ASTHMA SELF-MANAGEMENT EDUCATION EVALUATION

Comprehensive Asthma Control Through Evidence-based Strategic and Public Health – Healthcare Collaboration Cooperative Agreement (2014-2019)

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CONTENTS

CHAPTER 1: THE DISEASE BURDEN OF ASTHMA IN MAINE 1
Introduction 2
Asthma 2
Asthma Prevalence 2
Health Disparities 2
Asthma Treatment 3
Asthma Self-Management 4
Home, Work and School Environments 5
Quality of Life 6
Health Care Utilization 6
Asthma Mortality 8
Asthma Costs 8
CHAPTER 2: ADDRESSING ASTHMA IN MAINE 9
Statewide Public Health Response to Asthma 10
Infrastructure 11
Non-Physician Workforce Development 11
Asthma Self-Management Education 12
CHAPTER 3: MAINE IN-HOME ASTHMA PROGRAM 13
Goals 14
Educational Content and Settings 15
Educators 16
Efforts to Increase Educators' Competencies and Confidence 17
Target Audience 18
Delivery of Program 18
Implementing Agencies 19
Intended Outcomes 20
CHAPTER 4: EVALUATION METHODOLOGY 21
Study Design 22
Instruments 22
Data Collection 24
Analysis 24

CHAPTER 5: UPTAKE OF IN-HOME ASTHMA EDUCATION PROGRAM 25
Program Engagement 26
Client Characteristics 27
CHAPTER 6: PARTICIPANT-REPORTED SHORT-TERM OUTCOMES 30
Program Impact on Asthma Self-Management Behaviors 31
Program Impact on Emergency Health Care Utilization 36
Program Impact on Quality of Life 40
CHAPTER 7: PARTICIPANT-REPORTED INTERMEDIATE OUTCOMES 44
Program Intermediate Impact on Asthma Self-Management Behaviors 45
Program Intermediate Impact on Emergency Health Care Utilization 47
Program Intermediate Impact on Quality of Life 50
CHAPTER 8: DISCUSSION 54
Short-Term Efficacy 55
Intermediate efficacy 55
LIMITATIONS 56
REFERENCES 57

CHAPTER 1: THE DISEASE BURDEN OF ASTHMA IN MAINE

Introduction

Disease burden refers to the impact of a health problem as measured by mortality, morbidity, and financial costs. This chapter summarizes the prevalence of asthma in Maine and its burden.

Asthma

Asthma is a common chronic disease where the muscles surrounding the airways are hyperactive and become inflamed. When the muscles are inflamed, air may not be able to flow easily, resulting in an asthma episode / attack. The exact causes of asthma are unknown, and evidence suggests that it is probably the result of genetic and environmental factors. Asthma episodes / attacks are often triggered by exposure to an allergen (e.g. pollen, pet hair) or an environmental irritant (e.g. air pollution, smoke, chemical fumes). In addition, exercise and some illnesses may trigger an asthma episode.

There is no known cure for asthma. The goal of treatment is to achieve good asthma control through medication, avoidance of triggers, and self-management.

Asthma Prevalence

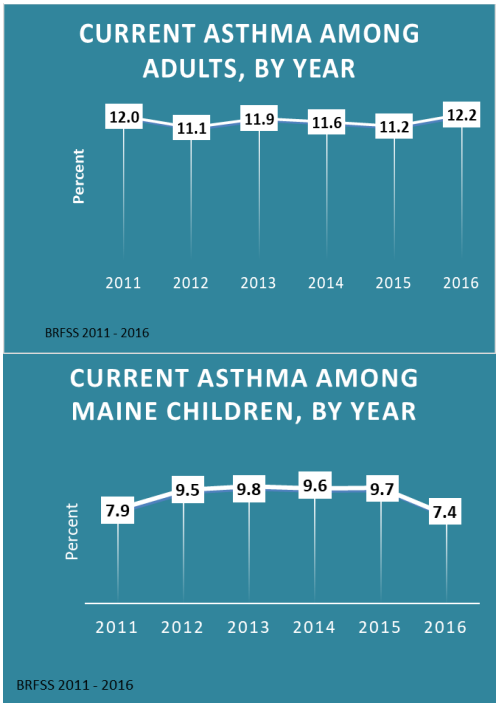
Disease or condition prevalence: the proportion of the population that has a disease or condition at a specific point in time.

The prevalence of current asthma is significantly higher among Maine adults than U.S. adults [Maine: 12.2%; US: 9.3% (2016)], while the prevalence among Maine children is similar to that of U.S. children [Maine: 7.4%; US: 8.5% (2016)]. Figure 1 illustrates that these prevalence rates have not changed significantly over time.

Approximately 149,001 Maine adults reported living with asthma in 2016. Counties with the highest adult asthma rates are Somerset (15.4%), Androscoggin (14.9%) and Penobscot (14.4%).

One-in-fourteen Maine children are reported to have current asthma. This is approximately 18,009 children. Aroostook has the highest child asthma rates at 15.3%.

Figure 1. Asthma Prevalence in Maine



Health Disparities

Health disparities: differences in health and wellbeing that result from belonging to less advantaged groups.

Health disparities manifest in multiple ways among adults in Maine. First, adult females are disproportionately affected with higher asthma prevalence rates compared to adult males, whereas males are disproportionately affected in childhood. The reason for these gender differences is not known. Second, adult populations with the highest rate of asthma include those who identify as multiracial (18.9%) or are American Indian or Alaskan Native (16.5%), have less than a high school education (20.9%), have household incomes of less than $15,000 (22.9%), and/or are MaineCare beneficiaries (21.6%). Finally, the diverse geography of Maine means that a person's ZIP code will significantly impact the availability of medical and supportive services.

Asthma Treatment

The most common treatment for asthma is the use of asthma controller medications which are typically inhalers used daily. Rescue medications (inhaled short acting beta agonists) are used during asthma flare ups.

The latest surveillance analysis (2006-2010) suggests low asthma medication adherence. Only four-in-ten Maine adults and children with asthma report using an asthma controller medication within the previous three months. However, more than half have used a rescue inhaler during that time. Cost may be one of the barriers to medication adherence, particularly among adults with asthma. One-in-six (16.3%) Maine adults with asthma reported a coverage gap in their health insurance in the previous year. Similarly, 15.1% were not able to buy needed asthma medication in the last 12 months due to cost.

Other health conditions and behaviors can impact asthma management. Clinical guidelines recommend that all people with asthma should receive an annual flu shot, avoid tobacco smoke, and maintain a healthy weight.

During the latest analysis (2006 – 2010), approximately half of Maine adults and children with asthma reported receiving an annual flu vaccination. Data show that flu vaccination rates among all Maine adults (including those with asthma) have increased since 2006 and that Maine adults with asthma are significantly more likely to have had a flu vaccination than Maine adults overall [Adults with asthma: 58.6% vs. all adults: 47.1% (2010)].

Adult health risk behaviors, such as smoking, remain high among adults with asthma. Approximately one-in-four adults (25.0%) with current asthma are current smokers. This rate is higher than adults without current asthma (17.9%). In the past year, roughly one-in-three (36.5%) adults with current asthma quit for one day or more.

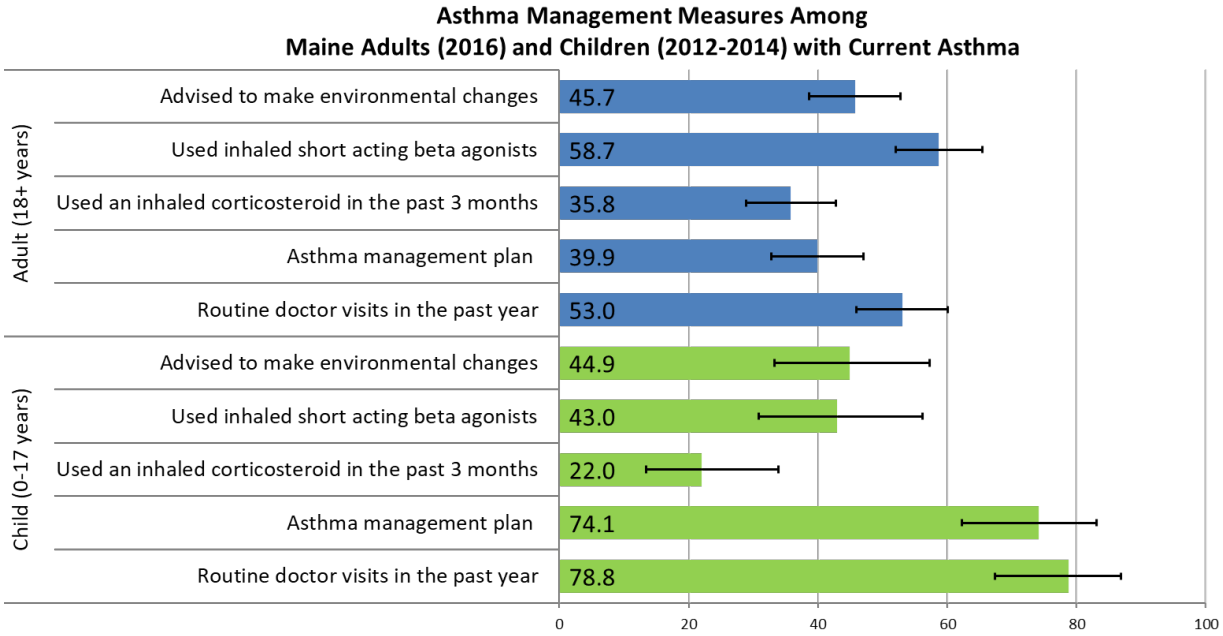
Asthma Self-Management

Two-thirds of adults with asthma report it as uncontrolled. This is higher than the proportion of children that report uncontrolled asthma (41.7%).

Appropriate asthma medical care and self-management (including medication adherence, education, and avoidance of triggers) can decrease asthma episodes (flare ups/attacks) and improve quality of life.

Recent surveillance data show differences in asthma self-management behaviors between adults and children with asthma (See Figure 2). The largest differences include annual routine doctor visits (adults: 53.0% vs. children: 78.8%) and having an asthma management plan (adults: 39.9% vs. children: 74.1%).

Figure 2. Asthma Management Measures among Maine Adults and Children



In a detailed analysis of data (2006-2010), asthma education among adults and children with asthma was relatively low. Among Maine adults, less than a quarter (23.2%) had been taught how to recognize asthma signs and symptoms, what to do during an asthma attack, and how to use a peak flow meter. This was higher among children with asthma with approximately 40% of children/parents reporting having been taught these three important skills.

Home, Work and School Environments

Home Environment. Indoor furry pets (especially if they have access to bedrooms), wood-burning stoves or fireplaces, gas cooking, indoor smoking, and carpeting or rugs in bedrooms are potential environmental factors that may precipitate asthma symptoms or exacerbations. As shown in Table 1, adults appeared to have greater exposure to environmental triggers, especially tobacco smoke, and were less likely to have taken precautionary measures such as use of mattress and pillow covers that control dust mites.

Table 1. 2006 – 2010 BRFSS data

	Adults with Asthma	Children with Asthma
Indoor furry pets allowed in the bedroom	54.1%	57.7%
Wood-burning stove or fireplace in home	30.9%	39.6%
Use gas for cooking in the home	31.4%	30.8%
Someone has smoked in the home in the past week	18.0%	6.3%
Carpeting or rugs in the bedroom	59.2%	60.5%
Smelled mold	14.6%	9.8%
Used dust mite controlling mattress	26.9%	43.1%
Used dust mite controlling pillow covers	25.6%	37.0%
Used a kitchen exhaust fan regularly when cooking	53.1%	58.5%
Used a bathroom exhaust fan that vents to the outside	58.6%	57.3%
Used an air purifier in the home	24.4%	24.4%
Used a dehumidifier in the home	27.7%	33.7%

Work Environment. Findings from the surveillance data analysis (2006 – 2010) suggest that about half (50.3%) of ever-employed Maine adults with asthma believed that their asthma was caused or made worse by chemicals, smoke, fumes, or dust at their places of work.

School Environment. Approximately half of children with asthma reported having written asthma action plans on file at school (52.0%) and/or being allowed to have medication with them at school (55.4%). Very few reported having feathered or furry pets in the classroom and/or having mold problems in school buildings (5.2%).

Quality of Life

Quality of life is important to everyone. It is a broad concept that includes important domains of overall quality of life: employment, schooling, housing, health, etc.

The relationship between asthma severity and quality of life has been comprehensively studied for both adult and child populations. A retrospective analysis of two clinical trials found that adults with mild asthma (compared to those with moderate-severe asthma) had higher health-related quality of life (HRQL) scores (Moy et al., 2001). Those with moderate-severe asthma scored significantly lower on "Activities, "Environment," and "Emotions" domains, compared to those with mild asthma (ibid). Chen et al. (2007) found that asthma control problems at baseline were associated with lower scores on quality of life measures (Chen et al., 2007). At follow-up, a change in the number of control problems was a significant predictor of quality of life score (ibid).

Research on quality of life for children with asthma also considers the quality of life of their adult caregivers. A study examining quality of life for both found that low asthma control scores, frequency of unplanned doctor's visits, and missed schooldays were associated with lower rated emotional quality of life (Okelo et al, 2004). Caregivers reported worry about the child's emotional health. Children reported feeling depressed, nervous, or uptight, and "crying a lot" (ibid). The study also found that fewer asthma control problems were significantly associated with better emotional functioning in children (ibid). Dean et al. (2010) found a significant difference in work productivity impairment for employed caregivers of children with uncontrolled asthma compared to children with controlled asthma (Dean et al., 2010). Caregivers of children with uncontrolled asthma lost an average of 4.1 additional hours per 40-hour work week (ibid).

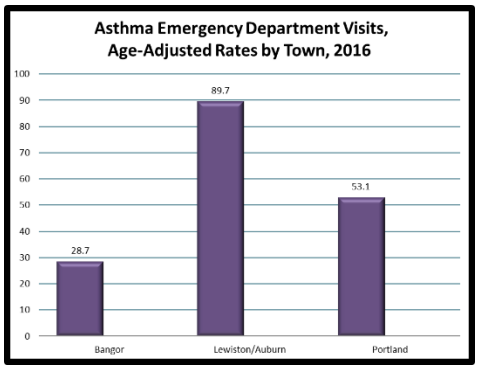
During the period 2006-2010, more than half of Maine adults and children with asthma that were surveyed (BRFSS) reported activity limitations due to their asthma. Poorly controlled asthma resulted in a large number of missed work and school days in Maine. During the same reporting period, more than one-third (39.6%) of Maine children with asthma who were in school or daycare missed one or more days in the past year because of their asthma.

Health Care Utilization

Urgent Doctor Visits. In the 2006-2010 reporting period, two-in-ten Maine adults (20.3%) and two-in-ten Maine children (23.5%) with asthma reported at least one urgent doctor visit for their asthma in the previous 12 months.

Emergency Department Visits. In 2016, a total of 5,297 adults and children visited an emergency department (ED) in Maine with a principal diagnosis of asthma. Maine's largest cities/towns had the highest number of age-adjusted ED visits, with the highest in Lewiston/Auburn at approximately 89.7 per 10,000 (See Figure 3).

