Family and Home Asthma Services across the Controlling Asthma in American Cities Project

Amanda Savage Brown, Sheri Disler, Laura Burns,
Angie Carlson, Adam Davis, Cizely Kurian, Dolores Weems,
and Kristen Wilson

ABSTRACT *Asthma is among the most common chronic childhood diseases, affecting 6.8 million children nationwide. The highest rates of morbidity and mortality associated with the disease occur among those living in the inner city. Because asthma is a complex disease affected by physiological, social, environmental, and behavioral factors, interventions to reduce its morbidity burden need to address multiple determinants of health. In response to this need, the Centers for Disease Control and Prevention developed a multisite cooperative agreement for the Controlling Asthma in American Cities Project (CAAC), with the primary goal of developing innovative, effective community-based interventions. All CAAC sites found a need for family and home asthma services (FHAS) and developed multicomponent (e.g., asthma self-management, social services, coordinated care) and multitrigger environmental interventions. This paper presents a synthesis of key program variables and process indicators for six CAAC FHAS interventions for consideration by communities, coalitions, or programs planning to implement similar activities.*

KEYWORDS *Home visit, Asthma, Trigger reduction, Self-management, Home education, Home remediation, Cross site, Social factors*

INTRODUCTION

Asthma is among the most common chronic childhood diseases, affecting 6.8 million children.^{1,2} It is a leading cause of hospitalizations and emergency department (ED) visits among children and adolescents.³ Children with asthma who live in inner cities have the highest rates of morbidity and mortality.⁴⁻⁸ Asthma is also costly—US school-aged children with asthma have direct medical care costs that exceed \$1 billion annually and indirect costs that total \$1 billion annually.⁹

Brown and Disler are with the Centers for Disease Control and Prevention, Air Pollution and Respiratory Health Branch, Atlanta, GA, USA; Burns is with the Chesterfield County Health Department, Virginia Department of Health, Chesterfield, VA, USA; Carlson is with the Data Intelligence, LLC, Eden Prairie, MN, USA; Davis is with the Children's Hospital and Research Center Oakland, Oakland, CA, USA; Kurian is with the Merck Sharp & Dohme Corp, Philadelphia, PA, USA; Weems is with the School of Public Health, University of Illinois, Chicago, IL, USA; Wilson is with the School of Public Health, Saint Louis University, St. Louis, MO, USA.

Correspondence: Amanda Savage Brown, Centers for Disease Control and Prevention, Air Pollution and Respiratory Health Branch, Atlanta, GA, USA. (E-mail: abrown2@cdc.gov)

The findings and conclusions in this manuscript are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

*Members (Laura Burns, Angie Carlson, Adam Davis, Cizely Kurian, Dolores Weems Jr., and Kristen Wilson) of the Family and Home Asthma Services cross-site workgroup are listed alphabetically.

Asthma is a complex disease affected by physiological, social, environmental, and behavioral factors.^{10–13} Both the National Cooperative Inner-City Asthma Study and the Inner-City Asthma Intervention identified several interrelated risk factors for morbidity, all of which fell within the social (e.g., suboptimal medical care), environmental (e.g., allergens in the home environment), and behavioral (e.g., poor medication adherence) determinants of health.^{14,15} With such a broad range of contributing factors, reducing asthma morbidity requires asthma management that effectively addresses the full context of a person's life instead of clinical management alone, and interventions that address multiple determinants of health.¹⁶

The Centers for Disease Control and Prevention (CDC) addressed this need by developing a cooperative agreement for the Controlling Asthma in American Cities Project (CAAC). The CAAC used existing knowledge and tools to develop and sustain comprehensive, collaborative community-wide efforts to improve asthma care and control in defined urban populations with a large, unmet need to control asthma among youth ages 0–18. In fall 2001, seven cities across the United States received funding for a 2-year planning phase, followed by a 5-year implementation phase. The primary goal of the funding was to develop innovative, effective community-based interventions that would improve asthma control community-wide, and continue when funding ended.

