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Angela K Salerno 04/23/2012

PROPOSAL FOR IMPROVED CARE AND REDUCED HEALTH CARE COST IN PEDIATRIC ASTHMA

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An abstract of
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Abstract

Proposal for Improved Care and Reduced Health Care Cost in Pediatric Asthma
By Angela K Salerno

This paper describes pediatric asthma and its medical and financial burden in the United States. Asthma is the third leading cause for hospitalizations in pediatrics, costing $8 billion in 2006. Asthma is not preventable, but solutions exist to decrease exacerbations, Emergency Department visits, and hospitalizations. Significant racial, ethnic, and socioeconomic disparities exist in disease burden, treatment, and provider-patient perceptions regarding care. Lower socio-economic status is also associated with more environmental asthma triggers. Public insurance programs shoulder a disproportionate burden of healthcare costs. Additional societal burdens include missed school days, days of decreased activity, and missed parent workdays.

The National Asthma Education and Prevention Program under the auspices of the National Institutes for Health has four recommendations to decrease asthma morbidity: use of asthma action plans, use of controller medications, reduction of environmental allergens, and regular assessment and monitoring. Many children are not receiving recommended care.

Current studies indicate the best success is through comprehensive care that encompasses all four recommendations. Several urban-based programs have made great strides in decreasing asthma morbidity among their pediatric population. Only one has completed a thorough cost-analysis. Boston's Community Asthma Initiative's return on investment was $1.46 for every dollar invested. Medical home models used both in urban and rural areas also show promise by decreasing emergency department visits and hospitalizations, but have not been studied for pediatric asthma specifically.

Arguments for policy changes are strongly backed by current research; the potential of additional effective policy changes can be discerned with two additional cost-analyses and impact studies, as recommended below:

1) Environmental remediation with chemical-free allergen and pest removal should be part of standard medical care for high-risk asthma patients. By bundling with the other medical interventions, it has proven to be cost-effective.
2) Emergency Department-based comprehensive care including environmental assessments and remediation, similar to Boston's program, should be implemented in high asthma burden areas throughout the U.S.
3) Further research is needed in pediatric medical home and primary care models to discover their effects on childhood asthma morbidity.
4) Cost-analyses and impact studies for environmental remediation in non-urban areas should be conducted.

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AAP: Asthma Action Plan
ACA: Affordable Care Act
ACO: Accountable Care Organization
CAI: Community Asthma Initiative
CBPR: Community Based Participatory Research
CCNC: Community Care of North Carolina
CDC: Centers for Disease Control and Prevention
CHIP: The Children's Health Insurance Program
CHIPRA: The Children's Health Insurance Program Reauthorization Act of 2009
CHW: Community Health Worker
ED: Emergency Department
EPA: Environmental Protection Agency
FPL: Federal Poverty Level
FQHC: Federally Qualified Health Center
FY: Fiscal Year
HEPA filter: High-Efficiency Particulate Air Filter
IAP: Inpatient Attending Physician
ICHIA: Immigrant Children's Health Improvement Act
IPM: Integrated Pest Management
NHSC: National Health Service Corps
NO_2: Nitrous Dioxide
PCP: Primary Care Physician
ROI: Return on Investment
SES: Socioeconomic Status

INTRODUCTION:

Asthma is one of the leading causes of morbidity among pediatric patients. Significant disparities in both care received and care outcomes are reported across pediatric populations by race/ethnicity, gender, and socioeconomic status. No systematic, cost-effective national programs exist to address these disparities or to reduce asthma morbidity.

The purpose of this project is to assess the evidence that several local and state programs effectively reduce pediatric asthma morbidity across different populations, in both urban and rural settings, in order to gauge replicability and scalability. Program components requiring a more robust science base are identified. Recommendations are made for further research, as well as for expansion of successful programs, in order to create a national policy that provides the most effective and cost-effective programs to treat pediatric asthma for all population groups.

BACKGROUND:

Pediatric asthma burden in the U.S.

"Asthma is a chronic inflammation of the airways with reversible episodes of obstruction, caused by an increased reaction of the airways to various stimuli" (American Lung Association, 2010). Although "asthma attacks" are episodic in nature, the underlying inflammation is continuous. An asthma attack or asthma exacerbation is easily recognizable by its symptoms: coughing, wheezing, chest tightness, and difficulty breathing. This is caused by the airways narrowing from

swelling of the airway lining, tightening of the muscles, and an increase in mucous production. Asthma can be diagnosed at any point in a person's life, and at times can subside completely. Asthma can range from mild to severe; however, even mild cases of asthma can have extreme consequences such as hospitalization or death.

The prevalence of asthma in pediatrics more than doubled from 1980 when 3.6% of children were diagnosed with asthma, to the mid-1990s with 7.5% diagnosed (Akinbami, 2006). Asthma prevalence remains at high levels; Asthma affects 7.1 million children age 17 and under in the U.S., a prevalence of 9.6% (Akinbami & Moorman, 2011), (Woods, et al., 2012). In 2009, one in ten children had received a diagnosis of asthma (Centers for Disease Control and Prevention, 2011), (Sondik, Madans, & Gentleman, 2010). It is the third leading cause for hospitalization, and one of the leading chronic conditions in pediatrics (American Lung Association, 2010), (United States Environmental Protection Agency, 2011), (Akinbami, 2006). In 2006, approximately 32.7% of all hospital discharges with the admission diagnosis of asthma were in children under the age of 15; only 20.1% of the population in the U.S. was under 15 years old (American Lung Association, 2010).

The prevalence of asthma differs demographically. Children in poor health are almost five times more likely to have asthma than children in good or very good health (Sondik, Madans, & Gentleman, 2010). Although this disease affects children in all socioeconomic classes, prevalence increases below the poverty line.

In 2006, the rate of hospitalization for asthma-related conditions was 76% higher among the very poor compared to the wealthy, as defined in the following way: poor communities had median income levels less than $36,000 per year and wealthier communities had median income levels equal to or greater than $36,000 per year (Stranges, Merrill, & Steiner, 2008). Children are more affected than adults, and have higher prevalence of exacerbation. Of those already diagnosed with asthma in 2008, 57% of children had an asthma exacerbation compared to 51% of adults (Centers for Disease Control and Prevention, 2011). Boys have a higher prevalence of asthma and a higher risk of death than girls (Akinbami & Moorman, 2011), (Centers for Disease Control and Prevention, 2011), (American Lung Association, 2010), (Sondik, Madans, & Gentleman, 2010). Non-Hispanic black children have the highest prevalence of any racial or ethnic group, with 1 in 6 children now affected, and prevalence is increasing in this population at an alarming rate (see Figure 1) (Centers for Disease Control and Prevention, 2011), (Sondik, Madans, & Gentleman, 2010). From 2001 to 2009, the rate of diagnosed asthma among non-Hispanic black children increased by about 50% (Centers for Disease Control and Prevention, 2011). Rates of adverse outcomes, such as hospitalizations, emergency department (ED) visits, and deaths are also higher in this population (Akinbami, 2006). The disparity in mortality between black and white children is increasing (Akinbami, 2006). Although there does not appear to be a difference in prevalence between metropolitan and non-metropolitan areas, the Northeast and Midwest have a higher diagnosed prevalence than the rest of the U.S. (Akinbami & Moorman,

2011). State-by-state prevalence ranges from a high of 14.4% in Delaware to a low of 5.2% in Idaho and South Dakota (American Lung Association, 2010).

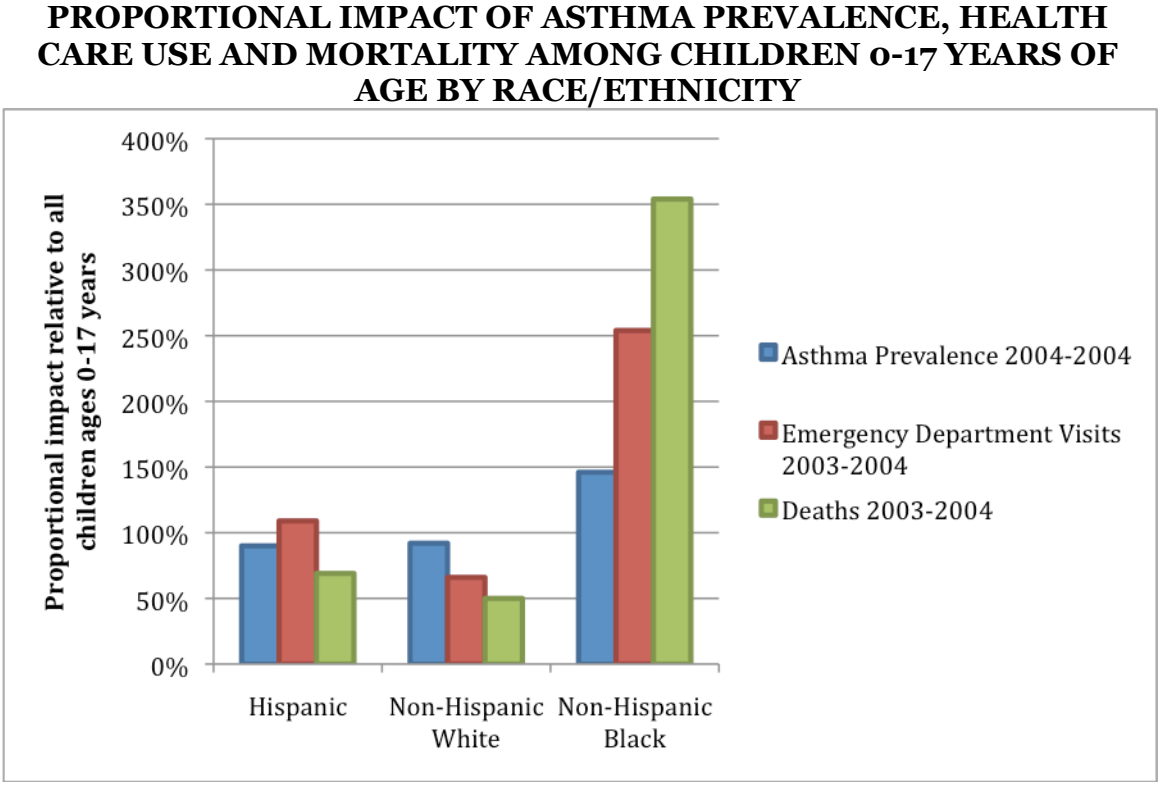

Figure 1: United States 2003-2005 (Akinbami, 2006, p. 9).

