Quality and Equity of Primary Care with Patient-Centered Medical Homes: Results from a National Survey

Jaya Aysola, MD, MPH,
Department of Health Care Policy, Harvard Medical School, Division of General Medicine, Brigham and Women's Hospital, jaysola@partners.org

Asaf Bitton, MD, MPH,
Division of General Medicine, Brigham and Women's Hospital, abitton@partners.org

Alan M. Zaslavsky, PhD, and
Department of Health Care Policy, Harvard Medical School, zaslavsky@hcp.med.harvard.edu

John Z. Ayanian, MD, MPP
Department of Health Care Policy, Harvard Medical School, 180 Longwood Avenue, Boston, MA 02115; phone: 617-432-3455; fax: 617-432-0173; ayanian@hcp.med.harvard.edu

Abstract

Background—The patient-centered medical home model has gained support, but the impact of this model on the quality and equity of care merits further evaluation.

Objective—To determine if patient-centered medical homes are associated with improved quality and equity in pediatric primary care.

Research Design—Using the 2007/2008 National Survey of Children's Health, a nationally representative survey of parents/guardians of children (age 0–17), we evaluated the association of patient-centered medical homes with ten quality of care measures using multivariable regression models, adjusting for demographic and socioeconomic covariates. For quality indicators that were significantly associated with medical homes, we determined if this association differed by race/ethnicity.

Results—Compared to children without medical homes, those with medical homes had significantly better adjusted rates for six of ten quality measures (all p 0.02) such as obtaining a developmental history (adjusted rates % (SE): 41.7 (1.3) vs. 52.0 (1.1), p<0.001). Having a medical home was associated with better adjusted rates of receiving a developmental history exam for both white and black children, but the disparity between these groups was not significantly narrowed (difference in risk differences (SE): 0.9 (4.3) for Whites vs. Blacks; p=0.83).

Conclusions—Our results underscore the benefits of the medical home model for children while highlighting areas for improvement, such as narrowing disparities. Our findings also emphasize the key role of patient experience measures in the evaluation of medical homes.

Correspondence to: John Z. Ayanian.

INTRODUCTION

The concept of the patient-centered medical home (PCMH) has gained support over the past decade from multiple stakeholders interested in strengthening the primary care delivery system. Yet its definition and implementation remains varied, thereby rendering evaluation of the medical home model a challenging and evolving process.[1] The PCMH was first introduced in pediatrics in 1967 as a primary care model to provide comprehensive family-centered care to children with special health care needs.[2] In 1992, the American Academy of Pediatrics (AAP) defined the essential elements of the medical home for all children as primary care that is accessible, comprehensive, continuous, coordinated, family-centered, compassionate, and culturally effective.[3] By 2007, the American Academy of Pediatrics, American Academy of Family Physicians, American College of Physicians, and American Osteopathic Association, jointly endorsed the PCMH as an primary care model for all ages and expanded the concept to incorporate health information technology, payment reform and quality improvement.[4] In 2008, the National Committee for Quality Assurance (NCQA), proposed operational standards to recognize medical practices as patient-centered medical homes. However, even among NCQA recognized medical homes, practices can achieve recognition in several ways,[5,6] and numerous other tools exist for recognizing practices as medical homes.[7] This variability in the operational definition and measurement of the medical home models has limited the ability to examine the impact of these models on improving quality and equity of primary care.

Modest evidence suggests that PCMH models are associated with improvement in health care quality for pediatric patients.[8–10] A recent study demonstrated that children with a medical home reported fewer unmet health care needs and were more likely to receive preventive care.[11] Multi-site PCMH demonstration projects are ongoing, with limited preliminary results.[12–14] While several studies have demonstrated disparities in access to a PCMH,[15–18] little is known about to assess whether the PCMH model reduces disparities in the quality of primary care.[19,20] Therefore, using a nationally representative survey that assesses whether practices meet the aims of the medical home model from the patient perspective, our study examined whether patient-centered medical homes are associated with improved quality and equity of primary care for children.

METHODS

Study Population

We analyzed the most recent available data from the National Survey for Children's Health, one of the only national surveys that comprehensively measures access to patient-centered medical homes from the patient/family perspective. This survey estimatesmultiple health indicators for childrenat the national and statelevels. A random-digit-dial survey sampling design is used to identify households with children ages 0–17 from each of the fifty states andDistrict of Columbia. After identifying households with children, one child from each sampled household is randomly selected to be the subjectof the survey, or index child.

Between April 2007 and July 2008, telephone interviews were conducted in English, Spanish, Chinese, Korean, and Vietnamese with the parent or guardian most familiar with the index child's health status and health care. The total sample included 91,642 childrenfrom birth through age 17 (1,725 to 1,932 children per state). The interview completion rate among known households with children was 66.0%. The survey methods aredetailed elsewhere.[21] Children's race and ethnicity was based on the reports of their parents or guardians using standard categories for federal surveys. Because we analyzed publicly available de-identified data, the study was deemed exempt by the Human Studies Committee of Harvard Medical School.

Predictor: Patient-Centered Medical Home

Our primary predictor was whether children had access to primary care services that satisfied the criteria for a patient-centered medical home. To make this determination we used a robust medical home measure derived from 18 survey questions, based on the AAP definition of the medical home included in the NSCH dataset.[21–23] Access is broadly defined to encompass both availability and utilization of services. A child is designated to have access to a patient-centered medical home, if he/she satisfies the following five subcomponents: 1) has a personal health care provider 2) has a primary care site that is his/her usual source of care 3) receives care that is family/patient centered, and if needed, 4) receives effective care coordination and 5) receives successful referral assistance. Each subcomponent is derived from responses to multiple survey questions from the child's primary caregiver. For example, care is deemed family/patient centered if the health provider/s reportedly satisfied the following criteria usually or always in the past 12 months: 1) listened to the family/child; 2) spent enough time with family/child; 3) were sensitive to family's values and customs; 4) provided needed information; 5) made the family feel like a partner in their child's care; and, 6) if needed, provided interpreter services (Appendix A).

