2017

Evaluation of a Childhood Community-Based Comprehensive Asthma Management Program

Stephanie E. Welsh
Wright State University - Main Campus

Evaluation of a Childhood Community-Based Comprehensive Asthma Management Program

Stephanie E. Welsh

Wright State University Boonshoft School of Medicine

Master of Public Health Program

Sabrina Neeley, PhD, MPH – Committee Chair

Jessica Saunders, MPA – Committee Member

Acknowledgements

Thank you to Dayton Children's Hospital, the Dayton Asthma Alliance, and the Comprehensive Asthma Management Program for allowing me to participate in and learn from the great work being done to help children with asthma. Thank you to Jessica Saunders, Jim Gross, Belinda Huffman, Tiffany Huber, and KaDae Jones for welcoming me and teaching me about the program. Thank you to Jeanie Bochenek for allowing me to collaborate with your project and learn from your findings.

Thank you to Dr. Sabrina Neeley for your guidance and assistance throughout this entire Culminating Experience, which would not have been possible without your help.

Thank you to Lori Metivier, Dr. Nikki Rogers, and the entire Master of Public Health Program, for helping me undertake this project.

Table of Contents

Abstract

Background: The Dayton Children's Hospital Comprehensive Asthma Management Program incorporates Community Health Worker (CHW) interventions to improve child asthma control and reduce urgent health resource utilization.

Methods: Children in grades two to five with parent- or physician-identified asthma received one of three levels of intervention, based on self-selection by caregivers: (1) child asthma education; (2) child and caregiver asthma education; (3) child and caregiver asthma education, plus home assessments. Child Asthma Risk Assessment Tool (CARAT) scores were collected before intervention to assess risk. Childhood Asthma Control Test (C-ACT) scores and urgent health visit numbers were collected before and after intervention. Analysis followed a pre- and post-intervention design, with children serving as their own controls.

Results: The study sample included 174 children who received intervention level one (n=109), level two (n=47), or level three (n=18). Study participants were 44.3% (n=77) female, 76.4% (n=133) African American, and 8.9 ± 1.2 average years of age. The average overall CARAT score was 25.2, below the high-risk threshold of 30. There was a significant improvement in average C-ACT scores from 18.5 (inadequate control) before intervention to 20.0 (adequate control) after (p = .015). There were no significant improvements in urgent health visits, and no significant differences in outcomes between intervention levels.

Conclusion: This program evaluation found that CHW interventions are effective in significantly improving C-ACT scores from inadequate asthma control to adequate control, and in identifying and remediating home asthma triggers. Future evaluation can be improved by longer follow-up periods and enhanced data collection.

Keywords: asthma, pediatrics, community health workers, environment and public health, program evaluation

Evaluation of a Childhood Community-Based Comprehensive Asthma Management Program

Asthma is the most common chronic disease of childhood, affecting 8.6% of children nationally and 9.4% of children in Ohio (Centers for Disease Control and Prevention [CDC], 2016a; CDC, 2016b). There is no known prevention or cure for asthma, and it is associated with significant morbidity and mortality. When poorly controlled, asthma symptoms lead to activity limitations, school absenteeism by children, work absenteeism by caregivers, and impaired psychosocial functioning. In 2008, 59% of children with asthma missed school—an average of four days per year—due to symptoms (CDC, 2011). Complications of asthma include acute exacerbations, pneumonia, collapsed lung, status asthmaticus, and respiratory failure (Aster, Abbas, Robbins, & Kumar, 2013). Any of the aforementioned complications can be fatal if emergency care is not received. The 2014 death rate for childhood asthma was 2.5 per million, with higher rates among racial minorities (CDC, 2016a).

The average level of asthma control in United States (U.S.) children is sub-optimal. In 2014, 48% of U.S. children reported having one or more asthma attacks in the past year (CDC, 2016a). Inadequate asthma control contributes to increased health resource utilization and health expenditures. In 2010, 18.3 children per 10,000 were hospitalized for asthma (CDC, 2016a). In 2007, asthma cost the U.S. $3,300 per person with asthma, totaling $50.1 billion over the year (CDC, 2011).

The management of asthma involves assessment and monitoring of asthma severity, patient education, control of environmental triggers and comorbid conditions, and medications (National Asthma Education and Prevention Program [NAEPP], 2007). Children with asthma often require interventions and counseling beyond the physician’s office because management is multifactorial. Furthermore, there are several social determinants of health that contribute to

asthma-related outcomes, such as family income, race, health literacy, healthcare access, and housing conditions (Postma, Karr, & Kieckhefer, 2009; Gargano, Thomas, & Stellman, 2016; Wood, Price, Dake, Telljohann, & Khuder, 2009; Margellos-Anast, Gutierrez, & Whitman, 2012).

To assist children and caregivers in managing asthma and navigating the healthcare system, comprehensive programs involving community-clinical linkages have become more common nationwide. These programs incorporate education, environmental home assessments, resource provision, and referrals to social services, into traditional medical asthma care. In particular, the effectiveness of community health worker (CHW) interventions in improving childhood asthma management has been demonstrated in several high-risk populations (Raphael, Rueda, Lion, & Giordano, 2013; Postma et al., 2009; Margellos-Anast et al., 2012; Beckham, Kaahaaina, Voloch, & Washburn, 2004; Peretz et al., 2012; Krieger, Takaro, Song, & Weaver, 2005; Gutierrez Kapheim, Ramsay, Schwindt, Hunt, & Margellos-Anast, 2015; Fox et al., 2016; Thyne, Marmor, Madden, & Herrick, 2007). CHWs are lay members of the community with training in public health, who serve as a paraprofessional bridge between community members and local health and social resources (American Public Health Association, 2009). Because of their shared backgrounds and experiences with their clients, CHWs excel at providing emotional support and culturally sensitive care.

In Dayton, Ohio, there is a high prevalence of asthma, allergies, and secondhand smoke. Asthma is the number one reason for emergency department (ED) visits at Dayton Children's Hospital (Dayton Children's); in 2015 and 2016 Dayton Children's had 1,587 ED visits and 815 hospital admissions due to asthma (Dayton Asthma Alliance, 2016). The children of the Dayton Public Schools (DPS) district are disproportionately affected by asthma (Dayton Asthma

Alliance, 2016). Approximately 1,095 out of 14,000 DPS students have parent- or physician-identified asthma (Dayton Asthma Alliance, 2016). The DPS student population is 99.9% economically disadvantaged and 64.7% African American (Dayton Asthma Alliance, 2016).

To improve childhood asthma control and to reduce asthma-related health resource utilization in Dayton, Dayton Children's and the Dayton Asthma Alliance (Appendix A) developed the Comprehensive Asthma Management Program (CAMP) in 2016. The CAMP includes a series of education sessions and home assessments provided by a CHW, a respiratory therapist, and student nurses.

As the first asthma program incorporating CHW interventions in Dayton, the effectiveness of these interventions needs to be assessed. Furthermore, there are currently no widely accepted criteria for eligibility for CHW home visits. In order to make best use of this scarce resource, appropriate criteria must be determined.

This program evaluation sought to assess the impact of the CAMP on pediatric asthma management, and to determine appropriate criteria for CHW referral. It was hypothesized that the CAMP would effectively improve asthma control, and reduce health resource utilization.

Statement of Purpose

The purposes of this study were to assess the effectiveness of the Dayton Children's and Dayton Asthma Alliance CAMP in improving asthma management in children of DPS, and to determine appropriate criteria for referral to CHW interventions for children with asthma.

Review of Literature

Asthma is a widely prevalent health problem in children, particularly minority children living in low-income urban areas. The management of asthma, like that of other chronic diseases, can be complex and time-consuming. It is important to achieve proper asthma management in

children because of their increased susceptibility to environmental irritants, infections, and long-term lung damage. Comprehensive management programs have risen in popularity to address the multiple needs of asthmatic children. This literature review summarizes the factors that affect asthma severity, the components of asthma management, and other programs and tools seeking to improve the health of asthmatic children.

Social Determinants of Asthma-Related Outcomes

Social determinants of health are contextual factors and living conditions that influence health status, including education, economic stability, neighborhood and environment, healthcare, and social support (Healthy People 2020, 2017). Several of these determinants have been linked to pediatric asthma outcomes. For example, children and adults with lower socioeconomic status face higher asthma burdens: 10.4% of Americans below the poverty level have asthma, compared to just 6.3% of Americans at or above 450% of the poverty level (CDC, 2016a). Children living in low-income households, defined as having an income ≤$75,000, are three times more likely to have poor asthma control (Gargano et al., 2016).

There are disparities in asthma prevalence and severity by ethnicity and race. White children (7.6%) have lower rates of asthma than African-American children (13.4%) and Hispanic children (8.5%) (CDC, 2016a). Both African-American and Hispanic children are significantly more likely than White children to have poor asthma management (Margellos-Anast et al., 2012; Thyne et al., 2007; Hovell, Meltzer, Wahlgren, Matt, & Hofstetter, 2002). Furthermore, the death rate for African-American children is over three times higher than for White children (CDC, 2016a).

Healthcare access and health insurance status are key determinants for asthma outcomes in children. Children with asthma who have unmet healthcare needs are over six times more

likely to have poor asthma management than children whose needs are met (adjusted odds ratio = 6.2) (Gargano et al., 2016). Parents of children with asthma commonly cite either a lack of health insurance or the type of health insurance as barriers to asthma management, since varying plans decrease access to EDs and dictate the amount, type, and delivery method of asthma medications (Mansour, Lanphear & DeWitt, 2000).

Housing conditions also contribute to asthma severity, particularly the presence of mold, furry pets, insects, rodents, and smoke from cigarettes or appliances. For example, in children with wheezing, exposure to household moisture increases the likelihood of having four or more wheezing attacks per week by 1.16 times (Weinmayr et al., 2013).

Conversely, increased health literacy in caregivers is associated with improved self-efficacy in asthma management, leading to improved level of asthma control in children (Wood et al., 2009). Health literacy is the ability to obtain and understand health information to make informed decisions about health, while self-efficacy is confidence in one's ability to perform a health behavior (Wood et al., 2009; Kindig, Panzer, & Nielsen-Bohlman, 2004; Bandura, 1997). Both health literacy and self-efficacy are related to health outcomes in a variety of conditions, including asthma (Wood et al., 2009).

Social support is associated with improved asthma management in children. In families with positive parent-child relationships, appropriate child attachment, and low levels of family conflict, children are more likely to adhere to asthma medications and manage indoor asthma triggers (Kaugars, Klinnert, & Bender, 2004). Furthermore, social support from case managers, CHWs, and school nurses is associated with improved outcomes (Williams, Portnoy, & Meyerson, 2010; Krieger et al., 2005; Thyne et al., 2007; Mansour et al., 2000).

Components of Asthma Management

The National Asthma Education and Prevention Program (NAEPP) Guidelines for proper asthma management include four components: assessment and monitoring, education, control of environmental triggers and comorbidities, and pharmacologic treatment (NAEPP, 2007).

Assessment and monitoring. Assessment and monitoring of asthma entails evaluating the severity of asthma, the level of asthma control, and the responsiveness of the individual to treatment (NAEPP, 2007). Asthma severity refers to the degree of symptom intensity at baseline, while asthma control is the presence of symptoms and activity limitations with treatment. Treatment responsiveness includes the relief of symptoms as well as the incidence of medication side effects.

There are two other indicators of asthma control that must be measured with medical instruments. Peak flow—the volume of air an individual can forcefully expire—can be monitored at home or by health workers using a peak flow meter. Forced expiratory volume in one second—the volume of air an individual can forcefully exhale in one second—must be measured by health providers using a device called a spirometer (NAEPP, 2007). These indicators reflect lung health; larger measurements indicate better functioning. Asthma indicators like severity and peak flow should be assessed with the help of a physician upon the initial diagnosis of asthma, and monitored by the child and/or caregiver at one- to six-month intervals thereafter (NAEPP, 2007).

Education. Education entails active knowledge building on the part of the child and/or caregiver by seeking information from healthcare providers and literature. Asthma-related knowledge includes understanding basic facts about asthma, causes of asthma, signs of an exacerbation, indications for care-seeking, environmental asthma triggers, and uses of

medications (NAEPP, 2007). Furthermore, children and families should have an asthma action plan, a written management plan detailing levels of asthma symptoms as green, yellow and red, with instructions for medication and care-seeking for each level.

Controlling environmental triggers and comorbid conditions. Controlling environmental triggers and comorbid health conditions are important ways to prevent asthma exacerbations. Common environmental triggers for children with asthma include pet dander, dust mites, mold, rodents, cockroaches, moisture, cigarette smoke, wood-burning stoves and fireplaces, and outdoor air pollution (Puranik, Forno, Bush, & Celedon, 2016; Brunekreef et al., 2012; Castro-Rodriguez, Forno, Rodriguez-Martinez, & Celedon, 2016; Postma et al., 2009). Children are especially vulnerable to exposures because of their airway physiology, their proximity to the floor, and their frequent exposures to viruses (Matsui, Abramson, & Sandel, 2016). Families should undertake efforts to reduce exposure to triggers by exterminating pests, removing household sources of mold and moisture, avoiding extended exposure to furry pets, encouraging smoking cessation by adult smokers, and avoiding excessive time outdoors during days with high air quality index. Efforts to reduce environmental exposure can be as effective as controller medications in reducing symptoms (Matsui et al., 2016).

The American Academy of Pediatrics (AAP) recommends that pediatricians gather environmental histories from their patients with asthma, and provide counseling and referrals for remediation (Matsui et al., 2016). Exposure to allergens such as dust mites, furry pets, rodents, and cockroaches, and to pollutants such as secondhand smoke, particulate matter, and nitrogen dioxide, should be assessed (Matsui et al., 2016). Particulate matter is generated by smoking, cooking, and sweeping, while nitrogen dioxide is a byproduct of combustion such as from gas stoves and space heaters (Matsui et al., 2016). Furthermore, allergen sensitivity should be

assessed using serum immunoglobulin E (IgE) antibody testing or allergen skin testing, and every allergen to which a child is found sensitive should be controlled (Matsui et al., 2016). Large proportions of asthmatic children are sensitized to home allergens like dust mites (30-62%), mold (50%), and cats and/or dogs (25-65%) (Matsui et al., 2016). However, it is important to note that children without allergies are still sensitive to pollutants and irritants.

Environmental abatement. The AAP suggests abatement measures to decrease exposure to both allergens and irritants, and specifically recommends that CHWs be utilized to provide education and home assessments so necessary abatement measures can be identified (Matsui et al., 2016).

Abatement measures for pests and rodents, both common sources of allergens, should include traps, rodenticide, pesticide, and sealing of entry points in walls and floors (Matsui et al., 2016). Replacing carpet with washable rugs, removing stuffed animals, frequent vacuuming and linen washing, and the use of allergen-proof mattress and pillow encasements are also recommended to decrease allergen levels. Sources of moisture in the home, such as inadequate ventilation, leaks, and flooding, should be remediated to decrease mold, cockroach and dust mite exposure. Exposure to furry pets such as dogs, cats, rabbits and hamsters should be minimized by relocating the pet to another home if possible, or keeping pets out of the child's bedroom (Matsui et al., 2016).

Children are also exposed to a variety of irritants in the home. Approximately 30% of U.S. children are exposed to secondhand smoke at home (Matsui et al., 2016). Smoking cessation by adults is the best way to limit secondhand smoke exposure in children, followed by smoking outdoors. Other sources of smoke, such as wood-burning stoves, marijuana, cigars, and e-cigarettes should be removed from the home. Furthermore, the use of irritants such as

household chemicals, cleaning products, air fresheners, incense, and strongly smelling cosmetics should be discontinued. Gas stoves should be properly vented while in use. High-efficiency particulate air (HEPA) purifiers can decrease levels of particulate matter in the air, but they are less effective than removing the source of particulate matter from the home. Furthermore, HEPA purifiers may not be effective at reducing allergen levels (Matsui et al., 2016).

Control of comorbidities. In addition to the physical environment, physical and mental illness can also affect asthma control. Specifically, acid reflux, respiratory allergies, sleep apnea, obesity, depression and other psychiatric disorders can all negatively impact asthma severity (NAEPP, 2007). For example, having one or more mental health conditions, like anxiety or depression, increases the risk of having impaired asthma management five-fold (adjusted odds ratio = 5.0) (Gargano et al., 2016). Female children with normal weight are 2.78 times more likely than obese female children to have good asthma management (Loman et al., 2016). Children with asthma should therefore receive evaluation and treatment for other medical conditions, and maintain adequate management.

