



Published in final edited form as:

*J Asthma*. 2010 December ; 47(10): 1136–1141. doi:10.3109/02770903.2010.517338.

## Disparities in Asthma Medication Dispensing Patterns: The Case of Pediatric Asthma in Puerto Rico

Doryliz Vila, MS<sup>a</sup>, Cynthia S. Rand, PhD<sup>b</sup>, Michael D. Cabana, MD, MPH<sup>c</sup>, Amarilis Quiñones, MS<sup>a</sup>, Mirla Otero, BS<sup>a</sup>, Christina Gamache, BS<sup>a</sup>, Rafael Ramírez, PhD<sup>a</sup>, Pedro García, MA<sup>a</sup>, and Glorisa Canino, PhD<sup>a</sup>

<sup>a</sup> University of Puerto Rico, Medical Sciences Campus, Behavioral Sciences Research Institute, Puerto Rico <sup>b</sup> Johns Hopkins School of Medicine, Baltimore, Maryland <sup>c</sup> Division of General Pediatrics, Philip R. Lee Institute for Health Policy Studies, University of California, San Francisco

### Abstract

**Background**—Disparities exist in asthma medication dispensing between children with public insurance and those with private insurance under a Managed Care Medicaid system in Puerto Rico.

**Objectives**—Island-wide medical claims data were used to examine the extent to which differences between the private and public health care sectors affect medication dispensing and health care utilization among asthmatic children.

**Methods**—Children 3–18 years old with at least one service claim (outpatient, hospitalization, or ED visit) for asthma or reactive airway disease from 2005–06 were selected. Chi-square analyses compared medication dispensing and health care utilization between the public and private sectors. Negative binomial regression identified factors associated with the mean dispensing rate of prescriptions for controller anti-inflammatory medication (CM).

**Results**—Private insurance families (n= 28,088) were dispensed significantly more CM (48.3% vs. 12.0%) and quick relief medication (47.4% vs. 44.6%) than public insurance families (n=13,220). The dispensing of inhaled corticosteroids (24.4% vs. 6.7%) and leukotriene modifiers and cromolyn (31.4% vs. 5.7%) was dramatically higher in the private sector. In contrast, ER use was significantly higher among public insurance children (51.7% vs. 13.8%). Multivariate analysis showed that age, number of beta-agonists, and type of insurance was associated with CM dispensing; private insurance showed the greatest effect.

**Conclusion**—Asthmatic Puerto Rican children enrolled in public insurance were significantly less likely to be dispensed CM than children with private insurance; suggesting that under-treatment of public insured children may substantially contribute to increased asthma morbidity in this population as evidenced by significantly higher rates of ED visits.

### Keywords

Asthma; disparities in medication dispensing; Puerto Rico; children; health care system

---

Corresponding author: Doryliz Vila, MS. Behavioral Sciences Research Institute, Medical Sciences Campus, PO Box 365067, San Juan, PR 00936-5067. Phone: (797) 754-8624; Fax: (787) 767-5959; doryliz.vila@upr.edu.

#### Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

## INTRODUCTION

Ethnic minority children and low-income populations are known to have a disproportionately high burden of asthma prevalence and morbidity when compared to non-Latino whites (NLWs).<sup>1,2</sup> Even among minority populations, asthma disparities in prevalence, morbidity, and mortality are greatest for Puerto Ricans, both in the mainland<sup>3,4</sup> and the island.<sup>5-7</sup>

Although there is extensive evidence documenting asthma disparities in prevalence and morbidity for island Puerto Rican children, explanations for this disparity have remained largely unexplored. One such asthma disparity frequently cited is the finding that minority children with persistent asthma are less likely to take controller medication (CM) whether prescribed or filled, as compared to NLW.<sup>8-14</sup> Other studies conducted in the mainland U.S., have suggested that low-income children receiving asthma care from public health care plans such as Medicaid, are less likely to receive controller therapy than children enrolled in private insurance plans.<sup>10,13</sup>