Outcome Measures

We analyzed ten quality-of-care measures, based on evidence-based pediatric guidelines.[24–28] These measures included the receipt of annual preventive medical and dental care visits, receipt of appropriate immunizations and developmental screenings, the absence of unmet health care needs, the receipt of needed mental health care services in a subset of children with mental health disorders, and number of missed school days in the subset of children with asthma. Table 1 details each quality measure, including the associated survey questions, eligibility criteria, and sample size analyzed.

Statistical Analysis

Our analysis had three main objectives. First, we determined the characteristics of children who had access to a PCMH. Second, we compared the proportion of children with and without a medical home that achieved each of our ten quality indicators. Third, among those quality measures for which the PCMH was associated with a significant benefit, we evaluated whether the benefit in quality of care differed across race/ethnicity strata.

We tabulated and compared the distributions of each covariate for children with and without a medical home in the entire sample, using chi square tests. In multivariable logistic regression models we assessed the association of medical homes with each dichotomous quality measure, adjusting for age (0–5, 6–11, 12–17 years) except in measures with narrow age ranges, sex, race, insurance type, consistency of insurance over a 12-month period, household income, maternal education, primary language, family structure, household employment, geographic region, and children with special health care needs (CSHCN). CSHCN were identified in the survey with questions from a validated screening tool (CSHCN Screener©).[21,29] We also assessed the relation between medical home status and number of missed school days among children with asthma using a log linear regression model for count data, adjusting for the same covariates above as well as asthma severity (mild vs. moderate/severe). Lastly, we examined the associations of each PCMH subcomponent with quality measures significantly associated with medical homes in our primary analysis. We excluded children who did not utilize care or require specific services necessitating care coordination or referrals in the past 12 months.

In each model, respondents with missing values for our predictor and specified outcome of interest were omitted, ranging from 6 to 9% of the original sample size for each subpopulation. For all other covariates, indicator variables for missing values were created

to include those respondents in the analysis. We calculated adjusted rates for achieving each quality measure for children with and without a PCMH, averaged across all other covariates.[30] For the categorical quality measures with a statistically significant difference between children with and without medical homes, we fitted multivariable logistic regression models including interactions of medical homes with race/ethnicity and adjusted for the same covariates. Similarly, for the continuous measure of missed school days among children with asthma, we fitted a multivariable log linear regression model with the same interactions and adjusted for the same covariates as well as asthma severity. We also computed adjusted rates of achieving each quality measure in children with and without a medical home by race/ethnicity, determined the difference in adjusted rates (risk difference), and contrasted those risk differences to determine statistical significance.[30]

All analyses were weighted to represent the U.S. population of non-institutionalized children. To account for the complex survey design, SUDAAN software version 10.0.1 (Research Triangle Institute, Research Triangle Park, NC) was used in the descriptive and adjusted analyses. To account for multiple hypothesis testing, we adjusted p values using false discovery rate methods.[31] Two-tailed p values and 95% confidence intervals are reported for all statistical tests, with $p<0.05$ considered statistically significant.

RESULTS

The population surveyed was nationally representative of approximately 73 million children residing in U.S. households during 2007 and 2008 (Table 2). About 22% of the children had public insurance (Medicaid/SCHIP), 7.5% were uninsured, and 29% resided in lower income households (<200% FPL). About 89% of the children came from households with at least one employed adult, and over 69% came from two-parent households. About 92% of the children were from households where English was their primary language. Children with special health needs comprised 20% of the cohort.

About 58% of the children in our cohort had primary care services that satisfied the criteria for a PCMH (Table 2). Children who received care from medical homes were more likely than the overall cohort to be non-Hispanic whites and from households with higher incomes, two parents, more educated parents, and where English is the primary language. Children with private insurance were more likely to have medical homes than those with public, or no insurance. Children with consistent insurance coverage during the past 12 months were more likely to have a PCMH than those with gaps in coverage. Medical home access also varied by region, about 65% of children from New England and one Midwestern region had medical homes compared to about 50% to 59% of children in the South and Southwest. In adjusted analysis, quality of care differed significantly between children with and without a PCMH for seven of the ten quality measures (Table 3). Children with a PCMH had better adjusted rates for preventive medical services, having a provider obtain a developmental history, receiving formal developmental screening exams, and receipt of provider recommended HPV vaccine. Children with medical homes also had significantly lower rates of unmet medical needs ($p<0.001$). In addition, among children with asthma, those with a medical home reported fewer missed school days compared to those without. However, among those children requiring mental health services, those with a PCMH were less likely to receive needed services ($p<0.01$). Children with and without a medical home did not differ significantly in obtaining preventive dental services, tetanus booster immunization, or the meningococcal vaccine. All findings of statistically significance persisted after adjustment for multiple statistical tests.

For quality measures positively associated with PCMH, we evaluated whether this effect was similar across racial/ethnic groups, finding differential effects for four of the seven

measures we assessed (Table 4). Hispanic and Black children had higher rates of preventive services compared to white children, regardless of their medical home status. The difference in rates of preventive care between those with and without medical homes, was significant in white children alone; however, the difference between minority and white children for these risk differences was not statistically significant (difference in risk differences (SE): Whites vs. Hispanics: 2.6 (1.7); *p*=0.11; Whites vs. Blacks 2.5 (1.4); *p*=0.076).