Pharmacologic treatment. Pharmacologic treatment of asthma is the final cornerstone of asthma management. Typically, medication regimens for asthma include a combination of daily inhalers or tablets for long-term control, and rescue inhalers when needed for quick relief (NAEPP, 2007). Children must use their daily medications regardless of symptoms, and use their as-needed rescue medications during signs of an exacerbation. Furthermore, children need to use proper inhaler technique with either a spacer or holding chamber to ensure the medicine is delivered effectively to the lungs.

Recommended levels of management behaviors. The Healthy People 2020 objectives (Healthy People 2020, 2016) for asthma provide recommended levels of asthma self-

management behaviors in children and adults, in compliance with the NAEPP guidelines (NAEPP, 2007). The objectives state that by 2020, the proportion of asthmatics with asthma action plans should increase from 33.4% to 36.8%; education about monitoring peak flow and about signs and treatment of exacerbations should increase from 64.8% to 68.5%; and guidance about minimizing environmental asthma triggers should increase from 50.8% to 54.6% (Healthy People 2020, 2016).

Comprehensive Asthma Programs

Given the multifactorial nature of asthma, the multitude of risk factors, and the high prevalence of asthma in children, many health entities have developed comprehensive asthma programs. Comprehensive asthma programs have been shown to improve knowledge, reduce symptoms, and decrease ED visits and hospitalizations. By tackling asthma from multiple angles, such as education, home assessments, resource provision, and social service referrals, these programs aim to improve outcomes and reduce spending in cost-effective ways (Raphael et al., 2013; Postma et al., 2009; Margellos-Anast et al., 2012; Beckham et al., 2004; Peretz et al., 2012; Krieger et al., 2005; Gutierrez Kapheim et al., 2015; Fox et al., 2016; Thyne et al., 2007).

Non-physician providers typically carry out these interventions, with CHWs at the forefront. CHWs are effective in helping children manage a variety of chronic conditions, such as diabetes and obesity, in addition to asthma (Raphael et al., 2013). Nurses, respiratory therapists, and case managers also frequently implement such programs.

A 2012 study by Margellos-Anast, Gutierrez, and Whitman analyzed the effect of a CHW intervention for low-income African-American children with asthma. CHWs provided home asthma education and helped families acquire primary care providers and asthma action plans over six months, resulting in a 35% decrease in symptom frequency and a 75% decrease in

urgent health visits. There were also significant improvements in asthma knowledge, trigger reduction, caregiver quality of life, and secondhand smoke exposure. The intervention was cost-effective, resulting in $2,561 saved for every dollar spent (Margellos-Anast et al., 2012).

The Washington Heights/Inwood (WIN) for Asthma Program provided education, home environmental assessments, trigger management supplies, and referrals to social services by bilingual CHWs (Peretz et al., 2012). A large proportion of the study population spoke English as a second language and lived below the poverty line. After one year, there were significant decreases in hospitalizations (63%) and ED visits (52%), and a significant increase in caregiver self-efficacy (97%) (Peretz et al., 2012).

Another study compared two levels of interventions provided by CHWs to children of urban, low-income, minority families (Kreiger et al., 2005). The low-intensity group received one CHW home visit and a mattress cover. The high-intensity group received an average of seven home visits and a greater number of resources including mattress covers, pillow covers, roach bait, rodent traps, and low-emission vacuums. Both the high- and low-intensity groups experienced significant improvements in symptoms, caregiver quality of life, and urgent services use, though improvements were more pronounced in the high-intensity group (Kreiger et al., 2005).

Gutierrez Kapheim, Ramsay, Schwindt, Hunt, and Margellos-Anast (2015) recruited CHWs living in public housing developments to deliver asthma interventions to children living in the same developments. The program consisted of in-home education, service referrals, and assistance obtaining primary care physicians and asthma action plans. Asthma symptoms, rescue medication use, and urgent health resource utilization significantly decreased, and caregiver quality of life significantly increased. For example, the percent of children who visited the ED

two or more times per year decreased from 27% at baseline to 5% at follow-up one year later. The proportion of children with very poorly controlled asthma decreased from 54% to 12%, while the proportion with well-controlled asthma increased from 24% to 78% (Gutierrez Kapheim et al., 2015).

In a 2016 study by Fox and colleagues, a cohort of clinics implemented a quality improvement project incorporating CHWs (Fox et al., 2016). CHWs worked within clinical teams of physicians and project coordinators to improve asthma care using asthma flow sheets, asthma action plans, clinician pocket guides, and training in the NAEPP guidelines. Furthermore, CHWs provided home assessments and education to patients. Findings consisted of decreased urgent visits, symptoms, and missed school days and increased caregiver self-efficacy, with greater improvements in clinics that adhered more closely to the NAEPP guidelines (Fox et al., 2016).

The *Yes We Can* Urban Asthma Partnership in San Francisco recruited asthmatic children living in low-income urban areas from urgent visits, asthma clinics, and a pediatric hospital (Thyne et al., 2007). Initially, *Yes We Can* provided CHW home visits with education and environmental assessments, and asthma clinic visits with medical care, allergy skin testing, and spirometry. There were several concerns with this model: the high level of care limited the possible reach of the program, there was a high no-show rate at the clinic, and many families found home visits to be unacceptable. Therefore, the program was altered to consist of CHW education during clinic visits and several phone calls between visits, with optional home visits only for those who needed additional services. Furthermore, children also began to be actively recruited when they sought urgent care for asthma–a time when they are most likely to accept

help. Also, widespread education for urgent care and emergency health providers was instituted to encourage asthma counseling and long-term treatments for patients (Thyne et al., 2007).

After changing the role of the CHWs, reducing home visits, and adding on active case finding of high-risk patients, the program was able to reach more children (Thyne et al., 2007). After instituting health worker education, hospitalizations for asthma decreased, even though ED visits remained stable, and prescriptions for spacers and inhaled corticosteroids increased. The authors concluded that the characteristics that predict success for urban asthma programs are targeting high-risk patients, providing education to clinicians, and integrating of the program into existing infrastructure for sustainability (Thyne et al., 2007).

A 2004 study by Beckham, Kaahaaina, Voloch, and Washburn came to similar conclusions that providing CHW education during clinic visits, seeking physician support, and recruiting participants during asthma exacerbations when they are more likely to be susceptible, all increase the chances of success. In this study, participants were also recruited using an electronic tracking system of ED visits and physician referrals. CHWs conducted home visits to assess environmental trigger and social support needs, and met with the treatment team to form individualized asthma management plans for each child. After intervention, there was a 59% decrease in symptoms during exercise, a 67% decrease in asthma-related doctors' visits, and a decrease in asthma-related health expenditures per capita from $310 to $129 (Beckham et al., 2004).

Other comprehensive asthma programs include both CHWs and other non-physician providers among personnel. For example, Woods, Bhaumik, Sommer, Ziniel, and Kessler (2012) studied a quality improvement project in which nurses served as case managers and CHWs conducted home visits and provided environmental remediation materials over a one-year period.

In the following year there was a 68% decrease in ED visits, 85% decrease in hospitalizations, 43% decrease in activity limitations, and 41% decrease in missed school days (Woods et al., 2012).

Some programs reach out to community members without the use of CHWs at all. In a 2003 study by Georgiou et al., households with asthmatic children received community-based asthma management assistance including educational materials, peak flow meters, and phone calls from case workers. There were significant reductions in symptoms, school and work absenteeism, and urgent healthcare utilization (Georgiou et al., 2003). In another program, children and caregivers seen in a pediatric allergy clinic received asthma education in addition to treatment, with follow-up phone calls conducted by nurses, resulting in significant decreases in urgent health visits (Kelly et al., 2000).

One comprehensive asthma program reported less promising results. A 2006 comprehensive school-based program consisting of educational sessions, medication management, and asthma action plan provision led to significant increases in asthma-related knowledge, but no improvement in school absences, grade point average, or emergency health resource use (Gerald et al., 2006). The authors concluded that the school-based program may not be the most reliable or effective way to improve childhood asthma, but instead more intensive interventions may be necessary (Gerald et al., 2006).

Systematic reviews of interventions involving CHWs also point out some limitations and inconsistencies. Raphael, Rueda, Lion, and Giordano (2013) conducted a systematic review of lay health worker interventions for children with asthma, type I diabetes, obesity, and failure to thrive. In this review, lay workers referred to CHWs, patient advocates, patient navigators, and other providers without professional education. The majority of studies covered asthma, and

most interventions focused on environmental triggers, asthma action plans, medication management, and increasing symptom recognition (Raphael et al., 2013). Of the 11 asthma studies reviewed, four reported a significant decrease in urgent care use, four reported no difference, and three did not report on this outcome. In regards to decreases in asthma symptoms, six reported a significant difference, three reported no difference, and two did not report on symptoms. The authors state that lay worker interventions lead to "modest improvements" (Raphael et al., 2013, p. 408) in outcomes like urgent care use, symptoms, and caregiver quality of life, and may be cost effective, and concluded that CHWs lead to positive outcomes in general, but findings are inconsistent (Raphael et al., 2013).

Another systematic review by Postma et al. (2009) specifically evaluated eight studies of CHWs performing in-home environmental interventions for urban minority children with asthma. Inclusion criteria varied, from physician asthma diagnosis, to allergen skin testing, to presentation to a healthcare setting for asthma symptoms (Postma et al., 2009). Interventions included education about environmental triggers and medications, provision of resources like mattress and pillow covers, and referral to other services like smoking cessation programs and professional cleaning services. All studies showed a consistent improvement in health, such as decreased asthma symptoms, decreased limitations on activities, and decreased visits to the ED or urgent care (Postma et al., 2009). There was an inconsistent improvement in efforts to remediate sources of triggers or to reduce allergen levels. When improvements in these areas were found, they were related to the provision of resources, such as mattress covers. Overall, the authors concluded that CHW interventions led to improved outcomes, and may be better suited to resource-poor communities. They also reported a dose-response relationship between interventions and outcomes, in which higher-intensity interventions produced better outcomes,

and called for continued research into the role of CHWs as members of the clinical care team, and as providers of social and emotional support to caregivers (Postma et al., 2009).

Asthma Risk Assessment Tools

To identify children with the greatest need for resource-intensive interventions like education sessions and home visits, asthma severity assessment tools have been developed.

Childhood Asthma Control Test (C-ACT). The C-ACT is a validated self-administered questionnaire to identify children aged 4 to 11 years with inadequate asthma control (Appendix B) (Liu et al., 2007). The seven-item questionnaire begins with four questions for the child regarding overall daily asthma status and the frequency in the past four weeks of cough, activity limitation, and nighttime awakening. The survey ends with three questions for the caregiver pertaining to daytime symptoms, nighttime symptoms, and wheezing (Liu et al., 2007). A numeric score is produced, and a score or 19 or below indicates inadequate control with a specificity of 74% and sensitivity of 68% (Liu et al., 2007).

There are several benefits to the C-ACT as an assessment tool because it is brief and convenient. It can be quickly completed and scored by hand on a single sheet of paper. It provides a single numeric score that can be readily interpreted as well-controlled asthma or not. A key limitation to the C-ACT is that it only gathers information about the previous four weeks. A child's asthma symptoms can easily change with acute illness or changes in environmental conditions, meaning the score may not be a good indicator of his or her overall level of asthma control. Furthermore, both the child and caregiver must be present to complete the C-ACT, which may not be possible when children are in school and caregivers are at work or in the home. Finally, while the single numeric score produced by the C-ACT is convenient, it cannot be used to guide therapy or identify etiology of asthma perturbations.

Child Asthma Risk Assessment Tool (CARAT). The CARAT is a 46-item online questionnaire tool for parents and health providers to determine individual asthma risk factors for children (Appendix C) (Mitchell, n.d.a; Mitchell, n.d.b). It was developed in response to the National Institute of Health-funded Phase I National Cooperative Inner-City Asthma Study findings that asthma was more multifactorial and risk factors were more individualized than previously thought (Mitchell, n.d.b; Evans et al., 1999).

The survey addresses nine categories:

1. Medical Care:
    - Use of regularly scheduled asthma care from a primary care physician or pulmonologist
    - Use of emergency services
    - Regular use of asthma medications, not just when symptomatic
    - Receipt of written instructions for medications
2. Environmental:
    - Presence of pillow and mattress covers
    - Use of humidifiers or gas stoves at home
    - Presence of carpeting and rugs at home
    - Problems with moisture, mildew, cockroaches, mice, or rats in the home
    - Presence of furry pets in the home
3. Smoking:
    - Exposure to secondhand smoke by caregivers
    - Child smoking behaviors
4. Responsibility:
    - Medication self-administration by the child
5. Adherence:
    - Timely medication administration
    - Event of running out of asthma medications
    - Access to medications during an asthma attack
6. Child Well-being:
    - Caregiver concern about the child's behavior or emotions
7. Caregiver Well-being:
    - Caregiver experience of stress or difficulty coping
8. Asthma-Related Attitudes:
    - The extent to which the caregiver believes he or she has control over the child's asthma symptoms
9. Allergies:
    - Results of skin allergy testing to dust mites, cockroaches, rodents, cats, dogs and mold.

An individual risk profile is generated, providing numeric scores for each of the nine categories, in addition to a personalized printout explaining the risks and recommended abatement measures. The risk scores are stratified into ‘Green’ (score 1 to 3), indicating low risk but requiring discussion, ‘Yellow’ (score 4 to 6), indicating moderate risk and needing to be addressed, and ‘Red’ (score 7 to 10), indicating high risk and needing to be addressed first (Mitchell, n.d.b). The CARAT has not been validated, and there are currently no recommendations for utilizing the total risk score in clinical practice.

The CARAT is useful for gathering robust information about a child’s behaviors and home environment. Only the caregiver is required to complete the CARAT, making it more convenient to complete, however, it is considerably longer than the C-ACT. Other benefits of the CARAT are the sub-section scores it produces, allowing the health worker to quickly identify the areas that should be addressed first. Another limitation is that, while the CARAT may be completed manually or electronically, it must be entered into the computer for scoring and generation of the risk profile. Furthermore, there are no recommendations for use of the total score. The CAMP chose a total score of 30 to indicate high-risk.

This tool should not be confused with the Control of Allergic Rhinitis and Asthma Test, a validated assessment by Azevedo et al. (2013) referred to by the same acronym.

While comprehensive asthma programs have been widely studied in children, and have overall shown to produce positive results, it has yet to be determined exactly which interventions should be implemented with which children to produce consistent results. The present study sought to parse out the details by comparing varying levels of intervention, from child education, to caregiver education, to home visits. Furthermore, previous studies use a wide variety of eligibility criteria, with few making use of the C-ACT or CARAT. The present study also aimed

to determine useful eligibility criteria to ensure that the appropriate interventions are distributed to children in need.

Methods

This study was an evaluation of the CAMP serving asthmatic children of DPS between September 13, 2016 and March 1, 2017. The study was undertaken with approval by the Dayton Children's Institutional Review Board (IRB) (Appendix D), in cooperation with standards of the Health Information Portability and Accountability Act (HIPAA) (United States, 2004). Additional approval from Wright State University was not required (B. Comer, personal communication, February 15, 2017). The CAMP consisted of three levels of intervention, defined below.

Child Education

The first level of intervention was a school-based child education program delivered by student nurses. The program consisted of the curriculum for the American Lung Association's (n.d.) *Open Airways for Schools* course. Student nurses were trained as course facilitators by a respiratory therapist. This intervention was part of the Dayton Children's IRB-approved project, "Easy Breathing for Elementary School Children with Asthma at Dayton Public Schools," conducted by Jeanine Bochenek (Appendix D). School nurses distributed invitations to all DPS students in grades two through five with parent- or physician-identified asthma, and caregivers provided informed consent. Participating children attended six 40-minute sessions covering the following topics: basic asthma information, trigger identification and control, symptom recognition and management, healthy lifestyles, and asthma medications (American Lung Association, n.d.). The fifth and sixth sessions were held on the same day due to scheduling reasons.

