	37329 (12.20%)	187 (3.80%)
Female Beneficiary	246694 (79.30%)	242765 (79.30%)	3929 (80.70%)
Age	40.82 (13.57)	40.83 (13.57)	40.15 (13.35)
Months of Medicaid enrollment	10.771 (2.40)	10.77 (2.40)	10.801 (2.32)
Chronic comorbidities	5.23 (4.31)	5.23 (4.31)	5.32 (4.26)
County % Under Poverty	18.80 (5.72)	18.81 (5.75)	18.16 (3.63)
County median income	43,726.33 (9,316.43)	43,702.24 (9,351.32)	45,240.96 (6,595.7111)
Rurality			
Rural: MSA-adjacent	65,664 (21.10%)	65,280 (21.30%)	384 (7.90%)
Rural	17,363 (5.60%)	17,292 (5.70%)	71 (1.50%)
Mental Health Professional Shortage Area (HPSA)			
Whole county	120,531 (38.80%)	119,977 (39.20%)	554 (11.40%)
Partial county	113,380 (36.50%)	110,821 (36.20%)	2,559 (52.60%)
County Supply of Psychiatrists	49.70 (89.47)	49.43 (89.45)	66.47 (88.62)
State			
Georgia	84,958 (27.30%)	84661 (27.70%)	297 (6.10%)
North Carolina	137,198 (44.10%)	132,995 (43.50%)	4,203 (86.40%)
Texas	88,750 (28.50%)	88,384 (28.90%)	366 (7.50%)
Year			
2008	63,713 (20.50%)	63,713 (20.80%)	0 (0.0%)
2009	83,764 (26.90%)	83,674 (27.30%)	90 (1.80%)
2010	94,296 (30.30%)	92,649 (30.30%)	1,647 (33.80%)
2011	69,133 (22.20%)	66,004 (21.60%)	3,129 (64.30%)

Table 3: *Unadjusted Rates of Quality Metrics*

	Non-PCMH N(%)	**PCMH** N(%)	**p-value** (t-test)
Depression			
Calendar Year			
Any psychotherapy	109,510 (40.6%)	1,721 (39.3%)	0.066
Any antidepressants	159,948 (59.4%)	3,174 (72.4%)	<0.001
Psychotherapy or antidepressants	203,058 (75.4%)	3,728 (85.1%)	<0.001
N	*269,460*	*4,383*	
Acute Episode			
Min. antidepressants	40,297 (24.0%)	1,035 (33.6%)	<0.001
N	*167,910*	*3,076*	
Diabetes			
A1c testing	52,963 (65.0%)	918 (76.7%)	<0.001
Retinal exam	26,780 (32.9%)	346 (28.9%)	0.004
Lipids panel	40,450 (49.7%)	751 (62.8%)	<0.001
Attn for nephropathy	24,151 (29.6%)	489 (40.9%)	<0.001
N	*81.483*	*1,197*	

Table 4: *Average Marginal Effect of PCMH Enrollment on Depression Outcomes*

	Calendar Year			Acute Episode
	Any Psychotherapy	Any Antidepressants	Psychotherapy or Antidepressants	Adequate Antidepressants
PCMH Enrollment	-0.0494***	0.0594***	0.0488***	0.0285**
	(0.0105)	(0.0108)	(0.00985)	(0.0123)
Race				
Black	0.0331***	-0.143***	-0.0735***	-0.153***
	(0.00295)	(0.00291)	(0.00258)	(0.00250)
Hispanic/Latino	0.0369***	-0.0546***	-0.0221***	-0.0801***
	(0.00464)	(0.00441)	(0.00354)	(0.00478)
Chronic Conditions	-0.00486***	0.00937***	0.000994***	0.00778***
	(0.000287)	(0.000280)	(0.000239)	(0.000298)
Rurality				
Non-metro (adjacent to urban area)	-0.000142	-0.0101***	-0.00803***	-0.00945***
	(0.00308)	(0.00300)	(0.00267)	(0.0318)
Non-metro (non-urban adjacent)	-0.0398***	-0.0187***	-0.0364***	-0.000935
	(0.00497)	(0.00494)	(0.00453)	(0.00524)
Beneficiary age	-0.00366***	-0.0 0159***	-0.00341***	0.00199***
	(8.58e-05)	(8.53e-05)	(7.65e-05)	(8.84e-05)
Female Beneficiary	0.00930***	0.0594***	0.0402***	0.0325***
	(0.00257)	(0.00252)	(0.00225)	(0.00267)
Months of Medicaid Enrollment	0.0166***	0.0112***	0.0148***	0.00926***
	(0.000455)	(0.000423)	(0.000352)	(0.000518)
FQHC	-0.0111***	0.0532***	0.0333***	0.00826**
	(0.00378)	(0.00356)	(0.00305)	(0.00408)
RHC	-0.0283***	0.0364***	0.0220***	0.0296***
	(0.00477)	(0.00453)	(0.00383)	(0.00512)
Female Provider	0.00529**	0.0442***	0.0341***	0.0238***
	(0.00255)	(0.00245)	(0.00213)	(0.00273)
County Percent Under Poverty	0.00156***	-0.00392***	-0.00119***	-0.00334***
	(0.000364)	(0.000347)	(0.000297)	(0.000401)
County Median Income	1.62e-06***	-1.79e-06***	-2.96e-07	-9.14e-07***
	(2.33e-07)	(2.24e-07)	(1.96e-07)	(2.50e-07)
County # of Psychiatrists	0.000183***	8.87e-05***	0.000127***	-1.65e-05
	(1.51e-05)	(1.41e-05)	(1.16e-05)	(1.79e-05)
Mental Health HPSA:				
Whole county	0.0136***	-0.00392	-0.000839	0.000480
	(0.00309)	(0.00301)	(0.00269)	(0.00324)
Partial county	0.0234***	-0.0190***	-0.00183	-0.00824***
	(0.00277)	(0.00275)	(0.00248)	(0.00289)
State				
North Carolina	-0.0261***	0.0775***	0.0416***	0.0361***
	(0.00295)	(0.00279)	(0.00229)	(0.00321)
Texas	-0.155***	-0.159***	-0.155***	-0.0767***

	Calendar Year			Acute Episode
	Any Psychotherapy	Any Antidepressants	Psychotherapy or Antidepressants	Adequate Antidepressants
	(0.00334)	(0.00345)	(0.00319)	(0.00350)
Year				
2010	0.00154	-0.0251***	-0.0122***	-0.0106***
	(0.00250)	(0.00241)	(0.00209)	(0.00260)
2011	-0.00150	-0.00189	0.00214	0.0355***
	(0.00284)	(0.00277)	(0.00247)	(0.00311)
Pearson Residual	-0.0494***	0.0594***	0.0488***	0.00188
	(0.00982)	(0.0101)	(0.00872)	(0.00226)
Bootstrapped standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 5: *Comparison of Predicted Probabilities and Disparities Changes for Depression Outcomes*

	White	Black	Disparity	Hispanic /Latino	Disparity
Any Psychotherapy (Annual)					
Non PCMH	0.396***	0.509***	-0.113***	0.411***	-0.0152***
	(0.00170)	(0.00248)	(0.00298)	(0.00352)	(0.00396)
PCMH	0.372***	0.468***	-0.0957***	0.450***	-0.0774***
	(0.00770)	(0.00825)	(0.00423)	(0.0112)	(0.00844)
Δ Disparity			0.0173***		-0.0623***
			(0.00321)		(0.00742)
Any Antidepressants (Annual)					
Non PCMH	0.666***	0.525***	0.141***	0.442***	0.224***
	(0.00160)	(0.00259)	(0.00307)	(0.00386)	(0.00423)
PCMH	0.781***	0.650***	0.131***	0.655***	0.126***
	(0.00636)	(0.00819)	(0.00457)	(0.0124)	(0.0101)
Δ Disparity			-0.00903**		-0.0972***
			(0.00381)		(0.00944)
Psychotherapy or Antidepressants (Annual)					
Non PCMH	0.792***	0.774***	0.0178***	0.693***	0.0993***
	(0.00143)	(0.00214)	(0.00253)	(0.00333)	(0.00361)
PCMH	0.873***	0.851***	0.0218***	0.842***	0.0311***
	(0.00497)	(0.00583)	(0.00330)	(0.00872)	(0.00719)
Δ Disparity			0.00399		-0.0681***
			(0.00295)		(0.00711)
Adequate Antidepressants (Episodic)					
Non PCMH	0.274***	0.120***	0.154***	0.105***	0.169***
	(0.00167)	(0.00145)	(0.00215)	(0.00213)	(0.00267)
PCMH	0.375***	0.179***	0.196***	0.198***	0.177***
	(0.00942)	(0.00606)	(0.00540)	(0.0106)	(0.00923)
Δ Disparity			0.0420***		0.00763
			(0.00501)		(0.00853)

Bootstrapped Standard Errors in Parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: *Average Marginal Effect of PCMH Enrollment on Diabetes Outcomes*

	Lipids	A1c	Retinal Exam	Attn for Nephropathy
PCMH Enrollment	0.117***	0.140***	-0.0551**	0.0753***
	(0.0217)	(0.0201)	(0.0252)	(0.0260)
Race				
Black	-0.0194***	0.00596	0.0218***	0.0344***
	(0.00483)	(0.00537)	(0.00454)	(0.00506)
Hispanic/Latino	0.0341***	0.0475***	0.0445***	0.0690***
	(0.00731)	(0.00831)	(0.00729)	(0.00744)
Chronic Conditions	0.00675***	0.0103***	0.0145***	0.0129***
	-0.00038	(-0.000409	-0.000367	-0.000361
Rurality				
Non-metro (adjacent to urban area)	-0.00906*	-0.00772	-0.0015	-0.0217***
	(-0.00506)	(-0.00527)	(-0.00516)	(-0.00511)
Non-metro (non-adjacent to urban area)	-0.0553***	-0.0457***	-0.0336***	-0.0766***
	(-0.00837)	(-0.00853)	(-0.00806)	(-0.0078)
Beneficiary age	-0.00182***	-0.00339***	2.43E-05	-0.00232***
	(-0.000194)	(-0.000209)	(-0.000205)	(-0.000196)
Female Beneficiary	0.00445	-0.000305	0.0170***	-0.00725*
	(-0.00415)	(-0.00436)	(-0.00425)	(-0.00424)
Months of Medicaid Eligibility	0.0243***	0.0190***	0.0144***	0.0103***
	-(0.000884)	(-0.000876)	(-0.00101)	(-0.00097)
FQHC	0.0268***	0.0376***	0.0405***	0.0524***
	(-0.00605)	(-0.00622)	(-0.00644)	(-0.00643)
RHC	0.0670***	0.0797***	0.141***	0.00633
	(-0.00776)	(-0.00786)	(-0.00862)	(-0.0082)
Female Provider	0.0631***	0.0867***	0.0338***	0.0674***
	(-0.00444)	(-0.00449)	(-0.00472)	(-0.00469)
County Percent Under Poverty	0.00144**	-0.00271***	0.00288***	-0.00017
	(-0.000592)	(-0.000608)	(-0.000582)	(-0.000581)
County Median Income	8.46e-07**	-1.36e-06***	-1.10e-06***	-5.05E-07
	(-4.06E-07)	(-4.19E-07)	(-4.16E-07)	(-4.03E-07)
County # of Psychiatrists	-8.27e-05***	-1.24E-05	-5.76e-05**	6.30e-05***
	(-2.46E-05)	(-2.68E-05)	(-2.46E-05)	(-2.36E-05)
Mental Health HPSA				
Whole county	0.0283***	0.00375	-0.0261***	-0.00397
	(-0.00529)	(-0.00546)	(-0.00547)	(-0.00538)
Partial county	0.00451	0.00890*	-0.0196***	0.00751
	(-0.0047)	(-0.00509)	(-0.00505)	(-0.004930
State (Referent state = Georgia)				
North Carolina	0.396***	0.138***	0.0795***	0.0548***
	(-0.00466)	(-0.00521)	(-0.00478)	(-0.00469)
Texas	0.512***	0.203***	0.115***	0.101***
	(-0.00567)	(-0.00611)	(-0.00598)	(-0.00597)
Year (Referent year=2009)				
2010	-0.0170***	-0.00399	0.0113***	-0.00383
	(-0.00415)	(-0.00432)	(-0.00437)	(-0.00419)

