



# The Impact of the Patient-Centered Medical Home on Asthma-Related Visits to the Emergency Room: A Fixed Effects Regression Approach

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Published online: 14 December 2018  
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## Abstract

**Objective** To estimate the effect of a patient-centered medical home (PCMH) intervention on asthma-related emergency room (ER) visits of pediatric patients. **Methods** Patients receiving care at pediatric primary care practices participating in the Florida Pediatric Medical Home Demonstration Project as well as pediatric patients treated at non-participating clinics were identified from 4 years of claims and enrollment data. We estimate several fixed effects logistic regression models using one pre-treatment year and three post-treatment years to investigate whether asthma-related ER visits decreased because of the PCMH intervention. **Results** The estimation suggests that the intervention did have a negative effect on asthma-related ER visits in the earlier part of the intervention (OR 0.34; 95% CI 0.16–0.73). However, this effect was not detected in the later years. Because fixed effects models require repeated observations on the same individual, we believe our estimations of the PCMH model's impact is more accurate than previous studies. **Conclusion for Practice** Reducing asthma ER visits is a task that might be immediately actionable for PCMH practices, or those undergoing transformation. Our results adds to the others suggesting positive impacts of the PCMH.

**Keywords** Patient-centered medical home · Pediatric · Emergency room · Asthma

## Significance

*What is Already Known on This Subject* Past empirical studies seem to suggest medical home interventions lead to a decrease in ER visits. However, most of these studies are cross-sectional and none use a sample of exclusively pediatric patients.

*What This Study Adds* We use repeated observations of the same pediatric patients over time to find that a medical home intervention caused a decline in asthma-related ER visits in the early part of the intervention but this decline was undetectable in later years.

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## Introduction

In recent years, the patient-centered medical home (PCMH) has become one of the most popular health care delivery models promoted to transform traditional primary care in the US. The PCMH has become important in the national effort to improve primary care in order to lower health care costs and improve quality. According to the American Academy of Pediatrics (AAP 2002), the six fundamental tenets of the PCMH model of healthcare are: “accessible, continuous, comprehensive, family centered, coordinated, compassionate, and culturally competent.” The PCMH has been promoted in recent state and federal legislation that seek to improve the quality of care. For example, as part of the provision in the Children’s Health Insurance Reauthorization Act (CHIPRA) of 2009 to improve health care delivery by a provider-based model, several participating states chose to adopt the PCMH model. Additionally, the Patient Protection and Affordable Care Act of 2010 encourages the adoption of the Accountable Care Organizations (ACO) model, and PCMHs form the core of ACOs (Cassidy 2010).

Because of its growing importance in health care legislation, there have been numerous studies evaluating

the performance of PCMHs. One of the most common approaches that has been used to document the effect of the PCMH has been to study the number of emergency room (ER) visits (Hoff et al. 2012). The expectation is the number of ER visits will be reduced through better primary care, thereby reducing total health care costs. There have been a number of studies examining the effect of a PCMH on ER visits.<sup>1</sup> Most of these studies suggest that ER visits seem to decrease with PCMH intervention anywhere between 4 and 29% (Hoff et al. 2012). Among the studies that reported a decrease in ER visits with a PCMH intervention, nearly all were cross-sectional. Out of the few existing longitudinal analyses, four notable studies are David et al. (2015), Friedberg et al. (2014), Fifield et al. (2013) and Rosenthal et al. (2013). All the PCMH intervention practices in these four studies were either a mixture of family practices, internal medicine practices and pediatric practices or only adult primary care practices. None of the studies examined pediatric practices exclusively. Additionally, all are general to the ER meaning that no specific findings exist to help manage disease.

