

Using the National Survey of Children’s Health to Examine Medical Home Effects on Asthma Hospitalizations for Vulnerable Children

Final Report

Gregory D. Stevens, Ph.D., M.H.S.

Trevor Pickering, M.S.

Kai-Ya Tsai, M.S.P.H.

I. Introduction

A. Nature of the research problem

As many as 6.5 million children in the United States have been diagnosed with asthma and are reported to currently have the disease. The burden of asthma in childhood is tremendous, accounting for about 730,000 emergency department visits and 190,000 hospitalizations each year, and costing more than \$850 million annually.¹ This burden is even greater for vulnerable children, where rates of emergency visits and hospitalizations are double or triple among the poor, racial/ethnic minorities and the uninsured.²⁻⁷

Children with asthma are recommended to seek a medical home provider. The concept of a medical home is to establish an ongoing relationship between the provider and patient to allow them to better manage the asthma and coordinate care when the child requires care from one or more specialists. The concept of a medical home is a key focus of pediatric practice for children with special health care needs (CSHCN),⁸ and Healthy People 2010 specifically monitors the extent to which children have a “specific regular source” of ongoing primary care.⁹

The American Academy of Pediatrics (AAP) describes seven features of a medical home. A medical home should be accessible, continuous, comprehensive, coordinated, family-centered, compassionate, and culturally effective.¹⁰ The first four features are core characteristics of a medical home. The provision of these features has been linked with fewer emergency department visits, lower health care costs, and better health outcomes.¹¹ The other features have been less well studied for their long-term benefits to children, but are widely promoted.

The current study aims to understand what role a medical home may play for children with asthma, particularly with regard to reducing the need for hospitalization. There are three specific research questions that were addressed:

- To what extent are there disparities in cardinal features of a medical home?
- How do state-level policy variables affect cardinal features of a medical home?
- Are cardinal features associated with reports of asthma hospitalizations?

B. Purpose, scope, and methods of the investigation

The current study uses data from the 2003 National Survey of Children’s Health to examine the prevalence of having a high quality medical home according to the AAP definition in a nationally representative sample of children who currently have asthma. The study specifically assesses whether:

- Differences exist in a quality medical home according to a set of demographic risk factors: race/ethnicity, poverty status, parent education level, insurance

status, and language. The experiences of those with multiple risks are analyzed with a “risk profile” index developed for vulnerable children.

- Two policy level variables are associated with reports of having a quality medical home: State Title V spending on CSHCN and provider to patient ratios.
- A relationship exists between having a medical home and all of its key domains with reports of asthma hospitalizations and non-accident, injury or poisoning emergency visits.

C. Nature of the findings

This study finds large national disparities in the prevalence of a quality medical home for children with asthma. The higher the number of risk factors a child has, the lower the likelihood of having a quality medical home. The disparities were particularly prevalent for uninsured children and those in or near poverty. A lower ratio of providers to child population (i.e., lower provider availability) at the state level was associated with a lower prevalence of having a quality medical home, but no similar association for Title V spending was found. Better medical home scores were not significantly associated with reports of asthma hospitalizations, but were associated with a lower likelihood of an emergency visit among children with asthma and a lower burden of asthma on the family.

II. Review of the Literature

There are likely to be considerable disparities in having a quality medical home for children with asthma, as previous studies have shown racial and ethnic, socioeconomic, and insurance related disparities in children having a regular source of care, a component of establishing a medical home.¹²⁻¹⁶ Several studies have examined similar disparities in discrete characteristics of primary care for children, such as the accessibility of care and continuity of the patient-provider relationship.¹⁷⁻¹⁹

Two studies have examined disparities in the prevalence of a medical home in a nationally representative sample of CSHCN. These studies found that only 50% received care that met established criteria for the medical home characteristics that were studied. The studies also showed that the likelihood of having a quality medical home was lower for racial/ethnic minorities and those with lower socioeconomic status.^{20, 21} Such findings have also been replicated in two states.^{22, 23} There have been no estimates of the national prevalence of, and disparities in, having a medical home for children with asthma.