Figure 3. Asthma ED Visits

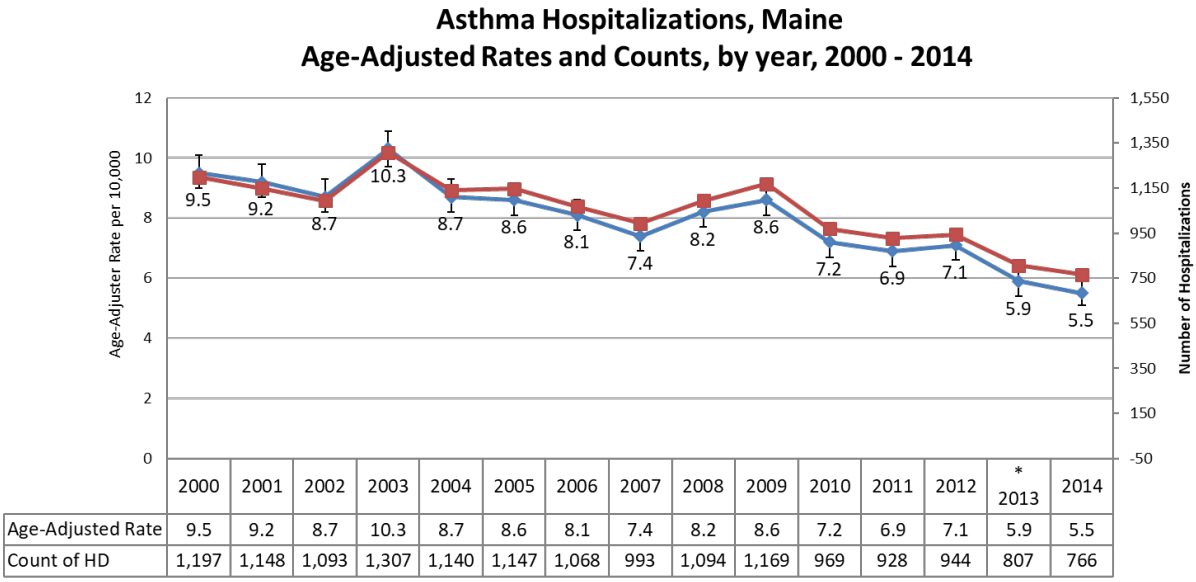


In a detailed surveillance analysis (2007 – 2009), ED visit rates were highest for Maine children 4 years and younger (106.5 per 10,000). Among Maine adults, asthma ED visit rates were highest among young adults ages 18 to 24 (103.9 per 10,000). Rates declined to 35.3 per 10,000 for adults ages 55 to 64, and then increased significantly to 39.0 in the 65+ year age group.

Hospitalization. In 2016, approximately 421 people were hospitalized with asthma as the principal diagnosis. Findings from the detailed surveillance analysis (2007 – 2009) show that hospitalization rates were significantly

higher among children (9.2 per 10,000) than adults (8.0 per 10,000) (See Figure 4). Similar to ED visits, hospitalization rates were highest among the youngest age group (4 years and younger). However, unlike ED visits, the rate of adult hospitalizations was highest among older adults.

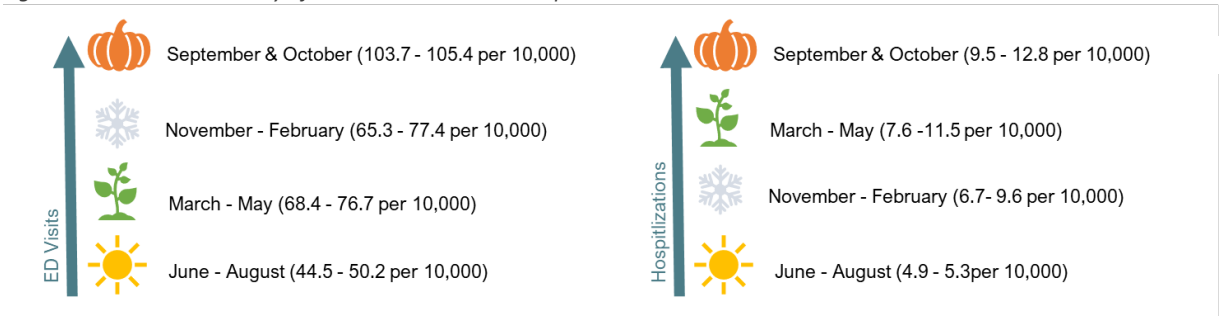
Figure 4. Asthma Hospitalizations in Maine (2000-2014)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	* 2013	2014
Age-Adjusted Rate	9.5	9.2	8.7	10.3	8.7	8.6	8.1	7.4	8.2	8.6	7.2	6.9	7.1	5.9	5.5
Count of HD	1,197	1,148	1,093	1,307	1,140	1,147	1,068	993	1,094	1,169	969	928	944	807	766

Seasonal Variability. Many common asthma triggers display seasonal variability, including outdoor allergens, poor outdoor air quality, and respiratory infections. Asthma ED visit rates and hospitalization rates vary by month and may mirror seasonal variations in the severity of common asthma triggers. As shown in Figure 5, the highest rates of ED visits and hospitalizations occur during the fall (September and October) and the fewest occur during the summer (June – August).

Figure 5. Seasonal Variability of Asthma ED vists and Hospitalization Rates



Asthma Mortality

Asthma deaths are those in which asthma is determined to be the underlying cause of death. Asthma-related deaths are those in which asthma is determined to be either the underlying or a contributing cause of death.

Death due to asthma represents the most severe outcome of asthma. Many asthma deaths could be avoided through appropriate asthma management.

Asthma mortality rates in Maine [8.5 per 1,000,000 (2008-2017)[1]] are similar to the US (9.4 per 1,000,000). Asthma deaths increase with age and continue to be higher among women than men (10.5 vs. 5.9 per 1,000,000).

Asthma Costs

There are two main types of asthma costs: direct and indirect costs. Direct asthma costs are those associated with hospital care, physician and nursing services, and medication. Indirect asthma costs include lost productivity due to morbidity and mortality. The US Centers for Disease Control and Prevention's Chronic Disease Cost Calculator is typically used to estimate costs. The calculator's estimates are based on 'treated populations': that is, sub-populations of people who received asthma treatment within a given time period.

Direct Costs. The calculator estimates that asthma results in approximately $160,000,000[2] in direct medical costs per year in Maine. Forty percent of this cost is paid by Medicare (MaineCare and Medicare). By 2020, the annual all-payer costs due to asthma in Maine are projected to increase by 60% to approximately $287 million.

Indirect Costs. It is estimated that asthma causes approximately 2.1 missed workdays per employed person with asthma. This results in an estimated 99,000 lost workdays and $19 million[2] in absenteeism costs in Maine annually.

[1] Single year asthma mortality rates in Maine are statistically unreliable because the numerator is 20 or less. Accordingly, mortality rates are pooled 10-year estimates.
[2] Using 2010 dollars

CHAPTER 2: ADDRESSING ASTHMA IN MAINE

Statewide Public Health Response to Asthma

Maine's large geographic landscape, its aging population, increasing poverty, low educational attainment, and rurality represent challenges to the state's ability to meet health goals.

Since 2002, the Asthma Prevention and Control Program, part of the Division of Chronic Diseases, Maine Center for Disease Control and Prevention (Maine CDC), has provided overall leadership and coordination for various statewide asthma prevention and management activities.

In 2014, the US Centers for Disease Control and Prevention awarded the Maine CDC a five-year Cooperative Agreement: Comprehensive Asthma Control Through Evidence-Based Strategic and Public Health – Health Care Collaboration. The Program aimed to achieve the following goals in the five-year funding cycle:

1. Increased availability of asthma education, including self-management education, to individuals with poorly controlled asthma
2. Increased availability of home-based environmental assessment and trigger reduction services to individuals with poorly controlled asthma
3. Increased coverage for asthma education, including self-management education, through public and private payers
4. Increased capacity among public health entities, health systems, and community organizations to identify poorly controlled asthma, identify and reduce asthma triggers, and improve the quality of asthma care

Strategies to achieve these goals were grouped in three different categories: infrastructure, services, and health systems.

Infrastructure. During the five years, the Asthma Program provided leadership, engaged strategic partners, supported strategic communication, and undertook surveillance and evaluation. Working with partners, the Program supported services such as self-management education, linkages to care, education for caregivers, and evidence-based asthma control practices.

Health Systems. At the start of the funding cycle, it was envisaged that the Maine CDC would provide resources to health systems to engage in quality improvement efforts, apply a team-based care approach, review health insurance coverage and reimbursement, and explore systems-level linkages. These objectives were changed in 2017 to focus on increasing the ability of the non-physician workforce to implement asthma self-management education.

Services. Many of the interventions focused on increasing asthma self-management education. This choice was based on the evidence that effective self-management resulted in better control of asthma, with consequent reductions in the utilization of expensive health care emergency services (such as ED visits).

Together these services and health systems strategies were intended to result in improved health and decreased morbidity and mortality on both a population and an individual level. This would ultimately achieve the Institute of Healthcare Improvements' Triple Aim framework of improved patient experience of care, improved health of populations, and reduced per capita cost of health care. In 2018, to align with the literature, the fourth aim "joy in work" was included.

Infrastructure

Maine CDC promoted statewide planning, coordination, and expansion of asthma activities. This was achieved through three parallel strategies. Firstly, the Asthma Program encouraged coordination with other grants such as the Maine State Innovation Model (2013-2017). Secondly, it coordinated an annual Asthma Self-Management Education Summit in 2018 and 2019. Finally, the Program provided resources for the rapid expansion of the Maine In-Home Asthma Education Program.

Non-Physician Workforce Development

Educating clients in self-management of asthma requires knowledgeable, competent people who provide evidence-based information in a way that is easy to understand (Cataletto, Abramson, Meyerson, & et al, 2012). Health care extenders (such as community health workers, community paramedics, patient navigators) are well positioned to effectively provide such education and to create bridges between communities and health systems. Health care extenders provide culturally appropriate and accessible health education and information, ensure that people get the services they need, provide informal counseling and social support, advocate for individuals and communities, and provide direct services such as basic first aid and health screening test administration (National Center for Chronic Disease Prevention and Health Promotion, 2015).

Maine Implementation. Since 2017, the Asthma Program has contracted with partners (such as Bangor Public Health and Community Services and United Ambulance Training Program) to provide asthma-specific training to Community Health Workers and Community Paramedics. In addition to content-based learning, case-based learning using the ECHO model was implemented in 2019. Collectively, fourteen CHWs and 17 Paramedics received content-specific training.

Impact. Details of the workforce development strategies and outcomes are available in a separate report (Maine Asthma Non-Physician Training Project, 2019).

Asthma Self-Management Education

Evidence. A substantial body of literature supports the effectiveness of asthma self-management education for both adults and children. A Cochrane Review of 36 medical trials involving adults compared the efficacy of self-management education to that of usual care. Findings included decreases in both high-level care utilization and school and work absenteeism, as well as improved quality of life (Gibson et al., 2002). Individual studies have found similar benefits of asthma self-management education, including increased medication adherence and self-reported asthma control (Janson et al., 2003); improved asthma symptoms (Barbanel, Eldridge & Griffiths, 2003); and improved health outcomes during pregnancy and after, including babies with higher birth weights for women with asthma action plans during pregnancy (Murphy, Gibson, Talbot, Kessell & Clifton, 2005).

Asthma self-management education is also effective for asthma control with children. A meta-analysis of 32 studies of pediatric asthma self-management found that an educational component improved activity restriction, lung function, school absenteeism, and number of emergency room visits (Guevara, Wolf, Grum & Clark, 2003). Greatest improvement was seen in those children with the most severe symptoms (ibid). Other studies found that self-management education improved monitoring of peak expiratory flow (Burkhart, Rayens, Oakley, Abshire & Zhang, 2007); improved quality of life and parental self-management knowledge (Shames et al., 2004); and parental intention to treat cough, a symptom of airway inflammation that is a prevalent early asthma symptom (Butz et al., 2005).

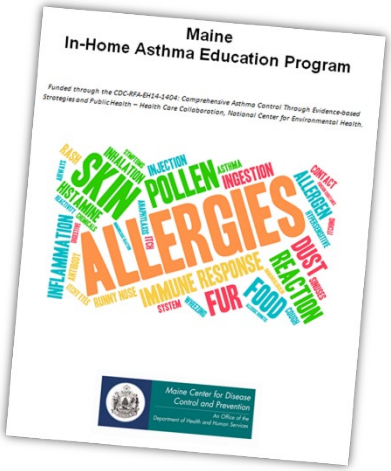
Maine Implementation. The Maine Center for Disease Control and Prevention's In-Home Asthma Education Program (HAEP) is an innovative, home-based asthma program that targets Maine adults and children whose asthma is not well controlled. The Program was developed by staff at the Maine CDC, a Certified Asthma Educator (CAE) at a local public health department, and staff at an independent evaluation agency.

A total of 155 people completed the HAEP.

Impact. Details of the evaluation methodology and results are described in the remaining chapters.

CHAPTER 3: MAINE IN-HOME ASTHMA PROGRAM

Home-based interventions are recommended by the Community Preventive Services Task Force for children and teens with asthma. According to a review of 23 studies, there is strong evidence indicating that such programming has been associated with reductions in symptom days and school absenteeism as well as improved quality of life (Crocker, et al., 2011). Although previous research suggested that in-home asthma education programs implemented among children have yielded positive results, there are limited studies on the effect of interventions for adults with poorly controlled asthma. The same systematic review examined adult home-based interventions for asthma and were unable to find sufficient evidence to support or refute their efficacy. A 2019 Technical Brief prepared for the Agency for Healthcare Research and Quality has yielded similar findings.



In the absence of an evidence-based, self-management education program for adults with current asthma, the Asthma Program coordinated the development, implementation and evaluation of the Maine In-Home Asthma Education Program (the Program).

The Program was developed with content experts from the Maine Center for Disease Control and Prevention, United Ambulance, Maine Access Immigrant Network, Bangor Public Health and Community Services, and Partnerships For Health. The Program was reviewed by project officers and staff at the National Center for Environmental Health, Centers for Disease Control and Prevention. Collaboration among stakeholders with diverse expertise and experience helped reduce reporting burden, minimize duplication of effort, and ensure that the Program was acceptable to the community.

Goals

The Program was designed to teach self-management skills to people with asthma and to provide education to their families and caregivers. The goals of the Program were as follows:

1. Increased client/caregiver asthma self-management knowledge and skills.
2. Improved health outcomes for clients receiving home visits.
3. Improved knowledge and understanding among professionals regarding appropriate asthma management practices and effective public health strategies related to asthma management.

Clients were referred to the Program by a health care professional, community organization, or by self-referral. If they agreed to participate, the client (or caregiver if the client was younger than 17 years old) was enrolled in the Program. Once enrolled, the educator worked with the client to strengthen/improve their self-management skills.

Educational Content and Settings

The Program was guided by the National Standards for Asthma Self-Management Education framework (Gardner A., March 2015) and the National Center for Environmental Health, US Centers for Disease Control and Prevention recommendations (National Center for Enviornmental Health , May 2017). Maine CDC staff, implementers, and evaluators worked closely with the National Center for Environmental Health to pilot test the new environmental assessment developed by the Environmental Protection Agency, US CDC, and US Department of Housing and Urban Development. This new assessment was developed to help identify environmental asthma triggers most commonly found in homes.

The Program consisted of six modules. Each module is detailed in the Program Guide and includes the setting, expected length, objectives, content that should be covered, resources available, and forms that are completed for case management and evaluation purposes. Most modules could be provided in the educator's office, the client's home or workplace. Table 2 provides an overall summary. For more details, refer to *The Maine In-Home Asthma Education Program, 2017*[3].

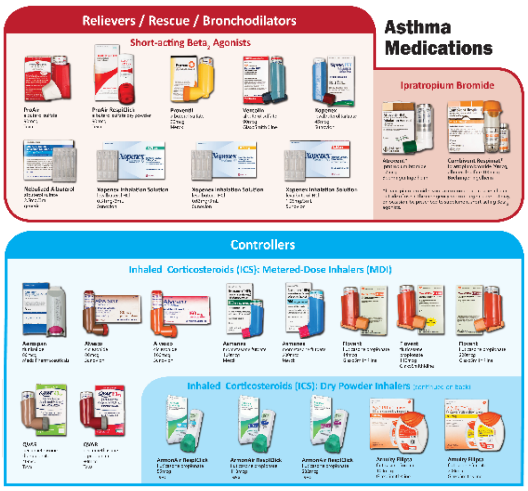
Table 2. Maine In-Home Asthma Education Program Modules

Module	Setting	Expected Length	Objectives
Assess Eligibility and Enroll	Phone or office	15 – 30 minutes	To assess whether the client will benefit from the Program and to schedule the first appointment.
Module 1: Establish Rapport and Obtain Baseline Information	Office, home, or phone	30 – 45 minutes	To establish a relationship between the educator and the client as well as obtain baseline information from the client.
Module 2: Asthma Education, Medication Assessment and Reconciliation	Office or home	60 minutes	To perform medication reconciliation and teach the client a basic overview of asthma pathophysiology, symptom recognition, and medication mechanisms.
Module 3: Asthma Management and Treatment Goals	Office or home	45 minutes	To introduce asthma classification and step management, as well as to teach self-management skills.
Module 4: Asthma Action Plan	Office or home	15 – 30 minutes	To encourage the client to have a current Asthma Action Plan
Module 5: Home Environmental Assessment and Trigger Reduction	Home	45 minutes	To identify home triggers and provide trigger reduction action steps.
Module 6: Evaluate and Reinforce	Office or home	30 minutes	To ensure that the client has learned the lessons of the Program and has the skills to self-manage their asthma effectively.