BACKGROUND AND METHODS

Although the CAAC did not require any particular types of asthma interventions, program workers from all seven sites identified a need for family and home asthma services (FHAS).^{17–25} Each CAAC FHAS intervention addressed multiple determinants of health by treating the whole person, instead of focusing only on providing appropriate medical therapy for the disease. All CAAC FHAS programs provided multicomponent, multitrigger environmental interventions, and additional non-environmental components such as asthma self-management, social services, or coordinated care.

This report features programs in six urban areas: Chicago, IL, USA; Oakland, CA, USA; Philadelphia, PA, USA; Richmond, VA, USA; St. Louis, MO, USA; and Minneapolis/St. Paul, MN, USA. The New York City program developed and refined its FHAS intervention too late in the CAAC's life cycle for inclusion in this publication. All sites received Human Subjects approval from their local Institutional Review Board.

Information on the implementation and evaluation of the FHAS interventions was drawn from multiple sources, including routine site reports, conference calls, and site visits. During the implementation phase, CDC helped each site develop indicator grids to track each intervention's annual progress toward its 5-year targets. Information specific to FHAS was compiled from the grids, and additional data about program management, content, and delivery were gathered by a CDC-developed cross-site questionnaire administered during the sites' final year of implementation. This paper synthesizes key program variables (Table 1) and process indicators (Table 2) across the CAAC FHAS interventions. Publications presenting outcome data and measures of effectiveness for individual sites are anticipated when sites finalize their data.

ORGANIZATIONAL STRUCTURE

Planning Partners Types of FHAS planning partners varied across sites, most often representing community resources identified during the 2-year planning phase.

Community-based social service organizations (CBO) were key partners at all CAAC sites. Other partners included (in order of frequency) clinical settings (e.g., hospitals, clinics), case management providers, federal, state, city, and local government agencies, and universities.

Referral Partners Types of referral partners who recruited CAAC participants (Table 1) also varied across sites as a result of differences in program focus. St. Louis reported referrals exclusively from a CBO. At the remaining sites, clinical referrals (i.e., hospitals, community clinics, primary care providers [PCP], managed care organizations, health maintenance organizations [HMO], and respiratory therapists) were the most common, followed by schools, CBOs, government agencies, and an asthma call center (Table 3).

Over the life of the program, most sites used a variety of approaches to expand their referral sources when the original pool proved inadequate. Four sites—Chicago, Philadelphia, Richmond, and Minneapolis/St. Paul—monitored referrals regularly, either quarterly or more frequently, and coaxed partners when referrals lagged. Philadelphia and Minneapolis/St. Paul staff sent reminder letters to partners during slow periods. St. Louis workers contracted with partners to provide a predetermined number of clients ($n=60/\text{year}$). Oakland staff ensured adequate referrals by partnering with the local Medicaid health plan and linking with the site's school-based asthma program.

Implementation Partners The St. Louis and Richmond sites used preexisting case management services within local social service organizations to deliver FHAS. St. Louis's partner focused on poverty-related concerns, with asthma being but one of many possible stressors identified by families. Richmond's partner focused primarily on health-related issues among children living in poverty. Both St. Louis and Richmond staff provided capacity building and evaluation guidance to their partner social service organizations.

Three sites used CAAC funding to either establish or expand FHAS programs. Chicago site staff used CAAC funds to expand a local social service agency's community educator program to also include a clinical setting and a CBO. Chicago CAAC staff managed all three sites to reach children with poorly controlled asthma consistently and systematically throughout the intervention area. Oakland used CAAC funding to create the Oakland Kicks Asthma Case Management Program as part of an integrated system that included the local school district, a children's hospital, and a Medicaid managed care plan. Workers at the Philadelphia site developed the Community Asthma Prevention Program's Home Visitor Program as part of a community-based effort based at the Children's Hospital of Philadelphia in West Philadelphia. Philadelphia site workers also used CAAC funds to adapt and expand an existing model in West Philadelphia²⁶ to target an equally disadvantaged neighborhood with high asthma prevalence in North Philadelphia.

The Minneapolis/St. Paul site began by partnering with two home environmental modification programs funded during a portion of the same grant period as CAAC by the Environmental Protection Agency and the Department of Housing and Urban Development to provide environmental remediation and self-management education in Minneapolis and St. Paul. Initially, site staff used CAAC funding to provide consistent evaluation measures for both programs. When the other federal funding ended for those programs, the site sustained FHAS activities by using CAAC funds to enroll additional families and homes.

