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Improving Residential Asthma Assessment Strategies Within a Low Socioeconomic Community

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IMPROVING RESIDENTIAL ASTHMA ASSESSMENT STRATEGIES WITHIN A LOW SOCIOECONOMIC COMMUNITY

by

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Monica Marie Ramirez

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Abstract

Background: Nationally, there are currently 6,000,000 children under the age of 18 with asthma. There are a variety of social determinants and in-home environmental triggers that can contribute to the development of or exacerbation of asthma in children. Therefore, it is important to recognize and improve the needs of children with asthma in older homes and in households with a lower socioeconomic status.

Aim: The aim of this project was to decrease the number of in-home environmental asthma triggers within at-risk homes in San Antonio, Texas.

Purpose: The purpose of this evidence-based practice project was to improve asthma outcomes for children in lower socioeconomic homes in the Bexar County area.

Key Activities: Three in-home visits, for a total of five families were completed, during which three different assessments were performed. These assessments were completed by using the Environmental Protection Agency Environmental Checklist, a knowledge test pre and post scores, and the total score of the Asthma Control Test. In-home assessment tool will increase surveillance of asthma triggers and ultimately decrease the negative health outcomes related to asthma in children.

Results: Objective one there was a 0% improvement in the Environmental Protection Agency Environmental Checklist scores for all five families. Objective two did not meet the 50% and 75% increase did not occur, as the families all did so well to begin with. Objective three also did not meet the 50% or 75% anticipated changes, but there were changes between each visit in 4 out of the 5 families.

Keywords: Asthma, environment, triggers, symptoms, in-home, visits.

As there are 6,000,000 children under the age of 18, in the United States with asthma it is important to recognize and improve the needs of children with asthma in older homes and in households with a lower socioeconomic status (Centers for Disease Control [CDC], 2018). Significant disparities in asthma have been observed among socioeconomic demographic groups (Dong et al., 2018; Pacheco et al., 2014). Both low income and racial/ethnic neighborhoods, tend to have substandard and poor-quality housing (Pacheco et al., 2014). With respect to the impact of health in relation to housing, it has been noted that children are a susceptible population (Skolowsky, Marquez, Sheehy, Barber & Gerstenberger, 2017). Children may be exposed to asthma triggers, including molds, dust, pet dander, pests, tobacco smoke, as well as lead-based paint hazards (Pacheco, 2014; Skolowsky et al., 2017). Furthermore, poor literacy has been strongly correlated with limited knowledge of asthma and improper use of inhalers, which results in higher emergency of department visits (Asthma and Allergy Foundation of America [AAFA], 2018).

Statement of the Problem

The problem is that there are varieties of social determinants and in-home environmental triggers that can contribute to the development of or exacerbation of asthma in children. Such disparities can include, low socioeconomic status, level of education, race, and ethnicity. As previously, mentioned, in-home environmental factors that contribute to the exacerbation of asthma include molds, dust, pet dander, pests, tobacco smoke, as well as lead-based paint hazards (Skolowsky et al., 2017).

Background and Significance

Socioeconomic status. Low socioeconomic status (SES) has been indirectly and directly related with health disparities, as well as with the severity of illness (Williams & Mofya, 2016). According to the CDC, in 2010 the national prevalence of asthma was greater among individuals who live in household yearly incomes of less than $15,000, which included a total of 13.3% of the asthmatic population (CDC, 2013). While nationally, 10.3% of the asthmatic population had an income of $15,000 to $25,000, 8.3% had an income between $25,000 to $50,000, 8.0% had an income of $50,000 to $75,000 and only 7.0% of the asthmatic population had an income greater than $75,000. Therefore, families within a higher income range are found to have a lower incidence of asthma (CDC, 2013).

With a low SES and the cost of asthma for an individual on the rise, it can be difficult for those with a low SES to be able to provide the appropriate care for their child. For example, according to the American Thoracic Society (2018), individuals who are receiving treatment and those who have asthma in general, have a greater out-of-pocket cost (American Thoracic Society [ATS], 2018). Previous data have also demonstrated that 16% of people with asthma have high health costs and spend over 10% of their income for out of pocket expenditures (AAFA, 2018).

Moreover, it has been noted that low SES has been linked to children's exposure to environmental risks (Chen, 2014). Children that come from low SES families have a higher likelihood of living in an impoverished environment that has a greater exposure to hazardous conditions (Chen, 2014;Williams & Mofya, 2016). Furthermore, low SES has been strongly correlated with the use of tobacco smoke, which has been known to exacerbate a child's asthma (Chen, 2014; Williams & Mofya, 2016).

Education and health literacy. Similar to the trend of income status, the prevalence of asthma is decreased in families with higher education. According to the CDC, in 2013 the prevalence of asthma was higher in those who did not graduate from high school. For example, 10% of the population who have a diagnosis of asthma did not graduate from high school (CDC, 2013). This is in stark contrast to the asthma prevalence rates in those who graduated from high school, 8.8%, and those who graduated from college, 7.5% (CDC, 2013).

Poor literacy has also been strongly correlated with limited knowledge of asthma and improper use of inhalers. This results in a higher number of emergency department visits (AAFA, 2018). Furthermore, it has been found that quality of care received is also limited in non-English speaking Hispanics due to the language barrier, which leads to longer wait times and difficulty in getting an appointment (Hosley, Collins, & Zahran, 2013). Statistics have shown that African Americans and Hispanics typically have a lower income and education, thus at least partly contributing to their health disparities (CDC, 2013).

Race and ethnicity. In 2017, there was a total number of 25,191 individuals nationally with a diagnosis of asthma, which comprises 7.9% of the total U.S. population. Out of this total, 3,910 African Americans have a diagnosis of asthma; this includes adults and children. There are 3,692 Hispanics with asthma out of the 25,191 asthma population (CDC, 2019). The total incidence of asthma between 2001 and 2010 increased by 2.9% each year (Follenweider & Lambertino, 2012). It has been noted that there are less Non-Hispanic Whites with asthma when compared to the current percentage of Non-Hispanic African American and Hispanic children with asthma (U.S. Department of Health and Human Services Office of Minority Health [HHS], 2018). Where there is a percentage of 7.3 Non-Hispanic White children with asthma there are 8.0 Hispanic and 13.4 African American children with asthma in the U.S. (HHS, 2017; HHS 2018).

Indoor environmental factors. Indoor allergens have been known to play a role in the severity and maintenance of asthma (Follenweider & Lambertino, 2013). House dust mites are among the common exposures that contribute to asthma exacerbations. They are typically found in carpets, mattresses, bedding, upholstered furniture, drapes, and even clothing. Dust mites thrive in a humid environment, as they absorb the humidity and feed on the skin shed by both humans and pets (Follenweider & Lambertino, 2013).

Tobacco smoke is another common airway irritant that is linked to increasing asthma symptoms and hospitalization rates (Follenweider & Lambertino, 2013). This also contributes to a decrease in lung function; it has been noted that secondhand smoke can contribute to the development of asthma early in a child's life (Follenweider & Lambertino, 2013). Additionally, cockroach and rodent allergen exposure, along with allergic sensitization contribute to the morbidity of asthma (Gautier & Charpin, 2017). An increased number of cockroaches in a home have been associated with an urban housing and a low SES (Pacheco, 2014). The exposure to mold and dampness within the home also contribute to increased respiratory symptoms in a child (Follenweider & Lambertino, 2013). Pets, including cats and dogs are also a typical source of allergens, as the particles are so miniscule that they remain airborne allowing them to remain on clothing and surfaces on the home (Gautier & Charpin, 2017).

It has also been found that lead is an environmental factor/toxin that increases the likelihood of a child developing asthma (Wang, Karmaus & Yang, 2017). Lead is commonly found in homes that were built prior to 1978, as it was then that lead-based paints were banned (CDC), 2013). In homes where lead-based paints were used, when the paint cracks and peals, it creates lead dust that can be inadvertently inhaled by the house's occupants (CDC, 2018). Although the lead-based paint was banned in 1978, there are other household products that can

also contain lead (CDC, 2018). This includes, certain water pipes, jewelry, toys, imported candies or even traditional home remedies (CDC, 2018). According to the Centers for Disease Control, there are approximately 24 million homes in the United States that still contain lead-based paint as well as high levels of lead contaminated house dust (CDC, 2018). Furthermore, there is an average of 535,000 children, ages 1 to 5 years old that have elevated lead blood levels considered to be high enough to damage their health (CDC, 2018).

Assessment

Bexar County

As per the 2016 Bexar County Community Health Needs Assessment, asthma in Bexar County has been recognized as a concern, particularly in low-income communities (Health Collaborative, 2016). Even though the overall poverty rate in Bexar County is only 18.4% it has been found that of the estimated 485,751 children under the age of 18 residing in Bexar County closer to 27% actually live in poverty (Health Collaborative, 2016). In 2014, the asthma hospitalization rate in Bexar County was greater than 170% of the overall rate in Texas (City of San Antonio, 2018). During this same year, it was found that the approximate cost faced by families for each inpatient treatment for asthma was $3,400 (City of San Antonio, 2018). Table 1 illustrates the number of asthma hospitalizations in Bexar County for children ages 0-17 years of age as per Health Collaborative (2016).

Table 1

Number of Asthma-Related Hospitalizations in Bexar County Per 10,000

Year	Ages 0-17
2010	20.6
2011	20.5
2012	21.3
2013	19.1
2014	19.4

Note. These data were adapted from the 2016 Bexar County Community Health Needs Assessment.

As per the American Lung Association (2019), there are a total of 40,001 children with a diagnosis of asthma in the Bexar County alone. In 2016, the pediatric asthma admission rate in Bexar County consisted of 754 admissions of children under the age of 18 (Texas Department of State Health Services, 2018). This admission rate was out of the total 444,934 children that reside in Bexar County. The observed admissions per 100,000 population was 169.46 with the mean charge per admission being $22,112 (Texas Department of State Health Services, 2018). This equals $16 million in asthma hospitalization-related charges.

Recent studies within the city of San Antonio have found that the children that live in impoverished areas have a higher need of acute care and are more frequently hospitalized than the general population (Health Collaborative, 2016). Data gathered from the Dallas-Fort Worth Hospital Council Foundation regarding the number of cases of asthma related hospitalizations in Bexar County during the first quarter of 2015 are noted in Tables 2, 3, and 4. This data also notes the total charge of all cases recorded. Medicare paying patients were excluded as they do not fall within the appropriate age range.

A common trend can be seen in Tables 2, 3, and 4. In Bexar County for the first quarter of 2015, it can be noted that children with Medicaid, which typically comprises lower income

families, have a higher incidence of asthma related hospitalizations compared to the insured and uninsured individuals. These data indicate that 84% of children below the age of 18 were Medicaid patients and were hospitalized with asthma unspecified diagnosis. While 82% of children hospitalized with diagnosis of asthma unspecified with status asthmaticus were also Medicaid patients. Moreover, 82% of children admitted with the diagnosis asthma unspecified with exacerbation were Medicaid patients.

Table 2

2015 First Quarter Asthma Unspecified Hospitalizations

	Insured Cases	Insured Total Charges	Medicaid Cases	Medicaid Total Charges	Uninsured Cases	Uninsured Total Charges
Age in Years						
1-4	7	$17,653	116	$279,855.	12	$20,811
5-9	12	$34,887	101	$181,258.	3	$6,222
10-14	6	$12,367	57	$101,512.	6	$11,684
15-17	5	$14,484	26	$79,138.	5	$18,009

Note: Data adapted from the Dallas-Fort Worth Hospital Council Foundation.

Table 3

2015 Quarter 1 Bexar County Asthma Unspecified with Status Asthmaticus Related Hospitalizations

	Insured Cases	Insured Total Charges	Medicaid Cases	Medicaid Total Charges	Uninsured Cases	Uninsured Total Charges
Age in Years						
1-4	-	-	24	$369,169	3	$24,548
5-9	8	$92,823	31	$523,423	2	$16,545
10-14	1	$57,298	15	$242,440	2	$66,195
15-17	-	-	4	$138,067	-	-

Note: Data adapted from the Dallas-Fort Worth Hospital Council Foundation. (-) indicates no cases documented.

Table 4

2015 Quarter 1Bexar County Asthma Unspecified with Exacerbation Related Hospitalizations

	Insured Cases	Insured Total Charges	Medicaid Cases	Medicaid Total Charges	Uninsured Cases	Uninsured Total Charges
Age in Years						
1-4	32	$120,098.	233	$638,041	27	$74,185
5-9	29	$67,833.	320	$788,163	26	$59,683
10-14	19	$51,438.	140	$403,319	20	$41,018
15-17	10	$25,105.	59	$163,396	3	$8,347

Note: Data gathered from the Dallas-Fort Worth Hospital Council Foundation.

In one local school district it was found that approximately 7,300 to 8,500 (11-13%) students of the 67,000 students have asthma (Gibbons, 2018). A study that was conducted in this school district revealed that students with asthma are more likely to miss 11 more school days when compared to their classmates who do not have asthma (City of San Antonio, 2018). This is significant as the inability to attend school can negatively impact their academic performance,

can cause the parents to miss work to care for their child, and affects school funding related to the number of children present in school each day. It is because of these numbers that this school district has been working closely with a local hospital and university to promote asthma awareness and education to the students and parents (North East Independent School District [NEISD], 2018). Only one of the seventeen school districts in San Antonio have this type of program in place. There is currently no information made available to the public stating the number of missed school days related to asthma or the number of students within the various districts that have asthma.

Moreover, quality housing is a significant factor that can affect an individual's health and wellbeing. It has been observed that substandard housing and housing conditions is correlated with the development of respiratory diseases, including asthma (Health Collaborative, 2016). Nearly half of Bexar County's housing was built prior to the 1980's (Health Collaborative, 2016). While older houses may be well-maintained, the children who are living in them may be at risk of lead poisoning and other hazards. It has been documented that the county's older houses primarily reside in neighborhoods in the south, east, and the north of downtown sectors of San Antonio (Health Collaborative, 2016). This can be observed in Figure 1, which is an image provided by the U.S. Census Bureau that illustrates the period of housing construction in Bexar County (Health Collaborative, 2016).

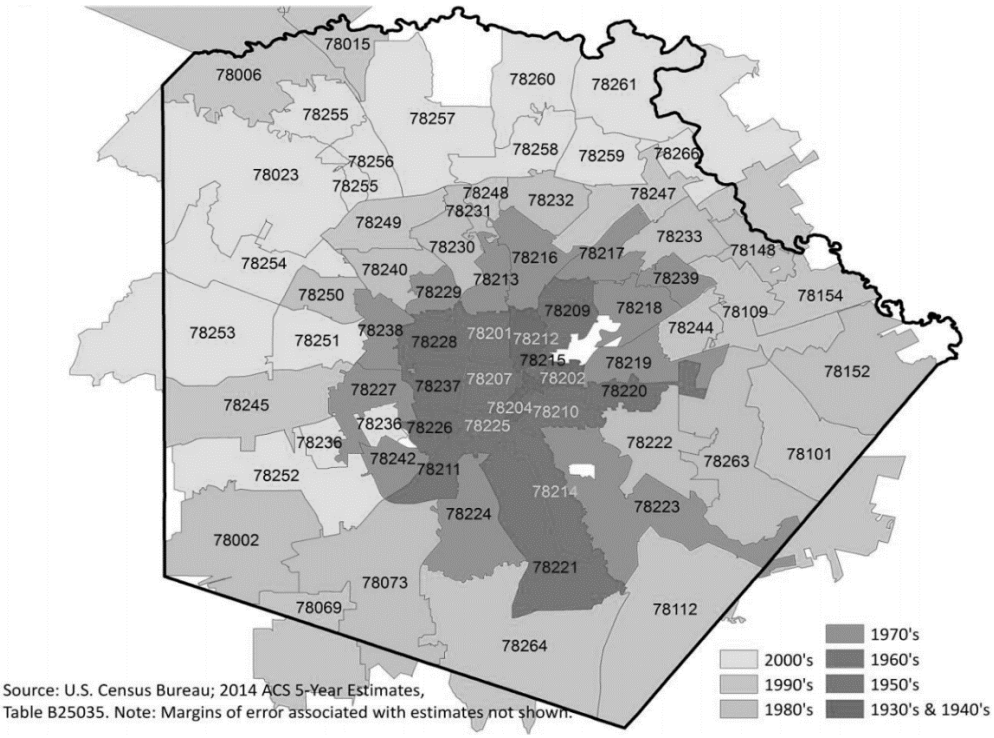

Figure 1. Period of housing construction in Bexar County (Health Collaborative, 2016).