[3] Available from the Asthma Program, Maine Center For Disease Control and Prevention

The Program was reviewed annually using real-time evaluation findings. One of the significant changes made in the second year of the Program was the inclusion of a visual showing various medication devices (see Figure 6). This was based on the finding that many clients had confused rescue and controller medication devices. Using the visual to match the prescribed devices with those of the poster, the educator was able to address the confusion and ensure the client understood the difference between a rescue and a controller device.

Figure 6: Medication Poster



EDUCATORS

The Program was developed to be delivered by educators working in various professional settings and based at agencies throughout Maine. Table 3 compares the scope of practice of the Certified Asthma Educator, the Community Paramedic/EMT, and the Community Health Worker (CHWs), as they relate to the modules of the In-Home Asthma Education Program. Due to the specialized scope of practice of the Certified Asthma Educator, the Community Paramedics and CHWs delivered some modified modules, which are noted as "modified."

Table 3. Scope of Practice and Module Implementation

Module	Certified Asthma Educator	Paramedic / EMT	CHW
Assess Eligibility and Enroll	✓	✓	✓
Module 1: Establish Rapport and Obtain Baseline Information	✓	✓	✓
Module 2: Asthma Education, Medication Assessment and Reconciliation	✓	modified	modified
Module 3: Asthma Management and Treatment Goals	✓	modified	modified
Module 4: Asthma Action Plan	✓	modified	modified
Module 5: Home Environmental Assessment and Trigger Reduction	✓	✓	✓
Module 6: Evaluate and Reinforce	✓	✓	✓
Re-evaluate and Reconnect	✓	✓	✓

Efforts to Increase Educators' Competencies and Confidence

Content-based learning

All educators received training from either United Ambulance or City of Bangor. Certified Asthma Educators from each agency facilitated the trainings. All Community Health Workers completed the Association of Asthma Educators curriculum: Asthma Education for the Community Health Worker. The curriculum consisted of 5 modules, each between 90 – 120 minutes long. Modules were interactive and covered basic information about asthma, its triggers and environmental control, medication, medication delivery devices, and assessment and monitoring.

In 2018, training for community paramedics and allied professionals was identified as needed. In the absence of an existing curriculum, the United Ambulance Paramedicine Program engaged medical and curriculum experts to develop and implement a curriculum titled: Asthma Self-Management Education Training for the EMS Professional. The curriculum focused on pathophysiology of asthma, pharmacology, home assessments, and asthma action plans.

Case-based learning

The growing community of asthma-trained educators identified case-based learning as needed to increase confidence in implementing in-home visits and developing a community of practice. Project ECHO is the model used to deliver case-based learning.

The Project ECHO: In-Home Asthma Self Education series included the following objectives:

- Increase knowledge of asthma guidelines and the role of self-management education
- Increase knowledge and confidence in conducting asthma home assessments
- Increase comfort with and confidence in supporting client asthma medication adherence
- Increase capacity to support Asthma Action Plans for children and adults
- Increase cultural competency
- Increase knowledge and use of best practices when implementing asthma self-management education visits with diverse populations
- Increase knowledge of and access to local resources to meet client needs

Faculty consisted of a pharmacist, a medical doctor, the program director of a nursing department at a local university, and community paramedic and community health worker representatives.

Target Audience

The Program was designed to educate people with asthma and their direct family members. It was primarily aimed at adults and children with uncontrolled asthma; however, the eligibility of each client was determined by the educator. The following were recommended exclusion criteria. It was recommended that the Program not be offered to clients and/or their caregivers who fulfilled one or more of the following at enrollment:

1. Have been diagnosed with asthma for less than 3 months.
2. Have received consistent asthma medical management for less than 3 months.
3. Their asthma is well controlled per clinical guidelines.
4. They will not be living in Maine for the duration of the Program.
5. They do not live within the geographic area defined by the implementing agency.

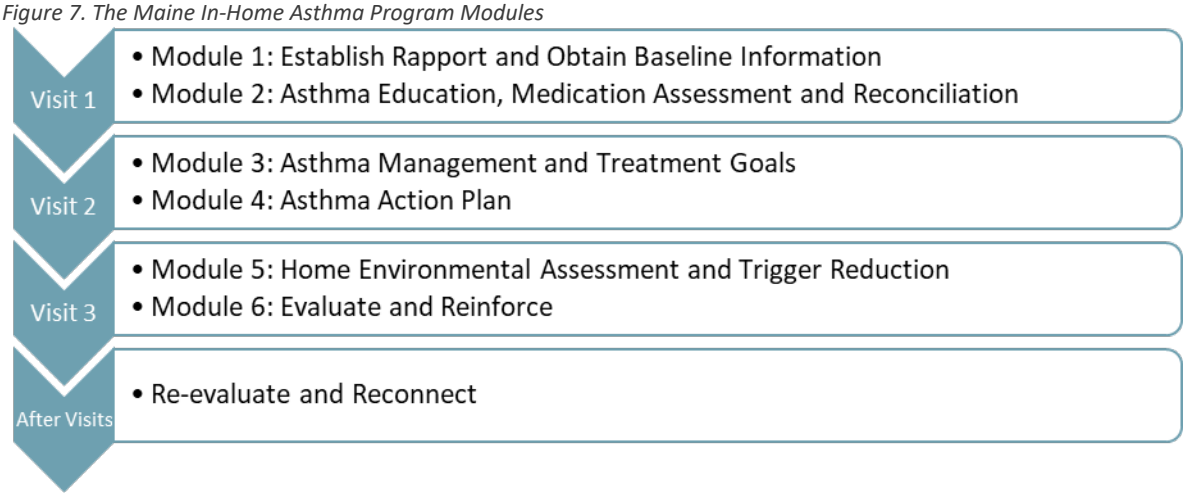
The Program was delivered in multiple languages, including English, Arabic, Somali, and French. Written educational materials/handouts were limited due to the many languages in which the Program was delivered.

Delivery of Program

The Program was intended to be implemented as a facilitated conversation between the educator and the client. This was primarily to ensure a safe space for interactive learning including questions, self-evaluation activities (e.g. asthma control scores), feedback, and demonstrations. Figure 6 summarizes the recommended workflow. Each Module was estimated to take 15 – 30 minutes depending on the content and the client's learning style. The longest module was the home environment assessment aimed at identifying asthma triggers and reducing exposure. This module was estimated to last at least one hour.

Modules could be scheduled on consecutive weeks or spaced out over a longer period depending on the client and the setting. The number of modules completed at each visit and the order in which the modules were completed were at the discretion of the educator and reflected the client's needs and situation. For example, clients with depressed affect often required shorter visits covering fewer modules.

Figure 7. The Maine In-Home Asthma Program Modules



The development and implementation of the Program was funded by Maine CDC. As a result, the Program was provided free to any person with asthma and/or their caregiver. The Program was also made available to other states to adapt and modify as needed.

Implementing Agencies

Bangor Public Health and Community Service. This is an agency of the City of Bangor that provides social and public health services to people living in the Bangor area. In 2015, a Public Health Nurse and Certified Asthma Educator piloted the Program. Between 2015 and 2016, a total of 60 patients enrolled in the Program and 36 patients completed it.

Maine Access Immigrant Network: Maine Access Immigrant Network (MAIN) is an ethnic-based community organization serving African and Middle Eastern immigrants and asylees in the greater Portland area. Between 2017 and 2019, six Community Health Workers enrolled 51 patients. Forty-nine completed the Program. In 2019, MAIN mentored the Portland Community Health Center during their HAEP implementation.

United Ambulance Community Paramedicine Program. This non-profit agency is funded through St. Mary's Hospital and Central Maine Medical Center. Paramedic and Community Paramedic services are provided to community members living in the Lewiston and Bridgton area. Since 2017, one Community Paramedic has worked with 48 patients to complete the HAEP. All clients enrolled completed the Program. In addition, staff at United Ambulance provided mentoring to other ambulance services implementing HAEP.

Portland Community Health Center: This Federally Qualified Health Center provides primary care to residents in the Portland area. In 2019, a Community Health Worker engaged 16 patients in HAEP.

St. George Volunteer Firefighters and Ambulance Association. This association provides emergency medical and ambulance services to residents of the town of St. George. In 2019, a Community Paramedic engaged 9 patients in HAEP.

NorthStar Ambulance: This MaineHealth associate provides ambulance and community paramedicine services to residents in Franklin county. In 2019, 3 patients were engaged in HAEP.

Northern Light Health Community Paramedicine Program. This division of the Charles A. Dean Memorial Hospital provides ambulance and community paramedicine service to the Greenville area. In 2019, Community Paramedics engaged 12 patients in HAEP.

Mayo Regional Hospital Emergency Medical Services. This organization provides ambulance and community paramedicine services to the Dover-Foxcroft area. In 2019, a Community Paramedic engaged 2 patients in HAEP.

Intended Outcomes

Funding, resources, and support are provided to the Maine CDC by the National Center for Environmental Health at the US CDC. In addition to funding these efforts, the US CDC provides programmatic and evaluation technical assistance, communicates new evidence and best practices, and provides scientific expertise.

The Maine CDC provides funding, resources, support, technical assistance, and contract management to the agencies implementing asthma self-management education. The Maine CDC also acts as a coordinating agency and central point of communication, allowing surveillance findings and evaluation results to be integrated into continuous quality improvement of overall asthma strategy implementation across Maine. Activities are implemented in order to ensure all federal and state accountability and performance measurement requirements are met.

In the short-term, patients who complete the HAEP will have an increased knowledge of asthma pathophysiology, signs and symptoms, triggers, and treatment. Client self-monitoring and self-management skills will increase, and clients will demonstrate the ability to use their medications correctly. They will also have a positive attitude toward their own ability to manage asthma (i.e. self-efficacy). Clients receiving home visits will have appropriate and current Asthma Action Plans that they know how to use. In addition, they will report increased knowledge of household triggers and their role in causing symptoms. Clients will increase their awareness of local resources that can be leveraged to address triggers or manage their asthma.

By participating in the Program, clients will self-monitor and self-manage their asthma more effectively. Clients will also be able to use their medications appropriately and at the correct times. Household triggers will be reduced or removed, and clients will continue to engage their PCPs for long-term asthma management.

Clients' chronic asthma symptoms and acute exacerbations requiring emergency department/urgent care visits will decrease. Clients' asthma-related quality of life will increase while symptoms are reduced. This will result in less work/school absenteeism due to asthma. The combination of decreased absenteeism and reduction in preventable emergency department/urgent care visits will result in decreased health care costs attributable to poorly controlled asthma.

CHAPTER 4: EVALUATION METHODOLOGY

Study Design

A fixed mixed-method with quantitative priority using a convergent parallel design was implemented. The evaluation focused on assessing the efficacy of the HAEP and was guided by the following evaluation questions:

1. To what extent have participants changed their asthma-related behaviors as a result of participating in the Program?
2. To what extent is there an impact on knowledge and attitudes among participants?
3. To what extent have participants' skills in properly using medication devices increased?

Instruments

Where possible, existing, validated instruments were included in surveys (see Table 4). Where instruments did not exist, tools were developed by the Evaluation Team in discussion with implementing agencies. Tools were reviewed for readability and cultural appropriateness by the implementing agencies: Maine CDC Asthma Program, US CDC project officers and evaluation technical advisors, public health experts, and health literacy experts.

Table 4. Summary of Instruments and Tools

Instrument / Tool	Description	Author
Asthma Control Test (ACT) ©2002	Standard test to assess the level of asthma control for clients 12 years old and older.	QualityMetric Inc.
Asthma-related knowledge and attitudes	Sub-set of questions to determine the level of asthma knowledge and positive attitudes toward asthma.	Partnerships For Health
Childhood Asthma Control Test (CAT) ©2002	Standard test to assess the level of asthma control for clients 5 – 11 years old.	QualityMetric Inc.
Demographics	Customized questions that collect demographic data, relevant medical history, tobacco use, and ability to afford care.	Partnerships For Health
Impact of uncontrolled asthma	Sub-set of questions to quantify the impact of asthma on work/school attendance, use of emergency medical facilities, and use of emergency steroids.	Partnerships For Health
Inhaler Device Assessment Tool ©2006	Standardized tool to assess client's ability to correctly use asthma medication.	Nursing Best Practice Research Unit, University of Ottawa
Mini Asthma Quality of Life Questionnaire ©1996	Standardized tool assessing the impact asthma has on the adult client.	QOL Technologies Ltd
Pediatric Mini Asthma Caregiver's Quality of Life Questionnaire ©1996	Standardized tool assessing the impact a child's asthma has on the caregiver.	QOL Technologies Ltd
Test for Respiratory Asthma Control in Kids (TRACK) ©2009	Standard test to assess the level of asthma control for clients 4 years and younger. The test is completed by the caregiver.	AstraZeneca LP

Surveys and forms were developed to collect data at 3 time points: prior to the start of the Program, as soon as the client completed the last module, and approximately 3 months after completing the Program. The Evaluation Team worked closely with the implementing agencies to ensure the correct surveys were implemented at the appropriate times – as shown in Table 5.

Table 5. Timeline of Surveys/Instruments

Survey / Form	Description	Instrument / Tool
Adult with Asthma Pre-Intervention Survey or Child with Asthma Caregiver Pre-Intervention Survey	The appropriate survey is completed by person with asthma/their caregiver prior to starting HAEP. It collects a baseline of the client's behavioral and health outcomes during the 3 months prior to participating in HAEP.	• ACT, CAT, or TRACK • Demographics • Impact of Uncontrolled Asthma • Inhaler Device Assessment Tool • (Pediatric) Mini Asthma Quality of Life Questionnaire
Adult with Asthma Post-Intervention Survey or Child with Asthma Caregiver Post-Intervention Survey	The appropriate survey is completed by person with asthma/their caregiver at the end of Program (directly following Module 6). It collects data to determine the immediate impact of participating in HAEP.	• ACT, CAT, or TRACK • Impact of Uncontrolled Asthma • Inhaler Device Assessment Tool • (Pediatric) Mini Asthma Quality of Life Questionnaire
Adult with Asthma Ex-Post Intervention Survey Or Child with Asthma Caregiver Ex-Post Intervention Survey	The survey is completed by person with asthma/their caregiver approximately 3 months after completing the Program.	• ACT, CAT, or TRACK • Impact of Uncontrolled Asthma • Inhaler Device Assessment Tool • (Pediatric) Mini Asthma Quality of Life Questionnaire
Intervention Log	The log is completed by the educator throughout the Program. It collects client referral and completed modules.	

Data Collection

All (163) HAEP participants consented to participate in the evaluation. Each participant was allocated a Personal Identification number (PID) to ensure anonymity. Eight PIDs were excluded from the data analysis because of critical errors or omissions (e.g. absence of the Post-Intervention completed survey). Accordingly, short-term efficacy data analysis is based on a 95% response rate.
Only United Ambulance and MAIN participated in the ex-post intervention component of the evaluation. Of a total of 97 potential respondents, data analysis was conducted on 94 PIDs. Outcome data analysis is accordingly based on a 97% response rate.

Data Collection Management. Monthly check-in calls with implementing agencies were used to understand challenges and barriers to the implementation of the outcome evaluation. All forms were reviewed for face validity and missing data. Omissions and errors were returned to the educator for correction.