	Lipids	A1c	Retinal Exam	Attn for Nephropathy
2011	-0.0696***	-0.0527***	-0.108***	-0.0250***
	(-0.00483)	(-0.00501)	(-0.00476)	(-0.00482)
Pearson Residuals	-0.00475*	-0.00656*	0.0152***	0.00474*
	(-0.00272)	(-0.00346)	(-0.00477)	(-0.002460)
Bootstrapped standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 7: *Comparison of Predicted Probabilities and Disparities Changes for Diabetes Outcomes*

	White	Black	Disparity	Hispanic/Latino	Disparity
Lipids Panel					
Non PCMH	0.472***	0.398***	0.0736***	0.686***	-0.214
	(0.00351)	(0.00526)	(0.00621)	(0.00675)	(0.00752)
PCMH	0.630***	0.593***	0.0371***	0.651***	-0.0216
	(0.0164)	(0.0167)	(0.0131)	(0.0262)	(0.0237)
Δ Disparity			-0.0365		0.193***
			(0.0125)		(0.0228)
A1c Testing					
Non PCMH	0.619***	0.597***	0.0227***	0.736***	-0.117***
	(0.00370)	(0.00557)	(0.00652)	(0.00635)	(0.00746)
PCMH	0.752***	0.760***	-0.00876	0.797***	-0.0454***
	(0.0150)	(0.0136)	(0.00922)	(0.0160)	(0.0131)
Δ Disparity			-0.0314		-0.0711***
			-0.0081		(0.0123)
Retinal Exam					
Non PCMH	0.304***	0.240***	0.0645***	0.333***	-0.029
	(0.00285)	(0.00371)	(0.00466)	(0.00625)	(0.00675)
PCMH	0.281***	0.224***	0.0570***	0.239***	0.0417***
	(0.0132)	(0.0108)	(0.00835)	(0.0157)	(0.0136)
Δ Disparity			-0.00748		0.0707***
			(0.00716)		(0.0125)
Attention for Nephropathy					
Non PCMH	0.259***	0.253***	0.00649	0.340***	-0.0814
	(0.00295)	(0.00435)	(0.00528)	(0.00657)	(0.00706)
PCMH	0.378***	0.380***	-0.00143	0.426***	-0.0481
	(0.0153)	(0.0154)	(0.00970)	(0.0203)	(0.0147)
Δ Disparity			-0.00791		0.0332***
			(0.00784)		(0.0127)

Bootstrapped Standard Errors in Parentheses
*** p<0.01, ** p<0.05, * p<0.1

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CHAPTER 3: THE EFFECT OF LEVEL OF NCQA PATIENT-CENTERED MEDICAL HOME RECOGNITION ON RACIAL/ETHNIC DISPARITIES IN QUALITY OF CARE

Overview

Objective: Determine whether level of NCQA PCMH recognition is associated with improvements in overall quality of care and the reduction of racial/ethnic disparities in quality among patients with major depressive disorder (MDD) and comorbid chronic physical conditions.

Data sources: Medicaid claims from 2008-2011 on beneficiaries age 18-64 years with MDD and at least one other chronic condition in Georgia, North Carolina, and Texas.

Study design: We used generalized linear models to determine the probability of receiving eight disease-specific quality measures for MDD and diabetes. To measure disparities between racial groups (white, Black, and Hispanic/Latino), we used a rank-and-replace method based on the Institute of Medicine definition of racial disparities that adjusts for health status and allows for mediation of socioeconomic factors.

Data Collection: Medicaid claims merged with provider- and area-level data.

Principal findings: We found that higher levels of NCQA recognition were associated with a reduction in the likelihood of receiving two quality measures. There was no statistically significant association between level of NCQA recognition and the remaining six measures. The effect of higher levels of NCQA recognition on racial/ethnic disparities on quality was mixed.

Conclusions: We found no evidence that higher level of NCQA recognition was associated with overall quality improvement for patients with MDD and comorbid chronic physical conditions. The effect of higher levels of NCQA recognition is inconsistent across racial groups, and sometimes, but not always associated with reductions in disparities.

Background

The patient-centered medical home (PCMH) model aims to improve outcomes, safety, system efficiency, and patient and provider experiences by reorganizing primary care into a team-based model that offers enhanced care coordination and disease management.[1–3] A growing body of evidence suggests that the PCMH is effective for chronic care and that PCMH transformation is associated with improved quality outcomes,[4] especially for patients who require long-term management for chronic conditions, including behavioral health.[5] For example, a 2012 study of PCMHs recognized by the National Committee on Quality Assurance (NCQA) found that PCMH enrollees were more likely than non-PCMH patients to receive A1c testing (82.11% vs. 77.7%), receive LDL screening (75.9% vs. 73.5%), and achieve LDL control (64.7% vs. 57.3%).[6]

While the rationale for PCMH transformation is well-documented,[2,7,8] patient populations may not benefit equally from this model, and the impact of the PCMH model on racial/ethnic disparities in quality has not been widely evaluated.[2,9,10] Studies examining the effect of the PCMH on racial/ethnic disparities report mixed results.[11] While some have found that the PCMH reduces or eliminates racial disparities in preventive care, cholesterol testing, and cancer screenings,[12] others found an exacerbation of disparities in quality.[13–17] Given that minorities with behavioral health concerns are more likely to seek mental health services in primary care than from mental health specialists,[18–21] it is important to assess

whether the PCMH has the potential to reduce disparities in quality of care among patients with MDD and chronic disease.

One challenge to understanding the effect of PCMH on these patients is that its definition is inconsistent.[11] Multiple organizations certify PCMH status, but the most the widely-used is the NCQA PCMH recognition program.[22] Developed in 2008, NCQA offers three levels of recognition based on the number of PCMH elements adopted by a practice.[4] However, there is still considerable heterogeneity across PCMHs with the same level of NCQA recognition. This variability exists because the NCQA uses a flexible set of criteria to determine which recognition level a practice receives.[23] Under the 2008 recognition criteria, there were nine standards and 100 possible points. Level 1 practices were required to achieve at least 25 points, level 2 recognition required 50 points, and level 3 recognition was awarded to practices that received 75 or more points. Yet even among PCMHs with the highest level of recognition, there are variations in the implementation of key medical home capabilities such as providing team-based care, providing referrals to community resources, and coordinating transitions of care.[25]

Many existing Medicaid PCMH initiatives utilize incentive structures that base payments on NCQA recognition; over 50 payers offer enhanced reimbursement for NCQA-recognized practices.[26] Moreover, many PCMH demonstrations and initiatives utilize incentive structures that tie reimbursement to level of NCQA recognition.[22,26] However, there is little evidence about how well quality outcomes correlate to NCQA level,[22] and no evidence regarding the effect that NCQA PCMH recognition level has on racial/ethnic disparities in quality of care. We sought to determine whether level of NCQA PCMH recognition is associated with improvements in overall quality of care and the reduction of

racial/ethnic disparities for patients with MDD and comorbid physical conditions. We hypothesized that PCMHs with higher levels of NCQA accreditation would provide higher rates of guideline-concordant care overall and see greater reductions in racial/ethnic disparities compared to providers with lower recognition levels.

Setting

We used Medicaid claims from NCQA-recognized PCMHs during 2008-2011 in North Carolina, Georgia, and Texas. The NCQA's PCMH recognition program was implemented in 2008; therefore, our study reflects the early stages of the program. During the study period, North Carolina was the only state in our sample with a state-developed medical home program.[27] The state's Medicaid PCMH program, Community Care of North Carolina (CCNC), began in 1998 as a primary care case management demonstration.[28] While CCNC does not require participating providers to attain NCQA recognition, it offers resources and support for practices seeking recognition. During the study period, medical home initiatives in Georgia and Texas were largely supported by private partnerships.[29,30]

Data

We used a novel dataset constructed from several administrative data sources, including the Medicaid Analytic eXtract (MAX), the National Plan and Provider Enumeration System (NPPES), NCQA PCMH recognition data, the Area Health Resource File, and the U.S. Census Bureau's Small Area Income and Poverty Estimates. The Medicaid MAX data files contain enrollment information and final claims for all enrolled Medicaid beneficiaries. We merged 2008-2011 MAX claims data from North Carolina, Georgia and Texas with NPPES data, which contains National Provider Identifiers (NPIs) and providers' sex, provider type, state, and Medicaid billing identifiers. These data were merged with NCQA PCMH recognition data, which includes date, duration, and level of NCQA PCMH

recognition. Finally, county supply of mental health professionals was measured using data from the Area Health Resource File[31] and county-level socioeconomic measures were derived from the U.S. Census Bureau's Small Area Income and Poverty Estimates.[32]

In addition to person-year outcomes, we also constructed an episode-level variable for minimally adequate antidepressant use because the guidelines for antidepressant use are based on episodes of treatment.[41] For the episode-level measure, we focused on the acute phase guidelines because it is typically period of most intensive treatment.[42] An acute episode was initiated by an outpatient service with a diagnosis of MDD or by initiation of antidepressant prescriptions, and we required two or more visits on different days and a period of at least three months without any new MDD claims before the initiation of a new episode. An episode was considered to have ended after either 120 days after the start of the episode or after 90 days of no MDD services or antidepressants. We adjusted for inpatient stays during these episodes by assuming beneficiaries received dispensed medication during an inpatient episode and resumed outpatient medications after discharge.