Conceptual and empirical work has validated a method for measuring child vulnerability through the use of child *risk profiles*.¹ These profiles have proven useful in understanding disparities in primary care experiences (and thus having a medical home),²⁻⁴ but still little is known about how risk profiles moderate the linkage between having a medical home and child health-related outcomes. Stevens and Seid have demonstrated that a limited set of medical home features do vary by risk profile in a sample of children from California.²

III. Study Design and Methods

¹ *Risk profiles*, described in full in the “variable specification section” below, are a methodology that counts well-known child risk factors for poor health outcomes. In this study, the risk profiles are based on race/ethnicity, poverty status, parent education level, child health insurance status, and language spoken at home.

A. Study design

This study uses nationally representative secondary data from the 2003 National Survey of Children's Health (NSCH) conducted by the National Center for Health Statistics and the Federal Maternal and Child Health Bureau. NCHS draws the sample from the State and Local Area Integrated Telephone Survey, which employs a random-digit-dial technique. Households were sampled so that about 2,000 interviews were conducted in each state. More information is available in a methodology report.²⁴

In order to weight the data to reflect actual state and national child populations, a sampling weight was assigned to each response to account for several factors. A base weight was obtained, equal to the reciprocal of the probability of the particular phone line being sampled in a given state, and was adjusted for multiple household telephone lines, multiple children in the household, and non-response due to unknown household status and unknown household eligibility. This weighting allows us to produce nationally representative prevalence estimates of a medical home for children with asthma.

B. Population studied

The survey was conducted from January 2003 to July 2004. It contains 102,353 completed interviews obtained with a response rate of 55.3%. Households containing at least one child <18 years of age were eligible, and one child was selected at random as the subject of the interview.

C. Sample selection

Subjects were included in our analyses only if they reported ever having been told they had asthma by a doctor or health professional and if the child "still has asthma". In the sample, 12,202 children (12.4% of the national population) had ever been diagnosed with asthma and 8,689 (8.8%)—our final analytic sample—reported still having asthma. The adult most knowledgeable about the child's health was asked to respond; in 96% of the interviews this was one of the child's parents.

D. Instruments used

Child Risk Factors: This study examines five child risk factors for poor health care access and quality. They are based on child race/ethnicity, family poverty status, parent education level, child health insurance coverage, and family language spoken at home. The categories considered to be "risk" include: 1) non-white race/ethnicity, 2) income <200% of the Federal Poverty Level (FPL) as calculated from reported family income and size by NSCH staff, 3) highest household education level < high school, 4) child uninsured status, and 5) not speaking English at home.

Child Risk Profiles: To summarize the risk factors a child experiences and their collective impact on the presence of a quality medical home, risk factors are combined into an index of risk (or "risk profile") that is a count of the co-occurring risk factors, in this case ranging from zero (meaning the child has no risk factors) to 4+ (the child has four or five risk factors, combined to assure a sufficient analytic sample size).

Medical Home Total Score and Its Cardinal Features: Five features of a medical home were measured: *accessibility, continuity, comprehensiveness, family-centered care, and coordination of care.* The measures selected for evaluating the quality of a medical home are based on the work of Bethell, Reed, and Brockwood, whose work provided the foundation for the inclusion of medical home questions in NSCH.²⁹ The NSCH assessed culturally effective care with questions about the availability of an interpreter, but these were applicable to less than 2% of the study sample, which was too small for analysis.

Each of the five features of a quality medical home was measured using one to four survey questions (see Appendix 1). Each question was assigned a score from 0 to 100, with 100 reflecting the best possible medical home. For questions containing $J + 1$ possible ordered responses (with J being the value for the best response and 0 the worst response), a given response j was assigned a score as:

$$MH = \frac{j}{J} \times 100$$

For example, if there were four possible responses to a question (e.g., never, sometimes, usually, and always) they were scored as follows: never=0, sometimes=33, usually=67 and always=100. A summary value for each medical home feature was computed as the average of all non-missing questions in each feature. A total medical home score was calculated by averaging all non-missing values of each of the features (i.e. an average of the averages). We defined a score of 67 as the cut-off criteria for having a “poor-quality” medical home for each feature and overall, reflecting a response of *usually* or less to most medical home questions.