All data collected was secured and maintained at Partnerships For Health according to their data management systems and procedures. At all phases of data submission, management, and transfer, PFH staff implemented industry best practices to maintain high quality data and confidentiality.

Analysis

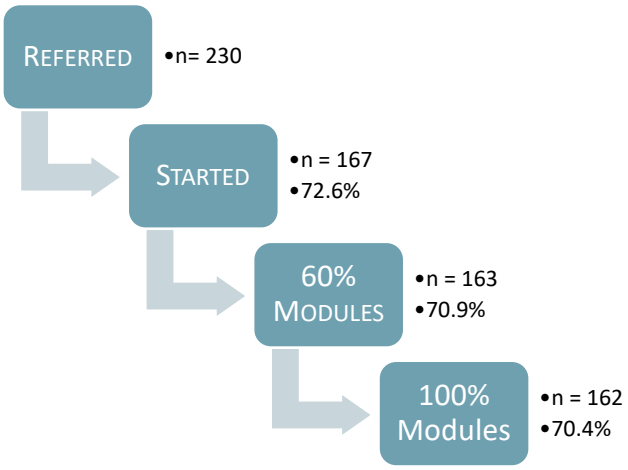
Descriptive and inferential statistics were used to analyze data. Data on demographic, socioeconomic, and other individual variables were tabulated to describe clients and their outcomes. Inferential statistics were used to examine the client outcomes. Specifically, asthma control, quality of life, and health service utilization were compared pre- and post- Program implementation.

CHAPTER 5: UPTAKE OF IN-HOME ASTHMA EDUCATION PROGRAM

Program Engagement

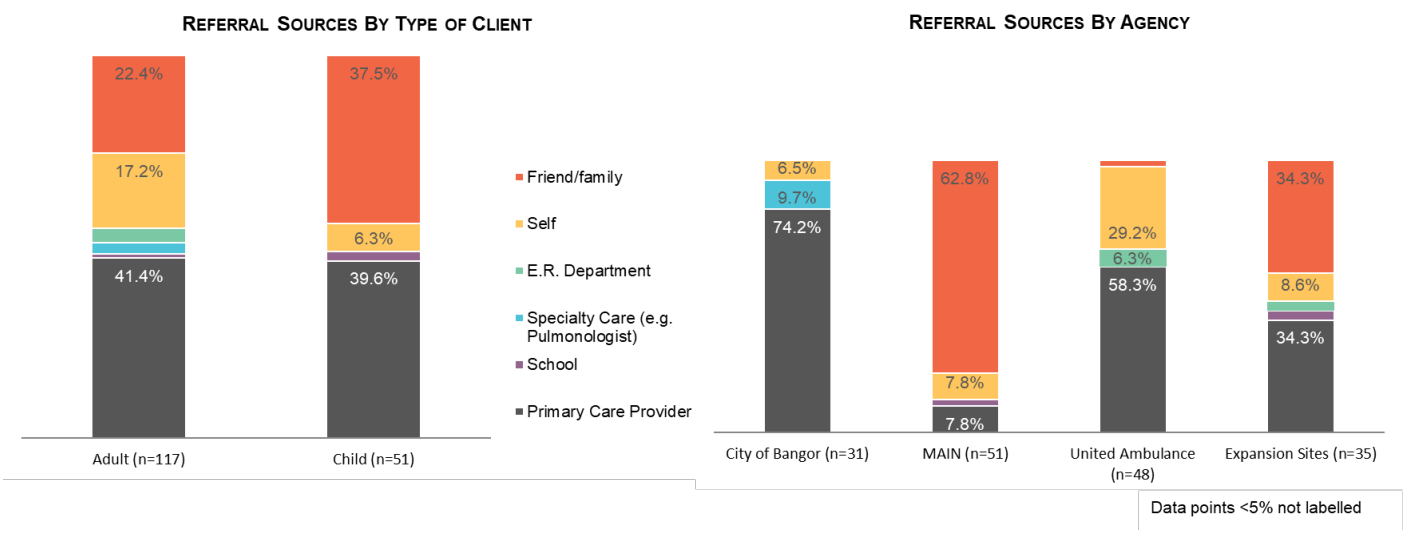
Enrollment. Of the 230 people that were referred to the Program between 2016 and 2019, 201 people (87.4%) agreed to participate. A total of 163 people completed the Program. One client exited the Program after completing 60%, as shown in Figure 8.

Figure 8. Program Uptake



Referral Source. Overall, almost half of all patients were referred by primary care providers. Children with asthma/their caregivers were more likely to be referred by friends/family. Implementing agencies with strong relationships with health systems were more likely to receive referrals from primary care providers, emergency departments, or specialty care. This contrasted with community-based organizations (such as MAIN) which received most of their referrals informally through word-of-mouth in the community (see Figure 9).

Figure 9. Referral Source by Type of Client and Implementing Agent



Average Length of Engagement. The average length of time taken for participants to complete the Program was 31 days. Caregivers/children with asthma tended to engage with the Program over a longer period of time than adults with asthma [caregiver average: 35 days; adult average: 29 days].

Implementing agencies also differed in the length of engagement with clients. This is shown in Table 6.

Table 6. Length of Program Implementation by Agency

Implementing Agency	Length of Intervention	
	Average	Median
City of Bangor (n=35)	69.6 days	57 days
MAIN (n=51)	22.5 days	18 days
United Ambulance (n=46)	27.0 days	24 days
Expansion Sites (n=35)	9.4 days	5 days

Client Characteristics

A summary of participant characteristics is shown in Table 7. Overall, there were more adult participants (70%) than children (30%). The proportion of male and female participants corresponds to national asthma prevalence data with more females (65.0%) among the adult clients and more males (52.0%) among the child clients (Centers for Disease Control and Prevention, 2015).

The typical adult participant was female and in her late 40s. Her asthma was diagnosed when she was approximately 26 years old. She has a medical home and is a MaineCare beneficiary. One-in-three adults with asthma reported not being able to work. This may be due to several reasons, including health conditions, visas, etc. Two-thirds of adult participants reported allergies (66.1%) and more than half (58.5%) experienced anxiety/depression. Adults were more likely than children to have a combination or self-pay health insurance and this may have contributed to approximately 15% stating that they could not afford a doctor visit and/or medication.

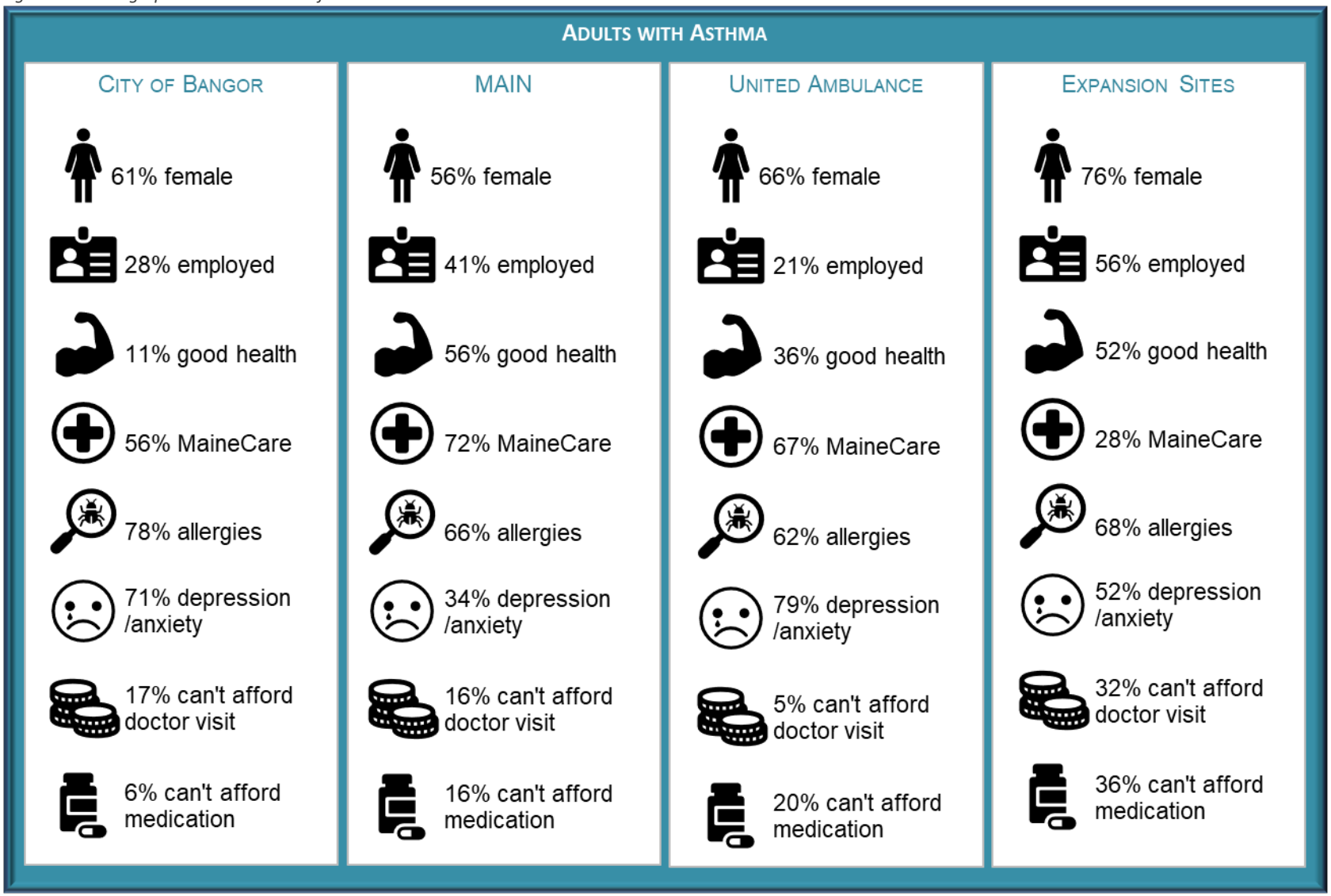
The typical child participant was younger than 8 years old and below Grade 3 at school. Like the adults, the children tended to report allergies (63.3%) as the most common co-morbidity. Almost three quarters of children were MaineCare beneficiaries (71.4%). While their caregivers were similar in age to the adult participants, they were more likely to be employed.

Table 7. Summary of Participant Characteristics

	Adults (n = 117)	Children (n = 50)	Caregivers (n=50)
Average age	47.3 years old	7.9 years old	43.5 years old
Gender	Female: 65.0% Male: 35.0%	Female: 48.0% Male: 52.0%	Female: 86.0% Male: 14.0%
Employment status / school grade	Not able to work: 33.9% Full-time employed: 25.6% Part-time employed: 10.2% Retired: 10.2% Homemaker/caregiver: 5.9% Looking for a job: 5.1%	Pre-K: 34.1% Grades 1 - 3: 20.5% Grade 4 – 6: 9.1% Grade 7 – 9: 18.2% Grades 10 – 12: 18.2%	Not able to work: 8.0% Full-time employed: 42.0% Part-time employed: 18.0% Retired: 0% Homemaker/caregiver: 20.0% Looking for a job: 4.0%
Health Insurance	MaineCare: 57.6% Medicaid: 28.0% Private: 11.9% Combination: 22.4% Self-pay: 10.3%	MaineCare: 70.0% Private: 30.0% Combination: 14.3% Self-pay: 6.0%	
Medical Home	Yes: 97.2%	Yes: 97.9%	
Age at first diagnosis	26.1 years old (Range: 0-68)	4.1 years old (Range: 1-13)	
Overall health	Excellent: 5.1% Very good: 3.4% Good: 39.8% Fair: 30.5% Poor: 21.2%	Excellent: 6.0% Very good: 16.0% Good: 64.0% Fair: 10.0% Poor: 4.0%	Excellent: 18.0% Very good: 16.0% Good: 56.0% Fair: 6.0% Poor: 4.0%
Common co-morbidities	Allergies: 66.1% Anxiety/depression: 58.5% GERD: 43.2% High blood pressure: 38.1% Obesity: 33.9%	Allergies: 62.0% Eczema: 32.0% Rhinitis: 22.0% GERD: 12.0% Sinusitis: 10.0%	
Can't afford doctor visit	15.25%	2.0%	
Can't afford medication	18.80%	4.0%	

Demographics by Implementing Agency. Adults with asthma who participated in the Program appeared to differ by implementation agency. Three-out-of-four adults with asthma who were engaged with MAIN tended to be MaineCare beneficiaries. At least half of the clients reported their health as good and were less likely to report being depressed or anxious. Differences may be accounted for by cultural differences. This will be explored in later chapters. Participants who engaged with expansion site agencies appeared to be very different. Many were employed and had private insurance. This may account for a higher proportion of the clients reporting not being able to afford doctor visits and/or medication (See Figure 10).

Figure 10. Demographic Characteristics of Adults with Asthma



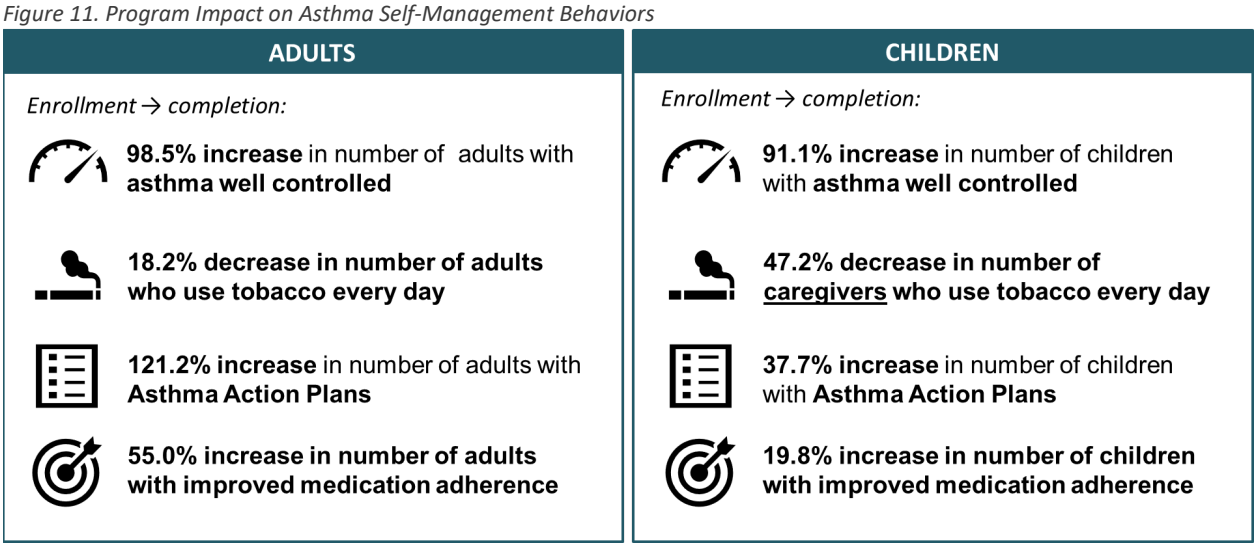
CHAPTER 6: PARTICIPANT-REPORTED SHORT-TERM OUTCOMES

The Program appears to have strengthened participants' ability to self-manage their asthma and, as a result, fewer participants reported use of emergency health care services. Overall, more participants reported missing less work/school and overall improvement in their quality of life.

Program Impact on Asthma Self-Management Behaviors

Overall, participants reported improved self-management behaviors after completing the Program (see Figure 11). Compared with 3 months prior to participation, asthma control improved. Adults with asthma and children's caregivers reported decreases in tobacco use. There was an increase in the number of participants with Asthma Action Plans, particularly among adults with asthma. Adults with asthma also showed more improvement in controller medication than children with asthma.

Figure 11. Program Impact on Asthma Self-Management Behaviors



Asthma Control

According to the National Heart, Lung, and Blood Institute, asthma is well controlled if a person has symptoms no more than 2 days a week, can do normal activities, use quick relief medications no more than 2 days a week, experience one or fewer asthma attacks that require corticosteroids by mouth, and peak flow does not drop below 80% of their personal best (National Heart, Lung, and Blood Institute, 2017).