We found differences by race/ethnicity on medical home access and receipt of needed mental health services. White children with medical homes reported lower rates of receiving needed mental health services than those without (adjusted rates (SE) 54.6 (3.0) vs. 66.2 (2.5); p=0.001). Among minority children, receipt of needed mental health services did not differ significantly between those with and without medical homes [(adjusted rates (SE) for Hispanic children with medical homes vs. no medical homes: 70.1 (6.5) vs. 63.5 (5.0); p=0.39); (adjusted rates (SE) for Black children with medical homes vs. no medical homes: 41.1 (6.2) vs. 52.6 (3.9); p=0.16)]

Having a medical home was associated with substantially and statistically significantly less unmet health care needs in each racial/ethnic group (Table 4). Parents or guardians of black children compared to those of white children reported fewer unmet health care needs, regardless of their medical home status. No statistical difference was detected in reports of unmet health care needs between Hispanic and white children.

For having a provider obtain a developmental history, adjusted rates were significantly higher in all three racial/ethnic groups for those with medical homes compared to those without (Table 4). For this measure, however, a significant disparity persisted between white and black children with and without medical homes (difference in risk differences (SE): Whites vs. Blacks 0.9 (4.3); *p*=0.83). For this quality measure, no statistically significant difference was noted between Hispanic and white children with or without medical homes.

In white children with asthma, PCMH was associated with significant reductions in the number of missed school days, but not among minority children with asthma who also had fewer missed school days than white children (Table 4). The difference in risk differences between minority and white children was statistically significant (difference in risk differences (SE): Hispanic vs. White: −3.9 (1.4); *p*=0.005; Black vs. White: −3.0(1.1); *p*=0.006).

In secondary analyses, we evaluated the associations of PCMH subcomponents with quality indicators (Table 5). Receiving patient/family centered care was significantly associated with improvement in five of six process measures assessed. Notably, none of the five medical home subcomponents were negatively associated with receipt of mental health services as the medical home composite measure was in our primary analysis. (Table 5) However, children who did not meet the threshold to assess care coordination but were classified as having a medical home in the NSCH composite measurewere much less likely to receive needed mental health care (p<0.001).

DISCUSSION

In a large, nationally representative survey, we found that having a PCMH was associated with significantly better performance for six of ten measures of pediatric quality of care we assessed. While improvements in preventive medical care and reductions in unmet medical needs were noted in a previous study of the National Survey of Children's Health,[11] we expanded on this research by evaluating seven additional pediatric quality of care measures in relevant subpopulations and also analyzed whether the significant associations of medical homes with quality of care varied by race/ethnicity.

Children with medical homes had better rates of achieving process measures involving active provider patient engagement, such as having a provider obtain a developmental history or recommending the HPV vaccine; compared to those quality measures that required limited provider patient communication, such as administering more routine adolescent vaccines (tetanus booster and meningococcal vaccine), for which no statistical difference was noted between children with and without medical homes. Moreover, among children with asthma, medical homes were associated with fewer missed school days. This result was consistent with a previous study using a modified medical home measure.[32] However, among children with behavioral or developmental conditions, medical homes were associated with lower rates of obtaining necessary mental health treatment or counseling, particularly among White children. None of the five PCMH subcomponents were associated with lower rates of receiving needed mental health care. Rather, children not meeting the threshold to assess care coordination, who were included in the PCMH composite measure as having a medical home, appeared to drive the negative association between medical homes and receipt of mental health care seen in our primary analysis. Therefore, this negative association was an anomaly of the NSCH algorithm used to derive the measure (Appendix A). However, our findings still suggest room for improvement in this area, as only one PCMH subcomponent, having a usual source of care, was associated with significantly higher adjusted rates of receiving needed mental health services.

We found benefits in quality of care from patient-centered medical homes, but also areas for improvement, namely in coordination of mental health services. One in five children have a developmental or behavioral health problem, yet only about half of the children requiring treatment receive it.[35] Medical homes within primary care can incorporate mental health services to improve quality.[36,37] Integrative models range from shared medical records and/or shared decision making between mental health and primary care providers, to co-locating mental health professionals with primary care teams.[38,39] Expansion of these integrative models will require PCMH payment reform to address financial barriers to integration, such as behavioral health carve-outs that exclude primary care providers from billing for mental health services, and the lack of reimbursement for services by multiple providers for the same patient on the same day and for services provided by care coordinators or social workers.[40,41]

Our findings were mixed on whether PCMH is associated with improved equity in primary care. Medical homes significantly reduced the relative risk of unmet health needs by about 75% for children across all racial/ethnic groups. Parents and guardians of black children with and without medical homes reported fewer unmet health care needs compared with parents or guardians of white children, which is consistent with more favorable experiences with care reported by minority patients in some other consumer health surveys.[33,34] Medical homes were associated with significantly fewer missed school days in children with asthma, but only for white children in the stratified analysis. Patient-centered medical homes also did not alter the disparity gap between black and white children for receiving a developmental history from their provider.