Health Services Utilization and Indirect Costs:

In 2007 primary care pediatric facilities had 6.7 million appointments due to asthma. Pediatric asthma resulted in 800,000 visits to outpatient departments in hospitals and 640,000 ED visits. There were 157,000 hospitalizations, with 185 deaths due to asthma. "Health care use is highest among children aged 0-4 (rates per 100 persons with current asthma for total ambulatory visits were 144.9, for ED visits 24.6, and for hospitalizations 8.4)." (Akinbami & Moorman, 2011)

Asthma currently accounts for large direct and indirect costs. The estimated annual cost of treating pediatric asthma was $8 billion in 2006 (Soni, 2009). It has been estimated that asthma increases pediatric health spending by 50 cents for every $1 spent on children with asthma compared to those unaffected (Markus, Lyon, and Rosenbaum 2010).

> "A much greater percent of children hospitalized for asthma were admitted through the emergency department (ED) compared to non-asthma pediatric stays (64.6 percent versus 44.1 percent, respectively). While pediatric asthma stays originated in the ED more often, the in-hospital death rate for these children was much lower (.03 percent or about 40 children in 2006) compared to children with no mention of asthma (0.56 percent or about 12,000 children in 2006). Secondary cases of asthma also originated in the ED more frequently (52.3 percent of stays) and resulted in fewer in-hospital deaths (0.16 percent or 321 children in 2006) compared to non-asthma stays." (Stranges, Merrill, & Steiner, 2008, p. 2)

Societal productivity is severely affected by asthma. This disease is one of the leading causes of school absenteeism and parent missed workdays. Missed school days are estimated to be 10.5 million each year, averaging 4.4 school days per child with an asthma diagnosis (Akinbami & Moorman, 2011). Parents' loss of productivity from asthma-related school absence days was $719.1 million in 1996 (Wang, Zhong, & Wheeler, 2005). Utilizing the U.S. inflation rate for medical care, the equivalent figure would be a loss of over $1.28 trillion[1] in 2012 (MetricMash, 2012). This figure is an underestimate because it does not account for the increase in asthma prevalence and its associated care.

[1] The 1996 inflation rate for medical care = 230.6; 2012 inflation rate for medical care =410.46. Setting up the ratio 230.6/410.46 = 719.1 million/x million, and solving for x, gives the 2012 equivalent to the 1996 expenditure of $719.1 million.

Asthma is not a disease that can be prevented; however, it can be controlled. Current treatment recommendations include medications given daily and/or as a rescue medication only when needed. Compliance with these medications in combination with knowledge of early warning signs and removal of triggers can successfully reduce asthma exacerbation. Exact causes of asthma exacerbations are unknown, but there are several common triggers:

- Dietary sulfites (used mainly as preservatives)
- Respiratory infections, colds, flu
- Exposure to cold air or sudden change in temperature
- Secondary or primary cigarette smoke
- Excitement, stress, or exercise
- Allergen exposure
    - Pollen, mold, pet dander, feathers, dust, food, cockroaches

A recent comprehensive review by Labre, et al. documented asthma burden and costs and assessed the evidence for patient, environmental, clinical, and systems interventions but did not report differences by subpopulation. Different ethnic and socioeconomic groups vary in their successes in controlling asthma. Better understanding why some groups struggle to control this disease process will inform targeted approaches to interventions. (Labre, Herman, Dumitru, Valenzuela, & Cechman, 2012)

DISPARITIES

Despite current treatments for pediatric asthma, black children, Hispanic children, and children from low-income families continue to experience disproportionate rates of asthma prevalence, morbidity, and mortality compared to white children and children from a higher socioeconomic status (SES). (Centers for Disease Control and Prevention, 2011), (Sondik, Madans, & Gentleman, 2010), (Akinbami, 2006)

Several studies have attempted to assess pediatric asthma disparities to determine root cause. Health care access, environmental factors, and social determinants have all been implicated. Differing perceptions of care provided, appropriate medical management, and treatment efficacy between health care providers, parents, and patients contribute to the gaps in disease treatment and outcome. Studies are now showing that disparities among asthmatic children are more than just genetics and SES.

Health Care

Ultimately, the goal for asthma management is to be symptom free with optimized care. This care involves treatment based on pulmonary function evaluations, trigger avoidance, self-management education, and severity classification which determines controller medications. American Academy of Pediatrics recommends that all children with a moderate or severe asthma score be referred to an asthma specialist. It is also a recommendation that all asthmatics have an asthma action plan (AAP). Disparities in health care revolve

around several key factors: the disproportionate use of asthma specialists, asthma action plans, appropriate medications, and communication between patient/parent and provider.

A study done by Flores, et al. discovered four important factors in reducing asthma exacerbation: using an asthma care specialist, having an asthma action plan, having at least one parent employed full time, and having non-smoking caregivers (Flores, et al., 2009). Of these four factors, two are medical interventions. Having an asthma specialist showed a mean reduction of 7 asthma exacerbations in one year; asthma action plans were associated with a mean reduction of 10 exacerbations per year. A child is 5 times more likely to have an action plan if an asthma specialist is seen.

Hispanic and black asthma patients are less likely than their white counterparts to receive appropriate medical care as defined by the American Academy of Pediatrics, including specialty care, controller medications, and asthma action plans. This population more often uses the emergency department for primary asthma care, and even if a primary care provider is used, these asthmatics are less likely to see a specialist (Flores, et al., 2009), (Bryant-Stephens, 2009). Unfortunately, a patient with higher asthma severity is no more likely to see an asthma specialist than one with mild asthma symptoms in the low-income population (Flores, et al., 2009); a patient in a lower income bracket exhibiting moderate asthma symptoms is three to four times less likely to have specialty care (Flores, et al., 2009). Black children are also less likely to use controller

medications than white children (Bryant-Stephens, 2009). Although asthma action plans are widely accepted as a means to significantly reduce the odds of an exacerbation in the medical community, severe asthmatics are not more likely to have action plans than mild asthmatics in the low-income population (Flores, et al., 2009).

Communication difficulties between providers and patients and their families also lead to greater disparities in this population. Several studies have shown that physicians seeing black patients are more likely to take control of the conversation and less likely to have a two-way patient-centered discussion about health concerns (Bryant-Stephens, 2009), (Stewart, Higgins, McLaughlin, Williams, Granger, & Croghan, 2010), (Diette, 2007). Health care providers tend to misinterpret common descriptive wording surrounding asthma symptoms among black patients, causing underestimation of asthma severity and, therefore, inappropriate treatment (Bryant-Stephens, 2009). Even when correct medications are prescribed, at least one third of the patients do not take medications appropriately due to cultural factors and health beliefs (Bryant-Stephens, 2009). Health care providers are less likely to have an understanding of their patients' literacy levels, health literacy understanding, and language barriers (Bryant-Stephens, 2009). It is believed that the most influential factor in changing a patient's health beliefs is a trusting, communicative relationship with his/her regular health care provider (Bryant-Stephens, 2009). Effective assessment of health literacy and health beliefs leads to improved patient/provider interactions. Improved communication and understanding

positively affects parent and patient health beliefs, improves adherence, and decreases ED visits and hospitalizations (Bryant-Stephens, 2009), (Stewart, Higgins, McLaughlin, Williams, Granger, & Croghan, 2010).

Environmental Factors

Environmental quality plays an important role in asthma. People in lower income homes and schools are disproportionately affected by increased numbers of allergens for prolonged exposure times. Studies have shown that those who have asthma are sensitive to more than one allergen or irritant (Bryant-Stephens, 2009). Older dilapidated homes frequently have increased levels of multiple allergens (Bryant-Stephens, 2009), (National Heart Lung and Blood Institute). Over-crowded and substandard housing are breeding grounds for allergens and irritants that are detrimental to asthmatics. Low income and dilapidated housing tend to have water damage and excessive moisture, breaks in walls, poor ventilation and deteriorated carpeting, producing increased levels of cockroaches, rodents, nitrous dioxide, and dust mites (Bryant-Stephens, 2009), (National Heart Lung and Blood Institute). Occupancy in a rental property for more than 2 years is also associated with cockroach allergen levels (Bryant-Stephens, 2009). Nitrous dioxide (NO_2) is a byproduct of combustion; gas stoves and space heaters are the most common sources of NO_2 inside low-income households. Because of poor ventilation, inner-city homes frequently exceed EPA recommended levels of this common byproduct (Bryant-Stephens, 2009). Low-income housing is generally located in industrial areas or near high-traffic areas. This combined with the poor ventilation increases exposure to air pollution from traffic, diesel

exhaust, and industrial sources (National Heart Lung and Blood Institute), (National Institute for Health Care Management Research and Educational Foundation, 2007). All of these environmental factors contribute to asthma morbidity.