A number of factors unique to Puerto Rico limit the generalizability of results from mainland studies to children with asthma living on the island. First, there is a disproportionate high enrollment of Puerto Rican children in the public health plans. Approximately 42% of families live below the poverty level<sup>15</sup> which makes them eligible for the Island-wide Puerto Rican Public Health Plan (PRPHP). Second, unlike most Medicaid Managed Care plans in the US, the PRPHP includes the cost of asthma medications as part of the capitation given to Managed Care Organization (MCOs). Thus, under the current policy in Puerto Rico, MCOs and the Independent Provider Associations (IPAs) with whom they subcontract are *directly* responsible financially for medication costs and referrals to specialists. Unlike the PRPHP, private insurance plans in Puerto Rico do not capitate asthma medication costs, thus providers bear no financial risk in prescribing controller medications.

Research on provider response to drug payment policy in the United States suggests that providers are more likely to prescribe medications when it does not implicate a financial risk.<sup>16</sup> In Puerto Rico, the contrast between PRPHP (where providers bear the risk for the cost of medications) and private health plans (where providers bear no risk) is stark and unique. As a result, we hypothesized that the difference in health care reimbursement arrangements between public and private payers in Puerto Rico would be associated with lower frequency of prescribing asthma CMs for low-income children with public insurance compared to private insurance. Subsequently, decreased use of asthma CMs would be associated with increased health disparities, as measured by ED use and hospitalizations. The current study utilized island-wide medical claims data to examine the extent to which differences in payment policies between the private and public health care sectors could explain differences in medication dispensing and health care utilization among children with asthma enrolled in the PRPHP as compared to children enrolled in private insurance plans.

## METHODS

### Population and Setting

Island Puerto Rican children were selected to participate in the study if they were 3–18 years old, and had at least one service claim (outpatient, hospitalization or ED visit) with a diagnostic code for asthma or reactive airway disease (International Classification of Diseases (ICD 9) diagnostic code 493.xx) from July 1, 2005 to June 30, 2006. Children included in the study were insured either by the PRPHP (similar to Medicaid eligible patients) or by a private insurance company. In order to qualify for the PRPHP the family

has to be at most 100% above the poverty level (monthly income of \$400). In fiscal year 2005–2006, there was an average of 457,821 children (3–18 years old) enrolled in PRPHP in the entire island. Children from the private sector were insured by one insurance company which covered 144,731 lives from the 78 municipalities of the entire island. The observation period started at July 1, 2005 or at the date of enrollment in the insurance, whichever was later, and ended in June 30, 2006.

### Data Sources

Both the PRPHP and the private insurance companies maintain computerized files of all doctor's office visits, hospitalizations, prescriptions, and emergency department visits for every person enrolled in their plans. Unfortunately, the only demographic information contained in these claim files was age of the participant. No information on education, occupation, or income is collected in claims data files. Although sex is collected, we were not given this variable in one of the data sets.

### Study Procedures

Each insurance company identified eligible children and extracted fixed-length data files according to enrollment during that year, and asthma related claims. The utilization files contained one record for each service provided. The prescription information included the National Drug Code of the dispensed medications. Medications analyzed included *controller medications* which refer to leukotrienes and cromolyn, inhaled corticosteroids, beta-agonists of prolonged action, cromolyn, nedocromil, and theophylline, and *quick relief medications* which included short beta-agonists of short duration, inhaled anticholinergic medications (e.g. atrovent) and systemic corticosteroids.

### Statistical Analysis

Asthma drug dispensing and service rates (e.g. ED use) were calculated by dividing the number of prescriptions dispensed or services received by the number of children aged 3–18 with at least one health care service claim. Data were analyzed as dichotomous (any controller medication or health service utilization) and count variables (Table 1). Chi-square analyses were used to compare the number of children in the public and private sector who filled prescriptions and utilized health care services. We then conducted the same analysis as in Table 1 with a selected subset of children that had two or more emergency visits a year (Table 2) or three or more albuterol canisters a year (Table 3) as proxies for uncontrolled asthma.

