COMPARATIVE EFFECTIVENESS OF MANAGED CARE ON QUALITY OF CARE FOR MEDICAID ADULTS WITH DISABILITIES

By

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LIST OF ACRONYMS/TERMS

AMI	Acute myocardial infarction
AWD	Adults with disabilities
CABG	Coronary artery bypass graft
CHIP	Children's health insurance program
COPD	Chronic obstructive pulmonary disease
CRG	(3M) Clinical risk group
DD	Difference-in-difference
ED	Emergency department
FFS	Fee-for-service
HCBS	Home-based and community-based services
HEDIS	The healthcare effectiveness data and information set
HMO	Health maintenance organization
ICD-9-CM	The international classification of diseases, ninth revision, clinical modification
ICHP	Institute for child health policy
ICM	Integrated care management
LTSS	Long-term services and supports
MCO	Managed care organization
MMC	Medicaid managed care
MRSA	Medicaid rural service area
NCQA	National committee for quality assurance
PACE	Program of all-inclusive care
PCCM	Primary-care case management

PCI	Percutaneous coronary intervention
SAS	Statistical analysis system
SSI	Supplemental security income
US	United States

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Medicaid is the main source of health care for individuals who have chronic medical conditions severe enough to inhibit their gainful employment. Yet the complexity and longevity of health service needs for these individuals, often delivered through a fragmented system, contribute to expensive and low quality health care. In response, managed care delivery models have become a popular mechanism to increase integration and coordination across the spectrum of care while containing or ensuring greater predictability of costs. However, little is known about managed care's effects on quality of care for this subpopulation. There is concern that savings may be achieved by reducing quality of or access to care rather than through encouraging more appropriate care utilization– a result which would further jeopardize the well-being of an already vulnerable group. Thus, the objective of this dissertation is to assess the effects of comprehensive managed care on the quality of health care for adults in Medicaid managed care (MMC) who qualify due to disability, relative to more traditional fee-for-service (FFS) or primary-care case management (PCCM) health service delivery models. This goal will be achieved by leveraging a natural experiment in Texas where

mandatory MMC enrollment was legislated in 2007 for a subset of Texas' 254 counties. The proposed studies utilize longitudinal quasi-experimental designs to provide ecologically valid information with immediate relevance to policy decision-makers. Through this work, we will increase the evidence base for Medicaid managed care, which currently serves more than 3.3 million enrollees nationally.

CHAPTER 1
INTRODUCTION

Background and Significance

Despite a recent slowing of growth, United States (US) health care spending has reached unsustainable levels, accounting for 17.1% of gross domestic product in 2013.[1] Paradoxically, such spending has led to only fair performance on health outcome and health care quality indicators in comparison to other developed nations.[2,3] This has fueled intense focus on understanding the sources of increased spending[4] and relatively poor health outcomes[1–3,5] and has prompted development of new models of health care delivery and financing.[6,7] Considerable attention, especially by governmental leaders and tax-payers, has been focused on refining health care programs financed by federal or state government. By number insured, the largest among these is Medicaid[1], a jointly funded state-federal health care entitlement program serving primarily low-income families, children, related caretakers, pregnant women, adults aged 65 and older, and individuals with disabilities.[8]

Similar to other health care programs, expenditures in Medicaid are highly concentrated among a relatively small proportion of enrollees[2]. For example, although only 15% of Medicaid enrollees qualify due to disability[3], these individuals account for

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[1] Programs financed directly by the US government also include Medicare, Veterans Health Administration and Indian Health Service, among others. The focus on Medicaid is driven by pragmatic and ethical motivations: (1) a favorable (i.e. unsaturated) research niche, (2) stakeholder research needs, (3) desire to generate evidence which could benefit traditionally underserved and marginalized population, and (4) data availability and expertise owing to my fellowship within the Institute for Child Health Policy, the External Quality Review Organization for Texas Medicaid.

[2] The term enrollee is used throughout in a manner synonymous with beneficiary or recipient.

[3] To aid in readability, hereafter we use terms such as “enrollee with disability” or “disabled enrollee” to represent enrollees who qualify for Medicaid due to a chronic medical impairment that inhibits engagement in any substantial gainful activity. This is the disability criteria used to determine eligibility for

close to half of all health care spending for the program. Correspondingly, disabled Medicaid adults cost an average of $20,000 per year compared to just $3,000 per Medicaid child.[9] Unfortunately, this increased spending is associated with poorer health care quality and lagging health outcomes when compared to the general population or to relatively healthier persons receiving Medicaid services.

In the following sections, I describe the diverse population with disabilities served by the Medicaid program, discuss factors contributing to this increased cost, lower quality care and poorer outcomes, and describe key strategies to improve the value of health care for this important population, which encompasses more than 9 million adults nationwide.[9] Subsequently, I present my strategy to evaluate a large implementation of one of these strategies.

Characteristics of Medicaid Enrollees with Disabilities

Clinical and Health Characteristics

Although often grouped as a single population in discussing reform, individuals with disabilities served by Medicaid have marked variation in the types of disability they experience. Broadly classified, 42% qualify due to a physical condition, 26% qualify due to mood or psychotic disorders and 20% qualify due to intellectual disorders.[9] For example, the program includes “working-age adults with spinal cord and traumatic brain injuries…adults with severe and persistent mental illnesses; and [individuals] with other serious, chronic illnesses and disorders such as diabetes and cardiac and pulmonary diseases.”[10] This heterogeneity, in turn, leads to substantial variation in acute and long-

supplemental security income (SSI). In Texas, the focus of this analysis, SSI recipients are automatically eligible for Medicaid.

term needs, forming the first set of challenges in providing efficient and patient-centered care for this population.

In addition to this variation in disability type and care needs, Medicaid enrollees with disabilities experience a very high burden of illness relative to the general population. This high illness burden proceeds from disability eligibility standards requiring that enrollees have chronic medical conditions severe enough to prevent substantial gainful activity for at least 12 months. Oftentimes, this illness burden takes the form of multiple co-occurring chronic health conditions. For example, it is estimated that over 60% of Medicaid beneficiaries who qualify due to disability and over 95% of the costliest 5% receiving Medicaid have 2 or more chronic conditions.[11] Both this multi-morbidity and poorer health status further complicate care delivery and disease management and lead to high levels of health care utilization.[12]

One of the most prevalent and expensive forms of disease multi-morbidity in Medicaid is co-occurring physical and mental illness. Mental illness and/or substance abuse disorders co-occur in approximately two-thirds of Medicaid disabled enrollees experiencing the most common physical health conditions (hypertension, diabetes, coronary heart disease, congestive heart failure and chronic obstructive pulmonary disease or asthma).[13] Among the highest-cost 5% receiving Medicaid, 3 of the top 5 most frequent disease dyads and triads include psychiatric illness.[11]

Among the general US adult population, the co-occurrence of physical and mental health conditions is associated with substantially increased health care costs and reduced health care quality compared to those with a physical condition alone. For example, analysis of national health care claims revealed that monthly medical expenditures for chronic conditions were increased $560 for individuals with co-

occurring depression and $710 for those with co-occurring anxiety.[14] Adults with co-morbid conditions are less likely to receive preventive care and their mental illness is more likely to go undiagnosed and untreated, compared to the general population and those with a physical condition alone.[15–17] A study of Medicaid adults with diabetes demonstrated an almost 20% decreased odds of receiving quality outpatient diabetes care and 32% increased odds of preventable hospitalizations for those also suffering from mental illness.[18]

This disease co-occurrence also has profound impacts on length and quality of life. As compared to adults with a single condition, mental and physical health comorbidity is associated with lost productivity, increased functional impairment and decreased health-related quality of life.[19–22] Most astounding, even after adjustment for physical health conditions, mental illness is associated with a 2- to 4-fold excess risk of premature death.[23] This is equivalent to a life expectancy 25 years shorter than the general population.[24]

Further complicating the clinical morbidity burden experienced by this population, emerging evidence suggests that enrollees with disabilities served by Medicaid also have impairments in cognitive functioning domains implicated in poor disease management and limited patient engagement. For example, phone-based assessments with a sample of Texas Medicaid enrollees with disabilities who have behavioral health conditions[25] revealed deficits in working memory, attention, verbal fluency and ability to encode novel information nearly indistinguishable from reference populations with dementia. Moreover, cognitive functioning is highly related to health literacy,[26] which has been situated as a critical determinant of health and efficient health care utilization.[27] By type of insurance, including the uninsured, individuals served by

Medicaid have the lowest levels of health literacy, with for example, 60% being unable to correctly specify the time a medication is be taken after reading a prescription label.[28] These observations of diminished health literacy and relatively poor performance on executive-functioning tasks suggest that cognitive barriers to engaging in appropriate health care use and disease management may be multifaceted.

Demographic, Social and Economic Characteristics

Persons with disabilities receiving Medicaid services are also diverse in terms of demographic characteristics. Although representative state-level Medicaid program enrollment data is not often readily available, enrollment in the Supplemental Security Income (SSI) program provides insights, in that SSI is the most common route to Medicaid eligibility for the disabled and confers automatic Medicaid eligibility in most states. Of the approximately 5 million adults aged 18-64 receiving SSI nationally, 57% are women.[29] Among the non-institutionalized subset of this SSI population, 31% are African-American and 14% are Hispanic.[30]

In addition, the living situation of adults receiving SSI (and thus qualifying for Medicaid due to disability) reflects a greater degree of social and economic instability than the general population. For example, only 20% of these individuals are married, compared to a 60% rate among all US adults. In addition, 45% of adult SSI recipients have less than a high school education.[30] Economic circumstances reflect income eligibility requirements, whereby about 70% of households with a member receiving SSI have annual income below $10,000, 13% live in public housing, and 40% receive food stamps.[30] As discussed in more detail below, these social and economic characteristics are primary contributors to the inequitable illness burden and poor health care quality

experienced by this population. Furthermore, these factors describe a local context where disease management and engagement in care are unlikely to be satisfactory.

Conceptual Frameworks Describing Health Care Use and Health Outcomes

While clinical disease burden and related deficits appear to be driving health and health care disparities for the Medicaid disabled, it is important to situate these individual-factors in the larger social and structural ecology that both accentuates and fundamentally determines these disparities. Theory posits that social and economic stratification, along with the very structuring of political, social and economic institutions in society, lead to the inequitable access to and distribution of resources (e.g. financial, social, power, knowledge). Such resources largely determine individuals' and groups' abilities to attenuate and adapt to disease risks, and ultimately, promote health.[31–33] In many ways, this theory suggests that efforts to address proximal factors like risk behaviors will ultimately be ineffective, because prior disease paths will be replaced by new disease mechanisms, for which disadvantaged groups will still lack resources to deploy. For example, developed countries have seen unequal infectious disease burdens transition to unequal non-communicable disease burdens over the previous century, with similar marginalized groups disproportionately affected. Medicaid, Supplemental Security Income (SSI) for those individuals with disabilities, food vouchers and subsidized housing represent several important, yet insufficient, social programs which seek to diminish the imbalance in resources of those with limited income and wealth. The research described in this proposal does not seek to directly address these fundamental causes or improve the *relative* position of disadvantaged groups; rather it contributes to efforts to improve the *absolute* value of care for a vulnerable population.

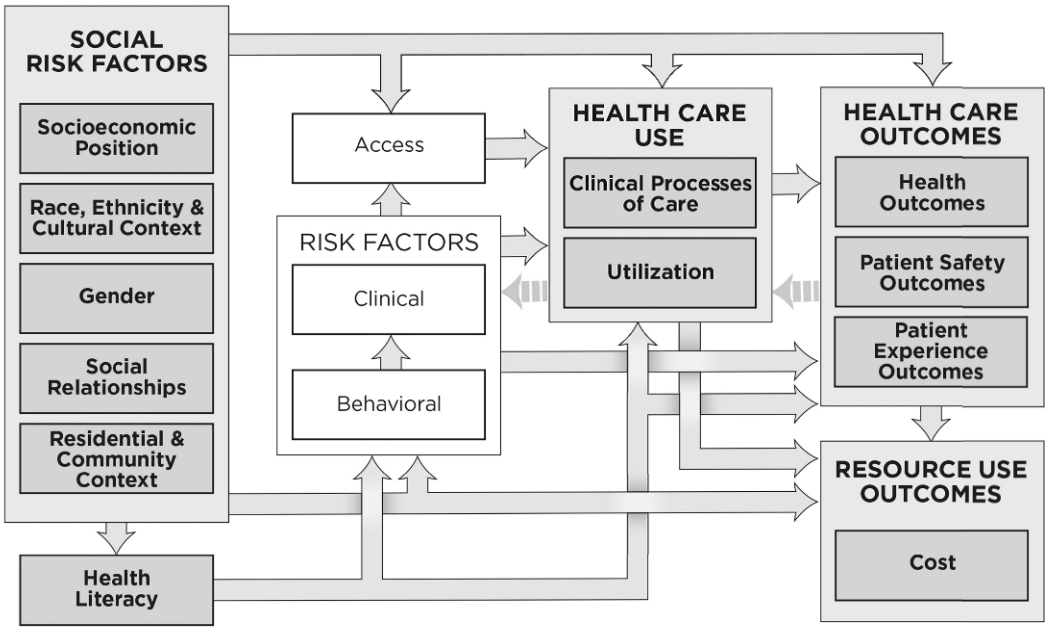

Figure 1-1. Institute of Medicine's Social Risk Factors of health care use, outcomes and cost model.

One recent conceptual framework developed by the Institute of Medicine (see Figure 1-1) provides more detail on the social factors implicated in health care use and outcomes, and is helpful in understanding differences not only *between* groups of widely varying social position but also *within* a defined group.[34] For example, among Medicaid enrollees with disabilities with similar health conditions, differences in education and occupation portend different abilities to access and engage with health care and achieve improved outcomes, despite enrollees having similar income and health status. In this same group, measures of race and ethnicity may capture well-documented differences in access, patient-provider trust and provision of care, or may serve as a proxy for cultural differences in beliefs and preferences for care. Socially- and biologically-derived gender-specific differences in outcomes, and in accessing and receiving care, would also be expected. Enrollees are also likely to experience different

physical environments and communities, which can impact their ability to access health care or the saliency of and capacity in managing disease.

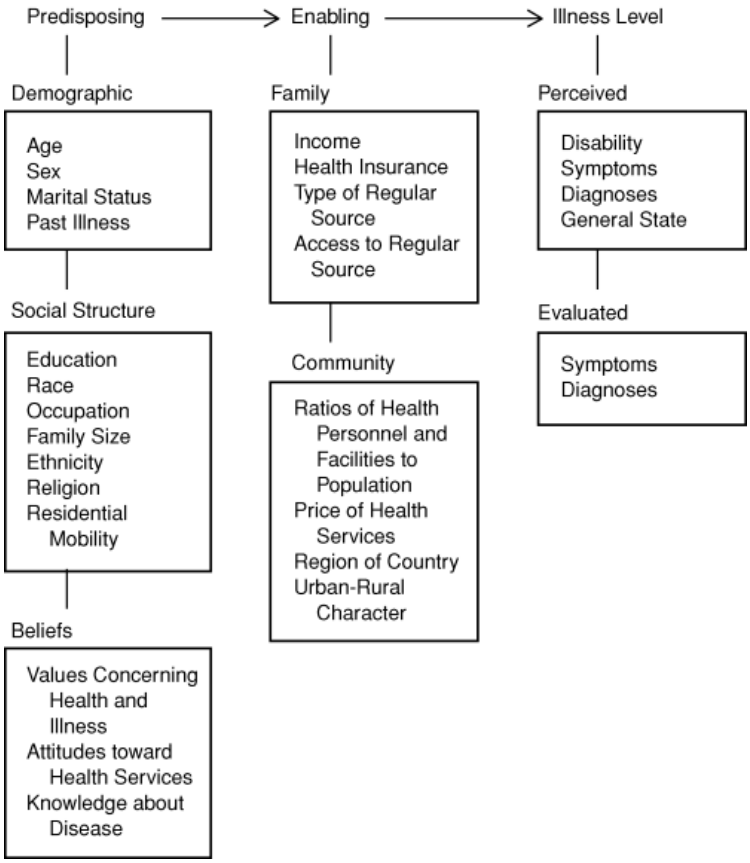

Figure 1-2. Andersen's Health Service Utilization Framework.

This social risk factors model coincides with the “predisposing” and a subset of the “enabling” components of a more encompassing health service utilization framework described originally by Andersen and shown in Figure 1-2.[34] The remaining determinants of the “enabling” component include factors related more directly to health care, including the acquisition of health insurance, and local or regional availability to and patterns of and prices for health care. For example, findings over the past decade, many of which were driven by the Dartmouth Atlas project, have documented high levels of between-region variation and within-region consistency in utilization and prices, suggesting the role of supply-side driven utilization in health care, which is by definition

independent of clinical need or individual enrollee characteristics.[35] This local "enabling" context could also be envisaged to distinguish between enrollees living in the community and those who reside in an institutional nursing or assisted-living facility, since the health care provided in these settings would be expected to differ. According to the Andersen model, the final and perhaps most proximal component driving health care use, as I have discussed first, is that of clinical need, which can be complicated by functional limitations (physical and mental), symptomology, and clinical multi-morbidity.

Medicaid, the States and Enrollees with Disabilities

Formed by the Social Security Amendments of 1965, Medicaid is the primary social program in the US providing health care to those with low income and limited resources. Social Security Amendments of 1972 replaced existing state-administered welfare with the federally administered SSI program and largely extended Medicaid to all SSI recipients while greatly expanding income- and disability- related eligibility requirements. Since this time, additional amendments have generally extended eligibility to include additional disability segments.[36]

State and the federal governments share responsibility for the Medicaid program in each respective state, with the federal government setting eligibility, services and financing guidelines and the state administering the program. For example, all participating states must offer the required inpatient, outpatient, laboratory and home health services. In addition, federal guidelines require that Medicaid beneficiaries have "freedom of choice", such that they are not limited in the provider from whom they seek care; have "state-wideness", such that benefits are not tied to an enrollee's location of residence; have "comparability of services", disallowing discrimination in benefits based on diagnosis, type of illness or condition; and reimburse services which are "medically

necessary" and of "sufficient amount, duration, and scope to reasonably achieve its purpose".[37]

Within these limits, states have flexibility in choosing to participate in Medicaid, in providing any number of optional health care services, in expanding eligibility to "categorically related" groups with more liberal eligibility criteria, and in determining amount and duration of services.[37,38] Furthermore, states can petition the federal Secretary of Health and Human Services for a variety of waivers to many of these federal requirements. The first of these, enacted prior to Medicaid in 1962, is provided under section 1115 of the Social Security Act, and allows discretion for broad changes in eligibility, benefits, cost sharing, and provider payments.[39] The Omnibus Budget Reconciliation Act of 1981 provided an additional mechanism, with the 1915(b) waiver allowing states to require beneficiaries to enroll in managed care (discussed in greater detail below), and permitting these programs to offer different benefits targeted to groups living in selected geographic areas. Section 1915(c) waivers allow states to provide long-term services (also discussed in greater detail below) in home and community-settings as opposed to traditional institutional settings to targeted groups. Additional, related waivers in sections 1915, 1937 and 1945 may also be considered by states desiring flexibility in administering their programs.

In addition to the general legal and administrative structure of Medicaid described above, there are several salient characteristics that provide additional useful context. First, in a manner similar to those with commercial insurance, Medicaid beneficiaries receive their care from many types of providers, including those in private small-group office-based practices, as well as those in large groups, hospitals, academic medical centers and safety-net health centers (such as federally-qualified health centers).[40]

Health care professionals are typically paid through contracts with the state or with organizations contracted by the state to provide a defined schedule of services. Due to general shifts in organizational consolidation as well as targeted efforts among small-group providers to limit Medicaid rolls, increasingly, care for Medicaid enrollees is concentrated among a smaller proportion of all providers, mainly the large group and community health center organizations.[41]

Second, access to health care services is substantially better than the uninsured receive and in some cases may even rival that received by those with employer-sponsored insurance.[42] However, data also suggest several gaps, including limited specialist availability, particularly for critically needed mental health and substance abuse services.[43] Limited access to these services is particularly ominous for enrollees with co-occurring physical and behavioral conditions, as unmanaged behavioral health issues contribute to worsening physical health conditions. Similarly, adults served by Medicaid have very limited access to dental care[44]; and new patient health care appointments are relatively restricted compared to commercially insured patients.[45] The reasons for limited provider participation in Medicaid compared to employer-sponsored insurance are not entirely clear, although low payments rates, on average 40% less than Medicare,[46] are suggested as a partial explanation.[47] In addition, provider shortages may be more likely in areas where Medicaid enrollees are concentrated. Limited after-hours care and transportation barriers represent additional obstacles to access faced by many adults receiving Medicaid services.

Third, and similar to other programs in US health care, Medicaid programs provide less than-optimal care due to failures of care delivery, care coordination, overtreatment, pricing failures, administrative complexities and fraud and abuse.[4]

Despite this waste, Medicaid's per enrollee costs have remained stable relative to those of employer-sponsored insurance and Medicare, which routinely outpace inflation.[48] Although comparisons between payers on quality of care are limited, Medicaid enrollees are more likely to have less inclusive care, and have poorer health outcomes.[49,50] Compared to those with employer-sponsored insurance, Medicaid enrollees benefits are typically more limited and are often provided in an even more fragmented manner. This latter aspect is reinforced by service carve-outs, whereby certain services (e.g. mental health) are provided by organizations separate from the other health care providers.

Fourth, Medicaid enrollees are subject to more frequent (i.e. often monthly) and burdensome application processes than most who have employer-coverage, which leads to high rates of disenrollment or frequent coverage gaps. Those who qualify for Medicaid due to disability are the exception to this pattern, in that enrollment is longer-term, resulting in more stability for this population.

Fifth, for Medicaid enrollees with disabilities limiting gainful activity, long-term services and supports (LTSS) form an important and expensive subset of services provided by Medicaid. LTSS are used by 16% of Medicaid enrollees qualifying due to disability, with average annual costs of more than $60,000 per institutionalized adult and $30,000 for adults receiving these services in a community setting. LTSS encompass the personal and medical care enrollees may need over extended periods of time delivered by both paid and unpaid (e.g. family and friends) providers.[51] This care often includes assistance with activities of daily living, instrumental activities of daily living and other services such as nursing facility care, adult daycare programs, home health aide services, personal care services, transportation, and supported employment. In light of many disabled enrollees using LTSS, coordination between the long-term services and

acute medical care is often cited as a barrier to improving quality and value.[52] Unfortunately, very few states have developed comprehensive systems where these aspects of care are coordinated.[53]

Sixth, despite many commonalities across states in the characteristics described above, Medicaid programs also demonstrate substantial variation between states due political, economic, and demographic factors that vary across regions and over time.[54] Since states contribute more than 50% of their respective Medicaid budgets, Medicaid budgeting is a key consideration in state fiscal decisions. This is further complicated by the fact that the need for Medicaid, similar to other welfare programs, is inversely related to state prosperity. That is, increased expenditures and enrollment often coincide with decreased tax revenue. In addition, those served by Medicaid are almost exclusively individuals with limited political or social capital, such that outside public opinion, interest groups, political ideology and political culture dominate the discussion on policy changes and implementation.[54]

Managed Care for Medicaid Enrollees with Disabilities

The health disparities and high health care costs experienced by Medicaid enrollees with disabilities underscore the importance of focusing on this population; these results also suggest the failings of traditional health care delivery in adapting to the complexity, intensity and longevity of care required to meet these enrollees' health needs.[55] In response, and motivated to restrain or ensure greater predictability in state Medicaid budgets, policy makers have experimented with variations in Medicaid service delivery and financing for enrollees with disabilities. Increasingly, managed care health service delivery, and home- and community-based service alternatives to care have

become central approaches[4] to address these concerns.[10,11,56] In subsequent sections, I provide more context for these health care delivery innovations.

Managed care draws its roots from efforts in the early 1900s to create more predictable revenue streams for providers and restrain costs for consumers and companies. Selected groups of individuals or companies arranged regular pre-payments (premiums) to provider groups or hospitals in return for no-added-cost or reduced-price access to a schedule of medical services (outpatient, inpatient or both). Over time these arrangements became more like the independent practice association model of present where a third party, the health maintenance organization, or more generally the managed care organization (MCO), contracts with physicians or physician groups in private fee-for-service (FFS) practices.

The 1960s marked the first time that the majority of all medical care was paid for by a third party (including Medicare, Medicaid, most private insurance, and the Veterans Administration). This economic arrangement began to exacerbate the already existing moral-hazard that typifies health insurance, leading to further increases in utilization and costs. The high prevalence of third-party FFS payment, combined with the advances in technology and rising consumer expectations for health care, are thought to be the cause of the inflationary health care costs first occurring in the late 1960 -- inflationary costs which have largely persisted (absent the Great Recession) to present day.[39]

The concern over accelerating health care costs during the 1970s led to development of managed care as it is currently known, including varied formulations

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[4] Other common approaches include those, which, similar to managed care, seek to shift financial risk to the provider level (in order to drive accountability): global budgets, shared-savings/risk, bundled payments and pay-for-performance programs, in payer-specific or all-payer formulations. Additional approaches include medical homes models of care delivery (which may be integrated with abovementioned financing models).

(e.g. preferred provider organizations). Subsequently, the mid-1980s to early 1990s were characterized by rapid growth in managed health care and consolidation of the industry. Mirroring private insurance trends, state policy makers began to implement managed care in Medicaid, initially through 1915(b) waivers enacted through the Omnibus Budget Reconciliation Act of 1981. The mid-1990s were marked by backlash from the general public over utilization management (described in further detail below), leading to decreasing private managed care enrollment. During the same time, policymakers generally expanded managed care in their state Medicaid programs.[39] Managed care was almost exclusively first offered to or mandated for relatively healthier Medicaid children and their parents, rather than those with disabilities or the elderly, due to concerns over disrupting ongoing disease management, developing and maintaining appropriate provider networks and managing greater and more complex financial risk. However, beginning in the late 1990s, managed care has increasingly been made available to Medicaid adults with disabilities. As of 2012, managed care was available to disabled Medicaid enrollees in over two-thirds of US counties.[57,58] Recently California, Texas, Florida, New York and Illinois for example, have passed legislation requiring millions of disabled beneficiaries to enroll in Medicaid managed care.[59]

In managed care, MCOs leverage several tools to promote appropriate utilization of health care services. First, MCOs often modify the payment system such that providers and the insurance companies are better aligned. In Medicaid and many commercial implementations, this is often accomplish by contracting with independent primary care providers or provider groups and paying a recurring fixed amount (known

as a capitation rate) for each enrollee in that provider's panel in exchange[5] for delivering a schedule of medical services.[57]Additional financial incentives are also sometimes used to encourage more appropriate referrals to specialists, who often remain in FFS payment systems. Second, MCOs use their purchasing power to negotiate lower rates with providers and provider groups, and exclude providers unwilling to accept discounted rates, or who may be deemed to not be utilizing health services efficiently. Third, MCOs employ utilization management, including pre-authorization for elective procedures or hospitalizations, and actively monitor inpatient stays (to reduce length of stay). Another example of a prior authorization involves requiring referrals from a primary care physician in order for specialist services to be covered. MCOs may also place increased restrictions on the types of medications or medical testing covered. Utilization review involves MCOs monitoring service use furnished by providers and incentivizing or de-incentivizing below or above average use, respectively. Fourth, MCOs use case management, which involves coordination of health care and social services for patients with chronic conditions. Oftentimes, these case management activities proceed from initial and recurring enrollee medical and service needs assessments. Additionally, MCOs may employ technologies and processes to increase inter-provider and provider-patient communication, mail, phone or in-person beneficiary education, care transition supports, and additional targeted process improvement and quality incentives.[8,59] While cost-sharing (including co-payments, co-insurance and deductibles) are key tools in employer-sponsored and Medicare managed care, federal law restricts cost-sharing to only nominal levels for Medicaid managed care enrollees.

[5] In this arrangement, providers are usually "at-risk" (wholly or partially) for additional costs/provision of services beyond those additionally predicted.

Much of the description thus far has centered on comprehensive risk-based Medicaid managed care service delivery. In these managed care models, prospective payments are typically a uniform amount risk-adjusted for a particular case mix (i.e. illness burden) cared for by the MCO. To provide services,[6] MCOs in turn contract with a network of providers, arranging various financial and administrative relationships, including payments to providers that may be bundled by care-episode or remitted per unit of service. The Centers for Medicare & Medicaid Services, which administers Medicaid at a federal level, also considers primary-care case-management (PCCM) and limited-benefit plans as managed care programs. In PCCM, providers receive standard FFS payments as well as a monthly case management fee in return for providing care management and coordination. In limited-benefit plans, coverage is provided for a limited set of services in exchange for a capitation payment.[39] These payment and service delivery models are, to varying degrees, different from the traditional FFS health care financing system, where the state only directly reimburses health care providers or their entities an amount for each unit of service they provide.

When implemented in a third-party payment manner, FFS incentivizes unnecessary health care use because providers financially benefit from all (necessary and unnecessary) service delivery and patients have no direct financial burden. In such a system, uncoordinated care and worsening health outcomes are often financially rewarding for providers because this requires duplicated or increased intervention and services. In comparison, under set prospective payments, it is thought that MCOs are

[6] States vary on which benefits they include or exclude from their managed care programs. States often carve out or exclude certain Medicaid services from the set of benefits that a comprehensive risk-based managed care plan is responsible for providing enrollees.

incentivized to provide less costly (i.e. more proactive/preventive) care to delay or decrease the onset of higher-cost utilization which would be incurred by the MCO at a later date.[60] Thus, the goal is to promote comprehensive, high-quality, primary-care centered services better matched to enrollee needs.[60] At the same time, services not decreasing subsequent health care utilization (e.g. services that solely improve quality of life) may be less likely to be provided. In addition, the short time-horizon for capitation may promote temporary intervention in lieu of proactive or preventive care, which has benefits on a longer time scale.

Medicaid Home- and Community-Based Service Alternatives

Home-based and community-based service (HCBS) alternatives to institutional care represent a second health service innovation increasingly employed in Medicaid programs. Since the early 1980s when the 1915(c) waiver option became available, HCBS use has grown rapidly. In 2011, more than 3.2 million Medicaid beneficiaries received HCBS, accounting for almost half of Medicaid expenditures on long-term services and supports (LTSS).[58]

Dukett and Guy[61] trace the rise in Medicaid HCBS to several factors. Key among these was increased awareness of the disproportionate costs of institutional-based care and the tendency for Medicaid to favor institutionalization in eligibility and coverage determination (i.e. “institutional bias”). In addition, it was recognized that a large proportion of individuals in institutional settings were capable of living at home or in community residences, and many actually had a preference for doing so and experience unsatisfactory quality of life as a result.[61]This increased awareness was further punctuated by multiple court cases favoring deinstitutionalization.

Given this background, HCBS are emphasized as cost-effective, patient-oriented

options for enrollees to receive LTSS outside of the traditionally-required hospital or institutional setting.[62] HCBS commonly encompass 7 specific service categories: case management (coordination of care and promoting access to medical and social services), homemaker (i.e. cooking, cleaning, laundry, some maintenance and organization), home health aide (covering certain nursing or nursing aid services for disease management), personal care (covering activities of daily living, such as toileting, eating, dressing and bathing), adult day health care (e.g. activities and stimulation paired with skilled health services, provided during the day outside of the home), habilitation (such as occupational therapy, physical therapy and speech and language therapy), and respite care.

Managed Care and HCBS Together in Medicaid

Growing out of efforts to coordinate long term and acute services, as well as a desire to further stabilize growing costs, state policy makers have developed Medicaid programs which combine traditional managed care for acute and outpatient services with managed LTSS, including HCBS. One of the earliest examples of these programs, which still operates today, was developed exclusively for the elderly dual-eligible (i.e. Medicare and Medicaid eligible) population: The Program of All-inclusive Care for the Elderly (PACE). Arizona was the first state to develop a program which also included disabled (non-elderly) Medicaid enrollees, beginning in 1987.[63] Since this time, through combined 1915(b)/(c) waivers or 1115 demonstration waivers, the number of integrated managed care and HCBS programs serving enrollees with disabilities has continued to grow, from 8 states in 2004 to 18 in 2014, with projections for continued expansion.[64]

Existing Literature Evaluating Medicaid Managed Care and HCBS

Despite this growth in comprehensive managed care, including managed LTSS

delivered through HCBS, little is known about the quality of care in these programs. As managed care implementation in Medicaid focused initially on relatively healthy children and young adults, much of the existing evidence on Medicaid managed care describes populations with substantially different health states, care utilization and health needs than those qualifying due to disability. The literature focused on evaluating managed care for the elderly, namely evaluations of PACE, might also not serve as an appropriate reference, since the chronic condition distribution of enrollees with disabilities is different than for other Medicaid high-use groups. For example, enrollees with disabilities are more likely to have psychiatric illness, substance abuse, and developmental disability diagnoses compared with aged Medicaid enrollees.[11]

Among the limited studies that exist for the Medicaid disabled population, the large majority have investigated changes due to *voluntary* managed care enrollment. And so while these studies found expenditure reductions between 9% and 37%, selection bias is likely to diminish the validity of such findings.[9]

The very limited literature on the effects of *mandatory* managed care for disabled adults has been mixed. Burns[66] found that beneficiaries in mandatory managed care were more likely to report waiting to see a provider, difficulty obtaining specialty care and not receiving a flu shot. Yet these same beneficiaries were also more likely to have a usual source of care compared to FFS enrollees. Average total per beneficiary Medicaid expenditures did not differ by care-delivery model.[59]We caution that a large number of main comparisons were made with the analytical models in these studies, increasing the likelihood that some of these findings may have been due to chance alone. The studies were also limited in that all mandatory managed care was modeled

similarly. This assumption is less than ideal considering the large program heterogeneity across the country.

Harman et al[67] focused on Florida's recent Medicaid Reform Demonstration where per-member per-month costs for Adults with disabilities (AWD) and Temporary Assistance to Needy Families beneficiaries were examined in a difference in difference framework for the 2 counties relative to matched controls. Cost reductions were not seen for the total population, but enrollees with at least a 3-month enrollment prior to and following the transition did realize cost savings. Using the National Health Interview Survey, Coughlin, Long and Graves[62] explored access to care, flu shot receipt and use of primary care providers, specialty physicians and the emergency department for disabled Medicaid enrollees by their counties' managed care status (i.e. FFS, PCCM or HMO). The main finding revealed increases in the usual source of care reported by Medicaid adults with disabilities in managed care counties. It is important to note however, that the program status for each enrollee was unknown and based on the county proxy for which there was considerable discordance.[62]

The paucity of information on the effects of managed care for disabled adults[58] also reflects the inconsistent and heterogeneous reporting of quality and cost information[59,60] which occurs at a national level. Recognizing this, the congressionally authorized Medicaid and Children's Health Insurance Program (CHIP) Payment and Access Commission recently wrote that "priority should be given to quality measures that assess the impact of current programs and new service delivery innovations on Medicaid enrollees with disabilities."[57]

Additionally, the Department of Health and Human Services Office of the Inspector General identified concerns with inconsistent monitoring of the quality of

HCBS programs, noting that "the beneficiaries are among Medicaid's most vulnerable, and the nature of these programs puts beneficiaries at risk for receiving inadequate care."[68] With this context, we next describe our experimental setting.

Setting

In the past decade, the state of Texas legislatively mandated the transition of Medicaid service delivery from FFS and PCCM models to comprehensive managed care for adults receiving SSI for their disabilities. The program implemented is called STAR+PLUS.[8] The program delivers acute and long-term services and supports through 1 system, employs service coordinators who coordinate supports and develop individual plans of care; and emphasizes home and community based services.

