Published in final edited form as:

Med Care. 2018 October ; 56(10): 870–876. doi:10.1097/MLR.0000000000000973.

Utilization and Adherence in Medical Homes: An Assessment of Rural-Urban Differences for People with Severe Mental Illness

Mona Kilany, PhD*, Joseph P. Morrissey, PhD^{†,*}, Marisa Elena Domino, PhD^{†,*}, Kathleen C. Thomas, MPH, PhD*, and Pam Silberman, JD, DrPH^{*,†}

*Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill

[†]Department of Health Policy and Management, UNC Gillings School of Global Public Health

Abstract

Background: The complex nature of managing care for people with severe mental illness (SMI), including major depression, bipolar disorder and, schizophrenia, is a challenge for primary care practices, especially in rural areas. The team-based emphasis of medical homes may act as an important facilitator to help reduce observed rural-urban differences in care.

Objective: The objective of this study was to examine whether enrollment in medical homes improved care in rural versus urban settings for people with SMI.

Research Design: Secondary data analysis of North Carolina Medicaid claims from 2004–2007, using propensity score weights and generalized estimating equations to assess differences between urban, non-metropolitan urban and rural areas.

Subjects: Medicaid-enrolled adults with diagnoses of major depressive disorder, bipolar disorder or schizophrenia. Medicare/Medicaid dual eligibles were excluded.

Measures: We examined utilization measures of primary care use, specialty mental health use, inpatient hospitalizations, and emergency department use and medication adherence.

Correspondence: Mona Kilany, PhD, Post-doctoral Fellow, University of North Carolina at Chapel Hill, Cecil G. Sheps Center for Health Services Research Center, 725 Martin Luther King Jr. Blvd, Chapel Hill, NC 27599-7590, mkilany@live.unc.edu, Phone: 919-843-4152, Fax: 919-966-1634.

Mona Kilany PhD, Post-doctoral Fellow, University of North Carolina at Chapel Hill, Cecil G. Sheps Center for Health Services Research Center, 725 Martin Luther King Jr. Blvd, Chapel Hill, NC 27599-7590, mkilany@live.unc.edu, Phone: 919-843-4152, Fax: 919-966-1634

Joseph P. Morrissey PhD, Professor of Health Policy & Management, University of North Carolina at Chapel Hill, Cecil G. Sheps Center for Health Services Research Center, 725 Martin Luther King Jr. Blvd, Chapel Hill, NC 27599-7590, joe_morrissey@unc.edu, Phone: 919-955-5829, Fax: 919-966-1634

Marisa Elena Domino, PhD, Professor of Health Economics, Department of Health Policy and Management, The Gillings School of Global Public Health, Cecil G. Sheps Center for Health Services Research Center, The University of North Carolina at Chapel Hill, 1104G McGavran-Greenberg Hall, 135 Dauer Dr., Chapel Hill, NC 27599-7411, domino@unc.edu, Phone: 919-966-3891, Fax: 919-966-1634

Kathleen C. Thomas, MPH, PhD, Research Associate and Fellow, University of North Carolina at Chapel Hill, Cecil G. Sheps Center for Health Services Research Center, 725 Martin Luther King Jr. Blvd, Chapel Hill, NC 27599-7590, kathleen_thomas@unc.edu, Phone: 919-966-3387, Fax: 919-966-1634

Pam Silberman JD, DrPH, Clinical Professor, Department of Health Policy and Management, The Gillings School of Global Public Health, Cecil G. Sheps Center for Health Services Research Center, The University of North Carolina at Chapel Hill, 1106H McGavran-Greenberg Hall, 135 Dauer Dr., Chapel Hill, NC 27599-7411, pam_silberman@unc.edu, Phone: 919-966-4525, Fax: 919-843-6308

The authors declare no conflict of interest.

Results: Rural medical home enrollees generally had higher primary care use and medication adherence than rural non-medical home enrollees. Rural medical home enrollees had fewer primary care visits than urban medical home enrollees, but both groups were similar on the other outcome measures. These findings varied somewhat by SMI diagnosis.

Conclusions: Findings indicate that enrollment in medical homes among rural Medicaid beneficiaries holds the promise of reducing rural-urban differences in care. Both urban and rural medical homes may benefit from targeted resources to help close the remaining gaps and to improve the success of the medical home model in addressing the health care needs of people with SMI.