Negative binomial regression models were used to compare differences in CM dispensing rates between publicly and privately insured children. This approach was chosen because of over dispersion of the non-normally distributed count data in which the variance was larger than the mean. Multivariate models were adjusted for age and the number of beta-agonist prescriptions. Results were exponentiated and presented as rate ratios, which represents the factor by which the expected rate of the count variable is expected to change for 1 unit of change in the predictor variable. The percentage change in the expected count can also be estimated using the following formula:  $100 \times (\exp[b] - 1)$ , where  $b$  represents the regression coefficient associated with a predictor variable.

All analyses were conducted using SAS software version 9.1.3 service pack 3.<sup>17</sup>

## RESULTS

The total number of children aged 3–18 with at least one health care service claim (ED use, hospitalization or outpatient visit) for asthma during the year of study was 41,308 children;

28,088 from the public sector and 13,220 from the private sector (Table 1). More children with private insurance filled prescriptions for CM (48.3% vs. 12.0%,  $p < 0.0001$ ) and quick relief medication (47.4% vs. 44.6%,  $p < 0.0001$ ) than children with public insurance, except for beta-agonists which were filled more by children in the public sector. The most dramatic differences were related to the use of inhaled corticosteroids (24.4% vs. 6.7%,  $p < 0.0001$ ) and leukotriene modifiers and cromolyn (31.4% vs. 5.7%,  $p < 0.0001$ ) which were significantly filled more often by children in the private sector. Of interest, was the fact that oral corticosteroids, which are relatively inexpensive, were also filled significantly more by children in the private sector (20.3%) than the public sector (1.9%) ( $p < 0.0001$ ). ED use was the only service that showed a higher utilization by children in the public sector when compared to the private sector; 51.7% of children with public insurance used ED services in contrast to 13.8% of children with private insurance ( $p < 0.0001$ ) (Table 1). Hospitalizations were low for both groups (approximately 6% in both sectors,  $p = 0.4156$ ), while outpatient visits were more frequent in children in the private than the public sector (91.1% vs. 61.4%,  $p < 0.0001$ ).

Table 2 outlines medication dispensing and service utilization data for children with 2 or more ED visits in the private ( $n=247$ ) and public sector ( $n=4,733$ ). Having 2 or more ED visits was used as a proxy for poorly controlled asthma, and these findings highlight the need for increased CM use, especially among the public sector. Further, disparities in overall prescriptions filled prevailed between the private and public sector, as publicly insured children maintained lower rates for all medications (Table 2). In terms of services however, both hospitalizations and outpatient visits were significantly higher in the private sector (15.0% vs. 10.1% and 62.4% vs. 35.5%;  $p < 0.0001$ , respectively).

As another indicator of uncontrolled asthma, rescue medication use was examined among children who were dispensed 3 or more albuterol canisters (Table 3). Children in this subgroup had higher rates of medication dispensing if they had private insurance regardless of the medication. On the other hand, asthma related health care use such as ED use, hospitalizations, and outpatient visits were significantly higher for children with public insurance (49.4% vs. 15.6%; 13.5% vs. 11.1%; 80.7% vs. 71.5%, respectively). The most significant effect was observed in ED use and outpatient visits ( $p < 0.0001$ ).

We estimated the degree of relationship between two markers of uncontrolled asthma, yearly number of albuterol canisters and yearly number of ED visits. Because each of the variables is a count variable with a non-normal distribution we calculated a Spearman Rank Order correlation. The results, although significant because of our large sample size, revealed only weak correlations between the markers of uncontrolled asthma. The correlation between emergency room visits and albuterol canister was -0.00. These analyses were executed to determine if these two markers should be included in the multivariate analyses.