Achieving equitable care is essential to attain consistently high quality care as a cornerstone of high-performing health care systems.[42,43] Existing medical home recognition programs do not require practices to collect race/ethnicity data. The 2011 NCQA standards allow but do not require practices to stratify their performance data to assess potential racial/ethnic disparities.[44] The Institute of Medicine has recommended that health care providers collect race/ethnicity data from patient self-reports based on locally relevant ethnicity categories that can also be combined in traditional race/ethnicity categories as defined by the federal Office of Management and Budget.[45] Practices implementing PCMH models should collect

race/ethnicity data to determine how their quality improvement initiatives affect patients in all relevant racial and ethnic groups.[43,46]

Our study had several limitations. Given the cross-sectional survey data, we were not able to establish causal effects of medical homes on quality of care. Questions requiring respondents to remember care over the last 12 months may have been subject to recall bias. Our quality of care measures were based on self-reported data and not verified with medical records. However, prior studies have demonstrated the reliability of self-report data for similar measures.[10,47,48] Some subcomponents of our primary predictor and outcome variables appear to assess similar constructs, such as having a personal primary care provider and receiving preventive medical care, or reporting obtaining referrals without difficulty and unmet health care needs. However, Spearman correlation coefficients for these pairs of dependent and independent variables were low (range from 0.11–0.17), indicating weak relationships between these constructs. Our medical home measure lacked three well-established components of this model, specifically continuity, accessibility of care, and payment reform. Lastly, our medical home measure assessed whether practices met the intended goals of the model exclusively from the patient and their family's perspective, in contrast with NCQA and other medical home recognition tools that measure medical homes exclusively from the practice and provider perspective. A combination of these complementary approaches would provide a more comprehensive measure of medical homes.

Our study underscores the important role that patient/family-reported information can play in understanding the impact of PCMH. Robust assessments of patients' perspectives are largely absent from many operational definitions and measurements of the medical home model. In existing medical home standards, practices and providers individually or collectively report their assessments of whether they meet the criteria for the subjective elements of the PCMH model.[7] Yet key components of the model, such as patient-centeredness, cultural effectiveness, and shared decision-making, require the patient/family's perspective and input. A focus on assessing patients/families' experiences is a key element to achieve high quality primary care.[49] NCQA in collaboration with the CAHPS (Consumer Assessment Healthcare Providers and Systems) consortium has introduced an optional patient experience survey and incentive mechanism to promote the collection of this information.[44] The PCMH standards of the Joint Commission also require practices to collect data on patients' experience with care to achieve recognition. To date, none of these accrediting agencies utilize the patient experience data collected to evaluate practices' adherence to PCMH standards or their effects on the equity of care.[50] Our study suggests that patients' perspectives should be a required element in the operational definition and assessment of patient-centered medical homes.[46] Medical homes can only reliably be patient-centered if robust methods are used to incorporate patients' experiences in the evaluation of practices implementing this model.

Our study demonstrates the benefits of the patient-centered medical home on a broad range of pediatric quality of care measures, while highlighting areas for improvement in narrowing disparities in care and coordination of mental health services. Moving forward, the implementation and evaluation of patient-centered medical homes should include: 1) patient/family experience measures 2) quality improvement measures by race/ethnicity, and 3) efforts to integrate behavioral health and primary care services.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

References

1. Iglehart JK. No place like home–testing a new model of care delivery. N Engl J Med. 2008; 359:1200–2. [PubMed: 18799555]

2. Sia C, Tonniges TF, Osterhus E, Taba S. History of the medical home concept. Pediatrics. 2004; 113:1473–8. [PubMed: 15121914]

3. American Academy of Pediatrics Ad Hoc Task Force on Definition of the Medical Home: The medical home. Pediatrics. 1992; 90:774. [PubMed: 1408554]

4. Joint Principles of the Patient Centered Medical Home | The Patient Centered Medical Home (PCMH) Will Restructure Healthcare Around the Patient. (Accessed 3/29/12, at http://www.pcpcc.net/content/joint-principles-patient-centered-medical-home.)

5. Friedberg MW, Lai DJ, Hussey PS, Schneider EC. A guide to the medical home as a practice-level intervention. The American Journal of Managed Care. 2009; 15:S291–9. [PubMed: 20088633]

6. Vest JR, Bolin JN, Miller TR, Gamm LD, Siegrist TE, Martinez LE. Medical homes: "where you stand on definitions depends on where you sit". Med Care Res Rev. 2010; 67:393–411. [PubMed: 20448255]

7. Burton, RADKJ.; Berenson, RA. Patient-Centered Medical Home Recognition Tools: A Comparison of Ten Surveys' Content and Operational Details. The Urban Institute, Health Policy Center; 2011 May. 2011

8. Homer CJ, Klatka K, Romm D, et al. A review of the evidence for the medical home for children with special health care needs. Pediatrics. 2008; 122:e922–37. [PubMed: 18829788]

9. Cooley WC, McAllister JW, Sherrieb K, Kuhlthau K. Improved outcomes associated with medical home implementation in pediatric primary care. Pediatrics. 2009; 124:358–64. [PubMed: 19564320]

10. Stevens GD, Vane C, Cousineau MR. Association of Experiences of Medical Home Quality with Health-Related Quality of Life and School Engagement among Latino Children in Low-Income Families. Health Serv Res. 2011

11. Strickland BB, Jones JR, Ghandour RM, Kogan MD, Newacheck PW. The medical home: health care access and impact for children and youth in the United States. Pediatrics. 2011; 127:604–11. [PubMed: 21402643]

12. Patient-centered primary care pilot projects guide. Patient-Centered Primary Care Collaborative Web site. (Accessed 9/27/11, at http://www.pcpcc.net/content/pcpcc-pilot-projects-guide.)