Approximately one-in-three people had well controlled asthma prior to starting the Program. This doubled to two-in-three people by the end of the Program. As summarized in Table 8, there was an increase in asthma control over the Program period (adults: 98.5% and children: 91.11%).

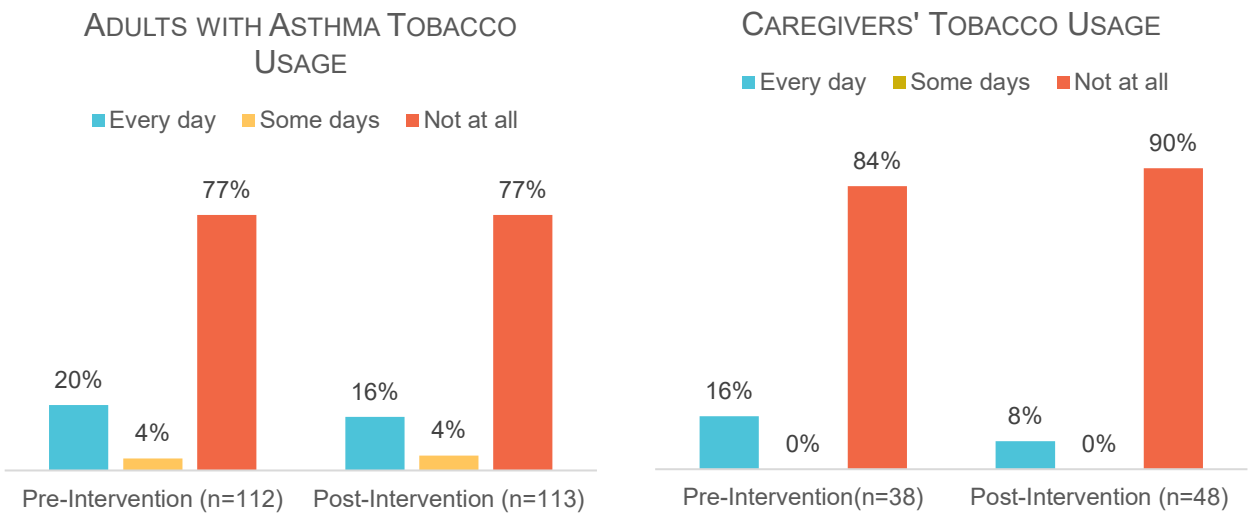
Table 8. Participants with Well Controlled Asthma

Pre-Intervention			Post-Intervention			Changes in Asthma Control		
Overall (n=169)	Adult (n=118)	Child (n=50)	Overall (n=162)	Adult (n=113)	Child (n=48)	Overall	Adult	Child
34.3%	33.9%	36.0%	67.9%	67.3%	68.8%	+98.0%	+98.5%	+91.11%

Mitigating Risk Factors

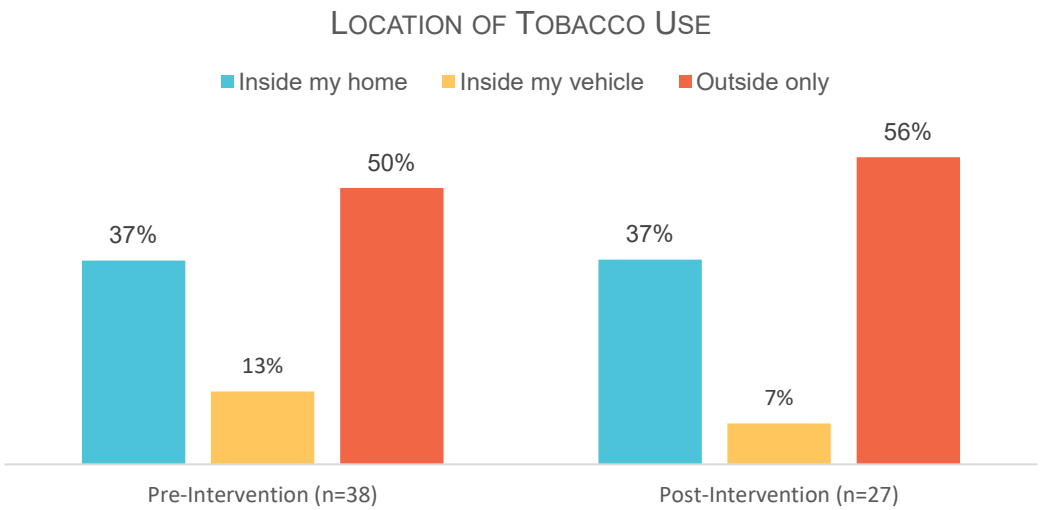
Tobacco Use and Exposure to Secondhand Smoke. Approximately one-in-five adults (21.19%) reported using tobacco every day or some days prior to starting the Program. As shown in Figure 12, more adults with asthma reported tobacco use compared with caregivers. While overall there was a 36% decrease in tobacco use after completing the Program, this appears to be mainly the result of changes in caregivers' tobacco usage (a 90% decrease).

Figure 12. Program Impact on Tobacco Use



While the number of participants who reported tobacco use inside the home, inside the vehicle, or outside only was small, it appears that the Program may have increased the percent of participants who used tobacco outdoors, and decreased the use of tobacco in vehicles. These changes are shown in Figure 13.

Figure 13. Program Impact on Location of Tobacco Use



Immunization. Most participants (83.93%) had received their seasonal flu injection prior to participating in the Program. Approximately half of participants had received pneumonia and/or pertussis vaccinations or boosters in the last year. Seasonal flu vaccine and pertussis boosters were higher among children with asthma than adults as shown in Table 9. Immunization after the Program was not analyzed as vaccinations are annual and the Program typically was implemented within three months.

Table 9. Immunization Prior to the Program

Immunization	Adults (n=118)	Children (n=50)
Seasonal flu	82.05%	88.00%
Pneumonia	46.15%	38.00%
Pertussis booster	34.48%	58.00%

Asthma Action Plans

Asthma Action Plans: An Asthma Action Plan, also known as an asthma management plan, is a written plan that details daily treatment, including how to use medications, achieve long-term asthma control, and deal with asthma attacks. The Plan also provides guidance on when to call the doctor or go to the emergency room (Centers for Disease Control and Prevention, 2012).

In the 3 months prior to participating in the Program, only 36.69% of participants had Asthma Action Plans. The lack of Asthma Action Plans was particularly evident in adults, with only 28.81% reporting having an Asthma Action Plan compared with 56.00% of children.

Immediately after the Program, two-thirds of participants reported having an Asthma Action Plan. As summarized in Table 10, there was an increase in the number of participants who had Asthma Action Plans over the Program period (adults: 121.2% and children: 37.7%).

Table 10. Program Impact on Asthma Action Plans

Pre-Intervention			Post-Intervention			Changes in Asthma Action Plans		
Overall (n=169)	Adult (n=118)	Child (n=50)	Overall (n=162)	Adult (n=113)	Child (n=48)	Overall	Adult	Child
36.7%	28.8%	56.0%	67.9%	63.7%	77.1%	+85.0%	+121.2%	+37.7%

Medication Usage and Adherence

Asthma Controller Medication Device. Most participants used a Metered Dose Inhaler (MDI) (89.70%) prior to the start of the program. The device was either used alone (41.82%), with a spacer (40.61%%), or with a spacer and mask (7.27%). Immediately following the Program, more participants reported using the MDI with a spacer (Figure 14 shows an MDI with a spacer).

Figure 14: MDI with Spacer

Proper use of equipment includes prepping the device; preparing the medication; and initiating, sustaining, and completing the treatment. For example, if using a nebulizer, the client removes the cap, primes the device, exhales, inhales appropriately from the device, and holds their breath.

Prior to the Program, less than one third (27.11%) of participants were able to demonstrate correct usage of their MDI. This increased to 91.57% at the end of the Program.

Adherence to Controller Medication Regime. There are two types of asthma medications: long-term controller medications and rescue medications. Long-term controller medication reduces airway inflammation and prevents symptoms. Rescue medication relieves asthma flare ups (National Heart, Lung, and Blood Institute, 2017). Controller medications are typically prescribed to be taken daily.

In the 3 months prior to the Program, one-in-three participants reported not missing a dose of their medication. Children reported higher medication regime adherence than adults (adults: 29.06% vs children: 40.00%). As summarized in Table 11, there was an increase in the number of participants who reported 100% medication adherence over the Program period (adults: 55.0% and children: 19.8%).

Table 11. Program Impact on Medication Adherence

Pre-Intervention			Post-Intervention			Changes in Adherence		
Overall (n=169)	Adult (n=118)	Child (n=50)	Overall (n=162)	Adult (n=113)	Child (n=48)	Overall	Adult	Child
32.1%	29.1%	40.0%	45.7%	45.1%	47.9%	+42.4%	+55.0%	+19.8%

Use of Oral Steroids. Oral steroids (corticosteroids) are used to treat acute asthma flare-ups (Palo Alto Medical Foundation, 2015). They are typically prescribed for short time periods (5 days to 2 weeks) and tend to cause more side effects than inhalers (ibid).

In the 3 months prior to the Program, 77 participants (53 adults and 24 children) reported using oral steroids. By the end of the Program, this decreased to 26 participants (19 adults and 7 children) (see Tables 12 and 13).

Table 12. Program Impact on use of Oral Steroids Among Adults with Asthma

Pre-Intervention (n=119)			Post-Intervention (n=114)			Changes in use of Oral Steroids	
Adults	Total Times	Average Times	Adults	Total Times	Average Times	Adults	Total Times ↓
53	134	3	19	95	4	-62.5%	-39

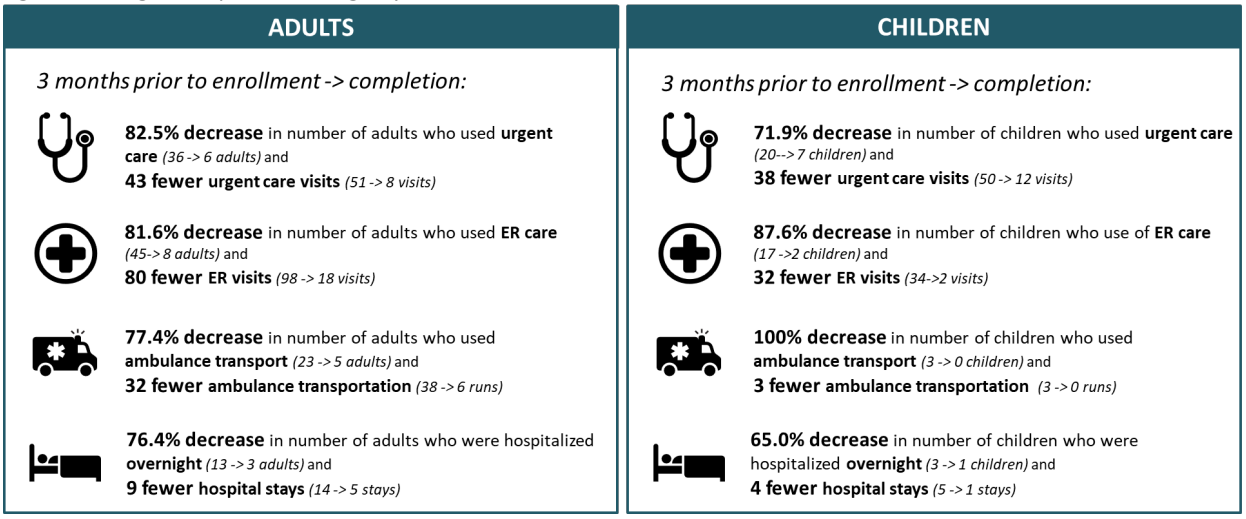
Table 13. Program Impact on use of Oral Steroids Among Children with Asthma

Pre-Intervention (n=50)			Post-Intervention (n=48)			Changes in use of Oral Steroids	
Children	Total Times	Average Times	Children	Total Times	Average Times	Children	Total Times ↓
24	51	2	7	9	1	-69.6%	-50

Program Impact on Emergency Health Care Utilization

Following the Program, adults and children reported less emergency health care utilization. This decrease was seen in both the number of participants who used the services as well as the number of times each service was used (*see Figure 15*).

Figure 15. Program Impact on Emergency Health Care Utilization



Use of Urgent/Walk-In Care

In the 3 months prior to the Program, 62 participants (36 adults and 26 children) visited urgent care 101 times. As summarized in Table 14 and Table 15, over the Program period there was a decrease in both the number of participants who used urgent care facilities (adults: -82.5% and children: -71.9%) and the number of times urgent care was used.

Table 14. Program Impact on Urgent Care Amongst Adults with Asthma

Pre-Intervention (n=119)			Post-Intervention (n=114)			Changes in Use of Urgent Care	
Adults	Total Visits	Average Visits	Adults	Total Visits	Average Visits	Adults	Total Visits ↓
36	51	1	6	8	1	-82.5%	-43

Table 15. Program Impact on Urgent Care Amongst Children with Asthma

Pre-Intervention (n=50)			Post-Intervention (n=48)			Changes in Use of Urgent Care	
Children	Total Visits	Average Visits	Children	Total Visits	Average Visits	Children	Total Visits ↓
26	50	2	7	12	2	-71.9%	-38

Use of Emergency Room Care

Emergency Room care is one of the most expensive forms of medical care. In the 3 months prior to the Program, 62 participants (45 adults and 17 children) reported 132 emergency room visits. As summarized in Table 16 and Table 17, over the Program period there was a decrease in both the number of participants who used emergency room facilities (adults: -81.6% and children: -87.6%) and the number of times emergency room facilities were used.

Table 16. Program Impact on Emergency Room (ER) Care Amongst Adults with Asthma

Pre-Intervention (n=118)			**Post-Intervention (n=114)**			**Changes in Use of ER Care**	
Adults	Total Visits	Average Visits	Adults	Total Visits	Average Visits	Adults	Total Visits ↓
45	98	2	8	18	3	-81.6%	-80

Table 17. Program Impact on Emergency Room (ER) Care Amongst Children with Asthma

Pre-Intervention (n=50)			**Post-Intervention (n=48)**			**Changes in Use of ER Care**	
Children	Total Visits	Average Visits	Children	Total Visits	Average Visits	Children	Total Visits ↓
17	34	2	2	2	1	-87.6%	-32

Use of Ambulances

Ambulance transportation is measured by ambulance runs. A run is defined as any time an ambulance is called to a location to assess and provide emergency medical care to a person. For the purposes of this evaluation, a run is only counted if an ambulance transported the person to a hospital.

In the 3 months prior to the Program, 41 ambulance runs were provided to 26 participants. As summarized in Table 18 and Table 19, over the Program period, there was a decrease in both the number of participants who required ambulance transportation (adults: -77.4% and children: -100.0%) and the number of ambulance runs.

Table 18. Program Impact on Ambulance Use Amongst Adults with Asthma

Pre-Intervention (n=118)			**Post-Intervention (n=114)**			**Changes in Ambulance Transport**	
Adults	Total Times	Average Times	Adults	Total Times	Average Times	Adults	Total Runs ↓
23	38	2	5	6	2	-77.4%	-32

Table 19: Program Impact on Ambulance Use Amongst Children with Asthma

Pre-Intervention (n=50)			**Post-Intervention (n=48)**			**Changes in Ambulance Transport**	
Children	Total Runs	Average Runs	Children	Total Runs	Average Runs	Children	Total Runs ↓
3	3	1	0	0	0	-100%	-3

Overnight Hospital Stays

Overnight hospital stays for asthma are not common and in the 3 months prior to participating in the Program, 16 participants reported 19 hospital stays. As summarized in Table 20 and Table 21, over the Program period, there was a reduction in both the number of participants who reported being hospitalized overnight (adults: -76.4% and children: -65.0%) and the number of overnight hospital stays.