Table 4 presents the results of a multivariate negative binomial regression model including four predictor variables; age, type of insurance (public or private), prescription of 3 or more beta-agonists, and 2 or more ED visits as proxy measures of uncontrolled asthma.<sup>18</sup> All the variables were significant predictors of the number of CMs ( $p < 0.0001$ ). Therefore, the magnitude of the relative importance of each predictor variable was examined. An increase in age was associated with a reduction in the rate of prescription filling for CM. For each additional year of age, the mean rate of dispensed CM declined by 3%, which is considered a small effect. Having private insurance was associated with a large increase in the number of CMs dispensed. For children with private insurance the mean rate of dispensed CM increased by a factor of 5.4, which is considered a large effect. The predictor of three or more beta-agonists dispensed, was also associated with an increase in the mean rate of CMs; the rate increased by a factor of 5.6 which is considered a large effect. For our last predictor,

2 or more ED visits, the mean rate of dispensed CM increased by a factor of 1.16, which corresponds to an increase of 16% in the rate of prescribed CM.

## DISCUSSION

Our results strongly suggest that the differences in public vs. private medication reimbursement policies in Puerto Rico have an influence on asthma medication use patterns and children's asthma outcomes. We found that low-income Puerto Rican children with a diagnosis of asthma who had public insurance were significantly less likely to be dispensed controller therapy medication than children with private insurance (12.0% to 48.3%). Furthermore, those children with at least one asthma health care claim (ED use, hospitalization or outpatient visit) in the public sector had extremely low rates of any dispensing CM medications as compared to children in the private sector, suggesting that under-treatment of low-income children may substantially contribute to increased asthma morbidity in this population.

Although age, type of insurance (public or private), ED visits, and number of beta-agonist were all significant predictors of the number of CMs dispensed, having private insurance and using three or more beta-agonists had the largest effects in predicting CM use. The large effect of dispensed beta-agonist was expected considering that it is a proxy of uncontrolled asthma and according to current recommended standards of care children with uncontrolled asthma require the prescription of CM. The large effect of insurance type however, reflects a disparity between the public and private health sector in the dispensing of controller medications.

Lower rates of CM dispensing among children with public insurance could be due to the low socio-economic (SES) background of the families given that in order to qualify for public insurance families must be at the 200% poverty level. Poverty is associated with other variables not measured by claims data such as low educational level, low health literacy, and poor asthma management that may affect patient's prescription fillings and or physicians prescription patterns.<sup>12,13,19,20</sup> The low SES of the children with public insurance could therefore be a determining factor in explaining the low rates of controller medications among these children. Preliminary analyses of a national survey of the island's pediatricians by our group however, showed that 84% of pediatricians reported that the present health care policy was a barrier for adequately prescribing asthma medication to children with public insurance (Canino et al.)<sup>21</sup> suggesting that the present health policy might also be another important factor affecting prescription practices of physicians.

Another possible explanation for the lower use of CM among children in the public sector maybe that children in the PRPHP are less likely to be seen by an asthma specialists<sup>22</sup> and to show up for a follow-up visit.<sup>23</sup> Specialist are more likely to follow treatment guidelines and prescribe controller medications,<sup>24-27</sup> because specialists as compared to generalists may take a more aggressive approach to pharmacologic asthma treatment.<sup>28</sup> On the other hand, it is also of concern, that almost 90% of children who had dispensed controller medication in the private health sector, also met criteria for one of our proxies of uncontrolled asthma (e.g. three or more canisters of albuterol in one year)(Table 3). This finding suggests that even within the private sector where there is better access to CM as compared to the public sector, quality improvement programs are needed to guarantee appropriateness of treatment and address family factors that affect compliance with medication treatment.

In Puerto Rico, the rates of ED use for asthma care are extremely high in the public sector (52%). Although the literature suggests that ED visits could be reduced by the appropriate prescribing and use of CMs, there are no incentives for physicians to prescribe these high

cost medications. As previously stated, Independent Provider Associations (IPAs) and physician networks are directly financially responsible for medication costs in the public sector. In addition, the capitated cost of periodic ED visits and hospitalizations in Puerto Rico are relatively low compared to the US. This cost is substantially less for public sector providers compared to the cost of regular guideline-based use of CMs for management of children's asthma. At present, it seems that the health policy in Puerto Rico does not foster physicians' use of asthma guidelines for treating children with public insurance.