Key Measures

Dependent variables included four disease-specific quality indicators derived from Medicaid claims for MDD and an additional four measures for the subgroup with both MDD and diabetes (see Table 8 for full definitions). We conducted additional analyses in a subgroup of individuals with MDD and comorbid diabetes (Type I or Type II) because diabetes is a condition that is highly prevalent in Medicaid populations[36,37] and because evidence indicates that comorbid MDD interferes with diabetes management.[38] We selected quality measures based on recommended core quality measures for the PCMH,[43] the Centers for Medicare and Medicaid Services (CMS) 2016 core set of adult quality measures for

Medicaid,[44] and the 2011 version of the Healthcare Effectiveness Data and Information Set (HEDIS).

Clinical guidelines for the treatment of MDD specify that treatment modality (i.e. use of antidepressants, psychotherapy, or both) should be based on clinical circumstances such as severity and complex psychosocial situations.[45] Because this information is not available in administrative data, in person-year analyses we measured whether beneficiaries received any antidepressant prescriptions, at least one psychotherapy visit, or either. Either treatment modality would be considered guideline-concordant, therefore the receipt of any of these treatments are a minimum standard of quality.[42,46] In episodic analyses, we assessed the HEDIS antidepressant management measure for effective acute phase treatment, defined as the likelihood that beneficiaries received at least 84 days of antidepressants during an acute episode.[41] Finally, for the subgroup of beneficiaries with diabetes we measured the likelihood of receipt of A1c testing, lipids profiles, retinal exams, and attention for nephropathy using annual data.

The exposure of interest was the level of NCQA-recognized PCMH to which a beneficiary was attributed. A provider's NCQA PCMH status was determined annually using NCQA recognition data. If a provider changed levels in a calendar year, they were assigned the highest level of recognition during that year. We created a binary indicator of annual enrollment in an NCQA-certified PCMH using the CMS "plurality rule" commonly used for attributing beneficiaries to Accountable Care Organizations.[47] A beneficiary's primary care provider was defined as the provider that delivered the plurality of their non-hospital evaluation and management (NH-E&M) servies.[48] In the event that a beneficiary received the

same number of services from two providers, they were attributed to the most recent provider.[48]

Because this study is focused on a population with MDD, we modified the plurality rule to assign patients to the primary care providers that delivered most of their MDD care. We attributed beneficiaries to the primary care provider where they received the plurality of NH E&M claims with a primary diagnosis of MDD. If a beneficiary did not see a primary care provider for a MDD-related NH E&M claim in a year, they were then attributed to the primary care provider where they received the plurality of general NH E&M services.

We derived beneficiary covariates from Medicaid claims, including age, sex, number of comorbidities (using the Agency for Healthcare Research and Quality's Chronic Condition Indicator software[49]), number of Medicaid-enrolled months during the relevant time period (annual or episode), and rurality (urban, rural, or mixed indicators using simplified county-level Rural-Urban Continuum Codes[50]). We derived beneficiary race data (white, Black, or Hispanic/Latino) from Medicaid claims; the remaining race categories were not sufficient for separate analysis, but these beneficiaries were included in the models for accuracy. For MDD and diabetes, we required that beneficiaries have at least one inpatient diagnosis or at least two outpatient or emergency department diagnoses during a single year in the study period, and at least one claim for the condition in each year to avoid "rule-out" diagnoses and/or errors in coding. PCMH-level covariates were derived from NPPES and NCQA recognition data and included Federally Qualified Health Center or Rural Health Center status, provider sex, and level of NCQA attribution. County-level socioeconomic characteristics were measured using percent of the population under poverty and median income. County-level supply of mental health professionals were included to control for the availability of

providers, which may be correlated with PCMH measures, and was measured using county supply of psychiatrists and Mental Health Professional Shortage Area (HPSA) status.

The Institute of Medicine (IOM) defines a racial disparity in health care as "racial or ethnic differences in the quality of health care that are not due to access-related factors or clinical needs, preferences, and appropriateness of intervention.''[51] Under this definition, measuring a disparity requires distinguishing differences driven by underlying health status or preference from those that are driven by healthcare systems factors or discrimination.[51,52] Unlike predictive margins, which estimate residual direct effect, or the unmediated effect of race/ethnicity after adjusting for all measured covariates, this definition accounts for the effects of mediating factors (other than health status and preferences), such as variables associated with geography or socioeconomic status.[51,53] We estimated racial disparities using the following IOM-compliant process: 1) fit a model describing relationships between quality/utilization and health status, race, and other characteristics using non-Hispanic whites as a reference group 2) transform the distributions of health status variables (age, gender, and number of comorbidities) for minority groups to be the same as those of non-Hispanic whites using a rank and replace method while leaving other variables unchanged 3) calculate predictions using the coefficients from the initial models and the transformed health status distributions for minority groups, and 4) aggregate these predictions by racial group to estimate disparities.[52] We generated standard errors for these aggregated predictions using 500 bootstrap iterations.

Statistical Analysis

The study population included non-elderly adult Medicaid beneficiaries with major depressive disorder (MDD) and at least one other physical chronic condition who are not dually enrolled in Medicare. We selected this population because adults with MDD and other

comorbid chronic conditions typically receive lower quality care[33,34] and because Medicaid beneficiaries have disproportionately high rates of comorbid behavioral and physical health conditions.[35] The sample was restricted to individuals contributing at least partial years of Medicaid enrollment during the study period (2008-2011). Individuals with schizophrenia or bipolar disorder were excluded because specialty providers are more likely to serve as the primary point of contact with the healthcare system for this population.[40] The sample was limited to years in which beneficiaries received care from a provider that achieved PCMH recognition at any point during the study period, including years prior to recognition.

Because receipt of care in a PCMH is non-random, PCMH status may be endogenous. To determine whether bias due to differential selection into varying levels of NCQA-recognized PCMHs was a concern, we ran a two-stage residual inclusion (2SRI) model where the first stage was an ordered logit on recognition levels 1-3. The second stage included two predicted residuals from the first stage equation; one residual was excluded because of collinearity. Equation 1 shows the second stage model, which includes the predicted residuals for levels 1 and 3:

Equation 1: $Y_{it} = \beta_0 + \beta_1 * PCMH\_enrollment_{it} + \beta_2 * X_{ipct} + \beta_3 * predicted\_residuals + \varepsilon_{ipct}$

where Y represents a set of dependent variables, defined as the receipt of each quality indicator. We found no evidence of selection bias; a Hausman test determined that the results were not significantly different with and without this instrumental variable approach.

Therefore, we assessed the effect of level of NCQA PCMH recognition on the likelihood of receiving each quality measure using generalized linear models (GLM) with a binomial family and logit link. The referent group for the overall quality models was practices that had not yet achieved NCQA recognition. For disparities models, the referent

group was practices with level 1 NCQA recognition. During the model selection process, we also assessed generalized estimating equations (GEE) with three different correlation structures to account for clustering across repeated observations: independent, exchangeable, and unstructured. The quasi-likelihood under the independence model criterion (QIC) indicated that the independent correlation structure was the best fit for the data. This is likely because 79% of beneficiaries contributed only one year of data. Beneficiaries attributed to years prior to a provider achieving recognition were included as the referent group (pre-recognition years). We included state and year fixed effects to account for time-invariant confounders due to geographic differences and time trends. In addition, we conducted sensitivity analyses including practice-level fixed effects. The results of these models were almost identical to the primary analyses in magnitude, direction, and significance. We used the likelihood ratio test to assess the functional form of covariates, including quadratic forms of age and median income and interactions between race, median income, and percent under poverty. The results indicated that age should be included as a quadratic, but other higher-order and interaction terms did not improve model fit. The equation for the GLM was:

$$\textit{Equation 2: } Y_{it} = \beta_0 + \beta_1 * NCQA\_level_{pt} + \beta_2 * X_{ipct} + \mu_{pt} + \mu_s + \varepsilon_{ipct}$$

where *NCQA_ level* represents level of NCQA PCMH accreditation, i, p, and c represent individual, provider, and county level variables and t is the time-period (year). Finally, μ_s and μ_{pt} represent fixed effects at the state and year level. Marginal effects for the overall estimates were obtained using predictive margins and Delta method standard errors. In the disparities models, predicted probabilities were obtained using the methods described above and standard errors were obtained via bootstrapping (500 replicates). Bootstrap replicates were clustered at the beneficiary level to account for repeated observations over

time. All analyses were performed using Stata (Version 13). We also conducted sensitivity analyses using a different definition of PCMH attribution; in these analyses PCMH enrollment was defined as any claim with an NCQA-recognized PCMH provider during a year. We retained observations from patients attributed to an NCQA-recognized PCMH practice both prior to recognition as well as during recognition periods, to estimate the effect that recognition level had on quality outcomes.

Results

The final sample (Table 9) consisted of 9,169 person-years contributed by 7,343 unique beneficiaries, and a total of 262 NCQA-PCMH recognized providers. The sample included data on pre-recognition years for 228 providers. The majority (40.2%) of beneficiary-years were attributed to a level 3 NCQA PCMH. 8.3% of beneficiary-years were attributed to level 1 PCMHs and 4.6% were attributed to a level 2 PCMH. The remaining beneficiary-years were attributed to pre-recognition practices. The average beneficiary age was 40. The overall sample was 53.3% white, 35.3% Black, and 8.1% Hispanic/Latino.

In unadjusted comparisons (Table 10), bivariate tests of differences in service use were all statistically significant. Level 3 enrollees had the highest rates of any annual antidepressant use (73.0%), episodic antidepressant use (32.7%), and A1c testing (79.9%). Because of higher rates of antidepressant use, level 3 enrollees also had the highest rates of receipt of either psychotherapy or antidepressants (84.0%). Level 2 enrollees had the highest rates of receipt of psychotherapy (38.7%). Level 1 enrollees had the highest rates of attention for nephropathy (47.5%). Finally, beneficiaries in pre-recognition years had the highest rates of retinal exams (36.4%) and lipids panels (69.7%).

Overall Quality

We found that compared to the pre-recognition period, PCMH enrollees in level 1 medical homes saw a 5.90 percentage point decrease in the likelihood of any yearly antidepressant use ($p<0.01$) and level 2 enrollees saw a decrease of 7.34 percentage points ($p<0.01$) (Table 11). There was no statistically significant association between level 3 enrollment and annual receipt of antidepressants. Level 2 enrollees also had a 16.5 percentage point decrease in receipt of lipids panels ($p<0.01$), but there was no statistically significant association for enrollees in levels 1 or 3. We found no statistically significant association between level of PCMH enrollment and yearly receipt of psychotherapy. In episodic analyses, we also found no statistically significant association between NCQA recognition level and minimally adequate antidepressant use. Finally, in diabetes models, (Table 12), we found no statistically significant association between level of NCQA recognition and A1c testing, retinal exams, or attention for nephropathy.