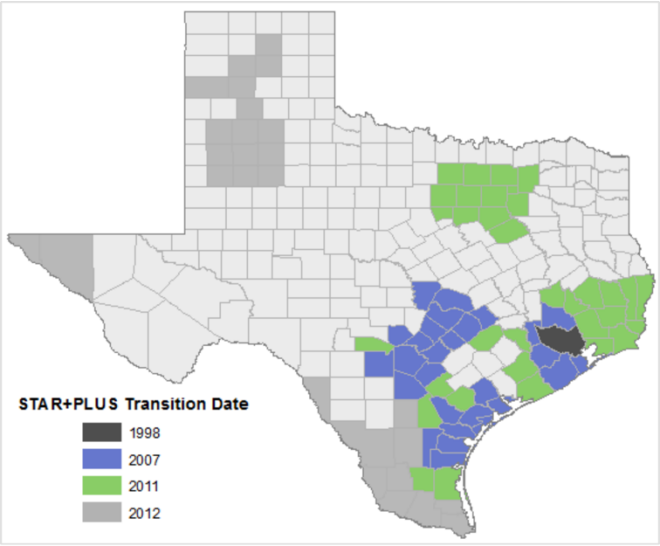

Figure 1-3. Map of Texas counties, with color indicating the date of STAR+PLUS implementation

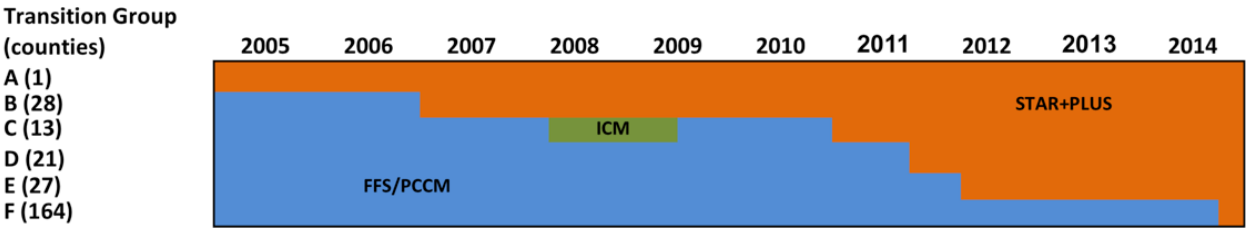

Figure 1-4. STAR+PLUS expansion by transition group

Figures 1-3 and 1-4 depict the history of implementation of the STAR+PLUS throughout the state of Texas over the past 2 decades. STAR+PLUS was first adopted in Harris County in 1998. Nine years later, in January and February of 2007, STAR+PLUS expanded to 28 additional counties. In February and September of 2011, and in March of 2012 STAR+PLUS was expanded to an additional 13, 21 and 27 counties, respectively.[62] In September 2014, STAR+PLUS was expanded to the state's remaining 164 counties, comprising the Medicaid Rural Service Areas (MRSAs). This phased implementation by county provides an opportune natural experiment that can be analyzed with high levels of ecological and internal validity.

CHAPTER 2
QUALITY OF CARE FOR CHRONIC CONDITIONS AMONG DISABLED MEDICAID ENROLLEES: AN EVALUTATION OF A 1915(b) AND (c) WAIVER PROGRAM

Introduction

Home- and community-based service (HCBS) alternatives to institutional care have been emphasized as cost-effective, patient-oriented approaches that allow Medicaid enrollees to receive long-term services and supports (LTSS) in their homes and communities.[58] In 2011, more than 3.2 million Medicaid beneficiaries received HCBS, accounting for almost half of Medicaid expenditures on LTSS.[58] There has been rapid growth in the use of managed care to provide LTSS through 1915 (b)/(c) managed care/HCBS waivers or 1115 demonstration waivers, increasing from 8 state Medicaid programs in 2004 to 18 programs in 2014.[64]

However, little is known about the quality of care delivered through these programs. The Department of Health and Human Services (DHHS) Office of the Inspector General identified concerns with inconsistent monitoring of the quality of HCBS programs, noting that "the beneficiaries … are among Medicaid's most vulnerable, and the nature of these programs puts beneficiaries at risk for receiving inadequate care."[68] Although there is considerable research on the effect of Medicaid managed care delivery for children, their parents and other low-income beneficiaries, there is a paucity of information on the effects of managed care and HCBS waiver programs for adults with disabilities (AWD), which may be due to the relatively recent

Reprinted with permission from Wegman MP, Herndon JB, Muller KE, et al. Quality of care for chronic conditions among disabled Medicaid enrollees: An evaluation of a 1915(b) and (c) waiver program. *Med Care*. 2015;53(7):599-606.

expansion of these programs or inconsistent and heterogeneous reporting of quality information.[57–60]

Of the existing research, Burns found that Medicaid AWD in mandatory managed care were more likely to wait to see a provider, report difficulty obtaining specialty care, and less likely to receive a flu shot compared with fee-for-service (FFS) enrollees; yet they were also more likely to report having a usual source of care.59 Coughlin, Long and Graves also found that Medicaid managed care was positively associated with having a usual source of preventive care among AWD compared with FFS.62 Neither study focused specifically on AWD enrolled in HCBS waiver programs.

More than one-third of AWD in Medicaid have three or more chronic conditions, and the chronic condition profile of AWD is different than for other Medicaid high-use groups. For example, AWD are more likely to have psychiatric illness, substance abuse and developmental disability diagnoses compared with aged Medicaid enrollees.70 The high rates of chronic disease comorbidity and differential chronic condition profile highlights the importance of understanding the impacts of HCBS on the quality of chronic disease care among Medicaid AWD.65,70 Ensuring the delivery of recommended care contributes to improved disease management and the ability to remain in a home setting.

The purpose of our study was to examine the effects of a large acute care and HCBS program delivered through managed care organizations (MCOs) in Texas Medicaid, the STAR+PLUS program, on the quality of chronic disease care for AWD. In 2012, Texas Medicaid enrollees accounted for one-half of all enrollees nationally in Medicaid managed care LTSS programs.[71] A primary focus of STAR+PLUS is to improve the quality of care for enrollees with disabilities through coordinated and

comprehensive care. The program delivers acute and LTSS through a single system; employs service coordinators who develop individual care plans and assist enrollees in receiving needed care; and emphasizes HCBS alternatives to institutional care.[8] Additionally, in a fully capitated health care delivery model like STAR+PLUS, evidence suggests that care which has the potential to reduce future visits, such as medications for chronic condition management, is provided more frequently compared with fee-for-service payment.[72]

Given this evidence and the key program objectives to provide more integrated and coordinated care compared to the pre-existing FFS and PCCM Medicaid program components, we hypothesized that the quality of care for chronic conditions would improve after STAR+PLUS enrollment and relative to a comparison group that remained enrolled in FFS or PCCM. To test this, we performed a series of longitudinal mixed model analyses with a comparison group.

Our study offers several contributions to the literature. First, it focuses specifically on Medicaid AWD <65 years in contrast to the more frequently studied Medicare-Medicaid dual-eligible populations.[73–76] Second, most research on HCBS has examined health care expenditures or access to care rather than specific quality indicators.[5,17] Third, we study a program with mandatory enrollment, overcoming the limitation of potential selection bias in prior research on waiver programs with voluntary enrollment. Thus, our study extends existing knowledge by examining the effects of HCBS delivered through an integrated managed care program on the quality of care provided for common chronic conditions among Medicaid AWD.

Methods

Overview

Currently, there are 13 STAR+PLUS service areas (SAs) that encompass all 254 counties in Texas. SAs are contiguous counties grouped together to organize health care delivery for Texas Medicaid. STAR+PLUS was phased in over time by SA, and some individual SAs transitioned asynchronously (i.e., subsets of counties within a SA transitioned in different years). STAR+PLUS was piloted in 1998 in the Harris SA (initially comprised of Harris County). The program expanded to 40 additional counties in January and February of 2007, comprising subsets of 4 SAs. The remainder of the counties in these 4 SAs, plus six additional SAs, transitioned in 2011 and 2012. On September 1, 2014, STAR+PLUS completed statewide expansion (see Figure 2-1 and Appendix A for a listing of county transitions).[18]

Texas selected SAs for initial implementation based on the presence of a strong health care infrastructure in order to increase the likelihood of successful program implementation. The phased implementation allowed us to compare the quality of care enrollees received for a range of chronic conditions before and after their transition to STAR+PLUS and relative to enrollees who were phased-in later.

We used Texas Medicaid administrative data from January 2006-December 2010 to estimate the treatment effect of the STAR+PLUS program on chronic care quality, focusing on the 2007 program expansions to allow for sufficient post-transition data for analysis. This time frame includes a baseline year (2006), a transition year (2007), and three years' post-transition for enrollees in the treatment counties. FFS and PCCM enrollees in counties that did not switch to STAR+PLUS during the study period served as the comparison group. We did not further distinguish between FFS and PCCM

enrollees in our analyses based on existing research indicating few differences in access to care among adult Medicaid enrollees in general and those with disabilities in particular.[19–22] In addition, post-analysis comparison of the control variables and baseline measure compliance between FFS and PCCM revealed only small differences (see Appendix B). Our university's Institutional Review Board approved this study.

Population and Data Sources

The study population included individuals 21-64 years old who were enrolled during the study time period and qualified for Supplemental Security Income (SSI) and Medicaid due to disability. Dual Medicare-Medicaid eligible were excluded because Medicare data were not available for those enrollees. Individuals <21 years old were excluded because STAR+PLUS enrollment was voluntary for this group. We excluded enrollees in the 1998 Harris SA pilot because it was not possible to generate separate program effect estimates to compare mature versus newly implemented STAR+PLUS with only a single observational unit.

Person-level administrative enrollment and claims/encounter data provided by the Texas Health and Human Services Commission were used to obtain enrollees' age, sex, race/ethnicity, county, service area, monthly enrollment, and delivery model (STAR+PLUS or FFS/PCCM). Enrollment records were linked to claims data that included International Classification of Diseases (ICD-9-CM) diagnosis codes, Current Procedural Terminology (CPT) codes, and National Drug Codes. These data were supplemented with county, Zip Code Tabulation Area (ZCTA), and census tract- level data from the Area Resource File, U.S. Census Bureau, and U.S. Department of Commerce to capture geographic contextual factors. The sample size varied for each

outcome according to the eligibility inclusion criteria for each quality measure described below.

Outcome Variables

We used chronic care quality indicators from the National Committee for Quality Assurance (NCQA)'s Healthcare Effectiveness Data and Information Set (HEDIS®): (1) Use of Appropriate Medication for People with Asthma, (2) Medication Management for People with Asthma at the 75% level, (3) Pharmacotherapy for COPD Exacerbation, (4) Cholesterol Management for People with Cardiovascular Conditions, (5) Persistence of Beta-Blocker Treatment after a Heart Attack, and (6) Comprehensive Diabetes Care. These measures were selected because they reflect quality of care for the Agency for Health Care Research and Quality's "Priority Conditions"[23] and were suggested by the Centers for Medicare & Medicaid Services (CMS) as initial health care quality core measures for adults in Medicaid. Strong performance on these indicators is linked to improved health outcomes.[24]

We used NCQA-certified software (Inovalon, Quality Spectrum Insight v15.2011), applying 2012 HEDIS® technical specifications to determine person-level compliance for each measure in each study year (see Appendix C, for measure definitions).[25] For COPD exacerbation pharmacotherapy, we calculated the average of the compliance rates for appropriate corticosteroid and bronchodilator dispensing. For diabetes care, we constructed a person-level composite measure used in prior research that averages the compliance rates of the subcomponents: annual hemoglobin A1c testing, eye-exam, LDL cholesterol screening, and nephropathy screening.[26] For the remaining measures, person-level dichotomous indicators of compliance were created.

Predictor Variables

For each member-year, we computed our main predictor variable as the number of STAR+PLUS enrollment months (0-12) (see Appendix D, for more detail on the main predictor's definition and behavior). We also controlled for several person-level and contextual variables.[59,77] First, for each outcome, person-level measure compliance in 2006 was used to control for baseline differences between the two studied groups. We constructed a variable to indicate if >5 enrollees were residing at the same address to identify group living arrangements. We also used the 3M Clinical Risk Groups (CRGs), which uses ICD-9-CM diagnosis codes from health care encounters for individuals enrolled >6 months to assign enrollees to the following hierarchically defined health status categories: healthy, significant acute conditions (e.g., chest pains), minor chronic conditions (e.g., migraine), moderate chronic conditions (e.g., asthma and diabetes), or major chronic conditions (e.g., cystic fibrosis and cancer).[78] Less than 1% of individuals lacked sufficient enrollment history for classification and were excluded. Additional individual characteristics included age at baseline (in years), gender, and race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other). Contextual geographic variables included the percentage of the population living in poverty in the enrollee's census tract (or ZCTA if census tract was unavailable) and county-level median household income. Dummy variables for each year were controlled for secular trends. The full model included two-, three- and four-way predictor interactions and predictor interactions with time to test for time-varying treatment effects.

Model Specification

Although SAs represent administrative clustering and the approximate unit at which STAR+PLUS was implemented, there were too few units to have sufficient

statistical power. In addition, some SAs were transitioned in phases. Accordingly, we selected an intermediate clustering unit (county), which provides sufficient power and accounts for potential non-independence among enrollees. The county reasonably represents the context within which enrollees seek health care and captures administrative similarity of the care environment, such as available health care resources that impact health service use.

We employed a two-stage, multilevel approach using general linear models. First, we computed person-level models separately for each year and outcome. Using individually-adjusted averages and assuming unstructured correlations over time, we then built the second tier model for each outcome, spanning the post-baseline years (2007-2010). With these 6 full models, fixed-order backwards selection of predictor variables with $\alpha = 0.05$ was used to arrive at the reduced models. Finding general agreement in terms retained between the models, we established one final reduced model form for consistency. R^2 statistics were then estimated. [79] Finally, we computed the least-squares-mean predicted compliance rates for the STAR+PLUS and FFS/PCCM counties using group-specific covariate distributions. The difference between these estimates reflects the STAR+PLUS effect.

Our modeling approach is a mathematical generalization of a difference-in-difference (DD) approach. The standard DD model compares differences between 2 groups at 2 time points to isolate and test the presence of an effect, assumed to be a deviation from the baseline difference. In a design with more than 2 time points (e.g., in our study with 4 post-baseline measurements), DD requires aggregation of the post-period measurements as a single time point or computation of 4 separate DD models for each outcome. Our strategy models all post-period measurements simultaneously,

while accounting for the covariance of repeated measurements, thus increasing power relative to the standard DD approaches. This generalized approach also relaxes the DD parallel trend assumption requiring similar rates of growth between groups by allowing for differing slopes (see Appendix E, for more technical detail). Analyses were performed using SAS 9.3 (SAS Institute Inc., Cary, NC, USA).

Results

Table 2-1 provides summary demographic and health status information for Texas Medicaid AWD meeting the inclusion criteria, stratified by time period and delivery system (STAR+PLUS counties or FFS/PCCM counties). Eighty percent of enrollees were assigned to the most severe health status category. Two-thirds were >50 years, and a similar fraction was female. Reflecting Texas' diversity, >50 percent of the sample was Hispanic or non-Hispanic black. Over half lived in census tracts designated as impoverished or extremely impoverished.

Table 2-1. Characteristics of eligible enrollees in transition and comparison counties during the baseline and post baseline periods.

	Transition counties (STAR+PLUS)		Comparison counties (FFS/PCCM)	
	Baseline (n=8,068)	Average Post (n=9,571)	Baseline (n=21,746)	Average Post (n=16,714)
Age (mean; std)	52.0 (9.8)	52.1 (9.6)	52.8 (9.5)	52.6 (9.6)
21-29	4.1%	3.8%	3.5%	3.9%
30-39	7.7%	7.5%	6.8%	6.9%
40-49	19.9%	20.7%	18.3%	18.5%
50-59	42.7%	43.2%	43.0%	43.1%
60-64	25.6%	24.8%	28.4%	27.6%
Female (n;%)	5304 (65.7%)	6350 (66.3%)	14281 (65.7%)	10836 (64.8%)
Race/Ethnicity (n;%)				
White, non-Hispanic	2460 (30.5%)	2876 (30.1%)	7811 (35.9%)	6536 (39.1%)
Black, non-Hispanic	975 (12.1%)	1225 (12.8%)	4392 (20.2%)	3028 (18.1%)

Table 2-1. Continued.

	Transition counties (STAR+PLUS)		Comparison counties (FFS/PCCM)	
	Baseline (n=8,068)	Average Post (n=9,571)	Baseline (n=8,068)	Average Post (n=9,571)
Hispanic	4159 (51.5%)	4834 (50.5%)	7492 (34.5%)	5684 (34.0%)
Other	474 (5.9%)	637 (6.7%)	2051 (9.4%)	1466 (8.8%)
Health status* (n;%)				
Healthy	216 (2.7%)	319 (3.3%)	543 (2.5%)	375 (2.2%)
Significant Acute	45 (0.6%)	58 (0.6%)	90 (0.4%)	70 (0.4%)
Minor Chronic	69 (0.9%)	90 (0.9%)	168 (0.8%)	142 (0.8%)
Moderate Chronic	1197 (14.8%)	1329 (13.9%)	2833 (13.0%)	2160 (12.9%)
Major Chronic	6541 (81.1%)	7776 (81.2%)	18112 (83.3%)	13967 (83.6%)
Census tract poverty (mean; std)	23.1% (0.120)	23.1% (0.121)	26.1% (0.136)	26.0% (0.132)
0.0%-4.9%	3.5%	3.7%	2.6%	1.9%
5.0%-9.9%	8.8%	9.3%	7.4%	7.3%
10.0%-19.9%	33.4%	32.3%	27.9%	29.0%
Poverty Area (20.0%-39.9%)	45.3%	45.7%	46.0%	45.9%
Extreme poverty area (> 40.0%)	9.1%	9.1%	16.1%	15.9%
County-level median income (mean; std)	$39,660 ($16,531)	$39,977 ($16,780)	$36,495 ($14,430)	$35,930 ($12,927)
Facility residence (n;%)	1751 (21.7%)	1876 (19.6%)	4849 (22.3%)	3677 (22.0%)
Years eligible for study, 2006-2010 (mean; std)	3.90 (0.38)		3.63 (0.75)	

All descriptive statistics were stable over the study period. However, enrollees residing in STAR+PLUS counties were more likely to be Hispanic and less likely to be non-Hispanic black or non-Hispanic white compared with those in FFS/PCCM counties. STAR+PLUS enrollees also resided in areas with slightly lower levels of poverty and higher median household income. Distributions of age, gender and health status were similar.

Table 2-2. Enrollee and county sample sizes in transition and comparison counties, by measure.

Measure	Number of enrollees			
	Transition Counties		Comparison Counties	
	Baseline	Post-Baseline*	Baseline	Post-Baseline*
Use of Appropriate Medication for People with Asthma	429	291 - 739	491	352-508
Medication Management for People with Asthma	363	322-599	393	274-386
Pharmacotherapy for COPD Exacerbation	280	308-513	1260	1,034-1,508
Cholesterol Management for People with Cardiovascular Conditions	1420	1,186-1,777	3173	2,989-3,788
Persistence of Beta-Blocker Treatment after a Heart Attack	69	64-87	251	149-194
Comprehensive Diabetes Care	7293	7,827-9,709	20,168	13,036-17,045
Use of Appropriate Medication for People with Asthma	26	24-26	86	70-86
Medication Management for People with Asthma	26	24-26	79	62-79
Pharmacotherapy for COPD Exacerbation	28	25-28	133	121-133
Cholesterol Management for People with Cardiovascular Conditions	28	28	154	126-154
Persistence of Beta-Blocker Treatment after a Heart Attack	11	8-11	46	41-46
Comprehensive Diabetes Care	28	28	207	177-207

* In the Post-Baseline period, data from four years were available; therefore, the range of enrollees/counties included in the analytic sample across these four years is given.

Table 2-2 describes the sample size range (enrollees and counties) by delivery system and outcome measure (see Appendix F, for full observation patterns by group and measure). The enrollee sample was largest for the diabetes care measure, reflecting relatively high prevalence. In contrast, the smallest enrollee sample was for Persistence of Beta-Blocker Treatment after a Heart Attack. Lower proportions of FFS/PCCM counties (225 in total) are represented in each measure compared to STAR+PLUS counties (28 in total), reflecting the smaller populations of many rural FFS/PCCM counties. The sample sizes remained relatively stable over time for each measure.

Table 2-3 provides unadjusted measure adherence rates by delivery system and time period. Measure adherence was similar between groups at baseline. However, baseline adherence rates varied widely between measures. For example, approximately 80% of enrollees with persistent asthma were dispensed at least asthma controller medication, whereas <50% of those enrollees remained on the medication for the majority of the baseline year. In 2006, members discharged with COPD exacerbation received sustained bronchodilator or systemic corticosteroid 55% of time. Members were given long-term beta-blocker therapy for approximately 50% of discharges after a heart attack.

Table 2-3. Unadjusted measure adherence (raw proportions) in transition and comparison counties during the baseline and post-baseline periods.

	Transition counties (STAR+PLUS)						Comparison counties (FFS/PCCM)					
HEDIS Measure	Baseline	Average Post	2007	2008	2009	2010	Baseline	Average Post	2007	2008	2009	2010
Use of Appropriate Medication for People with Asthma	84.6%	82.9%	84.1%	84.9%	82.3%	81.1%	80.0%	77.8%	80.0%	77.8%	78.8%	75.0%
Medication Management for People with Asthma	43.3%	42.9%	42.6%	42.8%	44.6%	41.6%	47.8%	47.0%	45.7%	47.8%	45.9%	48.8%
Pharmacotherapy for COPD Exacerbation	55.5%	82.0%	73.2%	84.7%	82.3%	85.0%	56.6%	57.9%	55.5%	57.2%	58.5%	59.7%
Cholesterol Management for People with Cardiovascular Conditions	74.6%	76.0%	61.6%	78.6%	79.1%	80.9%	76.1%	79.0%	76.8%	79.3%	79.9%	80.0%
Persistence of Beta-Blocker Treatment after a Heart Attack	50.7%	74.2%	54.7%	75.0%	82.8%	79.5%	52.6%	44.8%	47.9%	44.4%	43.6%	42.6%
Comprehensive Diabetes Care	71.7%	73.1%	63.4%	75.0%	75.0%	77.4%	74.5%	75.8%	75.6%	76.1%	74.9%	76.7%

Two of the 6 measures demonstrated sizable pre-post improvements in STAR+PLUS, but not in FFS/PCCM. Beta-blocker treatment after a heart attack increased from 51% in the baseline year to 74% in the post-transition period for STAR+PLUS enrollees; while rates for FFS/PCCM enrollees decreased from 53% to 45%. Similarly, the percentage of STAR+PLUS enrollees who received pharmacotherapy following a hospitalization or emergency department visit for COPD increased from 56% to 82%, while rates for FFS/PCCM enrollees remained stable at 58%. Little change between the pre-post periods was observed for the remaining measures (diabetes, asthma, and cholesterol management).

Table 2-4 provides fit statistics and model-based estimates of the predicted means between groups for the final reduced models. R^2 statistics ranged from 0.166 to 0.517, indicating fair to good model fit. Our model did not converge for the diabetes outcome, and so while the point estimates for this measure are reliable, the standard errors and model fit are undetermined. Also note that the effect of treatment was stable across time (i.e., there was no interaction between time and the STAR+PLUS program variable). Correspondingly, all model-based estimates reflect the predicted county-level average effects of STAR+PLUS implementation on measure adherence across the 4 post-implementation years.

Table 2-4. Model-estimated average post-baseline compliance in transition and comparison counties, and their differences, by measure.

HEDIS Measure	Transition County Proportion	Comparison County Proportion	Mean Difference (Transition - Comparison) (99.167% CI)	p-value (α = 0.05/6 = 0.00833)	Final model R^2 (p-value)
		Respiratory Condition Management			
Use of Appropriate Medication for People with Asthma	0.819	0.801	0.018 (-0.128, 0.164)	.724	0.278 (0.0006)
Medication Management for People with Asthma	0.509	0.494	0.015 (-0.132, 0.161)	.785	0.1663 (0.0023)
Pharmacotherapy for COPD Exacerbation	0.677	0.393	0.285 (0.216, 0.354)	< .001	0.3582 (<.0001)
		Cardiovascular Condition Management			
Cholesterol Management for People with Cardiovascular Conditions	0.763	0.744	-0.020 (-0.239, 0.200)	.697	0.517 (0.0023)
Persistence of Beta-Blocker Treatment after a Heart Attack	0.814	0.495	0.320 (0.068, 0.572)	.001	0.283 (0.011)
		Diabetes Care			
Comprehensive Diabetes Care	0.618	0.638	-0.020 (-1.000, 1.000)	.707	---

The model-based estimates, which were adjusted for control variables, administrative clustering, and correlation between outcomes over time, align closely with the unadjusted results. In STAR+PLUS counties, 28.5% (95% CI: 21.6%, 35.4%) more enrollees received appropriate medication following COPD exacerbation compared to FFS/PCCM counties. In addition, receipt of beta-blocker following heart

attack discharge demonstrated improvement of 32.0% (95% CI; 6.8%, 57.2%) in the STAR+PLUS counties relative to the FFS/PCCM counties. We did not find statistically significant differences for the remaining measures (see Appendix G, for final model coefficients and standard errors).

Discussion

Measuring the impact of Medicaid managed care HCBS waiver programs is critical given rapid expansion of these models nationally. In this study, we examined the effect of the Texas STAR+PLUS HCBS waiver program on the quality of chronic disease care for Medicaid AWD. Our results demonstrate large and sustained improvements in care following both heart attack and COPD exacerbation. However, differences were not observed in the quality of ambulatory care for diabetics or asthmatics, or for cholesterol screening for those with cardiovascular conditions.

Further research is necessary to identify the pathways through which the observed improvements were achieved and the reasons why improvements were not seen in all the measures. However, it is worth noting that the 2 measures for which we found significant improvements, Persistence of Beta Blockers after a Heart Attack and Pharmacotherapy for COPD Exacerbation, focus on care processes linked to an acute event. Thus, it may be that managed care quality improvement protocols were more readily implemented in the context of an acute event. For example, prior-authorization is sought during inpatient admissions concomitant with an acute event, thereby providing care-coordinators a near real-time opportunity to influence care. In contrast, difficulty with patient follow-up for the remaining measures may be a particularly important factor contributing to the lack of significant findings. The immediacy of costs

of poor quality may also be an important motivator for these differences. For example, with the acutely-linked care examined here, the costs of poor quality care are realized quickly in re-admissions and emergency department visits, while the consequences of inadequate ambulatory diabetes care or lipid screening occur over longer time spans.

Our study has several strengths. First, the study was conducted in Texas, which has the second largest Medicaid program in the US. The population in STAR+PLUS is racially and ethnically diverse providing greater insight into the effects of a comprehensive HCBS program in a broad population. Second, this study is based on a natural experiment in which STAR+PLUS was mandatorily phased into different counties for Medicaid AWD, providing a high level of internal and ecological validity. As in all observational studies, there is possibility of residual confounding. However, bias introduced by non-random phase-in is largely attenuated through the study design, which included the baseline value of the outcome and modeled separate slopes for each study group. To threaten internal validity, an external influence would have (1) needed to mirror the implementation of STAR+PLUS, that is occurring only in the transitioned counties and during the same period under study in this analysis and (2) not been closely correlated to the repeatedly-measured contextual and individual control variables.[80]

Our study also has limitations that should be considered when interpreting the results. First, the NCQA-certified software that we used to calculate the chronic care measures uses health care claims and encounter data, the quality of which may be affected by coding practices. As part of ongoing quality of care evaluation for the Texas Medicaid program, we conduct encounter data validation of the administrative claims

data against medical records following CMS external quality review protocols.[81] A random sample of >1,100 medical records for STAR+PLUS are reviewed annually by certified medical record coders and compared to claims/encounter data fields (e.g., ICD-9-CM codes, CPT codes, date of service, place of service, and rendering provider) with >92% agreement, lending confidence in the data quality. Second, Medicaid managed care HCBS waiver programs implemented through MCOs differ throughout the U.S. Therefore, it is possible that the findings in our study are not generalizable to other Medicaid programs. Even so, the pattern of improved care linked to specific acute events, versus that delivered in routine care settings is seen frequently.[82] Further, information about the structure of the STAR+PLUS program is available, and policymakers and health care providers can examine the extent to which the program design characteristics are similar to existing or proposed programs.[8,83-84] Given variability in HCBS programs, future research should examine specific types of HCBS received and their association with quality of care. It also would be prudent to explore potential heterogeneity in program implementation and see if this heterogeneity leads to differences in quality improvements between health plans. Finally, this study examined process of care measures; Future work should examine the extent to which these findings translate into improved health outcomes.

In summary, in one large Medicaid managed care HCBS program, the quality of chronic disease care linked to acute events improved while that provided during routine encounters appeared unaffected. Additional research is needed to further evaluate and refine care for this vulnerable population.

CHAPTER 3
IMPACT OF STAR+PLUS ON BEHAVIORAL HEALTH CARE QUALITY

Background and Significance

Mental and substance-use disorders (i.e. behavioral illnesses) are the leading contributors to disability worldwide.[24,85,86] These disorders portend decreased quality of life, decreased functioning, and dramatic rates of premature mortality.[87,88] Yet despite the profound individual and societal burdens, persons with behavioral illness are much less likely to receive behavioral health treatment or guideline recommended care.[90–92]

In the US, Medicaid is the largest source of funding for behavioral health services[93] with an estimated 35% of non-elderly enrollees having a chronic mental illness and 11.5% suffering from a substance use disorder.[94,53] Most of these individuals qualify for Medicaid by meeting eligibility requirements for disability, effectively concentrating those with high levels of behavioral illness severity and persistence, and high prevalence of co-occurring physical illness, in this group.[11,13,95] In this context, routine and timely behavioral health care and management, especially integrated with other needed health services, is critical. For example, in addition to acute behavioral health and medical illness needs, many Medicaid enrollees with disabilities regularly receive long-term services and supports (LTSS), including assistance with activities of daily living, nursing facility care, adult daycare programs, home health aide services, personal care services, transportation, and supported employment. Correspondingly, lack of coordination of physical and mental health services as well as long-term and acute services are often cited as key barriers to improving quality and value of care for this population.[52,90,96]

In response, and motivated to restrain or ensure greater predictability in state Medicaid budgets, policy makers have experimented with variations in Medicaid service delivery and financing for enrollees qualifying due to disability. Increasingly, states have implemented programs combining traditional comprehensive managed care for acute and outpatient services with managed LTSS, either provided in an institutional setting or through home community-based service (HCBS) alternatives.[10,56,70] For non-elderly Medicaid enrollees with disabilities, this reform has occurred primarily through 1915 (b)/(c) managed care/HCBS waivers and 1115 demonstration waivers, increasing in use from 8 states in 2004 to 18 states in 2014.[58]

Although there exists considerable research on the effects of Medicaid managed care delivery for children, their parents and other relatively healthier low-income beneficiaries, information on managed care for enrollees with severe and persistent physical and behavioral health conditions (i.e. those qualifying due to disability) is limited. In particular, there is an absence of research on care for behavioral health conditions, particularly when examining services delivered through managed care systems that encompass managed LTSS, including HCBS.[97]

The purpose of this study was to examine the effects of a large acute care and HCBS program delivered through managed care organizations (MCOs) in Texas Medicaid, the STAR+PLUS program, on the quality of behavioral health care for individuals qualifying for Medicaid due to disability. A primary focus of STAR+PLUS is to improve care by delivering acute services and LTSS through a single system; employing service coordinators who develop individual care plans and assist enrollees in receiving needed care; and emphasizing HCBS alternatives to institutional care.[98] At

the same time, STAR+PLUS employs a fully capitated health care delivery model, which can result in ambiguous effects on care (including behavioral health care) provision. For example, MCOs often employ mechanisms to restrict access to certain types of care, namely expensive or low value care, yet efficacious or high value services may be simultaneously limited. Conversely, MCOs typically implement programs to increase disease management and receipt of recommended care, in order to slow health declines and prevent future higher-cost utilization.

The importance of encouraging more timely and routine behavioral health care seems especially salient given the role of behavioral health on overall functioning, costs and care for co-existing physical conditions. Thus, we hypothesized that the quality of behavioral health care would improve after STAR+PLUS enrollment and relative to a comparison group that remained enrolled in FFS or Primary-Care Case-Management (PCCM).

Methods

Overview

Over the past two decades, the state of Texas has legislatively mandated the transition of Medicaid service delivery from FFS and PCCM models to STAR+PLUS for adults receiving SSI for their disabilities. STAR+PLUS was first implemented in Harris County in 1998. Nine years later, in January and February of 2007, STAR+PLUS expanded to 28 additional counties. In February and September of 2011, and in March of 2012 STAR+PLUS was expanded to an additional 13, 21 and 27 counties, respectively.[62] In September 2014, STAR+PLUS was expanded to the state's remaining 164 counties, comprising the Medicaid Rural Service Areas (MRSAs). (Figures 1-3 and 1-4 provides more detail on implementation of the STAR+PLUS on the timing and

counties affected by the transition). This phased implementation by county provides an opportune natural experiment that can be analyzed with high levels of ecological and internal validity.

The approach used in this study is similar to that described previously.[99] We estimate the intermediate-term (4-year) changes in behavioral health care for the initial primary STAR+PLUS implementation: January/February 2007. To accomplish this, we used a generalization of the commonly employed difference-in-difference (DD) framework – also known as a longitudinal time-trend or pre-post design with comparison group. More specifically, among eligible enrollees living in the counties which transition to STAR+PLUS, we estimated the change between the outcome measured during the post-implementation period and the outcome measured in the pre-implementation period, adjusted for potential confounding factors as described below. Then, we compared this difference to the corresponding adjusted change experienced by eligible enrollees living in counties remaining in FFS or PCCM models during the same time period.

To improve communication of the analysis plan and proposed group composition for the analysis we defined 6 STAR+PLUS implementation groups (A-F) comprising all Texas counties. Figure 1-4 displays these groups in an implementation graphic; this type of figure is commonly reported in stepped-wedge designs, which share many features of this study, except for the non-randomized ordering of program implementation. (Appendix A provides specific detail on the counties included in each group).

To examine the intermediate-term effects of the January/February 2007 implementation, outcomes reflecting 2006 (pre) and 2010 (post) were utilized. A single post-implementation year was selected to limit computational complexity of modeling an imbalanced longitudinal cluster design; the latest year (2010) for which data was available was selected to ensure sufficient time for implementation of the program. The experimental group was comprised of group B, the 28 counties in which STAR+PLUS was implemented in early 2007. The comparison group was selected from counties that were legislated to transition to STAR+PLUS after 2010, groups D, E and F. Note that group C (comprised of Dallas and Tarrant service areas) was not used in assembling comparison counties because Texas implemented an Integrated Care Management (ICM) program in these regions from February 2008 – May 2009. The ICM program is comparable in form to a non-capitated version of STAR+PLUS.[69]

Enrollees in a non-transitioned area were receiving care from either FFS or PCCM health care delivery models. We did not distinguish between FFS and PCCM in our analyses based on research indicating few differences among adult Medicaid enrollees and those with disabilities in particular.[62,100–102] In addition, comparison of the control variables and pre-implementation quality of care between FFS and PCCM revealed only small differences. Our university's Institutional Review Board approved this study.

Sample and Data

Since only enrollees >21 years old were mandatorily transitioned to STAR+PLUS and Medicare data was unavailable for our sample, we restricted our analysis to adults 21-64 years of age who qualified for Medicaid due to disability, but who were not dual-eligible. This sample is further evaluated for eligibility for each outcome measure,

according to HEDIS definitions, resulting in different samples for each outcome analysis.