## Limitations

Several limitations of this study should be noted. First, children qualified for the study with a single diagnosis of asthma during the one year study period. Because enrollment and disenrollment for participants was not available it resulted in the inclusion of some children that had insurance for less than a year. Second, the claims data did not include the necessary clinical information to determine severity or uncontrolled asthma.<sup>29</sup> The number of beta-agonists however, was used as a measure of poorly controlled-asthma.<sup>30,31</sup> Also, claims data did not allow us to distinguish between families that were not prescribed controller therapy versus those who did not fill their prescriptions. Based on prior studies,<sup>32-33</sup> it is likely that both factors played a role in the extremely low rates of CMs among children with public insurance. Furthermore, the claims data did not include important information regarding provider's characteristics such as whether providers were generalists or specialists, information that is important because it is known that specialists are more likely to prescribe CM. SES data on children from the private insurance sector was also not available, although it can be assumed that at least these children were not as poor as those in the public sector and most probably would belong either to middle or upper income SES backgrounds. In addition, we were able to obtain private insurance data on only one insurance company in the island, while there are three more insurance companies that did not share their data with us.

## Conclusions and Recommendations

A dramatic disparity in Puerto Rico exists in asthma medication dispensing between children with public insurance as compared to those with private insurance. The causes of this phenomenon seems to be multiple, complex and inter-related.<sup>34</sup> If asthma disparities in medication use in Puerto Rico are to be reduced, then a better understanding of the complex ways in which multiple variables related to the health care system policies, socio-economic factors, family and provider interactions, as well as the relative weight that each one contributes to the inequalities observed is needed.

A number of recommendations however, can be made that are likely to ameliorate the medication disparity observed on the island. Asthma cannot be controlled effectively unless patients have access to a full range of services and quality care to all patients. The current health policy makes it difficult for providers to deliver high quality care. Specifically, this policy needs to be revised so that primary care providers do not feel jeopardized by prescribing CMs to patients with persistent asthma, or to refer patients who require subspecialty care to specialists. Alternative strategies are to share costs with the state, or adjust the low capitation rates.

Provider training is also essential if more children are to be properly medicated. Research on physician education shows, that provider groups who have received training implement changes in their practices that result in improved disease control for patients.<sup>35-37</sup> Therefore, provider practices may be a key intervention area for reducing health disparities in asthma medication use.

Finally, parents' negative attitudes and concerns about asthma medication and asthma beliefs need to be addressed, as well as cost barriers and medication availability, in order to improve prescription filling and medication adherence by families. We acknowledge though that following these recommendations may be difficult with the increasing pressures on the economy that limit public resources. Cost analyses of different strategies to improve medication practices would be needed in order to arrive at a feasible alternative within a constrained economy.

## Acknowledgments

**Financial Support:** This study was supported by NIH Grant # 5P60 MD002261-02 funded by the National Center for Minority Health and Health Disparities

## Abbreviations

<b>CM</b>	Controller Anti-Inflammatory Medication
<b>ED</b>	Emergency Department
<b>PRPHP</b>	Puerto Rican Public Health Plan