Agency A

A San Antonio community organization (Agency A) was assessed to evaluate its readiness to assist the community with its asthma needs. The purpose of Agency A is to provide assistance to the residents, homeowners and landlords of residential properties built before 1978 in creating healthy, safe, and energy efficient homes for the families and children, specifically families with children of 5 years of age or younger (City of San Antonio, 2018). This agency is meant to assist the community in preventing and correcting home-related health and safety hazards, such as lead-based paint, mold and other household asthma triggers (City of San Antonio, 2018).

This agency is founded by the U.S. Department of Housing and Urban Development (HUD) Office of Healthy Homes and Lead Hazard Control. Agency A is also funded by the HUD Community Development Block Grant Program. Thus, both HUD programs fund the

renovations done to the houses that are found to have high levels of lead. Agency A's staff consists of a total of 9 staff members; this includes personnel that are in management, communications services, and environmental assessors.

During the initial meeting with the staff, the assessors expressed great interest as observed by their inquiries regarding asthma. Therefore, an impromptu information session was provided. Upon the staff's request, a more formal presentation was provided, at which point the staff was provided with a pre and posttest that consisted of a five-question asthma knowledge quiz from the U.S. Environmental Protection Agency (EPA). However, it must be noted that the results of pre and posttest may be skewed due to the impromptu session held in the initial meeting. The *Take the Asthma Quiz* can be seen in appendix A.

Even though members of the staff are environmental assessors, it is protocol for the agency to hire an outside, privately owned agency to assess the homes for lead to eliminate any conflicts of interest. As this agency primarily focuses on lead detection in homes, the agency will not assist the families in making any renovations or adjustments even if other hazards are found within in the home. This includes hazards such as molds or pests.

This agency has been in place for the past 18 years, during which they have assisted 1,681 families with home renovations. Although Agency A is open to assisting all of the City of San Antonio, it has primarily served districts 2 and 5. District 2 consists of zip codes 78202, 78203, 78208, 78218, 78219, and 78220. District 5 consists of zip codes 78204, 78207, 78225, and 78226 (City of San Antonio, 2018). The average income of families that have been assisted by the lead program run by Agency A have an area median income below 50% of the poverty level.

Applicant eligibility requirements consist of the following: the house must be located within the City of San Antonio and must be built prior to 1978 (City of San Antonio, 2018). The house must also be structurally sound for assistance to be provided. The house must also have a clear title and the property taxes must be current (City of San Antonio, 2018). A child age 5 years or younger must reside in the home or spend at least 6 hours a week in the residence. Lastly, the household income should meet the HUD established income guidelines for families earning 80% or below the area median income (City of San Antonio, 2018).

After a family has completed the application process Agency A will determine if the application meets the income requirements and a title search will be conducted to confirm that there is a clear title in place (City of San Antonio, 2018). The family is then contacted by the privately-run lead assessment organization hired by the city, to schedule a lead inspection and risk assessment. During the assessment the organization will use a hand-held lead detecting device that can detect lead-based paint in up to 30 layers of paint. The company will also take pictures to document any other household hazards that are found, such as mold, or evidence of pests including rodent droppings and the cockroaches. The soil around the perimeter of the house is also tested, along with samples of dust that are collected along the windowsills of the house. The results of this assessment are provided in a report to Agency A in 2 weeks, after which an environmental assessor from Agency A will contact the family to discuss the findings and determine what work needs to be done, if any, to the house (City of San Antonio, 2018). Regardless of whether or not the process continues, the family is always provided with a copy of the assessment report (City of San Antonio, 2018).

Figure 2 illustrates the percentage of the population in Bexar County living in poverty by zip code. Tables 5 and 7 describe the demographics of each zip code within districts 2 and 5,

including median income, percentage of the area's population that lives below the poverty line, and the number of whites, African Americans and Hispanics in that specific zip code. These data were gathered from the United States Census Bureau, 2016 (United States Census Bureau, 2016). While tables 6 and 8 depict the number of houses in each zip code within districts 2 and 5 that were built prior to 1979.

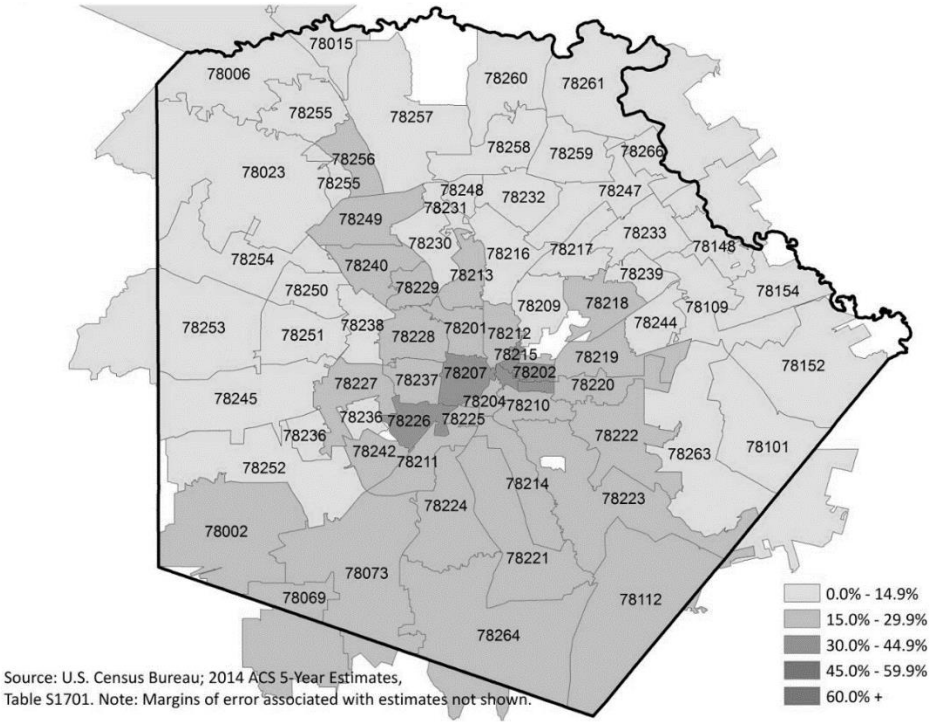

Figure 2. Percentage of people living in poverty by zip code (Health Collaborative, 2016).

Table 5

District 2 Zip Code Demographics

Zip Code	78202	78203	78208	78218	78219	78220
Median income	$24, 001	$28,643	$24,104	$40,170	$34,752	$30,525
Individuals below poverty level by percentage	44.5	37.0	35.0	20.8	24.2	31.9
Race by number						
Whites	6,560	3,466	3,172	23,743	8,750	6,978
African Americans	3,579	1,419	735	5,342	4,731	7,291
Hispanics	7,826	4,423	3,048	18,634	7,512	7,666

Note. These data were gathered from the United States Census Bureau, 2016.

Table 6

District 2 Number Of Houses Built Prior to 1980 in Corresponding Zip Codes

Zip Code	78202	78203	78208	78218	78219	78220
Year house built						
Built 1970 to1979	115	60	78	3,115	1,508	989
Built 1960 to 1969	360	235	68	2,607	1,246	1,793
Built 1950 to 1959	597	343	245	1,461	694	1,725
Built 1940 to 1949	1,085	330	235	199	107	377
Built 1939 or earlier	1,533	521	685	163	107	127

Note. This information was adapted from City Data, 2018.

Table 7

District 5 Zip Code Demographics

Zip Code	78204	78207	78225	78226
Median income	$35,392	$24,766	$30,012	$27,015
Individuals below poverty level by percentage	26.8	40.7	32.7	32.1
Race by number				
Whites	9,276	42,942	11,391	4,504
African Americans	97	1,575	66	79
Hispanics	9,996	4,423	13,192	5,716

Note. These data were gathered from the United States Census Bureau, 2016.

Table 8

District 2 Number of Homes Built Prior to 1980 in Corresponding Zip Codes

Zip Code	78204	78207	78225	78226
Year house built				
Built 1970 to 1979	237	1,404	345	417
Built 1960 to 1969	204	1,905	379	430
Built 1950 to 1959	534	3,378	1,384	671
Built 1940 to 1949	1,198	3,098	1,551	501
Built 1939 or earlier	1,565	3,770	751	211

Note. This information was adapted from City Data 2018.

Agency B

Agency B is a volunteer based and charitable tax-exempt organization that is comprised of a variety of different professionals with various backgrounds, which include health care

providers, parents of children who have asthma and individuals who have asthma (City of San Antonio, 2018). The mission of Agency B is to enhance the health of those with asthma by raising public awareness, as well as by conducting outreach and education to the community and health care providers who are not members of the agency (City of San Antonio, 2018).

Agency B has recently been reestablished after 8 years of inactivity. After its resurgence, the agency is now comprised of over 80 professional leaders throughout all areas of health care in San Antonio (City of San Antonio, 2018). This agency is under the leadership of an experienced pediatrician and a qualified doctorally-prepared nurse practitioner. Agency B has been working with the City of San Antonio to improve the health of children with asthma, reduce disparities and decrease asthma related hospitalizations (City of San Antonio, 2018).

Agency B is on the verge of launching a pilot program that will provide education on home environments to families and children with uncontrolled asthma who reside in vulnerable neighborhoods (City of San Antonio, 2018). By implementing this program, Agency B hopes that there will be a reduction in health costs as well as a decrease of missed school days (City of San Antonio, 2018). Funding for this program will come from the city of San Antonio's fiscal year budget, which has assigned Agency B $751,338 to use over the next 2 years (City of San Antonio, 2018).

As previously mentioned, Agency B's primary focus are those who live in susceptible neighborhoods. Therefore, they have determined that the San Antonio districts to be included are 1, 2, 4, 5, 6, and 7 (City of San Antonio, 2018). Of these districts the zip codes that have been noted to be in the highest need include, 78228, 78207, 78227, and 78218 (City of San Antonio, 2018). Table 9 illustrates the zip codes that Agency B has determined to be in the highest need of

intervention. The median income, the percentage of the residents in that area that are below poverty level, race, and number of children below the age of 5 are listed.

Table 9

Zip Codes with Highest Needs Demographics

Zip Code	78228	78207	78227	78218
District	7	5	6	2
Median income	$38,301	$24,766	$37,297	$40,170
Individuals below poverty level by percent	28.3%	40.7%	26.9%	2d0.8%
Race by number				
Whites	56,153	42,942	40,933	23,743
African Americans	1,772	1,575	2,956	5,342
Hispanics	54,460	4,423	38,321	18,634

Note. These data were gathered from the United States Census Bureau, 2016.

Both Agency A and B expressed the need for a community-based program that focuses on informing parents and care givers of children with asthma about the many asthma triggers that dwell within the home environment and are typically not addressed in the primary care setting. Agency A and B also conveyed that as the focus is within the home environment the logical thing would be to provide education and guidance on a personal basis within the families' homes. It was understood that the aim of both agencies was to assist families who are of low socioeconomic status in order to help reduce the number of asthma exacerbations, thereby decreasing the number of missed school days by the child, along with missed worked days by the parents. With this comes the possibility of reducing the overall asthma related health care costs to the families.

Organization's Readiness for Change

The Practice Improvement Capacity Rating Scale is a tool that was developed by the Robert Wood Johnson Foundation (RWJF) to assess the readiness for change of an organization

for the implementation of quality improvement measures (RWJF, 2014). The scoring consists of the colors red, yellow and green. If an organization's score is in the red, the affiliation is not ready, while a yellow score indicates a limited capacity for change, and green implies that the organization is ready and capable of change (RWJF, 2014). To determine the score, one must interview members of the organization (RWJF, 2014).

After meeting with the director of Agency A and assessing their readiness to change by use of the Practice Improvement Capacity Rating Scale, the agency was at a score between 100-249, putting them the yellow. This is due to factors that included: insufficient funds, changes in leadership, and the existence of competing priorities such as the Lead Hazard Program. Furthermore, an asthma program was not already in place; however, it is something that the leadership of this agency would like to put into practice. Therefore, Agency A currently had a limited capacity for change.

After speaking to the head of Agency B and assessing the organizations status, it was determined that the organization currently had a score between 250 or greater, which places then in the green. This agency has the resources, staff and the funds to initiate an asthma program. Although an asthma program was not previously in place, Agency B has a strong leadership that has worked with other organizations on implementing asthma programs. Thus, Agency B is ready for change. Both Agency A and Agency B have begun to work in collaboration with each other to initiate a community-wide in-home asthma program, as both agencies would greatly benefit from each other.

Project Identification

Purpose

The purpose of this evidence-based practice project was to improve asthma outcomes for children in lower socioeconomic homes in the Bexar County area.

Objective One

Objective one is to assist the families in reducing in-home asthma triggers by performing multiple home environmental assessments and providing preventive education. This will be accomplished by performing multiple home visits focused on assessing the environment and educating the caregivers about asthma management. During the initial assessment the family will also be educated on the measures they can take to decrease the environmental factors that can contribute to the child's asthma symptoms. After three home visits, there should be a 50% improvement in the home environment.

Objective Two

Objective two is to improve the parent/caregiver understanding of management of their child's asthma (environmental, medications, activities, etc.). Caregiver understanding of the child's asthma management will include medications and environmental triggers. An asthma management information booklet will be provided during visit one and reinforcement of the booklet will be done during each subsequent visit. Pre and post quizzes will be completed by the parent or caregiver during the visits. Post-test results on visit one should exhibit a 50% increase and post-test visit two and three should have displayed a 75% improvement from the initial pre-test score.

Objective Three

Objective three is to reduce the number of asthma symptoms experienced by the child during the project timeframe. Throughout the home visits, the parent or child will answer the Asthma Control Test (ACT) questionnaire regarding the asthma symptoms they experience. With an improvement in the home environment, the symptoms should also improve by 50% during the second visit and 75% during the third visit. The Asthma Control Test can be seen in Appendix B.

Summary and Strength of Evidence

When reviewing the literature, the John Hopkins Nursing Evidence-Based Practice Evidence Level and Quality Guide was used to grade the level of evidence of each individual journal that was used for the strength of evidence. This guide was derived from the *Johns Hopkins Nursing Evidence Based Practice, Third Edition, Model and Guidelines* (Dang & Dearholt, 2017).

In-Home Assessment Tool

There have been HUD funded studies and demonstration projects that have exemplified the value of using community health workers, nurses, environmental specialists, and others to perform in-home interventions (Ashley, 2015). Outcomes of such interventions have been positive and have even reported a financial benefit (Ashley, 2015). Furthermore, studies have shown that a universal visual assessment tool provides its users the ability to compare health and safety hazards within an individual's home (Skolowsky et al., 2017). There is currently no standard Healthy Homes visual assessment tool for HUD to use (Skolowsky et al., 2017). Currently, any organization that is under a grant by the HUD to perform a healthy homes asthma intervention is able to create their own assessment tool. However, a standard visual assessment

tool would make it possible for the HUD and the grantees to easily compare health and safety hazards in any community (Skolowsky et al., 2017).

This was particularly indicated in an evidence level VI descriptive study conducted in Southern Nevada (Skolowsky et al., 2017). The City of Henderson Lead Hazard Control and Healthy Homes program, which is funded by HUD, conducted visual home assessments in 106 homes within the community that resided in three zip codes (Skolowsky et al., 2017). For a family to qualify, their median household income required must be below 80% of the median income level (Skolowsky et al., 2017). After conducting their in-home visual assessment, the authors strongly recommended the development of a standardized visual assessment tool to allow for the comparison of housing conditions between various communities (Skolowsky et al., 2017). This recommendation came after an inconsistency was noted in the data collected. The authors felt that what they saw in the homes of their participants did not coincide with the data provided by the American Healthy Homes Survey, which is meant to track housing conditions in the U.S., as the conditions seemed to be underreported (Skolowsky et al., 2017).

Home Visits

Despite the lack of a standardized tool, it has been found that home visits are an opportunity to educate people with asthma and to help them effectively manage their disease. Home visits are meant to identify and alleviate the effects of exposure to the in-home environmental triggers (Ashley, 2015; Dong et al., 2018; Skolowsky et al., 2017). It has also been found that going into the home of an individual with asthma can be effective as more information can be learned and given to a person in a face-to-face home setting rather than via telephone or in a doctor’s office (Ashley, 2015; Dong et al., 2018; Skolowsky et al., 2017).