The present study investigates the effect of a Florida-based PCMH intervention on asthma-related ER visits of pediatric patients, and makes two contributions to the literature. First, unlike the four previous studies mentioned, all the practices in the study are pediatric. Therefore, our findings give new insights about the effect of a PCMH intervention on ER utilization for a pediatric patient population. Second, the study investigates whether the asthma-related ER visits of pediatric patients have significantly decreased after a PCMH intervention using a fixed effects logistic regression model. The fixed effects model requires repeated observations, one at pre-treatment and the other at post-treatment, on the same patient to estimate the effect of the PCMH intervention. Because the PCMH is meant to be a continuous model of care, the longitudinal design of this study provides more accurate measurement of the effect of PCMH on ER visits than previous studies.

## Methods

### Florida Pediatric Medical Home Demonstration Project

The Florida Pediatric Medical Home Demonstration Project is a 5-year program funded by the Centers for Medicare and Medicaid Services (CMS) as part of CHIPRA. Recruitment of pediatric practices for the project involved

an application process that began in 2011. Twenty of the pediatric primary care practices who applied were selected and began the medical home transition in August 2011. A Learning Session was held in September 2011. During this 2-day session, practices received educational content from the AAP as well as state and national PCMH experts. After the session convened, practices began a 16-month long facilitated transformation in October 2011. Activities during this period included monthly conference calls, three additional face-to-face learning sessions, collection of monthly quality improvement data, and one-on-one mentorship by PCMH experts.<sup>2</sup> Over the course of the project, three practices dropped out and one closed down. The current study includes the 16 pediatric primary care practices that remained over the course of the project.

In regards specifically to the improvement of care and reduction in hospital admissions of asthmatic pediatric patients, the PCMH intervention stressed the adoption of person and family engagement (PFE) strategies by the demonstration practices. For all pediatric patients and families, a patient and family advisory group would welcome them on their initial visit to the practice. After the diagnosis of asthma and its severity, a health literacy assessment of the patient and her family is conducted followed by teaching the patient and her family medication management. These steps involve assessing the meaningful treatment information that must be conveyed to the patient's family and the family's knowledge, skills and willingness to take action on self-management. Based on the gathered information, the patient and her family are then educated on medication use. After these steps, an asthma action plan is developed for the patient which involves shared decision-making between the patient's family and the practice. The plan involves the identification of patient and family goals such as fewer visits to the ER and fewer missed days at school and the treatment options preferred by the family. The practice is then responsible for regularly following up with the patient by the use of an electronic patient portal easily accessible both to the practice staff and the patient's family. The portal is used to schedule appointments, answer patient questions and send any kind of reminders to the patient. In addition, the demonstration practices were instructed to be able to timely connect patients and families to the appropriate services and supports when required. The demonstration practices were taught how to enhance communications between themselves and specialists, emergency departments, schools, local public health departments and community-based organizations.

An independent evaluation of the PCMH project also occurred. This study focuses on a pediatric quality of care

<sup>1</sup> For recent surveys of the literature, see Jackson et al. (2013), Hoff et al. (2012) and Peikes et al. (2012).

<sup>2</sup> For a detailed account of the Florida Pediatric Medical Home Demonstration Project, see Knapp et al. (2012).

measure that was part of the evaluation: Annual Number of Asthma Patients with  $\geq 1$  Asthma-Related Emergency Room (Center of Medicaid and CHIP Services and CMS 2013). Per the technical specifications this measure is assessed using 12 months of administrative data and the measurement period is the prior calendar year. The main objective of this paper is to determine if the number of ER visits for children with asthma changed over time, and how this change differed for the control and treatment groups.

To determine changes over time, the asthma ER measure was assessed in 1 pre-treatment year (calendar year 2010) and in 3 post-treatment years (calendar years 2011, 2012 and 2013). One should note that although the PCMH intervention started in October 2011, all the observations of the asthma ER measure that occurred in the calendar year 2011 were used in the analyses in which 2011 was the post-treatment year. The pediatric patients from the intervention practices who were used in the sample were children who were all diagnosed with asthma and were treated at least once annually by a physician at the same demonstration practice for both pre-treatment and post-treatment years (and at least, also had one health care visit to the same practice in each of any intervening years between the pre-treatment and post-treatment years). Because this study measures the effect of a single PCMH intervention, patients who attended different demonstration practices during the 4 years of the study were dropped from the analysis. For the entire period of the study, there were just five such cases.