Person-level administrative enrollment and encounter data provided by the Texas Health and Human Services Commission were used to obtain enrollees' age, sex, race/ethnicity, county, monthly enrollment, and delivery model. Enrollment records were linked to professional, inpatient and pharmacy encounter data that included International Classification of Diseases (ICD-9-CM) diagnosis codes, Current Procedural Terminology codes, and National Drug Codes. These data were supplemented with county-, Zip Code Tabulation Area-, and census tract-level data from the Area Resource File, US Census Bureau, and US Department of Commerce to capture geographic contextual factors.

Outcome Measures

Encounter data was assessed using National Committee for Quality Assurance (NCQA)-certified software to calculate enrollee-level HEDIS behavioral health care measures for the calendar years 2006 and 2010. We selected 3 measures, each with 2 submeasures: 7- and 30-day follow-up after inpatient hospitalization for mental illness; initiation of and engagement in alcohol and other drug dependence treatment after a new episode of dependence; and short (12 weeks) and longer-term (6 months) coverage of antidepressants for those with depression. These measures were selected because they reflect quality of care for the Agency for Health Care Research and Quality's "Priority Conditions"[103] and were suggested by the Centers for Medicare & Medicaid Services as initial health care quality core measures for adults enrolled in Medicaid.[104] Strong performance on these indicators is linked to improved health outcomes.[105] The dichotomous indicator of compliance for each submeasure was

modeled and reported separately to provide more nuanced information on the quality of care.

Explanatory and Control Variables

For each enrollee-year, we computed the main predictor variable, time enrolled in STAR+PLUS in a given post-transition year, thus capturing any instances of differential transition timing and scale-up or partial Medicaid enrollment.

Although the pre-post design with comparison group provides some protection against selection bias, we controlled for enrollee-level and county-level characteristics which could influence the outcome and associate with enrollment in STAR+PLUS, as directed by the IOM's social risk factors framework and Andersen's health care delivery model.[106,107] Age, gender, and race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and other) were assigned using demographic information contained in the enrollment files. Because we do not have a specific indicator for group living facility, we constructed a variable to indicate if 5 or more enrollees were residing at the same address. This variable allowed us to distinguish between those residing in an individual residence as opposed to a group living arrangement.

Health status was measured using the 3M Clinical Risk Groups (CRGs), which uses ICD-9-CM diagnosis codes from health care encounters to assign individuals to hierarchically defined health status groups.[108]To be classified, individuals must have been enrolled for at least 6 months. Individuals were classified into the following health status categories: healthy, significant acute conditions (e.g., chest pain), minor chronic conditions (e.g., migraine), moderate chronic conditions (e.g., asthma and diabetes), or major chronic conditions (e.g., cystic fibrosis and cancer). Those who did not have a

sufficient enrollment history to be classified into one of the preceding categories were treated as missing values.

Contextual variables included the percentage of the population living in poverty, percentage of the population unemployed, and median household income, all assigned using the enrollee's census tract, (or Zip Code Tabulation Area if valid census tract was unavailable). Median county income was also included. These data were obtained from the Area Health Resource File, U.S. Census Bureau and U.S. Department of Commerce. We also included a variable measuring density of Medicaid health care utilization (Medicaid inpatient discharges per Medicaid enrollee), assigned by county, from the Area Health Resource File.

The full models also included 2-, 3-, and 4-way predictor interactions, between race/ethnicity, gender and the main explanatory variable.

Clustering Unit

Although service areas represent administrative clustering and the approximate unit at which STAR+PLUS was implemented, there are too few units to have sufficient statistical power. In addition, some service areas were transitioned in phases. Accordingly, we selected an intermediate clustering unit (county), which provides sufficient power and accounts for potential non-independence among enrollees. The county reasonably represents the context within which enrollees seek health care and captures administrative similarity of the care environment, such as available health care resources that impact health service use.

Empirical Model and Analyses

We employed a longitudinal design widely used in analyzing clinical trials. This design was analyzed using a 2-stage, multilevel approach using general linear

models.[78] First, we computed person-level models separately for the post-transition year (2010) and outcome, assuming compound symmetry correlation structure between participants nested by county. Using individually adjusted averages and weights derived from cluster sizes and intracluster correlation, we then built the second tier model for each outcome. We applied standard collinearity approaches to reduce the predictor space when computationally necessary.[109] Fixed-order backwards selection of predictor variables with $\alpha = 0.05$ was used to arrive at the reduced models. Assumption diagnostics were conducted for the final models; no major concerns with linearity, homogeneity or Gaussian distribution of residuals were noted. We performed sensitivity analyses of our results, whereby influence points, if detected, were removed. Predicted marginal means, including 95% confidence intervals were produced for the main explanatory variable. Analyses were conducted using R (Version 3.3.0 ;) and Rstudio (Version 0.99.902) using lme4 (Version 1.1.12) and lsmeans (Version 2.23) packages for the main analyses and model summarization.[110-113]

It is important to note that this modeling approach is a mathematical generalization of a difference-in-difference (DD) approach, where the standard DD model compares differences between 2 groups at 2 timepoints to isolate and test the presence of an effect, assumed to be a deviation from the baseline difference.[114] Our generalized approach relaxes the DD parallel trend assumption requiring similar rates of growth between groups by allowing for differing slopes. This approach also improves computational convergence for unbalanced cluster - a characteristic of our data due to extremely unequal county sizes. See Appendix C for more detail on this novel modeling approach for analyzing longitudinal clustered designs.

Recent analyses of quality of care measures using data derived from the entire population reveal low levels of enrollee-month missingness (<5%) for response or main individual level covariates.[99] For these data, list-wise deletion was performed.

Results

The overall study sample was comprised of 9645 enrollees clustered across 214 Texas counties, with ~90% cases with complete data. The subgroup of enrollees eligible for the initiation and engagement in alcohol/drug treatment measures represented the largest subgroup, with 6529 enrollees. Table 3-1 provides a summary of demographic, health and contextual characteristics for the study population eligible for at least one of the studied measures, as well as by measure subgroup.

Table 3-1. Demographic health and contextual characteristics for the study population

	Combined	Antidepressant Medication Management Subgroup	Follow-up After Hospitalization for Mental Illness Subgroup	Initiation and Engagement of Alcohol and Other Drug Dependence Treatment Subgroup
Unique enrollees	9645	1291	3150	6529
Unique counties	214	146	173	205
Enrollees with complete data	8661 (89.8)	1196 (92.6)	2775 (88.1)	5893 (90.3)
Counties with complete data, by year	209 (97.7)	140 (95.9)	165 (95.4)	201 (98)
Counties with complete data in post and pre-years		140 (95.9)	165 (95.4)	201 (98)
Age [mean (SD)]	44.4 (11.3)	46.1 (11.6)	41 (11.5)	44.9 (10.9)
Age categories [n (%)]				
21-30	1333 (13.8)	156 (12.1)	664 (21.1)	778 (11.9)

Table 3-1. Continued

	Combined	Antidepressant Medication Management Subgroup	Follow-up After Hospitalization for Mental Illness Subgroup	Initiation and Engagement of Alcohol and Other Drug Dependence Treatment Subgroup
30-39	1674 (17.4)	199 (15.4)	683 (21.7)	1106 (16.9)
40-49	3081 (31.9)	368 (28.5)	981 (31.1)	2168 (33.2)
50-59	2739 (28.4)	395 (30.6)	668 (21.2)	1931 (29.6)
60-64	818 (8.5)	173 (13.4)	154 (4.9)	546 (8.4)
Female [n (%)]	4979 (51.6)	904 (70)	1854 (58.9)	2912 (44.6)
Race/ethnicity [n (%)]				
Non-Hispanic black	1818 (18.8)	169 (13.1)	561 (17.8)	1339 (20.5)
Hispanic	3030 (31.4)	544 (42.1)	959 (30.4)	1973 (30.2)
Other	548 (5.7)	87 (6.7)	182 (5.8)	337 (5.2)
Non-Hispanic white	4249 (44.1)	491 (38)	1448 (46)	2880 (44.1)
Health status [n (%)]				
Healthy	278 (3.1)	69 (5.7)	3 (0.1)	211 (3.5)
Significant acute	91 (1)	14 (1.1)	0 (0)	77 (1.3)
Minor chronic	182 (2)	83 (6.8)	2 (0.1)	100 (1.7)
Moderate chronic	2208 (24.9)	274 (22.5)	759 (26.6)	1524 (25.2)
Major chronic	6124 (68.9)	779 (63.9)	2094 (73.3)	4144 (68.4)
Health status not available	762 (7.9)	72 (5.6)	292 (9.3)	473 (7.2)
County metro classification [n (%)]				
Large metro (>1M)	3176 (32.9)	461 (35.7)	1157 (36.7)	2097 (32.1)
Medium metro (250K – 1M)	2260 (23.4)	386 (29.9)	719 (22.8)	1431 (21.9)
Small metro (<250k)	1969 (20.4)	215 (16.7)	622 (19.7)	1365 (20.9)

Table 3-1. Continued

	Combined	Antidepressant Medication Management Subgroup	Follow-up After Hospitalization for Mental Illness Subgroup	Initiation and Engagement of Alcohol and Other Drug Dependence Treatment Subgroup
Adjacent to metro	1604 (16.6)	154 (11.9)	465 (14.8)	1190 (18.2)
Nonadjacent to metro (>20k)	350 (3.6)	36 (2.8)	119 (3.8)	233 (3.6)
Nonadjacent to metro (<20k)	286 (3)	39 (3)	68 (2.2)	213 (3.3)
Census tract poverty [mean (SD)]	23.9 (12.8)	25.7 (13.5)	23.2 (12.8)	23.9 (12.6)
Census tract poverty categories [n (%)]				
0.0% - 4.9%	274 (2.9)	33 (2.6)	97 (3.1)	170 (2.7)
5.0% - 9.9%	844 (8.9)	97 (7.6)	324 (10.5)	550 (8.6)
10.0% - 19.9%	3103 (32.7)	367 (28.8)	1024 (33.2)	2115 (33)
Poverty area (20.0% - 39.9%)	4121 (43.5)	579 (45.5)	1292 (41.9)	2834 (44.2)
Extreme poverty area (> 40.0%)	1135 (12)	197 (15.5)	345 (11.2)	743 (11.6)
Census tract not available	168 (1.7)	18 (1.4)	68 (2.2)	117 (1.8)
Census tract unemployment level [n (%)]				
0.0% - 4.9%	1804 (19)	222 (17.4)	603 (19.6)	1213 (18.9)
5.0% - 9.9%	4588 (48.4)	617 (48.5)	1460 (47.4)	3126 (48.8)
10.0% - 19.9%	2931 (30.9)	421 (33.1)	969 (31.5)	1957 (30.5)
> 20.0%	153 (1.6)	13 (1)	49 (1.6)	115 (1.8)
Census tract not available	169 (1.8)	18 (1.4)	69 (2.2)	118 (1.8)

Table 3-1. Continued

	Combined	Antidepressant Medication Management Subgroup	Follow-up After Hospitalization for Mental Illness Subgroup	Initiation and Engagement of Alcohol and Other Drug Dependence Treatment Subgroup
Census tract household income [mean (SD)]	38215.6 (15467.6)	36589.6 (14893.3)	39124 (15789.4)	37957.5 (15218.1)
County Medicaid discharge density [mean (SD)]	1 (0.6)	1.1 (0.6)	1 (0.6)	1 (0.6)
Census tract determined from address [n (%)]	7669 (79.5)	1045 (80.9)	2473 (78.5)	5190 (79.5)
Facility residence [n (%)]	2036 (21.4)	273 (21.4)	716 (23)	1323 (20.6)
Months enrolled in Medicaid [n (%)]				
12	7585 (78.6)	1109 (85.9)	2408 (76.4)	5159 (79)
9 - 11	1016 (10.5)	103 (8)	350 (11.1)	714 (10.9)
5 - 8	628 (6.5)	36 (2.8)	227 (7.2)	418 (6.4)
2 - 5	414 (4.3)	41 (3.2)	165 (5.2)	238 (3.6)
1	2 (0)	2 (0.2)	0 (0)	0 (0)
STAR+PLUS transition cohort [n (%)]				
A	0 (0)	0 (0)	0 (0)	0 (0)
B	3886 (40.3)	554 (42.9)	1420 (45.1)	2553 (39.1)
C	0 (0)	0 (0)	0 (0)	0 (0)
D	761 (7.9)	87 (6.7)	239 (7.6)	547 (8.4)
E	1720 (17.8)	318 (24.6)	464 (14.7)	1114 (17.1)
F	3278 (34)	332 (25.7)	1027 (32.6)	2315 (35.5)

There are several important aspects to note. First, as expected, the study population has significant morbidity, with approximately two-thirds belonging to the most severe health status category. Second, more than half of the study population lives in locations deemed poverty or extreme poverty areas, portending the challenging context

in which these patients live. Third, nearly 20% of the study population lives at addresses with 5 or more enrollees, suggesting either a high degree of institutionalization or high levels of residential clustering in this population. Fourth, we observed high levels of continuous enrollment, with more than 85% of the sample enrolled in Medicaid for more than 9 months in the year. Almost the entire study population lives in metropolitan or adjacent areas. The majority of the study population is non-white or Hispanic.

In addition, many sample characteristics vary by the measure being evaluated, reflecting differences in the subpopulations being diagnosed with or presenting for the qualifying conditions (i.e. depression, mental illness hospitalization, and drug/alcohol hospitalization/emergency department visit). Those hospitalized for mental illness are younger, with more than 40% under 40 years of age. Seventy percent of those qualifying for the antidepressant management measure are female, compared to only 45% of the subgroup presenting acutely with an alcohol/drug-use disorder.

Table E-1 demonstrates that only a small proportion (~20%) of the study population was eligible for multiple measures. The most common dyad or triad was having both a qualifying mental illness hospitalization and a substance abuse diagnosis during a hospitalization/emergency department visit (14%). Tables E2–4 present separate descriptive statistics for the transition and comparison groups for each measure. The large majority of characteristics are very similar between groups, except for race/ethnicity and metropolitan classification. Enrollees from transition counties were almost twice as likely to be Hispanic; much of this difference is attributable to a lesser proportion of white, non-Hispanic enrollees. Enrollees in transition counties were more likely living in large metropolitan areas (~80%) as compared to those from comparison

counties who were living in medium, small and adjacent metropolitan areas. Of note, the characteristics demonstrated stability over time. For patients hospitalized with mental illness, individuals were eligible for the measure multiple times per year, however, three-quarters met eligibility criteria only once, and ~16% qualified for the measure twice.

The total sample size for each measure (over time) by group is presented in Figure D-1 and a summary of the number of observations per county is presented in Table E-6. Changes in sample size over time and the degree of clustering by county were similar between the groups. Figure D-2 provides a spatial description of the sample sizes by group.

Table 3-2. Weighted, unadjusted measure performance

Measure Type	Measure Sub	Group	2006	2007	2008	2009	2010
Antidepressant Medication Management	3 months	Comparison	64.0	58.5	55.7	57.4	54.5
		Transition	54.6	57.0	51.8	53.0	52.2
	6 months	Comparison	45.1	43.4	38.0	39.4	39.3
		Transition	36.2	36.1	38.5	37.4	39.7
Follow-up After Hospitalization for Mental Illness	7 day	Comparison	18.2	18.9	18.4	20.3	20.5
		Transition	20.7	11.2	14.9	22.7	27.3
	30 day	Comparison	41.1	40.6	36.8	44.8	45.6
		Transition	43.7	19.0	27.4	49.4	51.8
Initiation and Engagement of Alcohol and Other Drug Dependence Treatment	Initiation	Comparison	46.4	46.6	36.8	34.4	32.8
		Transition	45.4	44.8	38.0	34.8	35.5
	Engagement	Comparison	4.2	2.7	3.7	2.5	3.2
		Transition	3.9	2.8	4.8	3.0	5.8

Weighted, unadjusted outcome measure performance is illustrated in Table 3-2 and Figure D-3. Across all measures, compliance is rarely greater than 50%, except for the measure reflecting antidepressant medication receipt for the 3 month period following a new depression diagnosis. For some measures, compliance is very low,

including rates of follow-up within 7 days following hospitalization for mental illness and intermediate-term engagement in alcohol/drug treatment.

During the baseline year, transition and comparison counties appeared to have similar rates of follow-up after hospitalization for mental illness and initiation/engagement of substance abuse treatment. However, during the same baseline period, enrollees in transition counties were about 10% less likely than those in comparison counties to receive antidepressant mediations. There was notable variation in measure performance over the transition period.

Table 3-3 provides the predicted marginal means during 2010 for each measure. Of note, differences between comparison and transitioned counties were not significant, except for engagement in substance abuse treatment following a hospitalization/emergency visit with substance abuse diagnosis. For this measure, transition counties were twice as likely to engage eligible patients in substance abuse care -- that includes both initiating substance abuse care, and ensuring receipt of two or more additional related services within the subsequent 30 days. Yet, expressed on an absolute scale, the difference due STAR+PLUS is small, at 3%.

Sensitivity analyses involving the removal of influential points was not found to substantially impact these results.

Table 3-3. Predicted marginal means during 2010, by measure.

Measure	Measure Sub	FFS/PCCM (Comparison)	STAR+PLUS (Transition)	Difference	p-value
Antidepressant Medication Management	3 months	0.55 (0.52-0.58)	0.51 (0.46-0.55)	-0.04	0.119
	6 months	0.39 (0.35-0.42)	0.39 (0.34-0.44)	0.00	0.909

Table 3-3. Continued

Measure	Measure Sub	FFS/PCCM (Comparison)	STAR+PLUS (Transition)	Difference	p-value
Follow-up After Hospitalization for Mental Illness	7 day	0.22 (0.20-0.25)	0.25 (0.19-0.31)	0.02	0.491
	30 day	0.47 (0.44-0.50)	0.52 (0.47-0.58)	0.05	0.097
Initiation and Engagement of Alcohol and Other Drug Dependence Treatment	Initiation	0.32 (0.30-0.34)	0.34 (0.30-0.38)	0.03	0.241
	Engagement	0.03 (0.03-0.04)	0.06 (0.05-0.07)	0.03	0.000

Discussion

Measuring the impact of Medicaid managed care and HCBS on quality of behavioral health care is critical, given the high prevalence, cost and quality of life impacts associated with poorly managed behavioral health conditions.[115] In this study, we found that the Texas STAR+PLUS program did not affect rates of follow-up after mental illness hospitalization or linkage to substance abuse treatment after a new substance abuse diagnosis. Additionally, STAR+PLUS was not associated with increased antidepressant medication receipt within either 3 or 6 months following a new depression diagnosis. However, STAR+PLUS did significantly increase rates of more sustained engagement with substance abuse treatment, although the absolute increase was small (3%).

To our knowledge, no studies have examined the impact of managed care on behavioral health care delivery for Medicaid patients with disabilities. Recently however a few studies have examined the role of various emerging payment reforms on

behavioral health care. For example, Busch[116] found that implementation of accountable care organizations in Medicare was not associated with changes in follow-up after mental health admissions, rates of depression diagnosis or mental health readmissions spending. Barry[117] found slight decreases in mental health care use, but not in mental health spending in an analysis of a global payment model in Massachusetts. Thus, similar to our analysis, global payment reforms have not been shown to have substantial impact on behavioral health care delivery.

There are several explanations for the limited STAR+PLUS effect on the selected behavioral health measures. First, all of these measures essentially require engagement in outpatient care after an acute episode -- an episode marking a period of considerable instability and morbidity in a patient's life. Although STAR+PLUS utilized care coordinators and other follow-up supports, it is unclear whether such services were targeted towards acute behavioral health needs. Complex social and economic barriers often occurring in Medicaid populations could also have diminished the impact of any provided supports. Furthermore, the very conditions for which the enrollees need treatment - mental illness or substance abuse disorder - can lead to cognitive and behavioral impediments to engagement in care, especially in comparison to many physical health conditions. Thus, the low rates of measure performance may require considerable system redesign or additional investments to realize any substantial gains.

In a related manner, there is a well-known shortage of mental health providers, particularly those serving Medicaid, and this may inhibit the formation and growth of satisfactory managed care organization provider networks.[118] Many managed care organizations have limited experience delivering behavioral health services, as these

provisions have historically been carved out. Finally, it is likely that managed care organizations, similar to accountable care organizations in Medicare, were focused on alternative health care priorities during initial implementation.[116]

In addition to examining the impact of STAR+PLUS, we found unsatisfactory performance for all behavioral health measures, regardless of study group. This poor performance was fairly stable over time. Even further, several rates were substantially below national averages published by NCQA.[119] For example, in 2010, 43% of Medicaid managed care patients nationally received follow-up after hospitalization for a mental illness within 7 days, but only 22-25% in our sample received this level of care. Rates of initiation of substance abuse treatment in our sample were also lower than national rates (32-34% vs 43%), and rates of intermediate-term engagement were roughly one-third the national average (3-6% vs 14%). Receipt of antidepressant medications after a new depression diagnosis approximated national rates of 50% and 34% at 3 and 6 months, respectively. However, even meeting these low national averages is insufficient, since this means that two-thirds of patients with depression have not received sufficient antidepressant treatment in the 6 months following their diagnosis. The implementation of the Mental Health Parity and Addiction Equity Act of 2008, for which final rules for Medicaid were published in March 2016, may signal a shift in focus towards behavioral health care, although many remain skeptical that this will result in substantial change.[120, 121]

Our study offers several contributions to the literature. It focuses on non-elderly adults in Medicaid qualifying due to disability -- a historically understudied group. Second, most research on HCBS has examined health care expenditures or access to

care rather than specific quality indicators, particularly for behavioral health.[5,17] Third, we study a program with mandatory enrollment, overcoming the limitation of potential selection bias in prior research on waiver programs with voluntary enrollment.

Several considerations are necessary to contextualize these results. First, Medicaid-managed care programs differ throughout the United States. For example, Duggan and Hayford[122] discuss the importance of financing and organizational arrangements in moderating the effect of Medicaid managed care on expenditures. Therefore, it is possible that our findings may not be generalizable to other Medicaid programs. Even so, the information gained will be directly relevant for more than 1 million adults in Texas Medicaid program. The population in STAR+PLUS is also racially and ethnically diverse providing greater insight into the effects of a comprehensive HCBS program in a broad population. Further, information about the structure of the STAR+PLUS program is available, and policymakers and health care providers can examine the extent to which the program design characteristics are similar to existing or proposed programs.

The possibility of residual confounding must also be considered, particularly as it relates to the appropriateness of the comparison group. The Texas legislature selected areas for initial implementation based on the presence of a strong health care infrastructure to increase the likelihood of successful program implementation. As presented above, these were more likely to include larger metropolitan areas. However, few large metropolitan areas were present in the comparison sample. This was mainly due to the exclusion of the Dallas-Fort Worth metropolitan area, as these counties were undergoing a separate health care delivery reform pilot from 2008-2010. If metropolitan

size is related to differential change in measure performance over time, the limited overlap between the groups on this characteristic may predispose to bias.

Finally, because we have focused on only one post-transition year, it is possible that the results differ by measure timing, and may not reflect the average change due to the transition or shorter term differences (1-3 years post-transition). However, review of weighted, unadjusted compliance suggests that large effects are unlikely. Furthermore, the absence of effect at the 4th year post-transition is a meaningful result and suggests that STAR+PLUS does not have extended effects on quality of behavioral health care.

CHAPTER 4
IMPACT OF STAR+PLUS ON RECEIPT OF PREVENTATIVE CARE

Background and Significance

Managed care has received continued attention from state policy makers as a model for delivering health care services to individuals qualifying for Medicaid due to disability.[57,64] Increasingly these models have combined managed acute care with managed long-term-services and supports, including home and community based service alternatives, through dual 1915(b)/(c) or 1115 waivers.[9] These trends continue despite limited evidence of the programs' impacts on access to care and preventive care provision.

Managed care is premised on promoting more efficient utilization of health care services by encouraging uptake of high-value preventive and ambulatory care to avert, attentuate or possibly substitute for costly emergency and inpatient-based care. This health care delivery model holds particular promise for individuals with disabilities, who experience substantial gaps in receipt of guideline-recommended screening and preventive care.[123–125] Those qualifying for Medicaid due to disability also experience well-documented challenges in accessing ambulatory and specialty physican care.[59,66] The importance of timely and routinue care is particulary pronounced given the high prevelence of multiple risk factors for cardiovascular and cancer morbidity and mortality in this population, such as high rates of smoking, obesity, and limited physical activity.[126,127]

Despite this promise, there is concern that commonly employed managed-care tools (e.g. pre-authorization including required-referrals, provider networks, formularies) aimed to reduce ineffcient care will simulatanously limit access to and utilization of

desired or high-value services. Under fixed revenue streams (i.e. capitation), this organizational behavior might be particularly incentivized because already low provider rates restrict the ability of managed care organizations to negotiate down prices. Furthermore, under a short-term (i.e. monthly) capitation horizon, the increased costs associated with disease progression due to inadequate preventive care may not be borne by managed care organizations.

Of the limited literature on managed care for adults qualifying due to disability, the results on access and receipt of preventive care have been null or uncertain. Burns[59] found that beneficiaries in mandatory managed care were more likely to report waiting to see a provider, difficulty obtaining specialty care and not receiving a flu shot. Yet these same beneficiaries were also more likely to have a usual source of care compared to enrollees receiving care through Fee-For-Service (FFS), a traditional delivery model. Using the National Health Interview Survey, Coughlin, Long and Graves[62] explored access to care, flu shot receipt and use of primary care providers, specialty physicians and the emergency department for disabled Medicaid enrollees by their counties' managed care status. The main finding revealed increases in the usual source of care reported by Medicaid adults with disabilities in managed care counties. A recent analysis by Caswell and Long[128] was unable to detect differences in access or expenditures for disabled enrollees, likely due to a relatively small overall sample (n = 1000). In a study by our group using enrollee-level encounter data from Texas, we found mixed improvements in quality of chronic disease care resulting from managed care implementation, relative to FFS and Patient-Centered Case-Management (PCCM).

There were increases in quality of care following acute inpatient events, but no changes in ambulatory care for diabetes, asthma and cardiovascular conditions.[99]

Responding to the call by Caswell and Long[128], and expanding on our previous work, this study seeks to provide information on the impacts of a compreshensive managed care program in Texas Medicaid – the STAR+PLUS program – on the receipt of screening for cancer and access to ambulatory care, for individuals qualifying for Medicaid due to disability. STAR+PLUS is more extensively described elsewhere.[98] In brief, the program delivers acute and long-term services by contracting with managed care organizations (MCOs). These MCOs develop primary and specialty provider networks, employ service coordinators who develop individual care plans and assist enrollees in receiving needed medical and community services, implement disease management programs, and emphasize HCBS alternatives to institutional care.[98]

Given the intended role of managed care on promoting higher value care, we hypothesized that receipt of recommended cancer screenings and access to care would increase after STAR+PLUS enrollment relative to a comparison group that remained enrolled in FFS or PCCM.

Methods

Overview

In 1998, the state of Texas piloted a new Medicaid service delivery model in Harris county by contracting with managed care organizations to provide acute and long-term supports to enrollees qualifying due to disability in lieu of the previous FFS and PCCM delivery models. Following continued cost-pressures, the Texas legislature mandated the expansion of this program, STAR+PLUS, to 28 additional counties in early 2007.[62]Since this time, STAR+PLUS has been expanded to all Texas counties.

We defined 6 STAR+PLUS implementation groups (A-F) to aid in communication of these transitions and our ultimate analytic design. (Figure 1-3 provides more detail on implementation of the STAR+PLUS on the timing and counties affected by the transition; Appendix A provides specific detail on the counties included in each group). Note that the phased manner of STAR+PLUS implementation serves as a unique natural experiment on which to base our analysis.

In this paper, we focus on examining the impact of the first main expansion of STAR+PLUS, occurring in January and February of 2007. We have chosen to focus on only this earlier transition to allow for construction of "treated" and comparison groups with sufficient post-transition follow-up, since data availability lags by several years. Furthermore, this focus is motivated by gaining a more nuanced understanding of the findings presented previously in Wegman et al (2015) which were centered on the same 2007 transition.[99]

Our design employs a generalization of a difference-in-difference approach.[114]In this, we estimate the change in the outcome from the pre-implementation period to the post-implementation period among our target sample living in counties transitioned in 2007, adjusting for potential confounding variables. We then compare this change to that experienced by a similar sample during the same timeframe living in counties not transitioned to the STAR+PLUS delivery model during the study period.

We sought to examine the intermediate effects of the 2007 transition. Data from 2006-2010 was available from Texas HHSC for use in this analysis. Accordingly, data from 2006 provided information on pre-implementation measure performance. A single post-implementation year was selected to limit the computational complexity of an

imbalanced longitudinal cluster design and based on previous research which demonstrated stability in measure performance during the post-implementation years.[99] The latest year for which data was available (2010) was selected as the post-implementation data period to ensure sufficient time for implementation of the program and maximal programmatic effect.

The transition group was comprised of selected enrollees living in the 28 counties in which STAR+PLUS was implemented in early 2007 (i.e. group B). The comparison group was comprised of selected enrollees living in counties which were transitioned to STAR+PLUS after 2010 (i.e. groups D, E and F). Enrollees in group C (comprised of Dallas and Tarrant service areas) were not included in the comparison group because Texas implemented an Integrated Care Management (ICM) program in these regions from February 2008 – May 2009. The ICM program is similar in form to a non-capitated managed care service delivery model.[69]

Selected enrollees in a non-transitioned county were receiving their health services from either FFS or PCCM healthcare delivery models. Our analyses do not distinguish between FFS and PCCM based on the similarity of these delivery models and previous research indicating similar quality of care among relatively healthier adult Medicaid enrollees receiving care from these models.[100–102] In addition, one previous study of Medicaid managed care for enrollees with disabilities found that PCCM does not appear to differentially impact access to care.[62,] The University of Florida's Institutional Review Board approved this study.

Sample and Data

We began by selecting individuals enrolled in Medicaid during 2006 and/or 2010, and living in the counties discussed above. We then restricted our sample to adults >21

years old, as enrollees younger than 21 were not required to enroll in STAR+PLUS in the transitioned counties. We further focused our study eligibility on enrollees <65 and those who were not dual-eligible as the purpose of this analysis was to understand the impact of managed care on non-elderly adults who were not also receiving Medicare. We followed HEDIS definitions separately for each measure to arrive at measure-specific samples.

We abstracted enrollees' age, sex, race/ethnicity, county of enrollment and monthly enrollment information from person-level enrollment and encounter data provided by the Texas Health and Human Services Commission. We also linked enrollment records to professional, inpatient and pharmacy encounter data that included International Classification of Diseases (ICD-9-CM) diagnosis codes, Current Procedural Terminology codes, and National Drug Codes for use with NCQA-certified software to calculate enrollee-level HEDIS measures for the calendar years 2006 and 2010. Using enrollee-level address information when available, we incorporated county-, Zip Code Tabulation Area-, and census tract-level data from the Area Health Resource File, US Census Bureau, and US Department of Commerce.

Outcome Measures

We selected 4 outcome measures to examine the impact of STAR+PLUS on receipt of preventive health care: receipt of routine screening for colorectal cancer, for cervical cancer and for breast cancer (i.e. mammography) and access to ambulatory care. Centers for Medicare & Medicaid Services suggested these as initial core quality measures for adults enrolled in Medicaid.[104] Furthermore, strong performance on these indicators is linked to improved health outcomes.[119]

Explanatory and Control Variables

The main explanatory variable was constructed as the amount of time a given individual was enrolled in STAR+PLUS during the evaluated post-transition year (2010). Accordingly, this variable captured differential transition timing or partial Medicaid enrollment.

We controlled for enrollee and contextual characteristics which could confound the relationship between STAR+PLUS enrollment and the preventive care measures. Selection of these variables was based on IOM's social risk factors framework and Andersen's healthcare delivery model.[106, 107]

Demographic control variables included age, age-squared, gender (male and female), and race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and other). Health status was measured using the 3M Clinical Risk Groups (CRGs), which were assigned using health care encounter data.[108] Individuals were assigned to one of the following categories: healthy, significant acute conditions (e.g., chest pain), minor chronic conditions (e.g., migraine), moderate chronic conditions (e.g., asthma and diabetes), or major chronic conditions (e.g., cystic fibrosis and cancer). These health status categories were then recoded as a polynomial function reflecting health status. Patients enrolled for less than the 6 months required for classification were assigned missing values.

Many individuals qualifying for Medicaid due to disability require long-term supports; some of these individuals live at assisted living facilities, while others live in low-occupancy homes in the community or group-style independent living facilities. Access to care may be different in group-living arrangements, particularly assisted living facilities where health care providers are often co-located. However, our data did not

include a specific indicator designating whether an individual resided in such a facility. For this reason, we constructed a proxy variable to indicate if 5 or more enrollees were residing at the same address.

Using data from the Area Health Resource File, U.S. Census Bureau and U.S. Department of Commerce, we controlled for several contextual variables in our analysis. These included the percentage of the population living in poverty, percentage of the population unemployed, and median household income, all assigned using the enrollee's census tract, (or Zip Code Tabulation Area if valid census tract was unavailable). Median county income and metropolitan classification (recoded as a polynomial function) were also included. Additionally, we included a variable measuring density of Medicaid health care utilization (Medicaid inpatient discharges per Medicaid enrollee), assigned by county, in order to capture geographic differences in Medicaid health care utilization. Finally, the county-level average of the pre-transition (2006) measure performance was computed and merged with the individual level data by county.

The full models also included 2- and 3-way predictor interactions, between race/ethnicity, gender and the main explanatory variable. Due to a high proportion of complete-cases (>90%), list-wise deletion was performed for enrollees with missing data.

Empirical Model and Analyses

For each measure separately, we employed a 2-stage, multilevel approach which used general linear models.[78] First, we computed person-level models of the outcome during the post-transition year, assuming an exchangeable correlation, and taking county as the clustering unit. We chose county as the clustering unit despite the fact

that (supra-county) service areas represent the natural administrative units in which STAR+PLUS was transitioned and administered. This was primarily motivated by the limited number of service areas, which would result in insufficient statistical power. Further, some service areas were transitioned in phases. Fortunately, the county level is likely representative of the context within which enrollees receive health care, including available health care resources that impact health service use.

A second tier model was constructed using individually adjusted county-specific averages and weights derived from computed cluster sizes and the intra-class correlation coefficient. We performed computation diagnostics and reduced the predictor space when necessary.[109] Then we conducted fixed-order backwards selection of the predictor variables, with $\alpha = 0.05$ used as the exclusion threshold, to arrive at the final, reduced models. Assumption diagnostics for the final models revealed no serious violations of linearity, homogeneity or Gaussian distribution of residuals. Sensitivity analyses in which influence points were removed were found not to substantially impact the results. Analyses were conducted using R (Version 3.3.0) and Rstudio (Version 0.99.902) using lme4 (Version 1.1.12) and lsmeans (Version 2.23) packages for the main analyses and model summarization.[110–113]

After model fitting, we computed the predicted compliance rates for the STAR+PLUS and FFS/ PCCM counties using the overall covariate distributions and varying the enrollment in STAR+PLUS (i.e. predicted marginal means). The difference between these estimates for each group reflects the effect we attribute to the STAR+PLUS implementation.

Results

The overall study sample was comprised of unique enrollees meeting HEDIS eligibility criteria for any or multiple of the studied measures. This overall sample was comprised of 93,635 enrollees clustered across 237 Texas counties. Table G-1 demonstrates that ~32% of the study population met eligibility criteria for only the access to preventive/ambulatory health services measure, and 20% met eligibility criteria for all measures, with the large majority of the remaining sample qualifying for the access to preventive/ambulatory health services measure and either colorectal cancer screening or cervical cancer screening measures.