For instance, in a level I evidence meta-analysis done by Dong et al., (2018), the evidence illustrated that in-home assessments and multiple home visits where beneficial. This study was done in the Greater Boston Area of Massachusetts were there have been several completed and ongoing asthma programs (Dong et al., 2018). These asthma intervention programs consist of organizations such as the Boston Asthma Home Visit Collaboration, Boston's Children's Hospital Community Asthma Initiative and Tufts Medical Center Floating Hospital for Children Asthma Prevention and Management Initiative (Dong et al., 2018).

Many of these programs have found that home interventions and the use of other tools to assess an individual's asthma symptoms, such as the Asthma Control Test (ACT), have been useful in increasing the number of participants with well-controlled asthma. A number of these programs consisted of an average of three home visits, during which there were significant changes in the number of asthma triggers. As a result of improved ACT scores and a decrease in the amount of in-home asthma triggers, many of these programs have also found that there was a reduction in the number of emergency department visits (Dong et al., 2018).

Similar results were seen in a level III quasi-experimental study by Gruber et al. (2016). The Asthma Partnership in North Carolina found that after providing education to the families of the 41 households about the potential asthma triggers found during the in-home assessment there was a reduction in asthma symptoms and the need for fast-acting inhalers (Gruber et al., 2016). This was also a result of the minor home repairs done on the homes' ventilation systems and the interventions done to reduce mold or pest infestations (Gruber et al., 2016). Additionally, it was determined that a collaboration of health care professionals and healthy homes specialists is critical in any community to affectively address asthma and the environmental risk factors that affect children with asthma (Gruber et al., 2016). However, more studies should be done to

enable communities to find feasible and effective strategies to address the in-home asthma triggers.

Asthma Control Status

There are currently a handful of tools that have been used to determine the status of asthma and evaluate asthma control, such as the ACT, spirometry and the Asthma Control Questionnaire (ACQ). However, there are few aimed for use in preschool aged children. One that has been developed and validated in longitudinal and cross-sectional cohorts is the Test for Respiratory and Asthma Control in Kids (TRACK) (Zeiger et al., 2011). In a level III observational study, it was found that the TRACK addresses the current National Asthma Education and Prevention Program's Expert Panel Report 3 guideline recommendations of monitoring asthma symptoms and control to verify whether management should be adjusted (Zeiger et al., 2011). In this study there were a total of 426 caregivers that provided baseline TRACK data; of these only 396 caregivers provided follow-up TRACK data. The study ran for a span of 5 months and was only done for children under the age of 5 years old. It was concluded, that the TRACK, which is a Likert-type questionnaire is validated as an easy to use tool to identify respiratory control status over time in individuals below the age of 5 years. It was also determined that a TRACK score change of 10 or more points signifies a clinically substantial change in respiratory or asthma control (Zeiger et al., 2011).

Guidelines

In 1999, Congress instructed the initiation of the Healthy Homes Initiative. Since then, HUD has officially been engaged in promoting the healthy homes approach (HUD, 2018). HUD has been working in collaboration with the CDC, EPA and the National Heart, Lung and Blood Institute (NHLBI) on instituting and promoting practices for housing interventions to control

asthma triggers (HUD, 2018). Furthermore, the HUD has recognized the guidelines developed by NAEPP, an expert panel that was assembled in 2007 for the NHLBI, as an important tool in the communities' responses to asthma (HUD, 2018). This is because there are four crucial components of successful asthma care. These four components consist of assessing and monitoring the level of asthma control and adjusting the patient's treatment plan accordingly (HUD, 2018). It also includes educating the patient and family on improving self-management skills, pharmacological treatment and the reduction of environmental triggers that can exacerbate asthma (HUD, 2018).

The *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma* is based off level I evidence as it incorporates systematic reviews, meta-analysis and randomized control trials (National Heart, Lung and Blood Institute [NHLBI], 2007). These guidelines by the NHLBI state that community-based asthma education delivered by trained community members can lead to behavioral change and improved quality of life (NHLBI, 2007). Furthermore, comprehensive education on allergens and asthma control interventions provided to individuals in the home setting is highly recommended (NHLBI, 2007). Education should also include reinforcing the consistent use of a written asthma action plan and peak flow meter, how to appropriately use a metered dose inhaler and the avoidance of tobacco smoke (NHLBI, 2007).

The NHLBI also has guidelines and recommendations on how to control in-home asthma triggers. As many people who have asthma are allergic to dust mites, it is ideal to encase one's mattress and pillows in a dust mite proof cover, washing sheets and covers once a week in hot water, reduce the indoor humidity to 60 percent and if possible remove carpeting in bedrooms (NHLBI, 2007). Other recommendations include: keeping pets out of the home or out of the bedrooms, vacuuming once or twice a week with a HEPA filter vacuum, fixing leaking faucets

and pipes to eliminate the incidence of indoor mold, and cleaning moldy surfaces (NHLBI, 2007). Like with dust mites, many people with asthma are also allergic to the droppings and remains of cockroaches; therefore kitchen hygiene including maintaining food in sealed containers and keeping garbage in closed trash cans will assist in the incidence of unwanted pests (NHLBI, 2007). When attempting to eliminate pests, poison baits, gels or pastes are ideal for asthmatics rather than sprays (NHLBI, 2007).

Overall, in-home visual assessments along with patient and family education and multiple follow up visits have been found to be successful in reducing asthma symptoms. These results have in turn had positive effects in reducing the number exacerbations, thus reducing emergency department visits. Although, the studies previously mentioned were successful, the use of a standardized visual assessment tool could possibly provide more consistent results throughout various communities. This could provide the HUD the ability to optimize Healthy Homes interventions to better assist those in need. Unfortunately, information is lacking on the process or the importance of educating environmental assessors on the basics of asthma, and the significance of home interventions to reduce in-home asthma triggers. Section 3, Component 3 of the NHLBI, 2007 Guidelines can be seen in Appendix C.

Methods

Project Intervention

The project leader met with a community agency in the City of San Antonio (Agency A) to discuss the need for an in-home asthma intervention program that would be available to qualifying families who have children with a current diagnosis of asthma. This need was determined based on the number of the children who have asthma and the number of asthma-related hospitalizations in Bexar County. Nationally, it was noted that in-home asthma triggers

contribute to the number of symptoms and asthma exacerbations that a child with asthma may experience (CDC, 2018).

From the information gathered it can be established that in-home asthma intervention programs have begun to emerge. Thus, taking into consideration the asthma related statistics in Bexar County, such programs would be beneficial to the local community. The intervention plan consisted of recruiting 10 to 20 families who have a child between the ages of three to 14 years of age, with a current diagnosis of asthma. Recruitment took place in specific school districts in San Antonio, and through a collaboration with local Head Start programs. Recruitment was accomplished by the distribution of flyers, in both English and Spanish that were made by the project leader. These flyers were distributed to the local Head Starts through the authority of the City of San Antonio school officials. A total of seventeen centers and schools where included in the recruitment process. The recruited families had an in-home environment asthma assessment to determine the total number of asthma triggers in the home. Each child's asthma symptoms were assessed using the ACT. Both assessments were performed during each of the three home visits, which were done by the project leader. The intended outcomes of these interventions were to see a decrease in the number of in-home asthma triggers, provide education to the family regarding the mentioned triggers, and to observe a reduction in the child's asthma symptoms. Intervention steps can be noted in Appendix D and the intervention timeline can be seen in Appendix E

In-home environmental assessments. The in-home visits were completed using the Asthma Home Environment Checklist from the EPA (Appendix F). The Checklist consists of eighteen "yes or no" items. The visits were based on a simple scoring system where one point was given for every "yes" answer. However, if the question was answered with a "no", a score of

zero was given. The higher the point score the more triggers present. With each visit the total number of points given should have decreased. This would be indicative that the identified environmental factors had been appropriately addressed by the families. Each home visit was done in a two to four hour time-frame to provide ample time for the assessment and education of the family. The family was provided with an In-Home Assessment Tool (Appendix G) that is adapted from the EPA checklist that has been modified to a simpler format, which the family can continue to use to perform their own assessments as they see fit.

Education. Education provided to the families was obtained from the Asthma and Allergy Foundation of America Wee Breathers. These educational materials consisted of providing the family with a basic understanding of asthma, information on triggers and irritants, medications and asthma management. Family education was tested with pre and post-tests on the initial assessment day, as well as a post-test on the second and third visit. This consisted of a simple five item quiz, that was also adopted from the EPA.

Asthma symptoms. In order to assess the correlation of asthma symptoms and the triggers found within the home, the child or the parents of the child were asked to answer the ACT questionnaire. ACT has been validated to be a useful tool to assess the respiratory and asthma control in preschool-aged children. The ACT is a 7-item Likert-scale survey addressing the type and severity of asthma symptoms in the last 4-weeks. A score of 19 or less may indicate that the child's asthma is not in control, while a score greater than 19 suggests that the child's asthma is well controlled.

The ACT validity and reliability was assessed by Schatz et al. (2006), who observed the ACTs reliability in 301 patients aged 12 to 84 years, by using internal consistency and retesting methods (Schatz et al., 2006). While validity, was evaluated by calculating the correlations

between the ACT scores during the baseline visit and the subsequent visits. To validate the ACT scores, they were also compared to the patients' Asthma Control Questionnaire (ACQ) results and the predicted Forced Expiratory Volume (FEV_1) values that were gathered at the baseline visit (Schatz et al., 2006). This exemplified that the ACT correlated with both the ACQ and the FEV_1 values. This indicates that the ACT scores are valid, reliable and reactive to changes in asthma control (Schatz et al., 2006).

Settings and Population

The in-home assessment and family education took place within the homes of the participant families. The geographical locations of the homes were based on the families recruited by the project leader with the assistance of local school districts. Target population was Hispanics, given that a large percentage of the population in these areas are of minority ethnic groups. With the assistance from the San Antonio Head Start Department of Human Services, families living in certain zip code areas that are known to be lower in socioeconomic status were recruited. Collaboration with the San Antonio Head Start for recruitment was key as the Head Start program is specifically meant for families of low household incomes.

Barriers and Facilitators

Barriers. Barriers encountered included that recruited families were not comfortable with the idea of having the project leader enter their home. Organizational barriers included the lack of health care personnel in Agency A to assist with educating the families on asthma management. Moreover, Agency A's assessors' lack of knowledge regarding this subject would also have been a barrier. Furthermore, as Agency A was hiring independent companies to perform their lead assessments for their current lead-reduction program, this brought up the question of whether they intended to do the same for the in-home asthma program in the future. This could have led to inconsistent use of the in-home asthma assessment tool, as well as the

gaps in education provided to the patient. It is also important to consider that even with the assistance from the Head Start, there may be a difficulty recruiting families due to families being uncomfortable having a stranger come into their home and assessing the environment.

Facilitators. Facilitators included the potential collaboration between both Agency A and Agency B. Agency B has beneficial healthcare related resources that could assist Agency A; this would have included supplemental education materials and other asthma related resources. Furthermore, Agency A had the potential to expand this program further by assisting the families with more than just patient education and some financial assistance. For instance, the agency may have been able to equip cleaning supplies to the families to better address triggers. Other forms of assistance that are within the organization's budget could also be given to the families. As previously mentioned, both Agency A and B recognize the need for an in-home asthma program and have expressed that it would be a benefit to the community, which in turn facilitates the program's continuation. Also, as Agency B has recently been reestablished, the leadership has conveyed their desire to see positive changes in the community and have been granted funding to support their aim to better serve the community.

Ethical Considerations

It was imperative to maintain the privacy of the families throughout the process. Only the project leader had knowledge of the addresses of the homes involved. Furthermore, as the City of San Antonio is diverse and is close to the Mexico border, families were not asked their legal status in order to ensure a perception of the family's safety in their own home and to prevent them from feeling discriminated against. Additionally, during recruitment the families were assured that this project was not led by any government organization and is only meant to assist families in providing a better home environment for their child to reduce their asthma symptoms

and provide them a healthier life. Complete anonymity was assured and in response to the sensitivity of home visits, families were asked to sign a consent form to allow the DNP student to come to their home. All of the information, such as addresses, and the data collected were stored in a password-protected computer and excel document. The physical assessment forms were kept in file folders that were only handled and viewed by the project leader. During the process of transporting files, all the files were kept in crate in the project leader's trunk, which was always locked.

Evaluation Plan

This project measured the number of asthma triggers noted and documented within a home through multiple-visit home assessments. In-home assessments began in late February to early March and took place through the end of June. The follow-up visits after the initial assessment occurred monthly to evaluate the status of the home. Visits were also meant to evaluate the families' understanding of the education provided regarding the in-home environment. As the triggers were addressed, the child's asthma related symptoms were measured by using the ACT tool to assess the correlation between the symptoms and the triggers recorded.

During each visit the EPA Home Environment Checklist, the asthma knowledge tests, and the ACT were collected. An excel spread sheet was made for each individual tool used, the score for each individual item was entered to appropriately gather the total score, specifically for the ACT and the asthma knowledge quiz. While the EPA tool itself did not have a specific coding system one was made by the project leader. This was done to attempt to provide more clarity in the process of inputting the data. All the data were arranged to compare every visit of

each family to asses each individual families' progression throughout the visits. After which all five families results were compared to each other.

Results

This evidenced based project occurred over the time span of three months, where every family had home visits in 1-month intervals. There were total of five families that participated, all of which had one child with asthma in the household. Parents and children were of Hispanic descent. All five children were below the age 10 with the youngest being 4 years old, while the oldest were 7 years old. Demographic data including age of child, number of children with asthma in the household, how long the child has had asthma (duration of asthma) and list of medications can be seen on Table 10. As home type and whether the family owns or rents can be an important factor on the home environment and what changes can done to improve such environment, the type of home (e.g. house, apartment or trailer home) and owner status can also be seen in Table 10.

Table 10

Demographics

Family	Number of children	Age	Duration of asthma	Medications	House type	Own or rent
1	1	4	1 year	Flovent Albuterol	House	Own
2	1	4	5 months	Pulmicort Albuterol	House	Own
3	1	5	2 years	Symbicort Albuterol	House	Own
4	1	7	3 years	Flovent Albuterol	House	Rent
5	1	7	2 years	Flovent Albuterol	Trailer Home	Own

Note. Demographic data including age of child in years, number of children with asthma in the household, how long the child has had asthma and list of medications. Home type and whether the family owns, or rents was also noted.

It can be noted that all the children had both a short-acting, to use as needed, and long-acting medication used daily to maintain their asthma. All five parents/caregivers did express that they were compliant with their child's medications and administered them as prescribed by their provider. It was also documented that all the children had a prescribed fast-acting inhaler used when they were symptomatic or before doing any physical activity that consisted of continuous running, such as playing soccer. Furthermore, four of the five families owned their own home, while family four was renting their house they were living in. Parent in family four did express that it was difficult to make certain changes in the home that would benefit her child, as they would need to get permission from their landlord.

Outcome 1: Reduction of Asthma Triggers

Unfortunately, as per the EPA Home Environment Checklist, there were no asthma trigger changes in any of the homes. Therefore, there was a 0% improvement in the EPA scores

for all five families. However, when looking at the individual items on the checklist there were a few variants between the families. Items one and two were not considered in the overall total of the triggers as they were demographics that asked about the type of home and ownership of the home. However, items 3 to 25 were documented as triggers and are shown in Table 11. Common triggers can also be noted in Table 11 and were found for items 6,10, 11, 13, 14, and 15. The total triggers in each home are seen in Figure 3, which compares the total triggers of each family.