Social Determinants

Environmental factors are not the only causes of increased asthma morbidity among certain population subgroups. Many pediatric asthma patients have insufficient access to care to effectively treat their condition. Medicaid may improve access to care, but like other forms of insurance, it does not insure continuity of care or even the ability for families to receive care (National Institute for Health Care Management Research and Educational Foundation, 2007). Segregation of neighborhoods leads to social and geographic isolation. Caregivers have less ability to procure transportation to get to appointments or to pick up medications (Bryant-Stephens, 2009). Pharmacies in segregated and poor neighborhoods are less likely to be properly stocked (Williams, Sternthal, & Wright, 2009). Quality of care suffers because there are lower rates of board certification among physicians in low-income neighborhoods. Physicians in these neighborhoods are also less likely to refer to specialists (Williams, Sternthal, & Wright, 2009), (Bryant-Stephens, 2009). Hospitals in these areas tend to have lower resources, have a higher patient to nurse ratio, and are more likely to close (Williams, Sternthal, & Wright, 2009).

Because of both the patients' and caregivers' limited resources and support, it is

essential for healthcare providers to become familiar with each family's social stressors. Psychosocial stressors are a known cause of increased inflammatory response, causing decreased pulmonary function and increased illness and hospitalization (Bryant-Stephens, 2009). The health care provider's unfamiliarity with caregiver social stressors, therefore, affects his/her ability to maintain appropriate treatment (Williams, Sternthal, & Wright, 2009), (Bryant-Stephens, 2009), (Garg, Butz, Dworkin, Lewis, & Serwint, 2009). Effective provider/patient communication can optimize care when based on knowledge of lifestyle, including the social stressors at home (Bryant-Stephens, 2009).

A unique study done in the military population showed similar results to those discussed throughout this section (Stewart, Higgins, McLaughlin, Williams, Granger, & Croghan, 2010). Over 800 thousand pediatric asthmatics with equal access to health care (n=822,900) were included in this retrospective cohort study. Pay grade and rank were used to mimic SES. After stratifying by age group, Stewart et al. found that black children in all age groups and Hispanic children in the 5 to 10 year old age group were significantly more likely to have potentially avoidable asthma-related ED visits or hospitalizations. They were also significantly less likely to see an asthma specialist, which the authors defined as either an allergist or a pulmonologist. Although black children were more likely to have filled a prescription for corticosteroids, Hispanic and black children had worse outcomes and a higher prevalence of asthma compared to white children.

Because asthma outcome disparities remained in spite of equal access to health

care (universal health care), the authors investigated possible reasons for the differences in the population subgroups. The authors found similar reasons as for those summarized in the multiple studies discussed above. There was a large difference in quality of care provided to minority children. It is widely accepted that asthma specialists use the asthma guidelines and prescribe controller medications more appropriately. Hispanic children and black children were less likely to have ever been seen by an asthma specialist. It was also discovered that there is a difference in communication and trust between health care providers and either black or Hispanic families compared to white families. Again, it was found that black families were not being involved in two-way patient-centered conversations with their health care providers. In this study, however, black children were most likely to have filled their corticosteroid prescriptions. It was hypothesized that because of differences in health care beliefs and health literacy, medication adherence may not have occurred. (Stewart, Higgins, McLaughlin, Williams, Granger, & Croghan, 2010)

This study did not investigate environmental factors. Because military families move with frequency and do not have prolonged exposure to any specific set of allergens, the authors believe environmental triggers may not be as great a factor in this population.

Perceptions

Several studies have looked at perceived barriers to asthma control from the point of view of health care providers, patients, and parents. Communication

between the providers and the patients' families are not always ideal. Even when information is available, the patient and his/her family may not always understand the information. Although early warning sign programs exist, about one-half of asthmatics state they have not been taught how to avoid triggers or how to identify early warning signs (Sondik, Madans, & Gentleman, 2010).

A small study in Atlanta (n=28) investigated health beliefs regarding asthma and daily medications in children and their caregivers (Laster, Holsey, Shendell, Mccarty, & Celano, 2009). Children report a feeling of invincibility and a general lack of concern about taking medications as reasons not to adhere to prescribed treatment. The children also felt that their daily medications were pointless; taking them did not increase or decrease their risk of having an asthma attack.

In the Atlanta study, caregivers had several reasons for not enforcing daily medications: inaccurate health beliefs, financial constraints, and beliefs that the health care system is inadequate. Caregivers in general did not see the importance of daily medications, believing that their children would "outgrow" this illness. Controller medications were perceived as necessary only during allergy season or when the child was ill. Caregivers were also concerned with both addiction and immunity toward the daily controller medications.

Common concerns with financial constraints included both medical care costs and the expense of remediating environmental triggers. Many families in the study had inconsistent and/or inadequate insurance coverage. Navigating the

system is difficult. Several families did not meet the income requirements for Georgia's Children's Health Insurance Program (CHIP), but found that private insurance and their co-pays were cost-prohibitive. Environmental remediation was too difficult for the majority in this study. The families' concerns included: overcrowded living conditions, caregivers' inability to afford environmental remediation on their own, and landlords who were unwilling to provide this service. Several also mentioned the concern of environmental triggers in the schools, which they felt powerless to control. Caregivers also believed that school systems were ill equipped to handle a child with asthma.

Caregivers were disappointed in the health care system, feeling that the physicians were not forthright with their diagnoses, and therefore had a difficult time believing in the treatments. Parents found that multiple diagnoses were given (bronchiolitis, bronchitis, and colds) before a final diagnosis of asthma. Because formularies in hospitals and in insurance companies constantly change, their children were unable to stay on effective regimens, thus furthering frustrations with the system.

The majority of caregivers in this study, as well as in many other studies, believe that the most influential factor in their child's asthma treatment is a positive relationship with the health care provider. Although this study is small, it gives us insight into how perceptions and health beliefs can affect appropriate care.

Another small qualitative study by Flores et al investigated differing perceptions of 55 parents, 63 primary care physicians (PCP), and 87 inpatient attending physicians (IAP) on preventable asthma hospitalizations of 230 children (Flores, Abreu, Tomany-Korman, & Meurer, 2005). As the table below indicates, there is a significant disparity in the perceptions that each group has on triggers, adherence to medications, follow-up care, education, and quality of care. The results are similar to the Atlanta study. Both of these studies were small and only included inner-city populations. Further evaluation on perception should be evaluated with larger and more diverse samples.

REASONS FOR PREVENTABILITY OF HOSPITALIZATIONS, ACCORDING TO PARENTS, PCPS, AND IAPS OF CHILDREN WHO WERE HOSPITALIZED WITH A PRIMARY DIAGNOSIS OF ASTHMA (N=230)

Reason Asthma Hospitalization Was Preventable	Proportion Considered Preventable by Source*		
	Parent (N=55), %	PCP (N+63), %	IAP (N=87), %
Parent/patient related	43.6[a]	82.5[e]	66.7[h]
Medication related (adherence problems, ran out, did not call in refill)	29.1	47.6	39.1
Inadequate prevention, including not avoiding known disease trigger	12.7	12.7	9.2
Delayed or did not bring child in for follow-up	0[a]	31.7	21.8[f]
Needed to call earlier	0	1.6	0
Did not monitor child's peak flow	0	1.6	0
Appropriate care not provided at home	1.8	0	3.4
Parents did not adequately educate themselves	0[b]	14.3	10.3[g]
Physician related	27.3[c]	11.1[d]	26.4
Inadequate or no intervention administered to child	9.1	6.3	11.5
Physician did not adequately educate parent / child	3.6	4.8	6.9
Poor quality of care	9.1	1.6	8.0
No follow-up arranged	1.8	0	2.3
Child discharged from hospital too early	1.8	0	1.1
Child not referred to specialist	1.8	0	1.1
Inappropriate admission	0	0	1.1
Equipment / medication failure	7.3	1.6	2.3
Housing conditions	5.5	4.8	3.4
Financial issues	1.8	0	1.1
Health care system issues	0	4.8	4.6
Social issues	0	6.3	5.7
Employment exposure	1.8	0	0
No reason / don't know	5.5	3.2	4.6
Other	9.1[c]	0	1.1[i]

* Each source could choose >1 reason, so column totals exceed 100%
P values for comparisons between parents and PCPs: a <.001; b <.01; c .02
P values for comparisons between parents and IAPs: d <.001; e .01; f <.01; g .03
P values for comparisons between PCPs and IAPs: h .02; i .03

Figure 2: Source: (Flores, Abreu, Tomany-Korman, & Meurer, 2005)

MEDICAID, CHIP, AND CHILDREN

As stated above, low-income children have a much higher prevalence of asthma incidents. In order to study the effectiveness of interventions, environmental remediation, or even healthcare perceptions, we must understand the insurance options and the corresponding financial limitations placed upon the pediatric asthmatic patient and his/her family. Since both the federal and state governments have taken on a major role in providing medical coverage for the

poor and, in particular, the children, we must understand how these programs currently work in order to improve the care of the pediatric asthmatic.

Medicaid was established in 1965 as a federal-state public health insurance program for low-income and disabled individuals. It has become the largest source of funding for medically related services for low-income people in the U.S., and covered an estimated 51.9 million children in 2009 (Georgetown University, 2009). Each state is able to create its own minimum requirements for eligibility after meeting the minimum federal standards. By 2014 the Patient Protection and Affordable Care Act (ACA, signed into law March 23, 2010) will extend minimum federally required coverage for individuals who fall into an income bracket up to 133% of the federal poverty line, and expand to include childless individuals. During the recent recession Medicaid became the safety net for millions, especially children, who would have otherwise become uninsured. Nationwide, there was a 16.4% increase in enrollment of children in Medicaid from June of 2008 to June of 2010 (Kaiser Family Foundation, 2011).