In fully-adjusted models that control for socioeconomic and geographic factors, Black enrollees overall were 7.80 percentage points more likely to receive psychotherapy than their white counterparts ($p<0.01$). Black enrollees were also less likely to receive annual antidepressants (-13.6 percentage points, $p<0.01$), minimally adequate antidepressants (-15.4 percentage points, $p<0.01$), either psychotherapy or antidepressants (-5.18 percentage points, $p<0.01$), lipids panels (4.67 percentage points, $p<0.01$). Hispanic/Latino enrollees were 6.82 percentage points more likely to receive yearly psychotherapy ($p<0.01$) and 4.35 percentage points less likely to receive to receive yearly antidepressants ($p<0.05$).

In sensitivity analyses defining PCMH enrollment as any claims with an NCQA recognized provider during a given year, the results were consistent with the primary

analyses in direction and magnitude. However, we found no statistically significant associations between level of NCQA recognition and the eight quality measures assessed.

Racial Disparities

We found that both Black and Hispanic/Latino enrollees had higher rates of receipt of annual psychotherapy than whites, and these disparities persisted in all three levels of NCQA recognition (Table 13). In annual antidepressant use, we found statistically significant disparities for both Black and Hispanic/Latino beneficiaries in all three levels of recognition. Compared to their counterparts enrolled in a level 1 PCMH, Black enrollees in level 3 saw a 4.20 percentage point reduction in disparities ($p<0.05$). Disparities in this measure were also reduced by 27.5 percentage points for Hispanic/Latino beneficiaries enrolled in level 3, as compared to their counterparts in level 1 and by 19.3 percentage points relative to enrollees in level 2. In receipt of either annual MDD measure, Black beneficiaries enrolled in a level 2 or 3 PCMH saw a statistically significant decrease over Black beneficiaries enrolled in level 1. Finally, while Hispanic/Latino beneficiaries in level 3 PCMHs saw a 5.83 percentage point reduction in disparities for minimally adequate episodic antidepressant use versus level 1 ($p<0.05$) and a 5.18 percentage point reduction versus level 2 ($p<0.1$), Black beneficiaries in a level 3 PCMH saw a 4.02 percentage point exacerbation in disparities for this measure ($p<0.05$).

For diabetes (Table 14), we found statistically significant Black-white and Hispanic-white disparities in receipt of lipids panels at all three NCQA PCMH levels. Although both groups improved in level 3, these disparities were exacerbated for Black beneficiaries in a level 3 PCMH; we found a Black-white disparity in receipt of lipids panels of -25.9 percentage points among level 3 enrollees, compared to -16.4 percentage points among enrollees in level 2 and 15.0 percentage points among level 1 enrollees ($p's<0.01$). There was

no statistically significant reduction in Hispanic-white disparities for receipt of lipids panels. A statistically significant Black-white disparity existed in the level 3 group for receipt of A1c testing, but not for the level 1 or level 2 groups, suggesting that disparities were exacerbated among level 3 enrollees, even though both Black and white beneficiaries saw higher predicted probabilities for A1c in level 3 than in levels 1 and 2. We saw a similar pattern in Hispanic-white disparities in retinal exams and attention for nephropathy. For retinal exams there was a Hispanic-white disparity of 6.84 percentage points among level 3 enrollees but no statistically significant disparity among level 1 or 2 enrollees. For attention for nephropathy, the Hispanic-white disparity among level 3 enrollees was 7.28 percentage points ($p<0.1$), and there were no statistically significant disparities among enrollees in levels 1 or 2. We saw no statistically significant Black-white disparities in any PCMH level for either of these measures.

Discussion

Contrary to our hypothesis, we did not find any statistically significant improvements in overall quality among Medicaid beneficiaries with higher levels of NCQA PCMH recognition. In fact, we found that enrollees in levels 2 and 3 were less likely to receive any annual antidepressants and lipids panels, compared to beneficiaries enrolled in practices that have not yet received recognition.

In IOM-compliant disparities analyses, we found statistically significant disparities between racial groups for several measures. We found that while both Black and white enrollees in a level 3 PCMH saw an increase in A1c testing compared to levels 1 and 2, white enrollees saw a larger improvement, exacerbating disparities between these groups. Conversely, disparities analyses suggest that higher levels of NCQA recognition are associated with reductions in Black-white and Hispanic-white disparities in yearly receipt of

antidepressants. Notably, our analyses focus on Medicaid beneficiaries and therefore these results are not driven by insurance status. While prior research has shown that racial disparities in care are often driven in large part by differential access to insurance coverage,[54] our results suggest that disparities in some quality measures persist even among individuals with comparable insurance coverage.

In the fully-adjusted models, null results may be because the comparison was composed of group practices that had not yet attained NCQA recognition, and these practices may already have been high-performers. Therefore, achieving NCQA recognition did not improve outcomes. The overall lack of association between level of NCQA recognition and quality outcomes may also be due to heterogeneity of practice characteristics, even within the same level of recognition. A 2014 study found that even among practices with the same level of certification, different types of practices demonstrated strengths in different PCMH capabilities. For example, among practices with NCQA PCMH recognition, community health centers were significantly more likely to have scored full credit for after-hours access while more large physician-owned practices received full credit for having structured data on patient demographics and clinical data.[25] Similarly, prior work has shown that affiliation larger practices health systems provided PCMHs with more support for implementing the core activities of the medical home, including population management, care coordination, and quality measurement/improvement.[4] Finally, "intangible" or difficult-to-measure contextual factors such as engaged leadership are important indicators of high-performing primary care practices, but these factors are not easily reflected in the NCQA recognition criteria.[55,56]

Limitations

This study has several limitations. First, PCMH recognition level may be achieved through different combinations of activities, and there is likely great heterogeneity of available services or practice characteristics within recognition levels. However, these recognition categories are relevant in a "real-world" setting that incentivize NCQA-recognition levels. Second, the measures used in this study are utilization-based quality indicators; other practice-based measures of quality may show different results. Third, because individual-level socioeconomic data are not available in Medicaid claims, we used county-level measures of socioeconomic status. Previous studies have shown that using area-based socioeconomic measures is a reasonable method to address the absence of socioeconomic data in claims.[57] Third, we only have claims data for services paid by Medicaid. This should not cause bias as this underreporting would not differentially affect enrollees in different levels of NCQA PCMH. Fourth, although NCQA is the most prevalent PCMH recognition program,[22] our results may not be generalizable to PCMHs recognized by accrediting body. Finally, measures of patient perspective or experience of care are not available in administrative claims data.

Conclusions

Our findings show that higher levels of NCQA recognition are not directly associated with improvements in quality outcomes. However, the effects of PCMH recognition vary across racial groups. Enrollment in a higher level of NCQA is sometimes, but not always associated with a reduction in racial/ethnic disparities in quality of care, and for some metrics disparities were exacerbated for beneficiaries enrolled in a PCMH with the highest level of NCQA recognition. This suggests that while incentivizing practices to attain higher levels of NCQA recognition has potential to reduce disparities, higher levels of NCQA recognition

alone may not be sufficient to reduce racial inequities in quality of care. Providers or policymakers should consider racial/ethnic disparities explicitly when designing, implementing, and evaluating PCMH programs.

Table 8: *Disease-Specific Dependent Variables*

Variable	Definition	Calendar-Year	Acute Episode
MDD			
Antidepressant use	Percent of patients with MDD who received any antidepressant prescriptions.	X	
	At least 84 days of antidepressants during a 120-day episode.		X
Psychotherapy	Percent of patients with MDD receiving any group/individual psychotherapy	X	
Any MDD treatment	Receipt of any antidepressant prescriptions or group/individual psychotherapy	X	
Diabetes			
A1C Testing	Percent of diabetic patients receiving A1C testing	X	
LDL-C Testing	Percent of diabetic patients receiving an LDL–C test	X	
Retinal exam	Percent of diabetic patients receiving a retinal exam	X	
Nephropathy screening	Percent of diabetic patients screened for nephropathy	X	

Table 9: *Summary Statistics (Person-Years)*

Factor	N(%) or Mean(SD)				
	Total	**Pre-Recognition**	**Level 1**	**Level 2**	**Level 3**
N	9,169	4,303 (46.9%)	762 (8.3%)	421 (4.6%)	3683 (40.2%)
Female Beneficiary	7,299 (79.6%)	3,370 (78.3%)	587 (77.0%)	308 (73.2%)	3034 (82.4%)
Beneficiary Age	40.73 (13.42)	41.39 (13.47)	43.37 (13.18)	43.54 (13.05)	39.10 (13.25)
Race					
White	4,888 (53.3%)	2,380 (55.3%)	365 (47.9%)	159 (37.8%)	1,984 (53.9%)
Black	3,241 (35.3%)	1,338 (31.1%)	280 (36.7%)	225 (53.4%)	1,398 (38.0%)
Hispanic/Latino	534 (5.8%)	348 (8.1%)	43 (5.6%)	22 (5.2%)	121 (3.3%)
Months of Medicaid Enrollment	10.72 (2.41)	10.63 (2.51)	10.73 (2.41)	10.74 (2.53)	10.82 (2.27)
# Chronic Conditions	5.35 (4.20)	5.38 (4.13)	5.85 (4.78)	4.96 (3.76)	5.25 (4.17)
Female Provider	3,515 (38.3%)	1,469 (34.1%)	272 (35.7%)	162 (38.5%)	1,612 (43.8%)
FQHC	283 (3.1%)	116 (2.7%)	73 (9.6%)	0 (0.0%)	94 (2.6%)
RHC	95 (1.0%)	23 (0.5%)	0 (0.0%)	0 (0.0%)	72 (2.0%)
County % Under Poverty	17.67 (3.64)	17.11 (3.57)	19.05 (4.13)	17.71 (1.49)	18.03 (3.67)
County Median Income	45,223.93 (6752.08)	45,204.65 (6925.6125)	44,800.913 (7345.1623)	44,846.964 (2856.3185)	45,377.036 (6732.24)
Rural					
Metropolitan	8196 (89.4%)	3785 (88.1%)	670 (87.9%)	414 (98.3%)	3327 (90.3%)
Metro-Adjacent	819 (8.9%)	435 (10.1%)	59 (7.7%)	7 (1.7%)	318 (8.6%)
Rural	148 (1.6%)	77 (1.8%)	33 (4.3%)	0 (0.0%)	38 (1.0%)
HPSA					
Full	1601 (17.5%)	1047 (24.4%)	300 (39.4%)	41 (9.7%)	213 (5.8%)
Partial	4767 (52.0%)	2208 (51.4%)	270 (35.4%)	11 (2.6%)	2278 (61.9%)
State					
GA	530 (5.8%)	233 (5.4%)	141 (18.5%)	0 (0.0%)	156 (4.2%)
NC	7245 (79.0%)	3042 (70.7%)	427 (56.0%)	382 (90.7%)	3394 (92.2%)
TX	1394 (15.2%)	1028 (23.9%)	194 (25.5%)	39 (9.3%)	133 (3.6%)
Year					
2008	777 (8.5%)	777 (18.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
2009	1,711 (18.7%)	1,621 (37.7%)	66 (8.7%)	11 (2.6%)	13 (0.4%)
2010	3,552 (38.7%)	1,905 (44.3%)	344 (45.1%)	191 (45.4%)	1,112 (30.2%)
2011	3,129 (34.1%)	0 (0.0%)	352 (46.2%)	219 (52.0%)	2,558 (69.5%)