Caregiver Education

Caregivers of children who have received the first level of intervention were invited to participate in the second level of intervention, and self-selected based on their individual availability. The second level of intervention consisted of the first level of intervention, plus caregiver education. Caregiver education consisted of an hour-long community-based session in which caregivers, with or without their children, received clinical medication education from a respiratory therapist, and environmental trigger education from a CHW. Green cleaning kits, consisting of salt, vinegar, baking soda, measuring cups, and storage containers were also distributed to caregivers at these sessions (Figure 1). Recipes for using these products for cleaning were also provided.

Figure 1. Green cleaning kit distributed at caregiver education sessions and home visits (picture taken by A. Rymarczyk, 2017).

Home Visits

Caregivers who attended the caregiver education were invited to participate in the third level of intervention, which consisted of the first two levels of intervention, plus at least two home visits by a CHW. These visits included assessments for environmental triggers and

recommendations for remediation, continued asthma education, and referrals to community resources and/or social services. Remediation supplies were provided as needed, including green cleaning kits, furnace filters, mattress and pillow covers, HEPA-filtered vacuums, spacers, and pest control kits. Community referrals included resources for food, housing, bills and utilities assistance, employment and job training, healthcare, adult education, public benefits programs like Social Security, child care and education, clothing and other household supplies, and transportation to medical appointments. Families also received gift cards for their participation in these visits.

Figure 2 below illustrates the logic model for the CAMP, showing the components behind each level of intervention and the expected outcomes.

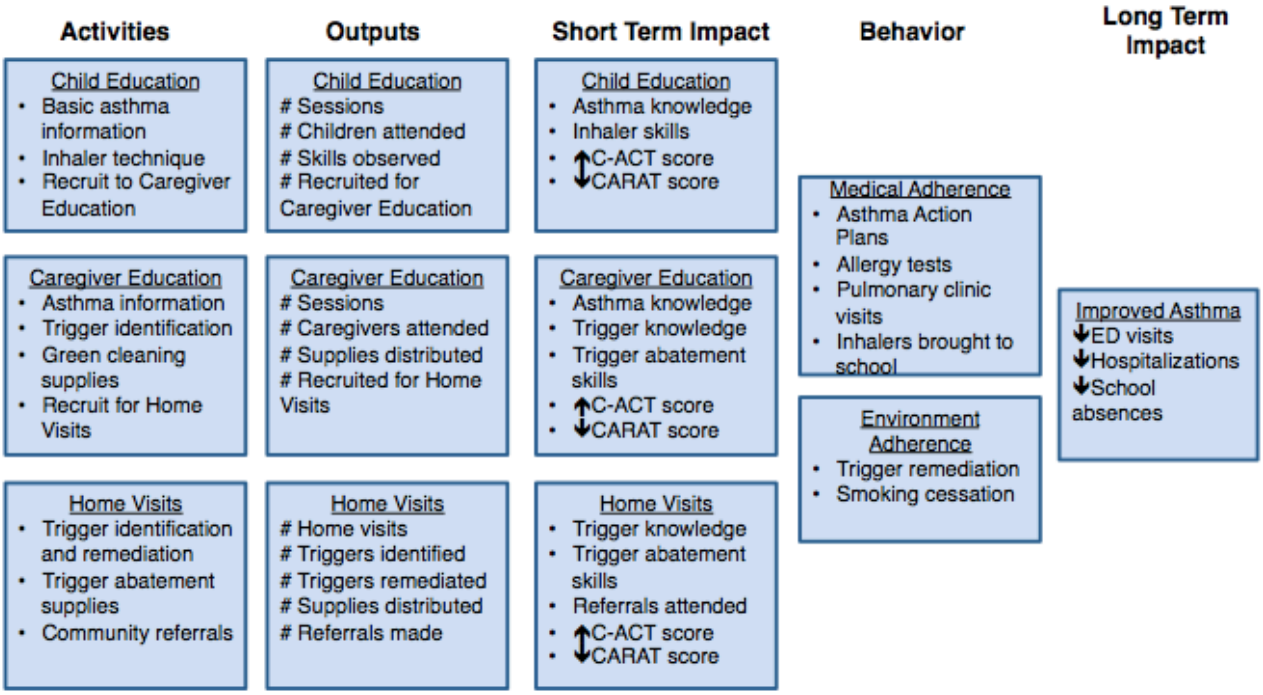


Figure 2. Logic model for the Comprehensive Asthma Management Program (CAMP).
Note: C-ACT = Childhood Asthma Control Test; CARAT = Child Asthma Risk Assessment Tool; ED = Emergency Department.

Research Questions

The purposes of this study were to assess the effectiveness of the CAMP and to determine CHW referral criteria. To achieve these purposes, the following key questions were investigated:

1. Did the CAMP reach the appropriate population?
2. Did the CAMP improve asthma outcomes in the participants?
3. Were there differences in asthma outcomes between intervention groups?

Data Collection and Analysis

Of the 297 children who received child education within 17 schools, 174 children from seven schools were selected to participate in the study. Data for this analysis were collected from CAMP internal program documents and from Dayton Children's electronic medical records.

C-ACT scores were collected before the first child education session. The number of asthma-related ED visits and hospitalizations that occurred both 30 days and 12 months before the first child education session were gathered from each child's Dayton Children's electronic medical record; visits to hospitals other than Dayton Children's were not collected. The presence of asthma action plans, rescue inhalers, and spacers at school were also assessed before the first child education session, and inhaler skills were assessed during the child education sessions. Asthma-related knowledge scores, CARAT scores, and self-reported missed school days due to asthma in the previous 12 months were collected at the caregiver education sessions. Asthma-related knowledge was assessed using the Check Your Asthma I.Q. Tool (Appendix E) developed by the National Heart, Lung and Blood Institute (NHLBI) (1992) and adapted by Dayton Children's (2015); there is a maximum score of 12.

The C-ACT score and the number of ED visits and hospitalizations were collected 30 days after the last intervention received to assess possible improvement. The last intervention indicates the last child education session, the caregiver education session, or the last home visit, depending on the level of intervention received.

A descriptive analysis was completed using IBM SPSS Statistics 24. Categorical variables were analyzed using Chi-Square (χ^2), and continuous variables were analyzed using t-tests and Analysis of Variance (ANOVA). Continuous C-ACT scores and CARAT scores were re-coded into categorical variables describing risk level as low, moderate, and high. Analysis of C-ACT scores, ED visits, and hospitalizations followed a pre- and post-intervention design, with children serving as their own historical controls for paired sample t-tests. Outcomes were compared between children receiving the first, second, and third levels of intervention. P-values were generated using t-test or ANOVA for continuous variables and χ^2 for categorical variables to determine statistical significance at a level of $\alpha < .05$. Two-tailed p-values were utilized when applicable.

Results

Program Participation

The study population included 174 children with parent-identified or physician-identified asthma who were reached by the CAMP between September 13, 2016 and March 1, 2017. All 174 children received child education; 109 of the 174 (62.6%) received only level one of the intervention. The remaining 65 children received further interventions: 47 (27.0%) received level two, comprising child and caregiver education, and 18 (10.3%) received level three, which includes child education, caregiver education, and home visits. Figure 3 summarizes the levels of program participation below.

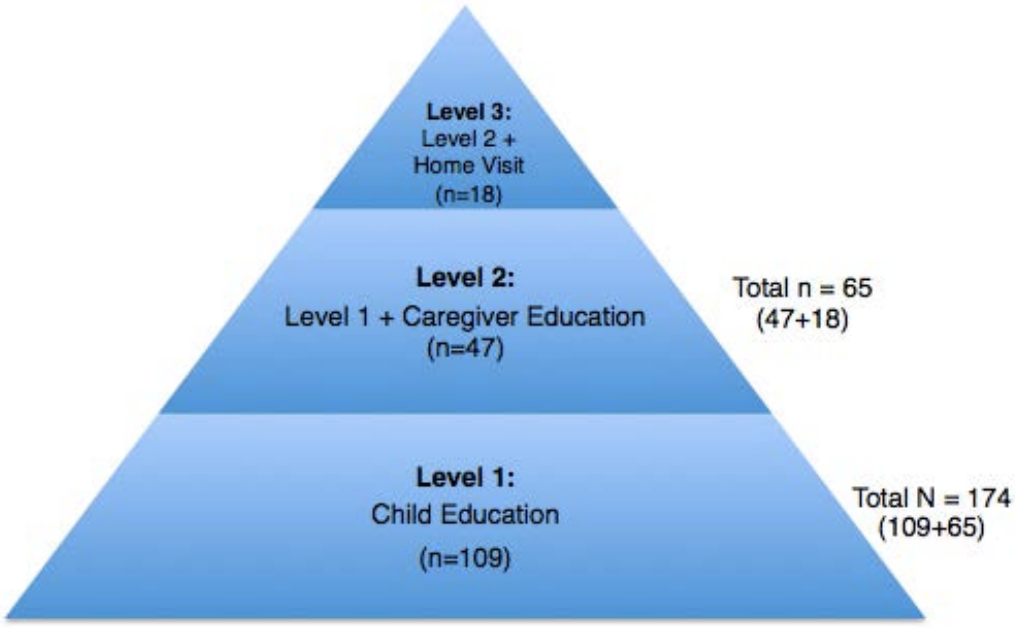


Figure 3. Program participation by level of intervention.

Table 1 provides attendance information for each intervention level. Six child education sessions occurred at all seven schools, for a total of 42 sessions. Children were expected to attend all six sessions if possible, while caregivers needed only attend one caregiver education session. Forty-eight percent (*n*=69) of children attended all six child education sessions. Seventy-two caregivers attended a caregiver education session, representing 64 children who attended child education, as some children had multiple caregivers attend. The 88 children who attended the caregiver education included children who attended child education and their siblings without asthma. While children were welcomed to attend the caregiver education, their caregivers were the primary audience of the sessions. Eighteen children were reached by home visits to 14 caregivers, as there were two households with multiple asthmatic children. Five caregivers received two home visits, and nine caregivers received three home visits.

Table 1

Program Attendance by Level of Intervention

	Child Education		**Caregiver Education**		**Home Visits**	
Sessions	42 Sessions		11 Sessions		37 Visits	
Attendance	143 Children[a]		72 Caregivers of 65 Asthmatic Children 88 Children		14 Caregivers of 18 Asthmatic Children	
Intervention-Specific Attendance	Session 1	118 (83%)	Session 1	1 Adult, 0 Children	Visit 1	14 Visits Affecting 18 Children
	Session 2	130 (91%)	Session 2	6 Adults, 7 Children	Visit 2	14 Visits Affecting 18 Children
	Session 3	110 (77%)	Session 3	8 Adults, 10 Children	Visit 3	9 Visits Affecting 10 Children
	Session 4	115 (80%)	Session 4	8 Adults, 10 Children		
	Session 5	121 (85%)	Session 5	15 Adults, 23 Children		
	Session 6	120 (84%)	Session 6	15 Adults, 15 Children		
	Attendance at All 6 Sessions	69 (48%)	Session 7	7 Adults, 10 Children		
			Session 8	2 Adults, 2 Children		
			Session 9	4 Adults, 4 Children		
			Session 10	0 Adults, 0 Children		
			Session 11	6 Adults, 7 Children		

[a]Attendance data are only available for 143 of the 174 children who received child education.

Attendance at childhood education sessions ranged from 77 to 91%, with 48% of children completing all six sessions. Participation at caregiver sessions varied from zero caregivers to 15 per session. The caregiver education with zero attendance (session 10) was attributed to snowy weather conditions.

Demographics

The age, sex, and race distributions of each level of intervention are provided in Table 2. The average age of all children was 8.85 ± 1.23 years. More males (55.7%, *n*=97) participated

than females (44.3%, *n*=77). There were statistically significant differences in child race within the study population, as the majority (76.4%, *n*=133) of participating children were Black or African American (χ^2 = 24.4, df = 4, *p* = .001).

Table 2

Age, Sex, and Race of Participants by Level of Intervention

	Level One (*N*=109)		**Level Two (*N*=47)**		**Level Three (*N*=18)**		**Overall (*N*=174)**		
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	***p*-value**
Age	8.98	1.20	8.64	1.29	8.61	1.30	8.85	1.23	0.19000
Sex	**Count (*n*)**	**Percentage (%)**	**Count (*n*)**	**Percentage (%)**	**Count (*n*)**	**Percentage (%)**	**Count (*n*)**	**Percentage (%)**	***p*-value**
Male	62	56.9	24	51.1	11	61.1	97	55.7	0.71000
Female	47	43.1	23	48.9	7	38.9	77	44.3	
Race	**Count (n)**	**Percentage (%)**	**Count (n)**	**Percentage (%)**	**Count (n)**	**Percentage (%)**	**Count (n)**	**Percentage (%)**	***p*-value**
White	15	13.8	9	19.1	2	11.1	26	14.9	
Black	89	81.7	35	74.5	9	50.0	133	76.4	.00007[a]
Other	5	4.6	3	6.4	7	38.9	15	8.6	

[a]*p*-value is significant at $p < .05$.
Note. SD = Standard Deviation.

Asthma Control Before and After Intervention

C-ACT scores, CARAT scores, knowledge test scores, and asthma-related school absences in the previous 12 months were collected before intervention levels two and three. Only C-ACT scores were collected before level one. These indicators, summarized in Table 3, demonstrate the level of need for asthma interventions.

Table 3

Pre-Intervention Asthma Control Indicators by Level of Intervention

	Level One (*N*=109)		**Level Two (*N*=47)**		**Level Three (*N*=18)**		**Overall (*N*=174)**		
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	***p*-value**
C-ACT (*n*=93)	19.80	4.25	19.13	4.57	15.21	2.64	18.83	4.44	.003[a]
CARAT (*n*=59)	-	-	24.83	13.50	26.17	11.95	25.24	12.96	0.720
Knowledge (*n*=33)	-	-	9.67	1.915	10.44	0.98	10.09	1.51	0.140
School Absences (*n*=18)	-	-	1.67	4.08	2.58	4.44	2.28	4.23	0.678

[a]*p*-value is significant at $p < .05$.
Note. C-ACT = Childhood Asthma Control Test; CARAT = Child Asthma Risk Assessment Tool, SD = Standard Deviation.

Given that a C-ACT score above 19 indicates adequate asthma control, the average child had under-controlled asthma, with a mean score of 18.83 ± 4.44. The large standard deviations, particularly in levels one and two, are likely related to small sample sizes. The level one (19.8 ± 4.25) and level two (19.13 ± 4.57) means indicate that some children had inadequate asthma control, and some had adequate.

With each increasing level of intervention, the average C-ACT score significantly decreased ($F_{(2,90)} = 6.4$, $p = .003$), such that children with worse asthma control received more intensive interventions. The level three mean (15.21 ± 2.64) indicates that all 18 children who received level three of intervention had inadequate asthma control.

Average CARAT scores (overall mean = 25.24) were below 30, indicating lower-risk, in all groups assessed. Average knowledge scores (overall mean = 10.09 out of 12) were below perfect. The average child missed 2.28 days of school in the previous 12 months due to asthma.

Besides the C-ACT, there were no significant differences in asthma indicators between intervention levels.

Average CARAT sub-section scores are given in Table 4. The mean score for each was below 7, indicating that no mean score was high-risk. However, the mean scores for the environmental (5.47) and responsibility (4.07) sub-sections were both moderate-risk, between four and six.

Table 4

Mean Child Asthma Risk Assessment Tool (CARAT) Sub-section Scores

Sub-Section	Mean	SD
Medical Care	3.27	2.78
Environmental	5.47	2.34
Smoking	2.49	3.47
Responsibility	4.07	4.96
Adherence	2.98	3.61
Adult Well-being	1.86	3.93
Child Well-being	1.19	3.26
Attitudes	1.93	2.54
Allergies	2.03	4.06

Note. SD = Standard Deviation.

While the average CARAT score was 25.24, indicating lower risk, 32.2% (*n*=19 out of 59 children with CARAT scores) of children had high-risk CARAT scores > 30. Figure 4 shows the percentage of children with high-risk sub-scores (> 7) by CARAT sub-sections.