Table 20. Program Impact on Hospital Stays Amongst Adults with Asthma

Pre-Intervention (n=118)			Post-Intervention (n=114)			Changes in Hospital Stays	
Adults	Total Stays	Average Stays	Adults	Total Stays	Average Stays	Adults	Total Stays ↓
13	14	1	3	5	3	-76.4%	-9

Table 21. Program Impact on Hospital Stays Amongst Children with Asthma

Pre-Intervention (n=50)			Post-Intervention (n=48)			Changes in Hospital Stays	
Children	Total Nights	Average Nights	Children	Total Nights	Average Nights	Children	Total Nights ↓
3	5	2	1	1	1	-65.0%	-4

Use of Services

As shown in Figure 16 and Figure 17, there was a substantial decrease in the use of emergency health care services. These decreases often have a positive ripple effect on the person and their family in terms of financial, emotional, and social benefits.

Figure 16. Impact of the Program on Adults with Asthma Use of Emergency Health Care Services

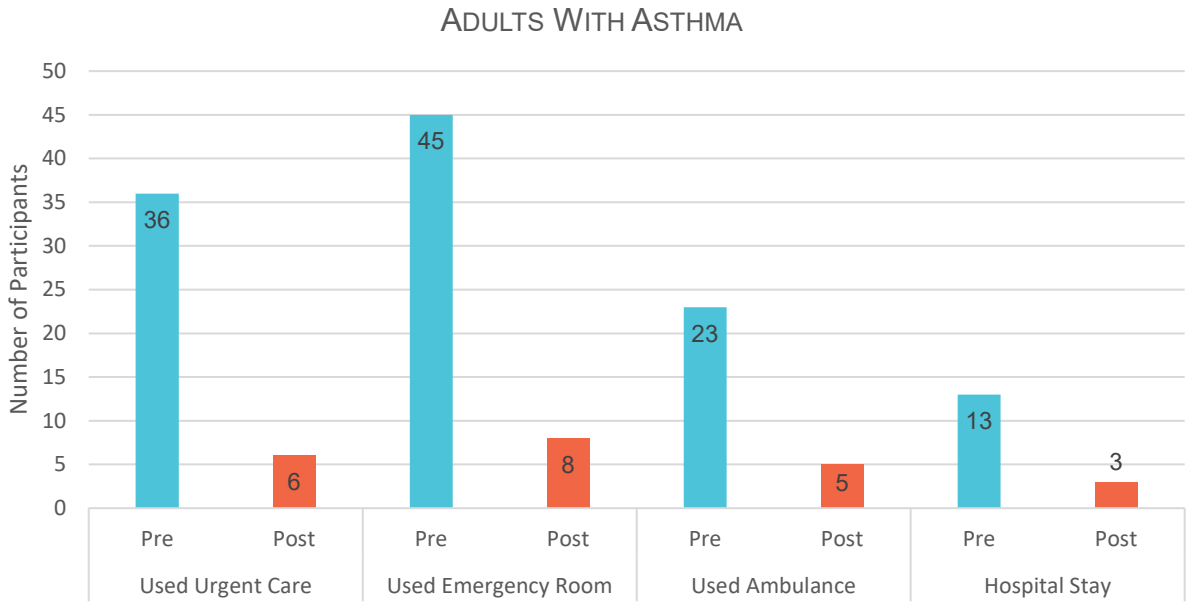
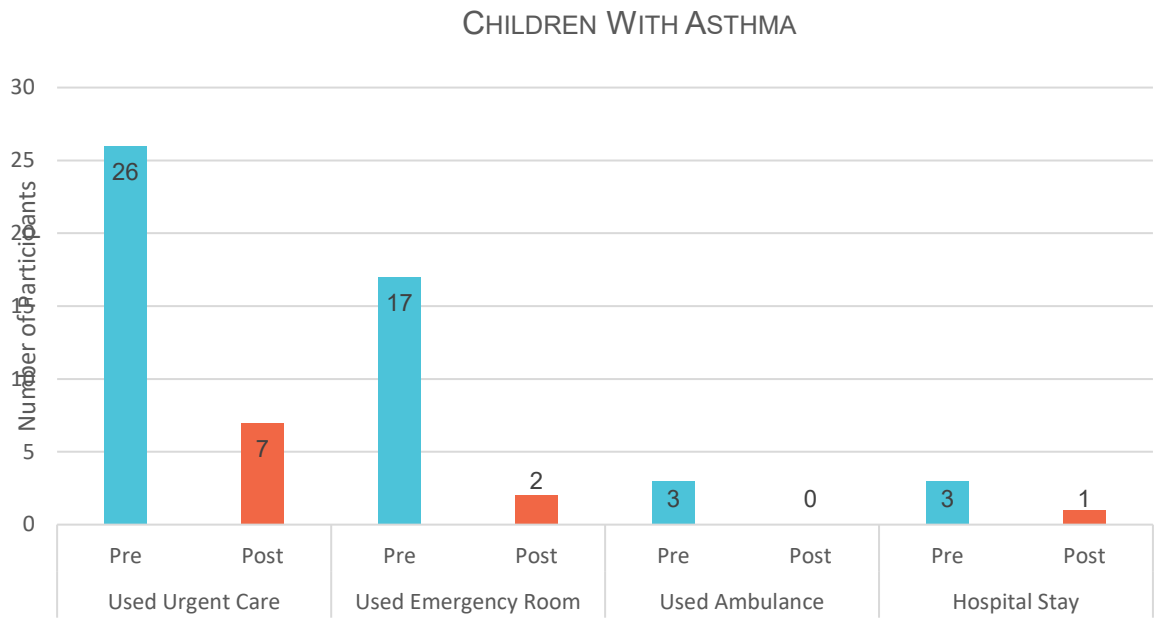


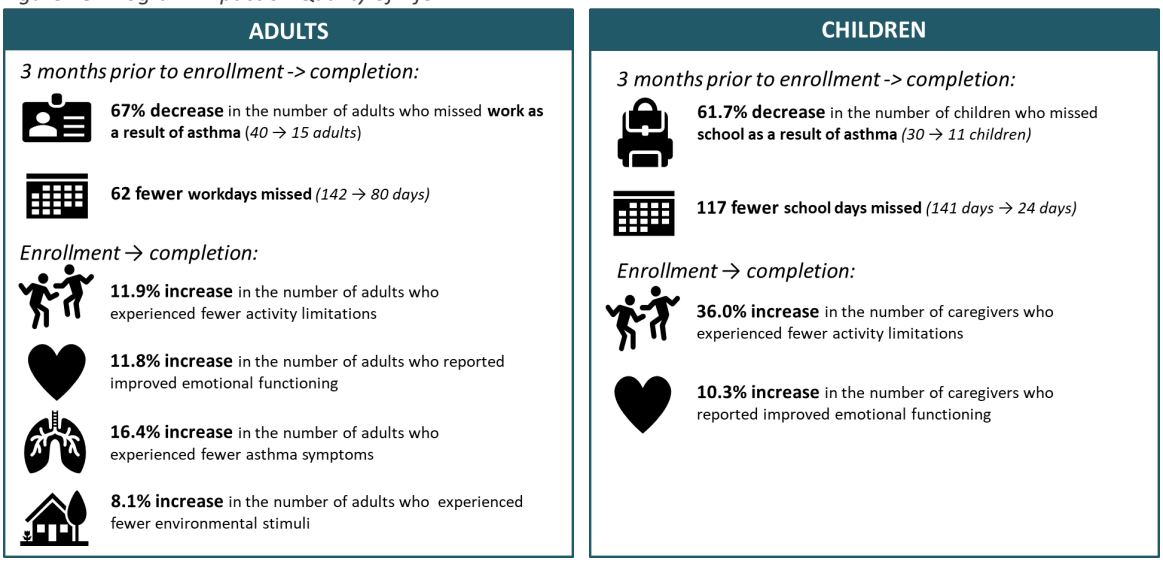
Figure 17. Impact of the Program on Children with Asthma Use of Emergency Healthcare Services



Program Impact on Quality of Life

The Program appears to have improved functioning and quality of life of adults with asthma, children with asthma, and their caregivers. This includes decreasing the number of work and school days missed, increasing activity levels, and improving emotional functioning. During the period of the Program, there was also an increase in the number of adults who reported less asthma symptoms and environmental asthma triggers. A summary of the quality of life outcome measures is shown in Figure 18.

Figure 18. Program Impact on Quality of Life



Absenteeism

Overall, absenteeism from work or school decreased substantially among both adults and children (adults: -167%; children: -173%) as seen in Table 22 and Table 23.

In the 3 months prior to the Program, 40 adults missed a total of 142 workdays (average 4 days) due to asthma. After participating in the Program, 15 adults missed a total of 80 workdays (average 5 days) due to asthma. In the 3 months prior to the Program, 30 children missed a total of 141 schooldays (average 5) due to asthma. After participating in the Program, 11 children missed a total of 24 schooldays (average 2 days).

Table 22. Program Impact on Work Absenteeism

Pre-Intervention (n=119)			Post-Intervention (n=114)			Changes in Work Absenteeism	
Adults	Total Days	Average Days	Adults	Total Days	Average Days	Adults	Total Days ↓
40	142	4	15	80	5	-60.7%	-62

Table 23: Program Impact on School Absenteeism

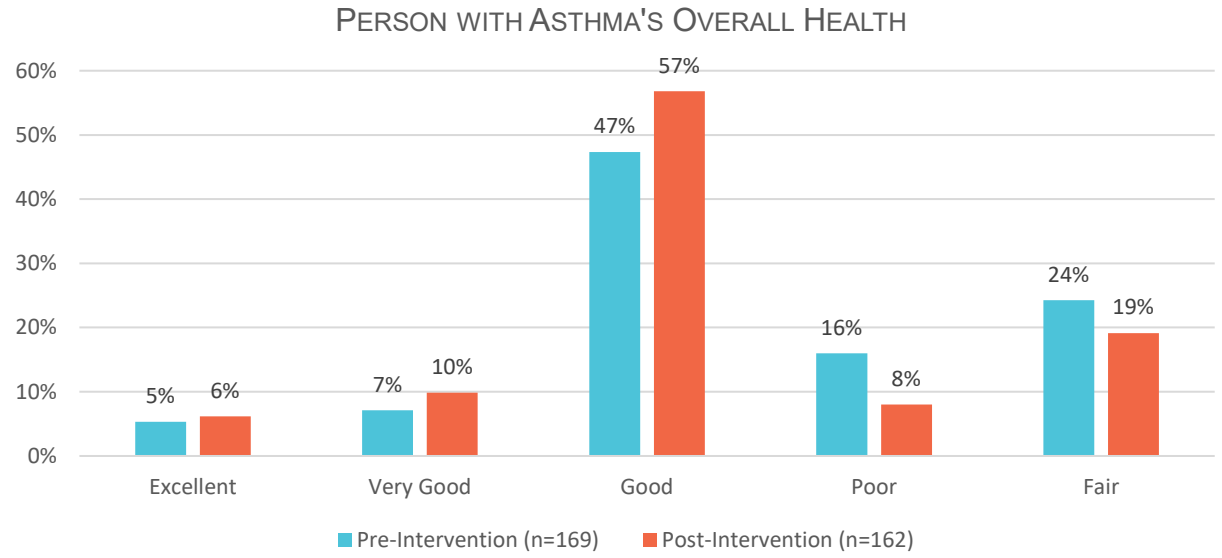
Pre-Intervention (n=50)			Post-Intervention (n=48)			Changes in School Absenteeism	
Children	Total Days	Average Days	Children	Total Days	Average Days	Children	Total Days ↓
30	141	5	11	24	2	-61.7%	-117

Overall Health Status

Self-rated health is a proxy measure for quality of life and is associated with general happiness and life satisfaction (Siahpush, Spittal, and Singh, 2008). In addition, it is an indicator of a population's overall well-being (ibid). Lower ratings have been associated with increased mortality, health care system utilization, and illness severity (ibid).

Participants' self-reported health status appears to have improved during the Program. As shown in Figure 19, fewer participants reported their health to be *poor* or *fair*. This aligned with an increase in the proportion of participants who reported their health as *good* or *very good*.

Figure 19. Program Impact on Self-Reported Health



Quality of Life

In addition to increased uptake of Asthma Action Plans and correct device usage, participants experienced increases in daily functioning and quality of life. Immediately following the Program, many participants reported increased engagement in physical, social, and work-related activities and decreased preoccupation due to improved management of symptoms and environmental triggers. Rating scales for children and adults differ. While the adult tool assesses the impact of asthma on day-to-day lifestyle, the child tool assesses the impact of the child's asthma on the caregiver's daily activities. Accordingly, these are reported separately.

Adult Quality of Life

The adult quality of life questionnaire consists of four domains:

- Activity Limitations assesses the extent to which asthma impacts an individual's ability to engage in strenuous or moderate activities, social activities, and work-related activities. Examples of these activities include exercising, shopping, playing, work tasks, etc.
- Emotional Function assesses the level of emotional distress resulting from asthma (e.g. feeling frustrated, concerned about having asthma, etc.).
- Symptoms quantifies the extent of asthma symptoms experienced during the last two weeks. Symptoms include shortness of breath, chest tightness, sleeping, wheezing, etc.

- Environmental Stimuli assesses the level of exacerbation that environmental triggers have on a person's asthma. Stimuli include dust, cigarette smoke, and weather/air pollution.

Scores can be interpreted in two ways. Firstly, the lower a score, the higher impact asthma has on this domain. For example, a low activity limitations score means that asthma has severely limited the individual's ability to undertake activities in the last two weeks. This is referred to as the absolute score value.

Table 24 provides a summary of the average score for each domain before and after the Program. There is an increase in the number of adults with asthma who report better quality of life across all domains.

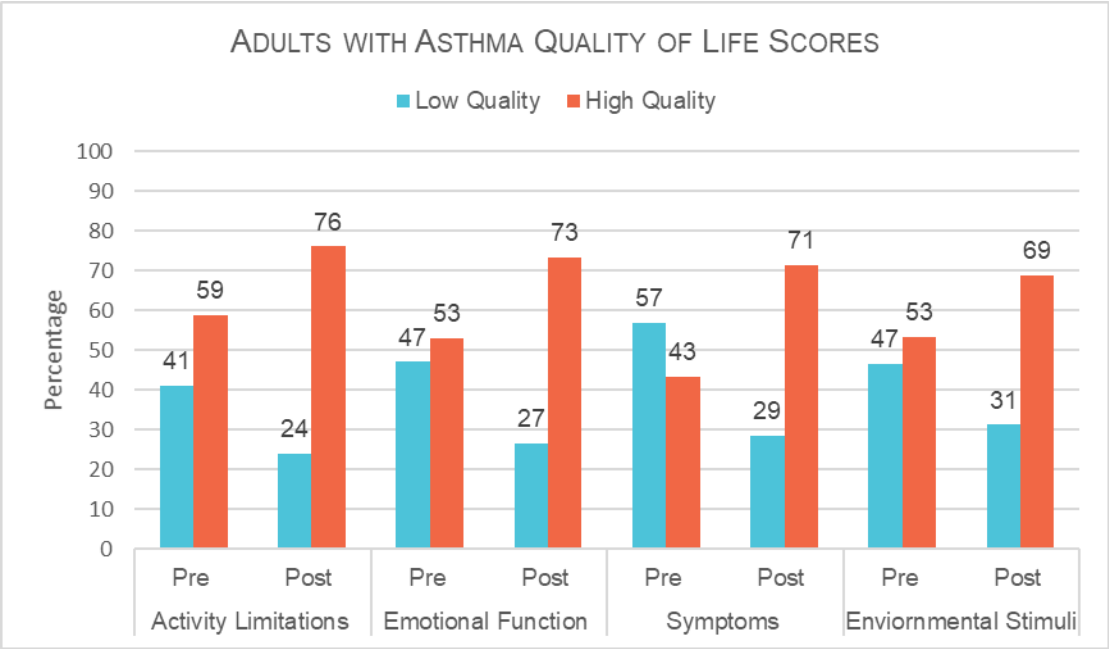
Table 24. Program Impact on Adult Quality of Life Domains

	Activity Limitations	Emotional Function	Symptoms	Environmental Stimuli
Pre-Intervention (n=119)	69.75%	70.03%	63.56%	67.43%
Post-Intervention (n=114)	78.03%	78.30%	73.98%	72.87%
Changes in Quality of Life	+ 11.9%	+11.80%	+16.4%	+8.1%

A relative score value is calculated based on evidence that suggests that scores above a domain-specific threshold are likely to result in more emergency health care utilization. Using the activity limitation domain as an example, a score of 64 or below indicates a lower quality of life for that domain. The greater the number of low scores across the domains, the higher the likelihood that the person will seek emergency health care (e.g. ER visits).