TABLE 1 CAACP family and home asthma services program delivery

	Chicago	Oakland	Philadelphia	Richmond	St. Louis	Minneapolis/St. Paul
Referral Sources	MD Schools Hospitals Clinics CBOs Community health events	MD Schools Hospitals Clinics MCOs	MD Schools Hospitals Clinics Family self-refer MCOs CBOs DOH Asthma Link Line Other health events	MD Schools Hospitals Family self-refer CBOs HMOs	CBO partners	MD Schools Home-visiting RTs Self-referral (verified with MD)
Inclusion Criteria	Age: 0–18 Asthma Dx All asthma Reside in catchment area	Age: 8–18 Asthma Dx Uncontrolled or Hosp/ED visit for asthma Reside in catchment area	Age: 2–17 Asthma Dx Controller meds Reside in catchment area	Age: 0–18 Asthma Dx Income <200% poverty level Reside in catchment area	Age: 2–17 Asthma Dx At or below poverty Reside in catchment area	Age: 0–18 Moderate persistent or severe asthma Uncontrolled or hosp/ED visit for asthma Reside in catchment area Excessive school days missed Medical assistance qualified Home environmental mitigation
Focus of Education	Home environmental mitigation Asthma education and self-management Life skills (including communicating with medical care provider) Exposure to passive smoke	Home environmental mitigation Asthma education and self-management Obtaining/working with care provider Referrals to PCP, smoking cessation, insurance, others as needed	Home environmental mitigation Asthma education and self-management Smoking cessation and exposure to passive smoke Obtaining/working with care provider Referral to social services	Referral to home environmental mitigation program Asthma education and self-management Obtaining/working with care provider Referral to social services	Home environmental mitigation Asthma education and self-management Life skills Referral to other services	Asthma education and self-management Smoking cessation Obtaining/working with care provider

Number of Sessions	Min: 3 Max: 4	Min: 3 Max: 4	Level 1: Min: 1, Max: 2 Level 2: Min: 2, Max: 5 Level 3: Min: 9, No max	Min: 1–2 No max	Min: 1 No max	Min: 2 No max
Session Duration Resources or Modifications	1.5–2 h Home-use products	1–1.5 h Home-use products	1–1.5 h Home-use products	1–1.5 h Home-use products	≥30 min All appropriate environmental control products and cleaning supplies Asthma education literature	1 h Home-use products
	Pest management products Asthma education literature	Medical supplies Cleaning products	Pest management products Cleaning products Other services as needed and available Asthma education literature	Asthma education literature		Pest management products Limited structural changes Other services as needed and available
Client incentives	Products received as part of program \$20 incentive cards	Products received as part of program \$15 at second visit \$10 at follow-up call	Products received as part of program \$15 of gift certificates for each month of completed follow-up symptom diary	None beyond products received as part of program	None beyond products received as part of program	None beyond products received as part of program
Completion Criteria	(\$10 at 2nd and last visit) 12 months with completion of 3 or 4 visits	Min. 3 visits and 3- and 9-month follow-up	Level 1: 1 visit Level 2: min. 2 visits, and 4–6-month follow-up Level 3: min. 9 visits, and 3–6-month follow-up	12 months service Family elects termination or moves from catchment area	No completion criteria (may be in program as long as needed). Visit counted by completed checklist.	12 months from completion of home modifications or product delivery
Funding Source	CDC	CDC EPA grant Reimbursement from MCOs	CDC	CBO supplemented with CDC funding	CBO budget supplemented in part with CDC funds	CDC HUD grant EPA grant MCO funding

TABLE 2 Family and home asthma services indicators measured by CAAC sites

	Chicago	Oakland	Philadelphia	Richmond	St. Louis	Minneapolis/St. Paul
↓ Hospitalization	•	•	•	•	•	•
↓ Emergency Department Visits	•	•	•	•	•	•
↓ Unscheduled Asthma Visits	•					•
Appropriate Medication Use ^a	•	•	•		•	•
↓ Asthma Symptoms ^b	•	•	•	•	•	•
↑ Use of Asthma Action Plans	•		•		•	
↓ School Absences	•		•			
↓ Functional Limitations	•	•				•
↑ Quality of Life ^c					•	
Use of Environmental Controls ^d	•		•	•	•	
Links to PCP			•	•		•
Insurance Coverage			•	•		
Current Childhood Immunizations				•		