Keywords

medical home; mental illness; rural

Introduction

The medical home model is a primary care approach for prevention, care coordination, and management of chronic disease.¹ The model focuses on care that is comprehensive, patient-centered, coordinated, accessible, high quality and safe.² Although evidence is beginning to emerge about the benefits of medical homes for adults with chronic physical health conditions, people with severe mental illness (SMI), many of whom also have a high rate of physical comorbidities, may also benefit from the enhanced care provided by medical homes.³ However, many primary care providers have limited training and limited experience managing people with SMI, especially managing bipolar disorder and schizophrenia. The team-based approach of medical homes offers primary care providers greater capacity to better address the needs of more complex patient populations such as people with SMI through greater contact and communication between primary care, specialty providers and care managers.⁴

Evidence is currently lacking, however as to whether medical homes for people with SMI in rural areas work as well as those in urban areas.⁵ Primary care providers in rural areas often take a greater role than specialists in patient's mental health care.^{6,7} Rural-urban differences in health care patterns have been well documented, including among people with SMI.^{6,8-10} In rural areas, people with SMI are two to three times more likely to visit primary care providers than mental health providers for their mental health needs.^{6,7} In turn, primary care providers in rural areas often have more difficulties getting referrals to mental health providers than do their counterparts in urban areas.^{6,11} Additionally, people with SMI in rural versus urban areas are more likely to use emergency departments or to be hospitalized for either physical or mental health problems.^{12,13} Compared to urban areas, the rural mental health system has fewer treatment and support resources available to people with SMI, which increases reliance on small numbers of primary care providers, social services, and informal care networks.^{6,14}

In principle, a rural medical home might be able to mitigate some of these shortfalls. However, to date, most available medical homes studies have focused on urban rather than rural settings.^{15,16} The medical home model may help rural areas compensate for a lack of

specialty providers through teams comprised of mid-level mental health specialists. It remains unclear whether the medical home model can reduce or overcome the rural-urban differences noted above.¹⁷ The objective of this study was to examine the utilization of outpatient and inpatient services as well as medication adherence among people with SMI between rural versus urban medical homes. We hypothesize that, while urban medical homes will outperform rural medical homes on these indicators, rural medical home enrollees will fare better than non-medical home enrollees in rural areas, even after controlling for selection differences. As found in previous work¹⁸ and given greater physician confidence in managing depression in primary care than other mental disorders^{19,20}, we hypothesize that the medical homes effects will be different across SMI conditions, with the largest effect concentrated in people with major depressive disorder.

Methods

Setting

The study examines the medical homes developed by Community Care of North Carolina (CCNC) for the North Carolina Medicaid program.²¹ Implemented in 1998 as an enhanced primary care case management program, CCNC developed regional networks of primary care providers responsible for coordinating prevention, treatment, and referral services.²¹ Each CCNC network includes local primary care providers, local hospitals, local health departments, and social services. During our study period, participating primary care providers received a \$2.50 per member per month (PMPM) enhanced case management fee and each CCNC network received an additional \$2.50 PMPM enhanced care management fee.²² These enhanced care management fees support primary care providers and their networks in order to conduct comprehensive assessments, develop individualized care plans, coordinate care, monitor each patient's progress, hire local case managers and provide resources associated with managing beneficiaries, and focus on quality improvement.²² It should be noted that the CCNC medical homes predate the National Committee for Quality Assurance (NCQA) recognition program by more than a decade and thus they may or may not be recognized as such by the NCQA. While CCNC may not meet the traditional definition of a medical home, it has been consistently recognized as a medical home (Table 1).^{23–25}

Data Sources and Study Sample

We obtained North Carolina Medicaid claims data through the Carolina Cost and Quality Initiative on individuals with major depressive disorder, bipolar disorder, and/or schizophrenia (URL: <http://www.shepscenter.unc.edu/ccqi/>). Medicaid paid claims between January 1, 2004 and December 31, 2007 were collapsed to the person-month level for this study. This time period reflects growing enrollment in CCNC medical homes by Medicaid enrollees with severe mental illness, which is relevant to other states that are only now ramping up their medical homes programs.

The study sample included adults aged 18 years and older with major depressive disorder, bipolar disorder, or schizophrenia who were enrolled in North Carolina Medicaid at any point during 2004–2007. We limited the sample to include individuals who received at least

two outpatient diagnoses or one inpatient diagnosis in the North Carolina Medicaid claims data. We excluded dual eligibles from the analysis because of the potential for incomplete data in the Medicaid claims on services and medications reimbursed through Medicare.

Measures

The outcome measures for this study were medical and mental health care utilization and medication adherence. We defined utilization as a count of the number of patient visits to the following health care settings regardless of diagnoses given: 1) primary care, 2) outpatient mental health specialty providers, 3) emergency department and 4) inpatient hospitalization. We defined medication adherence by therapeutic class (antidepressants or antipsychotics) according to the proportion of days covered.^{26,27} This measure reflects the proportion as a fraction of the days in the month for which at least one medication was dispensed.