Table 11

EPA Home Environment Checklist Items Per Family

Item number	Description	Family number
3	Smoking in home	1
4	Asthma is worse around pets	1, 3, 5
5	Worsened asthma symptoms with strong odors, such as those from candles and cleaning products	3, 5
6	Appropriate filters in their heating and cooling system	1, 2, 3, 4, 5
7	Fuel burning appliances	-
8	Supplemental heating source	-
9	Window units in home	1
10	Sleep on a mattress with box springs	1, 2, 3, 4, 5
11	children slept with a bedspread, blankets, pillows and sheets	1, 2, 3, 4, 5
12	Carpeting, a throw rug or both, in addition to the vinyl or tile flooring in home	2, 3, 5
13	Upholstered furniture present	1, 2, 3, 4, 5
14	Stuffed animals present	1, 2, 3, 4, 5
15	Window coverings, blinds, curtains and shades	1, 2, 3, 4, 5
16	Gas cooking appliances	-
17	Evidence of water damage	1
18	Evidence of mold	1
19	Evidence of standing water	-
20	Use humidifiers	-
21	Moisture appliances not properly vented	1
22	Evidence of pests (cockroaches or rat droppings)	-
23	Evidence of food crumbs	-
24	Noticeable gaps and cracks in the walls	4
25	Water leaks and standing water	-

Note. EPA home environment checklist items per family, (-) indicates that none of the families had this item or environmental issue in the home.

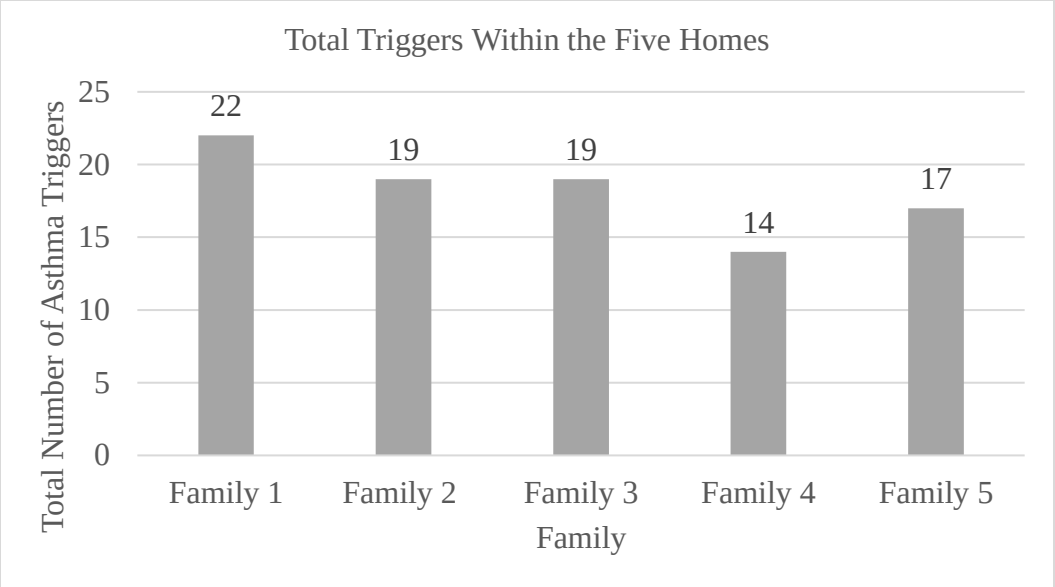

Figure 3. Total number of asthma triggers present in each family's home.

Outcome 2: Improving Asthma Education

During the process of this evidence-based practice project it was found that the parents and care givers of the five children were familiar with asthma triggers, as evidenced by the test scores. For that reason, the objective to meet the 50% and 75% increase did not occur, as the families all did so well to begin with. Only the parent of family four missed one of the five questions of the pre-test during visit one. The pre-and post-test for all five families during visit one can be seen in Figure 4. While, the post-test scores for each family during each visit can be seen in Table 12. The post test scores for every family were consistent during each visit, indicating that their knowledge of asthma had remained the same during visits two and three. Again, based on the pre-test scores, it can be noted that families one, two, three, and five already had a good understanding of asthma overall. Nonetheless, the project leader gave an explanation to every answer to reinforce why the answer they chose was the appropriate response.

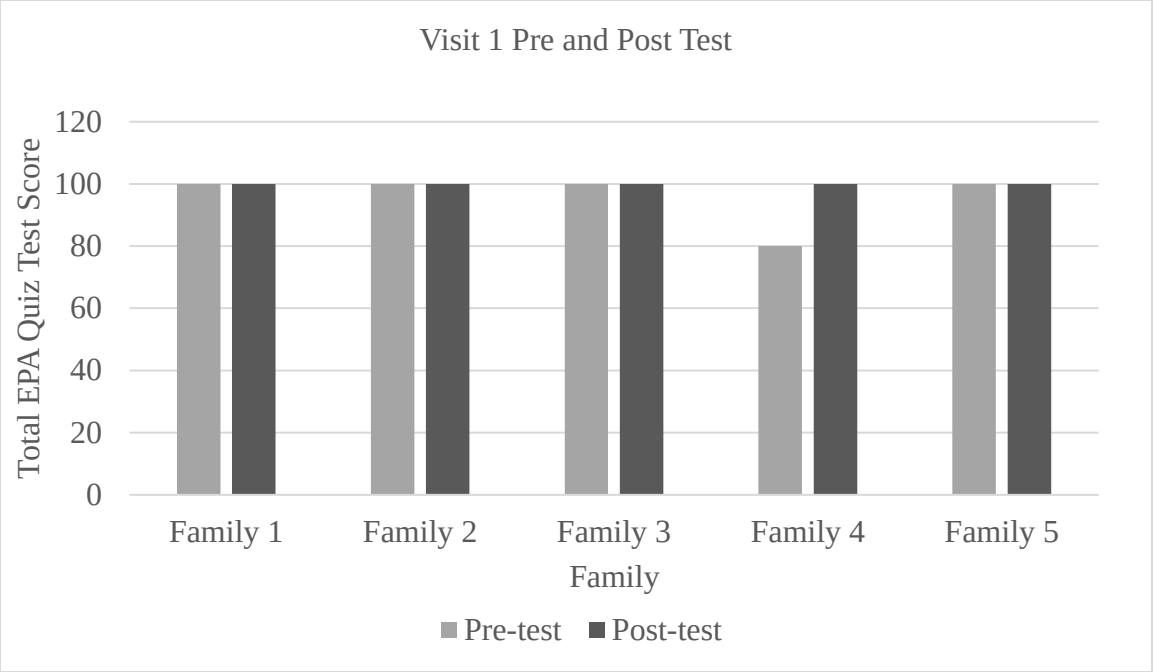

Figure 4. Visit one pre- and post-test scores. Pre and post test scores of the EPA quiz during visit one, based on a one-hundred-point scoring system.

Table 12

EPA Asthma Knowledge Quiz Post Test Scores

Family	Visit 1	Visit 2	Visit 3
1	100	100	100
2	100	100	100
3	100	100	100
4	80	100	100
5	100	100	100

Note. EPA post quiz scores in the scale of a hundred for each family during all three home visits.

Outcome 3: Reduction of Asthma Symptoms

Despite the lack of reduction of asthma triggers per visit and not meeting the objective of the 50% or 75% anticipated changes, improvements were seen in each visit. For 4 out of the 5 families there was a positive trend in the ACT score with each visit for each family. As illustrated in Figure 5, even though the child in family one had an initial score of 22, indicating well-controlled asthma, each subsequent ACT score has an increase of two points, which

indicated an improvement in asthma symptoms. Family two had an increase of eight points from the initial visit. It can also be seen that during the initial visit the child's ACT score was eighteen, which is a score that is exemplifies uncontrolled asthma symptoms. However, the score collected during visit two and three was 26, which denoted controlled asthma symptoms. Family three's scores improved with each subsequent visit; this consisted of a three-point increase between visit one and two and a one-point increase during visit three. For family four the score between visit one and visit two had a three-point improvement and a two-point improvement between visit two and three. Lastly, family five did not exhibit improvements during all three visits. Nevertheless, all the scores for this child were at the maximum score possible for the ACT, indicating that her asthma was very well controlled. Table 13 compares the total scores for each family during all the three visits. Table 14 demonstrates the percentage increase in score between visits for all five families.

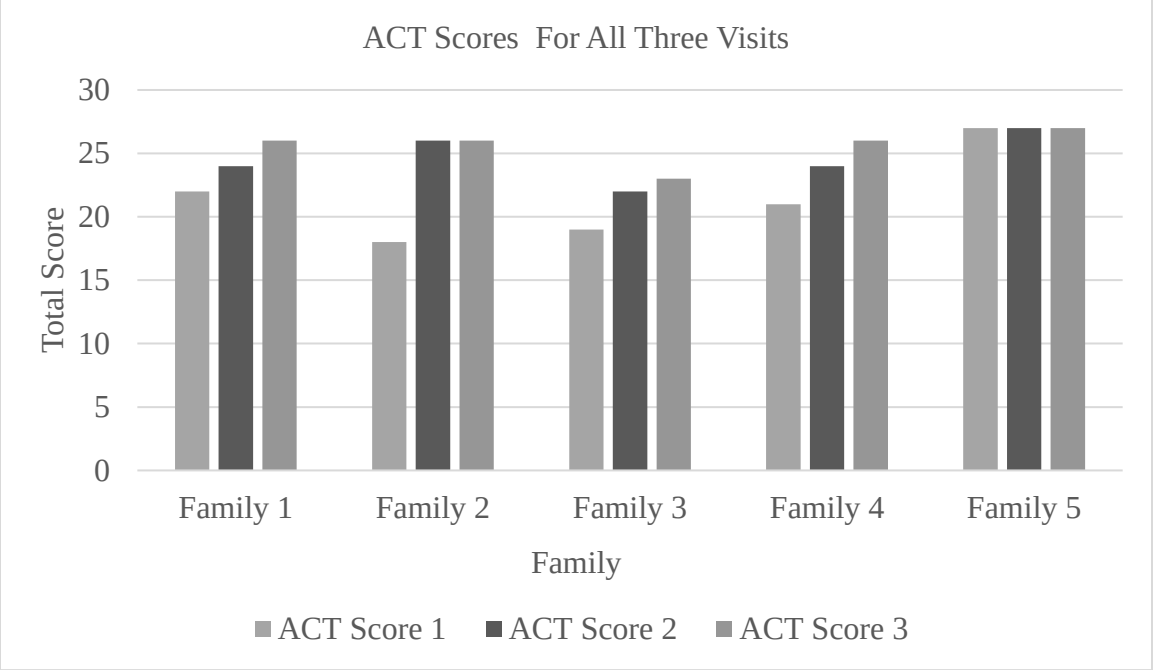

Figure 5. Total asthma control status scores for each visit and all five families.

Table 13

Comparative ACT Scores for All Five Families

Family Number	Visit 1	Visit 2	Visit 3
1	22	24	26
2	18	26	26
3	19	22	23
4	21	24	26
5	27	27	27

Note. Total asthma control test scores for all families during the three home visits.

Table 14

Improvements Between Visits and Overall in Percentage

Family Number	% improvement between visit 1 and 2	% improvement between visit 2 and 3	% overall improvement
1	9	8	18
2	44	0	44
3	16	5	21
4	14	8	24
5	0	0	0

Note. Percentage change between visit one and two, as well as between two and three. Overall improvement is also included.

Discussion

Participant Recruitment

Throughout the course of the project there were a few issues that arose. First and foremost, difficulties in participant recruitment occurred when the support from Agency A was withdrawn with a change in organizational leadership. It was deemed an inappropriate time to expand their services from only environmental lead testing to include asthma environmental screening as well. Although, attempts were made to continue a modified collaboration with Agency A and the new management, attempts were unsuccessful. This made the process of

implementation difficult as Agency A had agreed to assist in the recruitment of families for the project.

After regrouping with the project mentor and faculty advisor, another collaboration for recruitment was formed with the assistance from the local Head Start Centers. Although a total of seventeen centers and schools where included in the recruitment process recruitment continued to be a difficult as only five families agreed to participate in the project's home visits.

Success of Home Visits

Environmental assessment. All the participating families were willing to have their homes assessed and expressed that they wanted to do all they could to improve the environment for their children. In many cases, particularly the initial visit, parents asked a variety of questions, specifically questions regarding the suggested frequency of vacuuming, mopping, and overall maintenance of the home to control potential triggers. The EPA tool was effective in assessing the home environment for the initial home visit and it did contain guidance on methods to control asthma triggers; however, it did have limitations for the subsequent visits. These limitations were noticed in the results as there were no environmental changes noted for any of the families. However, changes in behaviors to address the environment were noted. This is not captured well in the EPA tool scores. Limitations of the EPA tool will be discussed further in the limitations section. Behavior changes noted included the parents increasing the frequency of washing their child's bedding and vacuuming both carpets and upholstered furniture. Parents also began to wash their curtains and clean their blinds more frequently. All parents also began washing their child's stuffed animals as recommended and limited their use of harsh odors, including candles and strong cleaning agents in the home.

Patient education. Despite there only being five families for this project, all of which turned out to be well-informed about their child's asthma management, the home visits were successful as the project leader was able to spend quality time with each family and meticulously review the home assessment and asthma management information provided to the families. A part of the patient education did include speaking to the family about ensuring that the child has a primary care provider, access to urgent or emergency services, and they were instructed on what signs and symptoms to observe for in the event of an exacerbation. As it is recommended by the guidelines for every child to have an asthma action plan, all families were provided with one so that they would be able to track what medications the child should take and when (NHLBI, 2007).

All families involved were willing and eager to learn how they can improve their home in order to better suit their child's asthma. This made the process of the home visits simple. In assessing parent knowledge of asthma management, only one parent missed one question during the initial pre-test. Otherwise, all other parents consistently answered all five questions in the subsequent post-tests correctly. As per the quiz provided it was interpreted that all the families were aware of the basics of asthma management and maintained a consistent knowledge level. Although the home visits are time intensive, there can be no doubt about their worth in building rapport and ensuring knowledge regarding asthma management.

Asthma symptom control. The ACT tool was straightforward for the project leader and the parents to understand. This made analyzing the scores effortless and it gave the families peace of mind knowing that their children were doing well in their asthma management. It was documented that most of the children experienced asthma symptoms while playing sports, running, or exercising. Most also expressed that they cough and wake up at night because of their

asthma. However, it was noted that during every visit asthma symptoms for each child were better controlled. This was specifically noted between the initial visit and the second visit. Whereas, between the second and third visits the ACT scores either increased or stayed the same. Nonetheless, all scores gathered during the third visit were still above the minimum required score to be considered well-controlled.

Relationship to Evidence

In a study by Shani et al. (2014), it was found that the authors had to alter the EPA Home Environment Check list they used in order to see any change in the data gathered when assessing the homes of their participants. This can indicate that the authors experienced the same difficulties in gathering the environmental data with the same tool used in this evidence-based project. Regardless of the minimal change that Shani et al. (2014) found in the homes they assessed with the EPA Home Environment Checklist, they were also able to see an improvement in the ACT scores of the participants.

Similar to what has been stated in previous studies, despite the lack of a home environment assessment tool that is consistent, in-depth and can be used as a universal standard, these home visits did serve as a great opportunity to educate parents with asthma and to help them effectively manage their disease. This was comparable to what Ashley (2015), Dong et al. (2018) and Skolowsky (2017) found. Going in the individual homes of families who have children with a diagnosis of asthma was effective when it came to providing parents with information. Although, there were hardly any changes in the scores of the EPA quiz provided to the families in this project, there was a consistency that demonstrated an understanding of the information provided.

Limitations

Limitations included the lack of support from Agency A. Without their support, the recruitment process took longer than anticipated, as other methods for recruitment had to be identified. Furthermore, though families seemed interested in participating in this project, many were trepidatious about having someone come into their home to assess the environment. Therefore, only a handful of families were willing to participate in the project. The limited number of participants means that this project may not be the strongest model on which to base future projects.

Limitations that arose during the home visits and gathering of the data consisted of the EPA checklist not having its own coding system built in. This made interpreting the data collected difficult. Additionally, the EPA tool was very restrictive on the type of information that could be gathered to better assess changes in the home environment. It is due to this limitation that the results of the EPA checklist did not vary. Although the EPA tool was effective in assessing the home environment for the initial home visit, the checklist itself does not really focus on the changes made, especially behavior changes such as: increased frequency of moping/dusting, use of different cleaners, frequency of laundering linens, and vacuuming. However, this is not to say that the family did not make any improvements within their home environments or behavior towards their management of in-home asthma triggers. Families did begin to follow guidelines, such as washing their child's stuffed animals if the child had any, but this positive behavior could not be assessed with the EPA tool.