^aIncreased use of controller medications, decreased use of rescue medications, and decreased use of oral corticosteroids

^bSymptom information collection differed: some sites collected daytime symptoms, nighttime symptoms, and some overall symptoms over various time frames (30 days, 3, 6, 9, 12 months)

^cImproved sleep quality, participation in athletics

^dPrimarily the use of mattress and pillow covers

INCLUSION CRITERIA, RECRUITMENT, AND ENROLLMENT

CAAC funds were intended for the development of programs for urban youth with asthma in a defined population with a large, unmet need for asthma control. The only inclusion criterion specified was an upper age limit of 18 years. As indicated in Table 1, staff from three sites chose a more limited age range. All sites added residence in the site-defined catchment area and an asthma diagnosis from a healthcare provider as additional criteria. Other common criteria were asthma severity, income, medication use, and number of hospitalizations and ED visits.

As described in Table 3, approaches to recruitment varied. Workers at the Minneapolis/St. Paul site contracted with a health services agency for referrals from

TABLE 3 Average annual referrals by source^a

	Chicago Average (%)	Oakland Average (%)	Philadelphia Average (%)	Richmond Average (%)
Clinical	110 (61)	98 (31)	193 (64)	26 (34)
Schools	69 (39)	58 (19)	17 (6)	7 (9)
CBO/Social Service Agencies	n/a	n/a	36 (12)	12 (16)
Other	n/a	150 (50) ^b	55 (18) ^c	31 (41) ^d
Total	179	306	301	76

^aSt. Louis and MN did not track overall clients referred by source and are excluded from table

^bLocal health plan

^cExisting asthma call center, insurance companies, self-referral

^dSelf-referral and one from a government agency

physicians, school nurses, other healthcare professionals, or self-referrals. Program staff promoted referrals by distributing pamphlets to partners and going to physician offices and schools. Recruitment at the other five sites included calling a referral list provided by partners, mailing information to referral partners, and visiting various settings (e.g., schools, clinics, community centers). The percentage of persons enrolled through these recruitment efforts ranged from 49% to 72% (Table 4).

Enrollment varied considerably by referral source. Among the four sites that tracked referral and enrollment by source, Chicago and Oakland achieved high enrollments (>80%) by using clinical-based sources. Both sites called persons on referral lists; Oakland also mailed information to persons on their referral lists and Chicago also recruited in-person. Philadelphia achieved its highest enrollments (76%) by partnering with CBOs and also called a referral list, mailed follow-up information when requested, and recruited some in-person. Richmond’s highest enrollment (67%) was among clients who self-referred. Richmond’s proactive recruitment activities included recruiting in-person and calling from referral lists. If clients were unreachable after two telephone attempts, Richmond’s third attempt included a home visit; if the potential client was not home, a door hanger was left with contact information for the program.

CONTENT AND REMEDIATION INTENSITY

All CAAC FHAS programs focused on multiple components and triggers (Table 1). All provided environmental and trigger-reduction education. Nonenvironmental components included asthma education (i.e., symptoms, medications) and self-management education and training (i.e., asthma action plans, use of peak flow meters and spacers). Some programs also offered referrals to social services or coordinated care.

Staff from all sites conducted a home-environment assessment (i.e., visual audits with checklists) during the first or second home visit and provided tailored environmental remediation of varying levels of intensity, depending on assessment findings. Sites with less focus on traditional case management and more focus on the home environment tended to allocate more resources to home environment

TABLE 4 Percent of clients from each referral source^a enrolling in services

	Chicago	Oakland	Philadelphia	Richmond	Minneapolis/St. Paul ^b
Clinical	83	82	48	53	n/a
Schools	45	57	38	45	n/a
CBO/Social Service	n/a	n/a	76	38	n/a
Agencies					
Other	n/a	41 ^c	39 ^d	67 ^e	n/a
Total	68	57	49	56	72