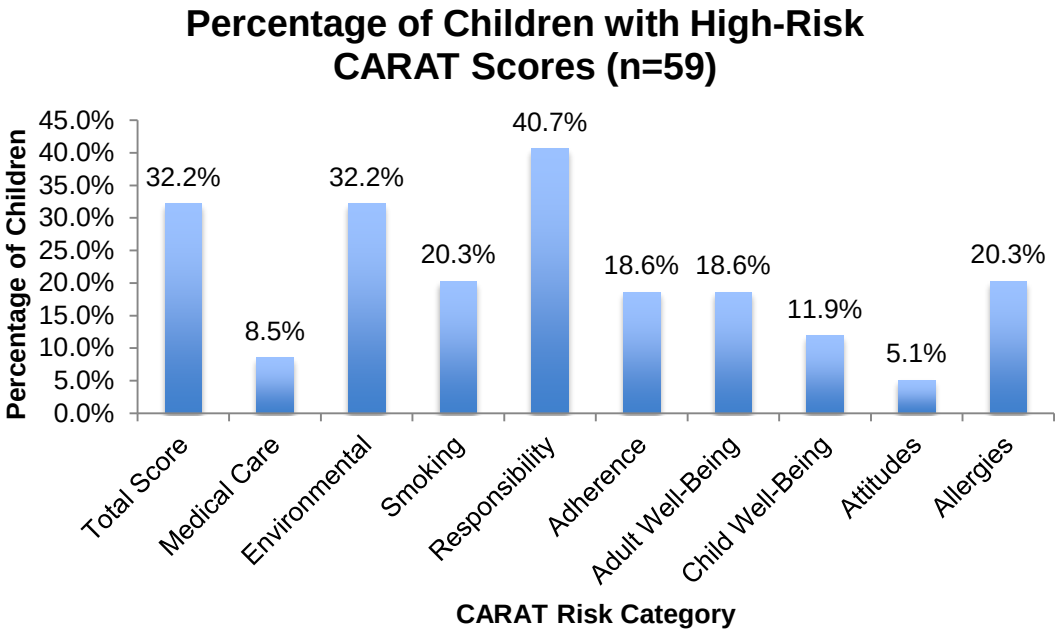


Figure 4. Percentage of children with Child Asthma Risk Assessment Tool (CARAT) scores indicating high risk by sub-section (Mitchell, n.d.a).

The responsibility sub-section had the largest percentage of children with a high-risk score (40.7%, *n*=24), indicating that many children use their asthma inhalers without proper supervision. The sub-section with the next largest percentage (32.2%, *n*=19) was environmental, signifying that the presence of environmental triggers in the home was common in the study population, and could be addressed by CHWs through home visits. Of children who received home visits (*n*=18), 33.3% (*n*=6) had a high-risk score in the environmental sub-section of the CARAT.

Additional indicators of asthma management were collected for children receiving level one of intervention, summarized in Table 5.

Table 5

Percentage of Children with Asthma Management Supplies at School (N=143)

Indicator	Percentage (Count)
Asthma Action Plan	4.2% (6)
Rescue Inhaler	21.0% (30)
Spacer	0.0% (0)

Note. Management supplies data are only available for 143 of the 174 children who received child education.

Of the asthma management supplies assessed, children were most likely to have a rescue inhaler at school (21%, *n*=30), followed by an asthma action plan (4.2%, *n*=6). No child had a spacer at school to use with his or her rescue inhaler.

Table 6 gives the average pre- and post-intervention C-ACT scores in children for whom this was measured (*n*=53), along with the variance between the two values. All pre-C-ACT scores were collected immediately before the first child education session. Post-C-ACT scores were collected immediately following the final child education session for children receiving intervention level one, immediately following the caregiver education session for children receiving level two, and at the second home visit for children receiving level three.

Table 6

Variance in Mean Childhood Asthma Control Test (C-ACT) Scores Pre- and Post-Intervention

	Mean C-ACT Pre-Intervention	SD	Mean C-ACT Post-Intervention	SD	Variance Between Pre- and Post-Intervention	*p*-value
Level One (*n*=27)	19.81	4.11	21.07	3.45	-1.26	0.120
Level Two (*n*=12)	19.25	4.48	20.50	3.92	-1.25	0.420
Level Three (*n*=14)	15.21	2.64	17.64	3.82	-2.43	0.100
Overall (*N*=53)	18.47	4.28	20.04	3.87	-1.57	.015[a]

[a]*p*-value is significant at $p < .05$.
Note. The mean C-ACT values differ from those in Table 3 because pre-C-ACT scores were collected for 93 children for use in Table 3, but paired pre- and post-C-ACT scores were only collected for 53 children for the present table. SD = Standard Deviation.

There was a statistically significant improvement in overall average C-ACT scores from 18.47 (under-controlled asthma) to 20.04 (controlled asthma) ($t = -2.5$, $df = 52$, $p = .015$). A score of 19 or below indicates inadequate asthma control, while a score above 19 indicates adequate control. While C-ACT scores also increased within each level of intervention, differences were not statistically significant.

The wide standard deviations for each level and overall indicate that the distributions of mean C-ACT scores span both sides of the asthma control threshold. Therefore, it is more feasible for children to cross the threshold from under-controlled to controlled asthma, particularly for children in levels one and two. Indeed, overall and within each level, mean C-ACT scores improved. Figure 5 below demonstrates the distribution of C-ACT scores before (n=93) and after (n=57) intervention, with the reference line set to 19. The proportion of scores above 19 visibly increased after intervention. Before intervention, 59.1% (n=55) children had a high-risk C-ACT score ≤ 19 and 40.9% (n=38) had a low-risk score > 19. After intervention, more children had low-risk scores (57.9%, n=33) than high-risk (42.1%, n=24).

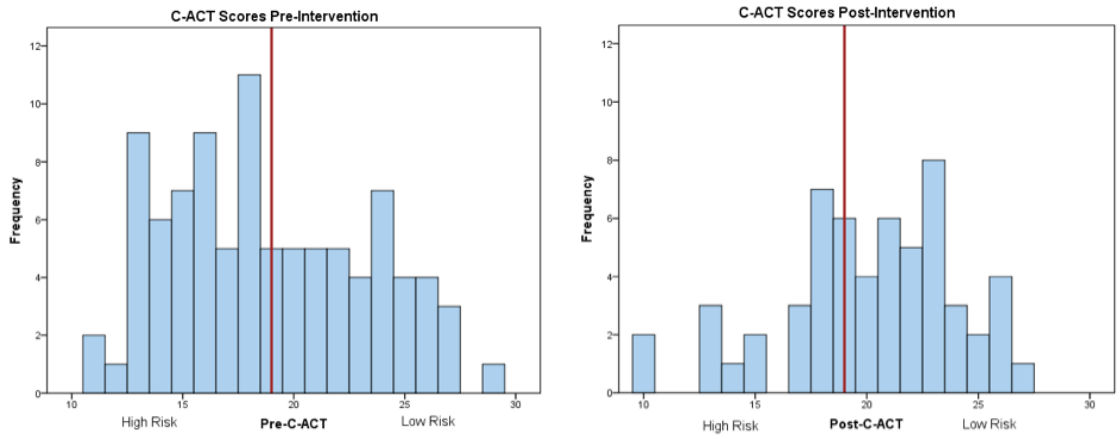


Figure 5. Histograms of pre- and post-intervention Childhood Asthma Control Test (C-ACT) scores, with red reference line set to the well-controlled threshold of 19.

Health Resource Utilization Before and After Intervention

Asthma-related health resource use before interventions is another indication of asthma severity in the study population. The average number of ED visits and hospitalizations 12 months and 30 days before the first child education session are summarized in Table 7.

Table 7

Pre-Intervention Health Resource Utilization by Level of Intervention

	Level One (*N*=109)		**Level Two (*N*=47)**		**Level Three (*N*=18)**		**Overall (*N*=174)**		
12 Months Pre-Intervention	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	***p*-value**
ED Visits	0.27	0.72	0.23	0.56	0.22	0.43	0.25	0.65	0.94
Hospitalizations	0.28	2.50	0.17	0.48	0.00	0.00	0.22	1.99	0.84
30 Days Pre-Intervention	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**p-value**
ED Visits	0.05	0.25	0.00	0.00	0.00	0.00	0.03	0.20	0.34
Hospitalizations	0.03	0.29	0.00	0.00	0.00	0.00	0.02	0.23	0.74

Note. ED = Emergency Department; SD = Standard Deviation.

The overall mean ED visits (0.25) and hospitalizations (0.22) were greater in 12 months preceding intervention compared to 30 days (0.03, 0.02 respectively). Children receiving level one of intervention had the greatest number of health visits across both time periods.

The majority of children had zero ED visits and hospitalizations in the observed time periods before intervention. Eighty-two percent (*n*=143) had zero ED visits and 93.7% (*n*=163) had zero hospitalizations in the 12 months preceding interventions. Ninety-seven percent (*n*=170) had zero ED visits and 99.4% (*n*=173) had zero hospitalizations in the 30 days before intervention.

Table 8 provides the mean number of asthma-related ED visits before and after intervention. No child receiving levels two or three of intervention visited the ED for asthma within the 30 days before and after receiving CAMP interventions, so paired sample t-tests could not be completed for these sub-groups.

Table 8

Mean Values and Variance in Emergency Department (ED) Visits 30 Days Pre- and Post-Intervention

	Mean ED Visits Pre-Intervention	**SD**	**Mean ED Visits Post-Intervention**	**SD**	**Variance Between Pre- and Post-Intervention**	***p*-value**
Level One (*n*=109)	0.05	0.25	0.02	0.14	0.03	0.32
Level Two (*n*=47)	0.00	0.00	0.00	0.00	-	-
Level Three (*n*=18)	0.00	0.00	0.00	0.00	-	-
Overall (*N*=174)	0.03	0.20	0.01	0.11	0.02	0.32

Note. ED = Emergency Department; SD = Standard Deviation.

While mean ED visits did decrease overall (from 0.03 to 0.01) and in children receiving child education only (from 0.05 to 0.02), differences before and after intervention were not significant ($t = 1.0$, $df = 173$, $p > .05$ and $t = 1.0$, $df = 108$, $p > .05$ respectively).

Table 9 below contains the average number of asthma-related hospitalizations pre- and post-intervention. As with ED visits, there were zero asthma-related hospitalizations for children receiving level two and level three, thus preventing the calculation of paired sample t-tests.

Table 9

Mean Values and Variance in Hospitalizations 30 Days Pre- and Post-Intervention

	Mean Hospitalizations Pre-Intervention	**SD**	**Mean Hospitalizations Post-Intervention**	**SD**	**Variance Between Pre- and Post-Intervention**	***p*-value**
Level One (*n*=109)	0.03	0.29	0.04	0.23	-0.009	0.57
Level Two (*n*=47)	0.00	0.00	0.00	0.00	-	-
Level Three (*n*=18)	0.00	0.00	0.00	0.00	-	-
Overall (*N*=174)	0.017	0.23	0.023	0.19	-0.006	0.57

Note. ED = Emergency Department; SD = Standard Deviation.

The average number of asthma-related hospitalizations increased overall (from 0.017 to 0.023) and in the child education sub-group (from 0.03 to 0.04), though these differences were not statistically significant ($t = -0.58$, $df = 173$, $p > .05$ and $t = -0.57$, $df = 108$, $p > .05$ respectively).

Environmental Triggers Identified during Home Visits

Eighteen children were reached by home visits to 14 caregivers, as there were two households with multiple asthmatic children. Five caregivers received two home visits, and nine caregivers received three home visits.

Environmental triggers were self-reported by caregivers and confirmed by CHWs, or identified originally by CHWs, in the homes of all children receiving home visits (*n*=18) (Appendix F).

The percentage of children whose homes contained triggers are presented in Figure 6, grouped by the type of asthma trigger.

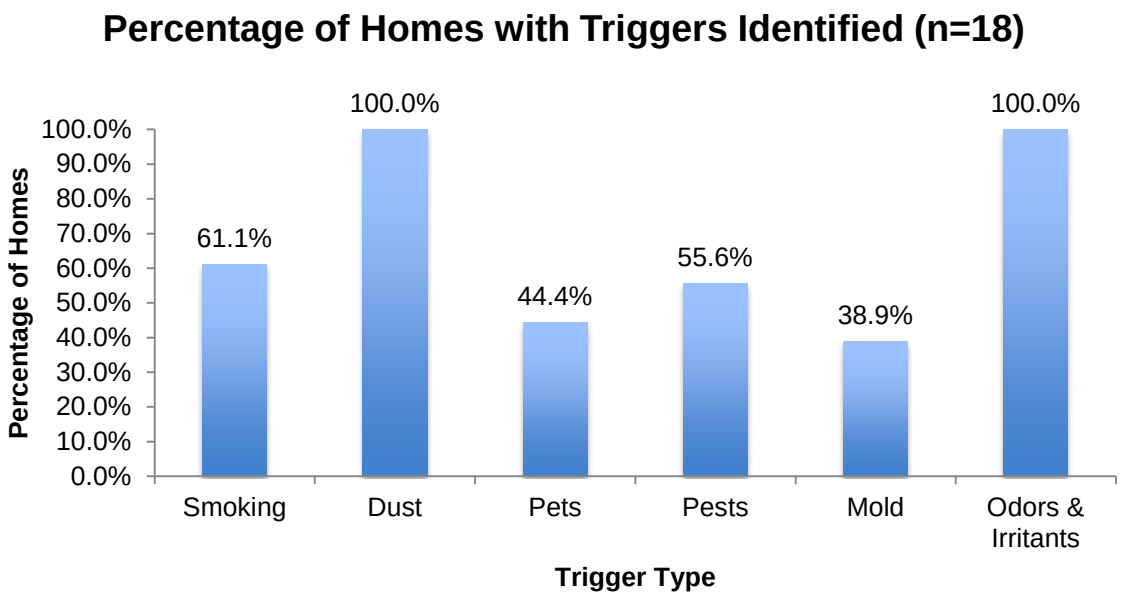


Figure 6. Percentage of children receiving home visits with environmental triggers, by trigger type (Appendix F).

Dust and odors/irritants were both identified in 100% of homes. Common irritants included strongly scented home cleaning products, candles, and incense. Smoking referred to inhaled tobacco products or marijuana. Sixty-one percent (*n*=11) of children were exposed to secondhand or third-hand smoke in the home or car. Less frequently identified environmental triggers were furry pets (44.4%, *n*=8), pests like cockroaches and mice (55.6%, *n*=10), and mold (38.9%, *n*=7).

In addition to asthma triggers, other issues of safety and medication management were assessed during home visits. Safety issues included the storage of household chemicals in low or unlocked cabinets, and the absence of smoke or carbon monoxide detectors. Safety issues were identified for 83.3% (*n*=15) of children receiving home visits. Medication management included refilling inhalers appropriately, adhering to daily controller medications, adhering to asthma

action plans, and attending regularly scheduled doctor's appointments. Issues with medication management were identified for 61.1% (*n*=11) of children receiving home visits.

A total of 312 recommendations for remediating triggers, safety issues, and medication management issues were given by the CHW, signifying an average of 17.3 recommendations per child. For example, recommendations for dust abatement included vacuuming using a HEPA filter while the child was out of the house, and using dust-proof mattress and pillow covers. Of the 312 recommendations, 223 (71.5%) were accomplished by either the second or third home visit. On average, 12.4 recommendations were accomplished per child.

Resource Needs of Children Receiving Home Visits

Trigger management supplies and spacers were distributed to children receiving home visits. The amounts provided of each resource are summarized below in Table 10.

Table 10

Resource Distribution during Home Visits (N=18)

Resource Type	Count Distributed (*n*)	Percentage of Homes Receiving Resource (%)
Pillow Cover	14	77.8
Mattress Cover	14	77.8
Green Cleaning Kit	17	94.4
High-Efficiency Particulate Air (HEPA)-Filtered Vacuum	16	88.9
Spacer	17	94.4
Pest Control Kit	10	55.6

Almost all children (94.4%, *n*=17) receiving home visits were provided with green cleaning kits and spacers. Pest control kits were least likely to be needed in homes (55.6%, *n*=10).

In addition to trigger management supplies, community referrals were also provided by the CHW during home visits. A screening tool was used at all home visits to identify resource

needs, and a community referral was given to fulfill each need (Appendix F). Figure 7 shows the proportion of homes with different types of resource needs, and corresponding referrals given.