13. Roby DH, Pourat N, Pirritano MJ, et al. Impact of patient-centered medical home assignment on emergency room visits among uninsured patients in a county health system. Med Care Res Rev. 2010; 67:412–30. [PubMed: 20519430]

14. Reid RJ, Coleman K, Johnson EA, et al. The group health medical home at year two: cost savings, higher patient satisfaction, and less burnout for providers. Health Aff (Millwood). 2010; 29:835–43. [PubMed: 20439869]

15. Strickland BB, Singh GK, Kogan MD, Mann MY, Van Dyck PC, Newacheck PW. Access to the medical home: new findings from the 2005–2006 National Survey of Children with Special Health Care Needs. Pediatrics. 2009; 123:e996–1004. [PubMed: 19482751]

16. Beal A, Hernandez S, Doty M. Latino access to the patient-centered medical home. Journal of general internal medicine. 2009; 24(Suppl 3):514–20. [PubMed: 19842000]

17. Raphael JL, Guadagnolo BA, Beal AC, Giardino AP. Racial and ethnic disparities in indicators of a primary care medical home for children. Academic pediatrics. 2009; 9:221–7. [PubMed: 19487171]

18. Stevens GD, Cousineau MR, Pickering TA, Lee P. Healthy kids insurance and experiences of medical home quality for vulnerable children. Med Care. 2011; 49:828–33. [PubMed: 21478776]

19. Closing the Divide: How Medical Homes Promote Equity in Health Care: Results From The Commonwealth Fund 2006 Health Care Quality Survey – The Commonwealth Fund. (Accessed 8/27/11, at http://commonwealthfund.org/Content/Publications/Fund-Reports/2007/Jun/Closing-the-Divide--How-Medical-Homes-Promote-Equity-in-Health-Care--Results-From-The-Commonwealth-F.aspx#citation.)

20. Raphael JL, Zhang Y, Liu H, Tapia CD, Giardino AP. Association of medical home care and disparities in emergency care utilization among children with special health care needs. Academic pediatrics. 2009; 9:242–8. [PubMed: 19608125]

21. Child and Adolescent Health Measurement Initiative (CAHMI) 2007 NSCH Dataset. Data Resource Center for Child and Adolescent Health. (Accessed 9/27/11, at www.childhealthdata.org)

22. Strickland BB, Jones JR, Ghandour RM, Kogan MD, Newacheck PW. The Medical Home: Health Care Access and Impact for Children and Youth in the United States. Pediatrics. 2011

23. Bethell CD, Read D, Brockwood K. Using existing population-based data sets to measure the American Academy of Pediatrics definition of medical home for all children and children with special health care needs. Pediatrics. 2004; 113:1529–37. [PubMed: 15121922]

24. Recommendations for preventive pediatric health care. Committee on Practice and Ambulatory Medicine, Bright Futures Steering Committee. Pediatrics. 2007; 120:1376.

25. Beil HA, Rozier RG. Primary health care providers' advice for a dental checkup and dental use in children. Pediatrics. 2010; 126:e435–41. [PubMed: 20660547]

26. Identifying infants and young children with developmental disorders in the medical home: an algorithm for developmental surveillance and screening. Pediatrics. 2006; 118:405–20. [PubMed: 16818591]

27. Policy statement–Recommended childhood and adolescent immunization schedules–United States, 2010. Pediatrics. 2010; 125:195–6. [PubMed: 20048088]

28. Mattke S, Martorell F, Sharma P, Malveaux F, Lurie N. Quality of care for childhood asthma: estimating impact and implications. Pediatrics. 2009; 123(Suppl 3):S199–204. [PubMed: 19221164]

29. Newacheck PW, Strickland B, Shonkoff JP, et al. An Epidemiologic Profile of Children With Special Health Care Needs. Pediatrics. 1998; 102:117–23. [PubMed: 9651423]

30. Bieler GS, Brown GG, Williams RL, Brogan DJ. Estimating model-adjusted risks, risk differences, and risk ratios from complex survey data. Am J Epidemiol. 2010; 171:618–23. [PubMed: 20133516]

31. Benjamini, YaH Y. Controlling the False Discovery Rate: A Practical and Powerful Approach to Multiple Testing. Journal of the Royal Statistical Society 1995. 1995; B:289–300.

32. Stevens GD, Pickering TA, Laqui SA. Relationship of medical home quality with school engagement and after-school participation among children with asthma. The Journal of asthma : official journal of the Association for the Care of Asthma. 2010; 47:1001–10. [PubMed: 20831470]

33. Morales LS, Elliott MN, Weech-Maldonado R, Spritzer KL, Hays RD. Differences in CAHPS adult survey reports and ratings by race and ethnicity: an analysis of the National CAHPS benchmarking data 1.0. Health Serv Res. 2001; 36:595–617. [PubMed: 11482591]

34. Weech-Maldonado R, Morales LS, Spritzer K, Elliott M, Hays RD. Racial and ethnic differences in parents' assessments of pediatric care in Medicaid managed care. Health Serv Res. 2001; 36:575–94. [PubMed: 11482590]

35. Merikangas KR, He JP, Brody D, Fisher PW, Bourdon K, Koretz DS. Prevalence and treatment of mental disorders among US children in the 2001–2004 NHANES. Pediatrics. 2010; 125:75–81. [PubMed: 20008426]

36. Petterson SM, Phillips RL Jr, Bazemore AW, Dodoo MS, Zhang X, Green LA. Why there must be room for mental health in the medical home. Am Fam Physician. 2008; 77:757. [PubMed: 18853532]

37. Butler M, Kane RL, McAlpine D, et al. Integration of mental health/substance abuse and primary care. Evid Rep Technol Assess (Full Rep). 2008:1–362. [PubMed: 19408966]

38. Williams J, Klinepeter K, Palmes G, Pulley A, Foy JM. Diagnosis and treatment of behavioral health disorders in pediatric practice. Pediatrics. 2004; 114:601–6. [PubMed: 15342827]

39. Williams J, Shore SE, Foy JM. Co-location of mental health professionals in primary care settings: three North Carolina models. Clin Pediatr (Phila). 2006; 45:537–43. [PubMed: 16893859]

40. National Council For Community Behavioral Healthcare. Behavioral Health / Primary Care Integration and the Person-Centered Healthcare Home. 2009. (Accessed 9/27/11, at http://www.thenationalcouncil.org/cs/resources_services/resource_center_for_healthcare_collaboration/clinical/personcentered_healthcare_homes.)