## References

1. Akinbami LJ, Schoendorf KC. Trends in childhood asthma: prevalence, health care utilization, and mortality. *Pediatrics*. 2002; 110(2 Pt 1):315–322. [PubMed: 12165584]
2. Hunninghake GM, Weiss ST, Celedon JC. Asthma in Hispanics. *Am J Respir Crit Care Med*. 2006; 173(2):143–163. [PubMed: 16210666]
3. Lara M, Akinbami L, Flores G, Morgenstern H. Heterogeneity of childhood asthma among Hispanic children: Puerto Rican children bear a disproportionate burden. *Pediatrics*. 2006; 117(1):43–53. [PubMed: 16396859]
4. National Center for Health Statistics' Public Health Report (CDC, Brief Article). From: Morbidity and Mortality Weekly Report Publication of Health, United States, 2005. December 23. 2005
5. Cohen RT, Canino GJ, Bird HR, Shen S, Rosner BA, Celedon JC. Area of residence, birthplace, and asthma in Puerto Rican children. *Chest*. 2007; 131(5):1331–1338. [PubMed: 17494783]
6. Loyo-Berrios NI, Orengo JC, Serrano-Rodriguez RA. Childhood asthma prevalence in northern Puerto Rico, the Rio Grande, and Loiza experience. *J Asthma*. 2006; 43(8):619–624. [PubMed: 17050228]
7. Ortega AN, Goodwin RD, McQuaid EL, Canino G. Parental mental health, childhood psychiatric disorders, and asthma attacks in island Puerto Rican youth. *Ambul Pediatr*. 2004; 4(4):308–315. [PubMed: 15264963]
8. Adams RJ, Fuhlbrigge A, Guilbert T, Lozano P, Martinez F. Inadequate use of asthma medication in the United States: results of the asthma in America national population survey. *J Allergy Clin Immunol*. 2002; 110(1):58–64. [PubMed: 12110821]
9. Diaz T, Sturm T, Matte T, Bindra M, Lawler K, Findley S, et al. Medication use among children with asthma in East Harlem. *Pediatrics*. 2000; 105(6):1188–93. [PubMed: 10835056]
10. Flores G, Lee M, Bauchner H, Kastner B. Pediatricians' attitudes, beliefs, and practices regarding clinical practice guidelines: a national survey. *Pediatrics*. 2000; 105(3 Pt 1):496–501. [PubMed: 10699099]
11. Halterman JS, Aligne CA, Auinger P, McBride JT, Szilagyi PG. Inadequate therapy for asthma among children in the United States. *Pediatrics*. 2000; 105(1 Pt 3):272–276. [PubMed: 10617735]
12. Kozyrskyj AL, Mustard CA, Simons FE. Socioeconomic status, drug insurance benefits, and new prescriptions for inhaled corticosteroids in schoolchildren with asthma. *Arch Pediatr Adolesc Med*. 2001; 155(11):1219–1224. [PubMed: 11695930]