Figure 20 illustrates the relative scores per domain both prior to the Program and immediately after completion. It is evident that, across all domains, the proportion of participants with low quality scores decreased and those with high quality scores increased at the end of the Program.

Figure 20. Program Effect on Adults' Quality of Life



Caregiver Quality of Life

While similar to the adult questionnaire, there are only two domains that are assessed for caregivers:

- Activity Limitations assesses the extent to which asthma impacts the family's ability to engage in activities (e.g. having to change plans due to a child's asthma, interference in work productivity, etc.).
- Emotional Function assesses the level of emotional distress the caregiver feels and includes items such as feeling upset when a child coughs, worrying about the child, sleep disturbances, etc.

The caregiver's quality of life questionnaire is only scored using absolute score values. As shown in Table 25, quality of life improved across both domains, particularly for family activities.

Table 25. Program Impact on Caregivers' Quality of Life Domains

	Activity Limitations	Emotional Function
Pre-Intervention (n=50)	70.55%	75.06%
Post-Intervention (n=48)	95.98%	82.77%
Changes in Quality of Life	+ 36.04%	+10.27%

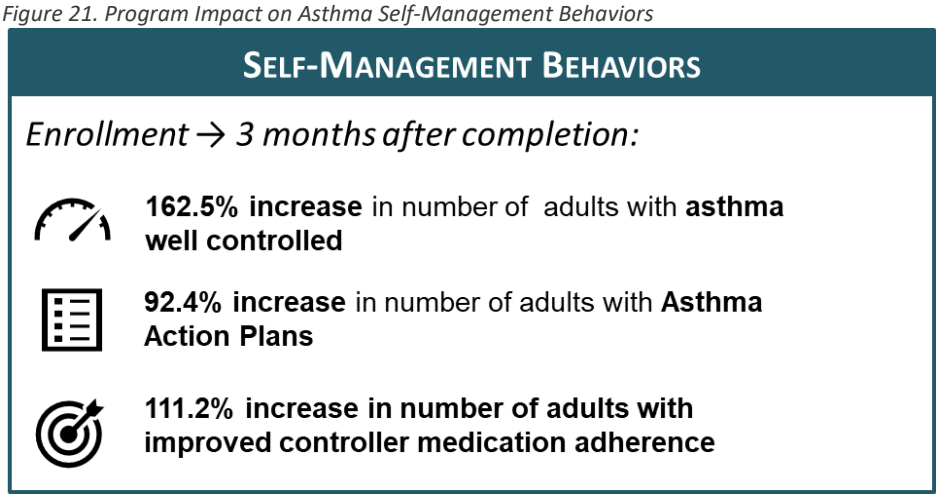
CHAPTER 7: PARTICIPANT-REPORTED INTERMEDIATE OUTCOMES

Two agencies, United Ambulance (UA) and Maine Access Immigrant Network (MAIN), implemented the Program over two consecutive years. This provided the opportunity to engage participants to assess outcomes at least 3 months after they had completed the Program. Accordingly, outcomes of 80 participants were analyzed.

Program Intermediate Impact on Asthma Self-Management Behaviors

Overall, participants reported improved self-management behaviors after completing the Program (see Figure 21). Compared with 3 months prior to the Program, participants from both implementing agencies reported improved asthma control, especially those from United Ambulance. For both groups, there was an increase in the number of participants with Asthma Action Plans and improved medication adherence, with greatest improvement observed in the United Ambulance group. At 3 months after the Program, improvements from baseline and immediately following the Program were observed, except for a slight decrease in the number of participants reporting 100% medication adherence at 3 months after the Program.

Figure 21. Program Impact on Asthma Self-Management Behaviors



Asthma Control

Prior to starting the Program, 39.47% of MAIN participants and 21.05% of UA participants had well-controlled asthma. Table 26 illustrates a sizeable increase in the percentage of participants with well-controlled asthma immediately following the Program (MAIN: +73.35% and UA: +312.54%). This trend continued in the 3 months following the Program (MAIN: +86.67% and UA: +337.58%).

Table 26. Program Impact on Number of Participants with Well-Controlled Asthma (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	30.00%	39.47%	21.05%
Post-Intervention	75.00%	68.42%	86.84%
Ex-post Intervention	78.75%	73.68%	92.11%
Changes in Asthma Control Immediately after Program	+150.00%	+73.35%	+312.54%
Changes in Asthma Control 3 Months after Program	+162.50%	+86.67%	+337.58%

Asthma Action Plans

In the 3 months prior to starting the Program, approximately half of MAIN participants and fewer than a quarter of UA participants had Asthma Action Plans. Immediately following the Program, the number of participants with Asthma Action Plans increased to approximately two-thirds for both groups. This is an especially large increase in percentage of participants with Asthma Action Plans for UA participants compared to MAIN participants (MAIN: +14.30% and UA: +166.72%). Both groups continued to see adoption of Asthma Action Plans 3 months after the Program (MAIN: +27.16% and UA: +200.04%). (See Table 27).

Table 27. Program Impact on number of Participants with Asthma Action Plans (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	37.50%	55.26%	23.68%
Post-Intervention	65.00%	63.16%	63.16%
Ex-post Intervention	72.15%	70.27%	71.05%
Changes in Asthma Action Plans Immediately after Program	+73.33%	+14.30%	+166.72%
Changes in Asthma Action Plans 3 Months after Program	+92.40%	+27.16%	+200.04%

Adherence to Controller Medication Regime

In the 3 months prior to the Program, a quarter of MAIN participants and approximately 16% of UA participants reported not missing a dose of their medication. As summarized in Table 28, both groups increased medication adherence immediately following the Program (MAIN: +69.98% and UA: +166.69%) and again at 3 months after the Program (MAIN: +54.03% and UA: +191.00%). UA participants experienced a larger percent increase in number of participants reporting 100% medication adherence during these periods.

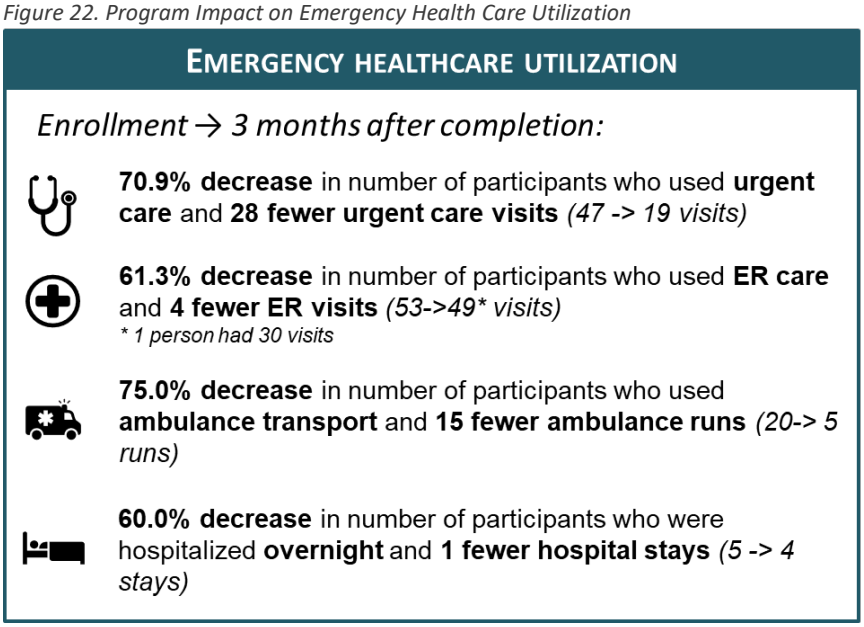
Table 28. Program Impact on Number of Participants with 100% Controller Medication Adherence (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	21.25%	26.32%	15.79%
Post-Intervention	46.25%	44.74%	42.11%
Ex-post Intervention	44.87%	40.54%	45.95%
Changes in Medication Adherence Immediately after Program	+117.65%	+69.98%	+166.69%
Changes in Medication Adherence 3 Months after Program	+111.15%	+54.03%	+191.00%

Program Intermediate Impact on Emergency Health Care Utilization

Following the Program, all participants reported less emergency health care utilization. This decrease was seen in both the number of participants who used the services as well as the number of times each service was used (*see Figure 22*). At 3 months after the Program, there was an increase in the use of emergency health care compared to figures immediately after the Program. With the exception of overnight hospital stays for MAIN participants, these increases remained below baseline figures.

Figure 22. Program Impact on Emergency Health Care Utilization



Use of Urgent / Walk-in Care

In the 3 months prior to the Program, half of MAIN participants and approximately one-in-three UA participants had visited urgent care 47 times (MAIN: 31 and UA: 15). As summarized in Table 29 and Table 30, over the Program period, there was a decrease in both the percentage of participants who used urgent care facilities (MAIN: -95.00% and UA: -81.83%) and the number of times urgent care was used (MAIN: 2 and UA: 2). At 3 months after the Program, there was a decrease from baseline in both percentage of participants using urgent care services (MAIN: -15.79% and UA (-72.75%) and total number of visits (MAIN: 15 and UA: 4). These figures at 3 months following the intervention were larger than those immediately following the intervention.

Table 29. Program Impact on Number of Participants Using Urgent Care (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	40.00%	52.63%	28.95%
Post-Intervention	3.75%	2.63%	5.26%
Ex-post Intervention	11.25%	15.79%	7.89%
Changes in Use of Urgent Care Immediately after Program	-90.63%	-95.00%	-81.83%
Changes in Use of Urgent Care 3 Months after Program	-70.88%	-15.79%	-72.75%

Table 30. Program Impact on Total Number of Urgent Care Visits (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	47	31	15
Post-Intervention	4	2	2
Ex-post Intervention	19	15	4
Change in Total Urgent Care Visits Immediately after Program	-43	-29	-13
Change in Total Urgent Care Visits 3 Months after Program	-28	-16	-11

Use of Emergency Room Care

In the 3 months prior to the Program, 16% of MAIN participants and two-thirds of UA participants reported a total of 53 emergency room visits (MAIN: 12 and UA: 41). As summarized in Table 31 and Table 32, over the Program period, there was a decrease in both the percentage of participants who reported emergency room visits (MAIN: -100.00% and UA: -87.51%) and the number of reported emergency room visits (MAIN: 0 and UA: 6). At 3 months after the Program, there was a decrease from baseline in both percentage of participants using urgent care services (MAIN: -16.66% and UA: 70.84%) and total number of visits (MAIN: 41 and UA: 8). It should be noted that one participant reported visiting the emergency room 30 times in the 3-month period following the program, which dramatically impacts data interpretation.

Table 31. Program Impact on Number of Participants Using Emergency Room Care (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	38.75%	15.79%	63.16%
Post-Intervention	3.75%	0.00%	7.89%
Ex-post Intervention	15.00%	13.16%	18.42%
Changes in Use of ER Care Immediately after Program	-90.32%	-100%	-87.51%
Changes in Use of ER Care 3 Months after Program	-61.29%	-16.66%	-70.84%

Table 32. Program Impact on Total Number of Emergency Room Visits (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	53	12	41
Post-Intervention	6	0	6
Ex-post Intervention (*1 participant used ER 30 times)	49*	41*	8
Change in Total ER Visits Immediately after Program	-47	-12	-35
Change in Total ER Visits 3 Months after Program	-4	+29	-33

Use of Ambulances

In the 3 months prior to the Program, less than 10% of MAIN participants and one-quarter of UA participants reported a total of 20 ambulance runs (MAIN: 4 and UA: 16). As summarized in Table 33 and Table 34, over the Program period there was a decrease in both the percentage of participants who reported ambulance runs (MAIN: -100.00% and UA: -88.89%) and the total number of ambulance runs (MAIN: 0 and UA: 1). At 3 months after the Program, there was a decrease from baseline in both percentage of participants using ambulance services (MAIN: -33.33% and UA: -88.89%) and total number

of runs (MAIN: 4 and UA: 2), but there was an increase in use of ambulance services compared to immediately following the Program.

Table 33. Program Impact on Number of Participants Using Ambulance Transportation (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	15.00%	7.89%	23.68%
Post-Intervention	1.25%	0.00%	2.63%
Ex-post Intervention	3.75%	5.26%	2.63%
Changes in Use of Ambulance Services Immediately after Program	-91.67%	-100.00%	-88.89%
Changes in Use of Ambulance Services 3 Months after Program	-75.00%	-33.33 %	-88.89%

Table 34. Program Impact on Total Number of Ambulance Runs (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	20	4	16
Post-Intervention	1	0	1
Ex-post Intervention	5	4	2
Change in Total Ambulance Runs Immediately after Program	-19	-4	-15
Change in Total Ambulance Runs 3 Months after Program	-15	0	-14

Overnight Hospitalization

Overnight hospital stays for asthma are not common and in the 3 months prior to the Program, less than 6% of MAIN participants and 6% of UA participants reported a total of 5 overnight stays (MAIN: 2 and UA: 3). As summarized in Table 35 and Table 36, immediately following the Program no participant reported an overnight hospital stay (MAIN: -100.00% and UA: -100.00%). At 3 months after the Program, there was an increase in overnight hospital stays for MAIN participants that equaled baseline, but UA participants continued to report no overnight hospital stays.

Table 35. Program Impact on Number of Participants with Overnight Hospital Stays (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	6.25%	5.26%	7.89%
Post-Intervention	0.00%	0.00%	0.00%
Ex-post Intervention	2.50%	5.26%	0.00%
Changes in Hospital stays Immediately after Program	-100.00%	-100.00%	-100.00%
Changes in hospitals stays 3 Months after Program	-60.00%	0.00 %	-100.00%

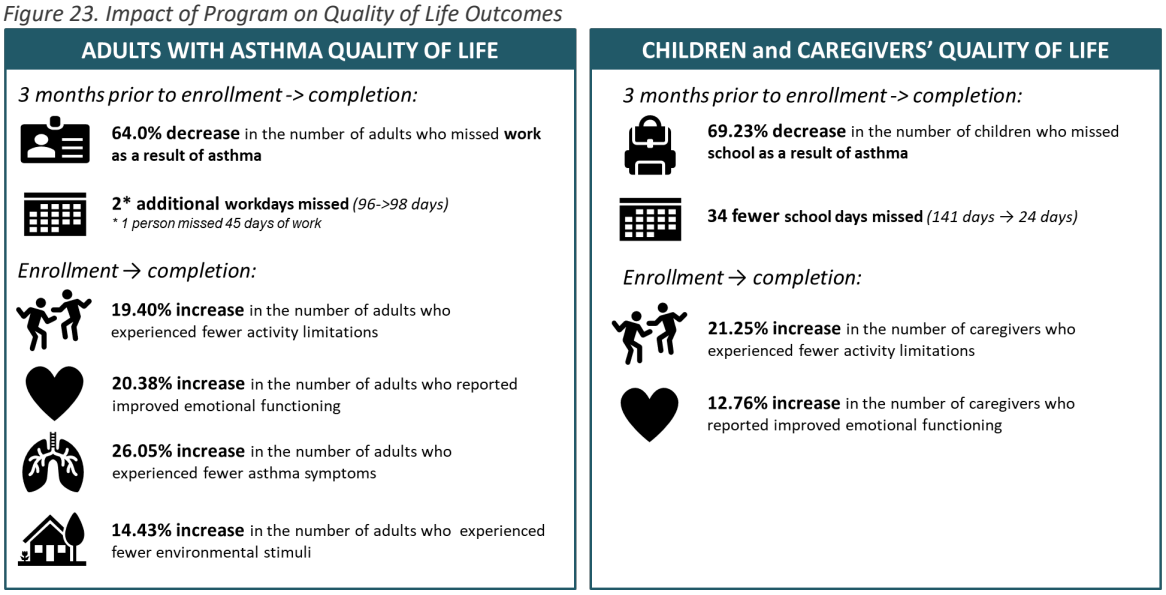
Table 36. Program Impact on Total Number of Overnight Hospital Stays (Pre-Intervention as benchmark)

	Overall (n=80)	MAIN (n=38)	UA (n=42)
Pre-Intervention	5	2	3
Post-Intervention	0	0	0
Ex-post Intervention	4	4	0
Change in Total hospital stays Immediately after Program	-5	-2	-3
Change in Total hospital stays 3 Months after Program	-1	+2	-3

Program Intermediate Impact on Quality of Life

The Program appears to have improved functioning and quality of life for adults with asthma, children with asthma, and their caregivers. Adults and children experienced fewer missed days of work and school due to asthma. Adults and caregivers of children with asthma also reported increased activity levels and emotional function. During the period of the Program, there was also an increase in the number of adults who reported fewer asthma symptoms and environmental asthma triggers. A summary of the quality of life outcome measures is shown in Figure 23.