The main effect of interest was the interaction between the geographic area indicator and medical home indicator. The medical home indicator was a measure of whether a patient was enrolled in a medical home through the CCNC program in contrast to primary care practices that served Medicaid enrollees but were not paid the PMPM to serve as a medical home. We identified medical home enrollment from the Medicaid claims based on the presence of two fees: (1) PMPM enhanced case management fee to the primary care practice, and (2) PMPM enhanced care management fee to the affiliated CCNC network. Medicaid enrollees could switch in and out of medical homes on a monthly basis during the study period. We used the 2003 Rural-Urban Continuum Codes (RUCC) to categorize each North Carolina county as urban, non-metropolitan urban or rural.²⁸ In North Carolina, 40 counties were metropolitan (RUCC 1, 2, or 3), 39 were non-metropolitan urban (RUCC 4, 5, 6, or 7), and 21 were non-metropolitan rural (RUCC 8 or 9). We chose a three-level categorical variable instead of a dichotomous definition of rural and urban areas to capture the heterogeneity that exists within rural areas.²⁹ For simplicity, we only present the findings on urban and rural areas. We were interested in several comparisons involving the interaction between geographic areas and medical homes. First, we were interested in the differences in the outcomes across the urban and rural geographic areas. Next, we were interested in whether utilization and medication adherence differed among geographic areas for medical home and non-medical home enrollees.

Control variables included measures for age, sex, race (categorized as white, black or other), ethnicity (Hispanic, not Hispanic), and the total number of physical health comorbidities ever diagnosed in the administrative data files during the study period.

Statistical Analysis

We adjusted for selection bias due to non-random assignment to the medical home using individual level inverse propensity score weighting. We controlled for demographic characteristics (age, sex, race, ethnicity, rural residence, number of comorbidities, comorbid mental health diagnoses, and Medicaid categorical eligibility as disabled) in the propensity score model. We selected these demographic characteristics as risk factors for the study outcomes, based, in part, on other analyses of medical homes for people with SMI.¹⁸ The likelihood ratio test was used to check correct specification of the propensity score model,

including tests of functional form and omitting variables. Details of the specification checks are reported as supplemental digital content (see Supplemental Digital Content: Methods Appendix and Table SDC 1). We calculated the standardized differences of the means based on the absolute difference in the sample means divided by the pooled standard deviation of each variable.³⁰ Standardized differences of the unweighted means showed a number of imbalances between the medical home and non-medical home groups on the demographic characteristics. After the samples were weighted, the standardized differences were all less than 10%, showing a strong balance on all of the variables in each diagnosis group sample.³⁰ We then examined utilization and medication adherence with person-month level generalized estimating equation (GEE) models in order to account for the correlation across monthly observations for each individual. The utilization models used GEE with a negative binomial distribution, log link and exchangeable correlation structure. The medication adherence models used GEE with the gamma distribution, log link and exchangeable correlation structure. We selected the designated correlation structure for the utilization and medication adherence models based on lowest values of the quasi-likelihood information criterion. All models used robust standard errors and were estimated in Stata 12. Results are presented as average marginal effects, which express the difference in each outcome between medical homes enrollees and non-enrollees, for each geographic area. These differences were simulated using the method of recycled predictions, across all individuals in the sample and thus reflect the full distribution of control characteristics statewide. Post-estimation tests were then conducted on average marginal effects to determine if differences across the three geographic areas in utilization and medication adherence were significant.

The study protocol was exempted by the University of North Carolina Institutional Review Board.

Results

The final sample included 107,706 persons with major depressive disorder, 26,666 persons with bipolar disorder, and 15,636 persons with schizophrenia (Table 2). A number of differences in the unweighted sample can be seen between medical home enrollees and non-medical home enrollees with regard to sex, race, age, disability status, and diagnosis. Across the diagnosis groups, the majority of the sample lived in urban areas and was female. Whereas the majority of persons with major depressive disorder (64.3%) and bipolar disorder (74.7%) were white, the majority of people with schizophrenia were African American (55.2%). Most within each diagnosis group were enrolled in medical homes (62–72%). Across all of the diagnosis groups, the average age was lower among medical home enrollees compared to non-medical home enrollees (35.4 to 40.7 yrs.). Fewer people with major depressive disorder and fewer bipolar disorder who were enrolled in a medical home were categorically eligible for Medicaid due to a disability compared to those not in a medical home (40.1–48.2%). In contrast, a higher percent of people with schizophrenia in a medical home were categorically eligible for Medicaid due to a disability (89.9%) compared to those not in a medical home.