41. Kathol RG, Butler M, McAlpine DD, Kane RL. Barriers to physical and mental condition integrated service delivery. Psychosom Med. 2010; 72:511–8. [PubMed: 20498293]

42. Institute of Medicine. Crossing the Quality Chasm: A New Health System for the Twenty-first Century. Washington, DC: The National Academies Press; 2001.

43. Smedley, BDSA.; Nelson, AR., editors. Unequal Treatment: Confronting Racial and Ethnic Disparities in Healthcare. Washington, DC: The National Academies Press; 2003.

44. National Commitee of Quality Assurance (NCQA). Standards and Guidelines for NCQA's Patient-Centered Medical Home (PCMH) 2011. (Accessed 9/27/11, at http://www.ncqa.org/tabid/631/default.aspx.)

45. Ulmer, CMB.; Nerenz, DR., editors. Race, Ethnicity, and Language Data: Standardization for Health Care Quality Improvement. Washington, DC: The National Academies Press; 2009.

46. Rittenhouse DR, Thom DH, Schmittdiel JA. Developing a policy-relevant research agenda for the patient-centered medical home: a focus on outcomes. J Gen Intern Med. 2010; 25:593–600. [PubMed: 20467908]

47. Varni JW, Limbers CA, Burwinkle TM. Parent proxy-report of their children's health-related quality of life: an analysis of 13,878 parents' reliability and validity across age subgroups using the PedsQL 4.0. Generic Core Scales Health Qual Life Outcomes. 2007; 5:2.

48. Shea S, Stein AD, Lantigua R, Basch CE. Reliability of the behavioral risk factor survey in a triethnic population. Am J Epidemiol. 1991; 133:489–500. [PubMed: 2000859]

49. Berwick DM. A user's manual for the IOM's 'Quality Chasm' report. Health Aff (Millwood). 2002; 21:80–90. [PubMed: 12026006]

50. Berenson RADKJ, Burton RA. Will the Patient-Centered Medical HomeTransform the Delivery of Health Care? Timely Analysis of Immediate Health Policy Issues. Aug.2011

Table 1

Quality of Care Measures for Specified Pediatric Populations

Quality of Care Measures	Population	Sample Size	Survey Questions
Preventive Medical Services: Received one or more preventive medical visits in the past 12 months[24]	All Children Ages 0–17	**n=85,270**	During the past 12 months, how many times did the child see a doctor, nurse, or other health care provider for preventive medical care such as a physical exam or well-child check-up?
Preventive Dental Services: Received one or more preventive dental visits in the past 12 months[25]	Children Ages 1–17	**n=81,152**	During the past 12 months, how many times did the child see a dentist for preventive dental care, such as check-ups and dental cleanings?
Unmet Medical Needs: One or more unmet health care needs in four areas (medical, dental, mental health, other)	All Children Ages 0–17	**n=85,777**	During the past 12 months or since birth, was there any time when the child needed health care but it was delayed or not received? (By health care, we mean medical care as well as other kinds of care like dental care and mental health services.)
Received Needed Mental Health Services: Receipt of treatment and/or counseling by a mental health professional during the past 12 months	Children with behavioral or development needs requiring treatment/ counseling Ages 2–17	**n=5885**	1 Does the child have any kind of emotional, developmental, or behavioral problem for which [he/she] needs treatment or counseling? 2 During the past 12 months, has the received any treatment or counseling from a mental health professional? (Mental health professionals include psychiatrists, psychologists, psychiatric nurses, and clinical social workers)
Provider Developmental History: Parent/guardian was asked by health care professional during the child's preventive medical visit in the past 12 months, if they had any concerns with the child's learning, behavior or development.[26]	Ages 0–5	**n=25,021**	During the past 12 months or since child's birth, did the child's doctors or other health care providers ask if you have concerns about [his/her] learning, development, or behavior? (This question was asked only for children age 0–5 who received preventive medical visits)
Formal Developmental Screening: Received both types of screening content Behavioral and Developmental, at two age ranges (10–23 months and 2–5 years), using a parent-reported screening tool or instrument during a health visit in the past 12 months[26]	Ages 10 mos. to 5 yrs.	**n=21,132**	During the past 12 months, did a doctor or other health care provider have you fill out a questionnaire about specific concerns or observations you may have about the child's development, communication, or social behaviors? *(ages 10 months to 5 years only)* If yes, then: 1 Did this questionnaire ask about your concern or observations about how the child talks or makes speech sounds? *(ages 10–23 months only)* 2 Did this questionnaire ask you about how the child interacts with you or others? *(ages 10–23 months only)* 3 Did this questionnaire ask about your concern or observations about words and phrases the child uses and understands? *(ages 24–71 months only)* 4 Did this questionnaire ask about your concern or observations about how child behaves and gets along with you and others? *(ages 24–71 months only)*
Tetanus Booster Vaccine: Receipt of tetanus booster vaccine since turning 11 in adolescents[27]	Ages 12–17	**n=31,929**	Did the child receive **Td or Tdap** shot since turning 11 years of age?
Meningitis Vaccine: Receipt of meningitis vaccination in adolescents[27]	Ages 12–17	**n=26,564**	Did the child receive a **Meningitis shot**, sometimes called MENACTRA or MENOMUNE?
Provider Recommended HPV Vaccination: Receipt of HPV vaccine recommendation by provider in adolescent girls[27]	Girls only Ages 12–17	**n=15,506**	Did a doctor or health care provider recommend that the child receive **HPV** shots?
Outcome Measure in Children with Asthma only			

Quality of Care Measures	Population	Sample Size	Survey Questions
Missed School Days[28]	School Aged Children with Asthma Ages 6–17	**n=5899**	During the past 12 months, about how many days did the child miss school because of illness or injury?