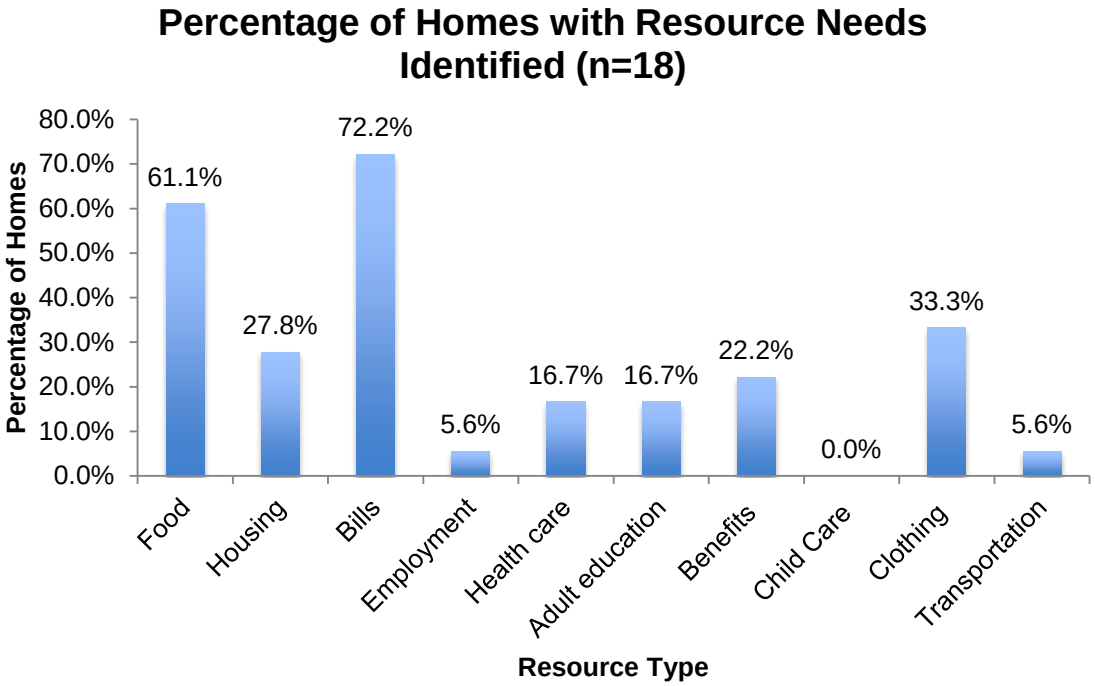


Figure 7. Types of community resource needs identified during home visits.

The most common need, and therefore the most common referral, was for assistance with bills, including gas, electric and telephone bills (72.2%, *n*=13). Referrals to help combat this need included a utility assistance program called Percentage of Income Payment Plan (PIPP) and a weatherization program offered by the Community Action Partnership (http://www.cap-dayton.org/weatherization). The second greatest need identified was for food (61.1%, *n*=11); corresponding referrals were given for Women, Infants, and Children (WIC) services, Supplemental Nutrition Assistance Program (SNAP) offices, and food banks. Homes needing clothing, diapers, and other household items (33.3%, *n*=6) were referred to local clothing and appliance pantries. Housing needs signified either avoiding homelessness or securing safe and healthy home conditions. For 27.8% (*n*=5) of homes, the CHW assisted caregivers in working

with their landlords to improve home conditions, such as requesting maintenance of leaks or replacement of air filters. Caregivers requesting assistance with public benefits programs (22.2%, *n*=4) were given information regarding Social Security Supplemental Security Income, temporary cash assistance, Code of Federal Regulations Title 20 Employees' Benefits, and/or Social Security Disability Insurance. Seventeen percent (*n*=3) received referrals for medical and/or mental health care. Another 17% (*n*=3) were referred to adult education classes including parenting classes, English language classes, or General Educational Development (GED) classes. Six percent (*n*=1) of households needed assistance with employment or job training and received corresponding referrals. An additional 6% (*n*=1) needed assistance with and received referrals for transportation to medical appointments. No households identified a need for child education or childcare.

Upon subsequent home visits, caregivers self-reported whether or not they accessed the referral, indicating that they had successfully used or received the service. A total of 49 community referrals were given by the CHW, of which 25 (51.0%) were accessed by the second or third home visit. On average, this indicates that for each child 2.7 referrals were given, and 1.4 were accessed.

Geographic Locations of Home Visits

The zip codes of each home visit were collected and compared to the zip codes in Montgomery County with the highest rates of asthma-related ED visits, shown below in Figure 8 and Table 11. Out of 18 home visits, seven (39%) were located in zip codes with the highest rates of ED visits; 10 (55.5%) were located in zip codes with the second-highest rates; and one (5.5%) was located in a zip code with the third-highest rates.

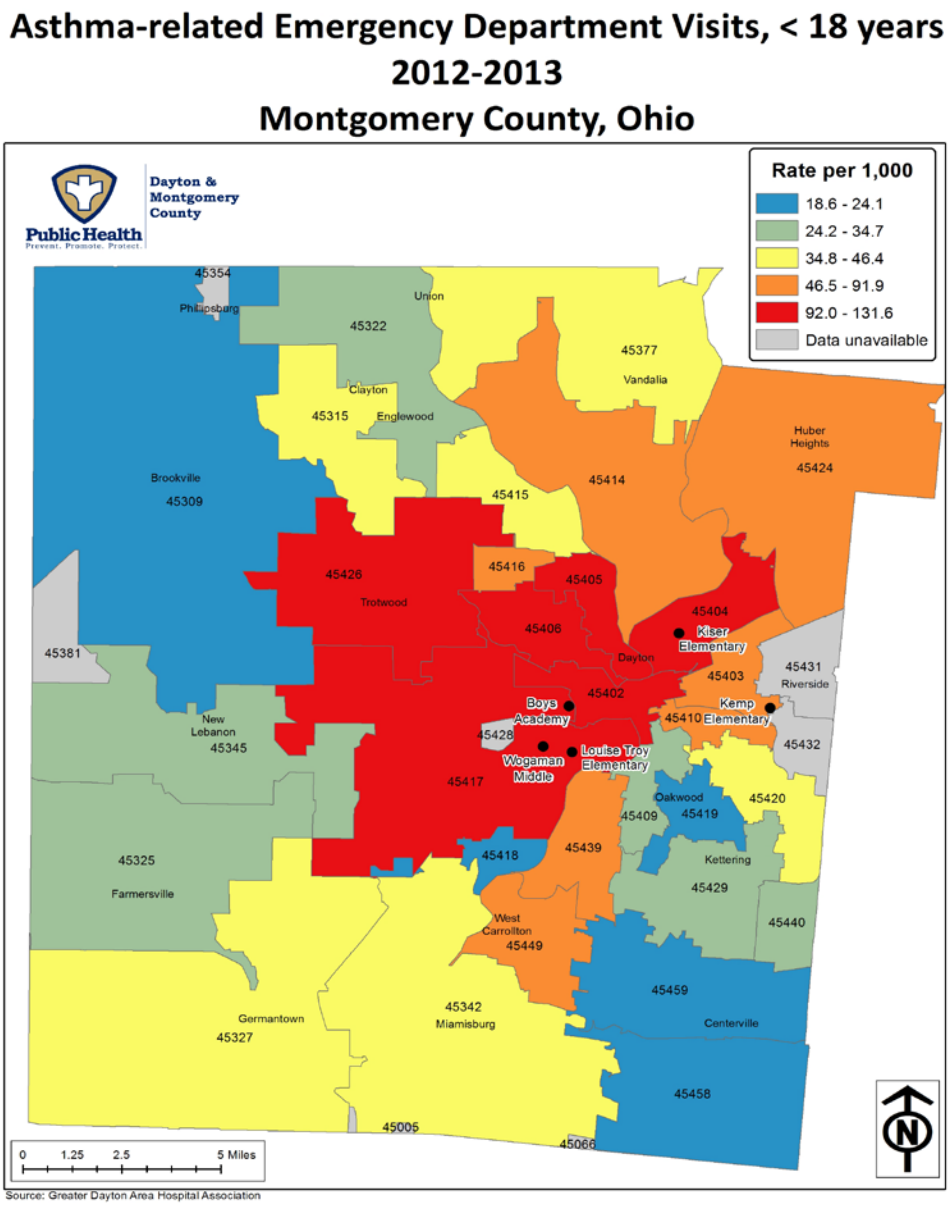


Figure 8. Rates of pediatric asthma-related Emergency Department (ED) visits in Montgomery County by zip code (Dayton Asthma Alliance, 2015).

Table 11

Zip Codes of Homes Reached by Home Visits (N=18)

Zip Code	Rate per 1,000	Children Reached (*n*)
45402	92.0 – 131.6	1
45403	46.5 – 91.9	2
45404	92.0 – 131.6	1
45405	92.0 – 131.6	1
45406	92.0 – 131.6	1
45410	46.5 – 91.9	6
45416	46.5 – 91.9	2
45417	92.0 – 131.6	3
45420	34.8 – 46.4	1

Note. Rates refer to asthma-related emergency department visits from Figure 8. Colors correspond to key in Figure 8 (Dayton Asthma Alliance, 2015).

Challenges with Data Collection

Information about data collection provides a picture of program implementation and follow-up. The following Table 12 summarizes the number of asthma data points that were gathered for each child. Note that level one did not involve the collection of CARAT scores, knowledge scores, or school absences.

Table 12

Number of Asthma Indicators Collected by Intervention Type

Number of Scores Collected	Child Education (N=174)	Caregiver Education (*N*=65)	Home Visits (*N*=18)	Total Obtained	Total Missing
Pre-C-ACT Score	51	28	14	93	81
Pre-CARAT Score	-	41	18	59	24
Pre-Knowledge Score	-	15	18	33	50
Pre-School Absences	-	6	12	18	65
Post-C-ACT Score	27	12	0[a]	39	135
Post-CARAT Score	-	0	0	0	83
Post-Knowledge Score	-	0	0	0	83
Post-School Absences	-	0	0	0	83

[a]Post-C-ACT Scores used in analysis were gathered from the second home visit, rather than the intended 30 days after the final home visit due to lack of 30-day follow-up.
Note. C-ACT = Childhood Asthma Control Test; CARAT = Child Asthma Risk Assessment Tool.

More pre-intervention indicators were collected than post-intervention indicators. Out of 174 potential C-ACT scores, 93 (65.0%) pre-C-ACT scores and 39 (22.4%) post-C-ACT scores were collected. Out of the remaining scores, for which there were 83 potential children, 59 (71.0%) pre-CARAT scores, 33 (39.8%) pre-knowledge scores, and 18 (21.7%) pre-school absences were collected. No post-CARAT score, post-knowledge scores, or post-school absences were collected following caregiver education or within 30 days of the last home visit.

Regarding other unique indicators collected at various intervention levels, inhaler skills were observed in 30 children (21%) receiving child education. The number of green cleaning kits distributed at caregiver education sessions and the number of furnace filters distributed at home visits were not gathered.

Discussion

This study was a program evaluation of the September 2016 to March 2017 outcomes of the CAMP, an ongoing program serving asthmatic students of DPS and their caregivers. The

goals of the CAMP are to improve pediatric asthma control and prevent asthma-related urgent health visits. In order to ensure that limited resources are well utilized, the efficacy of the CAMP and the need for home environmental evaluations were investigated. This study sought to answer three key research questions. In the following pages, each research question is individually re-stated, addressed with study results, and discussed.

Research Question One: Did the CAMP reach the appropriate population?

Almost all of the children who received home visits lived in high-risk or highest-risk zip codes, and few children who received child education had appropriate asthma management supplies at school, suggesting that home visits and child education were necessary. The average CAMP recipient had modest levels of asthma risk factors (determined by the CARAT) but inadequate asthma control (determined by the C-ACT). Therefore, the CAMP participants were in need of intervention to improve asthma control. However, in the 12 months before intervention, the average child had less than one asthma-related ED visit or hospitalization. Given the primary goal of reducing asthma-related urgent health visits, the study population may not have exhibited sufficient health resource utilization to warrant intensive intervention.

Research Question Two: Did the CAMP improve asthma outcomes in the participants?

After receiving CAMP interventions, there was a clinically and statistically significant improvement in C-ACT scores from inadequate to adequate asthma control. The decrease in ED visits and increase in hospitalizations compared to pre-intervention were not statistically significant, likely due to very low health resource utilization.

While there are challenges to demonstrating an improvement in long-term impacts, the program implementation and production of outputs were strong:

- Nearly three hundred children (of which 174 were studied) received child education.

- The caregivers of 65 children received caregiver education.
- The caregivers of 18 children received home visits.
- During the home visits, a total of 88 trigger management supplies were disseminated.
- The caregiver of each child receiving a home visit received an average of 17.78 trigger management recommendations, 70.3% of which were accomplished.
- The caregiver of each child receiving a home visit an average of 2.56 community referrals, 54.5% of which were accessed.

A summary of program deliverables is provided in Figure 9.

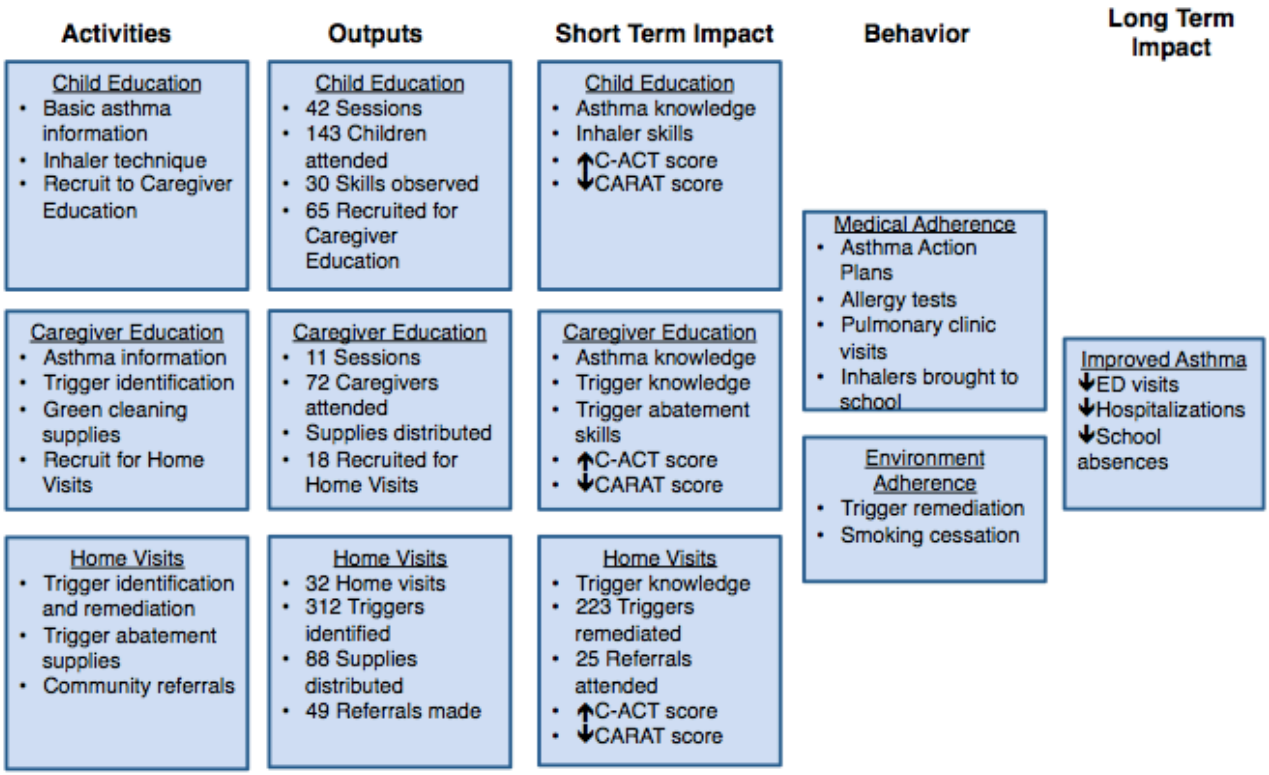


Figure 9. Completed Comprehensive Asthma Management Program (CAMP) Logic Model demonstrating outputs and outcomes achieved. Note: C-ACT = Childhood Asthma Control Test; CARAT = Child Asthma Risk Assessment Tool; ED = Emergency Department.