Although the state variation in Medicaid coverage differs greatly among adults, it is more stable for pregnant women and children. All states have expanded Medicaid/CHIP coverage for children to levels above the federal minimums. To help sustain this coverage for children, ACA requires states to maintain eligibility policies for children in Medicaid and CHIP until September 30, 2019 (Kaiser Family Foundation, 2010). As of January 1, 2012, all but four states (Alaska, Idaho, North Dakota, and Oklahoma) set their criteria to FPL of 200% or above,

with half of the states and Washington D.C. providing coverage to children with family income at 250% FPL or above (Kaiser Family Foundation, 2012). All but Arizona have CHIP as open enrollment (Kaiser Family Foundation, 2012).

CHILDREN'S ELIGIBILITY FOR MEDICAID/CHIP BY INCOME, JANUARY 2012

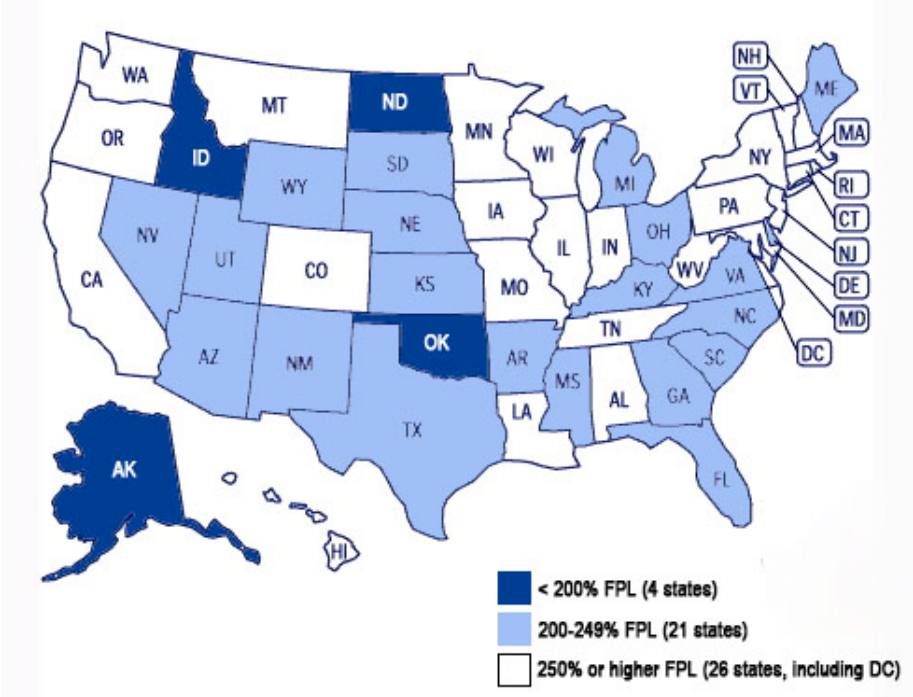

Figure 3: The federal poverty line for a family of 3 in 2011 is $$18,530 per year. OK has a premium assistance program for select children up to 200% FPL. AZ's CHIP program is currently closed to new enrollment. (Kaiser Family Foundation, 2012)

For children, Medicaid covers comprehensive medical services, including primary care, preventative care, hospitalizations, mental health care, and services for the disabled (which may not be covered by private insurance). Transportation and translation, also covered by Medicaid, are helpful in reducing barriers to access that inherently exist within a multi-cultural nation.

Medicaid is the largest source of health insurance for children, covering 29 million children 18 years of age and younger (Kaiser Family Foundation, 2009). The Children's Health Insurance Program (CHIP) builds on this coverage by insuring an additional 7 million children whose families do not qualify for Medicaid, but cannot afford private insurance. CHIP differs greatly between states. In twelve states, plus Washington D.C., CHIP is an integral part of the Medicaid program. Seventeen states use CHIP as a separate program, one which provides care for children who do not qualify for Medicaid but cannot afford private insurance. Twenty-one states use a combination of the two (Kaiser Family Foundation, 2011).

Together, Medicaid and CHIP insure 1 in 3 children in the U.S., and almost 3 in 5 low-income children (59%) (Kaiser Family Foundation, 2011). Medicaid and CHIP have helped to reduce the rate of uninsured children. Nationwide, 90% of children are insured, but this rate varies significantly between states. The lowest Medicaid and CHIP participation rate is 62.9% in Nevada, and the highest is in Washington, D.C. at 97%. Participation rates are defined as the ratio of eligible children enrolled in Medicaid/CHIP to the sum of those children plus eligible, but uninsured children. In 2009, the national average participation rate was 84.8% (Kaiser Family Foundation, 2011). A study by King, et al., found that participation rates among children were slightly higher in rural areas, but particularly low in the urban South (King, Slifkin, & Holmes, 2009). They also found that as a family's income increased, participation of eligible children decreased.

CHILDREN'S MEDICAID/CHIP PARTICIPATION RATES, 2009

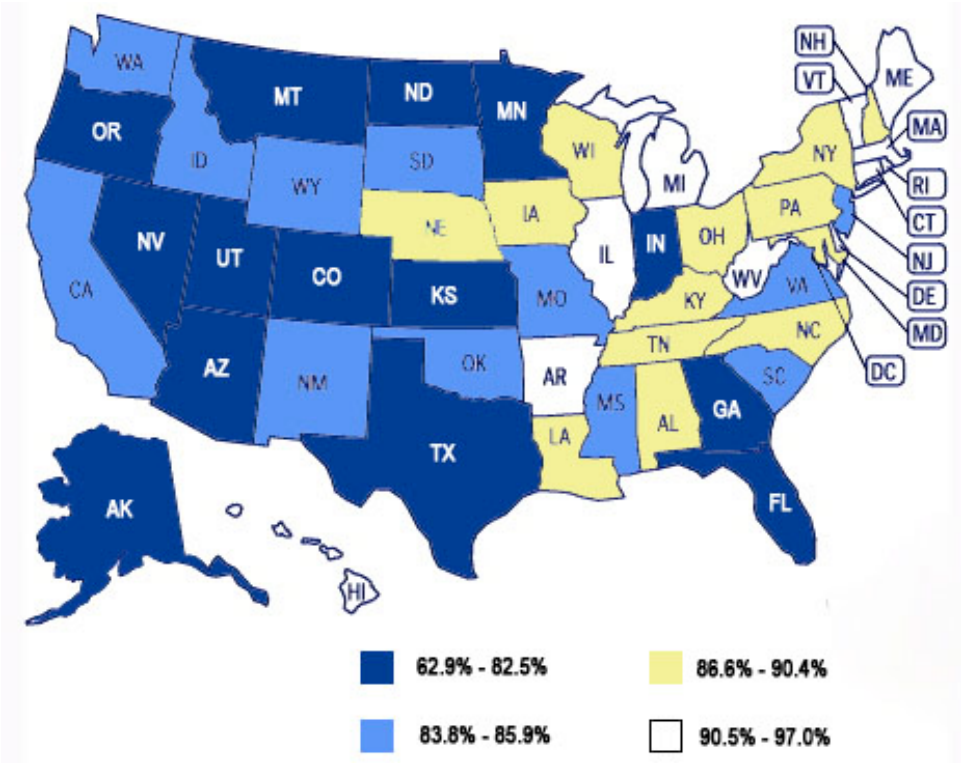

Figure 4: Participation rates are determined by the percent of eligible children who are enrolled in Medicaid/CHIP (Kaiser Family Foundation, 2009)

The Children's Health Insurance Program Reauthorization Act of 2009 (CHIPRA) was passed in order to change this discrepancy between states and to increase enrollment overall. Eight million children remain uninsured; 5 million of these children are thought to qualify for public insurance (Kaiser Family Foundation, 2011). CHIPRA gives monetary incentives to states that surpass national goals for enrollment and create programs to increase this enrollment. Nine states have been awarded money for their improvements by the end of 2009 (Kaiser Family Foundation, 2010).

Until CHIPRA was passed, lawfully residing immigrants could not be covered under Medicaid or CHIP for their first five years in the U.S. Congress allowed for states to receive federal Medicaid matching funds, through CHIPRA, for lawfully residing immigrant children (and/or pregnant women) during their first five years in the U.S. (Kaiser Family Foundation, 2009). This program is known as ICHIA, or Immigrant Children's Health Improvement Act. As of January 1, 2011, 20 states and the District of Columbia had adopted this option (Kaiser Family Foundation, 2011). This law does not change eligibility requirements, nor does it change the definition of a legally residing immigrant (Kaiser Family Foundation, 2009).

Medicaid/CHIP is intended to cover those in the lower-income brackets. Several studies have found that among other illnesses, Medicaid/CHIP children are more likely to have asthma than are those who are privately insured, and their care accounts for significant program outlays. "Hospital stays are usually the most expensive form of medical care, and children age 17 and under are much more likely to be admitted to a hospital for asthma than are adults (27.5 per 10,000 vs. 12.7 per 10,000). In fact, asthma admissions accounted for 7.4 percent (152,000) of all hospital admissions for children and adolescents in 2000. Almost half of hospitalizations for asthma among children are billed to Medicaid" (Agency for Healthcare Research and Quality, 2005).