The total medical home score was based on *at least* three of the medical home features—accessibility, continuity, and comprehensiveness—to which all individuals responded. At least half of the questions for each feature must have been answered in order to compute an average value for the feature. Some questions, however, were not applicable to certain children and were deemed as legitimate skips that counted towards this requirement. About 12% of children with asthma did not have a personal doctor and thus legitimately skipped questions about family-centered care; 58% of children did not have a personal doctor or did not see a specialist, and skipped questions on coordination.

State Title V Spending on CSHCN: Dollars spent on CSHCN were available from the MCHB for the 2003-2004 fiscal year to match the survey data collection period, and the variable was constructed as dollars spent per child ages 0-17 via census data.

Health Professional Shortage Areas: Data on the number of HPSAs from 2003-2004 in each state was available from the Bureau of Health Professions. Using U.S. census data on the total population of children (ages 0 to 17) in each state, a ratio was calculated that reflects the total number of HPSAs per 100,000 children in each state.

Adverse Outcomes: This study examined three separate adverse outcomes for children with asthma. They include (in the past 12 months): any overnight asthma hospitalization in the past year, any non-accident, injury, or poisoning (non-AIP) emergency department visit in the past year, and the reported burden of the child’s asthma on the family. Burden was categorized into any reported burden vs. no burden. All of the adverse outcome variables were self-reported and measured dichotomously.

Covariates: Several variables were considered as possible confounders of the relationship between medical home score and adverse outcomes, and were considered during model building. These covariates included measures of child age (continuous in years), gender, race (white vs. non-white), poverty (greater or less than 200% of the federal poverty level), insurance status (yes/no), parental education (high school graduate vs. less than high school), household language (English vs. other), parent employment status (someone in the household worked outside the home at least 50 weeks in the past year vs. not), and geographic region.

E. Statistical techniques employed

Univariate Analyses: Analyses, including descriptive statistics, were computed using Stata10. Survey procedures were invoked for all analyses to account for the complex survey design and sampling. Descriptive statistics are provided for the national child population with asthma including child demographics, risk factors and risk profiles.

Bivariate Analyses: The distribution of medical home scores (both overall and feature-specific) was non-normal, so medical home scores were dichotomized above and below the median score. The bivariate relationship of child demographics, risk factors and profiles with the proportion below a score of 67 is presented. The relationship of the total medical home

Multivariable Analyses: Multiple logistic regression was used to examine the relationship between individual risk factors and the proportion of the population below a score of 67 for the total medical home score and the five medical home features. Each risk profile was tested for statistical significance against zero risks and also its preceding profile (by changing the prior profile to be the reference group) to examine whether a dose-response relationship exists. A similar analyses was completed for the relationship between the total medical home score and five medical home features, and the adverse outcomes. In all cases, results were adjusted for study covariates, and odds ratios (OR) and 95% confidence intervals (CI) are presented.

IV. Detailed Findings

▪ Disparities in the cardinal features of a medical home?

Nationally, a large proportion of children with asthma are at-risk for poor access and quality of care. Almost half (46.6%) of children with asthma are in families with income <200% of FPL and 44.9% is non-white. Nationally, 5.7% of children with asthma are uninsured, 6.9% live in a family where English is not spoken as the primary language, and 7.4% live in a household where no adult has graduated from high school. Many children experience multiple risk factors. Nearly one-third (32.0%) have one risk factor, 23.1% have two, 7.6% have three, and 2.6% have four or five.