Table 2

Baseline Characteristics of US Children in Study Population and with Access to a Medical Home in 2007/2008

Variable	Total Population (n=91,642) *Pop est. 73,758,616*		
	% Children	**% Children with a Medical Home**	**P value**
Total		57.8	
Age-yr.			<0.001
0 – 5	30.1	64.0	
6 – 11	30.3	55.2	
12 – 17	39.6	53.4	
Sex			0.10
Male	51.9	56.8	
Female	48.1	58.2	
Race/ Ethnicity			<0.001
Hispanic	12.8	38.5	
White, non-Hispanic	68.1	68.0	
Black, non-Hispanic	9.9	44.2	
Multi/Other, non-Hispanic [*]	9.2	55.6	
Poverty Level			<0.001
< 100% FPL (Federal Poverty Level)	12.0	39.4	
100–199% FPL	17.0	49.4	
200–399% FPL	33.6	62.5	
400% FPL	37.4	69.3	
Insurance Status/Type			<0.001
Public (Medicaid/SCHIP)	21.8	45.4	
Private Health Insurance	70.7	66.5	
Uninsured	7.5	35.7	
Consistency of Insurance Coverage During Past 12 months			<0.001
Consistently insured	88.1	60.9	
Periods with no coverage	11.9	38.4	
Household Employment Status			
Unemployed	8.9	38.1	
Employed for at least 50 wks.	89.9	60.2	
Family Structure [†]			<0.001
Two Parent (biological or adopted)	69.9	62.2	
Two Parent (step family)	7.1	51.5	
Single Mother (no father present)	16.1	46.4	
Other [‡]	6.3	45.9	
Parental Education			
Mother			<0.001
Less than high school	7.5	34.3	

Variable	Total Population (n=91,642) *Pop est. 73,758,616*		
	% Children	% Children with a Medical Home	P value
12 yrs./high school graduate	18.4	51.6	
More than high school	66.7	65.7	
Father			<0.001
Less than high school	6.0	37.0	
12 yrs./high school graduate	17.9	55.6	
More than high school	54.7	67.7	
Primary Language			<0.001
English	92.7	61.7	
Language OTHER than English	7.3	28.8	
Children with Special Health Care Needs (CSHCN)			<0.001
Non- CSHCN	80.0	59.4	
CSHCN	20.0	49.8	
Geographic location by HRSA Region			<0.001
Region 1 (ME, VT, MA, RI, CT, NH)	11.7	65.3	
Region 2 (NY, NJ)	3.9	56.9	
Region 3 (PA, MD, DE, VA, WV, DC)	11.7	60.3	
Region 4 (KY, TN, NC, SC, GA, FL, AL, MS)	15.9	58.4	
Region 5 (MN, WI, IL, IN, MI, OH)	11.9	61.6	
Region 6 (NM, TX, OK, AR, LA)	9.9	52.0	
Region 7 (NE, KS, IA, MO)	7.9	65.1	
Region 8 (MT, ND, SD, WY, CO, UT)	11.6	61.1	
Region 9 (NV, CA, AZ, HI)	7.8	49.6	
Region 10 (WA, OR, ID, AK)	7.7	60.0	

[*]
Non-Hispanic children reporting only one race category of Asian, American because of small sample sizes in many states; Non-Hispanic children who reported more than one race are categorized as "Multi-racial". Given the small frequencies in both these categories, they are combined here as "Multi/Other", Non-Hispanic.

[†]
"Family structure" refers to parents living in the household. Any of the four family structure categories may include other people who act as parents, such as grandparents, aunts, uncles, or unmarried partners of the parents.

[‡]
Households identified as having two mothers of the same type (biological, step, foster, or adoptive) were classified as "other family structure." However, because of this ambiguity about whether the respondent was also counted as another parent in the household, these households may actually be "single mother" households. Other households with ambiguous structure (e.g., where a father refused to indicate whether he was the biological father) were also coded as "other family structure"

Table 3

Adjusted Rates in Selected Measures of Quality of Care Between Children with and without a Medical Home

Quality of Care Indicators	No Medical Home n=33,369 *Pop est. 29,981,563*	Medical Home n=54,393 *Pop est. 40,602,330*	P Value
	Adjusted [*] Rates % (SE)		
Preventive medical services	87.8 (0.4)	89.8 (0.3)	<0.001
Preventive dental services	79.1 (0.5)	77.9 (0.5)	0.08
Unmet medical needs	10.6 (0.4)	3.3 (0.2)	<0.001
Received needed mental health services	63.3 (1.8)	54.2 (2.5)	<0.01
Provider obtained development history (Age 0–5)	41.7 (1.3)	52.0 (1.1)	<0.001
Formal developmental screening (Age 0–5)	17.7 (1.0)	21.1 (0.9)	0.02
Tetanus booster (Age 12–17)	84.3 (0.7)	85.8 (0.6)	0.12
Meningitis vaccine (Age 12–17)	38.4 (1.2)	39.4 (1.0)	0.54
Provider recommended HPV (Girls Age 12–17)	27.5 (1.4)	34.7 (1.3)	<0.001
	No Medical Home n=3430 *Pop est. 3,188,584*	**Medical Home n=4244** *Pop est. 3,229,648*	
	Adjusted [†] Mean	**Number of Days (SE)**	**P Value**
Number of Missed School Days in Children with Asthma (Age 6–17)	7.5 (0.4)	5.7 (0.3)	<0.001

[*] Adjusted for sex, gender, race, categorical age (except in measures with narrow age ranges), insurance type, consistency of insurance over a 12 month period, income level, maternal education level, primary language, family structure, household employment, geographic region and children with special health care needs (CSHCN).