Table 4-1 provides a summary of demographic, health and contextual characteristics for the study population.

Table 4-1. Demographic health and contextual characteristics for the study population

	Combined	Access to Preventive/ Ambulatory Health Services Subgroup	Breast Cancer Screening Subgroup	Cervical Cancer Screening Subgroup	Colon Cancer Screening Subgroup
Unique enrollees	93635	93615	11505	51319	23048
Unique counties	237	237	218	237	233
Enrollees with complete data	89605 (95.7)	89585 (95.7)	11179 (97.2)	49336 (96.1)	22371 (97.1)
Counties with complete data, by year	237 (100)	237 (100)	217 (99.5)	236 (99.6)	233 (100)
Counties with complete data in post and pre-years		237 (100)	217 (99.5)	236 (99.6)	233 (100)
Age [mean (SD)]	45.5 (13)	45.5 (13)	58.3 (3.7)	48.2 (11.3)	57.6 (3.9)
Age categories [n (%)]					

Table 4-1. Continued

	Combined	Access to Preventive/ Ambulatory Health Services Subgroup	Breast Cancer Screening Subgroup	Cervical Cancer Screening Subgroup	Colon Cancer Screening Subgroup
21-30	16271 (17.4)	16271 (17.4)	0 (0)	4654 (9.1)	0 (0)
30-39	13861 (14.8)	13859 (14.8)	0 (0)	7592 (14.8)	0 (0)
40-49	20290 (21.7)	20285 (21.7)	0 (0)	12244 (23.9)	0 (0)
50-59	28226 (30.1)	28217 (30.1)	6710 (58.3)	17402 (33.9)	14705 (63.8)
60-64	14987 (16)	14983 (16)	4795 (41.7)	9427 (18.4)	8343 (36.2)
Female [n (%)]	54566 (58.3)	54553 (58.3)	11498 (99.9)	51298 (100)	14995 (65.1)
Race/ethnicity [n (%)]					
Non-Hispanic Black	16530 (17.7)	16527 (17.7)	1394 (12.1)	8486 (16.5)	3283 (14.2)
Hispanic	32059 (34.2)	32048 (34.2)	5123 (44.5)	18162 (35.4)	9255 (40.2)
Other	6891 (7.4)	6890 (7.4)	1180 (10.3)	4326 (8.4)	2163 (9.4)
Non-Hispanic white	38155 (40.7)	38150 (40.8)	3808 (33.1)	20345 (39.6)	8347 (36.2)
Health status [n (%)]					
Healthy	15840 (17.3)	15840 (17.3)	643 (5.7)	6130 (12.2)	1908 (8.4)
Significant acute	2514 (2.8)	2514 (2.8)	127 (1.1)	1242 (2.5)	326 (1.4)
Minor chronic	5331 (5.8)	5331 (5.8)	477 (4.2)	3092 (6.1)	1029 (4.5)
Moderate chronic	22234 (24.3)	22233 (24.3)	1877 (16.6)	11536 (22.9)	4138 (18.2)
Major chronic	45443 (49.7)	45424 (49.7)	8196 (72.4)	28290 (56.3)	15303 (67.4)
Health status not available	2273 (2.4)	2273 (2.4)	185 (1.6)	1029 (2)	344 (1.5)
County metro classification [n (%)]					

Table 4-1. Continued

	Combined	Access to Preventive/ Ambulatory Health Services Subgroup	Breast Cancer Screening Subgroup	Cervical Cancer Screening Subgroup	Colon Cancer Screening Subgroup
Large metro (>1M)	24026 (25.7)	24018 (25.7)	3874 (33.7)	12427 (24.2)	7363 (31.9)
Medium metro (250K - 1M)	24641 (26.3)	24634 (26.3)	3677 (32)	13898 (27.1)	7025 (30.5)
Small metro (<250k)	18743 (20)	18740 (20)	1583 (13.8)	10313 (20.1)	3450 (15)
Adjacent to metro	18292 (19.5)	18291 (19.5)	1794 (15.6)	10306 (20.1)	3834 (16.6)
Nonadjacent to metro (>20k)	3879 (4.1)	3878 (4.1)	279 (2.4)	2144 (4.2)	672 (2.9)
Nonadjacent to metro (<20k)	4054 (4.3)	4054 (4.3)	298 (2.6)	2231 (4.3)	704 (3.1)
Census tract poverty [mean (SD)]	23.9 (12.9)	23.9 (12.9)	26.2 (13.3)	24.2 (12.8)	25.7 (13.3)
Census tract poverty categories [n (%)]					
0.0% - 4.9%	3032 (3.3)	3031 (3.3)	298 (2.6)	1430 (2.8)	581 (2.5)
5.0% - 9.9%	8526 (9.2)	8525 (9.2)	779 (6.8)	4419 (8.7)	1648 (7.2)
10.0% - 19.9%	29589 (32)	29584 (32)	3199 (28)	16287 (32.1)	6650 (29.1)
Poverty area (20.0% - 39.9%)	40100 (43.4)	40087 (43.4)	5367 (47)	22289 (44)	10542 (46.1)
Extreme poverty area (> 40.0%)	11187 (12.1)	11187 (12.1)	1782 (15.6)	6245 (12.3)	3432 (15)
Census tract not available	1201 (1.3)	1201 (1.3)	80 (0.7)	649 (1.3)	195 (0.8)
Census tract unemployment level [n (%)]					
0.0% - 4.9%	18681 (20.2)	18680 (20.2)	1902 (16.7)	10078 (19.9)	3914 (17.1)
5.0% - 9.9%	44287 (47.9)	44279 (47.9)	5492 (48.1)	24126 (47.6)	10915 (47.8)
10.0% - 19.9%	27785 (30.1)	27775 (30.1)	3815 (33.4)	15536 (30.7)	7573 (33.1)
> 20.0%	1663 (1.8)	1662 (1.8)	212 (1.9)	918 (1.8)	446 (2)

Table 4-1. Continued

	Combined	Access to Preventive/ Ambulatory Health Services Subgroup	Breast Cancer Screening Subgroup	Cervical Cancer Screening Subgroup	Colon Cancer Screening Subgroup
Census tract not available	1219 (1.3)	1219 (1.3)	84 (0.7)	661 (1.3)	200 (0.9)
Census tract household income [mean (SD)]	38676.3 (15739.5)	38676.8 (15739.7)	36629.5 (15075)	38120.2 (14909.1)	36895.8 (15109.5)
County Medicaid discharge density [mean (SD)]	1 (0.6)	1 (0.6)	1.1 (0.6)	1 (0.6)	1.1 (0.6)
Census tract determined from address [n (%)]	72466 (77.4)	72450 (77.4)	9118 (79.3)	39814 (77.6)	18136 (78.7)
Facility residence [n (%)]	18847 (20.3)	18840 (20.3)	2601 (22.8)	10473 (20.6)	5263 (23.1)
Months enrolled in Medicaid [n (%)]					
12	91781 (98)	91761 (98)	11446 (99.5)	50303 (98)	22935 (99.5)
9 - 11	1824 (1.9)	1824 (1.9)	54 (0.5)	999 (1.9)	106 (0.5)
5 - 8	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
2 - 5	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
STAR+PLUS transition cohort [n (%)]					
A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
B	29164 (31.1)	29152 (31.1)	5171 (44.9)	15293 (29.8)	9640 (41.8)
C	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
D	8481 (9.1)	8481 (9.1)	466 (4.1)	4742 (9.2)	1273 (5.5)
E	22115 (23.6)	22112 (23.6)	3518 (30.6)	12366 (24.1)	6605 (28.7)
F	33875 (36.2)	33870 (36.2)	2350 (20.4)	18918 (36.9)	5530 (24)

Notably, the study population has poor health status, with approximately three-quarters belonging to the most severe health status category. Second, more than half of the sample lives in locations deemed impoverished or extremely impoverished. Around 20% of the sample lives at addresses with 5 or more enrollees, suggesting a high degree of co-location and perhaps utilization of assisted living services. More than 90% of the sample lives in metropolitan areas or areas adjacent to a recognized metropolis. Close to 40% of the sample is white, non-Hispanic, and one-third of the sample is Hispanic.

Several characteristics differ between the various subgroups qualifying for each measure. Those qualifying for breast cancer screening and colorectal cancer screening measures tend to be older, reflecting the later age at which these screenings are recommended. Additionally, the subpopulations eligible for breast cancer screening and colorectal cancer had more severe health status; these findings may be related to the increased age at which enrollees qualify for these measures. As expected, enrollees qualifying for breast cancer screening and cervical cancer screening were almost exclusively female; male enrollees were not included in modelling these measures.

Tables G2–5 present descriptive statistics for transition and comparison groups by measure. The large majority of characteristics were very similar between groups. However, enrollees from transition counties were more likely to be Hispanic and less likely to be white, non-Hispanic. Enrollees in transition counties were more likely from large metropolitan areas (80% vs 2%); enrollees from comparison counties were typically living in medium, small and adjacent metropolitan areas. Of note, characteristics largely demonstrated stability over time.

The total sample size for each measure by group is presented in Figure F-1 and a summary of the number of observations per county is presented in Table G-6. Figure F-2 provides a spatial description of the sample sizes by group. Note that the degree of clustering by county is similar between the groups. For ambulatory care access and cervical cancer screening measures, a decline in sample size was experienced temporarily in 2007 for the comparison group only, after which the sample size returned to baseline levels.

Weighted, unadjusted outcome measure performance is illustrated in Table 4-2 and Figure F-3. For cervical and colorectal cancer screening, steady improvement was observed for both groups; however actual measure adherence remained low at 40% and 30%, respectively. Breast cancer screening saw a more dramatic, nonlinear, increase in screening rates from <2% in 2006 to 50% by 2010. This trend was similar between groups. For ambulatory care access, the transition group appeared to increase by 4%, while the comparison group remained stable or slightly decreased.

Table 4-2. Weighted, unadjusted measure performance

Measure	Group	2006	2007	2008	2009	2010
Access to Preventive/Ambulatory Health Services	Comparison	75.9	74.6	73.3	73.4	74.0
	Transition	80.2	78.2	80.5	82.6	84.5
Breast Cancer Screening	Comparison	1.5	25.2	37.4	41.0	42.1
	Transition	1.2	20.7	36.7	43.4	46.9
Cervical Cancer Screening	Comparison	25.7	34.4	36.4	36.9	37.1
	Transition	31.8	35.4	35.7	38.0	41.1
Colorectal Cancer Screening	Comparison	17.5	20.8	24.3	27.0	29.2
	Transition	18.9	20.1	24.5	28.2	31.2

Table 4-3 provides the final model predicted marginal means during 2010 for each measure. Of note, the STAR+PLUS transition was associated with a significant

increase of 4% in rates of receipt of an annual preventive visit (.74 vs .78). For the remaining measures, no STAR+PLUS effect was found.

Table 4-3. Predicted marginal means during 2010, by measure.

Measure	FFS/PCCM (Comparison)	STAR+PLUS (Transition)	Difference	p-value
Access to Preventive/Ambulatory Health Services	0.74 (0.73-0.75)	0.78 (0.75-0.81)	0.04	0.011
Breast Cancer Screening	0.42 (0.40-0.43)	0.42 (0.39-0.46)	0.01	0.696
Cervical Cancer Screening	0.37 (0.36-0.38)	0.35 (0.33-0.37)	-0.02	0.098
Colorectal Cancer Screening	0.29 (0.28-0.30)	0.29 (0.27-0.31)	-0.00	0.881

Discussion

Assessing the impact of Medicaid managed care and HCBS on receipt of preventive health care is critical, given the substantial gaps in preventive care provision and the cost-effectiveness of such services.[115] In this study, we found that the Texas STAR+PLUS program slightly increased the proportion of qualifying enrollees who received an annual ambulatory/preventive care visit. However, STAR+PLUS did not affect receipt of screening for breast, cervical or colorectal cancer.

Our finding of improved access to ambulatory care due to STAR+PLUS is consistent with results from Burns[59] and Coughlin, Long and Graves[62] which also suggested that Medicaid managed care enrollees were more likely to have a usual source of care. There are multiple explanations for this observed increase in rates of annual ambulatory care. First, in STAR+PLUS and many managed care programs, the enrollee's primary care provider serves as a gatekeeper for many medical and specialty

services. Thus for patients with complex medical needs, who form the large majority of Medicaid patients with disabilities, a primary care provider visit is essential for accessing the added supports and services offered by the organization. Second, many managed care programs use annual visits as an opportunity to conduct health assessments to guide provision of services and added supports for the enrollee. To aid in this assessment goal, programs may provide reminders, convenient scheduling, convenient access points or transportation supports -- thereby increasing annual visit uptake.

To our knowledge, no previous studies have examined the effects of managed care on cancer screening receipt. Given our finding of no effect, it is likely that these forms of screening were not targeted by the managed care organizations. Regardless of group (i.e. transition or comparison), we found unsatisfactory performance overall for rates of cancer screening, even after modest improvements over the study period. For example, less than one-third of enrollees > 50 years of age were screened for colon cancer. These rates compare to national estimates of screening receipt for Medicaid adults[123] Such findings are significant, because colon cancer screening has been shown to decrease 11 to 12 year colorectal cancer mortality by 30% and with certain forms of screening, decrease the actual incidence of colorectal cancer by 20%.[124-125]

Our study has several limitations. First, our findings may not be generalizable to other Medicaid-managed care programs as these differ throughout the United States. Second, due to the non-randomized nature of our design, our study is vulnerable to bias due to residual confounding, particularly as it relates to the appropriateness of the comparison group. Such a bias could result if an unmeasured external effect differentially impacted our county groups during the studied time period. Finally, we

have focused on only one post-transition year; our findings may not reflect the average change due to the transition over all post-transition years. However, review of weighted, unadjusted measure performance above suggests that large departures from our modeled results are unlikely. Furthermore, the absence of effects in the 4th year of program implementation are important findings and suggest the limited impact of STAR+PLUS on receipt of screening services.

In summary, in this study of 1 large Medicaid program serving adults with disabilities, managed acute and long-term services relative to FFS, does not appear to affect rates of cancer screening and only modestly impacts rates of annual primary care visits.

CHAPTER 5
CONCLUSION

Over the past several decades, states have continued to experiment with new models of health care delivery and financing in an attempt to reduce or contain the escalating costs of their Medicaid programs. Some of the most radical shifts have been from fee-for-service financing to global payment models, including managed care. Expansion of managed care delivery models to Medicaid enrollees with disabilities has occurred in more than half of all states covering the majority of this enrollee group. Yet, very few robust evaluations have been conducted to understand if these programs are reducing unnecessary utilization, while also not compromising access and quality of care.

In this work, we have demonstrated that, across most of our selected nationally-validated quality of care measures, the effect of one of largest existing managed care programs is largely null. Several important exceptions exist, namely with large and sustained improvements in quality of care during discharge from the hospital after a heart attack and after COPD exacerbation, as well as to a lesser extent, receipt of an annual ambulatory/preventive health care visit and intermediate-term engagement in substance abuse treatment.

There are several possible explanations for managed care's limited impact on the explored set of measures. First, good performance on many of these measures is dependent on routinely accessing primary care. For example, receipt of asthma medications, antidepressant medications, cholesterol screening, and diabetes sequelae screening are tasks which occur during or as a result of regular primary care visits. STAR+PLUS led to only a slight increase (3%) in the number of enrollees accessing a

primary care provider in the previous year, with almost one-quarter of patients who qualified for Medicaid due to disability having no evidence of a primary care visit during this time frame. An even larger proportion of patients is likely to have not seen their primary care provider at recommend intervals (3-6 months), further explaining the lack of STAR+PLUS impact, and the poor performance overall, for measures which are clinically dependent on multiple visits yearly (e.g. longer-term asthma medication adherence, screening for diabetes sequelae). For STAR+PLUS to impact most of the studied measures, it is likely that even greater rates of engagement in regular primary care visits will be necessary.

Medicaid enrollees with disabilities face many barriers to accessing primary care. Among these are physical barriers, such as long distances between enrollees and providers, transportation difficulties, limited office hours, long provider wait times, and inaccessible facilities.[126-128] Relatedly, Medicaid's history of repeated service payment decreases has contributed to limited provider selection, insufficient networks to meet enrollee needs, and networks comprised of less preferred or under-resourced organizations.[96]

While STAR+PLUS made efforts to address some of these issues, including providing transportation supports and improving networks, the effects on access were likely minimal. For example, Medicaid enrollees have described the unreliability of medical transport and the long transportation times that such services require, discouraging regular use.[129] Without substantially increasing payments, provider networks were unlikely to meaningfully change. Furthermore, STAR+PLUS did not address many more deeply rooted behavioral and social barriers to accessing care. For

example, enrollees may be reluctant or unable to leave their homes due to medical or behavioral conditions. Other enrollees may have mistrust of the health care system due to previous mistreatment. For patients living with repeated exposure to factors such as violence, housing instability and food instability, routine or preventive health care is likely to lack salience. More than likely, most of these factors persisted with STAR+PLUS' implementation, limiting the program's impact.

Second, beyond visiting a primary care provider, most of our selected measures are heavily dependent on the enrollee performing a prescribed task. Tasks span a spectrum from laboratory testing (e.g. cholesterol screening, A1c screening), to medication filling (e.g. asthma, depression), to returning for follow-up visits (e.g. after psychiatric hospitalization, after substance abuse diagnosis), to more invasive screening testing (e.g. cervical cancer, colorectal cancer and breast cancer screenings).

Multiple barriers inhibit enrollees from engaging in these tasks. To begin, many of the barriers to accessing primary care described above also apply to accessing screening services, follow-up services, laboratory testing, and pharmacies. Furthermore, these activities often represent a component of a more complex disease management plan which is, to a large extent, completed by the patient. Optimal engagement in this plan requires high levels of cognitive and social resources, both of which are, on average, substantially diminished in individuals qualifying for Medicaid due to disability, by virtue of their marginalized position in society and their serious medical conditions.[130-131] Even though many enrollees with disabilities have informal caregivers to assist with chronic disease management and health care engagement,

research suggests that these caregivers have cognitive impairments and limited social capital themselves.[132]

Third, several specific aspects of STAR+PLUS financing likely limited the model's impact. While Texas Medicaid shifted from paying service-based fees to providers to issuing capitation-based payments to managed care organizations, providers were still largely paid in fee-for-service arrangements by the managed care organizations. Thus, despite small incentives and quality improvement projects aimed at improving the value of care, the resulting incentives were much more aligned with traditional volume-based financing for the participating providers.

Perhaps even more importantly, inpatient hospital services were carved out of the 2007 STAR+PLUS expansion, such that inpatient services were paid via fee-for-service financing. This structure removed one of the strongest incentives of the managed care model -- that expected to drive more appropriate utilization and increased preventive services use in order to avoid expensive hospital care. Paradoxically, of the limited effects due to STAR+PLUS, the largest change we observed was improvement in quality of *hospital-based care* following acute events. Thus, the hospital carve-outs may have played a lesser role in the limited changes seen in the measures overall than we might have expected a priori.

Providing high quality care for Medicaid patients with disabilities is challenging, given complex and interacting social and illness contexts. Thus the absence of change due to STAR+PLUS might reflect a local ceiling; further improvements may require even more substantial health care delivery redesign, or investments on par of those in the private market with a similar case mix. At the same time, recent literature suggests that

even more pronounced risk-bearing models in relatively more socially-advantaged Medicare populations have failed to demonstrate a significant effect on quality of care. For example, in an analysis of early changes due to implementation of accountable care organizations in Medicare, only 1 of 11 quality measures demonstrated significance.[133]

Towards this end, an expanding collection of research suggests that factors largely outside the traditional scope of health care play a substantial, if not overwhelming, role in determining population health outcomes.[134-136] For example, enrollees' lifelong exposures to physically and psychologically unhealthy environments produced from chronic violence, housing instability, poor access to quality employment and educational opportunities, pollution, and barriers to healthy food consumption and exercise have direct negative impact on health status and optimal management of their clinical conditions. Accordingly, research suggests that services including housing support, nutritional assistance, income support, and early childhood development support are linked to improvements in health and reduction in future health care costs.[137] Based on this work, the incremental benefit of investments in traditional health care services and supports is likely small, especially in relation to social service investments.

The results of this work can also be viewed in alternative light. If STAR+PLUS is shown to have achieved cost savings in the context of unchanged or improved quality of care, then STAR+PLUS might be considered a success. However, we feel that the low levels of health care quality for an already vulnerable population must be greatly improved before such a program would be deemed successful. To reach a definitive conclusion on the impact of STAR+PLUS, utilization, costs, satisfaction, mortality and

other health outcomes should be studied. Future research is needed to explore the mechanism of the effects observed in these studies.

In summary, managed care and HCBS, in its current formulation, does not appear to reliability impact the quality of care of Medicaid individuals with disabilities. Additional research is needed to further evaluate and refine service delivery for this vulnerable population.

APPENDIX A
TABLES FOR CHAPTER 1: INTRODUCTION

Table A-1. STAR+PLUS transition history

Bexar Service Area	Bexar 1: January 2007: Atascosa, Bexar, Comal, Guadalupe, Kendall, Medina, Wilson
	Bexar 2: September 2011: Bandera
Dallas Service Area	February 2011: Collin, Dallas, Ellis, Hunt, Kaufman, Navarro, Rockwall
El Paso Service Area	March 2012: El Paso, Hudspeth
Harris Service Area	Harris 1: April 1998: Harris
	Harris 2: January 2007: Brazoria, Fort Bend, Galveston, Montgomery, Waller
	Harris 3: September 2011: Austin, Matagorda, Wharton
Hidalgo Service Area	March 2012: Cameron, Duval, Hidalgo, Jim Hogg, Maverick, McMullen, Starr, Webb, Willacy, Zapata
Jefferson Service Area	September 2011: Chambers, Hardin, Jasper, Jefferson, Liberty, Newton, Orange, Polk, San Jacinto, Tyler, Walker
Lubbock Service Area	March 2012: Carson, Crosby, Deaf Smith, Floyd, Garza, Hale, Hockley, Hutchinson, Lamb, Lubbock, Lynn, Potter, Randall, Swisher, Terry
MRSA* - Central	September 2014: Bell, Blanco, Bosque, Brazos, Burleson, Colorado, Comanche, Coryell, DeWitt, Erath, Falls, Freestone, Gillespie, Gonzales, Grimes, Hamilton, Hill, Jackson, Lampasas, Lavaca, Leon, Limestone, Llano, Madison, McLennan, Milam, Mills, Robertson, San Saba, Somervell, Washington
MRSA* - Northeast	September 2014: Anderson, Angelina, Bowie, Camp, Cass, Cherokee, Cooke, Delta, Fannin, Franklin, Grayson, Gregg, Harrison, Henderson, Hopkins, Houston, Lamar, Marion, Montague, Morris, Nacogdoches, Panola, Rains, Red River, Rusk, Sabine, San Augustine, Shelby, Smith, Titus, Trinity, Upshur, Van Zandt, Wood

Table A-1. Continued

MRSA* - West	September 2014: Andrews, Archer, Armstrong, Bailey, Baylor, Borden, Brewster, Briscoe, Brown, Callahan, Castro, Childress, Clay, Cochran, Coke, Coleman, Collingsworth, Concho, Cottle, Crane, Crockett, Culberson, Dallam, Dawson, Dickens, Dimmit, Donley, Eastland, Ector, Edwards, Fisher, Foard, Frio, Gaines, Glasscock, Gray, Hall, Hansford, Hardeman, Hartley, Haskell, Hemphill, Howard, Irion, Jack, Jeff Davis, Jones, Kent, Kerr, Kimble, King, Kinney, Knox, La Salle, Lipscomb, Loving, Martin, Mason, McCulloch, Menard, Midland, Mitchell, Moore, Motley, Nolan, Ochiltree, Oldham, Palo Pinto, Parmer, Pecos, Presidio, Reagan, Real, Reeves, Roberts, Runnels, Schleicher, Scurry, Shackelford, Sherman, Stephens, Sterling, Stonewall, Sutton, Taylor, Terrell, Throckmorton, Tom Green, Upton, Uvalde, Val Verde, Ward, Wheeler, Wichita, Wilbarger, Winkler, Yoakum, Young, Zavala
Nueces Service Area	Nueces 1: January 2007: Aransas, Bee, Calhoun, Jim Wells, Kleberg, Nueces, Refugio, San Patricio, Victoria
	Nueces 2: September 2011: Brooks, Goliad, Karnes, Kenedy, Live Oak
Tarrant Service Area	February 2011: Denton, Hood, Johnson, Parker, Tarrant, Wise
Travis Service Area	Travis 1: January 2007: Bastrop, Burnet, Caldwell, Hays, Lee, Travis, Williamson
	Travis 2: September 2011: Fayette

* MRSA - Medicaid Rural Service Area. Table information obtained from:
1) Information Letter No. 12-26: Expansion of STAR in the Medicaid Rural Service Areas. Texas Health and Human Services Commission. Available at: http://www.dads.state.tx.us/providers/communications/2012/letters/IL2012-26.pdf. Accessed March 16, 2015.
2) Managed Care Service Areas. Texas Health and Human Services Commission. Available at: https://www.hhsc.state.tx.us/medicaid/managed-care/mmc/Managed-Care-Service-Areas-Map.pdf. Accessed March 16, 2015.
3) Texas Medicaid and CHIP in Perspective: Ninth Edition. Texas Health and Human Services Commission; 2013. Available at: http://www.hhsc.state.tx.us/medicaid/about/PB/PinkBook.pdf. Accessed June 16, 2014.

Table A-2. Comparing Fee for Service (FFS) and Primary Care Case Management (PCCM) on measure compliance at baseline and control variables

	FFS	PCCM
Averaged measure compliance at baseline* (mean; std)	0.59 (0.37)	0.62 (0.37)
Age (mean; std)	52.9 (10.1)	52.3 (9.9)
21-29	5.3%	4.8%
30-39	5.9%	7.2%
40-49	17.8%	20.0%
50-59	44.0%	44.5%
60-64	27.1%	23.5%
Female (%)	62%	62%
Race/Ethnicity (%)		
White, non-Hispanic	38.9%	44.1%
Black, non-Hispanic	17.8%	17.6%
Hispanic	32.6%	30.3%
Other	10.6%	8.0%
Health status# (mean; std)	4.81 (0.63)	4.72 (0.75)
Healthy	1.7%	2.5%
Significant Acute	0.4%	0.5%
Minor Chronic	0.8%	1.2%
Moderate Chronic	9.4%	14.1%
Major Chronic	87.7%	81.6%
Census tract poverty % (mean; std)	26.0 (13.9)	24.6 (12.7)
0.0%-4.9%	3.0%	1.8%
5.0%-9.9%	8.6%	8.1%
10.0%-19.9%	26.4%	33.2%
Poverty Area (20.0%-39.9%)	45.0%	43.7%
Extreme Poverty Area (> 40.0%)	17.0%	13.3%
County-level median income (mean; std)	$37,100 ($15,000)	$36,700 ($12,500)
Facility residence (%)	26.0%	19.7%
Years eligible for study, 2007-2010 (mean; std)	2.66 (1.21)	2.48 (1.11)

* Average compliance across the 6 outcome measures

5-level Clinical risk group (3M)

Table A-3. Abbreviated descriptions of outcome measures

Measure (Abbreviation)	Numerator	Denominator
Use of Appropriate Medications for People with Asthma (ASM)	Subset of denominator members who were dispensed at least one prescription for asthma controller medication during the measurement year	Members 21-64 years old enrolled in the measurement year and the preceding year meeting one of the following criteria during the measurement year and the preceding year: - > 1 ED visit with asthma as principal diagnosis - > 1 acute inpatient encounter with asthma as principal diagnosis - > 4 outpatient visits with asthma as a diagnosis, including two asthma medication dispensing events - > four asthma medication dispensing events Exclude: -members with a diagnosis of emphysema, COPD, chronic bronchitis, cystic fibrosis, or acute respiratory failure
Medication Management for People With Asthma (MMA)	Subset of denominator members who were dispensed asthma controller medication covering at least 75% of the treatment period	Members 21-64 years old enrolled in measurement year and preceding year with persistent asthma (as identified in ASM) Exclude: -members with a diagnosis of emphysema, COPD, chronic bronchitis, cystic fibrosis, or acute respiratory failure
Pharmacotherapy Management of COPD Exacerbation (PCE)	Numerator 1 - systemic corticosteroid: subset of denominator events for which members were dispensed a prescription for systemic corticosteroid < 14 days of the event date Numerator 2 - bronchodilator: subset of denominator events for which members were dispensed a prescription for bronchodilator < 30 days of the event date	Members 40-64 years old with an acute inpatient discharge or ED encounter with a principal diagnosis of COPD during the measurement year who were enrolled for > 30 days of the exacerbation event Exclude: -ED visits that resulted in an inpatient admission -event dates for which member was transferred directly to an acute or non acute care facility for any diagnosis -event dates for which the member was readmitted to an acute or non-acute care facility, or had an ED visit for any diagnosis, within 14 days of the event date
Cholesterol Management for Patients With Cardiovascular Conditions (CMC)	Numerator 1 – LDL-C Screening: subset of denominator members who had an LDL-C test in the measurement year Numerator 2 – LDL-C Control – subset of denominator members whose most recent LDL-C <100 mg/dL during the measurement year	Members 21-64 years old enrolled in the measurement year and preceding year discharged for AMI, CABG or PCI in the year preceding the measurement year or with a diagnosis of IVD in the measurement year and the preceding year

Table A-3. Continued

Measure (Abbreviation)	Numerator	Denominator
Persistence of Beta-Blocker Treatment After a Heart Attack (PBH)	Subset of denominator members who received treatment with beta-blockers with ≥ 135 days supplied for the 180 days after discharge (> 75% of days)	Members 21-64 years old discharged from an acute inpatient setting with an acute myocardial infarction (AMI) between July 1 of year preceding the measurement year through June 30th of the measurement year and enrolled for > 6 months of discharge date Exclude: -hospitalizations in which member transferred directly to non-acute care facility for any diagnosis
Comprehensive Diabetes Care (CDC)		
HbA1c testing	Subset of denominator members who had an HbA1c test during the measurement year	Members 21-64 years old enrolled during the measurement year diagnosed with type 1 or type 2 diabetes (type 1 and type 2) in the measurement year or the preceding year through *EITHER* - two face-to-face outpatient or non-acute inpatient encounters with a diagnosis of diabetes *or* - one face-to face ED or acute inpatient encounter with a diagnosis of diabetes *OR* - dispensed insulin or hypoglycemics/antihyperglycemics on ambulatory basis - Exclude: -members discharged with CABG or PCI -members with a diagnosis of IVD, CHF, MI, CRF/ESRD, dementia, blindness, or lower extremity amputation
Eye exam	Subset of denominator members who had an eye screening for diabetic retinal disease identified by a retinal or dilated eye exam by an eye care professional in the measurement year *OR* a negative retinal exam by an eye care professional in the year preceding the measurement year	Same as HbA1c testing
LDL-C screening	Subset of denominator members who received an LDL-C test during the measurement year	Same as HbA1c testing

Table A-3. Continued

Measure (Abbreviation)	Numerator	Denominator
Nephropathy screening	Subset of denominator members who received a nephropathy screening test during the measurement year *OR* have evidence of nephropathy	Same as HbA1c testing

Source: HEDIS 2012 Technical Specifications for Health Plans, Volume 2. Washington, DC: National Committee on Quality Assurance; 2011.

The following tables describe the patterns of measure eligibility for each study subject across the post-baseline years (i.e. 2007 to 2010). * indicates that the outcome was able to be calculated (i.e. the subject was eligible), while _ indicates the subject was not eligible for the measure for a given person-year. For example, 53 subjects in the fee-for-service (FFS) or primary care case management (PCCM) program components were eligible for the ASM measure in the first two post-baseline years, but were not eligible for the measure in 2009 or 2010. Note that both the counts of subjects with each measure eligibility pattern as well as the percentages of the sample attributable to a given pattern for each measure are provided.

Table A-4. Member eligibility counts – FFS/PCCM

Pattern, 2007-2010	ASM	CDC	CMC	MMA	PBH	PCE
****	88	5336	806	69	0	48
***_	48	1218	318	34	0	33
**_*	3	335	30	2	0	24
**__	53	1685	620	44	4	87
*_**	0	206	19	2	0	32
*_*_	2	67	5	2	1	45
__	9	215	132	7	0	33
*___	202	3399	1355	163	161	682
_***	34	2687	331	31	0	44
_**_	33	1068	247	30	7	81
_*_*	1	153	26	1	1	63
_*__	77	1872	519	52	127	500
__**	136	2730	889	94	5	153
__*_	127	1132	708	110	105	635
___*	216	4296	1355	160	122	866

Table A-5. Member eligibility percentages – FFS/PCCM

Pattern, 2007-2010	ASM	CDC	CMC	MMA	PBH	PCE
****	8.6	20.2	11.0	8.6	0	1.4
***_	4.7	4.6	4.3	4.2	0	1.0
**_*	0.3	1.3	0.4	0.2	0	0.7
**__	5.2	6.4	8.4	5.5	0.8	2.6
*_**	0	0.8	0.3	0.2	0	1.0
*_*_	0.2	0.3	0.1	0.2	0.2	1.4
__	0.9	0.8	1.8	0.9	0	1.0
*___	19.6	12.9	18.4	20.3	30.2	20.5
_***	3.3	10.2	4.5	3.9	0	1.3
_**_	3.2	4.0	3.4	3.7	1.3	2.4
_*_*	0.1	0.6	0.4	0.1	0.2	1.9
_*__	7.5	7.1	7.1	6.5	23.8	15.0
__**	13.2	10.3	12.1	11.7	0.9	4.6
__*_	12.3	4.3	9.6	13.7	19.7	19.1
___*	21.0	16.3	18.4	20.0	22.9	26.0

Table A-6. Member eligibility counts – STAR+PLUS

Pattern, 2007-2010	ASM	CDC	CMC	MMA	PBH	PCE
****	103	3999	354	86	0	15
***_	60	755	118	50	0	16
**_*	0	115	4	0	1	6
**__	59	984	207	48	0	19
*_**	0	251	3	3	0	8
*_*_	0	68	5	1	2	15
__	14	95	59	11	2	15
*___	135	1359	400	112	46	159
_***	146	1103	270	116	0	23
_**_	74	418	117	67	5	35
_*_*	1	47	6	7	0	18
_*__	128	417	252	114	76	189
__**	162	1676	380	131	3	56
__*_	114	561	322	90	73	252
___*	294	2275	668	231	69	343

Table A-7. Member eligibility percentages – STAR+PLUS

Pattern, 2007-2010	ASM	CDC	CMC	MMA	PBH	PCE
****	8.0	28.3	11.2	8.1	0	1.3
***_	4.7	5.3	3.7	4.7	0	1.4
**_*	0	0.8	0.1	0.0	0.4	0.5
**__	4.6	7.0	6.5	4.5	0	1.6
*_**	0	1.8	0.1	0.3	0	0.7
*_*_	0	0.5	0.2	0.1	0.7	1.3
__	1.1	0.7	1.9	1.0	0.7	1.3
*___	10.5	9.6	12.6	10.5	16.6	13.6
_***	11.3	7.8	8.5	10.9	0	2.0
_**_	5.7	3.0	3.7	6.3	1.8	3.0
_*_*	0.1	0.3	0.2	0.7	0	1.5
_*__	9.9	3.0	8.0	10.7	27.4	16.2
__**	12.6	11.9	12.0	12.3	1.1	4.8
__*_	8.8	4.0	10.2	8.4	26.4	21.6
___*	22.8	16.1	21.1	21.6	24.9	29.3

Reference groups are Female; Black non-Hispanic; and time=2010. Age is centered at 43.5 years. Coefficients for CDC are not reported because the model did not converge when using the county as the unit of clustering.