Evidence shows that trigger abatement and access to health and social services improve outcomes for children with asthma (Margellos-Anast et al., 2012; Peretz et al., 2012; Kreiger et

al., 2005; Gutierrez Kapheim et al., 2015). Therefore, while long-term health outcomes could not reliably be illustrated, the high level of successful program implementation is reassuring.

Because asthma is a multifactorial chronic condition, a longer follow-up period may be necessary to capture further improvement following interventions. The availability of follow-up data, particularly for CARAT scores, knowledge scores, and school absences, will require improvement in order to demonstrate intervention impact.

Research Question Three: Were there differences in asthma-related outcomes between intervention groups?

There were no significant differences in outcomes between the three intervention groups. The variance (improvement) in pre- and post-C-ACT scores was greater for children receiving level three than those receiving levels one and two, but not significantly. The improvements in ED visits and hospitalizations were difficult to compare between groups because children in levels two and three both had zero urgent health visits in the 30 days before and after intervention.

There were also minimal differences in baseline characteristics between the three intervention groups. While the mean pre-C-ACT score in level three (under-controlled) was significantly lower than those of levels one (controlled) and two (nearly controlled), there were no other significant differences in asthma-related risk. The key objective of home visits is identifying environmental triggers. However, the percentage of children receiving home visits with a high-risk CARAT Environmental sub-section score was similar to the overall percentage of children with high-risk Environmental scores, suggesting that the children with the greatest need for home visits may not have been identified from the study population.

Limitations

While this study has many strengths, including the inclusion of both self-reported data and data gathered from medical records, and access to robust environmental information gathered from home visits, there are several limitations.

First, the racial distribution of the study population did not reflect that of the general population. The majority of children studied were African American (76.4%), with smaller proportions of White children (14.9%) and children of 'other' race (8.6%). African-American children have almost twice the rate of asthma (13.4%) of White children (7.6%), but the study population had more than twice the amount of African-American as White children (CDC, 2016a).

The results of this study helped to assess other aspects of the CAMP, such as participation and data collection, which highlighted some key limitations. Participation at child education sessions was high, with nearly half of children attending every session. This is likely because sessions took place at school, a convenient location for children during the school day. However, participation at caregiver education sessions was variable; some sessions had very few caregivers present, while others had over a dozen. The session with zero attendance was attributed to snow, but overall, it may have been difficult for caregivers to attend if they were not given enough notice or enough session location options.

Home visit completion was limited by large gaps in time between visits, due to caregivers' difficulty keeping their appointments for home visits, and difficulty reaching caregivers via telephone. Originally, the caregiver of each eligible child was to receive three home visits, each two weeks apart, with final post-intervention data collected 30 days after the third home visit. Had this occurred, 30-day post-intervention data would have been available for

17 out of 18 children by March 1, 2017. However, by the time of the evaluation, eight children had received two home visits, 10 children had received three home visits, and 30-day post-intervention data had not been collected for any children. Therefore an important aspect of program implementation is scheduling interventions within shorter intervals to promote increased follow-up.

Several studies of CHW interventions for children with asthma conduct follow-up assessments one year after intervention (Peretz et al., 2012, Gutierrez Kapheim et al., 2015, Woods et al., 2012). The relatively shorter time period for gathering post-intervention information in the present study limited the ability to capture long-term outcomes. Therefore, the combination of long-term and short-term follow-up would be recommended.

It was challenging to complete data collection for all levels of intervention due to loss to follow-up. Incentives for return of follow-up information were used, such as small toys for children and gift cards for caregivers, with limited success. The missing values (Table 12) were numerous for many indicators, such as CARAT scores, knowledge scores, school absences, green cleaning kits distributed at caregiver sessions, and inhaler skills assessed at child sessions. Robust information was gathered pre-intervention regarding the need for asthma services, but post-intervention data was lacking. This again highlights the need for emphasizing follow-up in order to demonstrate improved outcomes.

Furthermore, limitations in data collection restricted the data analysis and may have obscured differences in risk or outcomes within the study population. Collecting the same data points at the same time intervals for all intervention levels would facilitate comparison between groups.

An additional limitation was the self-reported nature of the majority of asthma outcomes studied. While ED visits and hospitalizations were gathered from the electronic medical record, the other asthma control measures are generated using self-reported data, which can be limited by recall bias and/or reporting bias (Stone, Bachrach, Jobe, Kurtzman, & Cain, 1999). The use of more objective measurements of asthma status, such as peak flow or spirometry, would have added to the study validity.

However, ED visits and hospitalizations were only gathered from Dayton Children's electronic medical record; visits to hospitals other than Dayton Children's were not collected. It is possible that urgent visits to other hospitals or health centers were overlooked in this study.

Lastly, the absence of a control group receiving no intervention limits the ability to make comparisons across intervention levels. However, it was decided by CAMP staff that it would be ethically problematic to withhold intervention from children in need.

Recommendations

Further research with a longer follow-up period is needed to fully determine the long-term impact of the CAMP on participant asthma management and health resource utilization. However, the results of this study can be considered in the context of similar studies. For example, in the present study there were no statistically significant differences in outcomes between intervention levels. This is in contrast to the 2005 study by Kreiger et al., which found that children receiving higher-intensity interventions had greater improvements than those receiving lower-intensity interventions. This discrepancy may be due to a number of factors in the present study, including inadequate or inappropriate recruitment for home visits, missing data, or low statistical power due to small sample size.

Several studies concluded that, in certain situations, it would be more effective to recruit children for CHW interventions directly from urgent health visits (Thyne et al., 2007; Beckham et al., 2004; Gerald et al., 2006). For example, these situations might include low attendance at clinic visits, low recruitment for home visits, and/or a lack of improvement demonstrated from school-based recruitment. In our study, there was variable participation at caregiver education sessions and difficulty scheduling home visits. According to Thyne, Marmor, Madden, and Herrick (2007), Beckham et al. (2004), and Gerald et al. (2006), the best way to identify and recruit children in need is to recruit them from the ED during an asthma exacerbation.

The CAMP was a newly-developed program, implemented largely by a CHW with the use of grant funding. The large workload of multiple home visits per child limited the ability to reach more children through home visits, which may hinder program sustainability long-term. Thyne et al. (2007) suggest integrating comprehensive asthma programs into pre-existing programs in order to promote sustainability. The CAMP may benefit from increasing involvement with the Dayton Children's Family Resource Connection, which could assist with community referrals and allow the CHW to conduct home environmental assessments for a greater number of children.

While children were identified with high-risk CARAT sub-section scores in medical care, child well-being, adult well-being and allergies, communication between the CHW and the participants' physicians did not take place as part of the program model. However, care coordination could help to more rapidly identify and correct the underlying cause of impaired asthma control. CHW-provider communication is supported by Beckham et al. (2004), who recommended that CHWs and clinical treatment teams meet regularly to develop and coordinate asthma care plans for their shared patients.

In order to improve the CAMP's reach and promote the best use of scarce resources, the following recommendations are offered for consideration:

Program implementation.

- Schedule subsequent home visits within shorter time intervals, rather than two or more weeks apart, to promote the completion of follow-up visits.
- Facilitate the collection of follow-up data by scheduling in-person follow-up sessions as soon as possible instead of relying on telephone-based follow-up. Furthermore, financial incentives for completing follow-up should be continued.
- Create a CHW flow sheet in the Dayton Children's electronic medical record so providers can see basic information about their patients' environmental triggers and resource needs, promoting care coordination.
- To improve attendance at caregiver sessions and to conserve resources:
    - Hold fewer total sessions, but invite caregivers to attend sessions at any school, regardless of the school attended by their children.
    - Release the schedule of all caregiver sessions at the beginning of the school year to provide sufficient notice.
    - Hold sessions only at community schools where 2016 attendance was adequate.
    - Document the amount of resources distributed at caregiver sessions, like information packets and green cleaning kits, to monitor spending and inform supply orders.
    - Send out reminders to caregivers before sessions to encourage attendance, such as via text message.

Data collection.

- Further evaluation should occur over a longer follow-up period to capture long-term impacts.
- Utilize HIPAA-compliant technology (such as a tablet with an internet hotspot) for mobile data gathering at education sessions and home visits in order to promote efficient data collection and reduce paper waste.
- Consider gathering cost information to determine CAMP cost-effectiveness.

Recruitment and allocation of resources.

- Identify high-risk children in need of intervention from the ED and hospital, to ensure that the program reaches children with high levels of health resource utilization.
- Use sub-section CARAT scores to inform next steps based on the areas of high risk, rather than the total CARAT score.
- Limit the focus of home visits to environmental trigger assessment and abatement, and instead refer caregivers with additional non-environmental resource needs to the Family Resource Connection, to allow the CHW to complete more home visits.
- Consider the following algorithm (Figure 10), which begins by identifying high-risk children from the ED or hospital, for referral to CHW and other interventions:

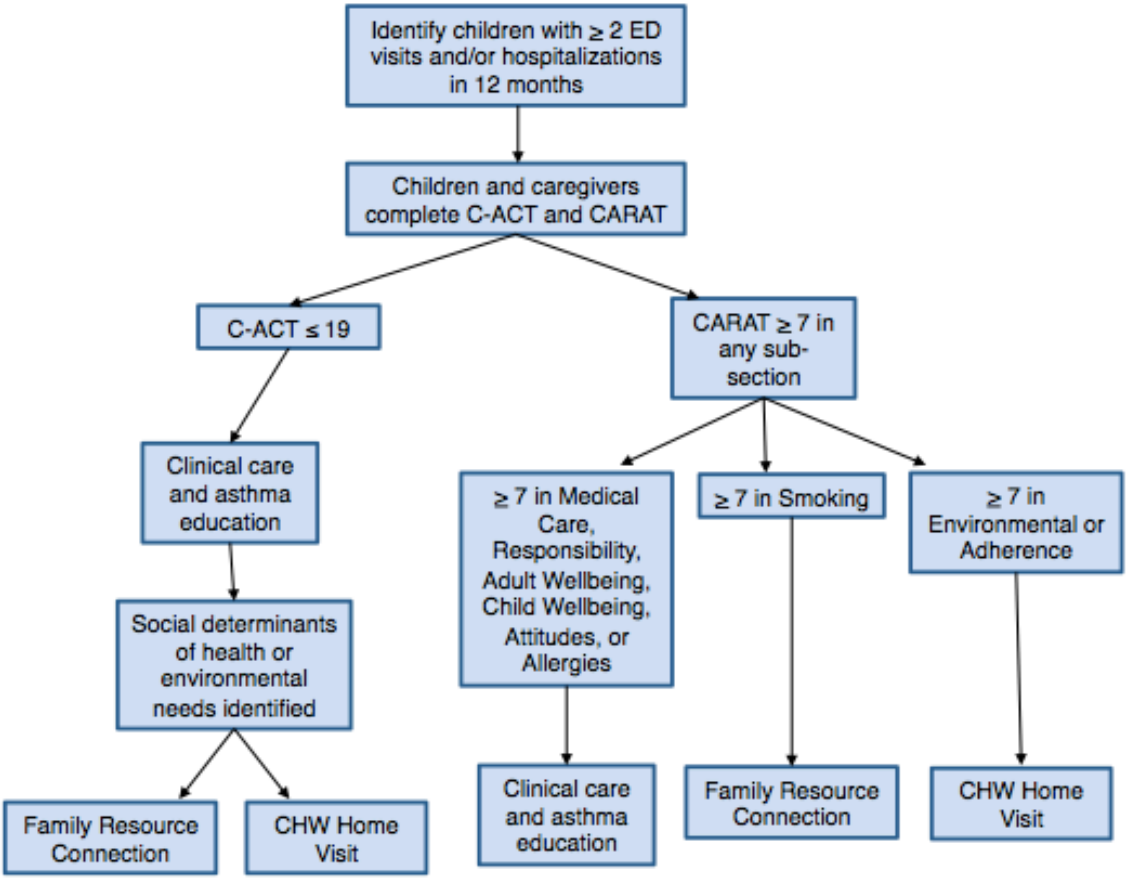


Figure 10. Suggested identification and referral process for asthmatic children to receive Community Health Worker (CHW) interventions. Note: ED = Emergency Department; C-ACT = Childhood Asthma Control Test; CARAT = Child Asthma Risk Assessment Tool.

Using this algorithm, children would be identified at their second asthma-related ED visit or hospitalization, and administered the C-ACT and CARAT. Under-controlled asthma, based on a C-ACT ≤ 19, would indicate a need for clinical care, either with the child's primary care physician or a pulmonary specialist, at the discretion of the physician. Under-controlled asthma would also indicate asthma education, provided by the CAMP. If at any point additional needs were identified, the child would be referred to the Family Resource Connection for social needs, or provided a home assessment for environmental needs.

High levels of risk identified by CARAT sub-section scores would also guide next steps. Children with scores ≥ 7 in medical care, responsibility, adult or child well-being, attitudes, or allergies would be provided with clinical care and education as described above. Children with a score ≥ seven in the smoking category would be referred to the Family Resource Connection for caregiver smoking cessation, and children with scores ≥ 7 in the environmental or adherence categories would be provided a CHW home assessment.

This algorithm combines several recommendations, including identifying high-risk patients directly in the ED or hospital, utilizing the CARAT sub-section scores to guide referrals, and making use of existing infrastructure such as the Family Resource Connection to allow for more home assessments.

Conclusion

Asthma is a multifactorial disease requiring a variety of clinical, social, and environmental interventions for management. CHWs have been proven to aid children with asthma by providing education, trigger management supplies, emotional support, and community referrals. This program evaluation found that CHW interventions are effective in significantly improving C-ACT scores from inadequate asthma control to adequate control, and in identifying and remediating asthma triggers in the home. Future evaluation can be improved by longer follow-up periods and enhanced data collection.

References

American Lung Association [Internet]. (n.d.) Chicago, IL: American Lung Association [cited March 28, 2017]. Retrieved from http://www.lung.org/lung-health-and-diseases/lung-disease-lookup/asthma/asthma-education-advocacy/open-airways-for-schools/

American Public Health Association. (2009). Policy Statement 20091. Support for Community Health Workers to Increase Health Access and to Reduce Health Inequities. Retrieved from http://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2014/07/09/14/19/support-for-community-health-workers-to-increase-health-access-and-to-reduce-health-inequities. Accessed January 3, 2017.

Aster, J. C., Abbas, A. K., Robbins, S. L., & Kumar, V. (2013). *Robbins Basic Pathology* (Ninth edition). Philadelphia, PA: Elsevier Saunders.

Azevedo, P., Correia-de-Sousa, J., Bousquet, J., Bugalho-Almeida, A., Del Giacco, S. R., Demoly, P., ... & Morais-Almeida, M. (2013). Control of Allergic Rhinitis and Asthma Test (CARAT): dissemination and applications in primary care. *Primary Care Respiratory Journal*, *22*, 112-116.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. Macmillan.

Beckham, S., Kaahaaina, D., Voloch, K. A., & Washburn, A. (2004). A community-based asthma management program: effects on resource utilization and quality of life. *Hawaii Medical Journal*, *63*, 121-126.

Brunekreef, B., Von Mutius, E., Wong, G., Odhiambo, J., García-Marcos, L., Foliaki, S., & ISAAC Phase Three Study Group. (2012). Exposure to cats and dogs, and symptoms of asthma, rhinoconjunctivitis, and eczema. *Epidemiology*, *23*(5), 742-750.

Castro-Rodriguez, J. A., Forno, E., Rodriguez-Martinez, C. E., & Celedón, J. C. (2016). Risk and protective factors for childhood asthma: what is the evidence? *The Journal of Allergy and Clinical Immunology*, *4*(6), 1111-1122. doi: 10.1016/j.jaip.2016.05.003

Centers for Disease Control and Prevention (CDC). (2016a). *Asthma: Data, Statistics, and Surveillance.* Retrieved from http://www.cdc.gov/asthma/asthmadata.htm

Centers for Disease Control and Prevention (CDC). (2016b). *Asthma in Ohio.* Retrieved from http://www.cdc.gov/asthma/stateprofiles/asthma_in_oh.pdf

Centers for Disease Control and Prevention. (2011). Vital Signs: Asthma Prevalence, Disease Characteristics, and Self-Management Education, United States, 2011-2009. *Morbidity and Mortality Weekly Report, 60*(17), 547-552.