HEALTH INSURANCE COVERAGE OF CHILDREN BY INCOME AND RACE, 2009

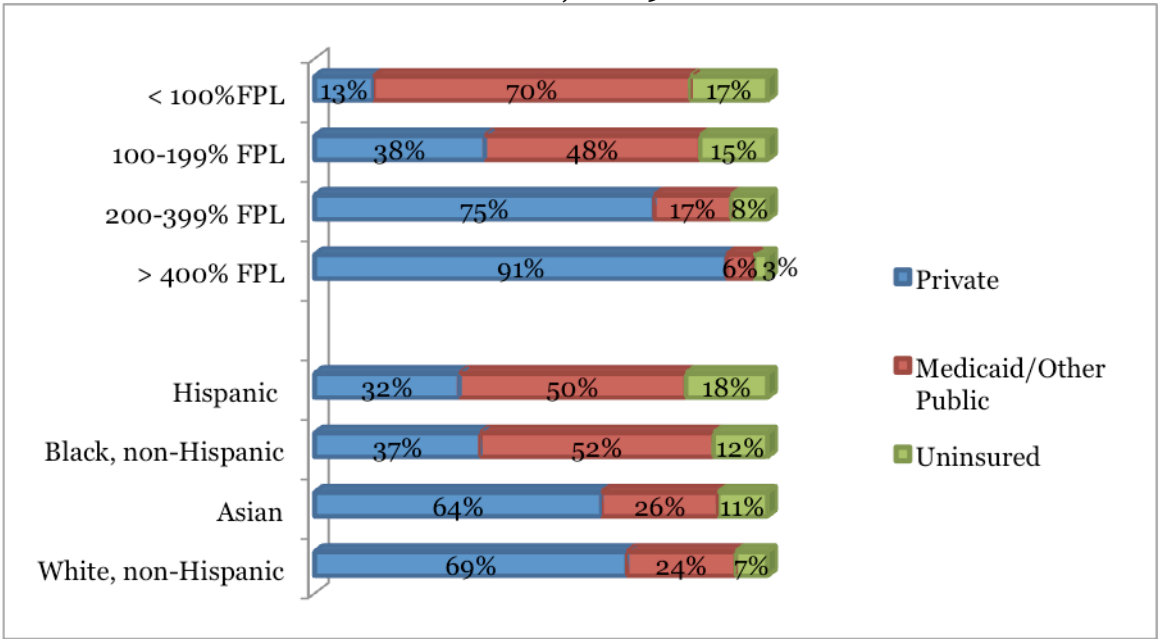

Figure 5: Asian includes Pacific Islander. The FPL for a family of 4 was $22,050 in 2009. (Kaiser Family Foundation, 2011)

One of the primary goals of health reform is to extend coverage to provide assistance to individuals whose income falls below the 400% FPL. By 2014, Medicaid will be expanded to a national eligibility minimum of 133% FPL, and include the disabled, pregnant women, children, and childless individuals (men and women). Most states cover children and pregnant women up to the 200% FPL, but will have the option of transitioning those above 133% FPL to the Exchange coverage. By expanding coverage, the hope is to provide assistance to those who were ineligible and uninsured. Kaiser commission prepared an analysis of state-by-state changes that will take place. They did not thoroughly examine the changes that will affect children, but state:

> [T]hese provisions generally seem to benefit states financially. Under the new law, states are required to maintain coverage levels for children in Medicaid and CHIP through 2019 and funding for CHIP is extended from 2013 through 2015. If CHIP is reauthorized by 2015, the new law provides states with a 23 percentage point increase in the CHIP match rate (up to 100 percent) and if CHIP is not reauthorized, we assume that these children (i.e., those above 133% FPL) would likely be enrolled in exchanges with all subsidies financed by the federal government. (Holahan & Headen, 2010)

In order to decrease disparities and improve asthma outcomes in the pediatric population, there needs to be increased access to care, including care by specialists, decreasing environmental triggers, and increasing use of controller medications. Access to this care is not only determined by insurance status, but also on effective programming. Because pediatric asthma disparities produce a great burden on the CHIP programs, finding ways to decrease asthma morbidity will assist with decreasing medical costs associated with asthma exacerbations.

CURRENT PILOT PROGRAMS:

Accounting for each factor that increases care outcome disparities among asthmatic children can seem overwhelming. It is important to focus on programs that have shown promise and have made strides in decreasing disparities. While there are predisposing factors of asthma that cannot be controlled, such as genetics and gender, several pilot programs have successfully altered outcomes by targeting controllable risk factors. By merging evidence-based clinical interventions with promising community-based supports in a realistic approach, both clinical and financial successes have been seen in several of these on-going asthma pilot programs.

Over the past two decades multiple studies and pilot programs to help reduce the burden of asthma have been conducted. Many have had very limited successes; however, several models show great promise.

The National Institutes for Health's National Asthma Education and Prevention Program (NAEPP) has defined four components of effective asthma management (National Heart, Lung, and Blood Institute, 2007, p. 35):

1. Measures of assessment and monitoring, obtained by objective tests, physical examination, patient history and patient report, to diagnose and assess the characteristics and severity of asthma, and to monitor whether asthma control is achieved and maintained;
2. Education for a partnership in asthma care;
3. Control of environmental factors and comorbid conditions that affect asthma;
4. Pharmacologic therapy.

NAEPP additionally recommends 6 key actions:

1. Use inhaled corticosteroids to control asthma.
2. Use written asthma action plans to guide patient self-management.
3. Assess asthma severity at the initial visit to determine initial treatment.
4. Assess and monitor asthma control and adjust treatment if needed.
5. Schedule follow-up visits at periodic intervals.
6. Control environmental exposures that worsen the patient's asthma.

Because current medical practice typically falls short of recommended guidelines, many programs have tried to target one or more specific aspects of care, with one or more of the following interventions: by increasing use of controller medications, by increasing use of specialist care, through parent/family education, through physician education in order to have more physicians practicing standard of care, through allergen avoidance, through environmental trigger education, or with single or multi-trigger environmental remediation.

These programs have had varied successes. Each of the interventions, with the exception of multi-trigger environmental remediation, has had only limited success by itself. When an intervention was combined solely with community outreach and/or patient-family education, it showed variable success rates and duration (Labre, Herman, Dumitru, Valenzuela, & Cechman, 2012).

The most successful type of education is self-management education (Labre, Herman, Dumitru, Valenzuela, & Cechman, 2012), a form of education recommended by the NAEPP. Self-management education is based on patients' perceptions of their asthma. Specific training in self-management coupled with expert care and regular follow-ups are important in improved quality of life, percieved control over this disease, and trust in treatment (National Heart, Lung, and Blood Institute, 2007).

Removing multiple allergens from the home is the only solo intervention that has proven to be effective. These home-based multi-trigger environmental remediation programs have consistently shown a reduction in asthma exacerbation rates, decreased ED visits, decreased missed school days, decreased missed parent workdays, and increased days of normal activity. Many of these environmental remediation programs also include a self-management education component (Labre, Herman, Dumitru, Valenzuela, & Cechman, 2012). A systematic review by Crocker, et al., found that home-based, multi-trigger environmental remediation improves overall quality of life and productivity in children and adolescents with asthma (Corcker, et al., 2011). This review also

reported economic analyses from six of the studies and found that the cost-benefit ratios of these programs suggest that home-based, multi-trigger environmental remediation provides substantial returns on each dollar invested for direct medical care and quality of life. In three studies, cost-benefit ratios ranged from $5.3-$14, which suggests that these interventions provide substantial returns on each dollar invested. Three additional studies reported costs ranging from $12-$57 per additional asthma symptom-free day. This cost-effectiveness range is lower than the standard cut-off used in the cost-effectiveness literature; it indicates a good value for money invested.

The programs that have had the greatest impact on pediatric asthma outcomes are comprehensive, employing two differing intervention models. One targets high burden areas through the emergency department and the other is centered on primary care in a broad patient population.

There have been several smaller models of comprehensive asthma care. Some examples of programs which have used ED-driven coordination of care in high-burden areas include Washington DC's IMPACT DC, Honolulu's Hawaii CARES, and Children's Hospital Boston's Community Asthma Initiative (CAI). Other models, such as San Francisco's Yes We Can Asthma Partnership and New York City's The Harlem Children's Zone Asthma Initiative are community or clinic based. Not all programs targeted all four areas of effective pediatric asthma management, so they had different levels of success. While IMPACT DC and CAI appear to be the most similar in the services provided, with the most similar and

impressive outcomes, CAI is the only program to date where the research has also included an extensive cost analysis.

The Children's Hospital Boston's Community Asthma Initiative (CAI) is a prime example of a successful, cost-effective program in a high-density area. Asthma was targeted for several reasons. The primary admission diagnosis at Boston Children's Hospital is asthma (Sommer, et al., 2011). Because of the high cost, high prevalence, and high rate of repeat admissions and ED treatments, especially among the Medicaid population, asthma was seen as a crucial topic to address.

Because Massachusetts' asthma prevalence (9.5%) was on par with the national average (9.6%) in 2009 (Woods, et al., 2012), and Boston's demographics are similar to other urban centers, Boston was the perfect location to study the effects of this type of health care initiative. Mirroring national asthma disparities, Boston shows a higher prevalence of pediatric asthma among African American children and Latino children, compared to white children.

CAI targeted children aged 2-18 who were admitted to the hospital or treated in the ED for asthma. Medicaid/CHIP covers more than 70% of this population; 47% are Hispanic and 46% are African American children (Woods, et al., 2012), (Sommer, et al., 2011) (Agency for Healthcare Research and Quality, 2011). The average prevalence in the urban Boston public school system is 16%, with >24% asthma prevalence in 5 schools (Woods, et al., 2012). The program was

implemented in three phases, beginning with 5 high-burden neighborhoods that accounted for 70% of the asthma-related admissions (Sommer, et al., 2011). Because of noted improvements, in July of 2008, one more zip code was added. A year later, CAI was able to hire more staff and extend their program to triage all children at risk, i.e., those with 1 or more hospitalizations related to asthma, 2 or more ED visits or courses of steroids in 12 months, or poorly controlled asthma with repeat urgent care visits with the following risk factors: non-adherence to medications, environmental triggers, or social stressors (Sommer, et al., 2011).