A comparison group was critical in determining if any changes realized in the treatment group were attributed to the intervention or not. Because there were difficulties in recruiting comparison practices a comparison group was created at the patient level. Nearest neighbor propensity score matching was conducted to identify pediatric patients to serve as a comparison group. The comparison group had the closest characteristics (age, race, gender, health plan and whether patient was a special health care need child) to the patients from the intervention practices as determined by the matching technique. Comparison children received care from a non-intervention practice during the same time period and were tracked over time to make sure that they were not subsequently treated in an intervention practice.

The University of Florida's Institutional Review Board approved the study (#80-2011).

## Analyses

A fixed effects logistic model was used to estimate the impact of the PCMH intervention on asthma-related ER visits for the intervention and comparison groups. In the models the dependent variable is binary and indicates whether the asthmatic pediatric patient had one or more asthma-related visit to the ER. The dependent variable was created using specifications from

Measure 20 of the “Core Set of Children’s Health Care Quality Measures for Medicaid and CHIP” published by the Center of Medicaid and CHIP Services and CMS (2013). The dependent variable is equal to 1 if at least one ER visit did occur in the year, and 0 otherwise.

In the models a binary time variable was included and equal to 0 to denote the pre-treatment year (calendar year 2010) and equal to 1 to denote a post-treatment year. A dummy variable called demonstration was included and equal to 1 if the child was treated at an intervention practice or 0 otherwise. Other time-invariant independent variables included in the model were age of the patient in the pre-treatment year (age), patient’s gender (male; referent group is female), and dummy variables indicating the patient’s race and ethnicity (Black, Hispanic and other race; referent group is White). We also included a time-invariant independent variable to denote the patient’s health status (unhealthy; referent group is a healthy status) in the pre-treatment year. To be considered healthy the patient should not have a primary chronic disease or have suffered from a significant acute disease in the most recent 6 months before the patient was treated in the pre-treatment year. Two error terms were included in the model to account for random error and the combined effect of all time-invariant unobservable variables on pediatric patient’s asthma-related ER visits.

All the analyses were performed using Stata version 12.0.

## Sample

All the pediatric patients in the study were enrolled in Florida’s Medicaid or Children’s Health Insurance Program (CHIP). Data were not available for children receiving commercial insurance. To identify the pediatric patients who attended the intervention practices, Medicaid Provider Numbers (MPNs) and National Provider Identifiers (NPIs) of all health providers employed in the demonstration practices were collected from the practices. These MPNs and NPIs were then used to query the claims and encounter datasets to identify the pediatric patients who were treated at these practices in the relevant years. This procedure was necessary because Florida’s claims data does not include a practice identifier. The pediatric patients included in both the demonstration and comparison groups were associated with one MPN or NPI during the entire period of analyses. The independent variables (i.e., age, race, gender and health status) were extracted from enrollment data. The asthma-related ER measure was certified as accurate by an NCQA-certified auditor.

**Table 1** Number of asthma-related ER visits in pre-treatment and post-treatment years (percentages are in the parentheses)

	No asthma-related ER visits		One or more asthma-related ER visits	
	Pre-treatment year	Post-treatment year 2011	Pre-treatment year	Post-treatment year 2011
Demonstration	1047 (88.28%)	1060 (89.38%)	139 (11.72%)	126 (10.62%)
Comparison	308 (91.12%)	296 (87.57%)	30 (8.88%)	42 (12.43%)
Total	1355 (88.91%)	1356 (88.98%)	169 (11.09%)	168 (11.02%)
	Pre-treatment year	Post-treatment year 2012	Pre-treatment year	Post-treatment year 2012
Demonstration	514 (87.71%)	524 (89.42%)	72 (12.29%)	62 (10.58%)
Comparison	648 (85.60%)	661 (87.32%)	109 (14.40%)	96 (12.68%)
Total	1162 (86.52%)	1185 (88.24%)	181 (13.48%)	158 (11.76%)
	Pre-treatment year	Post-treatment year 2013	Pre-treatment Year	Post-treatment year 2013
Demonstration	337 (87.99%)	342 (89.30%)	46 (12.01%)	41 (10.70%)
Comparison	453 (85.15%)	465 (87.41%)	79 (14.85%)	67 (12.59%)
Total	790 (86.34%)	807 (88.20%)	125 (13.66%)	108 (11.80%)