Without adjustment for other factors, each risk factor is strongly associated with having a quality medical home. For example, being uninsured was associated with a 26.4 percentage point increase in the proportion of children with a poor-quality medical home (35.8% vs. 9.4% for the insured, $p<.0001$). Similarly, living in a family with income <200% of FPL was related to a 9.1 percentage point increase in the proportion of children with a poor-quality medical home (15.8% vs. 6.7% for those with income >200%, $p<.0001$). Geographic region and employment status, but not general health status and presence of an activity limitation, were associated with a poorer quality medical home. Nearly one-third (29.7%) of children with 4+ risk factors had a poor-quality medical home vs. 4.5% for those with no risks ($p<.0001$ overall).

In multivariable analyses, many risk factors (except having < high school education and living in a non-English speaking household) were associated with a higher likelihood of having a poor-quality medical home overall: income <200% FPL [Odds Ratio (OR)= 2.21, 95% Confidence Interval (CI): 1.67-2.93], being uninsured (OR=5.01, CI: 3.40-7.40), and non-white ethnicity (OR=1.71, CI: 1.32-2.20). The risk factors were most consistently related with both continuity and comprehensive care, and not at all (or even inversely) related with coordination. Living in a non-English speaking household

was associated with a higher likelihood of poor-quality for accessibility (OR=1.81, CI: 1.01-3.23), whereas non-white race/ethnicity was not.

After adjustment for other factors, there was a gradient in the likelihood of having a poor-quality medical home according to the number of risk factors that a child has. Compared to zero risks, children with one risk had 2.32 higher odds (CI: 1.66-3.24) of having a poor-quality medical home, with greater odds for children with each increase in the number of risks: two risks (OR= 4.43, CI: 3.16-6.21), three risks (OR= 9.38, CI: 5.21-16.89), and four or five risks (OR= 11.66, CI: 5.44-25.03). This gradient was demonstrated strongly for continuity, comprehensiveness, and accessibility of care, and less clearly present for the other medical home features.

▪ **How do policy variables affect cardinal features of a medical home?**

Overall, a higher exposure to HPSAs (i.e., measured by an increase of HPSA per 100,000 child population in a given state) was associated with a lower likelihood of a quality medical home (OR=0.93, CI: 0.91-0.95), including each of the features except for coordination of care. Higher Title V spending on CSHCN (i.e., an increase of \$100 per child in a given state) was also associated with a lower likelihood of a quality medical home (OR=0.98, CI: 0.96-0.99) and each of the cardinal features except coordination of care. It is not clear why higher spending on CSHCN is negatively associated with medical home, but it is possible that higher spending on CSHCN reflects states that have higher levels of diversity and poverty (and thus higher rates of CSHCN), and these factors are associated with poorer access to primary care in general. We are continuing to examine this relationship further.

▪ **Are cardinal features associated with reports of asthma hospitalizations?**

Overall, total medical home score was not associated with reports of asthma hospitalizations in the past year (OR=1.12, CI: 1.05-1.19). This held both before and after adjustment for the study covariates, including measures of health status and asthma severity. However, better coordination of care was strongly associated with a higher likelihood of asthma hospitalization even after controlling for health status and asthma severity (OR=1.62, CI: 1.18-2.06).

Medical home, however, was predictive of lower rates of emergency department visits (excluding those for accidents, injuries, or poisonings). The total medical home score was inversely associated with an emergency department visit in the past year (OR=0.79, CI: 0.65-0.96). The combined measure of access/continuity was the key contributor to this lower emergency department visit rate (OR=0.67, CI: 0.54-0.83); comprehensiveness, family-centered care, and coordination were not associated with emergency visits at all. This held before and after adjustment for the study covariates.

Finally, a higher medical home total score was associated with a lower reported burden of asthma on the family (OR=0.82, CI: 0.70-0.96). Again, the combined measure of access/continuity was the key contributor to the lower emergency department visit rate (OR=0.75, CI: 0.62-0.91) though each of the other features of a medical home showed a similar, but non-statistically significant association.

V. Discussion and Interpretation of Findings

A. Conclusions to be drawn from findings

This study demonstrates large national disparities in the prevalence of a quality medical home for children with asthma. That the disparities are particularly prevalent for

uninsured children and those in or near poverty, both risk factors modifiable via public policy, suggests that health care reforms to expand the number of children with health insurance coverage and programs to help lift families out of poverty will be essential to ensuring that all children establish and maintain a quality medical home.