Table 10: *Unadjusted Rates of Quality Metrics*

	Pre-Recognition	Level 1	Level 2	Level 3	P value (χ^2)
MDD					
Calendar Year					
Any psychotherapy	1,390 (32.3%)	270 (35.4%)	163 (38.7%)	1,313 (35.7%)	0.002
Any antidepressants	3,001 (69.7%)	456 (59.8%)	264 (62.7%)	2,687 (73.0%)	<0.001
Any MDD treatment	3,407 (79.2%)	553 (72.6%)	326 (77.4%)	3,092 (84.0%)	<0.001
N	*4,303*	762	*421*	3,683	
Acute Episode					
Min. antidepressants	886 (27.4%)	138 (24.2%)	78 (26.0%)	876 (32.7%)	<0.001
N	*3,236*	*571*	*300*	2,675	
Diabetes					
A1c testing	927 (79.2%)	169 (69.0%)	76 (69.1%)	673 (79.9%)	<0.001
Retinal exam	426 (36.4%)	70 (28.6%)	37 (33.6%)	239 (28.4%)	<0.001
Lipids panel	815 (69.7%)	135 (55.3%)	55 (50.0%)	561 (66.6%)	<0.001
Attn for nephropathy	491 (42.0%)	116 (47.5%)	31 (28.2%)	342 (40.6%)	0.007
N	*1,170*	*245*	*110*	*842*	

Table 11: *Average Marginal Effects of NCQA PCMH on MDD Outcomes*

	Any Psychotherapy	Any Antidepressants	Any MDD Treatment	Adequate Antidepressants
NCQA Level 1	0.0301	-0.0590***	-0.0224	-0.0350
	(0.0234)	(0.0209)	(0.0170)	(0.0234)
NCQA Level 2	0.0409	-0.0734***	-0.0219	-0.0407
	(0.0300)	(0.0276)	(0.0232)	(0.0293)
NCQA Level 3	-0.0190	-0.000118	0.0101	-0.00623
	(0.0176)	(0.0158)	(0.0134)	(0.0177)
Race				
Black	0.0780***	-0.136***	-0.0518***	-0.154***
	(0.0127)	(0.0116)	(0.00974)	(0.0123)
Hispanic/Latino	0.0682***	-0.0435**	0.00482	-0.0375
	(0.0255)	(0.0208)	(0.0152)	(0.0288)
# Chronic Conditions	-0.00210	0.0104***	0.00192*	0.00807***
	(0.00148)	(0.00139)	(0.00111)	(0.00153)
Rurality				
Metro-adjacent	0.0477**	0.000468	0.0221	0.0181
	(0.0219)	(0.0200)	(0.0158)	(0.0217)
Rural	0.107**	0.00398	0.0126	0.0136
	(0.0483)	(0.0433)	(0.0347)	(0.0465)
Beneficiary Age	-0.00286***	0.000324	-0.00134***	0.00190***
	(0.000452)	(0.000429)	(0.000359)	(0.000456)
Female Beneficiary	-0.0138	0.0745***	0.0399***	0.0125
	(0.0134)	(0.0123)	(0.0102)	(0.0136)
# Months Medicaid Enrollment	0.0121***	0.0177***	0.0158***	0.00877***
	(0.00229)	(0.00184)	(0.00144)	(0.00245)
FQHC	-0.0883***	0.0754***	0.0197	0.0347
	(0.0304)	(0.0279)	(0.0257)	(0.0345)
RHC	-0.245***	0.0899*	0.00283	0.0610
	(0.0385)	(0.0483)	(0.0446)	(0.0491)
Female Provider	0.00320	0.0120	0.0215**	0.0100
	(0.0114)	(0.0100)	(0.00838)	(0.0117)
County % Under Poverty	0.0169***	-0.0160***	-0.00423**	-0.0117***
	(0.00261)	(0.00232)	(0.00188)	(0.00278)
County Median Income	3.77e-06**	-7.68e-06***	-2.13e-06**	-3.32e-06**
	(1.55e-06)	(1.33e-06)	(1.06e-06)	(1.57e-06)
Count # Psychiatrists	0.000350***	0.000160**	0.000133**	-2.50e-05
	(9.99e-05)	(7.83e-05)	(5.89e-05)	(0.000110)
Mental Health HPSA				
Full	0.0244	-0.00429	-0.0119	-0.0309
	(0.0233)	(0.0203)	(0.0169)	(0.0230)
Partial	0.0336**	-0.00653	-0.000921	-0.0177
	(0.0131)	(0.0120)	(0.0103)	(0.0130)
Year				
2009	-0.0277	0.0157	0.0231	0.0932***

	Any Psychotherapy	**Any Antidepressants**	**Any MDD Treatment**	**Adequate Antidepressants**
	(0.0230)	(0.0206)	(0.0162)	(0.0243)
2010	-0.0632***	0.0414**	0.0175	0.0791***
	(0.0230)	(0.0209)	(0.0167)	(0.0238)
2011	-0.0343	0.0273	0.0134	0.141***
	(0.0282)	(0.0255)	(0.0209)	(0.0286)
State (Referent: Georgia)				
North Carolina	0.217***	0.0963***	0.130***	0.0681***
	(0.0211)	(0.0245)	(0.0230)	(0.0259)
Texas	0.0439	-0.128***	-0.0650**	-0.0705**
	(0.0281)	(0.0333)	(0.0320)	(0.0308)
Delta Method standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 12: *Average Marginal Effects of NCQA PCMH on Diabetes Outcomes*

	Lipids Panel	A1c	Retinal Exam	Attention for Nephropathy
NCQA Level 1	-0.0226	-0.0539	-0.0373	0.0576
	(0.0387)	(0.0365)	(0.0373)	(0.0419)
NCQA Level 2	-0.165***	-0.0814	0.0420	-0.0843
	(0.0552)	(0.0512)	(0.0541)	(0.0558)
NCQA Level 3	-0.0118	-0.00232	-0.0153	-0.0274
	(0.0312)	(0.0285)	(0.0301)	(0.0331)
Race				
Black	-0.0467**	0.0129	0.00671	0.00293
	(0.0219)	(0.0198)	(0.0221)	(0.0238)
Hispanic/Latino	-0.0330	0.0412	0.0505	-0.0383
	(0.0394)	(0.0327)	(0.0400)	(0.0411)
# Chronic Conditions	0.00508**	0.00748***	0.0159***	0.00793***
	(0.00213)	(0.00199)	(0.00195)	(0.00219)
Rurality				
Metro-adjacent	0.0731**	0.0517*	0.0573	0.0508
	(0.0351)	(0.0305)	(0.0394)	(0.0412)
Rural	0.00676	-0.0181	-0.153**	0.0273
	(0.0810)	(0.0773)	(0.0630)	(0.0881)
Beneficiary Age	-0.000758	-0.00147	-0.000270	-0.00311***
	(0.00111)	(0.00101)	(0.00110)	(0.00114)
Female Beneficiary	0.000340	-0.0207	0.0321	-0.0416*
	(0.0225)	(0.0197)	(0.0223)	(0.0243)
# Months Medicaid Enrollment	0.0313***	0.0200***	0.0129***	0.0182***
	(0.00387)	(0.00332)	(0.00465)	(0.00482)
FQHC	-0.114*	-0.0275	-0.0585	0.00815
	(0.0624)	(0.0561)	(0.0574)	(0.0645)
RHC	-0.0180	-0.0235	0.158	-0.136
	(0.106)	(0.101)	(0.113)	(0.0986)
Female Provider	0.000131	0.0359**	0.0174	0.0672***
	(0.0202)	(0.0178)	(0.0204)	(0.0219)
County % Under Poverty	0.00665	-0.00279	0.00731*	-0.00985**
	(0.00446)	(0.00393)	(0.00437)	(0.00474)
County Median Income	3.68e-06	-1.45e-06	1.40e-06	-3.07e-06
	(2.70e-06)	(2.39e-06)	(2.72e-06)	(2.89e-06)
County # Psychiatrists	1.84e-06	-7.80e-05	-0.000163	-0.000216
	(0.000158)	(0.000137)	(0.000151)	(0.000166)
Mental Health HPSA				

	Lipids Panel	A1c	Retinal Exam	Attention for Nephropathy
Full	-0.0501	0.000494	-0.0289	0.0774*
	(0.0409)	(0.0366)	(0.0393)	(0.0424)
Partial	-0.00887	0.0270	-0.0105	0.0943***
	(0.0240)	(0.0222)	(0.0247)	(0.0256)
Year				
2009	0.0174	0.0505	0.0235	0.0258
	(0.0366)	(0.0350)	(0.0375)	(0.0389)
2010	0.00232	0.0827**	0.0859**	0.0711*
	(0.0370)	(0.0363)	(0.0372)	(0.0386)
2011	-0.0769	0.0210	-0.0773*	0.0644
	(0.0475)	(0.0465)	(0.0438)	(0.0489)
State (Referent: Georgia)				
North Carolina	0.356***	0.152***	0.0160	0.00993
	(0.0404)	(0.0424)	(0.0382)	(0.0421)
Texas	0.371***	0.153***	0.115**	0.0886*
	(0.0502)	(0.0497)	(0.0497)	(0.0530)

Delta Method standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 13: *Comparison of Predicted Probabilities and Disparities Changes for MDD Outcomes*