A review of the unadjusted monthly means for the utilization and adherence outcomes for non-medical home enrollees indicated that while the number of monthly primary care visits

was lower in rural versus urban areas for controls not in medical homes, the number of inpatient hospitalizations and emergency department visits were also lower, across all diagnosis groups (Table 3). However, contrary to what was anticipated, rural non-medical home enrollees had a higher number of monthly specialty mental health visits (4%–19% higher) and higher medication adherence (6%–13% higher) than urban non-medical home enrollees. Similarly, the number of monthly inpatient hospitalizations was 9.5%–27% lower among rural non-medical home enrollees than in urban non-medical home enrollees for all diagnosis groups.

In multivariate analyses, people in urban medical homes had higher primary care visits, had higher medication adherence, and had lower inpatient hospitalizations and emergency department visits than people in rural medical homes (Table 4, Figure 1). The pattern observed between urban medical homes and rural medical homes varied somewhat by diagnoses. For example, we observed significant differences between urban and rural medical homes in higher primary care visits for persons with major depressive disorder (0.46 more visits/month for urban medical homes vs. 0.38 more visits/month for rural medical homes) as well as for persons with schizophrenia (0.55 more visits/month vs. 0.4 more visits/month), but we did not observe significant differences among persons with bipolar disorder.

As hypothesized, people in rural medical homes generally had higher utilization and medication adherence than rural non-medical home enrollees (Table 4). The pattern observed between rural medical homes and rural non-medical homes varied somewhat by diagnoses. For example, each of the diagnosis groups in rural medical homes had higher monthly primary care visits than rural non-medical home enrollees (0.38–0.49 more visits/month). However, medication adherence was higher among rural medical home enrollees than rural non-medical home enrollees only for people with major depressive disorder (7.4 percentage points higher) and for people with bipolar disorder (4.5 percentage points higher). Similarly, only people with major depressive disorder and people with bipolar disorder in rural medical homes had fewer inpatient hospitalizations (0.13–0.22 fewer hospitalizations/month) than rural non-medical home enrollees.

Discussion

With increasing interest in models of comprehensive, coordinated care for people with chronic conditions, understanding rural-urban differences in medical home utilization and medication adherence is an important step in determining strategies to address rural-urban differences in care for people with SMI. The overall findings of this study support that the medical home can be an effective model for persons with severe mental illness in all geographic areas, though additional specialty mental health provider supports might prove useful for rural medical homes. Rural medical home enrollees generally had more utilization and higher medication adherence than rural non-medical home enrollees. This finding is in line with a growing body of evidence in support of primary care based medical homes for people who were traditionally served by specialty care providers.^{18,31,32} Additionally, urban medical homes were higher than rural medical homes on nearly all of the outcomes

considered for this study. These rural-urban medical homes effects varied somewhat across the SMI diagnoses, and were especially notable among persons with schizophrenia.

Our findings were consistent with the hypothesis that rural enrollees in medical homes would have higher utilization and medication adherence than rural enrollees in non-medical homes, but mostly among persons with major depressive disorder. Historically, the SMI population has a high number of physical comorbidities, such as diabetes and cardiovascular disease that can be addressed in a primary care setting.^{9,33} However, people with SMI frequently do not access the primary care services needed to address their physical comorbidities.³⁴ We learned that, people with SMI in rural medical homes used significantly more primary care services and had higher medication adherence than rural non-medical home enrollees. As a result, the SMI population in rural medical homes is now likely getting more of their physical health care needs met in primary care than non-medical home enrollees. This is also evidenced by fewer inpatient hospitalizations and emergency department visits. While we observed an already low number of inpatient hospitalizations among rural non-medical home enrollees, after multivariate analyses, the number of inpatient hospitalizations among rural medical homes was even lower compared to rural non-medical home enrollees. These fewer inpatient hospitalizations may be partially explained by higher use of primary care services by those enrolled rural medical homes.

Our other findings were somewhat consistent with the hypothesis that people in urban medical homes would have higher primary care and specialty mental health service use as well as medication adherence while also having fewer inpatient hospitalizations and emergency department visits than people in rural medical homes. However, with the exception of primary care, the unadjusted means for non-medical home enrollees in Table 2 showed that, people in urban areas had lower specialty mental health use, medication adherence and higher inpatient and emergency department use than those in rural areas. Our multivariate analyses showed that urban medical homes had significantly higher access to care and medication adherence, while rural medical homes generally maintained a similar level of care across all SMI diagnoses in comparison to non-medical homes. Further research that incorporates data from other states is needed to understand if the rural-urban variations in care observed in North Carolina are unique or a part of a broader mosaic observable elsewhere.