The NAEPP, Centers for Disease Control and Prevention (CDC), and Environmental Protection Agency (EPA) endorse home-based asthma education and environmental interventions; these interventions are seen as important and cost-effective (Sommer, et al., 2011). CAI modeled their program after two successful programs: San Francisco's Yes We Can Asthma Partnership and New York City's The Harlem Children's Zone Asthma Initiative, but CAI increased their efforts on environmental remediation and included a cost-analysis. Through community based participatory research (CBPR), CAI found that a family advisory board enhanced its program. CAI worked closely with and formed partnerships with community stakeholders and families, including existing community organizations. By working closely with these organizations, referrals for other needed services were easily made. Creating a sense of community ownership increased the success of the program further. CAI was able to decrease disparity by addressing the individual, the family, the community, and systematic changes (Sommer, et al., 2011).

CAI's program design has three major components (Sommer, et al., 2011), (Woods, et al., 2012):

1) Asthma case management

This element includes referrals to and the coordination of care between primary care providers, specialists, and community resources.

2) In-home assessments and education

Nurses are used for medically complicated or uncontrolled asthmatics; community health workers (CHWs) are used for controlled cases. This part of the program includes medication and trigger education, asthma action plans (AAP), and environmental assessments. The nurses and CHWs who are sent into the homes are culturally and linguistically competent in order to address personal beliefs and obstacles regarding asthma as a disease and the necessary treatments (Sommer, et al., 2011), (Woods, et al., 2012). The nurses and CHWs also act as advocates for the families they serve.

3) Case-by-case environmental remediation

When deemed necessary, actions that may be taken are bed encasements, HEPA filters, and Integrated Pest Management including non-chemical extermination. "Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage

by the most economical means, and with the least possible hazard to people, property, and the environment" (Environmental Protection Agency, 2012).

During the initial phase of implementation, CAI made several discoveries that affected subsequent programming. Many children required much more aggressive environmental services than originally planned (Woods, et al., 2012). They also discovered that the program was ineffective when using contracted employees (Sommer, et al., 2011), (Agency for Healthcare Research and Quality, 2011) because service coordination was not occurring. Centralized coordination of services at the hospital by staff rather than contractors made a significant positive difference in the results. Additionally, the family advisory board composed of parents involved in the program was found to be influential in program success. This board, which provided the families with an important role in the process, identified gaps in programming and community education, organized community forums, testified in legislative hearings, and shared personal experiences about their children (Sommer, et al., 2011).

CAI's results have been impressive. Parental reports of 12 months pre-enrollment to 12 months post-enrollment have all had statistically significant ($p<0.001$) results (Sommer, et al., 2011):

- ED visits: 64% reduction
- Hospitalizations: 79% reduction
- Days of limited physical activity: 32% reduction
- Missed school days: 41% reduction

- Missed parent workdays: 46% reduction
- Asthma Action Plans: 56% increase

The mild increase from 6 to 12 months post-enrollment shown in the graph below is thought to be due to seasonal variation (Woods, et al., 2012).

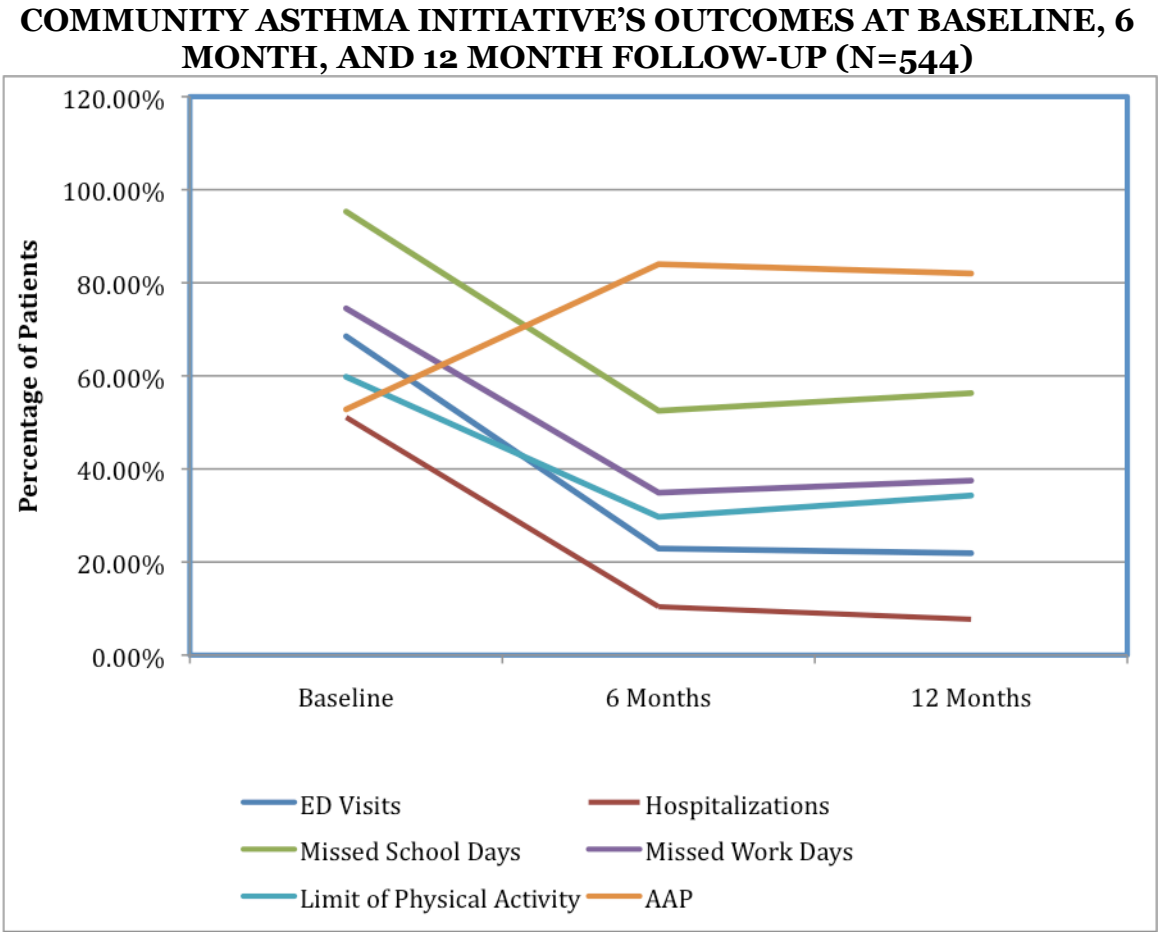

Figure 6: Source (Woods, et al., 2012)

A cost analysis was completed by using a comparison group in demographically similar zip code neighborhoods (Woods, et al., 2012). Initial costs were higher in the CAI group because enrolled patients had the highest need. By the end of the first year, however, costs were similar to the comparison group, but with a

significant reduction from baseline cost for the CAI group. At the end of the second year, this high-risk group had even lower costs than that of the comparison group. This is believed to be due to the ongoing improved allergen reduction and continued use of controller medications (Woods, et al., 2012). The cost of the clinical program was $2592/child and savings for the intervention group were $3827/child over 2 years of follow-up, yielding a return on investment (ROI) of $1.46, chiefly due to reductions in ED visits and unplanned hospitalizations (Woods, et al., 2012).

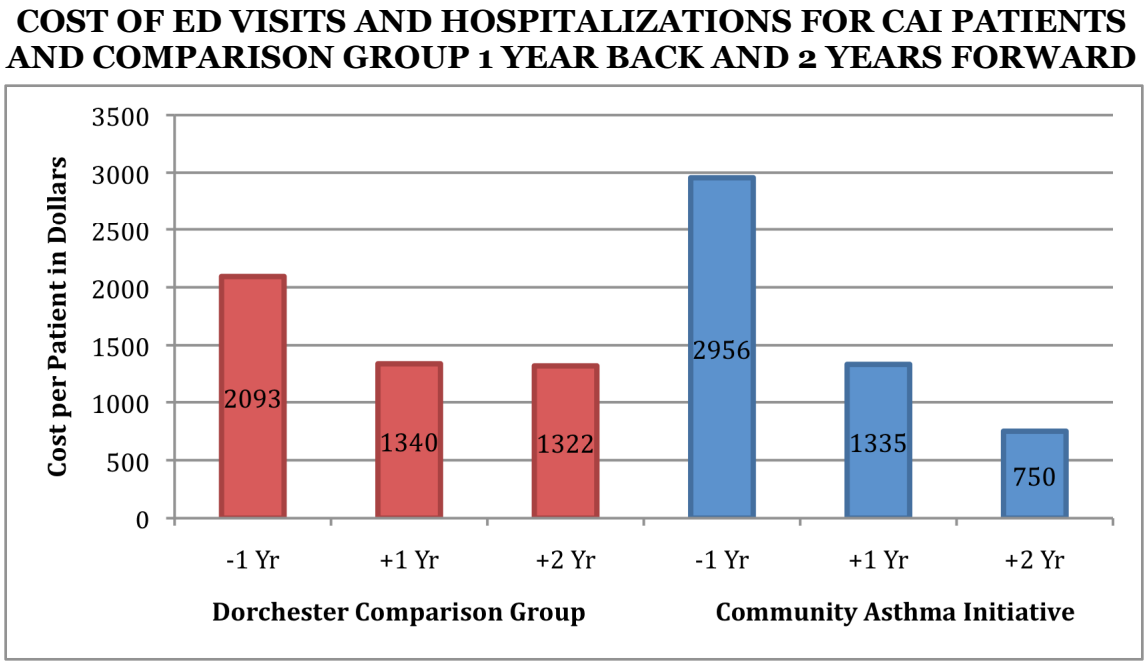

Figure 7: FY2006; CAI patients (n=102), Dorchester Comparison Group (n=559). Repeated-measures analysis comparing intervention and comparison groups, $p < .001$. (Woods, et al., 2012)

There are limitations to this study. At 33 months, only 50.3% of eligible patients were enrolled (Sommer, et al., 2011). Of these patients, only 77% received one or more home visits (Sommer, et al., 2011). The retention rate at 6 months was 68%,

and 60% at one year (Woods, et al., 2012). Additional initiatives need to be discovered for the patients who were not reached. The cost analysis was also incomplete. The cost savings for increased productivity for both children and parents was not assessed. Also, outpatient primary care services and medicines were not included in the cost analysis.