[†] Adjusted for asthma severity, categorical age (6–11, 12–17), gender, race, insurance type, consistency of insurance over a 12 month period, income level, maternal education level, primary language, family structure, household employment, geographic region and children with special health care needs (CSHCN).

Table 4

Adjusted Rates and Risk Differences for Quality of Care Measures by Race/Ethnicity

Quality of Care Indicator by Race/ethnicity	No Medical home n=33,369	Medical Home n=54,393	Adjusted Risk Difference (SE)	P Value
	Adjusted [*] Rates% (SE)			
Preventive Medical Services				
White	85.5 (0.7)	89.6 (0.4)	4.1 (0.7)	<0.001
Black	90.8 (0.8)	92.4 (0.9)	1.6 (1.2)	0.18
Hispanic	88.7 (1.2)	90.2 (1.0)	1.5 (1.5)	0.33
Unmet Medical Needs				
White	11.2 (0.6)	3.5 (0.3)	−7.7 (0.7)	<0.001
Black	9.0 (0.8)	2.8 (0.5)	−6.2 (0.9)	<0.001
Hispanic	10.3 (1.2)	3.1 (0.6)	−7.2 (1.3)	<0.001
Provider development history (Age 0–5)				
White	45.0 (1.8)	53.4 (1.3)	8.4 (2.0)	<0.001
Black	36.3 (2.8)	45.5 (2.8)	9.3 (3.8)	0.01
Hispanic	41.2 (3.3)	52.8 (3.2)	11.6 (4.6)	0.01
	No Medical Home n=3430	Medical Home n=4244	Adjusted Risk Difference (SE)	P Value
Number of Missed School Days in Children with Asthma (Age 6–17)	Adjusted [†] Mean Number of Days (SE)			
White	9.4 (0.8)	6.1 (0.3)	−3.3(0.8)	<0.001
Black	5.0 (0.5)	4.7 (0.6)	−0.3 (0.8)[‡]	0.68
Hispanic	6.7 (0.7)	7.2 (0.9)	0.6 (1.1)[‡]	0.60

[*] Adjusted for sex, gender, race, categorical age (except in measures with narrow age ranges), insurance type, consistency of insurance over a 12 month period, income level, maternal education level, primary language, family structure, household employment, geographic region and children with special health care needs (CSHCN).

[†] Adjusted for asthma severity, categorical age (6–11, 12–17), gender, race, insurance type, consistency of insurance over a 12 month period, income level, maternal education level, primary language, family structure, household employment, geographic region and children with special health care needs (CSHCN).

[‡] Difference in risk difference between this group and reference (white children) is statistically significant ($p<0.05$)

Table 5

Associations between Children With and Without Subcomponents of Medical Homes and Achieving Quality Indicators

	Preventive Medical Services	Unmet Medical Needs	Received Needed Mental Health Services	Provider Development history (Age 0–5)	Formal Developmental screening (Age 0–5)	Provider Recommended HPV (Girls Age 12–17)
			Process Quality of Care Measures Found Significant in Primary Analysis			
			Adjusted Rates % (SE)			
Medical Homes Subcomponents						
Personal Provider						
No	79.8 (1.1)	8.9 (0.9)	58.6 (5.2)	42.2 (2.7)	18.6 (2.1)	20.0 (2.6)
Yes	89.4 (0.3)	6.6 (0.2)	60.2 (1.6)	48.6 (0.8)	19.8 (0.6)	32.2 (1.0)
p	<0.001	=0.006	=0.76	=0.03	=0.6	<0.001
Usual Source of Care						
No	78.9 (1.4)	8.1 (0.8)	46.0 (5.7)	38.4 (3.5)	17.2 (2.6)	22.4 (3.5)
Yes	89.3 (0.3)	6.8 (0.2)	61.4 (1.6)	48.7 (0.8)	19.8 (0.7)	32.0 (1.0)
p	<0.001	=0.11	=0.008	=0.006	=0.36	=0.02
Received Family Centered Care [*]						
No	88.5 (0.5)	11.0 (0.5)	61.6 (2.2)	37.6 (1.5)	16.1 (1.1)	26.7 (1.8)
Yes	93.0 (0.3)	4.4 (0.2)	60.5 (2.1)	52.1 (1.0)	21.1 (0.8)	35.2 (1.2)
p	<0.001	<0.001	=0.73	<0.001	=0.001	<0.001
Received Effective Care Coordination When Needed [†]						
No	93.9 (0.5)	20.9 (1.0)	70.5 (2.0)	48.5 (2.4)	19.7 (1.8)	33.0 (2.2)
Yes	95.2 (0.3)	4.9 (0.4)	68.8 (2.2)	53.4 (1.6)	25.1 (1.5)	38.7 (1.6)
p	p=0.02	<0.001	=0.54	=0.07	=0.02	=0.04
Obtained Needed Referrals Without Difficulty [†]						
No	93.6 (0.8)	37.5 (2.1)	63.7 (3.8)	54.2 (3.9)	30.9 (4.2)	32.3 (3.8)
Yes	92.9 (0.6)	11.3 (0.8)	66.4 (3.0)	59.7 (2.0)	26.5 (1.9)	37.9 (2.4)
p	p=0.57	p<0.001	p=0.50	p=0.19	p=0.31	p=0.21

[*] Excluded children who did not use services in past 12 months (2.8%)

[†]Excluded children who did not meet the threshold for assessing care coordination (58.0%). Threshold criteria include children that used or needed 2 or more of the following services in past 12 months: preventive medical care, preventive dental care, mental health care, or subspecialty care

[‡]Excluded children that did not need a referral in the past 12 months to see any doctors or receive any services (83.5%).