Finally, the findings for persons with schizophrenia in particular differed from those for persons with major depressive disorder and bipolar disorder. After propensity weighted adjustments, the effect of medical homes across all of the utilization measures was more pervasive in urban compared to rural areas for people with schizophrenia. The difference in findings for persons with schizophrenia in comparison to persons with major depressive disorder and bipolar disorder suggests that a primary care based medical home might not be the ideal setting to address the physical and mental health care needs of people with schizophrenia. The complexity of managing their care needs may fall outside the training of a primary care provider. Primary care providers have been shown to be more confident managing major depressive disorder than more complex conditions like schizophrenia.^{19,20} Persons with schizophrenia in particular are less likely to receive minimally adequate care in the primary care setting than persons with major depressive disorder.³⁵ The health home, a

variation on the medical home model specified in the Affordable Care Act, is a Medicaid option that focuses on people with chronic conditions, including mental health conditions. Under health homes, states have the option of allowing providers other than primary care providers to serve as a patient's designated 'home' provider; this includes community mental health centers or other agencies/professionals that provide mental health services.³⁶ Allowing persons with schizophrenia to designate a mental health provider as their health home may help address the utilization differences that exist across geographic areas. This type of medical home would allow the patient to designate a mental health provider as their medical home, but the mental health provider either co-locates with a primary care provider or facilitates coordination and communications with a primary care provider to ensure that the patient's physical health needs are met.³⁷ Further research is needed on the impact of health homes for people with SMI as well as differences across geographic areas in health homes. Given that Medicaid is the largest payer of mental health services, additional research on how the types of changes in utilization across geographic areas we observed here impact the total costs of care would be particularly useful for states planning and implementing medical home models for persons with severe mental illness.

There are several limitations of this study. The data did not provide information on the severity of symptoms (mental health or physical health) or on other clinical measures, which would have been beneficial as control variables. As a result, some selection bias into medical home enrollment may remain on factors unobservable in our data. In addition, the data did not include information on care management actually provided. Data on care management would improve our understanding of how differences in the operation of medical homes impact the rural-urban differences. Finally, the measure for inpatient hospitalizations does not include state psychiatric hospitals because of Medicaid's prohibition of payments to Institutions for Mental Disease (IMDs) for adults aged 18–64. As a result, measures of inpatient hospitalizations may be underestimated because they do not capture psychiatric hospital use that may occur for some SMI patients. Despite these limitations, the data available for this study provided a strong start to examining differences in patterns of care brought about by medical homes in rural and urban areas.

States have an interest in evaluating how health services resources are allocated to communities within their jurisdictions. Findings from this study suggest that implementation of the medical home model in rural areas may help to reduce differences in care that exist between rural and urban areas for some people with SMI.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Disclosure of funding received for this work: National Research Service Award Postdoctoral Traineeship from the National Institute of Mental Health sponsored by Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, and the Department of Psychiatry and Behavioral Sciences, Duke University School of Medicine, Grant No: T32 MH019117.