The individual model coefficients are provided below for completeness. It is important to note that these do not represent the hypothesis that is the primary focus of the study, and these coefficients cannot be meaningfully interpreted in isolation. Rather, it is the linear combinations of the coefficients that are of interest. Therefore, these coefficients have little meaning without concurrently applying the groups-specific covariate distributions. The source of confusion lies in the dependence of the statistical results and interpretation on the choice of coding scheme (reference cell vs. cell mean), the choice of reference cells, and the fact that more than two categories are present for categorical predictors (i.e. health status). For these reasons, we focus on reporting the predicted means and associated confidence intervals in the main text, which directly address the hypothesis being tested.

Table A-8. Coefficients for final reduced models

	ASM	CMC	MMA	PBH	PCE
	0.3017	0.1853	0.8151	-0.1946	0.0504
Intercept	(0.1734)	(0.2143)	(0.2244)	(0.3718)	(0.1404)
	-0.0691	0.2093	0.0713	0.3026	0.1222
Male	(0.1013)	(0.1138)	(0.1496)	(0.1995)	(0.0871)
	0.1316	0.2871	-0.1076	-0.1024	-0.0258
Hispanic	(0.0747)	(0.0838)	(0.1007)	(0.1711)	(0.0701)
	0.0346	0.3505	0.1682	0.1769	0.0294
Other	(0.0986)	(0.1095)	(0.1303)	(0.1902)	(0.0813)
	0.074	0.0866	0.1148	0.1893	0.0709
White, non-Hispanic	(0.0665)	(0.08)	(0.0839)	(0.1667)	(0.0611)
	0.0886	-0.3499	0.2794	-0.1633	0.004
Male*Hispanic	(0.1602)	(0.1446)	(0.2254)	(0.2559)	(0.1198)
	-0.0583	-0.6357	0.1507	-0.6265	-0.1418
Male*Other	(0.2069)	(0.1804)	(0.3231)	(0.2901)	(0.1499)
	0.0924	-0.1429	-0.0484	-0.4537	-0.1908
Male*White, non-Hispanic	(0.1183)	(0.1273)	(0.1707)	(0.2309)	(0.0962)
	0.0013	0.0125	0.005	0.0104	0.0038
Age (Centered)	(0.0017)	(0.008)	(0.0023)	(0.0077)	(0.0096)
	0.0004	-0.0002	0.0002	0.0001	0.0002
Age (Centered, Quadratic)	(0.0002)	(0.0004)	(0.0002)	(0.0004)	(0.0004)
	0.0331	0.2002	-0.0088	0.2237	0.0224
CRG	(0.0383)	(0.0649)	(0.0475)	(0.1412)	(0.0683)
	0.0162	-0.0024	0.0211	-0.0133	-0.0039
CRG (Quadratic)	(0.0129)	(0.021)	(0.019)	(0.0502)	(0.0236)
	0.0007	0.0015	-0.0105	0.0028	0.0039
Poverty %	(0.0032)	(0.0032)	(0.004)	(0.0059)	(0.0021)
	0.016	0.0251	-0.0677	0.0645	0.0351
Median HHI ($10,000)	(0.0261)	(0.0256)	(0.0295)	(0.044)	(0.016)

Table A-8 Continued

	ASM	CMC	MMA	PBH	PCE
	0.0445	-0.0621	0.0993	-0.0139	
Facility residence	(0.0497)	(0.0401)	(0.0636)	(0.0949)	0.038 (0.0317)
Baseline Compliance	0.2657	0.0474	0.0776	0.0776	
Ratio (2006)	(0.0607)	(0.0478)	(0.0619)	(0.0892)	0.018 (0.0508)
Months Enrolled in	0.0015	-0.0016	0.0012	0.0266	0.0237
STAR+PLUS	(0.0042)	(0.0039)	(0.0045)	(0.0074)	(0.0021)
		0.0515	-0.0588	0.1918	-0.0953
TIME: 2007	0.0437 (0.037)	(0.0607)	(0.0427)	(0.1957)	(0.0779)
	0.0305			0.0258	-0.0373
TIME: 2008	(0.0392)	0.1769 (0.061)	-0.052 (0.0461)	(0.1928)	(0.0751)
			-0.0564	0.0731	-0.0089
TIME: 2009	0.065 (0.0304)	0.0877 (0.065)	(0.0426)	(0.1554)	(0.0673)
	0.0429	-0.1228	0.0912	-0.2437	0.0155
CRG*TIME: 2007	(0.0402)	(0.0755)	(0.0529)	(0.2218)	(0.0889)
	0.0447	-0.2273	0.0217	-0.0918	
CRG*TIME: 2008	(0.0447)	(0.0725)	(0.0575)	(0.2196)	-0.0186 (0.085)
	-0.0723	-0.1214	0.1292	-0.1854	-0.0175
CRG*TIME: 2009	(0.0383)	(0.0814)	(0.0521)	(0.1652)	(0.0771)

APPENDIX B
TEXT DESCRIBING TREATMENT VARIABLE OPERATIONALIZATION AND BEHAVIOR

The main predictor variable, time enrolled in STAR+PLUS in a given post-baseline year, was measured in months. In theory, this variable could take values from 0 to 12, capturing any instances of differential transition timing and scale-up or partial Medicaid enrollment. However, our data revealed that almost all transitions occurred quickly, that is during the first two months of 2007, and that HEDIS measure eligibility specifications precluded members enrolled for small portions of the year. As a result, this variable essentially behaved rather dichotomously. Even so, more accurate estimates of effect are obtained using the exact – rather than the approximate - enrollment information and thus we retained the original operationalization. As a result, the influence of measurements of individuals only enrolled for part of a year (typically 10 or 11 months of the year) are weighted appropriately – accounting for their partial exposure to the intervention during the measured year.

APPENDIX C
TEXT DESCRIBING THE STUDY'S STATISTICAL MODEL VIS-À-VIS STANDARD DIFFERENCE IN DIFFERENCE MODEL

Frequently used in evaluations of policy implementation, a classic difference-in-difference (DD) model compares differences in outcomes between two groups at two time points to isolate and test the presence of an effect, assumed to be the deviation from the baseline difference. The unadjusted DD model is given as:

$$(1)\quad Y_{ijk} = \beta_0 + \beta_3 p_k + \beta_5 t_j + \beta_7 p_k t_j + \varepsilon_{ijk}$$

where *i* is the observation unit for outcome Y during time *j* and for group *k*; *t* is the dichotomous time indicator, before or after policy implementation; *p* gives the dichotomous group indicator; and $t_j p_i$ represents their interaction. Accordingly, the average baseline difference between the groups is given by β_3. β_5 represents the average change in the outcome experienced by the control group. The average deviation from the baseline difference between the groups is given by β_7.

A mathematical generalization of the standard DD approach, our strategy allows the simultaneous modeling of more than two time points, while allowing for different slopes between groups over time. This flexibility is accomplished by including the baseline response value as a model covariate and by assuming an unstructured covariance matrix over time. In addition, we include time-invariant and time-varying control variables. Our model can be expressed as:

$$(2)\quad Y_{ijk} = \beta_0^* + \beta_1^* x_{ij} + \beta_2^* y_{i,j=0} + \beta_3^* p_k + \beta_4^* x_{ij} p_k + \beta_5^* t_j + \beta_6^* x_{ij} t_j + \beta_7^* p_k t_j + \beta_8^* x_{ij} p_k t_j + \varepsilon_{ijk}$$

where *i* is the observation unit for outcome Y during time *j* and for group *k*; x_{ij} represents the vector of person-level and county-level time-invariant and time-varying characteristics which we added as control variables; $y_{i,j=0}$ is an individual's compliance in the baseline year; *p* is the dichotomous group indicator; and *t* is a categorical variable representing time, which is allowed to have more than two levels. The DD model is a specific case of this more generalized model.

Our approach borrows strength over time, thus increasing overall statistical power. Under the standard DD approach, this analysis would require four paired time comparisons; our analytic strategy allows us to compare all four post-implementation time points simultaneously; subsequently, we are not bound by the parallel trend assumption. The model that we use further generalizes the DD model by allowing the baseline difference to be any value, which is restricted to 1.0 in DD (also by the parallel trend assumption). To illustrate, consider a two time-point study that has baseline compliance, $y_{i,j=0}$, and a post-baseline compliance, $y_{i,j=1}$, for subject *i* in group *k*. By way of the cell mean ANOVA model, the difference score $y_{i,j=1} - y_{i,j=0}$ can be expressed as:

$$(3)\quad d_{i,k=\mathrm{k}} = y_{i,j=1,k=\mathrm{k}} - y_{i,j=0,k=\mathrm{k}} = \mu_{k=\mathrm{k}} + \varepsilon_i.$$

Rearranging terms:

$$(4)\quad y_{i,j=1,k=\mathrm{k}} = 1 \cdot y_{i,j=0,k=\mathrm{k}} + \mu_{k=\mathrm{k}} + \varepsilon_i$$

where μ_k, the average change score for fixed group k, is given by equation (1) as:

$$(5)\quad \mu_{k=\mathrm{k}} = \beta_5 + \beta_7 p_{\mathrm{k}}$$

and substituting for $\mu_{k=\mathrm{k}}$ gives the following result:

$$(6)\quad y_{i,j=1,k=\mathrm{k}} = 1 \cdot y_{i,j=0} + \beta_5 + \beta_7 p_{\mathrm{k}} + \varepsilon_i.$$

This equation can be generalized to allow for varying group *k*:

$$(7)\quad y_{i,j=1,k} = 1 \cdot y_{i,j=0} + \beta_3 p_k + \beta_5 + \beta_7 p_k + \varepsilon_{ik}.$$

Allowing for more than one post-baseline measure and non-zero intercept:

$$y_{ijk} = \beta_0 + 1 \cdot y_{i,j=0} + \beta_3 p_k + \beta_5 t_j + \beta_7 p_k t_j + \varepsilon_{ijk}$$

This result reflects the special case in our model where $\beta_2^* = 1$, and individual control variables, other than the baseline measure compliance, are removed.

Model Fitting Details

The predictor variables (as described in the article text) were placed into the full model for each outcome in a fixed order: main effects, time, interactions within main effects, and interactions between main effects and time. For each of these full models, fixed-order backwards selection of predictor variables with alpha = 0.05 was used to arrive at the reduced models. Performing significance tests therefore required testing the higher-order interaction variables first. Thus, in the backwards selection process, only those main effect variables that did not have a statistically significant interaction were tested; any other main effects were retained. Finding general agreement in terms retained between the models, we established one final reduced model form for consistency.

APPENDIX D
FIGURES FOR CHAPTER 3: BEHAVIORAL HEALTH

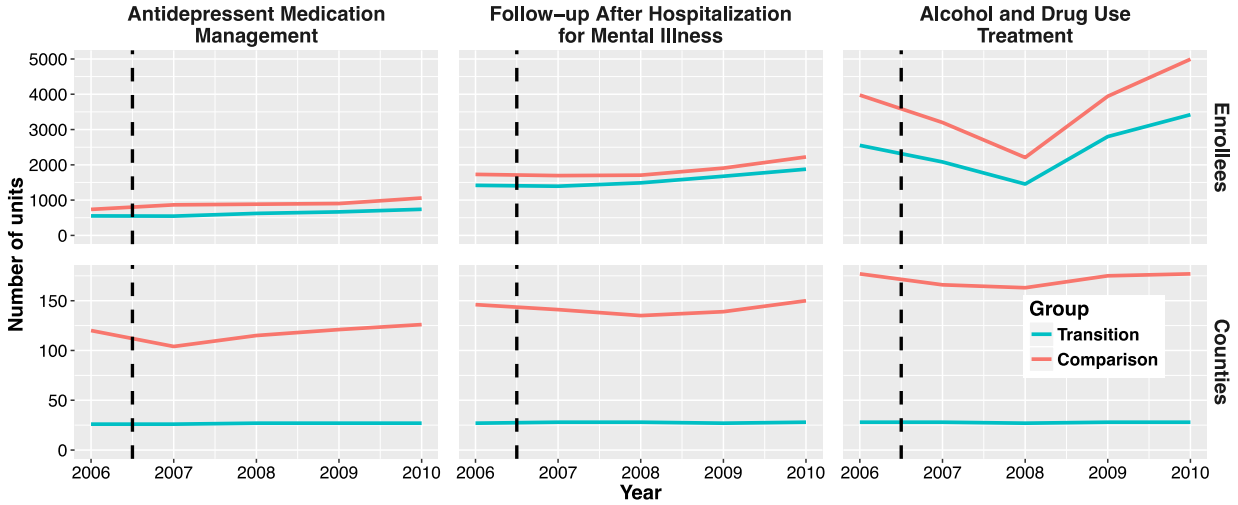

Figure D-1. Number of enrollees that qualify for a given measure, by year and by group

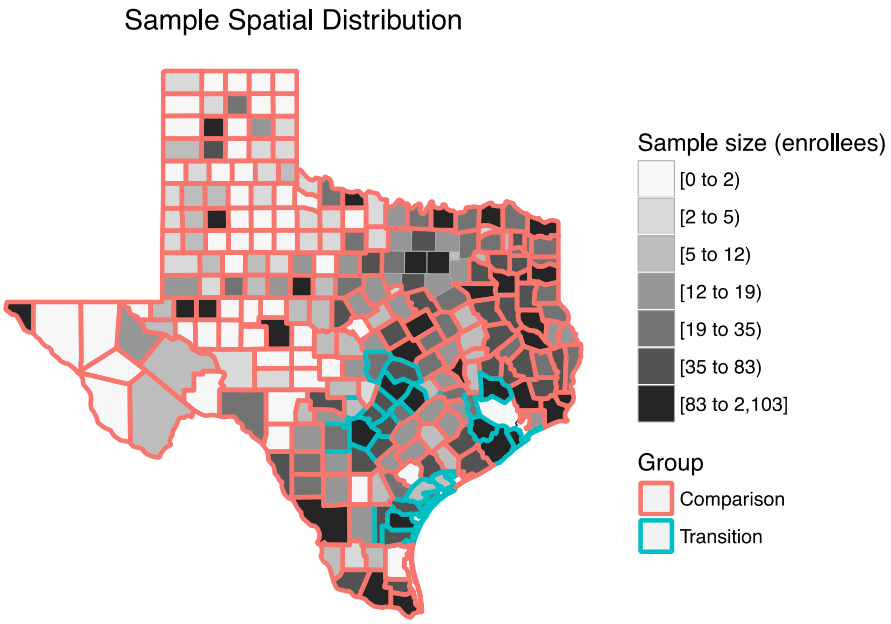

Figure D-2. Sample spatial distribution

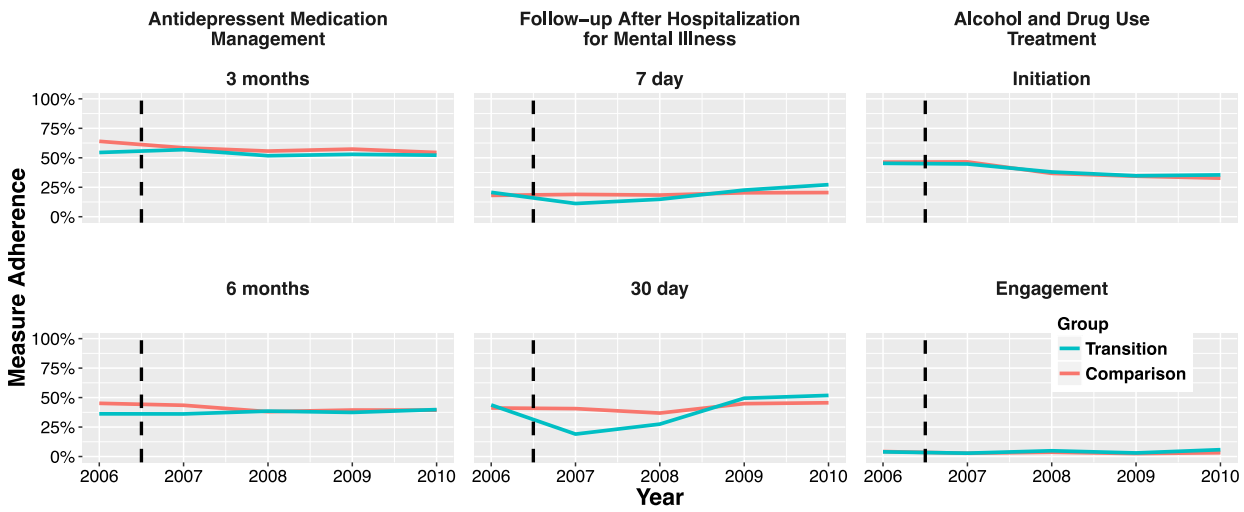

Figure D-3. Weighted, unadjusted measure performance over time, by group

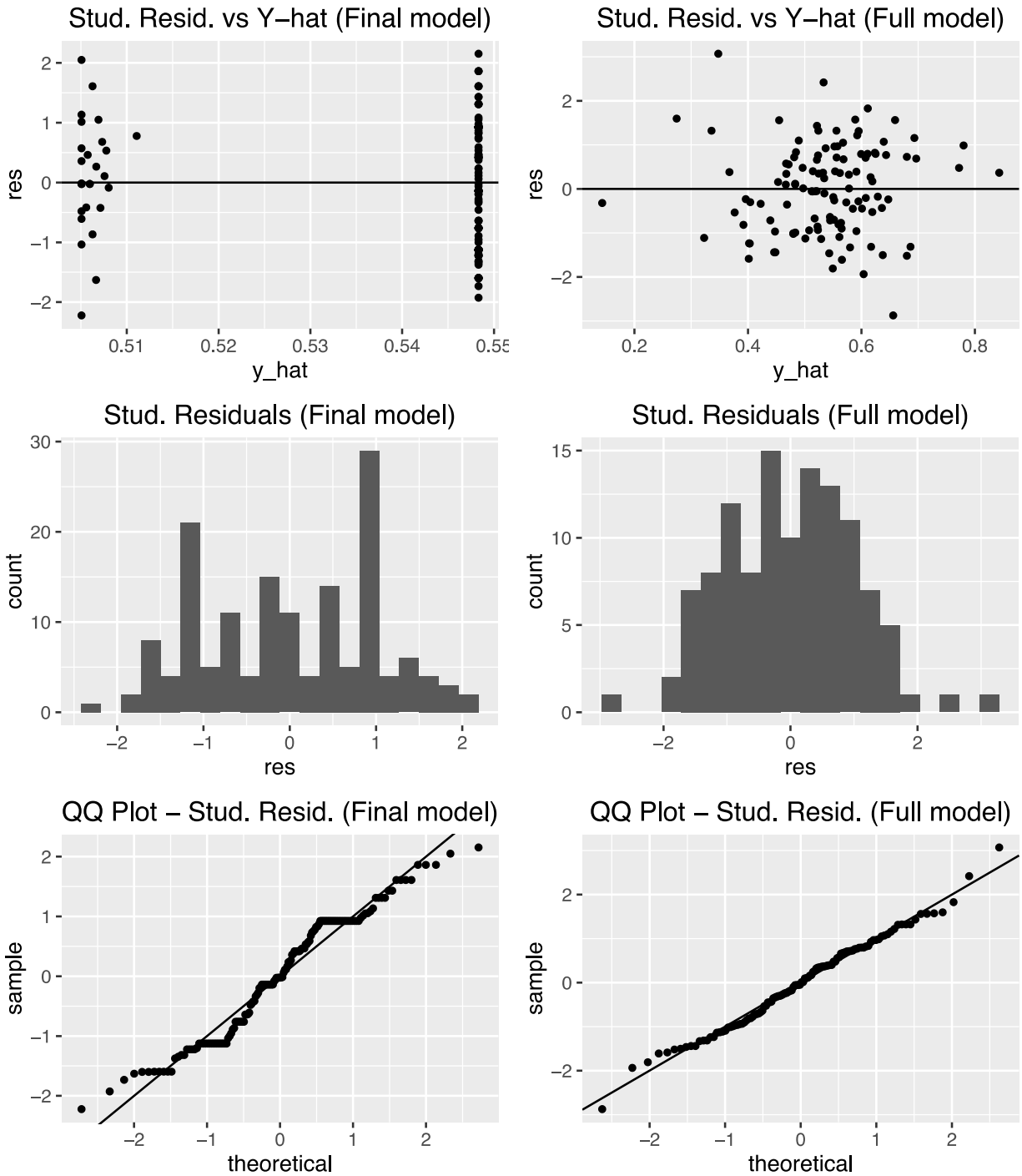

Figure D-4. Regression assumption diagnostics for AMM Acute (final and full models)

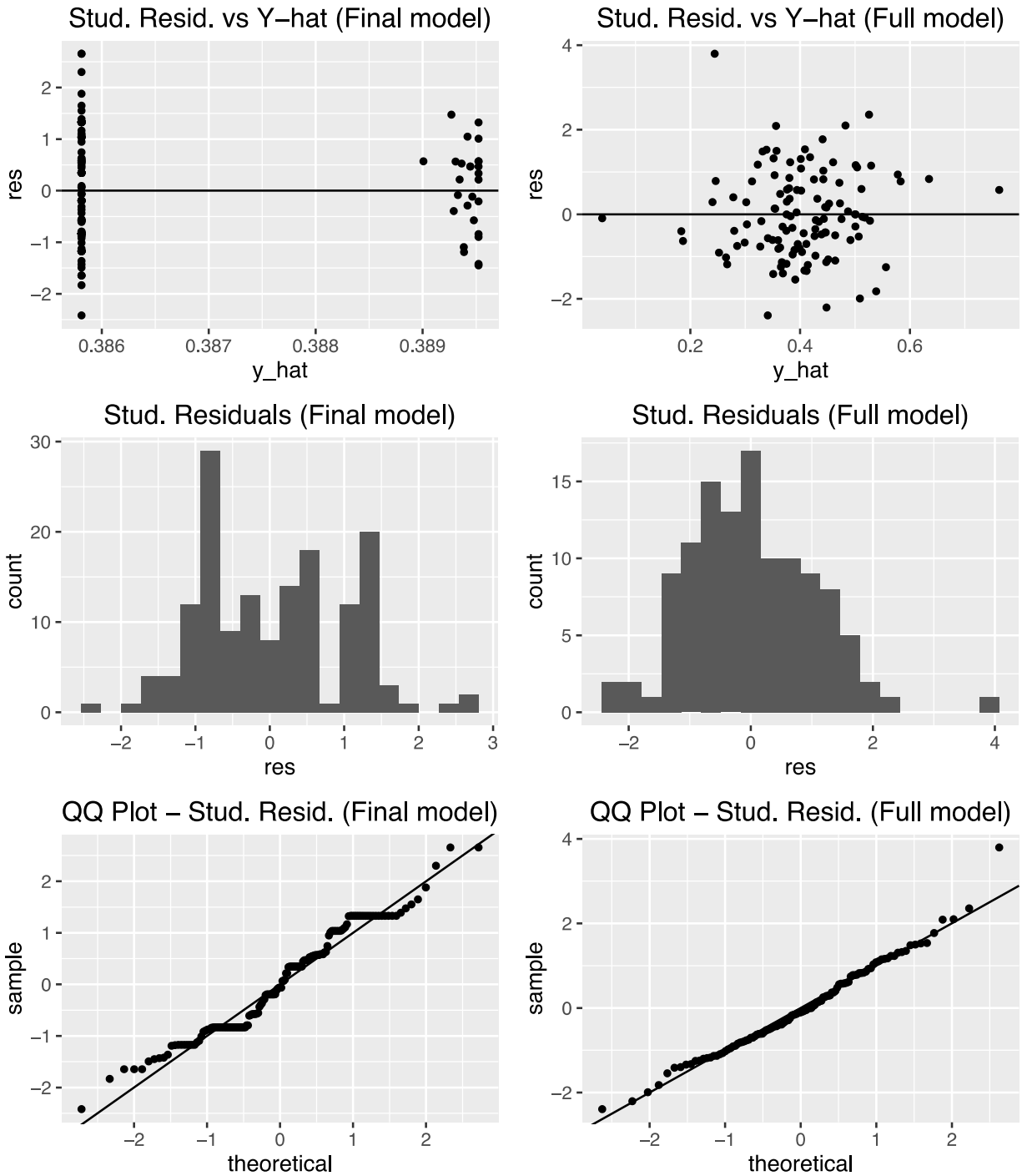

Figure D-5. Regression assumption diagnostics for AMM CONT (final and full models)

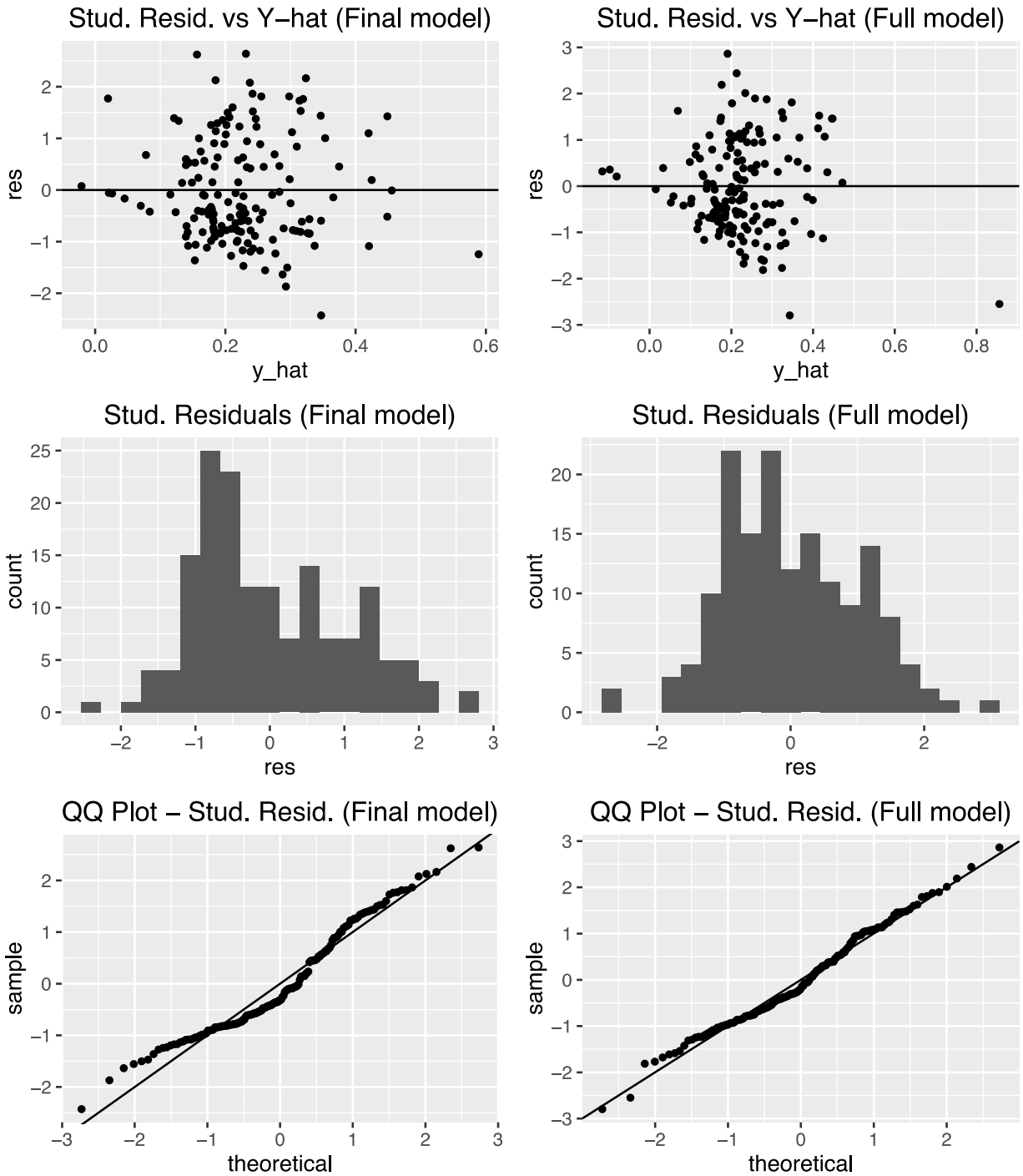

Figure D-6. Regression assumption diagnostics for FUH 7 (final and full models)

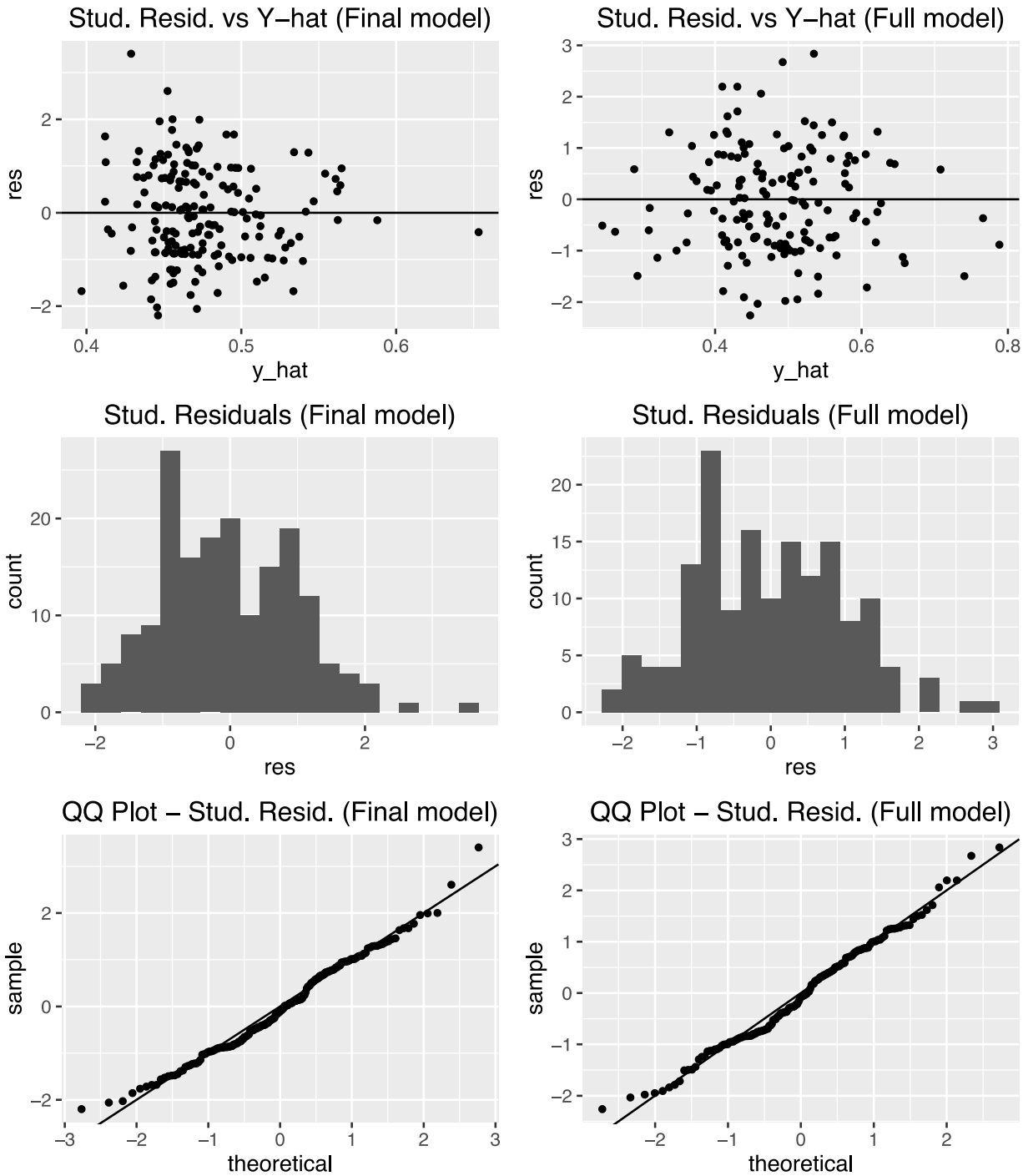

Figure D-7. Regression assumption diagnostics for FUH 30 (final and full models)

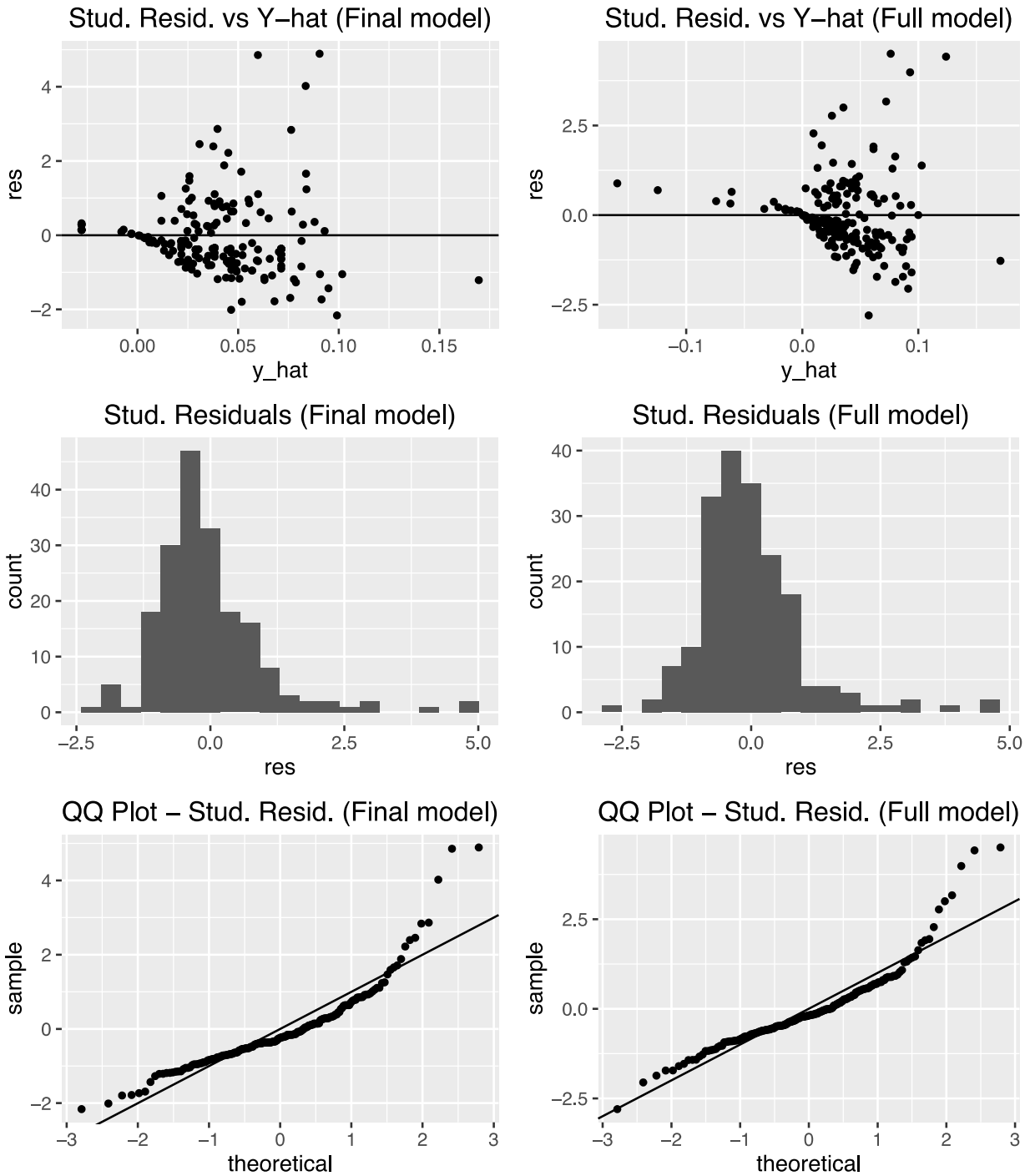

Figure D-8. Regression assumption diagnostics for IET EGMT (final and full models)