Total acceptance percentage from all sources is shown

^aSt. Louis is excluded from table as they did not track clients accepting services by referral source

^bMN tracked clients accepting services by referral source, but did not track overall clients referred by source

^cA local health plan partner

^dSelf-referrals and a local health plan partner

^eSelf-referrals

mitigation. Occasionally, site staff helped participants identify sources for repairs beyond the scope of the program. Richmond, the site with the most intensive asthma case management, offered the least intensive remediation, i.e., home-use products, such as bedding encasements. St. Louis provided cleaning products in addition to home-use products. Chicago provided pest management products, such as caulk guns and steel wool; Oakland provided high efficiency particulate air vacuums, based on need and availability; and the Philadelphia site tailored supplies to client need, including replacement tiles and shades, storage bins, pest management products, air conditioners, and professional pest or cleaning services. The Minneapolis/St. Paul site provided the most intense array of environmental remediation. By linking to preexisting programs with heavy environmental focus and funding, Twins Cities' workers offered limited home structural modifications, as well as handyman services.

LINK TO HEALTHCARE PROVIDERS

Communication with healthcare providers was an essential element addressed by all CAAC FHAS program staff. With the exception of St. Louis, site workers established two-way communication with care providers, receiving referrals from PCPs and providing feedback to PCPs about clients, either directly or indirectly through the clients. Although St. Louis did not receive referrals from PCPs, the site workers did advocate to PCPs on their clients' behalf. Workers at all sites coached clients on ways to communicate with their PCPs. Workers at four sites also provided clients with information, such as peak flow readings and symptom data, to take to their PCPs. Staff members at the Chicago and Minneapolis/St. Paul sites communicated directly with the PCP with their clients' consent. Staff members at five of the sites assisted clients in selecting a PCP if they did not have one upon program entry. Instead of directly assisting clients with PCP selection, Philadelphia staff members coordinated care by partnering with the Child Asthma Link Line, which used the telephone to link caregivers with local asthma-related resources, make referrals to a social worker, or provide insurance information to clients. Home visitors from Richmond, St. Louis, and occasionally Oakland attended PCP visits with clients.

DATA COLLECTION AND QUALITY CONTROL PROCEDURES

All home visitors received training, from either site staff or the accredited home health agencies for which they worked, about the role of the Institutional Review Board, the Health Insurance Portability and Accountability Act, and personally identifiable data protection. To ensure quality data collection, the Chicago site developed a biannual, mandatory 8 hour retraining session to review these issues. At most of the other sites, staff held less formal, regular meetings to review guidelines and data collection procedures. Several sites also conducted periodic shadow visits, either by program management staff or field supervisors, to observe, critique, and improve home-visitor field techniques. In addition, sites used case reviews to monitor data integrity. To ensure that home visitors completed forms consistently, Chicago and Philadelphia staff members used inter-rater reliability monitoring to assess the degree of agreement in form completion among home visitors.

Most of the sites established a maximum lag time between data collection and data submission. All electronic data were secured by password-protected files on

limited-access servers. All hard-copy data were stored in locked cabinets. Half of the sites chose to double enter a subset of the data as an accuracy check; the other half used only single-data entry.

SAFETY MEASURES

Delivering CAAC FHAS in underserved, high-poverty urban communities caused concern for home-visitor safety. Consequently, all sites provided cell phones to their home visitors. In addition, staff in more than half the sites (Oakland, Richmond, St. Louis, Minneapolis/St. Paul) restricted visits to daylight hours. To respond to participants' scheduling needs without compromising staff safety, Oakland occasionally offered meetings at alternate locations during evening hours. Chicago and Philadelphia staff permitted evening visits to the home. In Philadelphia, home visitors partnered for evening visits until they were comfortable with the area and the family. Richmond and St. Louis sites used sign-out boards listing each visitor's daily addresses. In Minneapolis/St. Paul, a security person accompanied the home visitor to neighborhoods with high-crime levels. Richmond staff reviewed local news each day and canceled visits when an area appeared unsafe. Staff in five sites tried to match home visitors' race or ethnicity with their target population to enhance acceptance and community trust. Minneapolis/St. Paul was unable to do so because health department staff ethnicity did not correspond to that of newly arrived immigrant populations.