CAI's cost analysis has shown that bundled payment for comprehensive, coordinated care of pediatric asthma could be cost-effective and perhaps cost-saving. CAI is currently moving forward working with Medicaid and other stakeholders to develop and implement a bundled payment pilot (Woods, et al., 2012, p. 471). Should this venture prove to be successful, CAI will have provided an effective pediatric asthma bundled care model that pulls together both medical and non-medical intervention techniques to provide the best and most cost-effective care available.

Because CAI's program aligns with the recommendations set forth by the NAEPP, it shows an impressive reduction in asthma morbidities, and it has a cost-effective business plan, CAI is a promising program for implementation in urban high-burden areas. There have been no studies for effective pediatric asthma control programming in lower density and/or rural areas. It is possible, however, that comprehensive programs may also be successful in these areas through care coordination in primary care settings. Two programs that show promise are Community Care of North Carolina (CCNC), a Medicaid enhanced medical home model, and Federally Qualified Health Centers (FQHC), a primary care system

for the underserved. Although CCNC stratified their cost-analysis data by disease, neither CCNC nor FQHCs have research focused specifically on pediatric asthma. Because a decrease in rates for hospitalizations and ED visits are associated with these medical home models, general health care costs have decreased. FQHC patients "were about one-third less likely than [patients of private, fee-for-service providers] to have emergency department visits, inpatient hospitalizations, or preventable hospital admissions" (Rothkopf, Brookler, Wadhwa, & Sajovetz, 2011). CCNC also had a decrease in ED visits and hospitalizations for their overall asthma population. Because of the great promise shown in the general population, these medical home models should be considered for improving pediatric asthma management as well.

These already existing medical home models are interesting because of their differences in community and location. CCNC is a community-based, statewide, managed care Medicaid program that covers both urban and rural areas. FQHC is a federally recognized program also in urban and rural areas, but is made up of isolated centers for medical care.

CCNC is an enhanced medical home that began in 1998. It has three components: 1) Care coordination: Each patient is linked to a primary care provider who provides medical care for acute, chronic, and preventative care, with 24/7 call hours. Case managers, who are social workers, nurses, or other clinicians, identify and help manage high-cost high-risk patients.

2) Disease management programs: These are programs that give targeted education, care coordination with appropriate specialists, and improved management. Asthma, diabetes, and congestive heart failure are examples of the diseases targeted.

3) Quality improvement: Increased continuing education and evidence-based best practice are emphasized. There is also a system in place for data collection, reporting, monitoring and evaluation for trends throughout the state. This enables sharing of successful strategies and shows areas for needed improvement. (Kaiser Family Foundation, 2009)

CCNC is a system of non-profit community networks which link providers, hospitals, social services and county health departments. Because each of the networks is local, they are able to tailor their care to the needs of each community. (Kaiser Family Foundation, 2009)

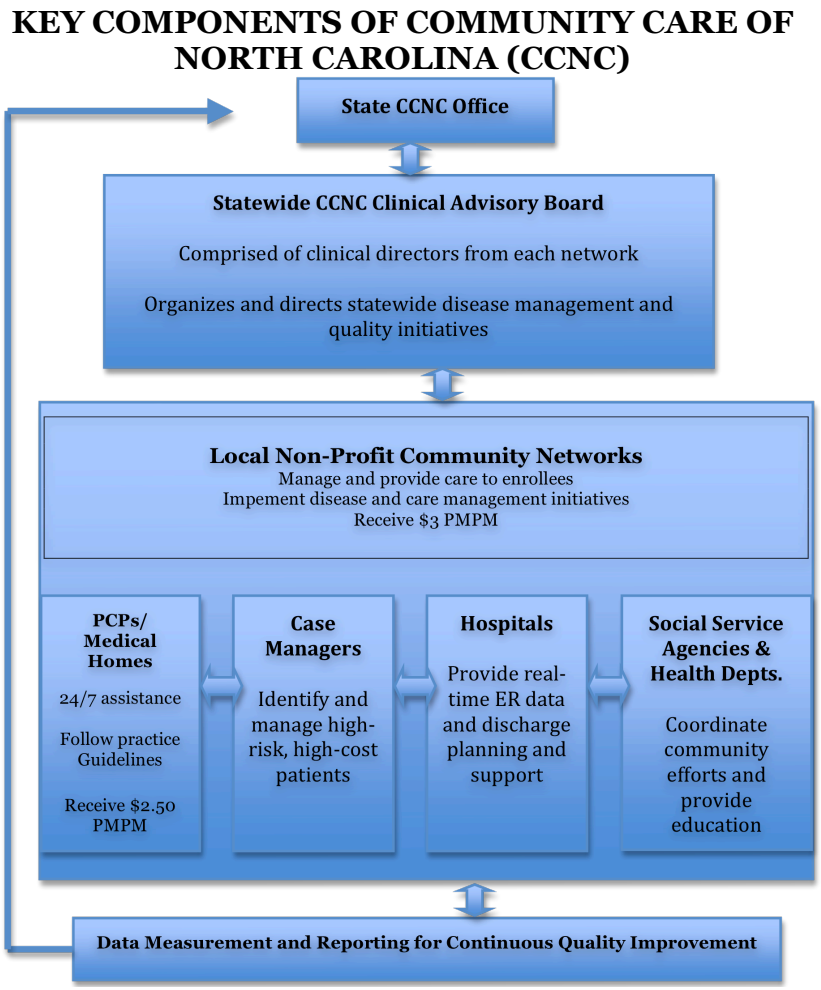

Figure 8: Source (Kaiser Family Foundation, 2009)

As of May 2009, CCNC covered over 67% of the state's Medicaid population. In order to remain community-based, CCNC is broken into multiple local networks. Each network receives an enhanced care management fee ($3-5 per person in the network) in order to hire local case managers and a physician clinical director who works with a state board to organize statewide medical care initiatives which enhance local quality improvement initiatives.

Cost-analysis of CCNC's managed care program is not complete, but is proving to be a promising avenue of health care management. Cost savings to the state under this type of model were not immediate, but accrued as more networks were implemented over time (Wilhide & Henderson, 2006). In comparison to North Carolina's previous primary care case management program, the Mercer consulting group estimated a savings of $150-$170 million for Fiscal Year 2006 (Kaiser Family Foundation, 2009), and University of North Carolina estimated a compared savings of $3.3 million for overall asthma care through reduction of ED visits and hospitalizations (Ricketts, Greene, Silberman, HA, & Poley, 2004). The savings for pediatric asthma is unknown. Increased use of controller medications, utilization of AAP, and quality of life were not studied. These indicators are important in determining better policy decisions.

Federally Qualified Health Centers (FQHC) are an integral part of the public health system, and should be studied for pediatric asthma benefit. They are considered to be a medical home in medically underserved areas or for medically underserved populations. As a medical home, FQHCs are dedicated to providing primary medical, dental, behavioral and social services, as well as hospital and specialty care (Adashi, Geiger, & Fine, 2010), (Rural Assistance Center, 2011). They are also required to have a core full-time staff providing care in the office, as well as 24/7 on call services (Rural Assistance Center, 2011). They provide these services to millions of the homeless, the uninsured, migrants, and the underinsured. They do not turn anyone away, regardless of insurance status or ability to pay. As part of the social services provided, they assist their patients in

applying for Medicaid/CHIP (Adashi, Geiger, & Fine, 2010). They aim to reduce health disparities associated with SES, race, culture, and language. Operating at over 8000 locations in the U.S., FQHCs are the medical home to about 5% of the U.S. population (Adashi, Geiger, & Fine, 2010). Seven out of ten patients seen at these facilities live in poverty; over half of the clients are minorities. Substantial numbers of this patient population are women and children. Thirty-five to forty-one percent are Medicaid beneficiaries (Adashi, Geiger, & Fine, 2010), (Hing & Hooker, 2011).

Forty-three percent of medically underserved areas did not have FQHCs according to a study by the Government Accountability Office in 2009 (Adashi, Geiger, & Fine, 2010). Over the last few years, provisions have been made to decrease this medical deficit. In 2008, President G. W. Bush's administration doubled annual funds for FQHCs to $2.1 billion. A one-time additional $2 billion was given to expand FQHCs in 2009 by President Obama's administration. Starting in 2011, an additional $12.5 billion will be administered for expansion of both FQHCs and the National Health Services Corps (NHSC) over a five-year period. The NHSC is partnered with FQHCs and is responsible for recruiting and placing health care professionals in shortage areas. (Adashi, Geiger, & Fine, 2010)

FQHCs are medical homes to millions, hoping to serve 20 million more by 2015 (Adashi, Geiger, & Fine, 2010). This may be an underestimate because there are many non-profit public health agencies serving as Federally Qualified Health

Center look-alikes, agencies following the same guidelines but not receiving the grant funding of FQHCs. This expands coverage to a greater population. FQHCs have been able to provide patient-centered medical homes to the populations living in medically underserved areas. Preliminary data from a study conducted by the Colorado Department of Health Care Policy and Financing compared Medicaid populations who used fee-for-service providers as a primary source of care to Medicaid populations who used FQHCs (Rothkopf, Brookler, Wadhwa, & Sajovetz, 2011). There was no specific data on children or on asthma, but the preliminary data showed a one third decrease in emergency department visits, hospitalizations, and preventable hospital admissions in the FQHC group as compared to those seeing private pay-for-performance providers (Rothkopf, Brookler, Wadhwa, & Sajovetz, 2011). Because the patient population that tends to use the FQHCs coincides with the population with the highest rates of asthma, studies should be conducted to discover if there is a decrease in incidence of emergency department visits, hospitalizations, and preventable hospital admissions among these pediatric asthma patients.