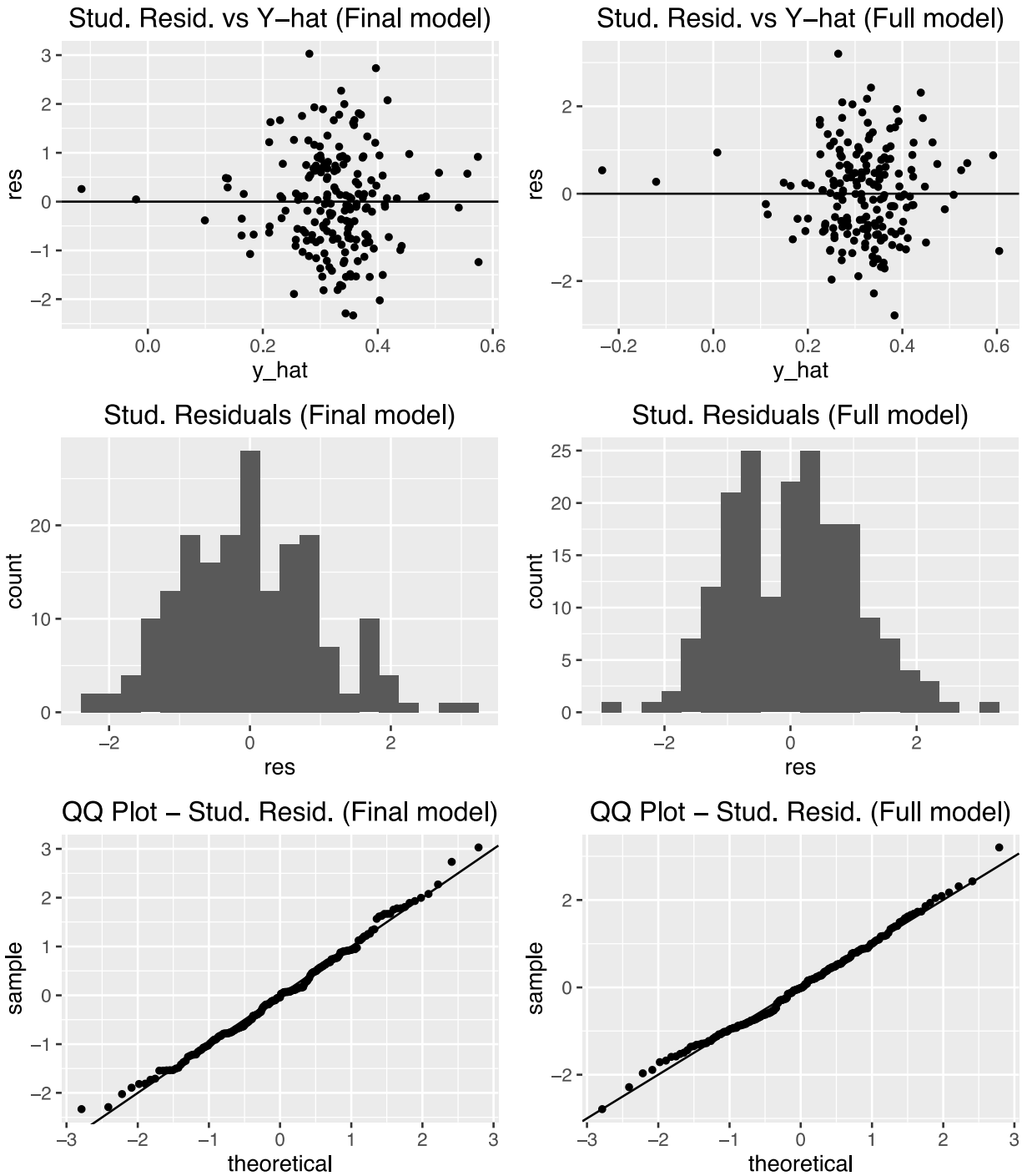

Figure D-9. Regression assumption diagnostics for IET INIT (final and full models)

APPENDIX E
TABLES FOR CHAPTER 3: BEHAVIORAL HEALTH CARE

Table E-1. Percentage of the sample qualifying for a given measure

	n [%]
AMM only	4827 (14.3)
FUH only	5863 (17.3)
IET only	16251 (48)
Only AMM and FUH	506 (1.5)
Only AMM and IET	932 (2.8)
Only FUH and IET	4753 (14.1)
All measures	691 (2)

Table E-2. AAM eligible enrollees: Characteristics of enrollees in transition and comparison counties during the baseline and post baseline periods

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Unique enrollees	554	741	737	1058
Unique counties	26	27	120	126
Enrollees with complete data	510 (92.1)	713 (96.2)	686 (93.1)	935 (88.4)
Counties with complete data, by year	26 (100)	26 (96.3)	114 (95)	90 (71.4)
Counties with complete data in post and pre-years		26 (96.3)		90 (71.4)
Age [mean (SD)]	45.2 (11.5)	46.3 (11.6)	46.7 (11.5)	46.1 (11.9)
Age categories [n (%)]				
21-30	74 (13.4)	91 (12.3)	82 (11.1)	139 (13.1)
30-39	98 (17.7)	111 (15)	101 (13.7)	164 (15.5)
40-49	153 (27.6)	214 (28.9)	215 (29.2)	260 (24.6)
50-59	169 (30.5)	226 (30.5)	226 (30.7)	347 (32.8)
60-64	60 (10.8)	99 (13.4)	113 (15.3)	148 (14)
Age not available	0 (0)	0 (0)	0 (0)	0 (0)
Female [n (%)]	368 (66.4)	529 (71.4)	536 (72.7)	748 (70.7)
Sex not available	0 (0)	0 (0)	0 (0)	0 (0)
Race/ethnicity [n (%)]				
Non-Hispanic black	67 (12.1)	94 (12.7)	102 (13.8)	208 (19.7)
Hispanic	291 (52.5)	401 (54.1)	253 (34.3)	298 (28.2)
Other	22 (4)	39 (5.3)	65 (8.8)	92 (8.7)
Non-Hispanic white	174 (31.4)	207 (27.9)	317 (43)	460 (43.5)
Race/ethnicity not available	0 (0)	0 (0)	0 (0)	0 (0)
Health status [n (%)]				
Healthy	41 (7.8)	30 (4.1)	28 (4)	65 (6.5)
Significant acute	10 (1.9)	7 (1)	4 (0.6)	7 (0.7)
Minor chronic	39 (7.4)	41 (5.7)	44 (6.3)	66 (6.6)

Table E-2. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Moderate chronic	112 (21.4)	162 (22.4)	162 (23.3)	229 (23)
Major chronic	322 (61.5)	484 (66.9)	457 (65.8)	630 (63.2)
Health status not available	30 (5.4)	17 (2.3)	42 (5.7)	61 (5.8)
County metro classification [n (%)]				
Large metro (>1M)	441 (79.6)	606 (81.8)	20 (2.7)	23 (2.2)
Medium metro (250K – 1M)	78 (14.1)	89 (12)	308 (41.8)	394 (37.2)
Small metro (<250k)	16 (2.9)	17 (2.3)	199 (27)	328 (31)
Adjacent to metro	19 (3.4)	29 (3.9)	135 (18.3)	221 (20.9)
Nonadjacent to metro (>20k)	0 (0)	0 (0)	36 (4.9)	45 (4.3)
Nonadjacent to metro (<20k)	0 (0)	0 (0)	39 (5.3)	47 (4.4)
Census tract poverty [mean (SD)]	24.4 (12.5)	24 (12.7)	26.7 (14.1)	25.1 (13.4)
Census tract poverty categories [n (%)]				
0.0% - 4.9%	22 (4.1)	30 (4.1)	11 (1.5)	22 (2.1)
5.0% - 9.9%	41 (7.6)	65 (8.9)	56 (7.7)	97 (9.3)
10.0% - 19.9%	159 (29.3)	215 (29.3)	208 (28.5)	326 (31.1)
Poverty area (20.0% - 39.9%)	262 (48.3)	344 (46.9)	317 (43.4)	431 (41.1)
Extreme poverty area (> 40.0%)	59 (10.9)	79 (10.8)	138 (18.9)	172 (16.4)
Census tract not available	11 (2)	8 (1.1)	7 (0.9)	10 (0.9)
Census tract unemployment level [n (%)]	0 (NA)	0 (NA)	0 (NA)	0 (NA)
0.0% - 4.9%	76 (14)	100 (13.6)	146 (20)	225 (21.5)
5.0% - 9.9%	259 (47.7)	369 (50.3)	358 (49)	472 (45.1)
10.0% - 19.9%	203 (37.4)	253 (34.5)	218 (29.9)	326 (31.1)
> 20.0%	5 (0.9)	11 (1.5)	8 (1.1)	24 (2.3)
Census tract not available	11 (2)	8 (1.1)	7 (0.9)	11 (1)
Census tract household income [mean (SD)]	38148.8 (16672.5)	39465.3 (17563)	35429.8 (13311.6)	37165.2 (13508.2)
County Medicaid discharge density [mean (SD)]	1.1 (0.5)	1.1 (0.5)	1.1 (0.6)	1.1 (0.6)
Census tract determined from address [n (%)]	466 (84.1)	632 (85.3)	579 (78.6)	833 (78.7)
Facility residence [n (%)]	106 (19.4)	126 (17.1)	167 (22.8)	203 (19.3)

Table E-2. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Months enrolled in Medicaid [n (%)]				
12	469 (84.7)	664 (89.6)	640 (86.8)	952 (90)
9 - 11	43 (7.8)	44 (5.9)	60 (8.1)	54 (5.1)
5 - 8	19 (3.4)	18 (2.4)	17 (2.3)	31 (2.9)
2 - 5	21 (3.8)	11 (1.5)	20 (2.7)	18 (1.7)
1	2 (0.4)	2 (0.3)	0 (0)	2 (0.2)
STAR+PLUS transition cohort [n (%)]				
A	0 (0)	0 (0)	0 (0)	0 (0)
B	554 (100)	741 (100)	0 (0)	0 (0)
C	0 (0)	0 (0)	0 (0)	0 (0)
D	0 (0)	0 (0)	87 (11.8)	188 (17.8)
E	0 (0)	0 (0)	318 (43.1)	340 (32.1)
F	0 (0)	0 (0)	332 (45)	530 (50.1)

Table E-3. FUH eligible enrollees: Characteristics of enrollees in transition and comparison counties during the baseline and post baseline periods

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Unique enrollees	1420	1875	1730	2223
Unique counties	27	28	146	150
Enrollees with complete data	1282 (90.3)	1718 (91.6)	1493 (86.3)	1851 (83.3)
Counties with complete data, by year	26 (96.3)	27 (96.4)	139 (95.2)	128 (85.3)
Counties with complete data in post and pre-years		27 (96.4)		128 (85.3)
Age [mean (SD)]	41.2 (11.3)	41.1 (11.9)	40.9 (11.5)	40 (11.9)
Age categories [n (%)]				
21-30	287 (20.2)	445 (23.7)	377 (21.8)	558 (25.1)
30-39	307 (21.6)	376 (20.1)	376 (21.7)	538 (24.2)
40-49	459 (32.3)	520 (27.7)	522 (30.2)	572 (25.7)
50-59	305 (21.5)	425 (22.7)	363 (21)	437 (19.7)
60-64	62 (4.4)	109 (5.8)	92 (5.3)	118 (5.3)
Age not available	0 (0)	0 (0)	0 (0)	0 (0)
Female [n (%)]	780 (54.9)	1027 (54.8)	1074 (62.1)	1242 (55.9)
Sex not available	0 (0)	0 (0)	0 (0)	0 (0)
Race/ethnicity [n (%)]				
Non-Hispanic black	233 (16.4)	286 (15.3)	328 (19)	358 (16.1)
Hispanic	600 (42.3)	719 (38.3)	359 (20.8)	545 (24.5)

Table E-3. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Other	68 (4.8)	153 (8.2)	114 (6.6)	230 (10.3)
Non-Hispanic white	519 (36.5)	717 (38.2)	929 (53.7)	1090 (49)
Race/ethnicity not available	0 (0)	0 (0)	0 (0)	0 (0)
Health status [n (%)]				
Healthy	0 (0)	1 (0.1)	3 (0.2)	2 (0.1)
Significant acute	0 (0)	1 (0.1)	0 (0)	0 (0)
Minor chronic	0 (0)	0 (0)	2 (0.1)	4 (0.2)
Moderate chronic	335 (25.3)	450 (25.5)	424 (27.6)	466 (24.1)
Major chronic	988 (74.7)	1310 (74.3)	1106 (72.1)	1464 (75.6)
Health status not available	97 (6.8)	113 (6)	195 (11.3)	287 (12.9)
County metro classification [n (%)]				
Large metro (>1M)	1113 (78.4)	1576 (84.1)	44 (2.5)	48 (2.2)
Medium metro (250K – 1M)	249 (17.5)	224 (11.9)	470 (27.2)	750 (33.7)
Small metro (<250k)	17 (1.2)	21 (1.1)	605 (35)	717 (32.3)
Adjacent to metro	41 (2.9)	54 (2.9)	424 (24.5)	510 (22.9)
Nonadjacent to metro (>20k)	0 (0)	0 (0)	119 (6.9)	96 (4.3)
Nonadjacent to metro (<20k)	0 (0)	0 (0)	68 (3.9)	102 (4.6)
Census tract poverty [mean (SD)]	23.5 (13.3)	22.1 (12.5)	23 (12.3)	23.6 (12.8)
Census tract poverty categories [n (%)]				
0.0% - 4.9%	63 (4.5)	122 (6.6)	34 (2)	61 (2.8)
5.0% - 9.9%	141 (10.2)	184 (10)	183 (10.8)	217 (10)
10.0% - 19.9%	419 (30.2)	564 (30.5)	605 (35.7)	742 (34.1)
Poverty area (20.0% - 39.9%)	601 (43.3)	815 (44.1)	691 (40.8)	902 (41.5)
Extreme poverty area (> 40.0%)	164 (11.8)	162 (8.8)	181 (10.7)	254 (11.7)
Census tract not available	32 (2.3)	28 (1.5)	36 (2.1)	47 (2.1)
Census tract unemployment level [n (%)]	0 (NA)	0 (NA)	0 (NA)	0 (NA)
0.0% - 4.9%	202 (14.6)	292 (15.8)	401 (23.7)	512 (23.6)
5.0% - 9.9%	651 (46.9)	941 (50.9)	809 (47.8)	967 (44.5)
10.0% - 19.9%	508 (36.6)	586 (31.7)	461 (27.2)	669 (30.8)

Table E-3. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
> 20.0%	27 (1.9)	28 (1.5)	22 (1.3)	26 (1.2)
Census tract not available	32 (2.3)	28 (1.5)	37 (2.1)	49 (2.2)
Census tract household income [mean (SD)]	39813 (17933.7)	42586.4 (19399.4)	38559.1 (13764.6)	38331.8 (13790)
County Medicaid discharge density [mean (SD)]	1.1 (0.5)	1.1 (0.5)	1 (0.6)	1 (0.6)
Census tract determined from address [n (%)]	1194 (84.1)	1605 (85.6)	1279 (73.9)	1695 (76.2)
Facility residence [n (%)]	292 (20.9)	364 (19.7)	424 (24.8)	474 (21.7)
Months enrolled in Medicaid [n (%)]				
12	1051 (74)	1380 (73.6)	1357 (78.4)	1592 (71.6)
9 - 11	164 (11.5)	260 (13.9)	186 (10.8)	253 (11.4)
5 - 8	117 (8.2)	135 (7.2)	110 (6.4)	279 (12.6)
2 - 5	88 (6.2)	100 (5.3)	77 (4.5)	99 (4.5)
1	0 (0)	0 (0)	0 (0)	0 (0)
STAR+PLUS transition cohort [n (%)]				
A	0 (0)	0 (0)	0 (0)	0 (0)
B	1420 (100)	1875 (100)	0 (0)	0 (0)
C	0 (0)	0 (0)	0 (0)	0 (0)
D	0 (0)	0 (0)	239 (13.8)	370 (16.6)
E	0 (0)	0 (0)	464 (26.8)	671 (30.2)
F	0 (0)	0 (0)	1027 (59.4)	1182 (53.2)
Frequency of times qualifying for measure				
1		1404 (74.9)		1771 (79.7)
2		335 (17.9)		347 (15.6)
3		99 (5.3)		81 (3.6)
> 3		37 (2)		24 (1.1)

Table E-4. IET eligible enrollees: Characteristics of enrollees in transition and comparison counties during the baseline and post baseline periods

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Unique enrollees	2553	3422	3976	4994
Unique counties	28	28	177	177
Enrollees with complete data	2354 (92.2)	3268 (95.5)	3539 (89)	4411 (88.3)
Counties with complete data, by year	28 (100)	28 (100)	173 (97.7)	160 (90.4)
Counties with complete data in post and pre-years		28 (100)		160 (90.4)
Age [mean (SD)]	44.6 (10.8)	45.4 (11.2)	45.1 (11)	44.9 (11.4)
Age categories [n (%)]				
21-30	313 (12.3)	428 (12.5)	465 (11.7)	692 (13.9)
30-39	428 (16.8)	579 (16.9)	678 (17.1)	827 (16.6)
40-49	875 (34.3)	973 (28.4)	1293 (32.5)	1442 (28.9)
50-59	755 (29.6)	1140 (33.3)	1176 (29.6)	1630 (32.6)
60-64	182 (7.1)	302 (8.8)	364 (9.2)	403 (8.1)
Age not available	0 (0)	0 (0)	0 (0)	0 (0)
Female [n (%)]	1113 (43.6)	1615 (47.2)	1799 (45.2)	2331 (46.7)
Sex not available	0 (0)	0 (0)	0 (0)	0 (0)
Race/ethnicity [n (%)]				
Non-Hispanic black	476 (18.6)	616 (18)	863 (21.7)	1115 (22.3)
Hispanic	1029 (40.3)	1320 (38.6)	944 (23.7)	1018 (20.4)
Other	115 (4.5)	242 (7.1)	222 (5.6)	375 (7.5)
Non-Hispanic white	933 (36.5)	1244 (36.4)	1947 (49)	2486 (49.8)
Race/ethnicity not available	0 (0)	0 (0)	0 (0)	0 (0)
Health status [n (%)]				
Healthy	67 (2.8)	110 (3.3)	144 (4)	189 (4.2)
Significant acute	20 (0.8)	34 (1)	57 (1.6)	69 (1.5)
Minor chronic	30 (1.2)	48 (1.4)	70 (1.9)	106 (2.3)

Table E-4. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Moderate chronic	642 (26.5)	703 (21)	882 (24.3)	1045 (23)
Major chronic	1665 (68.7)	2454 (73.3)	2479 (68.3)	3126 (68.9)
Health status not available	129 (5.1)	73 (2.1)	344 (8.7)	459 (9.2)
County metro classification [n (%)]				
Large metro (>1M)	1979 (77.5)	2869 (83.8)	118 (3)	140 (2.8)
Medium metro (250K - 1M)	408 (16)	399 (11.7)	1023 (25.7)	1142 (22.9)
Small metro (<250k)	41 (1.6)	46 (1.3)	1324 (33.3)	1730 (34.6)
Adjacent to metro	125 (4.9)	108 (3.2)	1065 (26.8)	1404 (28.1)
Nonadjacent to metro (>20k)	0 (0)	0 (0)	233 (5.9)	305 (6.1)
Nonadjacent to metro (<20k)	0 (0)	0 (0)	213 (5.4)	273 (5.5)
Census tract poverty [mean (SD)]	23.3 (12.3)	22.5 (12.3)	24.4 (12.8)	23.1 (12.3)
Census tract poverty categories [n (%)]				
0.0% - 4.9%	99 (4)	170 (5)	71 (1.8)	101 (2.1)
5.0% - 9.9%	216 (8.6)	329 (9.7)	334 (8.5)	473 (9.6)
10.0% - 19.9%	801 (32)	1113 (32.9)	1314 (33.6)	1737 (35.4)
Poverty area (20.0% - 39.9%)	1149 (45.9)	1458 (43.1)	1685 (43.1)	2087 (42.5)
Extreme poverty area (> 40.0%)	240 (9.6)	315 (9.3)	503 (12.9)	508 (10.4)
Census tract not available	48 (1.9)	37 (1.1)	69 (1.7)	88 (1.8)
Census tract unemployment level [n (%)]	0 (NA)	0 (NA)	0 (NA)	0 (NA)
0.0% - 4.9%	366 (14.6)	497 (14.7)	847 (21.7)	1180 (24.1)
5.0% - 9.9%	1248 (49.8)	1787 (52.8)	1878 (48.1)	2234 (45.6)
10.0% - 19.9%	842 (33.6)	1062 (31.4)	1115 (28.5)	1399 (28.5)
> 20.0%	49 (2)	39 (1.2)	66 (1.7)	91 (1.9)

Table E-4. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Census tract household income [mean (SD)]	40176.6 (17580.8)	41989.7 (18154)	36534.8 (13296.1)	37679.2 (13012.7)
County Medicaid discharge density [mean (SD)]	1.1 (0.6)	1.1 (0.5)	0.9 (0.6)	0.9 (0.6)
Census tract determined from address [n (%)]	2122 (83.1)	2977 (87)	3068 (77.2)	3850 (77.1)
Facility residence [n (%)]	510 (20.3)	606 (18)	813 (20.7)	913 (18.5)
Months enrolled in Medicaid [n (%)]				
12	1985 (77.8)	2787 (81.4)	3174 (79.8)	3889 (77.9)
9 - 11	271 (10.6)	387 (11.3)	443 (11.1)	434 (8.7)
5 - 8	180 (7.1)	188 (5.5)	238 (6)	576 (11.5)
2 - 5	117 (4.6)	60 (1.8)	121 (3)	95 (1.9)
1	0 (0)	0 (0)	0 (0)	0 (0)
STAR+PLUS transition cohort [n (%)]				
A	0 (0)	0 (0)	0 (0)	0 (0)
B	2553 (100)	3422 (100)	0 (0)	0 (0)
C	0 (0)	0 (0)	0 (0)	0 (0)
D	0 (0)	0 (0)	547 (13.8)	803 (16.1)
E	0 (0)	0 (0)	1114 (28)	1053 (21.1)
F	0 (0)	0 (0)	2315 (58.2)	3138 (62.8)

Table E-5. Summary of sample size, by group and by measure

	STAR+PLUS (Transition)					FFS+PCCM (Comparison)				
Measure Type	Min	Q1	Median	Q3	Max	Min	Q1	Median	Q3	Max
AMM	1	4.00	7.00	14.00	387	1	1.00	3.00	8.00	196
FUH	2	6.00	16.00	30.00	872	1	2.00	4.00	13.00	284
IET	4	19.00	37.00	76.00	1246	1	4.00	11.00	29.00	325

Table E-6. Backward step-wise regression results for AMM Acute

Labels	R^2	F	p	Action
Full Model	NA	NA	NA	
Gender X Enrolled In STAR+PLUS	0.0017	1.6	0.2143	Removed
Medicaid Discharge Density	0.1390	10.7	0.0015	Kept
Metro Classification^2	0.0007	1.0	0.3098	Removed
Metro Classification	0.0048	2.5	0.1150	Removed
Unemployment	0.0859	8.8	0.0039	Kept
Poverty	0.0009	1.1	0.2924	Removed
County Income	0.0020	1.6	0.2036	Removed
Median Household Income	0.0431	6.6	0.0118	Kept
Group Facility Proxy	0.0001	0.4	0.5360	Removed
Health Status^2	0.0695	8.0	0.0055	Kept
Health Status	NA	NA	NA	Kept
Age^2	0.5421	16.4	0.0001	Kept
Age	NA	NA	NA	Kept
Gender X Race/Ethnicity	0.4495	5.2	0.0024	Kept
Race/Ethnicity	NA	NA	NA	Kept
Gender	NA	NA	NA	Kept
Baseline	0.2529	12.9	0.0005	Kept

Table E-7. Backward step-wise regression results for AMM Cont

Labels	R^2	F	p	Action
Full Model	NA	NA	NA	
Gender X Enrolled In STAR+PLUS	0.0157	4.4	0.0378	Kept
Medicaid Discharge Density	0.0323	6.1	0.0156	Kept

Table E-7. Continued

Labels	R^2	F	p	Action
Metro Classification^2	0.0039	2.3	0.1303	Removed
Metro Classification	0.0008	1.1	0.3038	Removed
Unemployment	0.0000	0.1	0.7963	Removed
Poverty	0.0000	0.0	0.8833	Removed
County Income	0.0002	0.6	0.4466	Removed
Median Household Income	0.0057	2.8	0.0956	Removed
Group Facility Proxy	0.0000	0.1	0.7253	Removed
Health Status^2	0.0000	0.0	0.8777	Removed
Health Status	0.0122	3.0	0.0849	Removed
Age2	0.2060	8.6	0.0042	Kept
Age	NA	NA	NA	Kept
Gender X Race/Ethnicity	1.4760	5.0	0.0028	Kept
Race/Ethnicity	NA	NA	NA	Kept
Gender	NA	NA	NA	Kept
Baseline	0.0026	1.3	0.2522	Removed

Table E-8. Backward step-wise regression results for FUH 7

Labels	R^2	F	p	Action
Full Model	NA	NA	NA	
Gender*Enrolled In STAR+PLUS	0.0000	0.1	0.8101	Removed
Medicaid Discharge Density	0.0344	11.5	0.0009	Kept
Metro Classification^2	0.0357	11.7	0.0008	Kept
Metro Classification	NA	NA	NA	Kept
Unemployment	0.0009	2.1	0.1480	Removed
Poverty	0.0029	3.7	0.0562	Removed
County Income	0.0100	6.5	0.0118	Kept
Median Household Income	0.0253	9.8	0.0021	Kept
Group Facility Proxy	0.0001	0.8	0.3820	Removed
Health Status^2	0.0244	9.7	0.0023	Kept
Health Status	NA	NA	NA	Kept
Age^3	0.0012	2.4	0.1242	Removed
Age	0.0000	0.3	0.5702	Removed
Gender X Race/Ethnicity	0.1132	6.0	0.0007	Kept
Race/Ethnicity	NA	NA	NA	Kept
Gender	NA	NA	NA	Kept
Baseline	0.1094	17.7	0.0000	Kept

Table E-9. Backward step-wise regression results for FUH 30

Labels	R^2	F	p	Action
Full Model	NA	NA	NA	
Gender X Enrolled In STAR+PLUS	0.0000	0.1	0.7989	Removed
Medicaid Discharge Density	0.0094	3.8	0.0536	Removed
Metro Classification^2	0.0000	0.0	0.9238	Removed

Table E-9. Continued

Labels	R^2	F	p	Action
Metro Classification	0.0345	6.6	0.0111	Kept
Unemployment	0.0046	2.7	0.1026	Removed
Poverty	0.0000	0.2	0.6774	Removed
County Income	0.1388	11.4	0.0009	Kept
Median Household Income	0.2665	14.3	0.0002	Kept
Group Facility Proxy	0.0002	0.5	0.4746	Removed
Health Status	0.1565	12.0	0.0007	Kept
Age^2	0.0022	1.9	0.1711	Removed
Age	0.0000	0.0	0.8358	Removed
Gender X Race/Ethnicity	0.0293	2.1	0.1084	Removed
Race/Ethnicity	11.6010	10.6	0.0000	Kept
Gender	0.0178	4.9	0.0290	Kept
Baseline	0.0137	4.3	0.0391	Kept

Table E-10. Backward step-wise regression results for IET EGMT

Variable	R^2 Total	ΔR^2	F-value	p-value	Action
Full Model	0.3193	NA	NA	NA	
Medicaid Discharge Density	0.3178	0.0015	0.4	0.5443	Removed
Metro $Classification^2$	0.3144	0.0034	0.8	0.3636	Removed
Metro Classification	0.3134	0.0010	0.2	0.6280	Removed
Unemployment	0.3134	0.0000	0.0	0.9968	Removed
Poverty	0.3103	0.0031	0.8	0.3799	Removed
County Income	0.3102	0.0001	0.0	0.9107	Removed
Median Household Income	0.3082	0.0021	0.5	0.4760	Removed
Group Facility Proxy	0.3037	0.0045	1.1	0.2930	Removed
Health $Status^2$	0.2923	0.0115	2.9	0.0918	Removed
Health Status	0.2781	0.0142	3.5	0.0626	Removed
Age^3	0.2751	0.0027	0.7	0.4163	Removed
Age^2	0.2747	0.0004	0.1	0.7560	Removed
Age	0.2722	0.0025	0.6	0.4355	Removed
Gender X Race/Ethnicity	0.2721	0.0002	0.0	0.9977	Removed
Race/Ethnicity	0.2431	0.0290	2.4	0.0667	Removed
Gender	0.2431	0.0687	16.9	0.0001	Kept
Baseline	0.2431	0.1105	27.2	0.0000	Kept

Table E-11. Backward step-wise regression results for IET INIT

Variable	R^2 Total	ΔR^2	F-value	p-value	Action
Full Model	0.2436	NA	NA	NA	
Medicaid Discharge Density	0.2436	0.0197	4.3	0.0393	Kept
Metro $Classification^2$	0.2431	0.0005	0.1	0.7502	Removed
Metro Classification	0.2359	0.0072	1.6	0.2086	Removed
Unemployment	0.2342	0.0016	0.4	0.5506	Removed
Poverty	0.2241	0.0101	2.2	0.1372	Removed

Table E-11. Continued

Variable	R^2 Total	ΔR^2	F-value	p-value	Action
County Income	0.2181	0.0060	1.3	0.2526	Removed
Median Household Income	0.2164	0.0017	0.4	0.5400	Removed
Group Facility Proxy	0.2147	0.0016	0.4	0.5481	Removed
Health Status	0.2151	0.0569	12.6	0.0005	Kept
Age^3	0.2151	0.0000	0.0	0.9440	Removed
Age^2	0.2150	0.0001	0.0	0.8925	Removed
Age	0.2147	0.0003	0.1	0.8046	Removed
Gender X Race/Ethnicity	0.2098	0.0050	0.4	0.7728	Removed
Race/Ethnicity	0.1874	0.0224	1.7	0.1690	Removed
Gender	0.1874	0.0483	10.9	0.0012	Kept
Baseline	0.1874	0.0496	11.2	0.0010	Kept

Table E-12. Full model coefficients for AMM Acute

Variable	Value (std error)	95% C.I.
(Intercept)	0.7173 (0.1128)	(0.4933 - 0.9412)
Male	0.0695 (0.2375)	(-0.4021 - 0.5412)
Hispanic	-0.0595 (0.1070)	(-0.2719 - 0.1528)
Other	-0.0492 (0.2019)	(-0.4501 - 0.3517)
White	0.1001 (0.1096)	(-0.1176 - 0.3177)
Group Facility Proxy	0.1658 (0.1160)	(-0.0646 - 0.3962)
Male*Hispanic	0.0069 (0.0325)	(-0.0576 - 0.0715)
Male*Other	-0.0468 (0.0509)	(-0.1478 - 0.0542)
Male*White	-0.0070 (0.0269)	(-0.0604 - 0.0464)
Age	0.0051 (0.0044)	(-0.0036 - 0.0139)
Age^2	-0.0005 (0.0005)	(-0.0014 - 0.0004)
Health Status	-0.0747 (0.0639)	(-0.2016 - 0.0523)
Health $Status^2$	-0.0602 (0.0344)	(-0.1285 - 0.0082)
County Income	-0.0221 (0.0362)	(-0.0939 - 0.0498)
Median Household Income	0.0508 (0.0364)	(-0.0215 - 0.1231)
Poverty	0.0034 (0.0050)	(-0.0066 - 0.0133)
Unemployment	0.0025 (0.0101)	(-0.0175 - 0.0225)
Metro Classification	-0.0155 (0.0168)	(-0.0489 - 0.0180)
Metro $Classification^2$	0.0026 (0.0089)	(-0.0151 - 0.0203)
Medicaid Discharge Density	0.0377 (0.0283)	(-0.0186 - 0.0940)
Baseline	-0.0407 (0.0804)	(-0.2002 - 0.1189)
Months Enrolled in STAR+PLUS	-0.0016 (0.1069)	(-0.2139 - 0.2107)
Male*Months Enrolled in STAR+PLUS	-0.1719 (0.2722)	(-0.7124 - 0.3687)

Table E-13. Full model coefficients for AMM Cont

Variable	Value (std error)	95% C.I.
(Intercept)	0.4070 (0.1168)	(0.1751 - 0.6390)
Male	0.0959 (0.2369)	(-0.3746 - 0.5664)
Hispanic	-0.0301 (0.1113)	(-0.2511 - 0.1910)

Table E-13. Continued

Variable	Value (std error)	95% C.I.
Other	0.1498 (0.2085)	(-0.2643 - 0.5639)
White	0.2089 (0.1131)	(-0.0157 - 0.4335)
Group Facility Proxy	0.1872 (0.1152)	(-0.0415 - 0.4158)
Male*Hispanic	-0.0176 (0.0333)	(-0.0838 - 0.0485)
Male*Other	-0.0336 (0.0508)	(-0.1344 - 0.0672)
Male*White	-0.0050 (0.0266)	(-0.0579 - 0.0479)
Age	0.0038 (0.0044)	(-0.0050 - 0.0125)
Age^2	-0.0001 (0.0004)	(-0.0010 - 0.0008)
Health Status	-0.0465 (0.0645)	(-0.1745 - 0.0815)
Health $Status^2$	-0.0256 (0.0344)	(-0.0938 - 0.0426)
County Income	-0.0110 (0.0366)	(-0.0836 - 0.0617)
Median Household Income	-0.0247 (0.0395)	(-0.1032 - 0.0538)
Poverty	-0.0014 (0.0051)	(-0.0116 - 0.0088)
Unemployment	0.0020 (0.0105)	(-0.0189 - 0.0228)
Metro Classification	-0.0223 (0.0177)	(-0.0575 - 0.0130)
Metro $Classification^2$	0.0097 (0.0091)	(-0.0085 - 0.0278)
Medicaid Discharge Density	0.0153 (0.0301)	(-0.0446 - 0.0751)
Baseline	-0.0124 (0.0734)	(-0.1581 - 0.1334)
Months Enrolled in STAR+PLUS	0.0685 (0.1080)	(-0.1459 - 0.2829)
Male*Months Enrolled in STAR+PLUS	-0.2133 (0.2726)	(-0.7548 - 0.3281)

Table E-14. Full model coefficients for FUH 7

Variable	Value (std error)	95% C.I.
(Intercept)	0.1818 (0.0575)	(0.0680 - 0.2956)
Male	-0.2172 (0.2252)	(-0.6626 - 0.2283)
Hispanic	-0.0429 (0.0839)	(-0.2088 - 0.1230)
Other	-0.0720 (0.1488)	(-0.3663 - 0.2223)
White	-0.1230 (0.0834)	(-0.2880 - 0.0420)
Group Facility Proxy	-0.2003 (0.0808)	(-0.3602 - -0.0405)
Male*Hispanic	0.0267 (0.0277)	(-0.0281 - 0.0815)
Male*Other	0.0484 (0.0357)	(-0.0223 - 0.1190)
Male*White	0.0347 (0.0246)	(-0.0138 - 0.0833)
Age	-0.0034 (0.0040)	(-0.0113 - 0.0044)
Age^2	0.0001 (0.0003)	(-0.0004 - 0.0007)
Health Status	-0.0525 (0.1139)	(-0.2779 - 0.1728)
Health $Status^2$	-0.0253 (0.1163)	(-0.2554 - 0.2048)
County Income	0.0424 (0.0223)	(-0.0017 - 0.0864)
Median Household Income	-0.0061 (0.0307)	(-0.0668 - 0.0547)
Poverty	-0.0017 (0.0035)	(-0.0087 - 0.0053)
Unemployment	-0.0051 (0.0072)	(-0.0193 - 0.0091)
Metro Classification	-0.0029 (0.0118)	(-0.0262 - 0.0204)
Metro $Classification^2$	0.0126 (0.0054)	(0.0019 - 0.0233)
Medicaid Discharge Density	-0.0008 (0.0183)	(-0.0369 - 0.0354)