EVALUATION

As described in the CAAC Conceptual Framework paper by Herman,²⁷ sites receiving CAAC funding were required to conduct a comprehensive program evaluation. Although evaluation measures were not prescribed, CDC worked with sites to define preferred FHAS indicators for tracking process measures, such as numbers of children enrolled and numbers completing an intervention. CDC also defined intermediate indicators for monitoring intervention effectiveness, such as pre-/postknowledge, quality of life, symptom-free days or nights, activity limitations, school absences, or proper medication use.

Sites chose to evaluate additional process, intermediate, and outcome indicators. All monitored long-term outcomes of healthcare use (i.e., hospitalization and ED visits). Asthma symptom reduction was the most commonly measured intermediate indicator. Sites collected symptom information in different ways; some collected daytime symptoms, some gathered nighttime symptoms, and others used overall symptoms, applying various recall periods or follow-up intervals (30 days or 3, 6, 9, or 12 months). Appropriate medication use was the next most frequently measured intermediate indicator. For this indicator, staff monitored for increased use of controller medications and decreased use of rescue medications and oral corticosteroids. Another frequently measured intermediate indicator was the use of environmental controls, primarily mattress and pillow covers. Half, or fewer, of the sites also monitored asthma action plan use, links to PCPs, functional limitations, and other site-specific priorities (Table 2).

PROJECTED COST AND REACH

Several challenges complicated a unified approach to estimating costs across sites. The substantial variation among sites’ focus, methodology, and management was one barrier. For example, sites that paid partners or subcontractors for service provision on a per-family basis could not supply accurate data for associated costs. Conversely, sites that implemented their own interventions had detailed information on cost by category—e.g., staff, travel, mitigation and office supplies, administrative support. Other cost-data considerations included geographic variations in labor costs, different levels of in-kind support from partners, and difficulty determining time allocation by staff with other programmatic responsibilities. After reviewing program staffing and costs, staff from each site estimated annual costs and the number of families they could reach in a year—information they agreed would be useful for organizations seeking funding to implement similar FHAS in their communities (Table 5). Costs need to be considered in the context of each site’s approach, goals, and existing infrastructure, rather than simply making cost comparisons among sites.

SUSTAINABILITY AND INSTITUTIONALIZATION

Sites used various approaches to secure ongoing, stable funding (i.e., sustainability) and to integrate elements of their programs into established organizations (i.e., institutionalization) to maintain FHAS activities after CAAC funding ended. Most efforts to achieve sustainability sought funding or reimbursement from healthcare payers. Oakland staff successfully negotiated with local Medicaid managed care organizations for third-party reimbursement for members participating in FHAS programs and for bed casings and on-site interpreters. Richmond staff succeeded in fostering agreements between two Medicaid HMOs and Children’s Health Involving Parents of Greater Richmond, a home-visiting program serving low-income families, for providing FHAS among their high-risk children with asthma. Minneapolis/St. Paul staff approached two health plans about expanding their benefit coverage to include an asthma home environmental assessment; one plan’s foundation awarded a grant to the American Lung Association of Minnesota to provide these services to members, and the other plan’s foundation awarded a grant to a county health department.

Institutionalization efforts succeeded most often among local FHAS partners. For example, an Oakland Medicaid health plan’s institutionalization of referrals

TABLE 5 CAACP FHAS projected 1-year cost

	Chicago	Oakland	Philadelphia	Richmond	St. Louis	Minneapolis/St. Paul
Total Cost	\$331,550	\$233,000	\$215,725	\$144,000	\$55,875	\$87,050
Total Families	236	180	240	36	60	90
Average Cost/Family	\$1,400	\$1,300	\$900	\$4,000	\$925	\$950
Visits ^a /Family	4	3–4	5–6	12–30 ^b	2	2
Average Cost/Visit	\$350	\$375	\$165	\$200	\$450	\$475

^aVisit estimates are service-based only and do not include follow-up evaluation-based visits
^bHigh number of visits reflects the program’s intense case management service

eliminated the need for costly marketing, outreach, and recruitment. One of Philadelphia's partners incorporated asthma education into other existing programs and cross-trained its maternal-and-child-health case managers on environmental remediation for asthma. In Chicago, Richmond, and St. Louis, CAAC-site and FHAS-program alliances enhanced their data collection and evaluation capabilities, which enabled them to more effectively demonstrate program success, resulting in more effective marketing and increased capacity to benefit families most in need.