There were also a few limitations that can be considered in the home visits. For instance, the visits were time consuming, as each visit took approximately two to four hours and many times this did not include the time it took to drive to each house. This process would have been

more time-intensive had there been more families for only the project leader to visit. Therefore, if this type of evidence-based project is planned in the future, more evaluators should be used to perform home visits.

Unfortunately, there was an instance were an additional family did volunteer for this project and yet after several times rescheduling for the initial visit the family was not home and after several attempts to contact the family the phone calls were never returned. Nonetheless, the visits with all other five families were successful. However, it can also be said that these families did not contribute to the limited data collected as all the families were already well-informed and most of the children had their asthma well-controlled. It could be safe to assume that if these children were newly diagnosed, there may have been more of an improvement noted in the results of the project simply because the patient and caregiver would still be learning about asthma management.

Recommendations

In order to attain a larger group of participants more reflective of the general population, it can be recommended that any project involving in-home visits require a physician or provider referral at the time of asthma diagnosis. The referral for home visits by a provider may ease the concerns in regards to having a community health care worker or nurse visit the home, which again was a limitation in recruitment. This recommendation may be feasible for Agency B as they are an organization that consists of several health care providers that specifically focus on asthma management. If agency B can use resources to their benefit it may make the process of implementing in-home visits and referrals for such visits less problematic.

A more formal plan for patient/caregiver education is another recommendation. It was brought to the attention of the project leader that for most of the participants neither the

physician, nor the staff of their child's primary care provider office, ever discussed medication use, including the use of the nebulizer machine and the spacer. These recommendations were included in the *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma* (NHLBI, 2007). The guidelines have also recommended that in-home triggers should be reviewed with patients and caregivers. These are excellent education topics to be covered during home visits, but if in-home visits are not possible, group meetings at either the child's school or in the clinic can be held to provide the parents with an overview of all that is involved with their child's asthma. Regardless of the possibility of group meetings or in-home visits, physicians and practitioners should be advised to provide information packets, similar to those provided to the families in this evidence-based project, to all parents and caregivers who have a child with a diagnosis of asthma. This would also address the concerns of parents who already have a good understanding of asthma, but may have read information from a less reputable source, as well as for those that may not have access or availability to look up the information at home.

Moreover, although the EPA Asthma Home Environment Checklist is beneficial for assessments such as these, the In-home Assessment Tool developed by the project leader is a straight-forward instrument that is already coded and has the negatively worded questions rephrased to make data coding straightforward and data collection effortless. As this tool was adapted from that of the EPA checklist, it also has the recommendations on how to address and manage the asthma triggers found in the home. Therefore, if printed on a perforated sheet this information can be provided to the family immediately. This in turn, can be beneficial to others who attempt to perform a quality assessment project such as this. It would also be prudent to assess and capture behavioral changes. For example, one of the EPA checklist items asks if there is upholstered furniture present in home. Getting rid of any or all upholstered furniture can be

construed as an unrealistic expectation. However, behavior changes such as vacuuming the furniture more often to eliminate dust particles is a more feasible expectation and can be documented as data in future home visits.

The use of the ACT tool could also be recommended for future use in both home visits and clinic settings. This tool screens for current asthma symptoms and frequency of symptoms in the past four months, which makes it ideal to assess the most recent asthma regimen prescribed to the patient. Also, the questions are easy to understand, as is the scoring system, making it straightforward for the provider, the parents and older children to use.

The EPA quiz would also be recommended to use for the initial assessment of asthma knowledge. However, as it is a simple five question quiz it could become too simple of an assessment if done continuously. Thus a more in-depth quiz for the second and third visit may be recommended. It could also be recommended that the EPA quiz not be given so often, perhaps only a pre-test during the initial visit and a post-test during the third visit. Nonetheless, it was a good assessment tool for the families particularly because it is a short quiz, which can make it less tedious for parents to complete.

Implications for Practice

The asthma management information booklet from the Asthma and Allergy Foundation of America (AAFA) was found to be very informative; therefore, this booklet, or one similar, should be provided to parents as soon as the diagnosis of asthma is made. As this booklet is a resource with materials including the basics of asthma, both indoor and outdoor environmental triggers, and medications associated with this diagnosis, this would provide the parents with the knowledge that is imperative for management their child’s asthma. These booklets can either be downloaded and printed by individual clinics at no cost or physical booklets can be ordered by

the AAFA online at varying costs depending on the education booklet that is desired. This would also offer the parents comfort in knowing that they have a resource available to them at home to which they can refer at any given time.

Moreover, as advised by the *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma* (NHLBI, 2007), ensuring that every family has access to a primary care provider who can closely monitor the progress of their child's asthma is imperative to its management. With this, families should always be provided with an asthma action plan and if possible two or more copies of the plan because many parents must leave a copy with either the day care or school nurse. This issue can likely leave parents empty-handed when it comes to medication information, what to do in case of an emergency and which signs and symptoms to watch for during an exacerbation. Along these lines, practitioners should also discuss plans on what to do and review which urgent care facilities or emergency care centers are available to them should the need arise.

Providing the parents of children with asthma with a copy of the In-Home Assessment Tool developed by the project leader in their preferred language, can increase the surveillance of asthma triggers and ultimately decrease the negative health outcomes related to asthma in children. As stated before, the checklist is uncomplicated to use and was tailored to be read at a sixth-grade reading level making it accessible to the general population.

Sustainability

As previously mentioned, Agency A did not continue the collaboration throughout the course of the project, despite this loss Agency B continued to the provide support. This is due to their desire to improve asthma outcomes in the community by continuing to perform home visits for parents with children with a current asthma diagnosis who need guidance and assistance. In

order to sustain the development of the home visits, Agency B was presented with the results of this evidence-based project. It was emphasized that although the objectives were not met, improvement was noted in the ACT score. The possibility of reaching the objectives will be improved with a larger sample of participants. It was also suggested to assess the behavioral changes of the families in order to better monitor the management of in-home asthma triggers as this may exhibit more of an improvement in the overall asthma outcomes of the children.

Conclusion

Despite certain limitations, the implications of home visits have been proven to be beneficial and are within reach of doctorally prepared nurse practitioners. As nurses, the aim of patient care within in a community is to offer community members education on the maintenance of their health to reduce the incidence of disease. However, one advanced practice nurse can further assist the community by providing care beyond that of the scope of a nurse. For instance, as an advanced practice nurse, one can provide not only education, but also monitor asthma outcomes and adjust the asthma management/treatment plan on site if needed. Furthermore, by being in the upper level of healthcare hierarchy, nurse practitioners in the community can develop interprofessional collaborations for the benefit of the community, have the ability to efficiently create individualized care plans, and implement guidelines to improve health outcomes. Better asthma control reduces the number of exacerbations that are experienced by a child, which in turn reduces the number of missed school days and the missed workdays for the parents. This also can assist in eliminating unnecessary medical expenses that occur with asthma exacerbations.

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Appendix A: Take the Asthma Quiz

1. What is an asthma attack?

A. When the lungs fill with water

B. When airways tighten and the lungs don't get enough air

C. When the heart beats too fast

D. When the heart and lungs are working too hard

2. True or False: Asthma can be cured.

A. True

B. False

3. Which of the following are potential asthma triggers?

A. Dust mites and cockroaches

B. Pets

C. Secondhand smoke

D. All of the above

1. What can you do to reduce asthma triggers in your home?

A. Clean up mold with soap and water

B. Don’t smoke in the home

C. Vacuum carpets, rugs and furniture often

D. All of the above

5. True or false: Secondhand smoke increases the risk of preschool-aged children developing asthma.

A. True

B. False

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Appendix B: Asthma Control Test

Childhood Asthma Control Test for children 4 to 11 years old.

Know the score.

This test will provide a score that may help your doctor determine if your child's asthma treatment plan is working or if it might be time for a change.

How to take the Childhood Asthma Control Test

Step 1 Let your child respond to **the first four questions (1 to 4).** If your child needs help reading or understanding the question, you may help, but let your child select the response. Complete the remaining **three questions (5 to 7)** on your own and without letting your child's response influence your answers. There are no right or wrong answers.

Step 2 Write the number of each answer in the score box provided.

Step 3 Add up each score box for the total.

Step 4 Take the test to the doctor to talk about your child's total score.

19 or less If your child's score is 19 or less, it may be a sign that your child's asthma is not controlled as well as it could be. No matter what the score, bring this test to your doctor to talk about your child's results.

Have your child complete these questions.

SCORE

1. How is your asthma today?

0	1	2	3
Very bad	Bad	Good	Very good

2. How much of a problem is your asthma when you run, exercise or play sports?

0	1	2	3
It's a big problem, I can't do what I want to do.	It's a problem and I don't like it.	It's a little problem but it's okay.	It's not a problem.

3. Do you cough because of your asthma?

0	1	2	3
Yes, all of the time.	Yes, most of the time.	Yes, some of the time.	No, none of the time.

4. Do you wake up during the night because of your asthma?

0	1	2	3
Yes, all of the time.	Yes, most of the time.	Yes, some of the time.	No, none of the time.

Please complete the following questions on your own.

5. During the last 4 weeks, on average, how many days per month did your child have any daytime asthma symptoms?

5	4	3	2	1	0
Not at all	1-3 days/mo	4-10 days/mo	11-18 days/mo	19-24 days/mo	Everyday

6. During the last 4 weeks, on average, how many days per month did your child wheeze during the day because of asthma?

5	4	3	2	1	0
Not at all	1-3 days/mo	4-10 days/mo	11-18 days/mo	19-24 days/mo	Everyday

7. During the last 4 weeks, on average, how many days per month did your child wake up during the night because of asthma?

5	4	3	2	1	0
Not at all	1-3 days/mo	4-10 days/mo	11-18 days/mo	19-24 days/mo	Everyday

TOTAL

Please turn this page over to see what your child's total score means.

Appendix C: Section 3, Component 3 of the NHLBI, 2007 Guidelines

SECTION 3, COMPONENT 3: CONTROL OF ENVIRONMENTAL FACTORS AND COMORBID CONDITIONS THAT AFFECT ASTHMA

KEY POINTS: CONTROL OF ENVIRONMENTAL FACTORS AND COMORBID CONDITIONS THAT AFFECT ASTHMA

- Exposure of patients who have asthma to allergens (Evidence A) or irritants (EPR—2 1997) to which they are sensitive has been shown to increase asthma symptoms and precipitate asthma exacerbations.
- For at least those patients who have persistent asthma, the clinician should evaluate the potential role of allergens, particularly indoor inhalant allergens (Evidence A):
  - Use the patient's medical history to identify allergen exposures that may worsen the patient's asthma.
  - Use skin testing or in vitro testing to reliably determine sensitivity to perennial indoor inhalant allergens to which the patient is exposed.
  - Assess the significance of positive tests in the context of the patient's medical history.
  - Use the patient's history to assess sensitivity to seasonal allergens.
- Patients who have asthma at any level of severity should:
  - Reduce, if possible, exposure to allergens to which the patient is sensitized and exposed.
  - Know that effective allergen avoidance requires a multifaceted, comprehensive approach; individual steps alone are generally ineffective (Evidence A).
  - Avoid exposure to environmental tobacco smoke and other respiratory irritants, including smoke from wood-burning stoves and fireplaces and, if possible, substances with strong odors (Evidence C).
  - Avoid exertion outdoors when levels of air pollution are high (Evidence C).
  - Avoid use of nonselective beta-blockers (Evidence C).
  - Avoid sulfite-containing and other foods to which they are sensitive (Evidence C).
  - Consider allergen immunotherapy when there is clear evidence of a relationship between symptoms and exposure to an allergen to which the patient is sensitive (Evidence B). If use of allergen immunotherapy is elected, it should be administered only in a physician's office where facilities and trained personnel are available to treat any life-threatening reaction that can, but rarely does, occur.

- Adult patients who have severe persistent asthma, nasal polyps, or a history of sensitivity to aspirin or nonsteroidal anti-inflammatory drugs (NSAIDs) should be counseled regarding the risk of severe and even fatal exacerbations from using these drugs (Evidence C).
- Clinicians should evaluate a patient for the presence of a chronic comorbid condition when the patient's asthma cannot be well controlled. Treating the conditions may improve asthma management: ABPA (Evidence A), gastroesophageal reflux (Evidence B), obesity (Evidence B, limited studies), OSA (Evidence D), rhinitis/sinusitis (Evidence B), chronic stress/depression (Evidence D).
- Consider inactivated influenza vaccination for patients who have asthma. It is safe for administration to children more than 6 months of age and adults (Evidence A). The Advisory Committee on Immunization Practices of the CDC recommends vaccination for persons who have asthma, because they are considered to be at risk for complications from influenza. However, the vaccine should not be given with the expectation that it will reduce either the frequency or severity of asthma exacerbations during the influenza season (Evidence B).
- Use of humidifiers and evaporative (swamp) coolers is not generally recommended in homes of patients who have asthma and are sensitive to house-dust mites or mold (Evidence C).
- Employed persons who have asthma should be queried about possible occupational exposures, particularly those who have new-onset disease (EPR—2 1997).
- There is insufficient evidence to recommend any specific environmental strategies to prevent the development of asthma.

KEY DIFFERENCES FROM 1997 EXPERT PANEL REPORT

- Evidence strengthens recommendations that reducing exposure to inhalant indoor allergens can improve asthma control and notes that a multifaceted approach is required; single steps to reduce exposure are generally ineffective.
- Formaldehyde and volatile organic compounds (VOCs) have been implicated as potential risk factors for asthma and wheezing.
- Evidence shows that influenza vaccine, while having other benefits, does not appear to reduce either the frequency or severity of asthma exacerbations during the influenza season.
- The section has been expanded to include discussion of ABPA, obesity, OSA, and stress as chronic comorbid conditions, in addition to rhinitis, sinusitis, and gastroesophageal reflux, that may interfere with asthma management.

Introduction

See section 1, "Overall Methods Used To Develop This Report," for literature search strategy and tally of results for the EPR—3: Full Report 2007 on this component, "Control of Environmental Factors and Comorbid Conditions That Affect Asthma." Two Evidence Tables were prepared: 9, Allergen Avoidance; and 10, Immunotherapy.

For successful long-term management of asthma, it is essential to identify and reduce exposures to relevant allergens and irritants and to control other factors that have been shown to increase asthma symptoms and/or precipitate asthma exacerbations. These factors are in five categories: inhalant allergens, occupational exposures, irritants, comorbid conditions, and other factors. Ways to reduce the effects of these factors on asthma are discussed in this component of asthma management.

Inhalant Allergens

The Expert Panel recommends that patients who have asthma at any level of severity should be queried about exposures to inhalant allergens, particularly indoor inhalant allergens, and their potential effect on the patient's asthma (Evidence A). Exposure of a person who has asthma to inhalant allergens to which the person is sensitive increases airway inflammation and symptoms. Substantially reducing such exposure may significantly reduce inflammation, symptoms, and need for medication (See a summary of the evidence in box 3–5.).

DIAGNOSIS—DETERMINE RELEVANT INHALANT SENSITIVITY

Demonstrating a patient's relevant sensitivity to inhalant allergens will enable the clinician to recommend specific environmental controls to reduce exposures. It will also help the patient understand the pathogenesis of asthma and the value of allergen avoidance.

The Expert Panel recommends that, given the importance of allergens and their control to asthma morbidity and asthma management, patients who have persistent asthma should be evaluated for the role of allergens as possible contributing factors as follows (EPR—2 1997):

- **Determine the patient's exposure to allergens, especially indoor inhalant allergens. (See relevant questions in figure 3–17.)**
- **Assess sensitivity to the allergens to which the patient is exposed.**
  - **Use the patient's medical history, which is usually sufficient, to determine sensitivity to seasonal allergens.**
  - **Use skin testing or in vitro testing to determine the presence of specific IgE antibodies to the indoor allergens to which the patient is exposed year round. (See figure 3–18 for a comparison of skin and in vitro tests.) Allergy testing is the only reliable way to determine sensitivity to perennial indoor allergens (See box 3–6 for further explanation.).**
  - **For selected patients who have asthma at any level of severity, detection of specific IgE sensitivity to seasonal or perennial allergens may be indicated as a basis for education about the role of allergens for avoidance and for immunotherapy.**
- **Assess the clinical significance of positive allergy tests in the context of the patient's medical history (See figure 3–19.).**

BOX 3–5. THE STRONG ASSOCIATION BETWEEN SENSITIZATION TO ALLERGENS AND ASTHMA: A SUMMARY OF THE EVIDENCE

The association of asthma and allergy has long been recognized. Recent studies confirm that sensitization among genetically susceptible populations to certain indoor allergens such as house-dust mite, animal dander, and cockroach or to the outdoor fungus Alternaria is a risk for developing asthma in children (Halonen et al. 1997; Sears et al. 1993; Sporik et al. 1990). Sensitization to outdoor pollens carries less risk for asthma (Sears et al. 1989), although exposure to grass (Reid et al. 1986) and ragweed (Creticos et al. 1996) pollen has been associated with seasonal asthma. It is widely accepted that the importance of inhalant sensitivity as a cause of asthma declines with advancing age (Pollart et al. 1989).