Furthermore, the relationship between the number risk factors a child has and the proportion with a poor-quality medical home reveals a dose-response like gradient, with a ten-fold difference between the lowest and highest risk children. Even among children with zero risks, 4.5% (or about 50,000 children nationally) did not have a quality medical home by our definition, suggesting that difficulties establishing a quality primary care medical relationship are not limited entirely to vulnerable children.

These disparities are meaningful because this study also showed that a higher medical home score was associated with a lower rate of emergency department visits in the past year and a lower reported burden of asthma on the family. Both measures are potentially strong indicators of better-controlled asthma, resulting in fewer instances of acute asthma episodes that may have resulted in higher cost emergency care. Likewise, a lower burden of asthma on the family among children with a quality medical home may be important for family functioning, including reducing days that parents are absent from work to care for the child, potentially lower out-of-pocket costs, etc.

B. Explanation of study limitations

There are several limitations to this study. First, the data are cross-sectional and do not demonstrate causality between the risk factors and medical home quality. Second, even after weighting the data for non-response, the moderate response rate of 55% does not allow us to rule out the possibility of some selection bias, though the direction of a bias is not clear. Third, the measure of emergency department visits was not specific to asthma, and so it cannot be assumed that all emergency visits were asthma related.

Fourth, our choice of the a score of 67 out of 100 for indicating a quality medical home might underestimate existing disparities because it represents a relatively low cut-off point and captures only those with the poorest quality. It could be argued that a score equating to “usually” having these characteristics might also be an indicator of poor quality since it does not represent an ideal medical home that “always” provides quality care across all of the cardinal features. However, re-running the analysis using higher cut-offs such as 87 (a mid-way point between “usually” and “always”) or even a perfect medical home score of 100 points vs. else yields similar results, suggesting that the size or patterns of these disparities is not an artifact of the cutoff score.

Fifth, there was a relationship between better coordination of care and a higher likelihood of asthma hospitalization. This was not an expected finding because one would expect that better coordination would lead to better management of asthma. It is possible that there may be an endogenous relationship here, however, that leads those children requiring a higher level of coordination to require a higher level of care, in this case hospitalization. Thus, even though better coordination might be protective, this was not detected because of the overwhelming severity-driven need for coordination and use of higher levels of care.

C. Comparison with findings of other studies

Lacking health insurance coverage and being low-income (particularly when they are both present) were among the strongest predictors of lacking a quality medical home. As with many other previous studies showing the relationship between these factors and

aspects of access, quality, and outcomes of care,³⁸⁻⁴¹ the results of this study suggest that disparities in having a quality medical home would likely be very amenable to policies to expand insurance coverage for children and to those that reduce the burdens of poverty.

There were no other studies comparing overall medical home with lower rates of hospitalization or other adverse utilization events. However, several medical home features (accessibility and continuity of care) have been previously, strongly linked with fewer emergency department visits, lower health care costs, and better health outcomes among children generally.¹¹³³⁻³⁷

D. Possible application of findings to actual MCH health care delivery

Having a quality medical home may be particularly important for those children with more severe asthma, due to the higher level of care coordination that is likely to be required. That poorer health was associated with a better quality coordination of care is, thus, a reassuring finding. Also, it was found that care coordination was better among non-whites, suggesting that pediatric health care providers may not only be targeting their efforts at coordinating care to those with more severe asthma, but children who are more vulnerable based on race/ethnicity and may need the most assistance with scheduling and following-up on visits.

Nonetheless, our findings that 13.6% of children who have severe asthma and 11.9% of those in fair or poor health status had a poor-quality medical home are very troublesome. Nationally, this translates into roughly 80,000 children in fair or poor health and 40,000 children with severe asthma who had a medical home provider that only *sometimes or never* provides the cardinal features. This is important because these sicker children are higher users of emergency services.³⁰⁻³²

While medical home was not associated with fewer asthma hospitalizations in our study, it was found to be statistically-significantly associated with fewer emergency department visits and a lower burden of asthma on the family. These potential benefits of a medical home suggest the need for efforts to promote a medical home model for those children with special health care needs, such as those with asthma.