References

1. Iglehart JK. No place like home--testing a new model of care delivery. *N Engl J Med.* 2008;359(12):1200–1202. [PubMed: 18799555]
2. Agency for Healthcare Research & Quality. Patient-Centered Medical Home Resource Center: Defining the PCMH. n.d.; http://pcmh.ahrq.gov/portal/server.pt/community/pcmh__home/1483/pcmh_defining_the_pcmh_v2. Accessed August 12, 2012.
3. Alakeson V, Frank RG, Katz RE. Specialty Care Medical Homes For People With Severe, Persistent Mental Disorders. *Health Affairs.* 2010;29(5):867–873. [PubMed: 20439873]
4. Rosenthal TC. The Medical Home: Growing Evidence to Support a New Approach to Primary Care. *J Am Board Fam Med.* 2008;21(5):427–440. [PubMed: 18772297]
5. Bolin JN, Gamm L, Vest JR, Edwardson N, Miller TR. Patient-centered medical homes: will health care reform provide new options for rural communities and providers? *Fam Community Health.* 2011;34(2):93–101. [PubMed: 21378505]
6. Fox J, Merwin E, Blank M. De facto mental health services in the rural south. *J Health Care Poor Underserved.* 1995;6(4):434–468. [PubMed: 7495936]
7. Himelhoch S, Ehrenreich M. Psychotherapy by primary-care providers: results of a national sample. *Psychosomatics.* 2007;48(4):325–330. [PubMed: 17600169]
8. Hauenstein E, Petterson S, Rovnyak V, Merwin E, Heise B, Wagner D. Rurality and Mental Health Treatment. *Administration and Policy in Mental Health and Mental Health Services Research.* 2007;34(3):255–267. [PubMed: 17165139]
9. Wang PS, Lane M, Olfson M, Pincus HA, Wells KB, Kessler RC. Twelve-Month Use of Mental Health Services in the United States: Results From the National Comorbidity Survey Replication. *Arch Gen Psychiatry.* 2005;62(6):629–640. [PubMed: 15939840]
10. Ziller EC, Anderson NJ, Coburn AF. Access to Rural Mental Health Services: Service Use and Out-of-Pocket Costs. *The Journal of Rural Health.* 2010;26(3):214–224. [PubMed: 20633089]
11. Cunningham PJ. Beyond Parity: Primary Care Physicians' Perspectives On Access To Mental Health Care. *Health Affairs.* 2009;28(3):w490–w501. [PubMed: 19366722]
12. Rost K, Adams S, Xu S, Dong F. Rural-urban differences in hospitalization rates of primary care patients with depression. *Psychiatr Serv.* 2007;58(4):503–508. [PubMed: 17412852]
13. Hartley D, Ziller EC, Loux SL, Gale JA, Lambert D, Yousefian AE. Use of critical access hospital emergency rooms by patients with mental health symptoms. *J Rural Health.* 2007;23(2):108–115. [PubMed: 17397366]
14. Hauenstein E Building the rural mental health system: from De Facto system to quality care. *Annual Review of Nursing Research.* 2008;26:143–173.
15. Peikes D, Zutshi A, Genevro JL, Parchman ML, Meyers DS. Early evaluations of the medical home: building on a promising start. *Am J Manag Care.* 2012;18(2):105–116. [PubMed: 22435838]
16. Jackson GL, Powers BJ, Chatterjee R, et al. The Patient-Centered Medical Home: A Systematic Review. *Annals of Internal medicine.* 2013;158(3):169–178. [PubMed: 24779044]
17. Derrett S, Gunter KE, Nocon RS, et al. How 3 Rural Safety Net Clinics Integrate Care for Patients: A Qualitative Case Study. *Medical Care.* 2014;52:S39–S47 10.1097/MLR.0000000000000191.
18. Domino ME, Wells R, Morrissey JP. Serving Persons With Severe Mental Illness in Primary Care–Based Medical Homes. *Psychiatric Services.* 2015;66(5):477–483. [PubMed: 25686809]
19. Williams JW, Jr., Rost K, Dietrich AJ, Ciotti MC, Zyzanski SJ, Cornell J Primary care physicians' approach to depressive disorders. Effects of physician specialty and practice structure. *Arch Fam Med.* 1999;8(1):58–67. [PubMed: 9932074]
20. Goldman LS. Medical illness in patients with schizophrenia. *Journal of Clinical Psychiatry.* 1999.
21. Willson CF. Community care of North Carolina: Saving state money and improving patient care. *NC Med J.* 2005;66(3):229–233.
22. Steiner BD, Denham AC, Ashkin E, Newton WP, Wroth T, Dobson LA, Jr., Community care of North Carolina: improving care through community health networks. *Ann Fam Med.* 2008;6(4):361–367. [PubMed: 18626037]