An allergic reaction in the airways, caused by natural exposure to allergens, has been shown to lead to an increase in inflammatory reaction, increased airway hyperresponsiveness (Boulet et al. 1983; Peroni et al. 1994; Piacentini et al. 1993), and increased eosinophils in bronchoalveolar lavage (Rak et al. 1991). Other research has demonstrated that asthma symptoms, pulmonary function, and need for medication in mite-sensitive asthma patients correlate with the level of house-dust mite exposure (Custovic et al. 1998; Huss et al. 2001; Sporik et al. 1990; Vervloet et al. 1991) and that reducing house-dust mite exposure reduces asthma symptoms, nonspecific bronchial hyperresponsiveness, and evidence of active inflammation (Morgan et al. 2004; Peroni et al. 2002; Piacentini et al. 1993; Simon et al. 1994). Inhalant allergen exposure to seasonal outdoor fungal spores (O'Hollaren et al. 1991; Targonski et al. 1995) and to indoor allergens (Call et al. 1994) has also been implicated in fatal exacerbations of asthma. These reports emphasize that allergen exposure must be considered in the treatment of asthma.

The important allergens for children and adults appear to be those that are inhaled. Food allergens are not a common precipitant of asthma symptoms. Foods are an important cause of anaphylaxis in adults and children (Golbert et al. 1969; Sampson et al. 1992), but significant lower respiratory tract symptoms are uncommon even with positive double-blind food challenges (James et al. 1994). However, asthma is a risk factor for fatal anaphylactic reactions to food or immunotherapy (Bernstein et al. 2004; Reid et al. 1993).

BOX 3–6. RATIONALE FOR ALLERGY TESTING FOR PERENNIAL INDOOR ALLERGENS

Determination of sensitivity to a perennial indoor allergen is usually not possible with a patient's medical history alone (Murray and Milner 1995). Increased symptoms during vacuuming or bed making and decreased symptoms when away from home on a business trip or vacation are suggestive but not sufficient. Allergy skin or in vitro tests are reliable in determining the presence of specific IgE (Dolen 2001; Yunginger et al. 2000), but these tests do not determine whether the specific IgE is responsible for the patient's symptoms. That is why patients should be tested only for sensitivity to the allergens to which they may be exposed, and why the third step in evaluating patients for allergen sensitivity calls for assessing the clinical relevance of the sensitivity.

The recommendation to do skin or in vitro tests for patients who have persistent asthma and are exposed to perennial indoor allergens will result in a limited number of allergy tests for about half of all asthma patients. This estimate is based on the prevalence of persistent asthma and the level of exposure to indoor allergens. Based on data on children in the United States, it is estimated that at least 70 percent of all patients who have asthma have persistent asthma (Squillace et al. 1997; Taylor and Newacheck 1992). About 80 percent of the U.S. population is exposed to house-dust mites (Arbes et al. 2003; Nelson and Fernandez-Caldas 1995), 60 percent to cat or dog, and a much smaller percentage to both animals (Ingram et al. 1995). Cockroaches are a consideration primarily in the inner-city and southern parts of the United States.

Skin or in vitro tests are necessary to educate patients about the role of allergens in their disease. Education is an essential prerequisite for convincing patients about the need for specific allergen avoidance. Current recommendations for avoidance measures for dust-mite, cat, or cockroach allergens are allergen specific, and it is only possible to convince patients to undertake the measures once they know to what they are allergic.

MANAGEMENT—REDUCE EXPOSURE

The Expert Panel recommends that patients should reduce exposure, as much as possible, to allergens to which the patient is sensitized and exposed:

- **The first and most important step in controlling allergen-induced asthma is to advise patients to reduce exposure to relevant indoor and outdoor allergens to which the patient is sensitive (Evidence A) (See Evidence Table 9, Allergen Avoidance.).**
- **Effective allergen avoidance requires a multifaceted, comprehensive approach; individual steps alone are generally ineffective (Evidence A).**
- **Consider multifaceted allergen-control education interventions provided in the home setting that have been proven effective for reducing exposures to cockroach, dust-mite, and rodent allergens for patients sensitive to those allergens (Evidence A). Further research to evaluate the feasibility of widespread implementation of such programs will be helpful (see "Component 2: Education for a Partnership in Asthma Care.").**

Effective ways patients can reduce their exposures to indoor and outdoor allergens are discussed below and summarized in figure 3–20, which also addresses irritants. Although these recommendations focus on the home environment, reductions in exposures to allergens and irritants are also appropriate in other environments where the patient spends extended periods of time, such as school, work, or daycare. For information about companies that distribute products to help reduce allergen exposure, contact the Asthma and Allergy Foundation of America toll-free hotline at 800–727–8462 or the Allergy and Asthma Network/Mothers of Asthmatics at 800–878–4403.

See "Component 2: Education for a Partnership in Asthma Care" for a description of allergen-control education programs that are delivered in patients' homes. Multifaceted programs that focus on educating patients and providing tools for reducing exposure to cockroach, dust-mite, and rodent allergens have demonstrated success in reducing exposure and reducing asthma morbidity. Further evaluation is needed of the cost-effectiveness and feasibility for widespread implementation of these interventions; however, the efficacy of the interventions warrants their consideration, if available, for patients sensitive to these allergens.

Animal allergens. The Expert Panel recommends the following actions to control animal antigens (Evidence D):

- **If the patient is sensitive to an animal, the treatment of choice is removal of the exposure from the home.**
- **If removal of the animal is not acceptable:**
  - **Keep the pet out of the patient's bedroom.**
  - **Keep the patient's bedroom door closed.**
  - **Remove upholstered furniture and carpets from the home, or isolate the pet from these items to the extent possible.**
  - **Mouse allergen exposure can be reduced by a combination of blocking access, low-toxicity pesticides, traps, and vacuuming and cleaning.**

All warm-blooded animals, including pets and rodents, produce dander, urine, feces, and saliva that can cause allergic reactions (de Blay et al. 1991b; Swanson et al. 1985). Given recent evidence that exposure to cat allergens can be significant in homes, schools, and offices without animals, the issue of allergen avoidance in sites without animals has become more relevant. Successful controlled trials of animal dander avoidance have now been reported for schools and for homes without an animal (Popplewell et al. 2000). Studies suggest that mouse and rat allergen exposure and sensitization are common in urban children who have asthma (Phipatanakul et al. 2004).

High-efficiency particulate air (HEPA) cleaners reduce airborne Can f 1 in homes with dogs. Furthermore, preventing the dog from having access to the bedroom, and possibly the living room, may reduce the total allergen load inhaled (Green et al. 1999). Weekly washing of the pet will remove large quantities of dander and dried saliva that will otherwise accumulate in the house; however, the role of washing in allergen avoidance is not established (Avner et al. 1997, de Blay et al. 1991a, Klucka et al. 1995).

House-dust mite allergen. The Expert Panel recommends the following mite-control measures; effective allergen avoidance requires a multifaceted approach (Evidence A).

- **Recommended actions to control mites include:**
  - **Encase the mattress in an allergen-impermeable cover.**
  - **Encase the pillow in an allergen-impermeable cover or wash it weekly.**
  - **Wash the sheets and blankets on the patient's bed weekly in hot water.**
  - **A temperature of >130 °F is necessary for killing house-dust mites. Prolonged exposure to dry heat or freezing can also kill mites but does not remove allergen. If high temperature water is not available, a considerable reduction in live mites and mite allergens can still be achieved with cooler water and using detergent and bleach.**
- **Actions to *consider* to control mites include:**
  - **Reduce indoor humidity to or below 60 percent, ideally between 30 and 50 percent.**
  - **Remove carpets from the bedroom.**
  - **Avoid sleeping or lying on upholstered furniture.**
  - **Remove from the home carpets that are laid on concrete.**
  - **In children's beds, minimize the number of stuffed toys, and wash them weekly.**

House-dust mites are universal in areas of high humidity (most areas of the United States) but are usually not present at high altitudes or in arid areas unless moisture is added to the indoor air (Platts-Mills et al. 1997). Mites depend on atmospheric moisture and human dander for survival. High levels of mites can be found in dust from mattresses, pillows, carpets, upholstered furniture, bed covers, clothes, and soft toys. The patient's bed is the most important source of dust mites to control. Washing bedding is advised, preferably in hot water, but cold water, detergent, and bleach can also be effective (Arlian et al. 2003; McDonald and Tovey 1992). Several recent studies support the efficacy of allergen avoidance in the treatment of asthma (Carter et al. 2001; Halken et al. 2003; Htut et al. 2001; Morgan et al. 2004; Peroni et al. 2002; Rijssenbeek-Nouwens et al. 2003; van der Heide et al. 1997). Other studies provide important insight into the details of allergen avoidance. For example, three studies reported that mattress covers without other measures were not effective (Luczynska et al. 2003; Terreehorst et al. 2003; Woodcock et al. 2003). Likewise, two well-conducted studies failed to show an effect of HEPA filters alone (Francis et al. 2003; Wood et al. 1998). Thus, the conclusion remains that effective allergen avoidance requires a comprehensive approach, and that individual steps alone are generally ineffective (Platts-Mills et al. 2000).

Chemical agents are available for killing mites and denaturing the antigen; however, the effects are not dramatic and do not appear to be maintained for long periods. Therefore, use of these agents in the homes of persons who have asthma and are sensitive to house-dust mites should not be recommended routinely (Woodfolk et al. 1995). Vacuuming removes mite allergen from carpets but is inefficient at removing live mites.

Room air-filtering devices are not recommended for control of mite allergens, because the allergens are associated with large particles which remain airborne for only a few minutes after disturbance. They are, therefore, not susceptible to removal by air filtration.

Cockroach allergen. The Expert Panel recommends that cockroach control measures should be instituted if the patient is sensitive to cockroaches and infestation is present in the home (Evidence B).

Cockroach sensitivity and exposure are common among patients who have asthma and live in inner cities (Call et al. 1992; Gelber et al. 1993; Huss et al. 2001; Kang et al. 1993). In a study of asthma in an inner-city area, asthma severity increased with increasing levels of cockroach antigen in the bedrooms of children who were sensitized (Rosenstreich et al. 1997). Another major study demonstrated efficacy of cockroach avoidance as part of an overall plan for allergen avoidance (Morgan et al. 2004). Patients should not leave food or garbage exposed. Poison baits, boric acid, and traps are preferred to other chemical agents, because the latter can be irritating when inhaled by persons who have asthma. If volatile chemical agents are used, the home should be well ventilated, and the person who has asthma should not return to the home until the odor has dissipated. Care should be taken so that young children do not have access to cockroach baits and poisons.

Indoor fungi (molds). The Expert Panel recommends consideration of measures to control indoor mold (Evidence C). Indoor fungi are particularly prominent in humid environments and homes that have problems with dampness. Children who live in homes with dampness problems have increased respiratory symptoms (Institute of Medicine 2004; Verhoeff et al. 1995), but the relative contribution of fungi, house-dust mites, or irritants is not clear. Because an association between indoor fungi and respiratory and allergic disease is suggested by some studies (Bjornsson et al. 1995; Smedje et al. 1996; Strachan 1988), measures to control dampness or fungal growth in the home may be beneficial.

Outdoor allergens (tree, grass, and weed pollen; seasonal mold spores). The Expert Panel recommends that patients who are sensitive to seasonal outdoor allergens consider staying indoors, if possible, during peak pollen times—particularly midday and afternoon (EPR—2 1997). The strongest associations between mold-spore exposure and asthma have been with the outdoor fungi, such as *Alternaria* (Halonen et al. 1997; O'Hollaren et al. 1991; Targonski et al. 1995). Patients can reduce exposure during peak pollen season by staying indoors with windows closed in an air-conditioned environment (Solomon et al. 1980), particularly during the midday and afternoon when pollen and some spore counts are highest (Long and Kramer 1972; Mullins et al. 1986; Smith and Rooks 1954). Conducting outdoor activities shortly after sunrise will result in less exposure to pollen. These actions may not be realistic for some patients, especially children.

IMMUNOTHERAPY

The Expert Panel recommends that allergen immunotherapy be considered for patients who have persistent asthma if evidence is clear of a relationship between symptoms and exposure to an allergen to which the patient is sensitive (Evidence B) (see Evidence Table 10, Immunotherapy).

Immunotherapy is usually reserved for patients whose symptoms occur all year or during a major portion of the year and in whom controlling symptoms with pharmacologic management is difficult because the medication is ineffective, multiple medications are required, or the patient is

not accepting the use of medication. Reports, however, that immunotherapy can prevent the development of new sensitivities in monosensitized children and adults (Des Roches et al. 1997; Pajno et al. 2001; Purello-D'Ambrosio et al. 2001) and that immunotherapy with birch and timothy pollen extracts can prevent the development of asthma in children who have allergic rhinitis (Moller et al. 2002), along with evidence of persisting effect for at least 3 years after discontinuation (Durham et al. 1999), suggest that immunotherapy should be considered when there is a significant allergic contribution to the patient's symptoms. Specific immunotherapy has been shown to induce a wide range of immunologic responses that include the modulation of T- and B-cell responses by the generation of allergen-specific Treg cells; increases in allergen-specific IgG4, IgG1, and IgA; decrease in IgE and decreased tissue infiltration of mast cells and eosinophils. The relevance of these immunologic changes to the clinical efficacy of specific immunotherapy has yet to be established (Akdis and Akdis 2007).

Controlled studies of immunotherapy, usually conducted with single allergens, have demonstrated reduction in asthma symptoms caused by exposure to grass, cat, house-dust mite, ragweed, *Cladosporium,* and *Alternaria* (Creticos et al. 1996; Horst et al. 1990; Malling et al. 1986; Olsen et al. 1997; Reid et al. 1986; Varney et al. 1997). A meta-analysis of 75 randomized, placebo-controlled studies has confirmed the effectiveness of immunotherapy in asthma, with a significant reduction in asthma symptoms and medication and with improvement in bronchial hyperreactivity (Abramson et al. 2003). This meta-analysis included 36 trials for allergy to house dust mites, 20 for pollen allergy, and 10 for animal dander. On the other hand, only three trials for mold allergy and only six trials with multiple allergen therapy were included. In the United States, standardized extracts are available for house-dust mites, grasses, short ragweed, and cat, and there are unstandardized extracts of other pollens and for dog that appear to have similar potency (Nelson 2007). Available extracts for cockroach and mold, on the other hand, are of very variable allergen content and allergenic potency, and their effectiveness in specific immunotherapy has not been demonstrated (Nelson 2007). Few studies have been reported on multiple-allergen mixes that are commonly used in clinical practice. One, which included high doses of all allergens to which the children were sensitive (Johnstone and Dutton 1968), demonstrated reduction in asthma symptoms compared to lower doses of the same allergens or placebo. Another study, in which the children were given optimal medical therapy and in which the only perennial allergen administered was house-dust mite, demonstrated no improvement in asthma symptoms between active and placebo therapy (Adkinson et al. 1997).

The course of allergen immunotherapy is typically of 3–5 years' duration. Severe and sometimes fatal reactions to immunotherapy, especially severe bronchoconstriction, are more frequent among patients who have asthma, particularly those who have poorly controlled asthma, compared with those who have allergic rhinitis (Bernstein et al. 2004; Reid et al. 1993). If use of allergen immunotherapy is elected, it should be administered only in a physician's office where facilities and trained personnel are available to treat any life-threatening reaction that can, but rarely does, occur (AAAI Board of Directors 1994). For this reason, enthusiasm for the use of immunotherapy in asthma differs considerably among experts (Abramson et al. 2003; Canadian Society of Allergy and Clinical Immunology 1995; Frew 1993).