DISCUSSION

The publication *A Community Guide Task Force*, a systematic literature review, recommends the use of home-based, multicomponent, multitrigger environmental interventions for children with asthma.²⁸ According to the community guide, these interventions are thought to effectively reduce symptom days, improve quality of life or symptom scores, and reduce school absences. Although the community guide publication was unavailable during CAAC planning and implementation, staff from all CAAC sites recognized that such a FHAS intervention was needed to effectively reach and engage urban children with asthma and improve their health. While sites delivered FHAS differently, depending upon the resources in each community, each included additional nonenvironmental components, such as asthma self-management, social services, or coordinated care.

Enrolling clients in services was a challenge faced by all CAAC FHAS interventions. As each program matured, it needed to expand beyond its originally identified referral partners. When the actual number of clients fell short of initial estimates, sites had to add new referral partners, redefine contracts, and expand recruitment activities. They found that not only marketing and recruitment but also partnerships with clinical and community groups were essential for enrolling clients into the programs.

Each FHAS intervention applied a holistic approach to home-based care, often affecting the entire family by improving housing conditions and empowering the primary caregiver through increased access to care and links to additional social services. This holistic approach benefited persons with asthma in many ways, especially by linking them to, or in some instances establishing, their clinical care. By facilitating communication with healthcare providers, these links helped to integrate and coordinate asthma-care services.

Although the development of the CAAC FHAS programs preceded the release of the Expert Panel Report 3 (EPR-3) of the National Asthma and Education Program,²⁹ many of their approaches address specific recommendations in the report's home management guidelines. These programs provide successful real-world examples of the translation of the EPR-3 guidelines into asthma care in the community setting.

Each CAAC program effectively designed and implemented FHAS activities despite the many differences among sites. Institutionalization of components of these activities has been successful and will be sustained beyond the CAAC's life cycle. What the CAAC sites have learned by offering FHAS to their communities provides a unique perspective for others, especially those coalitions or programs wishing to plan and implement similar activities to reduce childhood asthma morbidity.