## Results

### Sample Characteristics

Table 1 shows the asthma-related ER visits in the pre- and post-treatment years. For example the top panel of Table 1 shows that there were 1524 children who were diagnosed with asthma in both the pre-treatment year and the post-treatment year 2011. Out of these 1524 children, 169 had at least one asthma-related ER visit in the pre-treatment year and 168 visited the ER in the post-treatment year. The next two panels of Table 1 present the same information for post-treatment years 2012 and 2013, respectively.

Because fixed effects analysis uses only within-person variation to estimate coefficients and the dependent variable is binary, we exclude from the sample those patients whose dependent variable was the same for both pre-treatment and post-treatment years. For example, out of the 1524 patients who were diagnosed with asthma in both the pre-treatment and post-treatment year 2011, we exclude 1307 children whose dependent variable was the same in both the pre and

post-treatment years. In our final sample, we are left with 217 patients (173 who attended a demonstration practice and 44 in the comparison group). The three panels of Table 2 present some of the characteristics of the remaining samples for post-treatment years 2011, 2012 and 2013, respectively. Most of the patients were under 11 years old and male. In addition, there are more black children in the samples for the three different post-treatment years than other race and ethnicity categories.

### Fixed Effects Logistic Regression Results

Table 3 presents the results of the fixed effects logistic estimation. Two models were estimated for each of the different post-treatment years—the first with just the demonstration dummy and the second includes the other independent variables as well.

Results from the model show that, Demonstration is negative and statistically significant at the 5% level in the models in which 2011 is the post-treatment year. The odds ratio (OR) for Demonstration in model (2) is 0.34 (95% CI

**Table 2** Demographic characteristics of pediatric asthma patients used in the study

	Demonstration	Comparison	Total	Percent
Post-treatment year 2011				
Age (years)				
0–5	83	18	101	46.5
6–10	55	19	74	34.1
11–15	25	6	31	14.3
16–19	10	1	11	5.1
Gender				
Female	65	17	82	37.8
Male	108	27	135	62.2
Race				
White Non-Hispanic	25	7	32	15.2
Black or African American	57	24	81	38.4
Hispanic	30	9	39	18.5
Other	55	4	59	28.0
Health				
Healthy	20	4	24	11.2
Not healthy	152	38	190	88.8
Post-treatment year 2012				
Age (years)				
0–5	33	67	100	45.0
6–10	37	42	79	35.6
11–15	14	23	37	16.7
16–19	1	5	6	2.7
Gender				
Female	36	55	91	41.0
Male	49	82	131	59.0
Race				
White Non-Hispanic	22	15	37	17.3
Black or African American	20	51	71	33.1
Hispanic	17	33	50	23.3
Other	24	32	56	26.2
Health				
Healthy	13	26	39	17.8
Not healthy	70	110	180	82.2
Post-treatment year 2013				
Age (years)				
0–5	26	48	74	43.8
6–10	29	29	58	34.3
11–15	18	15	33	19.5
16–19	0	4	4	2.4
Gender				
Female	32	40	72	42.6
Male	41	56	97	57.4
Race				
White Non-Hispanic	19	21	40	24.5
Black or African American	18	34	52	31.9
Hispanic	14	15	29	17.8
Other	19	23	42	25.8
Health				
Healthy	10	21	31	18.8
Not healthy	62	72	134	81.2

