The Seattle–King County Healthy Homes Project: Implementation of a Comprehensive Approach to Improving Indoor Environmental Quality for Low-Income Children with Asthma

James Krieger,[1–4] Tim K. Takaro,[2,3] Carol Allen,[1,4] Lin Song,[1] Marcia Weaver,[2] Sanders Chai,[2,3] and Philip Dickey[5]

[1]Public Health – Seattle and King County, [2]University of Washington School of Public Health and Community Medicine, [3]University of Washington School Medicine, [4]Seattle Partners for Healthy Communities, [5]Washington Toxics Coalition, Seattle, Washington, USA

Pediatric asthma is a growing public health issue, disproportionately affecting low-income people and people of color. Exposure to indoor asthma triggers plays an important role in the development and exacerbation of asthma. We describe the implementation of the Seattle–King County Healthy Homes Project, a randomized, controlled trial of an outreach/education intervention to improve asthma-related health status by reducing exposure to allergens and irritants in the home. We randomly assigned 274 low-income children with asthma ages 4–12 to either a high- or a low-intensity group. In the high-intensity group, community health workers called Community Home Environmental Specialists (CHES) conducted initial home environmental assessments, provided individualized action plans, and made additional visits over a 12-month period to provide education and social support, encouragement of participant actions, provision of materials to reduce exposures (including bedding encasements), assistance with roach and rodent eradication, and advocacy for improved housing conditions. Members of the low-intensity group received the initial assessment, home action plan, limited education during the assessment visit, and bedding encasements. We describe the recruitment and training of CHES and challenges they faced and explain the assessment and exposure reduction protocols addressing dust mites, mold, tobacco smoke, pets, cockroaches, rodents, dust, moisture, and toxic or hazardous chemicals. We also discuss the gap between the practices recommended in the literature and what is feasible in the home. We accomplished home interventions and participants found the project very useful. The project was limited in resolving structural housing quality issues that contributed to exposure to indoor triggers. *Key words*: asthma, children, community health workers, Healthy Homes, indoor environmental quality, inner city, interventions. *Environ Health Perspect* 110(suppl 2):311–322 (2).
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Asthma affects 15 million Americans (7% of the population), a third of them under the age of 18 (*1*). It caused 474,000 hospitalizations, 1.9 million emergency department visits, and 10 million outpatient visits in 1996 (*2,3*). The national economic burden of asthma was projected to rise to $14.5 billion by the year 2000 (*4*). Asthma especially affects children. It is the most common childhood chronic disease and the leading noninjury cause of hospitalization for children ages 0–15 (*2*). Nationally, asthma prevalence, health service utilization, and mortality (*5,6*) have increased among children and young adults since 1980. The self-reported prevalence of childhood asthma in the United States increased by 75% between 1980 and 1994. From 1975 to 1995, the estimated annual number of pediatric office visits for asthma more than doubled, from 4.6 million to 10.4 million. The hospitalization rate has increased among children and mortality rose by 118% between 1978 and 1995.

The causes of the increase in asthma morbidity are not well understood (*7*). However, a large body of evidence suggests that exposures found in indoor environments are major factors in the development and exacerbation of asthma (*8–28*). Table 1 summarizes the major indoor asthma triggers.

Asthma is an environmental justice issue with highly visible health effects. In the United States, low-income people and people of color are disproportionately affected by asthma. Relative to wealthier and White populations, they have higher asthma prevalence (*5,29–31*) and experience more severe impacts (*32–39*). In King County in the State of Washington, the asthma hospitalization rate of children living in high-poverty areas is three times that of those living in low-poverty areas (*40*). In addition, being poor or a person of color is associated with increased rates of sensitization to several asthma-associated allergens (*41–48*). Sensitization to allergens is one of the main risk factors for developing asthma and its complications (*49–51*).

Disparities in asthma morbidity and allergic sensitization may be due, in part, to disproportionate exposure to indoor environmental asthma triggers associated with living in substandard housing (*39,52–56*). Moisture and dampness, poor ventilation, crowding, residence in multiunit dwellings, deteriorated carpeting, and structural deficits can contribute to high levels of indoor asthma triggers. Such conditions are more common in housing inhabited by low-income people and people of color. A strong parallel thus exists between exposure to indoor asthma triggers and the differential exposure of vulnerable populations to hazards in the outdoor environment (e.g., toxic wastes)—a hallmark of environmental racism (*57–59*).