In Europe, interest has increased in high-dose sublingual immunotherapy (Canonica and Passalacqua 2003). It has been reported to be effective in asthma, with benefit persisting 4–5 years after its discontinuation (Di Rienzo et al. 2003), and to be free of systemic reactions, thus allowing home administration. Comparative studies suggest it is less effective, however, than immunotherapy administered by subcutaneous injection (Khinchi et al. 2004; Lima et al. 2002).

ASSESSMENT OF DEVICES THAT MAY MODIFY INDOOR AIR

The Expert Panel recommends the following actions to modify indoor air:

- **Vacuuming carpets once or twice a week to reduce accumulation of house dust. Patients sensitive to components of house dust should avoid using conventional vacuum cleaners, and these patients should stay out of rooms where a vacuum cleaner is being or has just been used (EPR—2 1997;** Murray et al. 1983**).** If patients vacuum, they can use a dust mask, a central cleaner with the collecting bag outside the home, or a cleaner fitted with a HEPA filter or with a double bag (Popplewell et al. 2000; Woodfolk et al. 1993).

- **Air conditioning during warm weather, if possible, for patients who have asthma and are allergic to outdoor allergens (Evidence C),** because air conditioning allows windows and doors to stay closed, thus preventing entry of outdoor allergens (Solomon et al. 1980). Regular use of central air conditioning also will usually control humidity sufficiently to reduce house-dust mite growth during periods of high humidity (Arlian et al. 2001). Reducing relative humidity is a practical way to control house-dust mites and their allergens in homes in temperate climates (Arlian et al. 2001).

- **Use of a dehumidifier to reduce house-dust mite levels in areas where the humidity of the outside air remains high for most of the year (EPR—2 1997).** House-dust mite levels can be reduced by use of dehumidifiers to maintain levels to or below 60 percent, ideally 30–50 percent, relative humidity (Cabrera et al. 1995).

- **There is insufficient evidence to recommend indoor air cleaning devices. They may reduce some, but not all airborne allergens, but evidence is limited regarding their impact on asthma control.** Indoor air-cleaning devices cannot substitute for the more effective dust-mite and cockroach control measures described previously, because these heavy particles do not remain airborne (Custis et al. 2003). However, air-cleaning devices (i.e., HEPA and electrostatic precipitating filters) have been shown to reduce airborne dog allergen (Green et al. 1999), cat dander (de Blay et al. 1991a; Francis et al. 2003; Wood et al. 1998), mold spores (Maloney et al. 1987), and particulate tobacco smoke (EPA 1990). Use of an air cleaning device containing a HEPA filter may reduce exposure, especially if added to other avoidance measures (Green et al. 1999). However, most studies of air cleaners have failed to demonstrate an effect on asthma symptoms or pulmonary function (Nelson et al. 1988; Reisman et al. 1990; Warburton et al. 1994; Warner et al. 1993; Wood et al. 1998). Air cleaners that are designed to work by the generation of ozone and that emit ozone into the air should be avoided by persons who have asthma.

- **There is insufficient evidence to recommend cleaning air ducts of heating/ventilation/air conditioning systems (Evidence D).** Cleaning has been reported to decrease levels of airborne fungi in residences (Garrison et al. 1993). The effect on levels of house-dust mite or animal dander has not been studied. Limited evidence continues to preclude the Expert Panel's making a recommendation in this area.

The Expert Panel does not generally recommend use of humidifiers and evaporative (swamp) coolers for use in the homes of house-dust mite-sensitive patients who have asthma (Evidence C). If use of a humidifier is desired to avoid excessive dryness, the relative humidity in the home should be maintained at or below 60 percent, ideally between 30 and 50 percent. These machines are potentially harmful because increased humidity may

encourage the growth of both mold (Solomon 1976) and house-dust mites (Ellingson et al. 1995; McConnell et al. 2002). In addition, humidifiers may pose a problem because, if not properly cleaned, they can harbor and aerosolize mold spores (Solomon 1974).

Occupational Exposures

The Expert Panel recommends that clinicians query patients who are employed and have asthma about possible occupational exposures, particularly those who have new-onset disease (EPR—2 1997). Early recognition and control of exposures are particularly important in occupationally induced asthma, because the likelihood of complete resolution of symptoms decreases with time (Pisati et al. 1993). Occupational asthma is suggested by a correlation between asthma symptoms and work, as well as with improvement when away from work for several days. Other indications of workplace exposure are listed in figure 3–21. The patient may fail to recognize the relationship with work, because symptoms often begin several hours after exposure. Recently, common jobs—such as domestic cleaner, laboratory technician, and house painter—have been associated with the disease (Moscato et al. 1995). Serial peak flow records at work and away from work can confirm the association between work and asthma (Nicholson et al. 2005).

Workplace exposure to sensitizing chemicals, allergens, or dusts can induce asthma which often persists after the exposures are terminated (Pisati et al. 1993). This effect should be distinguished from allergen- or irritant-induced aggravation of preexisting asthma.

Patient confidentiality issues are particularly important in work-related asthma. Because even general inquiries about the potential adverse health effects of work exposures may occasionally result in reprisals against the patient (e.g., job loss), patients who have asthma need to be informed of this possibility and be full partners in the decision to approach management regarding the effects or control of workplace exposures. This situation may require referral to an occupational asthma specialist.

Irritants

The Expert Panel recommends that clinicians query patients who have asthma at any level of severity about exposures to irritants that may cause their asthma to worsen, and advise them accordingly about reducing relevant exposures (EPR—2 1997). Sample assessment questions are in figure 3–17.

ENVIRONMENTAL TOBACCO SMOKE

The Expert Panel recommends that clinicians advise persons who have asthma not to smoke or be exposed to ETS (Evidence C). Query patients about their smoking status and specifically consider referring to smoking cessation programs adults who smoke and have young children who have asthma in the household (Evidence B).

Exposure to ETS is common in the United States (Gergen et al. 1998). ETS is associated with increased symptoms, decreased lung function, and greater use of health services among those who have asthma (Sippel et al. 1999) in all age groups, although exact negative effects may vary by age (Mannino et al. 2001). Exposure to maternal smoking has been shown to be a risk factor for the development of asthma in infancy and childhood (Henderson et al. 1995; Martinez et al. 1995; Soyseth et al. 1995). Effects of ETS on a child's asthma are greater when the mother smokes than when others in the household smoke (Agabiti et al. 1999; Austin and

Russell 1997; Ehrlich et al. 2001). Heavy smokers may be more unaware than those who smoke less of the effects of ETS exposure on children (Crombie et al. 2001). The primary modes of exposure to ETS for adults who have asthma may be when they are at work (Radon et al. 2002) or traveling (Eisner and Blanc 2002). ETS exposure operates as a cofactor in wheezing, along with other insults such as infections (Gilliland et al. 2001). Smoking out of doors to avoid exposing others may not adequately reduce exposure for children (Bahceciler et al. 1999). See "Component 2: Education for a Partnership in Asthma Care" for discussion of programs to encourage parents of children who have asthma not to smoke.

As a routine part of their asthma care, patients should be counseled concerning the negative effects of smoking and ETS.

INDOOR/OUTDOOR AIR POLLUTION AND IRRITANTS

The Expert Panel recommends that clinicians advise patients to avoid, to the extent possible, exertion or exercise outside when levels of air pollution are high (Evidence C).

Increased pollution levels—especially of particulate matter ≤10 micrometers (PM10) (Abbey et al. 1993; Atkinson et al. 2001; Gent et al. 2003; Koenig et al. 1993; Ostro et al. 1995; Pope et al. 1991; Schwartz et al. 1993; Slaughter et al. 2003; Walters et al. 1994) and ozone (Abbey et al. 1993; Cody et al. 1992; Kesten et al. 1995; Ostro et al. 1995; Ponka 1991; Romieu et al. 1995; Thurston et al. 1992; White et al. 1994), but also of SO_2 (Moseholm et al. 1993) and nitric oxide (NO_2) (Kesten et al. 1995; Moseholm et al. 1993)—have been reported to precipitate symptoms of asthma (Abbey et al. 1993; Koenig et al. 1987; Moseholm et al. 1993; Pope et al. 1991), increase SABA use (Gent et al. 2003), and increase ED visits and hospitalizations for asthma (Cody et al. 1992; Kesten et al. 1995; Ponka 1991; Romieu et al. 1995; Schwartz et al. 1993; Thurston et al. 1992; Walters et al. 1994; White et al. 1994).

High exposure to NO_2 in the week before the start of a respiratory viral infection, at levels within current air quality standards, may increase the severity of virus-induced asthma exacerbations (Chauhan et al. 2003).

Exposure to pollutants may increase airway inflammation (Hiltermann et al. 1999) and enhance the risk of allergic sensitization through simultaneous exposure to aeroallergens (Diaz-Sanchez et al. 1999; Fujieda et al. 1998; Jenkins et al. 1999). The propensity for particulate pollution to enhance allergic sensitization may be genetically regulated (Gilliland et al. 2004; Peden 2005).

Formaldehyde and Volatile Organic Compounds

Formaldehyde and VOCs—which can arise from sources such as new linoleum flooring, synthetic carpeting, particleboard, wall coverings, furniture, and recent painting—have been implicated as potential risk factors for the onset of asthma and wheezing (Garrett et al. 1999; Jaakkola et al. 2004; Rumchev et al. 2004). Clinicians should advise patients to be aware of the potential irritating effects of newly installed furnishings and finishes.

Gas Stoves and Appliances

The Expert Panel recommends that clinicians advise patients to avoid, if possible, exposure to gas stoves and appliances that are not vented to the outside, fumes from wood-burning appliances or fireplaces, sprays, or strong odors (Evidence C).

Appendix D: Intervention Plan

Step	Process
Step 1: Recruitment	Project leader will create a recruitment flyer that will be given to families with children that have a diagnosis of asthma at Nelson Head start.
Step 2: Staff education and training	Project leader will train staff how to use in-home assessment tool.
Step 3: In-home assessments	Project leader and agency staff will perform three assessments of the home (Visit 1, Visit 2, and Visit 3).
a. Assess Parent Asthma trigger knowledge	A pre-test will be given to parents on Visit 1 (the initial visit) and post-post test will be given on Visit 1 after the education has been provided. Another post-test will be administered on the Visit 2.
b. Family education	Educate family on how to reduce in home asthma trigger on the initial visit and reinforce on the follow-up visits.
c. Assess asthma symptoms	Child's asthma symptoms will be assessed using the ACQ during all three visits.

Appendix E: Time Line

Step	Month of initiation
Recruitment	January
Staff education and training	January
Visit 1	February
In-home assessments	
Asthma knowledge pre-test	Prior to family education Visit 1
Family education	Post knowledge assessment
Asthma symptom assessment	Post home assessment
Asthma knowledge post-test	Post symptom assessment
Visit 2	March
In-home assessments	
Assessment of asthma knowledge	Prior to education reinforcement
Family education reinforcement	Post knowledge assessment
Asthma symptom assessment	Post home assessment
Visit 3	April
In-home assessments	
Family education reinforcement	Post knowledge assessment
Asthma symptom assessment	Post home assessment

Appendix F: EPA Asthma Home Environment Checklist

United States Environmental Protection Agency

ASTHMA HOME ENVIRONMENT ☑ CHECKLIST

Home visits provide an opportunity to educate and equip asthma patients with the tools to effectively manage their disease in concert with a physician's care. This checklist—designed for home care visitors—provides a list of questions and action steps to assist in the identification and mitigation of environmental asthma triggers commonly found in and around the home. The checklist is organized into three sections—building information, home interior and room interior. The room interior is further subdivided by categories (such as bedding and sleeping arrangements, flooring, window treatments, and moisture control). This will allow the home care visitor to focus on the specific activities or things in a room—in particular the asthma patient's sleeping area—that might produce or harbor environmental triggers. The activities recommended in this checklist are generally simple and low cost. Information on outdoor air pollution follows the checklist. The last page includes information on U.S. Environmental Protection Agency (EPA) resources and an area for the home care visitor to record a home visit summary.

If the patient's sensitivities to allergens (such as dust mites, pests, warm-blooded pets and mold) and irritants (such as secondhand smoke and nitrogen dioxide) are known, the home care visitor should begin by focusing on relevant areas. This checklist covers the following allergens and irritants, which are commonly found in homes. Information is also provided on chemical irritants—found in some scented and unscented consumer products—which may worsen asthma symptoms.

Dust Mites

Triggers: Body parts and droppings.

Where Found: Highest levels found in mattresses and bedding. Also found in carpeting, curtains and draperies, upholstered furniture, and stuffed toys. Dust mites are too small to be seen with the naked eye and are found in almost every home.

Pests (such as cockroaches and rodents)

Triggers: Cockroaches – Body parts, secretions, and droppings.
Rodents – Hair, skin flakes, urine, and saliva.

Where Found: Often found in areas with food and water such as kitchens, bathrooms, and basements.

Warm-Blooded Pets (such as cats and dogs)

Triggers: Skin flakes, urine, and saliva.

Where Found: Throughout entire house, if allowed inside.

Mold

Triggers: Mold and mold spores which may begin growing indoors when they land on damp or wet surfaces.

Where Found: Often found in areas with excess moisture such as kitchens, bathrooms, and basements. There are many types of mold and they can be found in any climate.

Secondhand Smoke

Trigger: Secondhand smoke – Mixture of smoke from the burning end of a cigarette, pipe or cigar and the smoke exhaled by a smoker.

Where Found: Home or car where smoking is allowed.

Nitrogen Dioxide (combustion by-product)

Trigger: Nitrogen dioxide – An odorless gas that can irritate your eyes, nose, and throat and may cause shortness of breath.

Where Found: Associated with gas cooking appliances, fireplaces, woodstoves, and unvented kerosene and gas space heaters.

ASTHMA HOME ENVIRONMENT **CHECKLIST**

BUILDING INFORMATION

(This information may be helpful to determine reasonable mitigations.)

What type of building does the patient live in?

- ☐ House
- ☐ Duplex
- ☐ Apartment
- ☐ Mobile home
- ☐ Other_____

Notes:

Does the patient own or rent?

- ☐ Own
- ☐ Rent

Notes:

Questions	Answers	Action Steps
HOME INTERIOR		▲ **MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.**
Secondhand Smoke		
Does anyone smoke in the home or car?	☐ Y ☐ N	■ Keep the home and car smoke-free. ■ Do not allow visitors to smoke in the home. ■ Take the smoke-free home pledge and post a smoke-free home decal or magnet to show that the house is a "smoke-free" zone.
Notes:		
Warm-blooded Pets (such as cats and dogs)		
Is the patient's asthma worse when around warm-blooded pets?	☐ Y ☐ N	■ If possible, remove the pet from the home or keep the pet outside. ■ If this is not possible, keep the pet out of the patient's sleeping area and off of the furniture.
Notes:		
Consumer Products		
Is the patient's asthma worse when around chemicals or products with strong odors (such as cleaners, paints, adhesives, pesticides, air fresheners, or cosmetics)?	☐ Y ☐ N	■ Limit patient's exposure as much as possible by minimizing product use, using products only when patient is not present, or trying alternative products. ■ If products are used, carefully follow manufacturer's instructions on the label and make sure the area is well ventilated.
Notes:		
Heating and Cooling Systems		
Does the heating and cooling system use filters?	☐ Y ☐ N	▲ If so, replace the filters quarterly. ▲ Use filters with higher efficiency than standard furnace filters, such as upgraded pleated filters, if heating or cooling system manufacturer's specifications allow.
Notes:		

Questions	Answers	Action Steps
HOME INTERIOR (continued)		▲ MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.
Does the heating system use a fuel-burning appliance (such as an oil or gas furnace)? *Notes:*	☐ Y ☐ N	▲ Have the heating system - including furnaces, flues and chimneys - professionally inspected annually. ▲ Promptly repair cracks or damaged parts.
Are supplemental heating sources used? (Check all that apply) *Notes:*	☐ Fireplace ☐ Wood-burning stove ☐ Unvented kerosene or gas space heater ☐ Other_____	■ Properly ventilate the room where a fuel-burning appliance is used. Consider using appliances that vent to the outside whenever possible. ■ Never use a gas-cooking appliance as a heating source. ■ If using a fireplace, make sure it is properly vented to help ensure smoke escapes through the chimney. ■ If using a wood-burning stove, make sure that doors are tight-fitting. Use aged or cured wood only and follow the manufacturer's instructions for starting, stoking, and putting out the fire. ■ If using an unvented kerosene or gas space heater, follow the manufacturer's instructions for proper fuel to use and keep the heater properly adjusted.
Are there air conditioning window units? *Notes:*	☐ Y ☐ N	■ Run window air conditioner with the vent control open to increase the outdoor ventilation rate during the cooling season.
ROOM INTERIOR		
Bedding and Sleeping Arrangements		
What does the patient sleep on? (Check all that apply) *Notes:*	☐ Mattress with box springs ☐ Sofa ☐ Other_____	▲ Cover patient's mattress in a dust-proof (allergen impermeable) zippered cover. Clean cover according to manufacturer's instructions. ■ If it is necessary for the patient to sleep on upholstered furniture such as a sofa, then cover furniture with washable slipcovers or sheets and vacuum furniture regularly (including removing cushions and vacuuming in cracks and crevices).
What types of bedding does the patient use? (Check all that apply) *Notes:*	☐ Bedspread (e.g., comforter, quilt) ☐ Blankets ☐ Pillows ☐ Sheets ☐ Other (e.g., sleeping bag) _____	■ Choose washable bedding. ■ Wash bedding regularly in hot water and dry completely. ▲ Cover patient's pillow in a dust-proof (allergen impermeable) zippered cover. Clean cover according to manufacturer's instructions.