**Table 3** Fixed effects logistic regression of one or more asthma-related ER visits

	Post-treatment year 2011		Post-treatment year 2012		Post-treatment year 2013	
	(1)	(2)	(3)	(4)	(5)	(6)
	N=217	N=208	N=222	N=211	N=169	N=159
	OR	OR	OR	OR	OR	OR
	(P value; 95% CI)	(P value; 95% CI)	(P value; 95% CI)	(P value; 95% CI)	(P value; 95% CI)	(P value; 95% CI)
Intercept	1.75 (0.07; 0.95–3.22)	2.16 (0.28; 0.53–8.94)	0.83 (0.23; 0.59–1.16)	1.39 (0.58; 0.44–4.44)	0.78 (0.22; 0.52–1.16)	0.68 (0.54; 0.20–2.32)
Demonstration	0.48* (0.04; 0.24–0.95)	0.34** (0.006; 0.16–0.73)	0.99 (0.94; 0.57–1.69)	1.06 (0.85; 0.59–1.90)	1.12 (0.72; 0.61–2.07)	1.19 (0.61; 0.61–2.34)
Age		1.00* (0.01; 1.00–1.00)		1.00 (0.26; 1.00–1.00)		1.00* (0.03; 1.00–1.00)
Male		1.69 (0.09; 0.92–3.10)		0.72 (0.27; 0.41–1.28)		1.23 (0.56; 0.61–2.46)
Black		0.95 (0.90; 0.40–2.26)		1.30 (0.54; 0.56–3.04)		1.32 (0.54; 0.54–3.27)
Hispanic		0.73 (0.54; 0.27–1.99)		0.85 (0.73; 0.34–2.10)		1.43 (0.51; 0.50–4.05)
Other race		1.88 (0.18; 0.75–4.70)		1.03 (0.95; 0.43–2.45)		2.76* (0.04; 1.07–7.15)
Unhealthy		0.36* (0.04; 0.14–0.94)		0.44* (0.03; 0.21–0.92)		0.27** (0.004; 0.11–0.66)

Referent groups are female, White non-Hispanic and healthy

OR odds ratio, CI confidence interval

\*Significant at the 5% level, \*\*significant at the 1% level

0.16–0.73). This result suggests that the odds of going to the ER for a child with an asthma diagnosis treated at a demonstration practice are 0.34 times less in the post-treatment year 2011 versus children diagnosed with asthma being treated at a non-participating practice. However, Demonstration is not statistically significant in any of the models that incorporate the post-treatment years of 2012 and 2013. Therefore, the models suggest that the treatment was most effective in the first post-treatment year (2011).

For post-treatment years 2011 and 2013 [models (2) and (6)], Age has a statistically significant positive regression coefficient at the 5% level. This result implies that older children are more likely to experience an asthma-related ER visit in the post-treatment years 2011 and 2013. However, the magnitude of this change is small in both models (ORs 1.00026 in both models; 95% CIs 1.00006–1.00046 and 1.00025–1.00049, respectively).

Unhealthy is statistically significant in all models (2), (4) and (6) the ORs (95% CI) being 0.36 (0.14–0.94), 0.44 (0.21–0.92) and 0.27 (0.11–0.66). This finding implies that unhealthy patients had lower odds of visiting the ER versus healthy peers. In model (6), Other race is statistically significant at the 5% level. Results on Other race imply that the odds of a child of another race having an asthma-related ER

visit increases in the post-treatment year as compared to a white non-Hispanic child.

## Discussion

Our study investigates whether a particular PCMH intervention, the Florida Pediatric Medical Home Intervention, had an effect on the asthma-related ER visits of pediatric patients. For this purpose, a fixed effects logistic regression model that requires repeated observations of the response variable was used. Six such models were estimated: 2 for each of the post-treatment years 2011, 2012 and 2013. Because the PCMH is supposed to have the most impact on patients who regularly receive treatment at the practice, it is proposed that such analyses will provide a more accurate assessment of the PCMH's effect on asthma-related ER visits. Our results suggest that the PCMH intervention decreased asthma-related ER visits in the post-treatment year 2011. For subsequent post-treatment years 2012 and 2013, the results did not detect an impact of the PCMH intervention on asthma-related ER visits. One should note however that the Annual Number of Asthma Patients with  $\geq 1$  Asthma-Related Emergency

Room Visits for Florida’s entire Medicaid and CHIP population in 2012 was 12.6% (Knapp et al. 2013). In our sample of demonstration pediatric patients this rate was 10.5%.