The relationship between living in a state with more HPSA designations was suggestive of a relationship between poor primary care provider availability and a lower likelihood of having a quality medical home. This relationship has face validity and is in-line with recommendations to increase primary care capacity in underserved areas, but is limited by the absence of more detailed geographic data on patient-provider ratios.

E. Policy implications

While a protective relationship of medical home with asthma hospitalizations was not found, there was an observed relationship with non-accident, injury or poisoning-related emergency department visits and with reported burden of asthma on the parents. These findings suggest some potential benefits of a medical home for children, one of which may have major cost implications. As reported earlier, there are at least 700,000 emergency visits that occur annually due to asthma among children. Reducing these by even a fraction would result in substantial cost savings to the health care system.

There are now many strategies for promoting a quality medical home, including provider, facility, and patient-based trainings (since the relationship that occurs within a medical practice is influenced by all of these parties). It is not clear what trainings are most effective, but our findings would suggest that those which focus on improving the accessibility of the practice (including the ability to get needed care right away and the

ability to make contact with physicians by telephone) and those which help to assure the continuity of the patient-provider relationship would be particularly beneficial among children with asthma.

Finally, this study found large national disparities in the prevalence of a quality medical home. That the disparities are particularly prevalent for uninsured children and those in or near poverty, both risk factors modifiable via public policy, suggests that health care reforms to expand the number of children with health insurance coverage and programs to help lift families out of poverty will be essential to ensuring that all children establish and maintain a quality medical home. Nonetheless, it is clear that the reasons for lacking a quality medical home remain multi-factorial and that equity will only fully be achieved by addressing a fuller complement of risk factors.

F. Suggestions for further research

There are two clear research needs that emerge from this study. First, there is a need to attempt to understand and deconstruct the potentially endogenous relationship between medical home and asthma hospitalizations that might explain the absence of a relationship between medical home and asthma hospitalizations. We initially tried to assess whether this relationship existed using an instrumental variables analysis, but were unsuccessful in extracting the severity-related endogeneity we anticipated. Efforts to explore this area may benefit future health services research, particularly since there is now growing interest in examining the impact of quality of care (and variations in the delivery of care) on health and utilization outcomes, much like our work here.

Second, there is a need to further measure the impacts of a medical home on non-health care utilization aspects of family life, and the child's life in particular. As for other special health care needs, assuring that children with asthma are able to function well in many aspects of life, with particular attention to functioning and achievement in school (including readiness to learn) is a long-term goal of assuring a quality medical home. A range of efforts to assess the relationship of a medical home with these aspects of quality of life would be an important consideration for practice, but certainly for policy as well.

VI. List of products

The following articles from this study have been submitted to peer-reviewed journals and are at various stages of publication:

- Stevens GD, Seid M, Pickering TA, Tsai KY. National disparities in the quality of a medical home for children. *Maternal and Child Health Journal* (Stage: In Press, 2009).
- Stevens GD, Pickering TA, Seid M, Tsai KY. Disparities in the national prevalence of a quality medical home for children with asthma. *Ambulatory Pediatrics*. (Stage: Revise and Resubmit Oct. 2008)
- Stevens GD, Seid M, Pickering TA, Tsai KY. Relationship of medical home quality and adverse utilization events for children with asthma. (Stage: Under Review: Pediatrics)

- Stevens GD, Pickering TA, Tsai KY. Does a quality medical home reduce the burden of childhood asthma on families? (Stage: Final internal review. To be submitted January 15th, 2009 to Journal of Pediatrics)

We have an additional article under development regarding statistical imputation methods we used in preparing the previous manuscripts. We presented the preliminary findings at the American Public Health Association annual meeting in San Diego on Nov. 5th, 2008.

- Tsai KY, Pickering TA, Stevens GD. Strategies for imputing child poverty level in national survey data. (Platform Presentation).