The growing understanding of the contribution of indoor environmental exposures to asthma-related health disparities has sparked widespread enthusiasm for interventions to improve the environmental quality of homes of low-income people and people of color. Although the most comprehensive

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Address correspondence to J. Krieger, Public Heath–Seattle & King County, 999 Third Ave., Ste. 1200, Seattle, WA 98104 USA. Telephone: (206) 296-6817. Fax: (206) 205-5314. E-mail: james.krieger@metrokc.gov

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Table 1. Indoor asthma triggers.

Exposure	Source (and contributing factors)
House dust mites	Carpeting, mattresses, bed linens, toys, upholstered furniture (dampness, poor ventilation, unvented cooking, humidifiers)
Animal-derived allergens	Cats, dogs, rodents, birds
Cockroach allergen	Cockroaches (accessible food, food debris, moisture, structural defects, clutter)
Tobacco smoke	Smoking household member (poor ventilation, contact with child)
Mold	Carpeting, walls, windows (leaks, poor ventilation, water damage, dampness)
Nitrogen oxides (NO_x)	Space heaters, gas-fueled cooking stove (poor ventilation)
Wood smoke	Wood stoves and fireplaces (poor ventilation, faulty equipment)
Organic compounds	Pesticides, volatile organic compounds, formaldehyde (combustion products, poor ventilation, tobacco smoke, household products)
Viral respiratory infections	Exposures to persons infected (crowding)
Endotoxins	Gram-negative bacteria (soil, moisture, humidifiers)

intervention would be assuring access to affordable housing with safe and healthy environments, significant fiscal and political barriers limit the feasibility of this approach, leading advocates to adopt more modest strategies. In recent years, the Healthy Homes approach has gained popularity (*60–63*). Public health and community-based organizations have offered indoor environmental assessments, advice, resources, and advocacy to assess and improve indoor environmental quality. These programs have been based on current understanding of methods to reduce exposure to indoor asthma triggers (*8,9*). However, information regarding the effectiveness of these methods is incomplete (*8,64*). While limited evidence regarding the impact of reducing individual exposures exists, even less information is available regarding integrated interventions that address multiple exposures (*8*). To address this gap in knowledge, we designed and implemented the Seattle–King County Healthy Homes (SKCHH) project.

Seattle–King County Healthy Homes Overview

The National Institute of Environmental Health Sciences (NIEHS) Community-Based Prevention/Intervention Research program funded the SKCHH project for 4 years, beginning October 1997. The project was a randomized, controlled trial of an in-home educational intervention to improve asthma-related health status by reducing exposure to allergens, irritants, and toxics. We randomly assigned 274 low-income children 4–12 years of age with asthma to either a high- or a low-intensity group. In the high-intensity group, community health workers called Community Home Environmental Specialists (CHES) conducted initial home environmental assessments and provided individualized action plans specifying participant and CHES actions to reduce exposures for each household. The CHES made additional visits to each home over a 12-month period to provide a protocol-defined package of education and social support, encouragement of participant actions, materials to reduce exposures (such as bedding covers and low-emission vacuums), assistance with roach and rodent eradication, and advocacy for improved housing conditions. We also offered free allergy testing. Members of the low-intensity group received the initial assessment, home action plan, limited education during the assessment visit, and bedding covers. One year after joining, low-intensity group participants received the full package of materials and additional advice regarding remaining indoor environmental quality concerns. In this article, we describe the implementation of SKCHH. The evaluation of its effectiveness will be described in future publications. Primary outcomes are asthma-related quality of life (*65*) and asthma symptoms (days with any symptoms in past 2 weeks and nights with symptoms), and secondary measures include health service utilization (emergency department, hospital, and unscheduled clinic visits), medication use (days rescue medication used in past 2 weeks), spirometry (forced expiratory volume in 1 sec, FEV_1), allergen exposure (dust concentration and floor surface loading of cockroach, mite, cat, and dog antigen and fungal spore counts), and changes in knowledge and actions related to indoor environmental quality.