13. Riekert KA, Butz AM, Eggleston PA, Huss K, Winkelstein M, Rand CS. Caregiver-physician medication concordance and undertreatment of asthma among inner-city children. *Pediatrics*. 2003; 111(3):e214–220. [PubMed: 12612274]
14. Shields AE, Comstock C, Weiss KB. Variations in asthma care by race/ethnicity among children enrolled in a state Medicaid program. *Pediatrics*. 2004; 113(3 Pt 1):496–504. [PubMed: 14993540]
15. U.S. Census Bureau. US Census Bureau Data for Puerto Rico. 2000. <http://www.census.gov/census2000/states/pr.html>
16. Hillman AL, Ripley K, Goldfarb N, Weiner J, Nuamah I, Lusk E. The use of physician financial incentives and feedback to improve pediatric preventive care in Medicaid managed care. *Pediatrics*. 1999; 104(4 Pt 1):931–935. [PubMed: 10506237]
17. Statistical Analysis System, version 9.1.3 Service Pack 3. SAS Institute Inc; Cary, NC, USA:
18. Schatz M, Zeiger RS, Vollmer WM, Mosen D, Apter AJ, Stibolt TB, Leong A, Johnson MS, Mendoza G, Cook EF. Validation of a b-agonist long-term asthma control scale derived from computerized pharmacy data. *J Allergy Clin Immunol*. 2006; 117(5):995–1000. [PubMed: 16675324]
19. Wolf MS, Gazmararian JA, Baker DW. Health literacy and functional health status among older adults. *Arch Int Med*. 2005; 26;165(17):1946–1952.
20. Bender BG, Rankin A, Tran ZV, Wamboldt FS. Brief-interval telephone surveys of medication adherence and asthma symptoms in the Childhood Asthma Management Program Continuation Study. *Ann Allergy Asthma Immunol*. 2008; 101(4):382–386. [PubMed: 18939726]
21. Canino G, Vila D, Cabana M, Quiñones A, Chavez L, Otero M, Colon F, Rand C. Barriers to prescribing controller anti inflammatory medication among asthmatic children with public insurance: Results of National Survey of Pediatricians. *Pediatric, Allergy, Immunol, Pulmonol*. In press.
22. Ortega AN, Belanger KD, Bracken MB, Leaderer BP. A childhood asthma severity scale: symptoms, medications, and health care visits. *Ann Allergy Asthma Immunol*. 2001; 86(4):405–413. [PubMed: 11345283]
23. Yoon EY, Davis MM, Van Cleave J, Maheshwari S, Cabana MD. Factors associated with non-attendance at pediatric subspecialty asthma clinics. *J Asthma*. 2005; 42(7):555–559. [PubMed: 16169788]
24. Finkelstein JA, Lozano P, Farber HJ, Miroshnik I, Lieu TA. Underuse of controller medications among Medicaid-insured children with asthma. *Arch Pediatr Adolesc Med*. 2002; 156(6):562–567. [PubMed: 12038888]
25. Joseph CL, Havstad SL, Ownby DR, Johnson CC, Tilley BC. Racial differences in emergency department use persist despite allergist visits and prescriptions filled for antiinflammatory medications. *J Allergy Clin Immunol*. 1998; 101(4 Pt 1):484–490. [PubMed: 9564801]
26. Legorreta AP, Christian-Herman J, O'Connor RD, Hasan MM, Evans R, Leung KM. Compliance with national asthma management guidelines and specialty care: a health maintenance organization experience. *Arch Intern Med*. 1998; 158(5):457–464. [PubMed: 9508223]
27. Mahr TA, Evans R 3rd. Allergist influence on asthma care. *Ann Allergy*. 1993; 71(2):115–120. [PubMed: 8346862]
28. Vollmer WM, O'Hollaren M, Ettinger KM, Stibolt T, Wilkins J, Buist AS, et al. Specialty differences in the management of asthma. A cross-sectional assessment of allergists' patients and generalists' patients in a large HMO. *Arch Intern Med*. 1997; 157(11):1201–1208. [PubMed: 9183231]
29. Buchner DA, Carlson AM, Stempel DA. Patterns of anti-inflammatory therapy in the post-guidelines era: a retrospective claims analysis of managed care members. *Am J Manag Care*. 1997; 3(1):87–93. [PubMed: 10169253]
30. Donahue JG, Fuhlbrigge AL, Finkelstein JA, Fagan J, Livingston JM, Lozano P, et al. Asthma pharmacotherapy and utilization by children in 3 managed care organizations. The Pediatric Asthma Care Patient Outcomes Research Team. *J Allergy Clin Immunol*. 2000; 106(6):1108–1114. [PubMed: 11112894]
31. Donahue JG, Weiss ST, Livingston JM, Goetsch MA, Greineder DK, Platt R. Inhaled steroids and the risk of hospitalization for asthma. *JAMA*. 1997; 277(11):887–891. [PubMed: 9062326]



32. Garbutt J, Bloomberg G, Banister C, Sterkel R, Epstein J, Bruns J, et al. What constitutes maintenance asthma care? The pediatrician's perspective. *Ambul Pediatr*. 2007; 7(4):308–312. [PubMed: 17660103]
33. Ma J, Stafford RS. US physician adherence to standards in asthma pharmacotherapy varies by patient and physician characteristics. *J Allergy Clin Immunol*. 2003; 112(3):633–635. [PubMed: 13679830]
34. Canino G, McQuaid EL, Rand CS. Addressing asthma health disparities: a multilevel challenge. *J Allergy Clin Immunol*. 2009; 123(6):1209–17. quiz 18–9. [PubMed: 19447484]
35. Clark NM, Bailey WC, Rand C. Advances in prevention and education in lung disease. *Am J Respir Crit Care Med*. 1998; 157(4 Pt 2):S155–167. [PubMed: 9563775]
36. Kelly CS, Morrow AL, Shults J, Nakas N, Strobe GL, Adelman RD. Outcomes evaluation of a comprehensive intervention program for asthmatic children enrolled in Medicaid. *Pediatrics*. 2000; 105(5):1029–1035. [PubMed: 10790458]
37. Lozano P, Finkelstein JA, Carey VJ, Wagner EH, Inui TS, Fuhlbrigge AL, et al. A multisite randomized trial of the effects of physician education and organizational change in chronic-asthma care: health outcomes of the Pediatric Asthma Care Patient Outcomes Research Team II Study. *Arch Pediatr Adolesc Med*. 2004; 158(9):875–883. [PubMed: 15351753]