Dayton Asthma Alliance. (2016). Project Narrative. [Internal Document].

Dayton Children's Hospital. (2015). Check Your Asthma I.Q. [Internal Document].

Evans, R., Gergen, P. J., Mitchell, H., Kattan, M., Kercsmar, C., Crain, E., ... & Wedner, H. J. (1999). A randomized clinical trial to reduce asthma morbidity among inner-city children: results of the National Cooperative Inner-City Asthma Study. *The Journal of Pediatrics*, *135*(3), 332-338.

Fox, P., Porter, P. G., Lob, S. H., Boer, J. H., Rocha, D. A., & Adelson, J. W. (2007). Improving asthma-related health outcomes among low-income, multiethnic, school-aged children: results of a demonstration project that combined continuous quality improvement and community health worker strategies. *Pediatrics*, *120*(4), e902-e911.

Gargano, L. M., Thomas, P. A., & Stellman, S. D. (2016). Asthma control in adolescents 10 to 11 y after exposure to the World Trade Center disaster. *Pediatric Research*, *81*(1-1), 43-50.

Georgiou, A., Buchner, D. A., Ershoff, D. H., Blasko, K. M., Goodman, L. V., & Feigin, J. (2003). The impact of a large-scale population-based asthma management program on pediatric asthma patients and their caregivers. *Annals of Allergy, Asthma & Immunology, 90*(3), 308-315.

Gerald, L. B., Redden, D., Wittich, A. R., Hains, C., Turner-Henson, A., Hemstreet, M. P., ... & Bailey, W. C. (2006). Outcomes for a Comprehensive School-Based Asthma Management Program. *Journal of School Health, 76*(6), 291-296.

Gutierrez Kapheim, M., Ramsay, J., Schwindt, T., Hunt, B. R., & Margellos-Anast, H. (2015). Utilizing the Community Health Worker Model to communicate strategies for asthma self-management and self-advocacy among public housing residents. *Journal of Communication in Healthcare, 8*(2), 95-105.

Healthy People 2020 [Internet]. (2016). Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion [cited November 15, 2016]. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/respiratory-diseases/objectives

Healthy People 2020 [Internet]. (2017). Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion [cited January 3, 2017]. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health#one

Hovell, M. F., Meltzer, S. B., Wahlgren, D. R., Matt, G. E., Hofstetter, C. R., Jones, J. A., ... & Pirkle, J. L. (2002). Asthma management and environmental tobacco smoke exposure reduction in Latino children: a controlled trial. *Pediatrics*, *110*(5), 946-956.

Kaugars, A. S., Klinnert, M. D., & Bender, B. G. (2004). Family influences on pediatric asthma. *Journal of Pediatric Psychology, 29*(7), 475-491.

Kelly, C. S., Morrow, A. L., Shults, J., Nakas, N., Strope, G. L., & Adelman, R. D. (2000). Outcomes evaluation of a comprehensive intervention program for asthmatic children enrolled in Medicaid. *Pediatrics, 105*(5), 1029-1035.

Kindig, D. A., Panzer, A. M., & Nielsen-Bohlman, L. (Eds.). (2004). *Health literacy: a prescription to end confusion*. National Academies Press.

Krieger, J. W., Takaro, T. K., Song, L., & Weaver, M. (2005). The Seattle-King County Healthy Homes Project: A Randomized, Controlled Trial of a Community Health Worker Intervention to Decrease Exposure to Indoor Asthma Triggers. *American Journal of Public Health, 95*(4), 652–659. http://doi.org/10.2105/AJPH.2004.042994

Liu, A. H., Zeiger, R., Sorkness, C., Mahr, T., Ostrom, N., Burgess, S. et al. (2007). Development and cross-sectional validation of the Childhood Asthma Control Test. *Journal of Allergy and Clinical Immunology, 119*(4), 817-825.

Loman, D. G., Kwong, C. G., Henry, L. D., Mahl, C., Meadows, L., & Ellis, A. G. (2016). Asthma control and obesity in urban African American children. *Journal of Asthma*, 1-6. http://dx.doi.org/10.1080/02770903.2016.1244827. [Epub ahead of print]

Mansour, M. E., Lanphear, B. P., & DeWitt, T. G. (2000). Barriers to asthma care in urban children: parent perspectives. *Pediatrics, 106*(3), 512-519.

Margellos-Anast, H., Gutierrez, M. A., & Whitman, S. (2012). Improving asthma management among African-American children via a community health worker model: findings from a Chicago-based pilot intervention. *Journal of Asthma, 49*(4), 380-389.

Matsui, E. C., Abramson, S. L., & Sandel, M. T. (2016). Indoor Environmental Control Practices and Asthma Management. *Pediatrics*, *138*(5), e20162589.

Mitchell, H. (n.d.a). The National Cooperative Inner-City Asthma Study. The Child Asthma Risk Assessment Tool (CARAT). Retrieved from http://carat.asthmarisk.org/

Mitchell, H. (n.d.b). *Development of the web-based child asthma risk assessment tool.* Retrieved from http://www.asthmacommunitynetwork.org/sites/default/files/2%20Carat%20Overview.pdf

National, A. E., & Prevention, P. (2007). Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. *The Journal of Allergy and Clinical Immunology*, *120*(5 Suppl), S94.

National Heart, Lung and Blood Institute (NHLBI). (1992). *Check Your Asthma "I.Q."* NIH Publication No. 92-1128. Bethesda, MD: Department of Health and Human Services.

Peretz, P. J., Matiz, L. A., Findley, S., Lizardo, M., Evans, D., & McCord, M. (2012). Community health workers as drivers of a successful community-based disease management initiative. *American Journal of Public Health*, *102*(8), 1443-1446.

Postma, J., Karr, C., & Kieckhefer, G. (2009). Community health workers and environmental interventions for children with asthma: a systematic review. *Journal of Asthma, 46*(6), 564-76. doi:10.1080/02770900902912638

Public Health - Dayton & Montgomery County. (n.d.). Asthma-related emergency department visits, <18 years, 2012-2013, Montgomery County, Ohio [Online image]. Retrieved from http://www.childrensdayton.org/cms/media_releases/dayton_asthma_alliance_launch/index.html

Puranik, S., Forno, E., Bush, A., & Celedón, J. C. (2016). Predicting Severe Asthma Exacerbations in Children. *American Journal of Respiratory and Critical Care Medicine*, http://dx.doi.org/10.1164/rccm.201606-1213PP [Epub ahead of print]

Raphael, J. L., Rueda, A., Lion, K. C., & Giordano, T. P. (2013). The role of lay health workers in pediatric chronic conditions: a systematic review. *Academic Pediatrics*, *13*(5), 408-420. doi:10.1016/j.acap.2013.04.015

Rymarczyk, Abbey. "Green cleaning kit." 2017. Photograph. JPG.

Stone, A. A., Bachrach, C. A., Jobe, J. B., Kurtzman, H. S., & Cain, V. S. (Eds.). (1999). *The science of self-report: Implications for research and practice*. Psychology Press.

Thyne, S. M., Marmor, A. K., Madden, N., & Herrick, G. (2007). Comprehensive asthma management for underserved children. *Paediatric and Perinatal Epidemiology*, *21*(s3), 29-34.

United States. (2004). *The Health Insurance Portability and Accountability Act (HIPAA)*. Washington, D.C.: U.S. Dept. of Labor, Employee Benefits Security Administration

Weinmayr, G., Gehring, U., Genuneit, J., Büchele, G., Kleiner, A., Siebers, R., ... & Strachan, D. P. (2013). Dampness and moulds in relation to respiratory and allergic symptoms in children: results from Phase Two of the International Study of Asthma and Allergies in Childhood (ISAAC Phase Two). *Clinical & Experimental Allergy*, *43*(7), 762-774.

Williams, D., Portnoy, J. M., & Meyerson, K. (2010). Strategies for improving asthma outcomes: a case-based review of successes and pitfalls. *Journal of Managed Care Pharmacy*, *16*(1 Supp C), 1-20.

Wood, M. R., Price, J. H., Dake, J. A., Telljohann, S. K., & Khuder, S. A. (2010). African American parents'/guardians' health literacy and self-efficacy and their child's level of asthma control. *Journal of pediatric nursing*, *25*(5), 418-427.

Woods, E. R., Bhaumik, U., Sommer, S. J., Ziniel, S. I., Kessler, A. J., Chan, E., ... & Queenin, L. M. (2012). Community asthma initiative: evaluation of a quality improvement program for comprehensive asthma care. *Pediatrics*, *129*(3), 465-472.

Appendix A: Dayton Asthma Alliance Description

DAYTON ASTHMA ALLIANCE

The Dayton Asthma Alliance was formed in 2015 in response to the Dayton Children's Hospital Community Health Assessment, which found asthma to be a leading health issue for children in Dayton. Dayton Children's Hospital admitted nearly 900 patients for asthma and provided emergency department services to over 14,000 children with asthma during the fiscal year 2014-2015. The Alliance aims to positively impact the health and wellness of children with asthma in the Dayton area, focusing on the most at-risk populations.

Using the Collective Impact framework, the Alliance engages local, state and national members, as well as other partner organizations, to collaboratively implement a variety of strategic actions to improve outcomes for children with asthma.

To have the greatest impact and to ensure all children with asthma have the opportunity for optimal health outcomes, the Alliance has identified three strategic focus areas:

- Ensure asthma-friendly environments
- Enhance access to high quality healthcare and supportive social services through clinical-community linkages
- Educate and equip children, families and the community for asthma wellness

The primary goals of the Alliance are to reduce asthma-related hospital admissions, emergency department visits, and school absences.

To support work in these areas, Dayton Children's Hospital serves as the backbone organization convening a group of committed stakeholders and supporting the Alliance with staff and some resources. The Alliance staff consists of Jim Gross, MPH, Project Manager; Jessica Saunders, MPA, Director of Dayton Children's Center for Child Health and Wellness; and KaDae Jones, Community Health Worker.

Appendix B: Childhood-Asthma Control Test (C-ACT)

asthma.com

Patient's Name: _____

Today's Date: _____

Childhood Asthma Control Test for children 4 to 11 years

Know your score.

Parent or Guardian: The Childhood Asthma Control Test* is a way to help your child's healthcare provider determine if your child's asthma symptoms are well controlled. Take this test with your child (ages 4 to 11). Share the results with your child's healthcare provider.

Step 1: Have your child answer **the first four questions (1 to 4).** If your child needs help, you may help, but let your child choose the answer.

Step 2: Answer the last **three questions (5 to 7)** on your own. Don't let your child's answers influence yours. There are no right or wrong answers.

Step 3: Write the number of each answer in the score box to the right.

Step 4: Add up each score box for the total.

Step 5: Take the COMPLETED test to your child's healthcare provider to talk about your child's total score.

19 or less

If your child's score is 19 or less, your child's asthma symptoms may not be as well controlled as they could be. No matter what the score, bring this test to your child's healthcare provider to talk about your child's results.

Have your child complete these questions.

1. How is your asthma today?

0	1	2	3	SCORE
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, how many days did your child have any daytime asthma symptoms?

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

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

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

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

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

TOTAL

*The Childhood Asthma Control Test was developed by GSK.

This material was developed by GSK.

gsk

Appendix C: Child Asthma Risk Assessment Tool (CARAT)

Community Healthcare for Asthma Management and Prevention of Symptoms

CHILD ASTHMA RISK ASSESSMENT TOOL (CARAT)

A3. Patient Name:	**A1. Date:**

The questions on this form correspond to questions on the online CARAT evaluation tool, available at: http://carat2.asthmarisk.org/. You may fill out these questions directly online if you have a computer or tablet with internet access available for use with the patient. Otherwise, complete the written questionnaire with the patient and then enter the results into the CARAT website to generate a customized risk assessment report. The custom report used to identify counseling topics and modules for the asthma counseling sessions.

Note: To complete Section C, you will need completed allergen sensitivity test results.

Section A

A2. Child's date of birth?	**A4. Child's assessment age?**

Section B

B1. What grade is your child in? [If summer, enter the child's grade for next fall.]

- ☐ Kindergarten
- ☐ 1st
- ☐ 2nd
- ☐ 3rd
- ☐ 4th
- ☐ 5th
- ☐ 6th
- ☐ 7th
- ☐ 8th
- ☐ Not in school

B2. Do any of your child's parents, brothers, sisters, or grandparents have asthma?

- ☐ Yes
- ☐ No [SKIP TO B3]
- ☐ No response [SKIP TO B3]

B2a. Altogether, how many of these relatives have asthma?

_____

B3. Do you have a regular doctor or health care provider who treats your child's asthma? [Does not have to be an asthma specialist.]

- ☐ Yes
- ☐ No
- ☐ No response

B4. During the past 12 months, when your child went to a doctor for asthma care, was it usually in an ER or clinic/doctor's office? ☐ ER **[SKIP TO B5]** ☐ Clinic/office ☐ Both, mostly ER **[SKIP TO B5]** ☐ Both, mostly clinic/office ☐ Never had a doctor's visit **[SKIP TO B5]** ☐ No response **[SKIP TO B5]**	**B4a. Did your child usually see the same doctor at the clinic or office?** ☐ Yes ☐ No ☐ No response
B5. During the past 12 months, did your child take medicines for asthma? ☐ Yes ☐ No ☐ No response	**B6. Some asthma medicines are taken only when the child is having asthma signs or symptoms. Other medicines are taken even when the child is not having symptoms. Does your child take medicines only when he/she is having signs or symptoms or even when he/she is not having symptoms, or both times?** ☐ Only for symptoms ☐ Only when no symptoms ☐ Both ☐ No response
B7. Has a doctor or health care provider ever given you written instructions for what to do about taking medicines? ☐ Yes ☐ No ☐ No response	**B8. Has your child had any problems taking medications at school?** ☐ Yes ☐ No ☐ No response
B9. Many people have problems making and keeping doctor's appointments for their child's asthma. At other times, it is hard to get to the office or they are not open at good times. In the past year, have you had any of these types of problems making or keeping appointments for your child's asthma? ☐ Yes ☐ No ☐ No response	**B10. Does your child's pillow have a zipped cover for allergies?** ☐ Yes ☐ No ☐ No response

B11. Does your child's mattress have a zipped cover for allergies? ☐ Yes ☐ No ☐ No response	**B12. Do you use a humidifier/vaporizer in your child's bedroom?** ☐ Yes ☐ No ☐ No response
B13. Do you have carpeting (or rugs) in your child's bedroom? ☐ Yes ☐ No ☐ No response	**B14. Do you have carpeting (or rugs) in your TV/family room?** ☐ Yes ☐ No ☐ No response
B15. Does your kitchen have a gas stove? ☐ Yes ☐ No ☐ No response	**B16. Do you sometimes use the gas stove to help heat your house?** ☐ Yes ☐ No ☐ No response
B17. Is there any moisture or mildew anywhere in the house on the… (Choose all that apply) ☐ Ceiling ☐ Walls ☐ Windows ☐ Floors ☐ No response	**B18. Have you had any problems with… (Choose all that apply)** ☐ Cockroaches ☐ Mice ☐ Rats ☐ No response
B19. Do you have any pets? (Choose all that apply) ☐ Dog ☐ Cat ☐ Hamster, guinea pig, or rabbit ☐ No response	**B20. Do you smoke cigarettes?** ☐ Yes ☐ No ☐ No response
B21. Does your child smoke cigarettes? ☐ Yes ☐ No ☐ No response	**B22. How many other people who live in your home smoke?** _____

B23. Does anyone else who takes care of your child smoke? ☐ Yes ☐ No ☐ No response	**B24. Have you ever run out of medicines for your child's asthma and not had any on hand when your child had an asthma attack?** ☐ Yes ☐ No ☐ No response
B25. For many reasons, children do not always get their medicines exactly when they are supposed to. On a scale of 1 to 5, how many problems do you usually face when trying to be sure your child gets his/her medicines? [1 is no problems with medicines and 5 is a lot of problems with medicines.] No problems A lot of problems 1 2 3 4 5 No response	
B26. Have you ever run out of medicines for your child's asthma and not had any on hand when your child had an asthma attack? [1 is never misses a dose and 5 is often misses a dose.] Never misses a dose Often misses a dose 1 2 3 4 5 No response	
B27. Does your child take asthma medication on his/her own? Would you say… ☐ Not at all ☐ Once in a while ☐ Quite a bit ☐ All of the time ☐ No meds ☐ No response	**B28. Are you concerned about your child's behaviors or emotions?** ☐ Not at all ☐ Once in a while ☐ Quite a bit ☐ All of the time ☐ No response
B29. Do you have concerns about how you have been coping with things in the past few months? ☐ Not at all ☐ Once in a while ☐ Quite a bit ☐ All of the time ☐ No response	**B30. Have you been feeling unusually stressed lately?** ☐ Not at all ☐ Once in a while ☐ Quite a bit ☐ All of the time ☐ No response