	White	Black	Disparity	Hispanic/Latino	Disparity
Psychotherapy					
Level 1	0.346***	0.493***	-0.146***	0.514***	-0.168***
	(0.0209)	(0.0261)	(0.0206)	(0.0452)	(0.0422)
Level 2	0.383***	0.537***	-0.154***	0.511***	-0.128***
	(0.0291)	(0.0322)	(0.0251)	(0.0455)	(0.0400)
Level 3	0.337***	0.497***	-0.160***	0.453***	-0.116***
	(0.0100)	(0.0154)	(0.0169)	(0.0289)	(0.0290)
Δ Disparity					
2 vs 1			-0.00783		0.0405
			(0.0188)		(0.0354)
3 vs 1			-0.0131		0.0522
			(0.0146)		(0.0382)
3 vs 2			-0.00531		0.0116
			(0.0158)		(0.0334)
Any Antidepressants					
Level 1	0.728***	0.452***	0.275***	0.332***	0.396***
	(0.0199)	(0.0235)	(0.0206)	(0.0489)	(0.0494)
Level 2	0.754***	0.490***	0.264***	0.441***	0.313***
	(0.0235)	(0.0314)	(0.0247)	(0.0667)	(0.0656)
Level 3	0.820***	0.587***	0.233***	0.700***	0.121***
	(0.00782)	(0.0147)	(0.0144)	(0.0275)	(0.0270)
Δ Disparity					
2 vs 1			-0.0108		0.0822
			(0.0249)		(0.0728)
3 vs 1			-0.0420**		0.275***
			(0.0181)		(0.0468)
3 vs 2			0.0313		0.193***
			(0.0198)		(0.0610)
Either					
Level 1	0.812***	0.714***	0.0973***	0.686***	0.125***
	(0.0178)	(0.0244)	(0.0216)	(0.0472)	(0.0461)
Level 2	0.856***	0.800***	0.0564**	0.740***	0.116**
	(0.0189)	(0.0283)	(0.0220)	(0.0503)	(0.0479)
Level 3	0.891***	0.839***	0.0519***	0.874***	0.0174
	(0.00632)	(0.0122)	(0.0120)	(0.0175)	(0.0172)
Δ Disparity					
2 vs 1			-0.0410**		-0.00960
			(0.0179)		(0.0446)
3 vs 1			-0.0454***		-0.108***
			(0.0149)		(0.0402)
3 vs 2			-0.00442		-0.0984**
			(0.0143)		(0.0434)
Adequate Antidepressants					
Level 1	0.309***	0.112***	0.197***	0.113***	0.195***
	(0.0238)	(0.0127)	(0.0173)	(0.0198)	(0.0234)
Level 2	0.344***	0.165***	0.180***	0.155***	0.189***
	(0.0332)	(0.0204)	(0.0212)	(0.0331)	(0.0342)

	White	Black	Disparity	Hispanic/Latino	Disparity
Level 3	0.397***	0.178***	0.220***	0.260***	0.137***
	(0.0120)	(0.00989)	(0.0132)	(0.0307)	(0.0300)
Δ Disparity					
2 vs 1			-0.0170		-0.00642
			(0.0230)		(0.0321)
3 vs 1			0.0232		-0.0583**
			(0.0168)		(0.0250)
3 vs 2			0.0402**		-0.0518*
			(0.0176)		(0.0288)

Bootstrapped Standard Errors in Parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14: *Comparison of Predicted Probabilities and Disparities Changes for Diabetes Outcomes*

	White	Black	Disparity	Hispanic/ Latino	Disparity
Lipids					
Level 1	0.544***	0.394***	0.150***	0.284***	0.260***
	(0.0396)	(0.0488)	(0.0505)	(0.0794)	(0.0796)
Level 2	0.502***	0.338***	0.164***	0.273*	0.229*
	(0.0611)	(0.0492)	(0.0533)	(0.140)	(0.137)
Level 3	0.699***	0.440***	0.259***	0.553***	0.146**
	(0.0221)	(0.0409)	(0.0434)	(0.0568)	(0.0573)
Δ Disparity					
2 vs 1			0.0141		-0.0306
			(0.0588)		(0.140)
3 vs 1			0.109**		-0.113
			(0.0455)		(0.0720)
3 vs 2			0.0951**		-0.0826
			(0.0480)		(0.139)
A1c					
Level 1	0.661***	0.580***	0.0808	0.533***	0.128
	(0.0393)	(0.0699)	(0.0655)	(0.122)	(0.118)
Level 2	0.644***	0.582***	0.0625	0.515***	0.129
	(0.0540)	(0.0819)	(0.0735)	(0.154)	(0.144)
Level 3	0.799***	0.672***	0.127*	0.754***	0.0450
	(0.0188)	(0.0665)	(0.0683)	(0.0466)	(0.0471)
Δ Disparity					
2 vs 1			-0.0183		0.00179
			(0.0479)		(0.113)
3 vs 1			0.0465		-0.0827
			(0.0337)		(0.0959)
3 vs 2			0.0648*		-0.0845
			(0.0393)		(0.129)
Retinal Exam					
Level 1	0.268***	0.250***	0.0174	0.301***	-0.0329
	(0.0304)	(0.0510)	(0.0487)	(0.0968)	(0.0954)
Level 2	0.295***	0.312***	-0.0165	0.444***	-0.148
	(0.0462)	(0.0689)	(0.0550)	(0.121)	(0.108)
Level 3	0.284***	0.244***	0.0395	0.216***	0.0684*
	(0.0188)	(0.0438)	(0.0442)	(0.0385)	(0.0383)
Δ Disparity					
2 vs 1			0.0340		-0.115
			(0.0350)		(0.0739)

	White	Black	Disparity	Hispanic/ Latino	Disparity
3 vs 1			0.0221		0.101
			(0.0245)		(0.0805)
3 vs 2			0.0561*		0.217**
			(0.0300)		(0.0936)
Attention for Nephropathy					
Level 1	0.470***	0.428***	0.0426	0.351***	0.120
	(0.0369)	(0.0622)	(0.0584)	(0.100)	(0.0979)
Level 2	0.261***	0.243***	0.0177	0.212**	0.0488
	(0.0472)	(0.0609)	(0.0488)	(0.0918)	(0.0832)
Level 3	0.414***	0.345***	0.0694	0.341***	0.0728*
	(0.0211)	(0.0535)	(0.0537)	(0.0446)	(0.0438)
Δ Disparity					
2 vs 1			-0.0249		-0.0708
			(0.0316)		(0.0670)
3 vs 1			0.0268		-0.0468
			(0.0245)		(0.0835)
3 vs 2			0.0517**		0.0240
			(0.0260)		(0.0758)
Bootstrapped Standard Errors in Parentheses *** p<0.01, ** p<0.05, * p<0.1					

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CHAPTER 4: HETEROGENEITY OF TREATMENT EFFECTS IN PATIENT-CENTERED MEDICAL HOMES: ADULTS WITH DEPRESSION AND MULTIPLE CHRONIC CONDITIONS

Overview

Objective: Identify the subgroups of adults with major depressive disorder (MDD) and other chronic conditions most likely to benefit from participation in a patient-centered medical home PCMH).

Data sources: Administrative claims from 2008-2011 on Medicaid beneficiaries age 18-64 years with MDD and at least one other chronic condition in Georgia, North Carolina, and Texas.

Study design: We used a person-centered treatment (PeT) effects model to assess heterogeneity of individual-level treatment effects among diverse subpopulations of PCMH enrollees, including the effects of beneficiary race, age, sex, rurality, and number of comorbid conditions.

Data Collection: Medicaid claims merged with provider- and area-level data.

Principal Findings: We found significant heterogeneity of treatment effects among PCMH enrollees, driven by patient race, sex, age, rurality, and number of chronic comorbidities. For four of six outcomes, being a racial/ethnic minority was predictive of deriving less benefit from the PCMH in terms of quality outcomes. Rural residence is predictive of increased benefit from the PCMH in terms of mental health services. an increase in number of comorbid chronic conditions was predictive of a small decrease in benefit in terms of all quality measures except use of antidepressants.

Conclusions: Our findings suggest that the PCMH alone may be insufficient to meet the needs of diverse patient populations. Providers and policymakers should consider heterogeneous treatment effects explicitly when designing, implementing, and evaluating PCMH programs.

Background/Significance

Persons with multiple chronic conditions utilize health care services more frequently and access a wider range of services than the general population, making coordination of their care more difficult.[1,2] Because mental health problems exacerbate the consequences of physical chronic conditions and complicate their management,[3] coordination challenges make persons with co-occurring mental illnesses such as depression particularly vulnerable to suboptimal quality of care.[1,4] Racial minorities with depression and other chronic conditions may be particularly susceptible to poor quality of care,[5] especially given that a higher proportion of individuals in minority communities have unmet mental and physical health needs.[6,7] Because racial minorities are more likely to seek mental health treatment from a primary provider than a mental health specialist, it is important to understand the potential for primary care models to address the intersection between race, depression, and chronic disease.[5,7]

The patient-centered medical home (PCMH) is an increasingly popular model to improve the quality of primary care, and several provisions of the Affordable Care Act incentivize the use of accredited PCMH models for patients with comorbid mental and physical health conditions.[8] The primary goal of the PCMH is to provide patient-centered, comprehensive, coordinated, and accessible care.[9] While the evidence that the PCMH improves overall quality of care is growing,[9,10] previous research has found that different racial groups may not benefit equally from the PCMH.[11–13] Some studies have found that the

PCMH model reduces or eliminates racial disparities in quality of care metrics such as preventive care reminders, cholesterol testing, and cancer screenings,[14] others report varying effects among racial/ethnic groups.[15–18]

However, even within racial groups, not all patients will receive the same benefit from PCMH; a phenomenon, known as heterogeneity of treatment effects (HTE). HTE is driven by several factors, including disease severity, responsiveness to treatment, susceptibility to adverse treatment effects, decision-making processes and patients' utility for different outcomes.[19,20] Estimating the average effects of PCMH enrollment can be useful to understand its overall impact; however, in the presence of HTE, the average marginal effect may obscure more nuanced patterns of treatment response where some patients benefit substantially while others experience no benefit or even detrimental effects.[19] Moreover, patients and providers may be aware of factors that moderate HTE, which leads to selection bias based on the expected benefits from treatment; this is known as essential heterogeneity.[21]

Understanding individual variation in outcomes can guide policymakers in targeting PCMH outreach to specific groups requiring enhanced or additional care. In this study, we use a novel method to account for differential selection into the PCMH and assess heterogeneity in the response to PCMH enrollment. Using local instrumental variable (LIV) methods, we estimate patient-centered treatment effects (PeT) to explore treatment effect heterogeneity across both observable patient characteristics and unobserved confounders.[22,23] This innovative approach assesses patient-level heterogeneity by taking individual treatment choices into account when predicting personalized treatment effects in observational data.[22]

We then used these individualized estimates to predict the characteristics of beneficiaries who are most likely to benefit from the PCMH model.