Table E-14. Continued

Variable	Value (std error)	95% C.I.
Baseline	0.2425 (0.0743)	(0.0955 - 0.3895)
Months Enrolled in STAR+PLUS	-0.0714 (0.1000)	(-0.2692 - 0.1264)
Male*Months Enrolled in STAR+PLUS	0.2072 (0.2107)	(-0.2096 - 0.6239)

Table E-15. Final model coefficients for 30

Variable	Value (std error)	95% C.I.
(Intercept)	0.3574 (0.0741)	(0.2108 - 0.5040)
Male	0.0141 (0.2898)	(-0.5591 - 0.5873)
Hispanic	-0.0237 (0.1074)	(-0.2361 - 0.1887)
Other	-0.0867 (0.1891)	(-0.4607 - 0.2873)
White	-0.1839 (0.1067)	(-0.3949 - 0.0271)
Group Facility Proxy	-0.1236 (0.1051)	(-0.3314 - 0.0843)
Male*Hispanic	0.0020 (0.0358)	(-0.0688 - 0.0729)
Male*Other	0.0321 (0.0463)	(-0.0594 - 0.1237)
Male*White	0.0007 (0.0318)	(-0.0621 - 0.0636)
Age	-0.0058 (0.0051)	(-0.0159 - 0.0043)
Age^2	0.0001 (0.0004)	(-0.0006 - 0.0009)
Health Status	0.0834 (0.1456)	(-0.2046 - 0.3714)
Health $Status^2$	0.0842 (0.1439)	(-0.2005 - 0.3689)
County Income	-0.0129 (0.0286)	(-0.0693 - 0.0436)
Median Household Income	0.0345 (0.0387)	(-0.0420 - 0.1110)
Poverty	-0.0022 (0.0045)	(-0.0111 - 0.0067)
Unemployment	-0.0126 (0.0092)	(-0.0308 - 0.0056)
Metro Classification	0.0051 (0.0150)	(-0.0246 - 0.0349)
Metro $Classification^2$	0.0088 (0.0069)	(-0.0049 - 0.0225)
Medicaid Discharge Density	0.0120 (0.0232)	(-0.0338 - 0.0579)
Baseline	0.0014 (0.0734)	(-0.1438 - 0.1467)
Months Enrolled in STAR+PLUS	0.0088 (0.1280)	(-0.2445 - 0.2621)
Male*Months Enrolled in STAR+PLUS	0.0459 (0.2698)	(-0.4878 - 0.5795)

Table E-16. Full model coefficients for IET EGMT

Variable	Value (std error)	95% C.I.
(Intercept)	0.0328 (0.0187)	(-0.0042 - 0.0698)
Male	0.0907 (0.0775)	(-0.0623 - 0.2436)
Hispanic	0.0120 (0.0244)	(-0.0360 - 0.0601)
Other	-0.0052 (0.0596)	(-0.1228 - 0.1124)
White	-0.0380 (0.0256)	(-0.0885 - 0.0125)
Group Facility Proxy	-0.0278 (0.0284)	(-0.0838 - 0.0282)
Male*Hispanic	-0.0048 (0.0200)	(-0.0443 - 0.0347)
Male*Other	-0.0152 (0.0265)	(-0.0676 - 0.0372)
Male*White	-0.0034 (0.0171)	(-0.0371 - 0.0303)
Age	-0.0019 (0.0032)	(-0.0083 - 0.0045)
Age^2	0.0001 (0.0001)	(-0.0002 - 0.0004)

Table E-16. Continued

Variable	Value (std error)	95% C.I.
Age-Cu	0.0000 (0.0000)	(-0.0000 - 0.0000)
Health Status	-0.0262 (0.0347)	(-0.0948 - 0.0424)
Health Status^2	-0.0192 (0.0110)	(-0.0410 - 0.0026)
County Income	-0.0005 (0.0064)	(-0.0132 - 0.0122)
Median Household Income	-0.0036 (0.0095)	(-0.0223 - 0.0151)
Poverty	-0.0012 (0.0011)	(-0.0033 - 0.0009)
Unemployment	-0.0002 (0.0021)	(-0.0044 - 0.0039)
Metro Classification	-0.0006 (0.0034)	(-0.0073 - 0.0061)
Metro Classification^2	0.0015 (0.0016)	(-0.0017 - 0.0046)
Medicaid Discharge Density	0.0035 (0.0058)	(-0.0079 - 0.0150)
Baseline	0.2540 (0.0558)	(0.1439 - 0.3642)
Months Enrolled in STAR+PLUS	0.0131 (0.0126)	(-0.0117 - 0.0380)

Table E-17. Full model coefficients for IET INIT

Variable	Value (std error)	95% C.I.
(Intercept)	0.3646 (0.0565)	(0.2531 - 0.4760)
Male	0.4672 (0.2028)	(0.0667 - 0.8677)
Hispanic	-0.0201 (0.0674)	(-0.1532 - 0.1130)
Other	0.2390 (0.1561)	(-0.0691 - 0.5471)
White	0.0812 (0.0701)	(-0.0573 - 0.2196)
Group Facility Proxy	-0.0252 (0.0743)	(-0.1718 - 0.1214)
Male*Hispanic	-0.0506 (0.0519)	(-0.1531 - 0.0518)
Male*Other	-0.0662 (0.0695)	(-0.2034 - 0.0709)
Male*White	-0.0454 (0.0448)	(-0.1338 - 0.0430)
Age	-0.0017 (0.0083)	(-0.0180 - 0.0146)
Age^2	-0.0001 (0.0004)	(-0.0009 - 0.0006)
Age^3	0.0000 (0.0000)	(-0.0001 - 0.0001)
Health Status	0.1390 (0.0413)	(0.0574 - 0.2206)
County Income	-0.0200 (0.0181)	(-0.0557 - 0.0158)
Median Household Income	0.0243 (0.0275)	(-0.0300 - 0.0786)
Poverty	0.0038 (0.0030)	(-0.0020 - 0.0097)
Unemployment	-0.0052 (0.0058)	(-0.0166 - 0.0061)
Metro Classification	-0.0120 (0.0093)	(-0.0303 - 0.0063)
Metro Classification^2	-0.0014 (0.0043)	(-0.0099 - 0.0072)
Medicaid Discharge Density	0.0341 (0.0164)	(0.0017 - 0.0666)
Baseline	0.1922 (0.0594)	(0.0750 - 0.3094)
Months Enrolled in STAR+PLUS	0.0204 (0.0354)	(-0.0494 - 0.0903)

Table E-18. Final model coefficients for AMM Acute

Variable	Value (std error)	95% C.I.
(Intercept)	0.5411 (0.0136)	(0.5142 - 0.5680)
Months Enrolled in STAR+PLUS	-0.0433 (0.0276)	(-0.0977 - 0.0112)

Table E-19. Final model coefficients for AMM Cont

Variable	Value (std error)	95% C.I.
(Intercept)	0.3864 (0.0148)	(0.3571 - 0.4157)
Months Enrolled in STAR+PLUS	0.0037 (0.0326)	(-0.0606 - 0.0681)

Table E-20. Final model coefficients for FUH 7

Variable	Value (std error)	95% C.I.
(Intercept)	0.2111 (0.0135)	(0.1845 - 0.2377)
Group Facility Proxy	-0.1799 (0.0763)	(-0.3306 - -0.0292)
County Income	0.0429 (0.0164)	(0.0105 - 0.0754)
Metro Classification	-0.0021 (0.0096)	(-0.0211 - 0.0170)
Metro Classification^2	0.0125 (0.0050)	(0.0026 - 0.0224)
Baseline	0.2320 (0.0653)	(0.1030 - 0.3611)
Months Enrolled in STAR+PLUS	0.0243 (0.0352)	(-0.0452 - 0.0938)

Table E-21. Final model coefficients for FUH 30

Variable	Value (std error)	95% C.I.
(Intercept)	0.4736 (0.0124)	(0.4491 - 0.4980)
Median Household Income	0.0321 (0.0170)	(-0.0015 - 0.0657)
Months Enrolled in STAR+PLUS	0.0543 (0.0325)	(-0.0099 - 0.1185)

Table E-22. Final model coefficients for IET EGMT

Variable	Value (std error)	95% C.I.
(Intercept)	0.0377 (0.0030)	(0.0318 - 0.0435)
Male	0.0992 (0.0242)	(0.0516 - 0.1469)
Baseline	0.2758 (0.0529)	(0.1714 - 0.3802)
Months Enrolled in STAR+PLUS	0.0290 (0.0070)	(0.0152 - 0.0428)

Table E-23. Final model coefficients for IET INIT

Variable	Value (std error)	95% C.I.
(Intercept)	0.3609 (0.0122)	(0.3368 - 0.3849)
Male	0.2183 (0.0662)	(0.0877 - 0.3488)
Health Status	0.1242 (0.0380)	(0.0492 - 0.1992)
Medicaid Discharge Density	0.0280 (0.0141)	(0.0003 - 0.0558)
Baseline	0.1896 (0.0567)	(0.0777 - 0.3015)
Months Enrolled in STAR+PLUS	0.0251 (0.0213)	(-0.0170 - 0.0671)

APPENDIX F
FIGURES FOR CHAPTER 4: PREVENTATIVE CARE

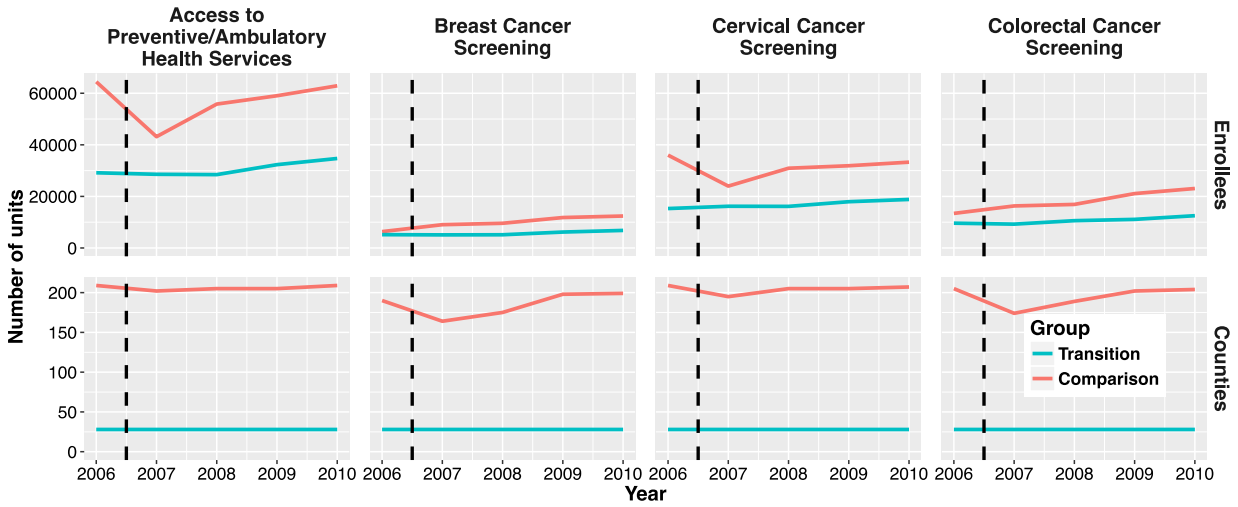

Figure F-1. Number of enrollees that qualify for a given measure, by year and by group

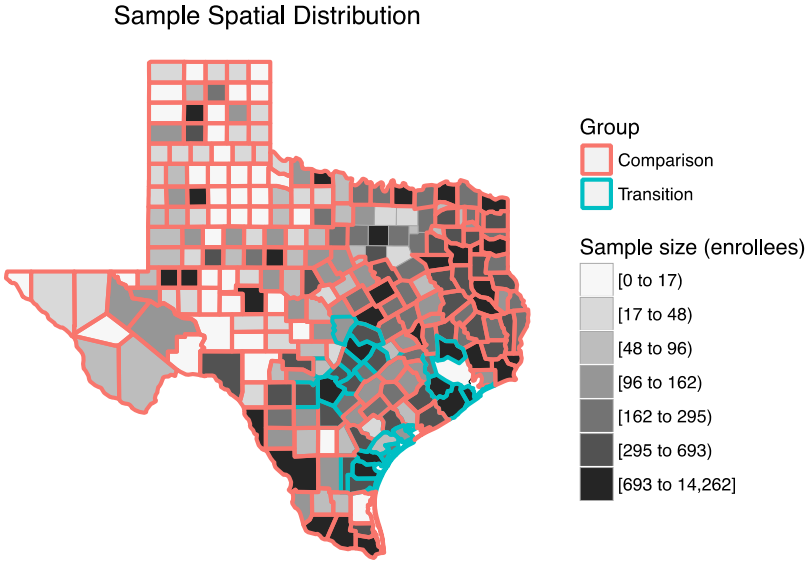

Figure F-2. Sample spatial distribution

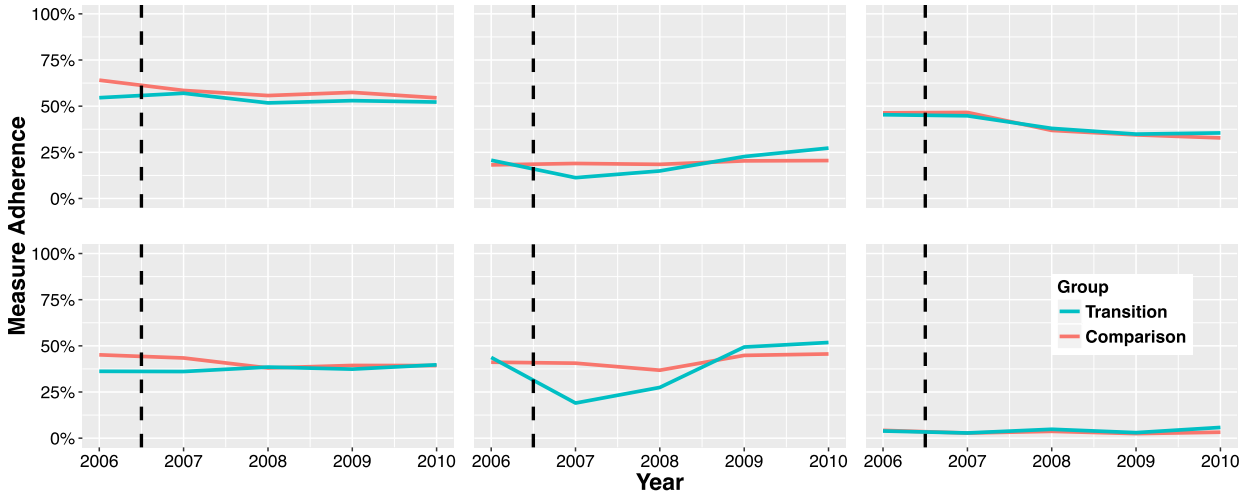

Figure F-3. Weighted, unadjusted measure performance over time, by group

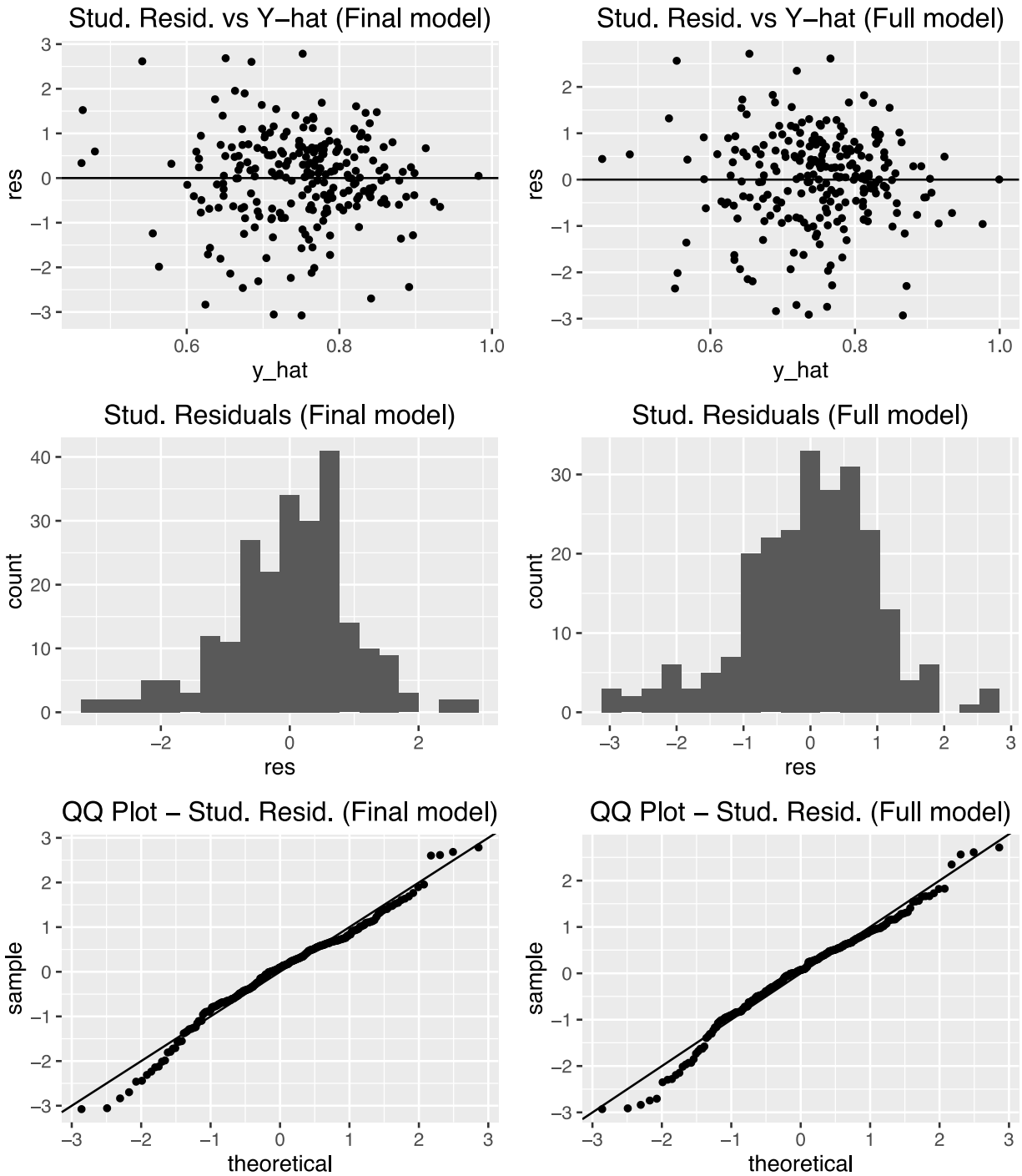

Figure F-4. Regression assumption diagnostics for AAP (full and final models)

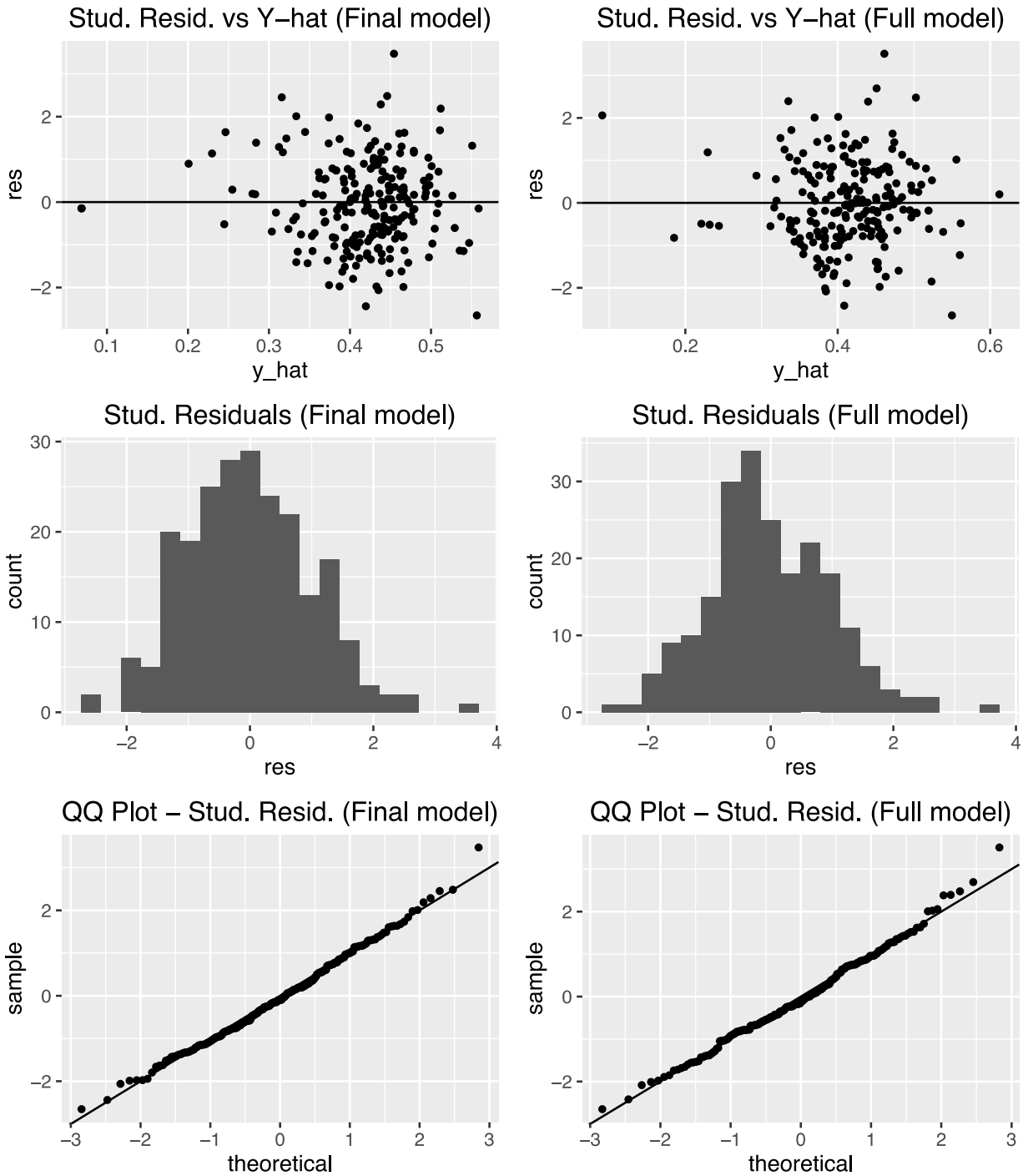

Figure F-5. Regression assumption diagnostics for BCS (full and final models)

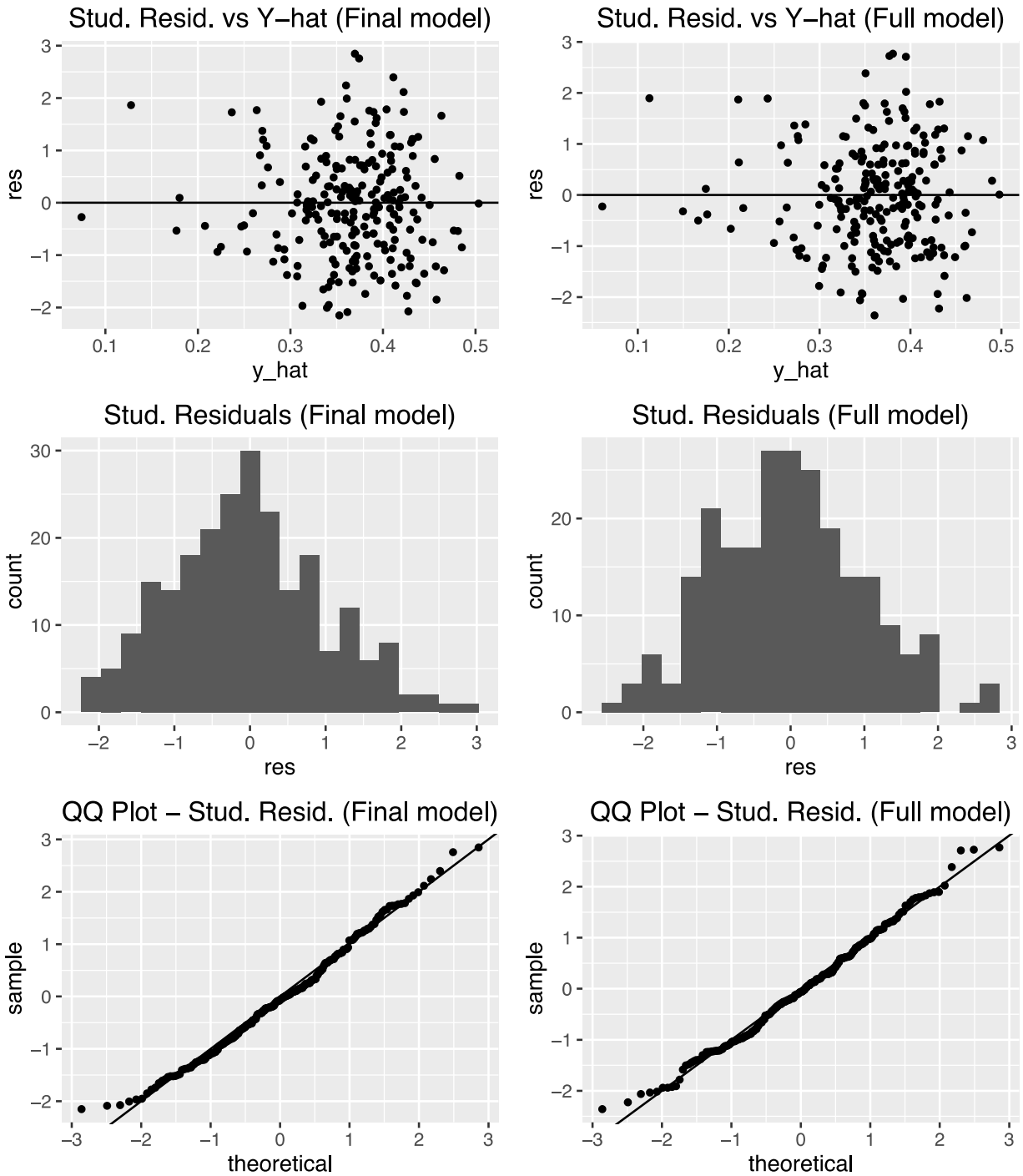

Figure F-6. Regression assumption diagnostics for CCS (full and final models)

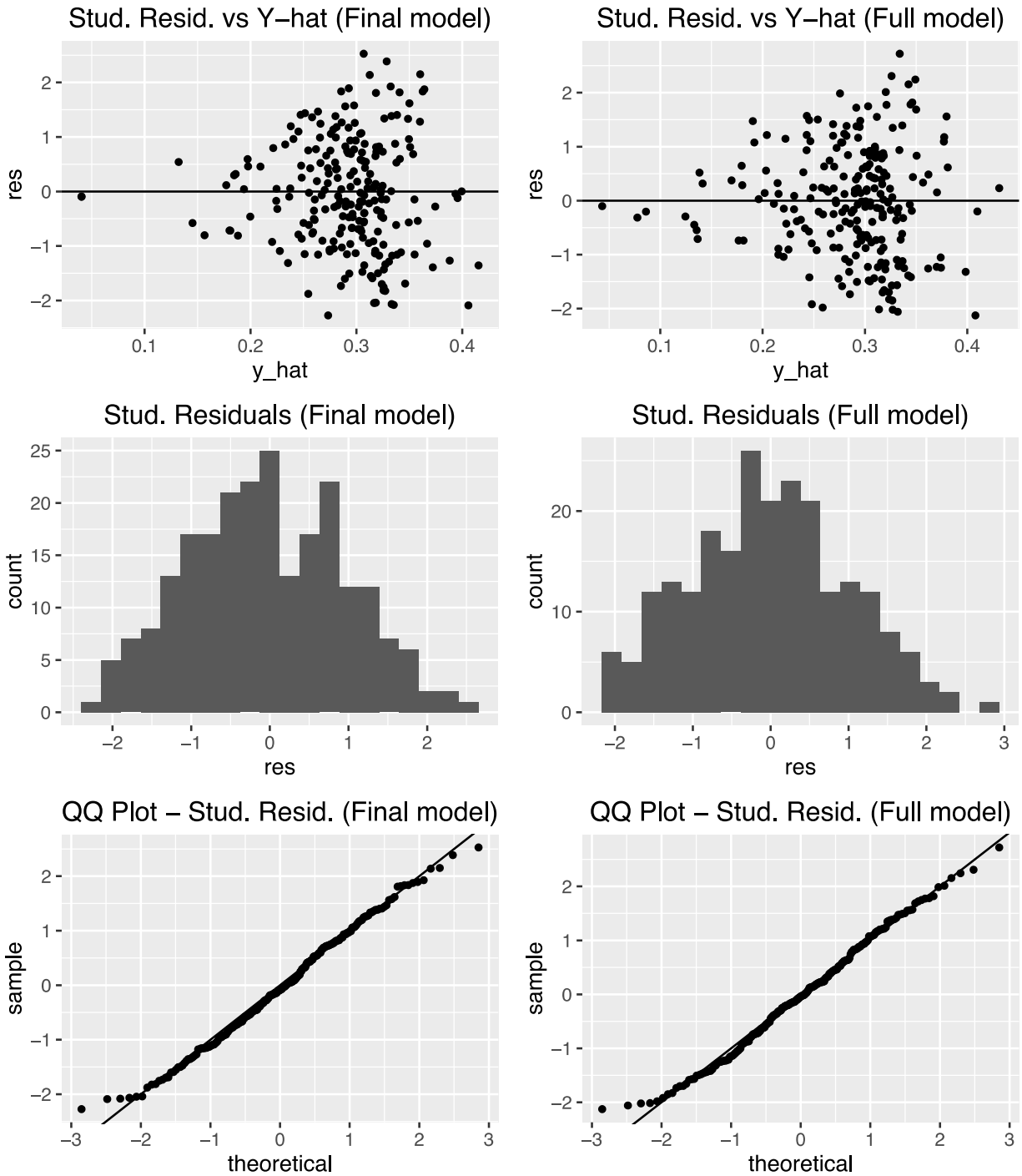

Figure F-7. Regression assumption diagnostics for COL (full and final models)

APPENDIX G
TABLES FOR CHAPTER 4: PREVENTATIVE CARE

Table G-1. Percentage of the sample qualifying for a given measure

	n [%]
AAP only	49566 (31.6)
BCS only	0 (0)
CCS only	4 (0)
COL only	9 (0)
Only AAP and BCS	0 (0)
Only AAP and CCS	49966 (31.9)
Only AAP and COL	21952 (14)
Only BCS and CCS	0 (0)
Only BCS and COL	1 (0)
Only CCS and COL	3 (0)
Only AAP, BCS and CCS	78 (0)
Only AAP, BCS and COL	103 (0.1)
Only AAP, CCS and COL	4319 (2.8)
Only BCS, CCS and COL	6 (0)
All measures	30627 (19.6)

Table G-2. AAP eligible enrollees: Characteristics of enrollees in transition and comparison counties during the baseline and post baseline periods

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Unique enrollees	29152	34701	64463	62888
Unique counties	28	28	209	209
Enrollees with complete data	28288 (97)	33992 (98)	61297 (95.1)	58975 (93.8)
Counties with complete data, by year	28 (100)	28 (100)	209 (100)	208 (99.5)
Counties with complete data in post and pre-years		28 (100)		208 (99.5)
Age [mean (SD)]	44.5 (13.1)	45.6 (12.7)	46 (12.9)	45.7 (13)
Age categories [n (%)]				
21-30	5701 (19.6)	5809 (16.7)	10570 (16.4)	10842 (17.2)
30-39	4464 (15.3)	5257 (15.1)	9395 (14.6)	9411 (15)
40-49	6491 (22.3)	7464 (21.5)	13794 (21.4)	12705 (20.2)

Table G-2. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
50-59	8413 (28.9)	11163 (32.2)	19804 (30.7)	20064 (31.9)
60-64	4083 (14)	5008 (14.4)	10900 (16.9)	9866 (15.7)
Age not available	0 (0)	0 (0)	0 (0)	0 (0)
Female [n (%)]	16569 (56.8)	20126 (58)	37984 (58.9)	35920 (57.1)
Sex not available	0 (0)	0 (0)	0 (0)	0 (0)
Race/ethnicity [n (%)]				
Non-Hispanic black	4357 (14.9)	5462 (15.7)	12170 (18.9)	12578 (20)
Hispanic	12327 (42.3)	14657 (42.2)	19721 (30.6)	17640 (28)
Other	1772 (6.1)	2719 (7.8)	5118 (7.9)	5101 (8.1)
Non-Hispanic white	10696 (36.7)	11863 (34.2)	27454 (42.6)	27569 (43.8)
Race/ethnicity not available	0 (0)	0 (0)	0 (0)	0 (0)
Health status [n (%)]				
Healthy	5356 (18.6)	5740 (16.6)	10484 (16.8)	10031 (16.7)
Significant acute	783 (2.7)	821 (2.4)	1731 (2.8)	1625 (2.7)
Minor chronic	1678 (5.8)	1593 (4.6)	3653 (5.8)	3552 (5.9)
Moderate chronic	7207 (25)	7702 (22.3)	15026 (24.1)	13982 (23.3)
Major chronic	13846 (48)	18694 (54.1)	31578 (50.5)	30708 (51.3)
Health status not available	282 (1)	151 (0.4)	1991 (3.1)	2990 (4.8)
County metro classification [n (%)]				
Large metro (>1M)	22544 (77.3)	28199 (81.3)	1474 (2.3)	1623 (2.6)
Medium metro (250K – 1M)	4243 (14.6)	4209 (12.1)	20391 (31.6)	16473 (26.2)
Small metro (<250k)	837 (2.9)	823 (2.4)	17903 (27.8)	19580 (31.1)
Adjacent to metro	1528 (5.2)	1470 (4.2)	16763 (26)	17365 (27.6)
Nonadjacent to metro (>20k)	0 (0)	0 (0)	3878 (6)	3935 (6.3)
Nonadjacent to metro (<20k)	0 (0)	0 (0)	4054 (6.3)	3912 (6.2)
Census tract poverty [mean (SD)]	21.7 (12.2)	21.8 (12.2)	25 (13.1)	24.3 (12.8)
Census tract poverty categories [n (%)]				