While SKCHH had asthma as its primary focus, the project also addressed other indoor health concerns, including lead, asbestos, pesticides, other toxic household products, and combustion products (CO, NO_x) (*9,66,67*). Once a community health worker was in the home, assessing these additional hazards and providing education and referrals to remediate them required little additional effort.

A household was eligible to participate if it included a child 4–12 years of age with health provider–diagnosed asthma of at least mild persistent severity (*68*) and if the child's caretaker spoke English, Spanish, or Vietnamese. All participants had household incomes below 200% of poverty level, and 56% had incomes less than 100% of poverty level. Among caretakers, the most common ethnicities were African American (30%), Vietnamese (24%), Latino (17%), and non-Latino White (16%). The remainder included other Asian groups (7%), Native Americans (2%), and others (5%). Fifty-three percent of caretakers had completed high school, and 8% had completed college. We have reported additional characteristics and baseline findings elsewhere (*69*).

Project Planning and Organization

The SKCHH project was designed as a community-based participatory research project (*70*) with overall sponsorship by Seattle Partners for Healthy Communities, an Urban Research Center funded by the U.S. Centers for Disease Control and Prevention. Seattle Partners is a multidisciplinary partnership of community agencies, community activists, public health professionals, academics, and health providers that supports community-based participatory research addressing social determinants of health (*71*). The Seattle Partners Board approved the initial proposal to NIEHS, supported project implementation, reviewed project progress, and offered guidance on implementing its principles of community–researcher collaboration (*72,73*).

Development of the proposal to NIEHS, creation of project protocols, and operational oversight of SKCHH were the responsibilities of the steering committee, whose members included the American Lung Association of Washington, the Apartment House Association of Washington, the Center for MultiCultural Health, Engineering Plus, Group Health Cooperative of Puget Sound, the League of Women Voters of Seattle, Public Health – Seattle & King County, the Washington Toxics Coalition, and the University of Washington (Figure 1). Both the Seattle Partners Board and the steering committee sought to assure that the project benefited all participants. This led to the staggered intervention design with low- and high-intensity groups. This design assured that low-intensity group participants initially received some immediate benefit [including interventions known to be useful, such as bedding encasements; (*74*)] while ultimately receiving all the benefits accorded the high-intensity group. While this design may have reduced the study's power to demonstrate an effect of the high-intensity intervention relative to a "pure" control group receiving no intervention, we felt such a design was not ethical. The Children's Hospital and Regional Medical Center Institutional Review Board approved the protocols.

The health department was responsible for coordination of project operations, project evaluation, and fiscal administration. Other partners developed the project training manual, provided training for project staff, and participated in project evaluation activities. A community agency implemented field activities during the first 18 months, after which the health department assumed responsibility for the remainder of the project with authorization from Seattle Partners. The health department had better capacity to deliver standard intervention protocols and conduct the research and evaluation aspects of the project. Locating activities at a single site improved coordination among project managers, field staff, and evaluators. We recruited project staff from the communities served by SKCHH, and they played important roles in protocol development and project evaluation in addition to their activities as health workers and data collectors. They were invaluable as knowledgeable community advocates.

The Parent Advisory Group consisted of nine participating parents representative of project enrollees. The CHES invited participants to join the group. CHES selected members to assure inclusion of each of the participating ethnic groups. The group met five times over 4 years to review protocols, project implementation, and evaluation findings and to advise on further program development. Its feedback led to development of protocols that were practical and culturally appropriate.

Additional advice was contributed by the four members of the scientific advisory group, who are nationally recognized for their expertise in asthma, air pollution, and environmental exposure assessment. The principle investigator provided overall leadership and scientific direction to the project while the field and research coordinators managed day-to-day operations.

Implementing SKCHH

The SKCHH project used an integrated approach to reducing exposure to asthma triggers and other indoor environmental risks. We emphasized that a limited number of underlying conditions, such as excessive moisture, dust, carpeting, structural deficits, and household cleanliness, were related to exposure to many of the risks. We worked with participants to implement simple, low-cost, and sustainable approaches to addressing these underlying conditions and took more specific measures directed at particular exposures. We assumed that empowering participants with knowledge, tools, and support for taking action, rather than carrying out actions on their behalf, would result in a more sustainable approach. The project focused on education and participant action because the available resources were inadequate to remediate the underlying housing conditions that increase exposure to asthma triggers. We discuss the need for additional interventions at the conclusion of this article.