Methods

Data

We constructed a dataset using several administrative sources. We merged 2008-2011 Medicaid Analytic eXtract (MAX) claims data which contain enrollment information and final claims for all enrolled Medicaid beneficiaries with data from the National Plan and Provider Enumeration System (NPPES). The NPPES contains National Provider Identifiers (NPIs) from practicing providers and organizations, along with provider characteristics including gender, provider type, state, and Medicaid billing identifiers. These data were also combined with NCQA PCMH data, which includes the date, duration, and level of NCQA PCMH recognition. We obtained county supply of mental health professionals from the Area Health Resource File,[24] and socioeconomic variables were measured at the county level using the U.S. Census Bureau's Small Area Income and Poverty Estimates.[25]

The study population includes Medicaid beneficiaries in three states (GA, NC, TX), ages 18-64 with a major depressive disorder (MDD) and at least one comorbid physical chronic condition. We focused on this population because quality outcomes are known to be poor for this group and because Medicaid beneficiaries have disproportionately high rates of comorbid psychiatric conditions[4,26,27] To avoid "rule-out" diagnoses and/or errors in coding, we defined depression and diabetes cohorts as those beneficiaries having at least one inpatient diagnosis or at least two outpatient or emergency department diagnoses during a single year in the study period, as well as at least one claim for the condition in the each year. We excluded individuals who were dually enrolled in Medicaid and Medicare because their Medicaid claims may not be complete. Additionally, we excluded individuals with

schizophrenia or bipolar disorder because this population is more likely to see a specialty provider as their primary point of contact with the healthcare system.[31]

The primary analyses were conducted at the person-year level, controlling for number of months of Medicaid enrollment in each year. However, due to the episodic nature of MDD we also constructed episode-level variables for antidepressant use. We focused on the acute phase of MDD treatment because there are clear guidelines for antidepressant usage during this phase.[32] We defined the beginning of an acute episode as two MDD outpatient services on different dates or initiation of an antidepressant prescription; the end of an episode was defined as either 90 days of no antidepressants or 120 days after the start of the episode.[33] We were unable to observe prescriptions dispensed during inpatient hospitalizations, therefore, we adjusted for inpatient episodes by assuming that patients received dispensed medication during their hospitalization and continued outpatient antidepressants after discharge.

Key Measures

We assessed seven disease-specific quality indicators for MDD and diabetes derived from Medicaid claims (see Table 15 for full definitions). We conducted subgroup analyses for beneficiaries with comorbid diabetes (Type I and Type II) because it is highly prevalent in Medicaid populations[28,29] and evidence indicates that comorbid MDD interferes with its management.[30] We selected annual quality measures based on recommended core measures for the PCMH,[34] the Centers for Medicare and Medicaid Services (CMS) 2016 core set of adult quality measures for Medicaid,[35] and the 2011 version of the Healthcare Effectiveness Data and Information Set (HEDIS). Clinical guidelines from the American Psychiatric Association specify that use of antidepressants or psychotherapy should be based on individual clinical circumstances such as disease severity and "complex psychosocial situations."[36] This information is not available in claims data, therefore we measured the

likelihood that beneficiaries with MDD received any psychotherapy or any antidepressant prescriptions. Either treatment modality would be considered guideline-concordant, but these measures represent a minimum standard of quality.[33,37] In episodic analyses, we assessed the HEDIS antidepressant management measure for acute phase treatment, which is defined as the receiving at least 84 days of antidepressants during an acute episode.[32]

The treatment variable was a binary indicator of yearly engagement in an NCQA-certified PCMH. We identified primary care providers using NPPES taxonomy codes, and NCQA-recognized PCMH providers were identified using NCQA recognition data. We attributed patients to a primary care practice using the "plurality rule" commonly applied by CMS[38] in which we defined a beneficiary's attributed primary care provider as the provider that delivered the plurality of the beneficiary's non-hospital evaluation and management (NH-E&M) visits.[39] If a beneficiary received the same number of services from two providers, they were attributed to the provider with the most recent claim.[39] We also modified this method by attributing beneficiaries first to the practice where they received the plurality of depression-related NH E&M claims. If a beneficiary had no depression-related NH E&M claims, they were attributed to the provider where they received the plurality of general NH E&M services.

Beneficiary variables included age, sex, number of chronic comorbidities, number of Medicaid-enrolled months and rurality. Chronic conditions were identified by International Classification of Disease (ICD9-CM) diagnosis codes using the Agency for Healthcare Research and Quality's Chronic Condition Indicator software.[40] Under this method, a chronic comorbidity was defined as a condition lasting at least 12 months and limiting self-care, independent living, and social interactions or resulting in need for ongoing medical

intervention.[40] Rurality was measured as urban, rural, or mixed using simplified county-level Rural-Urban Continuum Codes.[41] Provider-level covariates included Federally Qualified Health Center or Rural Health Center status and sex. County-level socioeconomic variables included percent of the population under poverty and median income. Finally, we controlled for county-level saturation of mental health professionals using county supply of psychiatrists and Mental Health Professional Shortage Area (HPSA) status (full or partial) using data from the Area Health Resource File.[24]

We created two continuous instrumental variables based on county rates of PCMH adoption: (1) the overall ratio of county PCMH adoption, defined as the number of unique PCMH providers in a county divided by the total number of primary care providers as measured by NCQA PCMH recognition data and the Area Health Resource File and (2) a similar county-level rate of NCQA medical home practices to all primary care providers, but both the numerator and denominator were contingent on the provider NPI appearing in Medicaid MAX claims during the study period.

Statistical Analyses

This analysis uses a PeT approach to understand heterogeneity of individual-level treatment effects among diverse subpopulations of PCMH enrollees. Using LIV techniques, PeT models can explore HTE across both observable characteristics and unobserved confounders by estimating marginal treatment effects (MTEs) parameters. MTEs are an average treatment effect that would be expected for patients who would be indifferent between receiving and not receiving treatment under random assignment.[42,43] The PeT methodology estimates an individualized treatment effect by averaging over MTEs that correspond to an individual's observed characteristics and the unobserved confounders associated with their observed treatment selection.[22,44]

We estimated individual-level PeT effects of PCMH enrollment for seven disease-specific quality outcomes. To estimate the PeT effects, we first used a logit model to estimate the propensity of PCMH enrollment as a function of baseline characteristics and two instrumental variables (Equation 1).

$$Equation\ 1:\ PCMH\_enrollment_{it} = \beta 0 + \beta 1 * instruments_{ct} + \beta 2 * X_{ipct} + \varepsilon_{ipct}$$

where X represents a vector of covariates and i, p, and c represent individual, provider, and county level variables and t is the time-period (year). This is analogous to the first stage in instrumental variable methods such as two stage residual inclusion. Next, we determined the appropriate specification for the second stage or outcome models. We used Wald tests to assess whether higher order or interaction terms improved model fit for the second stage model. We examined age as a quadratic variable and interactions between race and medical home status, median income, percent under poverty, and gender. Only the quadratic form of age improved model fit. Finally, we included state and year fixed effects as controls in the outcome models.

We then used the LIV techniques described above to estimate individual PeT effects for each quality outcome. Using 1,000 bootstrap replicates, we created a distribution of PeT effects for each individual, averaging over the PeT effects if the same individual was sampled multiple times within the same replicate.[45] Using these distributions, we determined which beneficiaries had PeT effects that were statistically significant at the 5% level. Finally, we examined which patient characteristics were predictive of increased benefit from the PCMH intervention using only statistically significant PeT effects as outcomes and regressing them on patient characteristics including race/ethnicity, age, sex, number of comorbidities, and rurality. All analyses were performed using Stata (Version 13).

Results

Our instruments were uniformly strong, with F statistics ranging from 987.97 to 4128.06. The final sample consisted of 261,602 person-years contributed by 181,139 individuals; 4,376 person-years (1.67% of the sample) were attributed to a PCMH, leaving 257,226 person-years as controls. PCMH enrollees were more likely to be Black (38.3% vs 28.5%), less likely to be Hispanic/Latino (3.8% vs 12.5%), and less likely to live in rural areas (Table 16). LIV methods only identify parameters over the range of support provided by the first-stage propensity score; in this sample propensity scores for PCMH engagement ranged from 8.86e^-07 to 0.87. We found that 95.49% of the sample (249,816 person-years) had statistically significant PeT effects for at least one of the depression outcomes. We excluded the remaining 11,786 person-years with PeT effects did not reach statistical significance for either psychotherapy or antidepressant use.

The diabetes subsample consisted of 82,669 person-years contributed by 38,149 unique individuals. Medical home enrollees contributed 1,036 person-years and comprised 1.62% of the diabetes subsample. Propensity scores for PCMH engagement ranged from 1.22e^-06 to 0.772 in the diabetes sample. 22.48% of person-years had PeT effects that did not reach statistical significance; therefore, the final diabetes subsample consisted of 58,477 person-years that had a statistically significant PeT effect for at least one of the four diabetes-specific outcomes.

Table 17 shows the characteristics associated with increased benefit from the PCMH, positive coefficients indicate characteristics that make beneficiaries significantly more likely to benefit from PCMH enrollment (where “benefit” is defined as a differential increase in the likelihood of receiving recommended services). We found that Black race was predictive of increased benefit of 12.40 percentage points in terms of receipt of psychotherapy and 3.00

percentage points in terms of lipids testing but associated with a reduced likelihood of antidepressant use (-33.1 percentage points), A1c testing (-3.10 percentage points), receipt of eye exams (-.239 percentage points), and attention for nephropathy (-1.71 percentage points). Hispanic/Latino ethnicity was predictive of a differential increase of 36.7 percentage points in terms of receipt of psychotherapy but associated with reduced benefit in terms of antidepressant use and all four diabetes-specific outcomes.

Being female was predictive of increased benefit from PCMH enrollment in terms of lipids testing (4.16 percentage points), A1c testing (3.98 percentage points), and eye exams (1.25 percentage points), and reduced benefit in terms of psychotherapy (-0.69 percentage points), antidepressant use (-1.28 percentage points), and attention for nephropathy (-2.06 percentage points). Overall, beneficiaries residing in rural areas were predicted to have less benefit for all diabetes services, except for an increased benefit in terms of eye exams for beneficiaries residing in rural counties that are not adjacent to a metropolitan area. However, rural residents were predicted to receive increased benefit for depression services. Older beneficiaries were likely to see small increases benefit from the PCMH in terms of psychotherapy, antidepressant use, and lipids and A1c testing, but decreased benefits for receipt of eye exams and attention for nephropathy. Notably, we found that an increase in number of comorbid chronic conditions was predictive of a small decrease in benefit in terms of all quality measures except use of antidepressants.