Figure 23. Impact of Program on Quality of Life Outcomes



Work Absenteeism Among Adults with Asthma

Overall, absenteeism from school and work decreased substantially among participants from both groups immediately following the program (MAIN: -60.00% and UA: -66.67%). At baseline, there was a total of 96 missed days of work and school (MAIN: 78 and UA: 17), which decreased to 71 days immediately following the Program (MAIN: 67 and UA: 4). At 3 months following the Program, work and school absenteeism increased substantially for MAIN participants, but remained low for UA participants (MAIN: 95 and UA: 3) (See Tables 37 and 38). It should be noted that one MAIN participant missed a total of 45 workdays in this period.

Table 37. Program Impact on Number of Adults Unable to Go to Work (Pre-Intervention as benchmark)

	Overall (n=60)	MAIN (n=23)	UA (n=33)
Pre-Intervention	41.67%	65.22%	27.27%
Post-Intervention	16.67%	26.09%	9.09%
Ex-post Intervention	15.00%	34.78%	3.03%
Changes in Work Absenteeism Immediately after Program	-60.00%	-60.00%	-66.67%
Changes in Work Absenteeism 3 Months after Program	-64.00%	-46.67%	-88.89%

Table 38. Program Impact on Total Number of Workdays Absent (Pre-Intervention as benchmark)

	Overall (n=60)	MAIN (n=23)	UA (n=33)
Pre-Intervention	96	78	17
Post-Intervention	71	67	4
Ex-post Intervention (*1 person missed 45 days of work)	98	95	3
Change in Total Missed Workdays Immediately after Program	-25	-11	-13
Change in Total Missed Workdays 3 Months after Program	+2	+17	-14

Quality of Life of Adults with Asthma

Participants from both implementing agencies reported improved quality of life across all four domains: activity limitations, emotional function, symptoms, and environmental stimuli. Table 39 illustrates that immediately following the Program and 3 months after the Program, there was a positive change in the average activity limitation score for all participants. Immediately after the Program, MAIN participants saw a minor decrease in average score (-1.06%), but this recovered at 3 months after the Program. At both time periods, UA participants saw more dramatic increases in average activity limitation score (3 months after Program, MAIN: +4.54% and UA: +31.82%).

Table 39. Program Impact on Adults with Asthma's Average Activity Limitation Score (Pre-Intervention as benchmark)

	Overall (n=60)	MAIN (n=23)	UA (n=33)
Pre-Intervention	69.94%	75.31%	66.34%
Post-Intervention	78.21%	74.51%	81.06%
Ex-post Intervention	83.57%	78.73%	87.45%
Changes in Average Activity Limitation Score Immediately after Program	+11.82%	-1.06%	+22.19%
Changes in Average Activity Limitation Score 3 Months after Program	+19.40%	+4.54%	+31.82%

The average emotional function score also improved for both groups. Both MAIN and UA reported higher emotional functioning scores immediately following the Program (MAIN: +8.86% and UA: +14.67%) and 3 months after the Program (MAIN: +7.93% and UA: +28.10%). As with activity limitation scores, UA participants saw greater change than MAIN participants at both timepoints (See Table 40).

Table 40. Program Impact on Adults with Asthma's Average Emotional Function Score (Pre-Intervention as benchmark)

	Overall (n=60)	MAIN (n=23)	UA (n=33)
Pre-Intervention	68.10%	65.22%	70.85%
Post-Intervention	77.00%	71.00%	81.10%
Ex-post Intervention	81.98%	70.39%	90.76%
Changes in Average Emotional Function Score Immediately after Program	+13.07%	+8.86%	+14.67%
Changes in Average Emotional Function Score 3 Months after Program	+20.38%	+7.93%	+28.10%

The average symptom scores also improved for both groups. Both MAIN and UA reported higher symptom scores immediately following the Program (MAIN: +16.28% and UA: +23.16%) and 3 months

after the Program (MAIN: +18.51% and UA: +30.97%). As with previous quality of life scores, Table 41 illustrates that UA participants saw greater change than MAIN participants at both timepoints.

Table 41. Program Impact on Adults with Asthma Average Symptoms Score (Pre-Intervention as benchmark)

	Overall (n=60)	MAIN (n=23)	UA (n=33)
Pre-Intervention	61.62%	59.75%	63.20%
Post-Intervention	74.62%	69.48%	77.84%
Ex-post Intervention	77.67%	70.81%	82.77%
Changes in Average Symptoms Score Immediately after Program	+21.10%	+16.28%	+23.16%
Changes in Average Symptoms Score 3 Months after Program	+26.05%	+18.51%	+30.97%

Immediately following the Program, and at 3 months after the Program, both groups saw improvements in Environmental Stimuli scores. Immediately following the Program, scores showed moderate improvement (MAIN: +7.50% and UA: +8.53%), but UA participants showed increased score improvement (compared to MAIN participants) at 3 months after the Program (MAIN: +7.10% and +21.13%) (See Table 42).

Table 42. Program Impact on Adults with Asthma's Average Environmental Stimuli Score (Pre-Intervention as benchmark)

	Overall (n=60)	MAIN (n=23)	UA (n=33)
Pre-Intervention	68.25%	58.39%	74.46%
Post-Intervention	74.50%	62.77%	80.81%
Ex-post Intervention	78.10%	62.53%	90.19%
Changes in Average Environmental Stimuli Score Immediately after Program	+9.16%	+7.50%	+8.53%
Changes in Average Environmental Stimuli Score 3 Months after Program	+14.43%	+7.10%	+21.13%

School Absenteeism Among Children with Asthma

Like their adult counterparts, immediately following and at 3 months after the Program, children saw a decrease in both the percentage of participants unable to go to school and total missed school days. In the 3 months prior to the Program, participants missed a total of 43 school days (MAIN: 27 and UA: 16). Immediately following the Program, the number of missed days had decreased to 7 (MAIN: 6 and UA: 1) as had the percentage of participants missing school days (MAIN: -72.73% and UA: -50.00%). While there was a slight increase in missed days 3 months after the Program (MAIN: 8 and UA: 1), the percentage of participants missing school remained static (MAIN: -72.73% and UA: -50.00%) (See Table 43 and Table 44).

Table 43.Program Impact on Number of Participants Unable to Go to School (Pre-Intervention as benchmark)

	Overall (n=20)	MAIN (n=15)	UA (n=5)
Pre-Intervention	65.00%	73.33%	40.00%
Post-Intervention	20.00%	20.00%	20.00%
Ex-post Intervention	20.00%	20.00%	20.00%
Changes in Missed School Days Immediately after Program	-69.23%	-72.73%	-50.00%
Changes in Missed School Days 3 Months after Program	-69.23%	-72.73%	-50.00%

Table 44. Program Impact on Total Number of School Days Absent (Pre-Intervention as benchmark)

	Overall (n=20)	MAIN (n=15)	UA (n=5)
Pre-Intervention	43	27	16
Post-Intervention	7	6	1
Ex-post Intervention	9	8	1
Change in Total Missed School Days Immediately after Program	-36	-21	-15
Change in Total Missed School Days 3 Months after Program	-34	-19	-15

Quality of Life Among Caregivers

Like adults with asthma, the quality of life among caregivers improved in activity limitation and emotional function. After participating in the Program, average activity limitation scores improved for all participants (MAIN: +21.45% and UA: +25.80%). While the improvement in scores continued for MAIN participant caregivers (+23.90%), there was a slight decrease in scores at 3 months after the Program for UA participant caregivers, though it remained above baseline scores (+15.05%) (See Table 43).

Table 44. Program Impact on Caregivers' Average Activity Limitation Score (Pre-Intervention as benchmark)

	Overall (n=20)	MAIN (n=15)	UA (n=5)
Pre-Intervention	60.53%	58.42%	66.43%
Post-Intervention	74.11%	70.95%	83.57%
Ex-post Intervention	73.39%	72.38%	76.43%
Changes in Average Activity Limitation Score Immediately after Program	+22.44%	+21.45%	+25.80%
Changes in Average Activity Limitation Score 3 Months after Program	+21.25%	+23.90%	+15.05%

Similarly, there were modest increases in caregivers' average emotional function scores at both timepoints. As Table 44 illustrates, both groups reported improved emotional function scores immediately following the Program (MAIN: +9.80% and UA: +17.55%). At 3 months after the Program, UA participants reported a decrease in scores, but still above baseline scores (MAIN: +12.63% and UA: +13.60%).

Table 45. Program Impact on Caregivers' Average Emotional Function Score (Pre-Intervention as benchmark)

	Overall (n=20)	MAIN (n=15)	UA (n=5)
Pre-Intervention	68.34%	66.89%	72.38%
Post-Intervention	76.35%	73.44%	85.08%
Ex-post Intervention	77.06%	75.34%	82.22%
Changes in Average Emotional Function Score Immediately after Program	+11.72%	+9.80%	+17.55%
Changes in Average Emotional Function Score 3 Months after Program	+12.76%	+12.63%	+13.60%

CHAPTER 8: DISCUSSION

Short-Term Efficacy

After participation in the Program, there were improvements in self-management behaviors, individual asthma burden, emergency health care utilization, and health outcomes. Under self-management behaviors, there was a modest reduction in everyday tobacco use by both adult participants and caregivers. At the completion of the Program, the number of individuals with Asthma Action Plans nearly doubled - from 55 to 101. There was also improvement in correct device usage and the number of participants who were correctly taking their controller medications.

The individual asthma burden that participants experienced also improved following the Program. There was a reduction in missed days of school and work, though there was still a small subset of adults that were missing considerable numbers of workdays. There was a sizeable reduction in missed school days for children, with fewer children missing on average fewer days of school. Quality of life improved for participants, with fewer activity limitations and improved emotional functioning and trigger management.

Most notably, there was a marked decrease in the use of emergency health care. Prior to participation in the Program, adults and children were over-utilizing emergency services including urgent care, emergency departments, ambulance services, and overnight hospital stays. Due to an increase in participants with asthma action plans, adherence to controller medications, and correct device use, utilization of the higher levels of care dramatically reduced for both adult and child populations.

Finally, overall health outcomes improved. Participants self-reported improved health status and reduced reliance on oral steroids. And the number of participants who felt their asthma was well controlled nearly doubled after completion of the Program.

Intermediate efficacy

Three months after participating in the Program, participants were still enjoying many of the improvements experienced immediately after the completing the Program, including self-management behaviors, health care utilization, and quality of life. Self-management behaviors continued to be practiced at 3 months following the Program. Most notably, well-controlled asthma and adoption of Asthma Action Plans showed improvement at 3-month follow-up compared to both immediate follow-up and baseline figures. Adherence to controller medication regime, while higher at 3 months than at baseline, experienced a small decrease among MAIN participants compared to immediately following the Program.

Emergency health care utilization showed increases at the 3-month follow-up compared to immediately following the Program. While the use of urgent/walk-in care services decreased dramatically immediately following the Program (-90.63%), there was an increase in the number of participants using these services at 3-month follow-up (3.75% vs. 11.25% overall). This trend continued across all other emergency health care services, but figures did not reach or exceed baseline data. It should be noted that one participant had utilized emergency room services 30 times at 3-month follow-up, which does impact data interpretation. Despite increases in the percentage of participants utilizing emergency health care services at 3-month follow-up, the Program is still effective at reducing these figures overall.

Finally, participants enjoyed continued improved quality of life at 3-month follow-up. Participants generally missed fewer days of work and school. On average scores on activity limitation, emotional function, symptoms, and environmental function continued to improve at 3-month follow-up.

LIMITATIONS

The following limitations should be considered prior to generalizing the results. Due to the limited sample size, no seasonal variations were controlled for. All client outcomes were self-reported and not verified by any external source. Educators completed the tools with clients and this may have influenced the clients' responses.

REFERENCES

Barbanel, D., Eldridge, S., & Griffiths, C. (2003). Can a self-management programme delivered by a community pharmacist improve asthma control? A randomised trial. *Thorax*, *58*(10), 851-854. doi: 10.1136/thorax.58.10.851

Burkhart, P., Rayens, M., Oakley, M., Abshire, D., & Zhang, M. (2007). Testing an Intervention to Promote Children's Adherence to Asthma Self-Management. *Journal Of Nursing Scholarship*, *39*(2), 133-140. doi: 10.1111/j.1547-5069.2007. 00158.x

Butz, A., Syron, L., Johnson, B., Spaulding, J., Walker, M., & Bollinger, M. (2005). Home-Based Asthma Self-Management Education for Inner City Children. *Public Health Nursing*, *22*(3), 189-199

Chen, H., Gould, M., Blanc, P., Miller, D., Kamath, T., Lee, J., & Sullivan, S. (2007). Asthma control, severity, and quality of life: Quantifying the effect of uncontrolled disease. *Journal Of Allergy And Clinical Immunology*, *120*(2), 396-402. doi: 10.1016/j.jaci.2007.04.040

Dean, B., Calimlim, B., Sacco, P., Aguilar, D., Maykut, R., & Tinkelman, D. (2010). Uncontrolled asthma: assessing quality of life and productivity of children and their caregivers using a cross-sectional Internet-based survey. *Health And Quality Of Life Outcomes*, *8*(1), 96. doi: 10.1186/1477-7525-8-96

Gibson, P., Powell, H., Wilson, A., Abramson, M., Haywood, P., & Bauman, A. et al. (2002). Self-management education and regular practitioner review for adults with asthma. *Cochrane Database Of Systematic Reviews*, (3). doi: 10.1002/14651858.cd001117

Guevara, J., Wolf, F., Grum, C., & Clark, N. (2003). Effects of educational interventions for self-management of asthma in children and adolescents: systematic review and meta-analysis. *BMJ*, *326*(7402), 1308-1308. doi: 10.1136/bmj.326.7402.1308

Janson, S., Fahy, J., Covington, J., Paul, S., Gold, W., & Boushey, H. (2003). Effects of individual self-management education on clinical, biological, and adherence outcomes in asthma. *The American Journal Of Medicine*, *115*(8), 620-626. doi: 10.1016/j.amjmed.2003.07.008

Moy, M., Israel, E., Weiss, S., Juniper, E., Dube, L., & Drazen, J. (2001). Clinical Predictors of Health-related Quality of Life Depend on Asthma Severity. *American Journal Of Respiratory And Critical Care Medicine*, *163*(4), 924-929. doi: 10.1164/ajrccm.163.4.2008014

Murphy, V., Gibson, P., Talbot, P., Kessell, C., & Clifton, V. (2005). Asthma self-management skills and the use of asthma education during pregnancy. *European Respiratory Journal*, *26*(3), 435-441. doi: 10.1183/09031936.05.00135604

Okelo, S., Wu, A., Krishnan, J., Rand, C., Skinner, E., & Diette, G. (2004). Emotional quality-of-life and

outcomes in adolescents with asthma. *The Journal Of Pediatrics*, *145*(4), 523-529. doi: 10.1016/j.jpeds.2004.06.043

Shames, R., Sharek, P., Mayer, M., Robinson, T., Hoyte, E., & Gonzalez-Hensley, F. et al. (2004). Effectiveness of a multicomponent self-management program in at-risk, school-aged children with asthma. *Annals Of Allergy, Asthma & Immunology*, *92*(6), 611-618. doi: 10.1016/s1081-1206(10)61426-3