Table 1

Medication use among all children with at least one asthma-related health service claim

Use of any...	Public (n=28,008)		Private (n=13,220)		p-value*
	n	%	n	%	
Controller Medication <sup>d</sup>	3366	12.0	6378	48.3	<0.0001
Inhaled Corticosteroids	1881	6.7	3222	24.4	<0.0001
Leukotrienes/Cromolyn	1591	5.7	4154	31.4	<0.0001
Quick relief medication	12500	44.6	6262	47.4	<0.0001
Oral Steroids	541	1.9	2677	20.3	<0.0001
Short Beta-Agonists	12308	43.9	5375	40.7	<0.0001
Asthma health care use					
ED Use	14484	51.7	1822	13.8	<0.0001
Hospitalization	1511	5.4	739	5.6	(n.s.) <sup>b</sup>
Outpatient visit	17193	61.4	12039	91.1	<0.0001

NOTE: Chi-square ( $\chi^2$ ) tests were used to test for significant differences between the groups.<sup>a</sup>Refers to anti-inflammatory controller medication<sup>b</sup>Not significant (n.s.)

**Table 2**

Medication use for children with 2 emergency department (ED) visits or more

Use of any...	Public (n=4733)		Private (n=247)		p-value*
	n	%	n	%	
Controller Medication	704	14.9	137	55.5	<0.0001
Inhaled Corticosteroids	389	8.2	71	28.7	<0.0001
Leukotrienes/Cromolyn	413	8.7	103	41.7	<0.001
Quick Relief Medication	2304	48.7	150	60.7	0.0002
Oral Steroids	106	2.2	56	22.7	<0.0001
Short Beta-Agonists	2282	48.2	141	57.1	<0.0001
<b>Asthma Health Care Use</b>					
Hospitalization	478	10.1	37	15.0	0.0141
Outpatient visit	1678	35.5	154	62.4	<0.0001

NOTE: Chi-square ( $\chi^2$ ) tests were used to test for significant differences between the groups.

**Table 3**

Medication use for children with 3 albuterol canisters or more in a year

Use of any...	Public (n=4464)		Private (n=3339)		p-value*
	n	%	n	%	
Controller Medication	733	42.6	963	86.1	<0.0001
Inhaled Corticosteroids	474	27.6	605	54.1	<0.0001
Leukotrienes/Cromolyn	370	21.5	753	67.2	<0.0001
Oral Steroids	84	4.9	464	41.5	<0.0001
Asthma Health Care Use					
ED Use	849	49.4	175	15.6	<0.0001
Hospitalization	233	13.5	124	11.1	<0.05
Outpatient Visit	1388	80.7	800	71.5	<0.0001

NOTE: Chi-square ( $\chi^2$ ) tests were used to test for significant differences between the groups.

**Table 4**

Effects of age, medical insurance, use of short beta-agonists medication and ED visits in asthma controller medication

	<b>B</b>	<b>95% CI</b>	<b>Rate Ratio</b>	<b><i>p</i>-value*</b>
Age	-0.03	-0.03,-0.02	0.97	<0.0001
Private Insurance (as compared to public)	1.69	1.65,1.72	5.39	<0.0001
3 or more Short Beta-Agonists Medication	1.72	1.66,1.78	5.59	<0.0001
2 or more ED visits	0.15	0.08,0.21	1.16	<0.0001

NOTE: Negative binomial reg significances

CI, confidence interval