Discussion

These results suggest that considerable HTE exists among PCMH enrollees, and this heterogeneity is driven by patient race, sex, age, rurality, and number of chronic comorbidities. For five of seven outcomes, being a racial/ethnic minority was predictive of deriving less benefit from the PCMH in terms of quality outcomes. These findings suggest

that the PCMH model is not adequately addressing the factors driving disparities in quality of care for racial minorities. We found that Black race and Hispanic/Latino ethnicity were predictive of increased benefit of the PCMH for psychotherapy, but decreased benefit for antidepressants. This finding may be due to differing patient preferences across racial groups; studies have shown that African-Americans and Latinos have differing beliefs and treatment preferences regarding depression than their white counterparts.[46] For example, African Americans and Latinos are both less likely than white patients to find antidepressant medication acceptable, and Latinos are more likely to find counseling acceptable.[47]

Interestingly, we found that an increase in the number of comorbid chronic diagnoses is associated with a slight decrease in quality of care that a beneficiary is expected to derive from PCMH enrollment (apart from antidepressant use). This finding is notable because the PCMH model has typically focused on the management of chronic conditions and is frequently touted as a solution for improving care for individuals with multiple chronic conditions.[48]

Being female was predictive of increased benefit from the PCMH in terms of lipids panels, A1c testing, and retinal exams, but decreased benefit for receiving psychotherapy, antidepressants, or attention for nephropathy. An increase in age was associated with increased benefit for four of the seven measures, apart from retinal exams and attention for nephropathy. Finally, rural residence is predictive of increased benefit from the PCMH in terms of mental health services, which suggests that PCMH enrollment is especially advantageous for beneficiaries that live in rural areas.

Limitations

This study has several limitations. First, these NCQA PCMH recognition is not necessarily indicative of the services that a practice provides. Non-PCMH primary care practices engage in many of the same activities as NCQA-recognized PCMHs but may not seek recognition due to financial or other concerns. Services may also vary between recognized PCMHs, as the required recognition criteria are flexible. Second, our findings may not generalize beyond Medicaid beneficiaries and NCQA-recognized PCMHs. Additionally, some research suggests that specific chronic condition dyads may differentially affect patient outcomes,[49]and our findings do not account for specific combinations of disease or include a measure of disease severity. Finally, administrative data we used lack information on patient preferences, which could be a significant factor related to HTE.

Conclusions

While the PCMH has the potential to improve overall quality of care, our findings suggest that the PCMH alone may be insufficient to meet the needs of diverse patient populations. Providers and policymakers should consider heterogeneous treatment effects explicitly when designing, implementing, and evaluating PCMH programs.

Table 15: *Disease-Specific Dependent Variables*

Variable	Definition	Calendar-Year	Acute Episode
MDD			
Antidepressant use	Percent of patients with MDD who received any antidepressant prescriptions.	X	
	At least 84 days of antidepressants during a 120-day episode.		X
Psychotherapy	Percent of patients with MDD receiving any group/individual psychotherapy	X	
Any MDD treatment	Receipt of any antidepressant prescriptions or group/individual psychotherapy	X	
Diabetes			
A1C Testing	Percent of diabetic patients receiving A1C testing	X	
LDL-C Testing	Percent of diabetic patients receiving an LDL–C test	X	
Retinal exam	Percent of diabetic patients receiving a retinal exam	X	
Nephropathy screening	Percent of diabetic patients screened for nephropathy	X	

Table 16: *Summary Statistics*

	N (%) or Mean (SD)		
	Non-PCMH	PCMH	p-value (t-test or χ^2)
N (person-years)	257,226	4,376	--
Race			
White	133,159 (51.8%)	2,294 (52.4%)	<0.001
Black	73,490 (28.6%)	1,674 (38.3%)	
Hispanic/Latino	32,139 (12.5%)	166 (3.8%)	
Female	204,279 (79.4%)	3,537 (80.8%)	0.022
Rurality			
Metro-adjacent	56,236 (21.9%)	337 (7.7%)	<0.001
Rural	14,315 (5.6%)	65 (1.5%)	
Age	40.0(13.5)	39.6 (13.3)	0.036
# Chronic Comorbidities	4.9 (4.2)	5.1 (4.2)	0.002

Table 17: *Characteristics Predicting Benefit from PCMH Enrollment*

	Psychotherapy	Any Antidepressant Use	Minimally Adequate Antidepressants	LDL-C testing	A1c Testing	Retinal Exams	Attention for Nephropathy
Race							
Black	0.124***	-0.331***	-0.274***	0.0300***	-0.0310***	-0.0239***	-0.0171***
	(0.00122)	(0.00145)	(0.00124)	(0.00234)	(0.00325)	(0.000928)	(0.00471)
Hispanic/Latino	0.367***	-0.351***	-0.256***	-0.0942***	-0.0208**	-0.106***	-0.0205***
	(0.00264)	(0.00139)	(0.00118)	(0.00404)	(0.00983)	(0.00129)	(0.00653)
Female	-0.00694***	-0.0128***	-0.0383***	0.0416***	0.0398***	0.0125***	-0.0206***
	(0.00142)	(0.00137)	(0.00118)	(0.00252)	(0.00243)	(0.000966)	(0.00533)
Rurality							
Metro-adjacent	0.308***	0.218***	0.136***	-0.0743***	-0.122***	-0.0315***	-0.174***
	(0.00200)	(0.00161)	(0.00158)	(0.00253)	(0.00265)	(0.00208)	(0.00616)
Rural	0.696***	0.349***	0.304***	-0.0808***	-0.126***	0.0243***	-0.141***
	(0.00315)	(0.00252)	(0.00301)	(0.00709)	(0.00444)	(0.00659)	(0.00948)
# Chronic Comorbidities	-0.00197***	0.000995***	-0.000673***	-0.00319***	-0.00451***	-8.88e-05	-0.00175***
	(0.000156)	(0.000143)	(0.000136)	(0.000247)	(0.000294)	(9.07e-05)	(0.000495)
Age	0.00362***	0.00811***	0.00175***	0.000843***	0.000437***	-0.00132***	-0.0191***
	(4.72e-05)	(4.56e-05)	(3.81e-05)	(9.70e-05)	(0.000139)	(6.13e-05)	(0.000161)
N (person-years)	199,955	194,777	87,604	38,234	13,920	43,541	15,050

Robust standard errors in parentheses

*** p<0.01

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CHAPTER 5: DISCUSSION

Overview of Findings

These studies produced several notable findings that contribute to the literature on the effect of the PCMH model on quality of care and racial/ethnic disparities. We found that while PCMH enrollment generally improves quality of care metrics for Medicaid beneficiaries with depression and other chronic conditions, this effect is not necessarily consistent across racial groups. Although many providers and policymakers believe that the PCMH model should reduce racial disparities by addressing barriers to high-quality care that disproportionately affect racial minorities,[1] our findings do not support this view. Overall the effect of the PCMH model on racial/ethnic disparities was inconsistent; PCMH enrollment was associated with a reduction in racial/ethnic disparities in quality of care for some quality metrics, but in other cases disparities were unchanged or even exacerbated. Therefore, implementing a PCMH model alone may not be sufficient to address racial inequities in health care. These findings run counter to our initial hypothesis that PCMH enrollment would reduce disparities in quality of care.

We also found that higher levels of NCQA PCMH recognition are not directly associated with improved quality outcomes. This finding may be because providers seeking NCQA recognition can choose from a flexible set of criteria, meaning that services offered may be heterogeneous even among providers with the same level of recognition. Additionally, because we compared providers before and after receiving NCQA recognition, another explanation for these findings is that providers that seek NCQA recognition may

already be providing higher quality of care. However, we did find that enrollment in a higher level of NCQA-recognized PCMH is sometimes associated with a reduction in racial/ethnic disparities in quality. This suggests that incentivizing practices to attain higher levels of NCQA recognition has the potential to reduce disparities, but higher levels of NCQA recognition alone may not be sufficient. These findings also contradict our original hypothesis that higher levels of PCMH enrollment would be associated with reduced racial/ethnic disparities in care. This may be due to the fact that providers choose from a flexible set of recognition criteria, meaning that PCMH providers with the same level of recognition may offer differing services.

Notably, we found that Black race and Hispanic/Latino ethnicity were predictive of increased benefit of the PCMH for psychotherapy, but decreased benefit for antidepressants. This may be indicative of increased attention to patient preference by PCMH providers; studies have shown that Black and Hispanic/Latino patients have different beliefs and preferences about depression treatment than their white counterparts.[46] For example, Black and Hispanic/Latino patients are both less likely than white patients to find antidepressant medication acceptable, and Hispanic/Latino patients are more likely to find counseling acceptable.[47] Therefore, the fact that Black and Hispanic/Latino beneficiaries enrolled in a PCMH are less likely to receive antidepressants may reflect the fact that PCMH providers are more likely consider patient preference when making treatment decisions. However, our analyses are based on administrative data that do not contain information on patient preference; future research should assess the role that patient preference plays in racial disparities in depression treatment in the PCMH.

Finally, we found considerable heterogeneity of treatment effects among PCMH enrollees; racial minorities were predicted to derive less benefit from PCMH enrollment than their white counterparts. We also found that other patient characteristics including sex, rurality, number of chronic comorbidities, and age also affected the likelihood of benefitting from PCMH services. These results suggest that while the PCMH has the potential to improve overall quality of care, this model alone may not be sufficient to meet the needs of diverse patient populations.

Policy Implications

Our findings suggest that while the PCMH model is associated with an improvement in quality metrics on average, estimating the average effects of PCMH enrollment obscures more nuanced patterns of treatment response. These findings highlight the importance of documenting and analyzing racial/ethnic disparities among PCMH enrollees. Providers, administrators, and policymakers should plan to explicitly address racial/ethnic disparities when designing, implementing, and evaluating PCMH programs. This may include designing culturally competent PCMH interventions, collecting and analyzing race-specific data, and incorporating efforts to address social determinants of health.

Additionally, we found that recognition as an NCQA PCMH improved quality metrics, but that there was no direct association between level of recognition and quality outcomes. This suggests that state Medicaid programs should incentivize NCQA-recognition, but that offering additional incentives based on level of recognition may not lead to improved process quality outcomes.

Areas for Future Research

Our studies use data on NCQA-recognized PCMH providers from 2008-2011. This study period reflects the early stages of the NCQA recognition program, and the PCMH

recognition standards have since been updated. Many of the disparities-related concerns raised by our findings are reflected in the NCQA's latest PCMH recognition standards, released in 2017. These new standards have several criteria relating to equity of care, including "targeting population health management on disparities in care," and "using information on the population served by the practice to assess equity of access."[2] Future research should assess whether these new standards are more effective at reducing racial disparities in quality of care.

Our findings also show that the PCMH has the potential to reduce racial disparities in quality. However, the PCMH is a multifaceted intervention and it is not clear which elements of this model are most effective at improving equity of care and why. Future research should assess which PCMH components (e.g. care coordination, enhanced access, etc.) is most important for improving care for racial/ethnic minorities and reducing disparities. Moreover, some research shows that the heterogeneous implementation of the PCMH model may exacerbate disparities if PCMH services are implemented unequally across providers serving minority and non-minority communities.[3] Therefore, future studies should explore the effect of implementation fidelity on quality and equity of care.

Finally, our studies rely on administrative claims data, which does not contain information on patient preference or experience of care. This is particularly important for disparities research because patient preference is a crucial aspect of the IOM definition of health care disparities. Future data collection and research should focus on assessing patient preferences and satisfaction with care in the PCMH model, especially in diverse populations.

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