Table G-2. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
0.0% - 4.9%	1670 (5.8)	1901 (5.5)	1361 (2.1)	1385 (2.2)
5.0% - 9.9%	3206 (11.1)	3789 (11)	5319 (8.4)	5603 (9)
10.0% - 19.9%	9573 (33.3)	11387 (33.1)	20011 (31.4)	20459 (32.8)
Poverty area (20.0% - 39.9%)	12017 (41.8)	14561 (42.3)	28070 (44.1)	26774 (43)
Extreme poverty area (> 40.0%)	2300 (8)	2774 (8.1)	8887 (14)	8064 (12.9)
Census tract not available	386 (1.3)	289 (0.8)	815 (1.3)	603 (1)
Census tract unemployment level [n (%)]				
0.0% - 4.9%	4716 (16.4)	5526 (16.1)	13964 (21.9)	14196 (22.8)
5.0% - 9.9%	14735 (51.2)	17654 (51.3)	29544 (46.4)	27917 (44.8)
10.0% - 19.9%	8848 (30.8)	10710 (31.1)	18927 (29.7)	18861 (30.3)
> 20.0%	467 (1.6)	522 (1.5)	1195 (1.9)	1294 (2.1)
Census tract not available	386 (1.3)	289 (0.8)	833 (1.3)	620 (1)
Census tract household income [mean (SD)]	42708 (19126.8)	42673.1 (18808.6)	36854.7 (13553.6)	37198.3 (13185.4)
County Medicaid discharge density [mean (SD)]	1 (0.5)	1 (0.5)	1 (0.6)	1 (0.6)
Census tract determined from address [n (%)]	24054 (82.5)	29496 (85)	48396 (75.1)	47846 (76.1)
Facility residence [n (%)]	5722 (19.8)	5985 (17.4)	13118 (20.5)	12083 (19.4)
Months enrolled in Medicaid [n (%)]				
12	28538 (97.9)	32886 (94.8)	63223 (98.1)	61083 (97.1)
9 - 11	585 (2)	1815 (5.2)	1239 (1.9)	1799 (2.9)
5 - 8	0 (0)	0 (0)	0 (0)	0 (0)
2 - 5	0 (0)	0 (0)	0 (0)	0 (0)
1	0 (0)	0 (0)	0 (0)	0 (0)

Table G-2. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
STAR+PLUS transition cohort [n (%)]				
A	0 (0)	0 (0)	0 (0)	0 (0)
B	29152 (100)	34701 (100)	0 (0)	0 (0)
C	0 (0)	0 (0)	0 (0)	0 (0)
D	0 (0)	0 (0)	8481 (13.2)	9563 (15.2)
E	0 (0)	0 (0)	22112 (34.3)	17920 (28.5)
F	0 (0)	0 (0)	33870 (52.5)	35405 (56.3)

Table G-3. BCS eligible enrollees: Characteristics of enrollees in transition and comparison counties during the baseline and post baseline periods

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Unique enrollees	5171	6819	6334	12423
Unique counties	28	28	190	199
Enrollees with complete data	5067 (98)	6708 (98.4)	6112 (96.5)	11793 (94.9)
Counties with complete data, by year	28 (100)	28 (100)	189 (99.5)	185 (93)
Counties with complete data in post and pre-years		28 (100)		185 (93)
Age [mean (SD)]	58 (3.7)	58 (3.7)	58.6 (3.6)	58.1 (3.7)
Age categories [n (%)]				
21-30	0 (0)	0 (0)	0 (0)	0 (0)
30-39	0 (0)	0 (0)	0 (0)	0 (0)
40-49	0 (0)	0 (0)	0 (0)	0 (0)
50-59	3174 (61.4)	4252 (62.4)	3536 (55.8)	7476 (60.2)
60-64	1997 (38.6)	2567 (37.6)	2798 (44.2)	4947 (39.8)
Age not available	0 (0)	0 (0)	0 (0)	0 (0)
Female [n (%)]	5165 (99.9)	6813 (99.9)	6333 (100)	12423 (100)
Sex not available	0 (0)	0 (0)	0 (0)	0 (0)
Race/ethnicity [n (%)]				
Non-Hispanic black	594 (11.5)	902 (13.2)	800 (12.6)	2132 (17.2)
Hispanic	2411 (46.6)	3047 (44.7)	2712 (42.8)	3786 (30.5)
Other	418 (8.1)	646 (9.5)	762 (12)	1485 (12)
Non-Hispanic white	1748 (33.8)	2224 (32.6)	2060 (32.5)	5020 (40.4)
Race/ethnicity not available	0 (0)	0 (0)	0 (0)	0 (0)
Health status [n (%)]				
Healthy	381 (7.4)	403 (5.9)	262 (4.2)	840 (7)

Table G-3. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Significant acute	81 (1.6)	65 (1)	46 (0.7)	160 (1.3)
Minor chronic	279 (5.4)	257 (3.8)	198 (3.2)	554 (4.6)
Moderate chronic	1002 (19.5)	1041 (15.3)	875 (14.1)	2112 (17.6)
Major chronic	3386 (66)	5033 (74)	4810 (77.7)	8340 (69.5)
Health status not available	42 (0.8)	20 (0.3)	143 (2.3)	417 (3.4)
County metro classification [n (%)]				
Large metro (>1M)	3799 (73.5)	5372 (78.8)	75 (1.2)	332 (2.7)
Medium metro (250K – 1M)	828 (16)	917 (13.4)	2849 (45)	3518 (28.3)
Small metro (<250k)	201 (3.9)	177 (2.6)	1382 (21.8)	3532 (28.4)
Adjacent to metro	343 (6.6)	353 (5.2)	1451 (22.9)	3443 (27.7)
Nonadjacent to metro (>20k)	0 (0)	0 (0)	279 (4.4)	757 (6.1)
Nonadjacent to metro (<20k)	0 (0)	0 (0)	298 (4.7)	841 (6.8)
Census tract poverty [mean (SD)]	22.8 (12)	22.4 (12)	28.9 (13.8)	25.4 (12.9)
Census tract poverty categories [n (%)]				
0.0% - 4.9%	213 (4.1)	297 (4.4)	85 (1.4)	210 (1.7)
5.0% - 9.9%	459 (8.9)	704 (10.4)	320 (5.1)	952 (7.7)
10.0% - 19.9%	1701 (33.1)	2227 (32.9)	1498 (23.8)	3862 (31.3)
Poverty area (20.0% - 39.9%)	2312 (45)	2996 (44.2)	3055 (48.6)	5523 (44.8)
Extreme poverty area (> 40.0%)	448 (8.7)	553 (8.2)	1334 (21.2)	1794 (14.5)
Census tract not available	38 (0.7)	42 (0.6)	42 (0.7)	82 (0.7)

Table G-3. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Census tract unemployment level [n (%)]				
0.0% - 4.9%	755 (14.7)	1007 (14.9)	1147 (18.2)	2722 (22.1)
5.0% - 9.9%	2610 (50.8)	3458 (51)	2882 (45.8)	5345 (43.3)
10.0% - 19.9%	1678 (32.7)	2194 (32.4)	2137 (34)	3997 (32.4)
> 20.0%	90 (1.8)	118 (1.7)	122 (1.9)	273 (2.2)
Census tract not available	38 (0.7)	42 (0.6)	46 (0.7)	86 (0.7)
Census tract household income [mean (SD)]	40383.1 (16879.2)	41239.9 (17451.8)	33567.4 (12624.7)	36097.7 (12321.4)
County Medicaid discharge density [mean (SD)]	1 (0.5)	1 (0.5)	1.1 (0.6)	1 (0.6)
Census tract determined from address [n (%)]	4267 (82.5)	5704 (83.6)	4851 (76.6)	9328 (75.1)
Facility residence [n (%)]	1136 (22.1)	1388 (20.5)	1465 (23.3)	2569 (20.8)
Months enrolled in Medicaid [n (%)]				
12	5143 (99.5)	6657 (97.6)	6303 (99.5)	12320 (99.2)
9 - 11	23 (0.4)	162 (2.4)	31 (0.5)	102 (0.8)
5 - 8	0 (0)	0 (0)	0 (0)	0 (0)
2 - 5	0 (0)	0 (0)	0 (0)	0 (0)
1	0 (0)	0 (0)	0 (0)	0 (0)
STAR+PLUS transition cohort [n (%)]				
A	0 (0)	0 (0)	0 (0)	0 (0)
B	5171 (100)	6819 (100)	0 (0)	0 (0)
C	0 (0)	0 (0)	0 (0)	0 (0)
D	0 (0)	0 (0)	466 (7.4)	1880 (15.1)
E	0 (0)	0 (0)	3518 (55.5)	4060 (32.7)
F	0 (0)	0 (0)	2350 (37.1)	6483 (52.2)

Table G-4. CCS eligible enrollees: Characteristics of enrollees in transition and comparison counties during the baseline and post baseline periods

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Unique enrollees	15293	18850	36026	33279
Unique counties	28	28	209	207
Enrollees with complete data	14850 (97.1)	18457 (97.9)	34486 (95.7)	31301 (94.1)
Counties with complete data, by year	28 (100)	28 (100)	208 (99.5)	207 (100)
Counties with complete data in post and pre-years		28 (100)		207 (100)
Age [mean (SD)]	47.3 (11.4)	47.5 (11.4)	48.5 (11.3)	47.9 (11.5)
Age categories [n (%)]				
21-30	1552 (10.1)	1875 (9.9)	3102 (8.6)	3305 (9.9)
30-39	2430 (15.9)	2995 (15.9)	5162 (14.3)	5071 (15.2)
40-49	3829 (25)	4498 (23.9)	8415 (23.4)	7520 (22.6)
50-59	5030 (32.9)	6408 (34)	12372 (34.3)	11451 (34.4)
60-64	2452 (16)	3074 (16.3)	6975 (19.4)	5932 (17.8)
Age not available	0 (0)	0 (0)	0 (0)	0 (0)
Female [n (%)]	15273 (99.9)	18832 (99.9)	36025 (100)	33279 (100)
Sex not available	0 (0)	0 (0)	0 (0)	0 (0)
Race/ethnicity [n (%)]				
Non-Hispanic black	2124 (13.9)	2797 (14.8)	6362 (17.7)	6144 (18.5)
Hispanic	6885 (45)	8349 (44.3)	11277 (31.3)	9543 (28.7)
Other	985 (6.4)	1556 (8.3)	3341 (9.3)	2950 (8.9)
Non-Hispanic white	5299 (34.6)	6148 (32.6)	15046 (41.8)	14642 (44)
Race/ethnicity not available	0 (0)	0 (0)	0 (0)	0 (0)
Health status [n (%)]				
Healthy	1975 (13.1)	2215 (11.8)	4155 (11.8)	3827 (12)
Significant acute	371 (2.5)	402 (2.1)	871 (2.5)	759 (2.4)
Minor chronic	954 (6.3)	938 (5)	2138 (6.1)	1929 (6.1)
Moderate chronic	3568 (23.6)	3837 (20.4)	7968 (22.7)	7018 (22.1)
Major chronic	8265 (54.6)	11373 (60.6)	20025 (57)	18268 (57.4)
Health status not available	160 (1)	85 (0.5)	869 (2.4)	1478 (4.4)

Table G-4. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
County metro classification [n (%)]				
Large metro (>1M)	11609 (75.9)	15324 (81.3)	818 (2.3)	889 (2.7)
Medium metro (250K – 1M)	2308 (15.1)	2241 (11.9)	11590 (32.2)	8929 (26.8)
Small metro (<250k)	486 (3.2)	459 (2.4)	9827 (27.3)	10125 (30.4)
Adjacent to metro	890 (5.8)	826 (4.4)	9416 (26.1)	9146 (27.5)
Nonadjacent to metro (>20k)	0 (0)	0 (0)	2144 (6)	2113 (6.3)
Nonadjacent to metro (<20k)	0 (0)	0 (0)	2231 (6.2)	2077 (6.2)
Census tract poverty [mean (SD)]	22.2 (12)	22 (12.1)	25.1 (13.1)	24.4 (12.8)
Census tract poverty categories [n (%)]				
0.0% - 4.9%	720 (4.8)	931 (5)	710 (2)	684 (2.1)
5.0% - 9.9%	1555 (10.3)	2006 (10.7)	2864 (8.1)	2862 (8.7)
10.0% - 19.9%	5063 (33.5)	6207 (33.2)	11224 (31.6)	10936 (33.2)
Poverty area (20.0% - 39.9%)	6539 (43.3)	8056 (43.1)	15750 (44.3)	14172 (43)
Extreme poverty area (> 40.0%)	1237 (8.2)	1491 (8)	5008 (14.1)	4293 (13)
Census tract not available	179 (1.2)	159 (0.8)	470 (1.3)	332 (1)
Census tract unemployment level [n (%)]				
0.0% - 4.9%	2375 (15.7)	2942 (15.7)	7703 (21.7)	7392 (22.4)
5.0% - 9.9%	7649 (50.6)	9551 (51.1)	16477 (46.4)	14706 (44.7)
10.0% - 19.9%	4836 (32)	5903 (31.6)	10700 (30.1)	10151 (30.8)
> 20.0%	254 (1.7)	295 (1.6)	664 (1.9)	687 (2.1)

Table G-4. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Census tract not available	179 (1.2)	159 (0.8)	482 (1.3)	343 (1)
Census tract household income [mean (SD)]	41557.2 (17790.6)	42128.8 (18117.1)	36659.1 (13231.8)	37064.1 (12846.7)
County Medicaid discharge density [mean (SD)]	1 (0.5)	1 (0.5)	1 (0.6)	1 (0.6)
Census tract determined from address [n (%)]	12659 (82.8)	16005 (84.9)	27155 (75.4)	25322 (76.1)
Facility residence [n (%)]	3072 (20.3)	3496 (18.7)	7401 (20.7)	6515 (19.7)
Months enrolled in Medicaid [n (%)]				
12	14986 (98)	17916 (95)	35317 (98)	32391 (97.3)
9 - 11	290 (1.9)	934 (5)	709 (2)	884 (2.7)
5 - 8	0 (0)	0 (0)	0 (0)	0 (0)
2 - 5	0 (0)	0 (0)	0 (0)	0 (0)
1	0 (0)	0 (0)	0 (0)	0 (0)
STAR+PLUS transition cohort [n (%)]				
A	0 (0)	0 (0)	0 (0)	0 (0)
B	15293 (100)	18850 (100)	0 (0)	0 (0)
C	0 (0)	0 (0)	0 (0)	0 (0)
D	0 (0)	0 (0)	4742 (13.2)	5139 (15.4)
E	0 (0)	0 (0)	12366 (34.3)	9477 (28.5)
F	0 (0)	0 (0)	18918 (52.5)	18663 (56.1)

Table G-5. COL eligible enrollees: Characteristics of enrollees in transition and comparison counties during the baseline and post baseline periods

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Unique enrollees	9640	12548	13408	23054
Unique counties	28	28	205	204
Enrollees with complete data	9437 (97.9)	12329 (98.3)	12934 (96.5)	21995 (95.4)
Counties with complete data, by year	28 (100)	28 (100)	205 (100)	202 (99)
Counties with complete data in post and pre-years		28 (100)		202 (99)

Table G-5. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Age [mean (SD)]	57.5 (4)	57.4 (3.9)	57.7 (3.9)	57.6 (3.9)
Age categories [n (%)]				
21-30	0 (0)	0 (0)	0 (0)	0 (0)
30-39	0 (0)	0 (0)	0 (0)	0 (0)
40-49	0 (0)	0 (0)	0 (0)	0 (0)
50-59	6200 (64.3)	8309 (66.2)	8505 (63.4)	14763 (64)
60-64	3440 (35.7)	4239 (33.8)	4903 (36.6)	8291 (36)
Age not available	0 (0)	0 (0)	0 (0)	0 (0)
Female [n (%)]	6012 (62.4)	7747 (61.7)	8983 (67)	14041 (60.9)
Sex not available	0 (0)	0 (0)	0 (0)	0 (0)
Race/ethnicity [n (%)]				
Non-Hispanic black	1228 (12.7)	1818 (14.5)	2055 (15.3)	4505 (19.5)
Hispanic	4163 (43.2)	5231 (41.7)	5092 (38)	6356 (27.6)
Other	713 (7.4)	1036 (8.3)	1450 (10.8)	2224 (9.6)
Non-Hispanic white	3536 (36.7)	4463 (35.6)	4811 (35.9)	9969 (43.2)
Race/ethnicity not available	0 (0)	0 (0)	0 (0)	0 (0)
Health status [n (%)]				
Healthy	1001 (10.5)	1198 (9.6)	907 (6.9)	2307 (10.3)
Significant acute	168 (1.8)	162 (1.3)	158 (1.2)	381 (1.7)
Minor chronic	513 (5.4)	481 (3.8)	516 (3.9)	1092 (4.9)
Moderate chronic	1979 (20.7)	2135 (17.1)	2159 (16.4)	4204 (18.9)
Major chronic	5911 (61.8)	8533 (68.2)	9392 (71.5)	14308 (64.2)
Health status not available	68 (0.7)	39 (0.3)	276 (2.1)	762 (3.3)
County metro classification [n (%)]				
Large metro (>1M)	7151 (74.2)	9923 (79.1)	212 (1.6)	644 (2.8)
Medium metro (250K – 1M)	1577 (16.4)	1721 (13.7)	5448 (40.6)	6047 (26.2)
Small metro (<250k)	315 (3.3)	287 (2.3)	3135 (23.4)	6704 (29.1)

Table G-5. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Adjacent to metro	597 (6.2)	617 (4.9)	3237 (24.1)	6670 (28.9)
Nonadjacent to metro (>20k)	0 (0)	0 (0)	672 (5)	1440 (6.2)
Nonadjacent to metro (<20k)	0 (0)	0 (0)	704 (5.3)	1549 (6.7)
Census tract poverty [mean (SD)]	22.8 (12.1)	22.5 (12)	27.9 (13.7)	24.9 (12.7)
Census tract poverty categories [n (%)]				
0.0% - 4.9%	392 (4.1)	535 (4.3)	189 (1.4)	388 (1.7)
5.0% - 9.9%	874 (9.1)	1247 (10)	774 (5.8)	1825 (8)
10.0% - 19.9%	3209 (33.6)	4122 (33.1)	3441 (25.9)	7316 (31.9)
Poverty area (20.0% - 39.9%)	4210 (44.1)	5490 (44.1)	6332 (47.6)	10241 (44.7)
Extreme poverty area (> 40.0%)	872 (9.1)	1069 (8.6)	2560 (19.3)	3130 (13.7)
Census tract not available	83 (0.9)	85 (0.7)	112 (0.8)	154 (0.7)
Census tract unemployment level [n (%)]				
0.0% - 4.9%	1370 (14.3)	1828 (14.7)	2544 (19.1)	5046 (22)
5.0% - 9.9%	4860 (50.9)	6351 (51)	6055 (45.6)	10049 (43.9)
10.0% - 19.9%	3145 (32.9)	4078 (32.7)	4428 (33.3)	7295 (31.9)
> 20.0%	182 (1.9)	206 (1.7)	264 (2)	503 (2.2)
Census tract not available	83 (0.9)	85 (0.7)	117 (0.9)	161 (0.7)
Census tract household income [mean (SD)]	40511.7 (17140.3)	41202.1 (17600.9)	34296.6 (12848.3)	36290 (12390.9)
County Medicaid discharge density [mean (SD)]	1 (0.5)	1 (0.5)	1.1 (0.6)	1 (0.6)

Table G-5. Continued

	STAR+PLUS (Transition)		FFS+PCCM (Comparison)	
	Pre	Post	Pre	Post
Census tract determined from address [n (%)]	7890 (81.8)	10540 (84)	10246 (76.4)	17317 (75.1)
Facility residence [n (%)]	2147 (22.5)	2419 (19.5)	3116 (23.5)	4764 (20.8)
Months enrolled in Medicaid [n (%)]				
12	9591 (99.5)	12211 (97.3)	13344 (99.5)	22861 (99.2)
9 - 11	42 (0.4)	337 (2.7)	64 (0.5)	191 (0.8)
5 - 8	0 (0)	0 (0)	0 (0)	0 (0)
2 - 5	0 (0)	0 (0)	0 (0)	0 (0)
1	0 (0)	0 (0)	0 (0)	0 (0)
STAR+PLUS transition cohort [n (%)]				
A	0 (0)	0 (0)	0 (0)	0 (0)
B	9640 (100)	12548 (100)	0 (0)	0 (0)
C	0 (0)	0 (0)	0 (0)	0 (0)
D	0 (0)	0 (0)	1273 (9.5)	3559 (15.4)
E	0 (0)	0 (0)	6605 (49.3)	6907 (30)
F	0 (0)	0 (0)	5530 (41.2)	12588 (54.6)

Table G-6. Summary of sample size, by group and by measure

	STAR+PLUS (Transition)					FFS+PCCM (Comparison)				
Measure Type	Min	Q1	Median	Q3	Max	Min	Q1	Median	Q3	Max
AAP	55	221.00	406.00	830.00	14260	1	32.00	106.00	292.00	7553
BCS	6	46.00	88.00	186.00	2907	1	9.00	21.00	56.00	1993
CCS	26	120.00	216.00	433.00	7884	1	18.00	57.00	152.00	4179
COL	12	81.00	162.00	333.00	5171	1	14.00	43.00	111.00	3180

Table G-7. Backward step-wise regression results for AAP

Variable	R^2 total	ΔR^2	F-value	p-value	Action
Full Model	0.5741	NA	NA	NA	
Medicaid Discharge Density	0.5725	0.0016	0.8	0.3737	Removed
Metro Classification^2	0.5698	0.0027	1.4	0.2411	Removed
Metro Classification	0.5698	0.0254	12.9	0.0004	Kept
Unemployment	0.5696	0.0002	0.1	0.7320	Removed
Poverty	0.5644	0.0052	2.6	0.1054	Removed
County Income	0.5635	0.0009	0.5	0.4935	Removed
Median Household Income	0.5621	0.0014	0.7	0.3993	Removed
Group Facility Proxy	0.5620	0.0001	0.1	0.8066	Removed
Health Status	0.5620	0.0499	25.5	0.0000	Kept
Age^3	0.5591	0.0028	1.4	0.2316	Removed
Age^2	0.5589	0.0002	0.1	0.7502	Removed
Age	0.5569	0.0020	1.0	0.3079	Removed
Race/Ethnicity	0.5527	0.0042	0.7	0.5435	Removed
Gender	0.5525	0.0002	0.1	0.7408	Removed
Baseline	0.5525	0.2420	124.9	0.0000	Kept

Table G-8. Backward step-wise regression results for BCS

Variable	R^2 total	ΔR^2	F-value	p-value	Action
Full Model	0.2766	NA	NA	NA	
Medicaid Discharge Density	0.2766	0.0255	6.9	0.0093	Kept
Metro Classification^2	0.2765	0.0001	0.0	0.8989	Removed
Metro Classification	0.2758	0.0008	0.2	0.6467	Removed
Unemployment	0.2619	0.0139	3.8	0.0526	Removed
Poverty	0.2488	0.0131	3.5	0.0618	Removed
County Income	0.2456	0.0032	0.9	0.3566	Removed
Median Household Income	0.2438	0.0018	0.5	0.4941	Removed
Group Facility Proxy	0.2412	0.0026	0.7	0.4058	Removed
Health Status^2	0.2305	0.0107	2.9	0.0923	Removed
Health Status	0.2305	0.0390	10.3	0.0015	Kept
Age	0.2282	0.0024	0.6	0.4308	Removed
Race/Ethnicity	0.2282	0.0538	4.8	0.0031	Kept
Baseline	0.2171	0.0111	2.9	0.0880	Removed

Table G-9. Backward step-wise regression results for CCS

Variable	R^2 total	ΔR^2	F-value	p-value	Action
Full Model	0.3874	NA	NA	NA	
Medicaid Discharge Density	0.3870	0.0004	0.1	0.7130	Removed
Metro Classification^2	0.3869	0.0000	0.0	0.9104	Removed
Metro Classification	0.3869	0.0152	5.4	0.0209	Kept
Unemployment	0.3861	0.0008	0.3	0.5960	Removed
Poverty	0.3856	0.0006	0.2	0.6532	Removed
County Income	0.3844	0.0012	0.4	0.5167	Removed
Median Household Income	0.3788	0.0056	2.0	0.1590	Removed
Group Facility Proxy	0.3788	0.0136	4.9	0.0284	Kept
Health Status^2	0.3787	0.0002	0.1	0.8081	Removed
Health Status	0.3717	0.0070	2.5	0.1139	Removed
Age^3	0.3665	0.0051	1.8	0.1782	Removed
Age^2	0.3665	0.0000	0.0	0.9612	Removed
Age	0.3665	0.0404	14.4	0.0002	Kept
Race/Ethnicity	0.3665	0.0500	5.9	0.0006	Kept
Baseline	0.3665	0.0994	35.4	0.0000	Kept

Table G-10. Backward step-wise regression results for COL

Variable	R^2 total	ΔR^2	F-value	p-value	Action
Full Model	0.2171	NA	NA	NA	
Medicaid Discharge Density	0.2072	0.0099	2.7	0.1034	Removed
Metro Classification^2	0.2059	0.0013	0.4	0.5500	Removed
Metro Classification	0.2027	0.0031	0.8	0.3596	Removed
Unemployment	0.1997	0.0030	0.8	0.3666	Removed
Poverty	0.1922	0.0075	2.0	0.1568	Removed
County Income	0.1898	0.0025	0.7	0.4175	Removed
Median Household Income	0.1893	0.0005	0.1	0.7228	Removed
Group Facility Proxy	0.1811	0.0082	2.2	0.1372	Removed
Health Status^2	0.1753	0.0058	1.6	0.2144	Removed
Health Status	0.1753	0.0260	7.0	0.0089	Kept
Race/Ethnicity	0.1719	0.0033	0.9	0.3452	Removed
Age	0.1719	0.0341	3.0	0.0297	Kept
Gender	0.1719	0.0000	0.0	0.9848	Removed
Baseline	0.1719	0.0910	24.5	0.0000	Kept

Table G-11. Full model coefficients for AAP

Variable	Value (std error)	95% C.I.
(Intercept)	0.7142 (0.0488)	(0.6181 - 0.8103)
Male	-0.0039 (0.0390)	(-0.0808 - 0.0729)
Hispanic	0.0229 (0.0170)	(-0.0106 - 0.0563)
Other	0.0467 (0.0685)	(-0.0883 - 0.1818)
White	0.0134 (0.0183)	(-0.0226 - 0.0494)
Group Facility Proxy	0.0244 (0.0378)	(-0.0501 - 0.0990)
Age	0.0105 (0.0076)	(-0.0044 - 0.0255)
Age^2	0.0001 (0.0003)	(-0.0006 - 0.0007)
Age^3	-0.0000 (0.0000)	(-0.0001 - 0.0000)
Health Status	0.9681 (0.2028)	(0.5684 - 1.3678)
County Income	0.0030 (0.0096)	(-0.0159 - 0.0220)
Median Household Income	-0.0183 (0.0140)	(-0.0458 - 0.0092)
Poverty	-0.0021 (0.0015)	(-0.0050 - 0.0007)
Unemployment	0.0012 (0.0024)	(-0.0035 - 0.0058)
Metro Classification	-0.0145 (0.0041)	(-0.0226 - -0.0064)
Metro $Classification^2$	-0.0023 (0.0019)	(-0.0060 - 0.0015)
Medicaid Discharge Density	0.0077 (0.0087)	(-0.0094 - 0.0249)
Baseline	0.5643 (0.0527)	(0.4605 - 0.6682)
Months Enrolled in STAR+PLUS	0.0454 (0.0177)	(0.0104 - 0.0803)

Table G-12. Full model coefficients for BCS

Variable	Value (std error)	95% C.I.
(Intercept)	0.3120 (0.0703)	(0.1733 - 0.4507)
Hispanic	-0.0023 (0.0247)	(-0.0510 - 0.0465)
Other	-0.0883 (0.0607)	(-0.2079 - 0.0314)
White	-0.0518 (0.0281)	(-0.1071 - 0.0035)
Group Facility Proxy	-0.0389 (0.0597)	(-0.1567 - 0.0789)
Age	0.0038 (0.0117)	(-0.0192 - 0.0269)
Health Status	0.9725 (0.4081)	(0.1676 - 1.7773)
Health $Status^2$	0.3590 (0.2760)	(-0.1854 - 0.9033)
County Income	-0.0105 (0.0143)	(-0.0388 - 0.0177)
Median Household Income	0.0422 (0.0222)	(-0.0016 - 0.0860)
Poverty	0.0035 (0.0022)	(-0.0009 - 0.0079)
Unemployment	0.0067 (0.0038)	(-0.0008 - 0.0141)
Metro Classification	-0.0029 (0.0065)	(-0.0157 - 0.0098)
Metro $Classification^2$	0.0004 (0.0031)	(-0.0057 - 0.0065)
Medicaid Discharge Density	0.0343 (0.0130)	(0.0085 - 0.0600)
Baseline	0.1523 (0.1327)	(-0.1095 - 0.4141)
Months Enrolled in STAR+PLUS	-0.0217 (0.0259)	(-0.0728 - 0.0295)

Table G-13. Full model coefficients for CCS

Variable	Value (std error)	95% C.I.
(Intercept)	0.3918 (0.0693)	(0.2551 - 0.5284)
Hispanic	0.0013 (0.0149)	(-0.0281 - 0.0306)
Other	0.0374 (0.0558)	(-0.0726 - 0.1474)
White	-0.0257 (0.0167)	(-0.0586 - 0.0072)
Group Facility Proxy	-0.0727 (0.0394)	(-0.1505 - 0.0050)
Age	-0.0196 (0.0080)	(-0.0355 - -0.0038)
Age^2	0.0000 (0.0003)	(-0.0005 - 0.0006)
Age^3	0.0000 (0.0000)	(-0.0000 - 0.0001)
Health Status	0.2814 (0.3214)	(-0.3522 - 0.9149)
Health $Status^2$	0.0293 (0.2311)	(-0.4262 - 0.4848)
County Income	-0.0059 (0.0081)	(-0.0219 - 0.0101)
Median Household Income	-0.0053 (0.0134)	(-0.0317 - 0.0212)
Poverty	0.0006 (0.0014)	(-0.0021 - 0.0033)
Unemployment	-0.0012 (0.0023)	(-0.0057 - 0.0034)
Metro Classification	-0.0087 (0.0038)	(-0.0161 - -0.0013)
Metro $Classification^2$	-0.0002 (0.0018)	(-0.0038 - 0.0033)
Medicaid Discharge Density	0.0028 (0.0075)	(-0.0121 - 0.0176)
Baseline	0.3700 (0.0684)	(0.2351 - 0.5048)
Months Enrolled in STAR+PLUS	-0.0108 (0.0145)	(-0.0394 - 0.0178)

Table G-14. Full model coefficients for COL

Variable	Value (std error)	95% C.I.
(Intercept)	0.2099 (0.0466)	(0.1181 - 0.3017)
Male	0.0110 (0.0340)	(-0.0560 - 0.0779)
Hispanic	-0.0027 (0.0178)	(-0.0377 - 0.0323)
Other	0.0669 (0.0559)	(-0.0434 - 0.1771)
White	-0.0464 (0.0183)	(-0.0825 - -0.0104)
Group Facility Proxy	-0.0421 (0.0447)	(-0.1303 - 0.0461)
Age	-0.0056 (0.0096)	(-0.0246 - 0.0134)
Health Status	1.0484 (0.3945)	(0.2708 - 1.8260)
Health $Status^2$	0.3513 (0.2201)	(-0.0825 - 0.7851)
County Income	-0.0124 (0.0096)	(-0.0314 - 0.0065)
Median Household Income	-0.0181 (0.0154)	(-0.0486 - 0.0123)
Poverty	-0.0029 (0.0016)	(-0.0060 - 0.0002)
Unemployment	-0.0030 (0.0026)	(-0.0081 - 0.0020)
Metro Classification	-0.0033 (0.0045)	(-0.0122 - 0.0055)
Metro $Classification^2$	0.0012 (0.0021)	(-0.0030 - 0.0054)
Medicaid Discharge Density	0.0147 (0.0090)	(-0.0030 - 0.0324)
Baseline	0.2899 (0.0580)	(0.1756 - 0.4042)
Months Enrolled in STAR+PLUS	-0.0117 (0.0178)	(-0.0467 - 0.0234)

Table G-15. Final model coefficients for AAP

Variable	Value (std error)	95% C.I.
(Intercept)	0.7457 (0.0046)	(0.7366 - 0.7547)
Health Status	1.0864 (0.1806)	(0.7306 - 1.4421)
Metro Classification	-0.0110 (0.0035)	(-0.0179 - -0.0040)
Baseline	0.5489 (0.0491)	(0.4522 - 0.6457)
Months Enrolled in STAR+PLUS	0.0375 (0.0146)	(0.0087 - 0.0663)

Table G-16. Final model coefficients for BCS

Variable	Value (std error)	95% C.I.
(Intercept)	0.3788 (0.0163)	(0.3468 - 0.4109)
Hispanic	-0.0048 (0.0210)	(-0.0461 - 0.0365)
Other	-0.0613 (0.0565)	(-0.1726 - 0.0500)
White	-0.0620 (0.0256)	(-0.1125 - -0.0115)
Health Status	0.8809 (0.2482)	(0.3918 - 1.3700)
Medicaid Discharge Density	0.0388 (0.0115)	(0.0161 - 0.0616)
Months Enrolled in STAR+PLUS	0.0067 (0.0172)	(-0.0272 - 0.0407)

Table G-17. Final model coefficients for CCS

Variable	Value (std error)	95% C.I.
(Intercept)	0.3957 (0.0091)	(0.3777 - 0.4137)
Hispanic	0.0115 (0.0131)	(-0.0142 - 0.0372)
Other	0.0141 (0.0520)	(-0.0883 - 0.1165)
White	-0.0302 (0.0149)	(-0.0595 - -0.0009)
Group Facility Proxy	-0.0875 (0.0354)	(-0.1573 - -0.0177)
Age	-0.0094 (0.0025)	(-0.0143 - -0.0045)
Metro Classification	-0.0083 (0.0033)	(-0.0148 - -0.0018)
Baseline	0.3841 (0.0645)	(0.2570 - 0.5113)
Months Enrolled in STAR+PLUS	-0.0195 (0.0117)	(-0.0426 - 0.0036)

Table G-18. Final model coefficients for COL

Variable	Value (std error)	95% C.I.
(Intercept)	0.2925 (0.0060)	(0.2808 - 0.3042)
Hispanic	-0.0143 (0.0139)	(-0.0416 - 0.0130)
Other	0.0550 (0.0514)	(-0.0462 - 0.1563)
White	-0.0416 (0.0164)	(-0.0738 - -0.0093)
Health Status	0.5242 (0.1942)	(0.1415 - 0.9069)
Baseline	0.2761 (0.0558)	(0.1662 - 0.3860)
Months Enrolled in STAR+PLUS	-0.0018 (0.0117)	(-0.0248 - 0.0213)

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BIOGRAPHICAL SKETCH

Martin Wegman received his PhD degree from the University of Florida, while enrolled in the MD-PhD program. His PhD was concentrated in epidemiology, under the mentorship of Dr. Elizabeth Shenkman, professor and chair of the Department of Health Outcomes and Policy. He was formerly an NIH Ruth L. Kirschstein National Research Service Awardee and served as a Doris Duke International Clinical Research Fellow at Yale School of Medicine from 2014 to 2015. He also holds a Bachelor of Science degree with Highest Distinction in Biomedical Engineering from the University of Rochester. Martin's work focuses on analyzing and developing policies and systems to improve population health and social outcomes, with attention to individuals living at the margins of society, including those affected by drug use and mental illness. His research has taken him to Malaysia and South Africa, and has spanned topics ranging from harm reduction, managed care and patient engagement. His achievements have include serving as principal investigator or lead author on over $450,000 in grant funding and publishing more than 20 articles, including work featured in the Lancet Global Health, JAMA and Health Affairs. He has received national recognition as a National Quality Scholar from the American College of Medical Quality and received the Excellence in Medicine Award from the American Medical Association Foundation. While at the University of Florida, he was inducted in the Gold Humanism Society. After his training, Martin plans to continue to influence patient and population health as a clinician-scientist.