ASTHMA HOME ENVIRONMENT **CHECKLIST**

Questions	Answers	Action Steps
ROOM INTERIOR (continued)		▲ MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.
Flooring		
What type of floor covering is present? (Check all that apply)	☐ Carpeting ☐ Hardwood floor, tile, or vinyl flooring ☐ Throw rugs ☐ Other_____	▪ If carpeting is present, vacuum carpets, area rugs, and floors regularly. ▪ If possible, use a vacuum cleaner with a high efficiency filter. ▪ Mop hard surface floors regularly. ▪ Wash throw rugs regularly in hot water. Dry completely. ▪ Clean baseboards regularly using a damp cloth with warm, soapy water. ▪ Someone besides the patient should vacuum, sweep, empty the dust canister and change the vacuum bag. ▪ If possible, the patient should stay out of rooms when they are being vacuumed or swept. ▪ If the patient vacuums, sweeps, empties the dust canister, or changes the vacuum bag, he or she should wear a dust mask.
Notes:		
Upholstered Furniture and Stuffed Toys		
Is there upholstered furniture present?	☐ Y ☐ N	▪ Cover upholstered furniture with washable slipcovers or sheets. ▪ Vacuum upholstered furniture regularly, including removing cushions and vacuuming in cracks and crevices. ▲ If replacing furniture, consider purchasing a non-upholstered furniture - such as vinyl, wood, or leather - that can be easily wiped down.
Notes:		
Are stuffed toys present?	☐ Y ☐ N	▪ Choose washable stuffed toys, and wash frequently in hot water. Dry completely. ▪ Limit the number of stuffed toys in patient's bed and sleeping area.
Notes:		
Window Treatments		
What window coverings are present? (Check all that apply)	☐ Curtains or drapes ☐ Blinds ☐ Shades ☐ Other_____	▪ Vacuum drapes regularly. ▪ Wash and dry curtains regularly. ▪ Dust window sills, blinds, and shades regularly using a damp cloth with warm, soapy water. Dry completely. ▲ If possible, replace curtains or drapes with plastic, vinyl, wood, or aluminum blinds.
Notes:		
Cooking Appliances		
Are gas cooking appliances used?	☐ Y ☐ N	▪ When cooking with a gas appliance, turn on an exhaust fan or open a window. ▪ Avoid misuse of the appliance by following the manufacturer's instructions for operation.
Notes:		

Questions	Answers	Action Steps
ROOM INTERIOR (continued)		▲ MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.
Moisture Control		
Is there evidence of water damage, moisture, or leaks (such as damp carpet or leaky plumbing)? *Notes:*	☐ Y ☐ N	▪ Dry damp or wet items within 24-48 hours to avoid mold growth. ▲ Fix water leaks (such as leaky plumbing) as soon as possible. ▲ Replace absorbent materials, such as ceiling tiles and carpet, if mold is present. ▲ Use air conditioner or dehumidifier to maintain low indoor humidity. If possible, keep indoor humidity below 60% (ideally between 30-50%) relative humidity.
Do you see or smell mold or mildew (such as in the bathroom on tub, shower, walls, or windows)? *Notes:*	☐ Y ☐ N	▪ Open a window or turn on an exhaust fan when there is excessive moisture in the room, such as when showering or cooking. ▪ Scrub mold off hard surfaces with detergent and water. Dry completely. ▪ Clean up mold and dry surfaces completely before painting or caulking. ▲ Replace absorbent materials, such as ceiling tiles and carpet, if mold is present.
Is standing water present (such as in refrigerator drip pans, air conditioner drip pans, or house plants)? *Notes:*	☐ Y ☐ N	▪ Empty and clean refrigerator and air conditioner drip pans regularly. ▪ Avoid standing water in plant containers.
Are humidifiers used in the patient's house? *Notes:*	☐ Y ☐ N	▪ Use humidifier only when conditions require it, use the correct setting to maintain indoor relative humidity between 30-50 percent, and clean humidifier reservoirs regularly. ▪ Use low mineral content water to prevent the build-up of scale and dispersal of minerals into the air. ▪ Follow manufacturer's instructions for use, maintenance, and replacement of any materials supplied with the humidifier.
Are rooms and moisture-producing appliances—such as stoves, clothes dryers, or dishwashers—properly vented (including venting to the outside if specified by the manufacturer)? *Notes:*	☐ Y ☐ N	▪ Increase ventilation or air movement by opening doors and/or windows when practical. Use fans as needed. ▪ Run the bathroom exhaust fan or open the window when showering. ▪ Use exhaust fans or open windows whenever cooking or washing dishes. ▪ Vent appliances properly according to manufacturer's specifications.

ASTHMA HOME ENVIRONMENT **CHECKLIST**

Questions	Answers	Action Steps
ROOM INTERIOR (continued)		▲ MAY REQUIRE ADDITIONAL TIME AND/OR RESOURCES.
Pest Control		
Is there evidence of cockroaches and/or rodents (such as droppings or dead specimens in traps)? *Notes:*	☐ Y ☐ N	▪ Clean all surfaces where you have seen pests. ▪ Use poison baits, boric acid, or traps to kill pests. Minimize use of sprays. If sprays are used: limit the spray to the infested area, carefully follow the instructions on the label, make sure there is plenty of fresh air where the spray is being used and, if possible, keep patient out of the room.
Are there food crumbs or open or unsealed food? *Notes:*	☐ Y ☐ N	▪ Clean all food crumbs or spilled liquids right away. ▪ Store food in sealed containers. ▪ Remove food, bags, newspapers, and empty boxes, cans, and bottles from the sleeping area. ▪ Put all garbage in plastic trash bags. Seal trash bags and put them into garbage cans with fitted lids every day.
Are there holes or gaps between construction materials and pipes that could allow pests to enter the house? *Notes:*	☐ Y ☐ N	▪ Seal holes or gaps between construction materials and pipes, or ask the owner to do so.
Is there evidence of standing water or leaks? *Notes:*	☐ Y ☐ N	▪ Dry damp or wet items within 24-48 hours to avoid mold growth. ▪ Avoid standing water in house plant containers and drip pans. ▲ Fix water leaks (such as leaky plumbing) as soon as possible.

OUTDOOR AIR POLLUTION

Exposure to air pollution (mainly ozone and particle pollution) can trigger asthma attacks. The Air Quality Index (AQI) is a tool to provide the public with clear and timely information on local air quality and whether air pollution levels pose a possible health concern. The AQI is reported and forecasted every day in many areas throughout the U.S. on local weather reports and through national media. Asthma attacks are most likely to occur the day after outdoor pollution levels are high.

People can take simple steps to reduce their exposure to outdoor air pollution. When the AQI reports unhealthy levels:

- Limit physical exertion outdoors.
- Consider changing the time of day of strenuous outdoor activity to avoid the period when air pollution levels are high or consider postponing sports activities to another time.
- Reduce the intensity of the activity, or spend less time engaged in strenuous activities. For example, coaches can rotate players more frequently in strenuous sports, like soccer. Resting players reduces their exposure to air pollution.

To learn more about and access the AQI, visit www.epa.gov/airnow.

Educational Resources:

To learn more about EPA's programs on:

- Asthma and steps you can take to remove environmental triggers from the home, visit www.epa.gov/asthma.
- Secondhand smoke and how to make your home and car smoke-free, visit www.epa.gov/smokefree or call the smoke-free home pledge number at 1-866-SMOKE-FREE (1-866-766-5337).
- Household pest management and how to apply integrated pest management at home, visit www.epa.gov/pesticides/controlling/home.htm.

To order materials at no cost on:

- Asthma and secondhand smoke, call EPA's Indoor Air Quality Information Line at 1-800-438-4318.
- Household pest management, call EPA's National Center for Environmental Publications at 1-800-490-9198.

SUMMARY

Use this space to record triggers identified and mitigations recommended. You are encouraged to provide this information to the patient's health care provider.

Appendix G: In-Home Environment Assessment Tool

In-Home Environment Assessment	**Yes =1**	**No =0**	**Education to provide to the family**
Second Hand Smoke			**Second Hand Smoke**
1. Does anyone smoke in the home?	Yes □	No □	Do not allow adults to smoke indoors.
Pets			**Pets**
2. Are there pets in the home? (Cats and dogs)	Yes □	No □	Keep pets out of the child's room or make sure that the pet is groomed weekly.
3. Does the pet sleep in the room of the child with asthma?	Yes □	No □	
Pest Control			**Pest Control**
4. Are there food crumbs or unsealed foods in the house?	Yes □	No □	Maintain the kitchen clean, make sure that food is in sealed containers. Use roach traps or gels.
5. Have you seen cockroaches, rodents, or rodent droppings?	Yes □	No □	
6. Are there gaps or holes in the walls of the home?	Yes □	No □	
Dust			**Dust**
7. Is there dust in the house?	Yes □	No □	Dust often, including lampshades and windowsills with a damp cloth. When polishing furniture, you can combine equal amounts oiled and distilled vinegar with a few drops of your favorite essential oil.
8. Is there dust on the ceiling fans?	Yes □	No □	
9. Are there curtains or drapes?	Yes □	No □	
10. Are there blinds?	Yes □	No □	
Flooring			**Flooring**
11. Is there carpet in the house?	Yes □	No □	Vacuum once or twice a week, preferably with a HEPA filter vacuum.
Consumer Products			**Consumer Products**
12. Do you use harsh smelling chemicals to clean the house?	Yes □	No□	Limit child's exposure to harsh cleaning chemicals be cleaning with these products with the child is not at home.

Moisture			**Moisture**
13. Is there water damage or standing in the house?	Yes □	No □	Fix any leaky pipes. To remove mold or mildew from in the bathroom or kitchen areas in the house, mix 1-part hydrogen peroxide with two parts water.
14. Is there mold or mildew in the house?	Yes □	No □	
15. Does the family use humidifiers?	Yes □	No □	
Upholstered Furniture and stuffed toys			**Upholstered Furniture and stuffed toys**
16. Is there clothed furniture in the home?	Yes □	No □	Clothed furniture should be covered in a washable cover, which should be washed once a week in hot water.
17. Does the child with asthma have stuffed animals?	Yes □	No □	Minimize the number of stuffed toys and wash weekly.
Bedding and Sleeping			**Bedding and Sleeping**
18. Does the child with asthma sleep on anything other than a mattress with box springs?	Yes □	No □	Wash sheets and blankets weekly in hot water. Encase mattress and pillows in a allergen-impermeable cover and wash them weekly.
19. Does the child with asthma sleep on a sofa with or without a washable mattress cover?	Yes □	No □	
20. Does the child's mattress missing a hypoallergenic mattress cover?	Yes □	No □	
Heating and Cooling Systems			**Heating and Cooling Systems**
21. Do you have air conditioner window units?	Yes □	No □	Change or clean the filters once a month. Wood-burning stoves, kerosene heaters and fire places should be avoided. Filters on the furnace should be changed monthly.
22. Do you have and use a fire place?	Yes □	No □	
23. Do you have and use a wood-burning stove?	Yes □	No □	
24. Do you have and use an unvented kerosene or gas space heater?	Yes □	No □	

Herramienta de Evaluación del Medio Ambiente en el Hogar

Evaluación del medio ambiente en el hogar	**Si =1**	**No =0**	**Educación para proporcionar a la familia**
Humo de segunda mano			**Humo de segunda mano**
¿Alguien fuma en el hogar?	Si =1	No =0	No permita que los adultos fumen en el interior.
Mascotas			**Mascotas**
¿Hay mascotas en el hogar? (Gatos y perros)	Si =1	No =0	Mantenga las mascotas fuera de la habitación del niño o asegúrese de que la mascota esté arreglada semanalmente.
¿Duerme la mascota en la habitación del niño con asma?	Si =1	No =0	
Control de plaga			**Control de plaga**
¿Hay migas de comida o alimentos no sellados en la casa?	Si =1	No =0	Mantener la cocina limpia cocina, asegúrese de que los alimentos están en recipientes sellados. Use trampas para cucarachas o geles.
¿Ha visto cucarachas, roedores o excrementos de roedores?	Si =1	No =0	
Polvo			**Polvo**
¿Hay polvo en la casa?	Si =1	No =0	Limpie el polvo a menudo, incluyendo las pantallas y windosills con un trapo húmedo. Al pulir los muebles usted puede combinar cantidades iguales engrasadas y destiladas vinigar con algunas gotas de su aceite esssential preferido.
¿Hay polvo en los ventiladores del techo?	Si =1	No =0	
Suelo			**Suelo**
¿Qué tipo de pavimento hay en la casa? (Alfombra o azulejo)	Si =1	No =0	Vaccuum una o dos veces por semana, perferably con un filtro HEPA vacío.
Humedad			**Humedad**
¿Hay daños por agua en la casa?	Si =1	No =0	Arregle las tuberías con goteras. Para remover moho o moho en el baño o en las áreas kithchen de la casa, mezcle 1 parte de peróxido de hidrógeno con dos partes de agua.
¿Hay moho en la casa?	Si =1	No =0	

Muebles tapizados y juguetes relleno			**Muebles tapizados y juguetes relleno**
¿Hay muebles vestidos en el hogar?	Si =1	No =0	Los muebles vestidos deben ser cubiertos en una cubierta lavable, que se debe lavar una vez por semana en agua caliente.
¿El niño con asma tiene animales de peluche?	Si =1	No =0	Los muebles vestidos deben ser cubiertos en una cubierta lavable, que se debe lavar una vez por semana en agua caliente.
Ropa de cama y dormir			**Ropa de cama y dormir**
¿Duerme el niño con asma en un colchón?	Si =1	No =0	Los muebles vestidos deben ser cubiertos en una cubierta lavable, que se debe lavar una vez por semana en agua caliente.
¿Duerme el niño con asma en un sofá?	Si =1	No =0	
¿El colchón del niño tiene una funda de colchón hipoalergénica?	Si =1	No =0	
Si el niño duerme en el sofá, ¿tiene el sofá una cubierta de deslizamiento lavable?	Si =1	No =0	
Sistemas de calefacción y refrigeración			**Sistemas de calefacción y refrigeración**
¿Tiene unidades de la ventana del acondicionador de aire?	Si =1	No =0	Cambie o limpie los filtros una vez al mes. Se deben evitar las estufas de leña, los keosene healters y los lugares de fuego. Filtros en el horno se debe cambiar mensualmente.
¿Tienes y usas un lugar de fuego?	Si =1	No =0	
¿Tiene y utiliza una estufa de leña?	Si =1	No =0	
¿Tiene y utiliza un calentador de espacio de gas o querosen no ventilado?	Si =1	No =0	

Appendix H: Letter of Support

December 13, 2018

Monica Ramirez
4301 Broadway St.
San Antonio, TX 78209

Dear Monica Ramirez,

I am aware of this community-based projected and agree for this community-based organization to participate in the recruitment process of our project entitled, "Improving Residential Asthma Assessment Strategies within a Low Socioeconomic Community."

Sincerely,

[redacted]