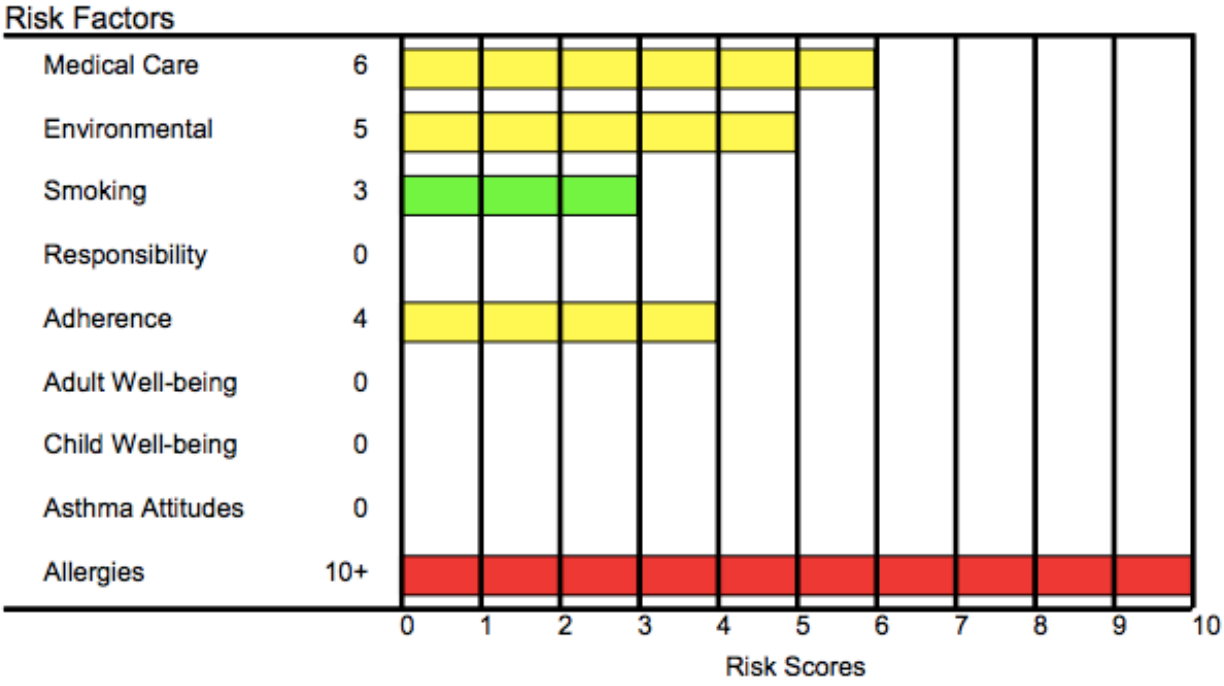
B31. It is possible to control my child's asthma so that he/she can play like other children. ☐ Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree ☐ No response	**B32. It is possible to manage my child's asthma so he/she is free of symptoms.** ☐ Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree ☐ No response
B33. My child should not have problems from the asthma medicine he/she takes. ☐ Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree ☐ No response	**B34. I have little control over my child's asthma.** ☐ Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree ☐ No response
B35. I often feel helpless in dealing with my child's asthma. ☐ Strongly agree ☐ Agree ☐ Disagree ☐ Strongly disagree ☐ No response	
Section C	
C1. Are skin test results available for this child? ☐ Yes ☐ No	**Does the skin test indicate that child is allergic to the following:** **C2. Dust mites** ☐ Yes ☐ No **C3. Cockroaches** ☐ Yes ☐ No **C4. Rodents** ☐ Yes ☐ No **C5. Cats** ☐ Yes ☐ No **C6. Dogs** ☐ Yes ☐ No **C7. Mold** ☐ Yes ☐ No

Sample Risk Profile

Asthma Risk Chart
SW
03/07/2017

Below you will find a graphical summary of the results of the assessment you completed for SW on 03/07/2017.

- The graph displays one horizontal bar for each risk factor on a grid with an endpoint of 10.
- Factors with a score of 7-10 are displayed with a red bar. These are the high factors for the child and should be addressed first.
- Moderate risk factors have a score of 4-6 and are displayed in yellow.
- Low risk factors are displayed in green with a score of 1-3.
- The total score for each risk factor is also included at the beginning of each bar.



Appendix D: Dayton Children's Hospital IRB Approval Letter and Addenda

Dayton Children's Hospital IRB
One Children's Plaza
Dayton, Ohio 45404-1815
(937) 641-4218

February 1, 2017

Ms. Stephanie Welsh
Master of Public Health Program
Department of Population & Public Health Sciences
Boonshoft School of Medicine
Wright State University
3123 Research Boulevard, Suite 200
Kettering, OH 45420
Email: Welsh.24@wright.edu

RE: Your new project submission dated 1/17/2017
IRB Non-Research, Quality Improvement Project Determination
Dayton Children's reference number **2017-005**: The Impact of Community Health Worker Interventions on Pediatric Asthma Control

Dear Ms. Welsh:

This is in response to your request for IRB review of the above-listed project.

Items reviewed:

- Your Petition for IRB Determination: dated 1/17/2017
- Proposal Protocol
- Variable Code Book Worksheet
- HIPAA De-Identification Certification Form, dated 1/31/2017

Upon IRB review it was determined that this qualifies as being a non-research, quality improvement project.

You may proceed with your project as described. No further reporting is required unless there is a change to the submitted project that may change the non-research determination. If there is such a change, the revision(s) must be submitted to the Dayton Children's IRB before implementation.

It is requested that you notify the IRB upon completion of this project.

Please contact Bev Comer (937-641-4218; fax 937-641-3201; email: ComerB@childrensdayton.org) if you have any questions or require further information.

Sincerely,

William Spohn, M.D., C.I.P.
Chair, Institutional Review Board

Dayton Children's Hospital IRB
One Children's Plaza
Dayton, Ohio 45404-1815
(937) 641-4218

February 8, 2017

Jeanine M. Bochenek, MS, RN, NCSN
Wright State University-College of Nursing & Health
118 University Hall
Dayton, OH 45435
Email: Jeanine.bochenek@wright.edu

Ms. Stephanie Welsh
Master of Public Health Program
Department of Population & Public Health Sciences
Boonshoft School of Medicine
Wright State University
3123 Research Boulevard, Suite 200
Kettering, OH 45420
Email: Welsh.24@wright.edu

RE: Your Quality Improvement Projects Addendum to the Petition dated: 2/7/2017
Dayton Children's reference numbers:
1) **2016-052**: Easy Breathing for Elementary School Children with Asthma at Dayton Public Schools
2) **2017-005**: The Impact of Community Health Worker Interventions on Pediatric Asthma Control

Dear Ms. Bochenek and Ms. Welsh,

The IRB has reviewed your Addendum to the Petition and the 2/6/2017 justification letter related to the above-listed quality improvement projects.

The IRB acknowledges and concurs with your request for full collaboration between the two projects, including adding sub-investigators to each project as described in the Addendum.

Upon IRB review it was determined that these projects continue to qualify as being a non-research, quality improvement projects.

You may proceed with your projects as described. No further action is required unless there is a change to the submitted projects that may change the non-research determination. If there is such a change, the revision(s) must be submitted to the Dayton Children's IRB before implementation.

Please contact Bev Comer (937-641-4218; fax 937-641-3201; email: ComerB@childrensdayton.org) if you have any questions or require further information.

Sincerely,

William Spohn, MD, CIP
Chair, Institutional Review Board

Dayton Children's Hospital IRB
One Children's Plaza
Dayton, Ohio 45404-1815
(937) 641-4218

February 15, 2017

Jeanine M. Bochenek, MS, RN, NCSN
Wright State University-College of Nursing & Health
118 University Hall
Dayton, OH 45435
Email: Jeanine.bochenek@wright.edu

Ms. Stephanie Welsh
Master of Public Health Program
Department of Population & Public Health Sciences
Boonshoft School of Medicine
Wright State University
3123 Research Boulevard, Suite 200
Kettering, OH 45420
Email: Welsh.24@wright.edu

RE: Your Data Collection Worksheets and Code Sheets submitted 2/10/2017 and 2/13/2017
Dayton Children's reference numbers:
1) **2016-052**: Easy Breathing for Elementary School Children with Asthma at Dayton Public Schools
2) **2017-005**: The Impact of Community Health Worker Interventions on Pediatric Asthma Control

Dear Ms. Bochenek and Ms. Welsh,

This is a follow-up to our IRB's 2/8/2017 review of your request to collaborate between the two above-listed projects.

This to additionally acknowledge receipt of the current data collection worksheets and code sheets for each study listed above for our IRB's further review and assessment. Receipt of the updated HIPAA de-identification certification form, signed by Jeanine Bocheneck on 7/25/2016 and by Stephanie Welsh on 2/10/2017 is acknowledged.

Upon IRB review, it is determined that there continues to be no problem with sharing the data described on your worksheets and it is further determined that these two projects continue to qualify as being non-research, quality improvement projects.

You may proceed with your collaboration on these projects as described. No further action is required unless there is a change to the submitted projects that may change the non-research determination. If there is such a change, the revision(s) must be submitted to the Dayton Children's IRB before implementation.

Please contact Bev Comer (937-641-4218; fax 937-641-3201; email: ComerB@childrensdayton.org) if you have any questions or require further information.

Sincerely,

William Spotn, MD, CIP
Chair, Institutional Review Board

Appendix E: Check Your Asthma I.Q. Tool

Check your asthma I.Q.

The following true-or-false statements test what you know about asthma. Be sure to read the correct answers and explanation on the second page.

1.	Asthma is a common disease among children and adults in the United States?	True	False
2.	Asthma is an emotional or psychological illness.	True	False
3.	The way that parents raise their children can cause asthma?	True	False
4.	Asthma episodes may cause breathing problems, but these episodes are not really harmful or dangerous.	True	False
5.	Asthma episodes usually occur suddenly without warning.	True	False
6.	Many different things can bring on an asthma episode.	True	False
7.	Asthma cannot be cured, but it can be controlled.	True	False
8.	There are different types of medicine to control asthma.	True	False
9.	People with asthma have no way to monitor how well their lungs are functioning.	True	False
10.	Both children and adults have asthma.	True	False
11.	Tobacco smoke can make an asthma episode worse.	True	False
12.	People with asthma should not exercise.	True	False

Your score — How many answers did you get correct?

11-12 correct	Congratulations! You know a lot about asthma. Share this information with your family and friends
10 correct	Very Good
Fewer than 10 correct	Go over the answers and try to learn more about asthma.

Dayton Children's

Appendix F: Home Assessment and Community Health Worker Consultation Form

dayton children's

One Children's Plaza Dayton, OH 45404

IN-HOME ASSESSMENT AND COMMUNITY HEALTH WORKER CONSULTATION FORM

Child's Name: _____ DOB:_____School: _____

Address_____Grade:_____

Home Telephone: _____ Email: _____

Primary Physician: _____ Pulmonary Specialist: _____

Unit Characteristics: Single ☐ Double ☑ Multiple ☐ Rented ☐ Owned ☐ Subsidized ☐

Trigger	Initial Home Visit Date: _____	1st Follow Up Date: _____	2nd Follow Up Date:_____
Smoke ashtrays, smell of smoke	☐ Do not smoke. Attend classes to help stop smoking. ☐ Do not allow smoking in the home or car. ☐ If you smoke, smoke outside.		
Dust carpeting, rugs, curtains, stuffed animals, bedding	☐ Vacuum weekly with high efficiency filter or central vacuum. ☐ Keep children with asthma out of rooms that are being vacuumed. ☐ Remove carpet and rugs if possible. ☐ Damp mop floors weekly. ☐ Wash bedding and stuffed toys in hot water every 1-2 weeks. ☐ Cover mattresses and pillows in dust proof covers. ☐ Replace heating system filters regularly. ☐ Reduce clutter and stuffed animals.		
Pets and	☐ Do not have pets with fur or		

Child's Name: _____DOB:_____

Animals dogs, cats, dander, hair	feathers in your home. If unavoidable, keep them out of children's bedrooms. ☐ Wash your and your child's hands after playing with animals.		
Pests mice, cockroaches, open food, crumbs	☐ Don't keep food in bedrooms. ☐ Use roach traps or poison baits such as boric acid to control roaches. ☐ Vacuum up cockroach bodies and fill holes. ☐ Do not leave food or garbage out. ☐ Store food in airtight containers. ☐ Fix leaky plumbing or other sources of water.		
Mold mold on ceiling or walls, water damage	☐ Fix leaky plumbing and pipes. ☐ Clean moldy surfaces with bleach in water (1 part bleach to 10 parts water). ☐ Clean shower curtains. ☐ Reduce humidity by using a dehumidifier. ☐ Use exhaust fans in kitchen, bathrooms and laundry.		
Odors and Irritants Strong smells, odors, labels of "danger" or "poison"	☐ Avoid using strongly scented products such as home deodorizers, candles, incense, laundry products and perfumed personal care items. ☐ Do not use stove for heating and avoid smoke from wood-burning stoves and fireplaces. ☐ When cleaning, keep children away and don't use strong smelling cleansers. Opts for "green cleaning" products.		
Safety fire and chemical, gas safety	☐ Avoid storing chemicals in low or unlocked cabinets ☐ Use smoke detectors and do weekly checks to be sure it is working. ☐ Use carbon monoxide detectors.		
Medication daily use of	☐ Refill inhalers when there are 20 doses left.		

Child's Name: _____DOB:_____

medication, communication with physician, school	☐ Take controller medication every day. ☐ Know and use your Asthma Action Plan. ☐ Keep scheduled doctor's appointments.			
Social Needs Screening Tool		**"Yes"**	**1st Follow Up**	**2nd Follow Up**
I want help getting food for myself / my family or applying for assistance (SNAP, WIC)		☐		
I worry my home is unhealthy or I might become homeless		☐		
I have received a disconnection notice, or have trouble paying my utility bills (gas, electric, phone		☐		
I need help finding employment or job training		☐		
I need help with health care (insurance, medical, mental health, specialty care, resources)		☐		
I want to find adult education classes (ESOL, GED, degree seeking, parenting)		☐		
I want to apply for public benefits cash benefits, Title 20, SSI/SSDI)		☐		
I want to find child-related activities or educational support for my child(ren)		☐		
I need help getting diapers, clothing, car seats, school supplies, or household items		☐		
I need help with transportation to my appointments		☐		

Items provided to family

- ☐ Mattress and pillow covers provided
- ☐ Vacuum with HEPA filter provided
- ☐ Green cleaning supplies provided
- ☐ Pest control supplies provided
- ☐ Spacer provided

Notes:

_____

_____

Appendix G: List of Competencies Met in CE

Wright State Program Public Health Competencies

Assess and utilize quantitative and qualitative data.
Apply analytical reasoning and methods in data analysis to describe the health of a community.
Describe how policies, systems, and environment affect the health of populations.
Communicate public health information to lay and/or professional audiences with linguistic and cultural sensitivity.
Engage with community members and stakeholders using individual, team, and organizational opportunities.
Evaluate and interpret evidence, including strengths, limitations, and practical implications.
Demonstrate ethical standards in research, data collection and management, data analysis, and communication.
Explain public health as part of a larger inter-related system of organizations that influence the health of populations at local, national, and global levels.

Concentration Specific Competencies

Population Health Concentration
Explain a population health approach to improving health status
Use evidence-based problem solving in the context of a particular population health challenge.
Demonstrate application of an advanced qualitative or quantitative research methodology.
Demonstrate the ability to contextualize and integrate knowledge of a specific population health issue.
Evaluate population health programs or policies that are designed to improve the health of the population, reduce disparities, or increase equity.