FQHCs and CCNC are promising primary care based models that have case-management as an integral aspect of care. However, specific research on their impact on pediatric asthma care is lacking. There have been multiple urban ED based programs that target pediatric asthma. The most successful of these programs target all four of the recommended actions described in the NAEPP guidelines and by emphasizing case management and providing in-home multi-trigger environmental remediation for the least controlled asthmatic children.

More recently developed programs, such as CAI, use culturally competent case managers and CHWs to gain trust and decrease communication issues. This could also account for increased successes of these particular programs. These programs show great promise at reducing the morbidity of asthma and may possibly help to reduce the disparities among different races and socioeconomic groups. However, these are only pilot programs and have not yet been implemented on a large scale.

COST AND IMPLEMENTATION:

Comprehensive asthma care programs are costly; however, preliminary data and pilot programs show that they are potentially cost-saving after the initial investment. One method to implement these programs is to utilize the concept of "hot spotting" for the expensive but necessary multi-trigger in-home environmental remediation.

There are several pilot programs around the country that are "hot spotting," or providing care to the super-utilizers of healthcare. Preliminary data is showing a significant decrease in overall healthcare costs for the areas that they serve. Generally, in any given area or hospital system, a small percentage of the population is using the most health care resources and incurring the highest health care costs. By targeting this small percentage with appropriate coordinated medical care, home visits, and social services, while gaining trust in this population, these pilot programs have reduced ED visits and hospitalizations. They are more expensive to run than traditional programs and do increase

prescription costs, but overall healthcare costs are down. (Gawande, 2011), (Robert Wood Johnson Foundation, 2012), (Green, Singh, & O'Byrne, 2010)

CAI's program utilized this concept of hot spotting by focusing on children who were high-risk asthma patients. Through a higher-cost preventative program, which includes multi-trigger in-home non-chemical environmental remediation for the highest-risk patients, and case management and community health workers for all at-risk patients, CAI was able to decrease overall hospitalizations and ED visits, enabling an ROI of $1.46.

CCNC also provided aspects of hot-spotting. Compared to Carolina ACCESS, the comparison Medicaid model in North Carolina, CCNC took higher-risk patients, targeted specific high-cost diseases, and provided care coordination. By targeting diseases at risk for high-cost healthcare, CCNC was able to decrease overall health care costs as compared to Carolina ACCESS.

These programs are only small pilot programs; in order to scale up and implement these policies in a national level program, federal monies must be allocated. The Center for Medicare and Medicaid Innovation is the ideal resource to implement these policy recommendations to affect pediatric asthma morbidity and healthcare costs. The Center for Medicare and Medicaid Innovation has the responsibility of "identifying, developing, assessing, supporting, and spreading" new programs that will reduce costs to Medicare, CHIP, or Medicaid while maintaining or improving care and service (Berenson & Cafarella, 2012).

RECOMMENDATIONS:

At a policy level, public health insurance should provide bundled care to all high-risk pediatric asthma patients. Bundling, i.e., charging a single fee for an episode of treatment in its entirety, has not been studied in pediatric asthma specifically. It has been successful in other chronic diseases with acute episodic exacerbations in both the public and private sectors. Bundling for these types of disease processes has shown a reduction of costs, reduction in repeat hospitalizations, and improvement in quality of care. (Cutler, 2010), (American Hospital Association Committee on Research, 2010) The ACA provides for both pediatric medical homes in Medicaid for children with chronic conditions, including asthma, and bundled payments in Medicare.

CAI's program, targeting high-risk pediatric asthmatics seen in the hospital, includes case management, in-home assessments, and case-by-case multi-trigger environmental remediation. Their noted successes in health outcomes and cost reductions indicate that CAI is an ideal type of program for bundled care. Bundled care in this population should include the typical medical interventions, but should also include in-home multi-trigger environmental remediation for those at highest risk for repeat exacerbations. Bundling should be standard for all high-risk pediatric asthma patients.

At a practice level, recommendations for pediatric asthma care should be based on the evidence-based guidelines set forth by NAEPP (National Heart, Lung, and Blood Institute, 2007) and the CDC's review of public health asthma

interventions (Labre, Herman, Dumitru, Valenzuela, & Cechman, 2012). These include measures of assessment and monitoring, education for a partnership in asthma care, control of environmental factors and comorbid conditions, and lastly, pharmacologic therapy. A national level program will also need to be cost-effective. Based on the successes of active urban-based pilot programs and current medical home models, the following are recommendations to move forward toward national level programs on pediatric asthma care:

1. Multi-trigger environmental remediation with chemical-free allergen and pest removal should be part of standard medical care for high-risk asthma patients. Allergen removal is costly without bundling as part of a medical intervention. Because the burden of asthma lies mostly with low-income families, most would not be able to afford this type of intervention without bundling. Since multi-trigger environmental remediation has been proven successful and cost-effective, including it into a medical plan will be beneficial for quality of life improvements for the children and cost-saving for medical programs.

2. ED based comprehensive care, including environmental assessments and remediation similar to CAI in Boston, should be implemented in high-burden asthma areas throughout the U.S.. Because Children's Hospitals are located in urban areas and generally have high Medicaid populations, initially centering these programs in Children's Hospitals will centralize care in the potentially highest burden areas in the country in hospitals which focus solely on childhood illness and disease. This plan would impact the most children in a timely manner.

To further inform practice, the following research should be conducted:

3. It is essential to discover how medical home models, as they currently exist, effect childhood asthma morbidity. Further research is also needed to discover if implementing similar comprehensive programs in primary care settings effectively decreases pediatric asthma morbidity.

4. Studies need to be done on cost-analysis and effectiveness of environmental remediation outside of urban areas; none has been done to date. Several studies have determined that environmental allergens are as detrimental in rural areas as in urban areas, however the allergens are different. These studies would determine the importance of initiating environmental remediation programs through primary care services or medical home models. The studies would also show if bundled care in this environment would be cost-effective or cost-prohibitive.

In summary, asthma is a disease that causes significant morbidity among the pediatric population. Disparities in asthmatic care and outcome are found in both race and socio-economic status. Pilot programs targeting high-risk urban patients through the ED, as well as general populations through primary care have shown promise. In order to implement a national level program, the four recommendations proposed above need to be implemented. Briefly, these

recommendations include (1) multi-trigger environmental remediation as a standard of care for all high-risk asthma patients, (2) implementation of ED-centered comprehensive care in high-burden high-density areas, (3) further research on pediatric primary care and medical home models on pediatric asthma morbidity, and (4) cost analysis and impact studies of environmental remediation in non-urban areas. Funding for a national program will need to have federal backing, such as through the Center for Medicare and Medicaid Innovation with bundled payments as the financing mechanism. The potential benefits of such funding would include decreasing healthcare disparities for pediatric asthma patients, improving overall health of pediatric asthmatics, and decreasing the healthcare cost burden that the federal insurance programs currently incur.

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RECOMMENDATIONS FOR MEDICAID/CHIP FOR DECREASING INCIDENCE OF ASTHMA EXACERBATIONS IN CHILDREN

Asthma basics:

"Asthma is a chronic inflammation of the airways with reversible episodes of obstruction, caused by an increased reaction of the airways to various stimuli" (American Lung Association, 2010). Although "asthma attacks" are episodic in nature, the underlying inflammation is continuous. Ultimately, the goal for asthma management is to be symptom free with optimized care.

Prevalence and disparity:

The prevalence of asthma in pediatrics more than doubled from 1980 to the mid-1990s and remains at extremely high levels. Asthma affects 7.1 million children age 17 and under in the U.S.. It is the third leading cause for hospitalization, and the leading chronic conditions in pediatrics. Black, Hispanic, and low-income children are disproportionately affected by asthma, and more likely to use the ED as asthma care than a primary care provider. Disparities in asthma care revolve around several key factors: the disproportionate use of asthma specialists, asthma care plans, appropriate medications, and communication between patient/parent and provider. Even in a population with universal health care (the military), these disparities still exist.

Medicaid/CHIP:

Together, Medicaid and CHIP insure 1 in 3 children (33%) in the U.S., and almost 3 in 5 low-income children (59%). Medicaid/CHIP children are more likely to have asthma than children with private insurance.

Recommendations:

1. Environmental remediation with chemical-free allergen and pest removal should be part of standard medical care for high-risk asthma patients. Allergen removal is costly without bundling it as part of a medical intervention. Since it has been proven successful and cost-effective, including it into a medical plan will be beneficial for quality of life improvements for the children, and cost-saving for medical facilities and/or public and private insurance companies.

2. ED based comprehensive care including environmental assessments and remediation, similar to CAI in Boston, should be implemented in high asthma burden areas throughout the U.S.. Because Children's Hospitals are located in urban areas and generally have high Medicaid populations, initially centering these programs in Children's Hospitals will centralize care, potentially in the highest burden areas in the country. This plan would impact the most children in a timely manner.

3. Further research is needed in current medical home models and in implementing similar comprehensive programs in primary care models. It is essential to discover how medical home models, as they currently exist, affect childhood asthma morbidity.

4. Studies need to be done on cost-analysis and effectiveness of environmental remediation outside of urban areas; none has been done to date. These studies would determine the effectiveness of initiating programs through primary care services or medical home models. The studies would also show if bundled care in this environment would be cost-effective or cost-prohibitive.