The finding that the PCMH intervention reduced asthma-related ER visits in 2011 should be interpreted with caution. One possibility is that the post-treatment year 2011 effect could be due to selection bias meaning that the practices who applied to participate in the PCMH intervention were practices already more likely to improve care of asthmatic pediatric patients. Of interest is the fact that the effect is not detected in the post-treatment years 2012 and 2013 which could be due to several reasons. Perhaps the practices in the project were able to take what they learned in the early phases of the intervention to improve care to asthmatic children quickly. Information from the Learning Sessions focused on integrating asthma action plans into management and information technology. Technical support was also provided to determine how direct secure messaging could be used by local ERs to inform the pediatric practices that one of their patients presented in the ER. Our results are corroborated by evidence from another study which found that children with chronic conditions realize improved outcomes in PCMH interventions as compared to healthy children (David et al. 2015). The fact that the decrease in asthma-related ER visits did not continually decrease could be because the early gains were difficult to maintain or that the practices had to focus on other chronic conditions, not just asthma. Crabtree et al. (2010) document how “tremendous effort and motivation” as well as “benefits from external support” are required to sustain the magnitude of a PCMH transformation.

All studies have limitations and ours is no exception. As previously mentioned we were unable to recruit control practices and we used individual-level controls. Because the PCMH intervention was at the practice level, we are unable to control for practice level characteristics that could have impacted the experiences of patients with asthma such as presence of an electronic health record or being a part of a health system whereby the ER and practice are linked. Additionally, if the comparison group of patients were from healthcare facilities that had asthma-specific protocols or programs in place, or had characteristics similar to a medical home then our estimations underestimate the effect of the PCMH on asthma-related visits to the ER assuming such programs are effective in asthma treatment. A fact that is well documented (for example, Hoff et al. 2012) is that the PCMH model is being implemented in a variety of ways in the US. As a result this makes it difficult to compare results across studies and use them to influence policy and practice, and consequently is a longstanding criticism of the variations in PCMH definitions and implementations. Finally, only children enrolled in Medicaid or CHIP were included in the study. A possibility is that payer mix could influence the

way that children with chronic conditions, such as asthma, are managed.

## Conclusion

Even with the stated limitations our findings are useful for practice and policy and extending the PCMH literature. Our study is the first to use a standardized measure for asthma-related ER visits. The measure is included in the CHIPRA Initial Core Set of Health Care Quality Measures and the results can be compared not only within Florida, but to other states that have voluntarily submitted their quality measurement data to the federal government. We are also able to comment on the effectiveness of the CHIPRA legislation in improving quality for children. Our results show that a PCMH intervention can positively influence asthma-related ER visits. This may also be of interest to health plans or pediatric primary care practices that might be motivated to financially reward or become medical homes. The next step in this research agenda will be to determine if the PCMH enrolled patients had lower ER-related costs, lower asthma-related pharmacy costs, or lower overall costs. Again, this information will be useful to health plans or governments that are still undecided about whether or not enhanced payments should be considered for PCMHs. Finally, by showing that a PCMH can reduce asthma-related ER visits, there is a suggestion that the family experience can be improved. Keeping children out of the ER will help alleviate stress and improve continuity of care for parents of asthmatic children. A PCMH provides a more effective place for treating children with asthma and parents should be encouraged to seek them out.

**Acknowledgements** This document was developed under Grant CFDA 93.767 from the U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services.

## Compliance with Ethical Standards

**Conflict of interest** Shourjo Chakravorty and Caprice A. Knapp declare that they have no conflict of interest.

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