23. Bitton A, Martin C, Landon B. A Nationwide Survey of Patient Centered Medical Home Demonstration Projects. *Journal of General Internal Medicine*. 2010;25(6):584–592. [PubMed: 20467907]
24. Takach M Reinventing Medicaid: State Innovations To Qualify And Pay For Patient-Centered Medical Homes Show Promising Results. *Health Affairs*. 2011;30(7):1325–1334. [PubMed: 21734207]
25. Fields D, Leshen E, Patel K. ANALYSIS & COMMENTARY: Driving Quality Gains And Cost Savings Through Adoption Of Medical Homes. *Health Affairs*. 2010;29(5):819–826. [PubMed: 20439867]
26. Peterson AM, Nau DP, Cramer JA, Benner J, Gwadry-Sridhar F, Nichol M. A checklist for medication compliance and persistence studies using retrospective databases. *Value Health*. 2007;10(1):3–12. [PubMed: 17261111]
27. Benner JS, Glynn RJ, Mogun H, Neumann PJ, Weinstein MC, Avorn J. Long-term persistence in use of statin therapy in elderly patients. *JAMA*. 2002;288(4):455–461. [PubMed: 12132975]
28. United States Department of Agriculture Economic Research Service. Measuring Rurality: Rural-Urban Continuum Codes. 2004; <http://www.ers.usda.gov/briefing/rurality/ruralurbcon/>. Accessed August 10, 2011.
29. Hall SA, Kaufman JS, Ricketts TC. Defining urban and rural areas in US epidemiologic studies. *Journal of urban health*. 2006;83(2):162–175. [PubMed: 16736366]
30. d'Agostino RB. Tutorial in biostatistics: propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. *Stat Med*. 1998;17(19):2265–2281. [PubMed: 9802183]
31. Goyal RK, Wheeler SB, Kohler RE, et al. Health care utilization from chemotherapy-related adverse events among low-income breast cancer patients: effect of enrollment in a medical home program. *N C Med J*. 2014;75(4):231–238. [PubMed: 25046085]
32. Lichstein JC, Domino ME, Beadles CA, et al. Use of medical homes by patients with comorbid physical and severe mental illness. *Med Care*. 2014;52 Suppl 3:S85–91.
33. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime Prevalence and Age-of-Onset Distributions of DSM-IV Disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry*. 2005;62(6):593–602. [PubMed: 15939837]
34. Salsberry PJ, Chipps E, Kennedy C. Use of general medical services among Medicaid patients with severe and persistent mental illness. *Psychiatric Services*. 2005;56(4):458–462. [PubMed: 15812097]
35. Bradford DW, Kim MM, Braxton LE, Marx CE, Butterfield M, Elbogen EB. Access to medical care among persons with psychotic and major affective disorders. *Psychiatr Serv*. 2008;59(8):847–852. [PubMed: 18678680]
36. Centers for Medicare & Medicaid Services. Health Homes for Enrollees with Chronic Conditions. 11 16, 2010.
37. SAMHSA-HRSA Center for Integrated Health Solutions. Behavioral health homes for people with mental health and substance use conditions: The core clinical features. Washington, DC2012.

Figure 1.
Significant Differences in Utilization Between Geographic Areas

Table 1:

Comparison of medical home features to the Community Care of North Carolina model

Features of the medical home	Definition	Community Care of North Carolina
1. Patient-centered	Providers are supportive of patients in the management and organization of their own care	Patients are provided with educational resources to encourage their active participation in their care.
2. Comprehensive	Multi-disciplinary team of care providers that for a patient's whole care, including physical and mental health care needs	Patients are linked to a primary care practice. This practice is also linked to regional, community care network to further assist with providing comprehensive primary care. The regional community care network provides linkages to additional community partners like hospitals, health departments and social services.
3. Coordinated	Care is organized across all areas of the health care system	Provider's enhanced case management fee goes towards conduct a comprehensive assessment, develop individualized care plans, coordinate care, and monitor each patient's progress. Providers can also turn to their community care network for local case managers and resources associated with managing their patient population.
4. Accessible	Care provided with shorter wait times, expanded in-person hours, and 24/7 electronic or phone access	Participating primary care practices provide 24-hour access to enrolled patients
5. Committed to quality and safety	A commitment to quality improvement, use of data and health information technology to allow for informed decision-making	This is a primary goal of CCNC. Quality improvement focuses on disease-specific care management initiatives, measuring quality on evidence-based care guidelines, working with local networks to provide care management support, provider access to web-based Provider Portal with population management reports and individual patient information.

Table 2:Selected descriptive statistics on unadjusted samples[†]

	In a Medical Home		Not in a Medical Home	
	Urban	Rural	Urban	Rural
Persons with Major Depressive Disorder (n=107,706, observations=2,968,066)				
Medical Home Enrollment – Ever (%)	70	70	30	30
Months in Medical Home (#)	29.7	29.2	7.3	8.4
Age (yrs.)	39.0	39.6	42.9	42.0
Male (%)	17.7	19.3	23.2	24.1
Race (%)				
White	58.5	70.4	67.8	70.7
African American	36.8	25.4	27.6	22.1
Other Race	4.8	4.2	4.5	7.1
Hispanic Ethnicity (%)	1.6	1.1	1.5	1.1
Comorbidities (#)	4.3	4.3	5.0	4.9
Medicaid Eligibility: Disabled (%)	50.5	53.9	54.7	60.5
Persons with Bipolar Disorder(n=26,666, observations=755,390)				
Medical Home Enrollment -Ever (%)	70	70	30	30
Months in Medical Home (#)	29.3	29.4	7.6	8.2
Age (yrs.)	37.5	38.8	39.2	38.9
Male (%)	21.4	20.2	26.1	26.5
Race (%)				
White	70.9	81.8	76.0	78.6
African American	25.4	14.2	20.1	14.1
RaceOther Race	3.7	4.0	3.8	7.3
Hispanic Ethnicity (%)	1.3	1.4	1.6	0.9
Comorbidities (#)	4.2	4.2	4.7	4.8
Medicaid Eligibility: Disabled (%)	61.2	64.0	66.8	72.1
Persons with Schizophrenia (n=15,636, observations=521,762)				
Medical Home Enrollment - Ever(%)	61	60	39	40
Months in Medical Home (#)	34.5	33.4	6.2	7.2
Age (yrs.)	42.3	45.2	45.3	45.8
Male (%)	45.3	44.2	52.1	50.3
Race (%)				
White	35.2	41.4	46.2	45.9
African American	60.1	54.5	49.3	49.2
Other Race	4.7	4.0	4.4	4.8
Hispanic Ethnicity (%)	1.5	1.5	1.2	0.7
Comorbidities (#)	4.0	4.3	4.6	4.2
Medicaid Eligibility: Disabled (%)	95.0	96.1	92.0	93.4