REFERENCES

1. Bloom BCR, Cohen R. Summary Health Statistics for U.S. Children: National Health Interview Survey, 2006. National Center for Health Statistics. *Vital Health Stat.* 2007; 10 (234): 1–79.
2. Moorman J, Rudd R, Johnson C, et al. National surveillance for asthma—United States, 1980–2004. *MMWR.* 2007; 56(SS-8): 1–54.
3. Health Data Interactive. *Centers for Disease Control and Prevention National Center for Health Statistics.* 2009; Available at: URL: www.cdc.gov/nchs/hdi.htm. Accessed January 29, 2009.
4. Bai Y, Hillemeier MM, Lengerich EJ. Racial/ethnic disparities in symptom severity among children hospitalized with asthma. *J Health Care Poor Underserved.* 2007; 18(1): 54–61.
5. Kattan M, Mitchell H, Eggleston P, et al. Characteristics of inner-city children with asthma: the National Cooperative Inner-City Asthma Study. *Pediatr Pulmonol.* 1997; 24 (4): 253–262.
6. Lieu TA, Lozano P, Finkelstein JA, et al. Racial/ethnic variation in asthma status and management practices among children in managed Medicaid. *Pediatrics.* 2002; 109(5): 857–865.
7. Smith LA, Hatcher-Ross JL, Wertheimer R, Kahn RS. Rethinking race/ethnicity, income, and childhood asthma: racial/ethnic disparities concentrated among the very poor. *Public Health Rep.* 2005; 120(2): 109–116.
8. Clark NM, Brown R, Joseph CLM, et al. Issues in identifying asthma and estimating prevalence in an urban school population. *J Clin Epidemiol.* 2002; 55(9): 870–881.
9. Wang LY, Zhong Y, Wheeler L. Direct and indirect costs of asthma in school-age children. *Prev Chronic Dis.* 2005; 2(1): A11.
10. Schulte A, Musolf J, Meurer JR, Cohn JH, Kelly KJ. Pediatric asthma case management: a review of evidence and an experimental study design. *J Pediatr Nurs.* 2004; 19(4): 304–310.
11. Weil CM, Wade SL, Bauman LJ, Lynn H, Mitchell H, Lavigne J. The relationship between psychosocial factors and asthma morbidity in inner-city children with asthma. *Pediatrics.* 1999; 104(6): 1274–1280.
12. van Gent R, van Essen-Zandvliet EE, Klijn P, Brackel HJ, Kimpfen JL, van Der Ent CK. Participation in daily life of children with asthma. *J Asthma.* 2008; 45(9): 807–813.
13. Chida Y, Hamer M, Steptoe A. A bidirectional relationship between psychosocial factors and atopic disorders: a systematic review and meta-analysis. *Psychosom Med.* 2008; 70 (1): 102–116.
14. Busse WW, Mitchell H. Addressing issues of asthma in inner-city children. *J Allergy Clin Immunol.* 2007; 119(1): 43–49.
15. Warman K, Silver EJ, Wood PR. Asthma risk factor assessment: what are the needs of inner-city families? *Ann Allergy Asthma Immunol.* 2006; 97(1 Suppl 1): S11–S15.
16. Center for Managing Chronic Disease UoM. Asthma programs with an environmental component: a review of the field and lessons for success. *Center for Managing Chronic Disease.* 2007. Accessed on November 30, 2009.
17. Brown JV, Bakeman R, Celano MP, Demi AS, Kobrynski L, Wilson SR. Home-based asthma education of young low-income children and their families. *J Pediatr Psychol.* 2002; 27(8): 677–688.
18. Butz AM, Malveaux FJ, Eggleston P, et al. Use of community health workers with inner-city children who have asthma. *Clin Pediatr (Phila).* 1994; 33(3): 135–141.
19. Butz AM, Syron L, Johnson B, Spaulding J, Walker M, Bollinger ME. Home-based asthma self-management education for inner city children. *Public Health Nurs.* 2005; 22 (3): 189–199.
20. Carter MC, Perzanowski MS, Raymond A, Platts-Mills TA. Home intervention in the treatment of asthma among inner-city children. *J Allergy Clin Immunol.* 2001; 108(5): 732–737.

21. Kattan M, Stearns SC, Crain EF, et al. Cost-effectiveness of a home-based environmental intervention for inner-city children with asthma. *J Allergy Clin Immunol*. 2005; 116(5): 1058–1063.
22. Krieger JW, Takaro TK, Song L, Weaver M. The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. *Am J Public Health*. 2005; 95(4): 652–659.
23. Levy JI, Brugge D, Peters JL, Clougherty JE, Saddler SS. A community-based participatory research study of multifaceted in-home environmental interventions for pediatric asthmatics in public housing. *Soc Sci Med*. 2006; 63(8): 2191–2203.
24. Morgan WJ, Crain EF, Gruchalla RS, et al. Results of a home-based environmental intervention among urban children with asthma. *N Engl J Med*. 2004; 351(11): 1068–1080.
25. Primomo J, Johnston S, DiBiase F, Nodolf J, Noren L. Evaluation of a community-based outreach worker program for children with asthma. *Public Health Nurs*. 2006; 23(3): 234–241.
26. Bryant-Stephens T, Kurian C, Guo R, Hauqing Z. Impact of a household environmental intervention delivered by lay health workers on asthma symptom control in urban, disadvantaged children with asthma. *Am J Public Health*. 2009; 99(S3): S657–S665.
27. Herman EJ. Conceptual Framework of the Controlling Asthma in American Cities Project. *J Urban Health*. 2010. doi:10.1007/s11524-010-9473-1.
28. Asthma Control. *Guide to Community Preventive Services* 2009 July 13; Available at: URL: <http://www.thecommunityguide.org/asthma/index.html>. Accessed on November 30, 2009.
29. National Asthma Education and Prevention Program Expert Panel Report 3. Guidelines for the Diagnosis and Management of Asthma. *National Institutes of Health*. 2007; Available at: URL: <http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm>. Accessed on November 30, 2009.