[†]Notes: Balance attained (not shown) on all covariates as determined by standardized differences between medical home enrollees and non-medical home enrollees.

Table 3:

Average Unadjusted Means in Monthly Utilization and Adherence by Geographic Areas for Controls

	Primary Care Visits	Specialty Mental Health Visits	Inpatient Hospitalizations	Emergency Department Visits	Medication Adherence (PDC) [‡]
Persons with Major Depressive Disorder (n=34,097 observations=1,525,285)					
Urban	1.03	1.18	0.44	0.45	0.32
Rural	0.97 ^a	1.23 ^a	0.40 ^a	0.44 ^a	0.35 ^a
Persons with Bipolar Disorder (n= 8,418, observations=407,455)					
Urban	1.09	2.24	0.50	0.56	0.17
Rural	1.01 ^a	2.39 ^a	0.38 ^a	0.54 ^a	0.18 ^a
Persons with Schizophrenia (n=6,907, observations=302,756)					
Urban	0.93	3.40	0.47	0.37	0.52
Rural	0.88 ^a	4.12 ^a	0.39 ^a	0.30 ^a	0.59 ^a

[‡]Medication adherence for persons with bipolar disorder only measures adherence to mood stabilizers

^a significant difference from urban

Table 4:

Propensity Score Weighted Average Monthly Marginal Effect of Medical Home Status on Geographic Area

	Primary Care Visits	Specialty Mental Health Visits	Inpatient Hospitalizations	Emergency Department Visits	Medication Adherence [‡]
Persons with Major Depressive Disorder (n=107,706, observations=2,968,066)					
Medical Home Status on: [†]					
Urban	0.46 ^{***a} (0.45 – 0.47)	0.11 ^{**} (0.085 – 0.15)	-0.23 ^{**} (-0.24 – -0.22)	-0.096 ^{**} (-0.098 – -0.087)	0.083 ^{**} (0.083 – 0.090)
Rural	0.38 ^{***a} (0.35 – 0.42)	0.074 (-0.055 – 0.20)	-0.22 ^{**} (-0.24 – -0.18)	-0.097 ^{**} (-0.11 – -0.071)	0.074 ^{**} (0.065 – 0.089)
Persons with Bipolar Disorder (n=26,666, observations=755,390)					
Medical Home Status on: [†]					
Urban	0.52 ^{**} (0.50 – 0.56)	0.27 ^{**} (0.19 – 0.38)	-0.20 ^{***a} (-0.22 – -0.18)	-0.088 ^{**} (-0.099 – -0.073)	0.040 ^{**} (0.036 – 0.047)
Rural	0.49 ^{**} (0.41 – 0.59)	0.26 (-0.015 – 0.53)	-0.13 ^{***a} (-0.19 – -0.069)	-0.074 ^{**} (-0.13 – -0.014)	0.045 ^{**} (0.028 – 0.076)
Persons with Schizophrenia (n=15,636, observations=521,762)					
Medical Home Status on: [†]					
Urban	0.55 ^{***a} (0.53 – 0.61)	0.025 ^{***a} (0.019 – 0.42)	-0.13 ^{***a} (-0.16 – -0.10)	-0.056 ^{***a} (-0.071 – -0.044)	0.058 ^{**} (0.051 – 0.072)
Rural	0.40 ^{***a} (0.27 – 0.52)	-0.62 ^a (-1.24 – 0.062)	-0.031 ^a (-0.12 – -0.063)	0.0075 ^a (-0.054 – 0.067)	0.026 (-0.0067 – 0.063)

95% confidence intervals are in parentheses. All models control for age in quadratic form, sex, race and ethnicity.

^{***} Statistically significant at the 5% level compared to non-medical home enrollees

^a significant (p<0.05) difference between urban and rural

[†] compared to patients not in the medical home

[‡] Medication adherence for persons with bipolar disorder only measures adherence to mood stabilizers