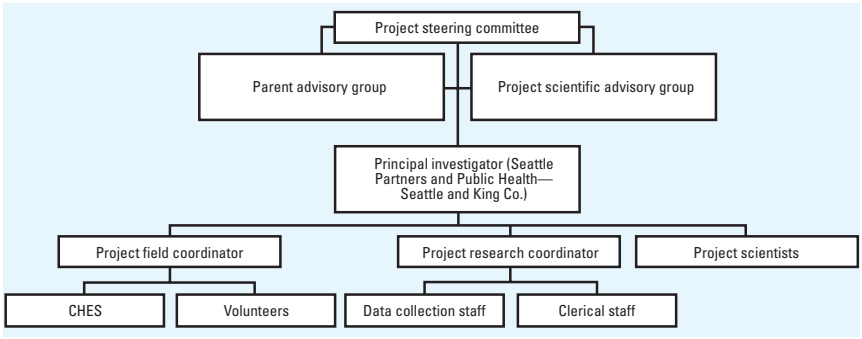

Figure 1. Organizational structure of SKCHH project.

Because we developed SKCHH *de novo*, implementation was an iterative process. Staff and steering committee developed initial protocols based on existing scientific evidence. The Parent Advisory Group reviewed them and suggested changes. We made further changes after pilot testing in the field. We continued to revise protocols as we gained additional experience during project implementation. This section reviews the strategies and protocols we developed.

Community Health Workers

Our major strategy was the deployment of salaried community health workers (the CHES) to visit the homes of participants, where they conducted environmental assessments and provided education and support for creating a healthier indoor environment. The CHES had characteristics that allowed them to bridge the gap between community members and health agencies and institutions: connection to and understanding of the community; shared ethnic, linguistic, and cultural background with project participants; and recognition as a person who can be respected and trusted (*75*–*78*). Six CHES (including their coordinator) worked for the project over the course of its 4 years, with one or two full-time workers and their coordinator providing services at any one time. The CHES were of diverse ethnic backgrounds (four African Americans, one Latin American, and one Vietnamese). Five were female, and all lived in the targeted geographic area. Four were either personally affected by asthma or had a child who was, and the remaining two had close family members with asthma. We used several methods for recruiting CHES, including word of mouth, networking with community-based organizations, advertising in city and community newspapers, and posting in the county personnel system. The first two approaches were most effective and have been used by other community health worker programs (*79*).

The CHES completed a 40-hr SKCHH training program that included didactic sessions, in-class exercises, role playing, and field practice. We developed a training manual adapted from one prepared by the Master Home Environmentalist (MHE) program of the American Lung Association of Washington (*80*) (see below). CHES also participated in 10–20 hr of continuing education per year. They met with the principal investigator every 2 weeks and the steering committee every 2–3 months to review protocols and discuss challenging cases. We also prepared a protocol manual for use in the field [a list of training topics and the training manual are available at the project's website (*81*)] The CHES supervisors found frequent review and reinforcement of protocols and field observation valuable for assuring quality of services.

During the early years of the project, CHES visited participants nine times over the course of a year, according to a defined visit protocol. The interval between the first four visits was 2 weeks, after which subsequent visits occurred every 2 months. We expected CHES to complete specific tasks at each visit as well as work in a more open-ended manner to meet participants' unique needs. As we accumulated feedback from participants and CHES, we reduced the number of visits per client to five to seven total visits. We now follow a structured six-visit schedule (Table 2), with supplemental visits as needed.

Participants often had unpredictable schedules that initially made it challenging to set appointments. Ultimately, CHES developed a process in which they fixed the next visit date before leaving the home and confirmed the next visit by telephone the day before. The most effective method for assuring participant presence at the

Table 2. CHES visit schedule. X indicates the activities that all homes receive; (X), additional activities per protocol that homes with specific issues receive.

Activity	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6
Time (months)	0.0	0.5	1.0	4.5	7.5	10.5
General activities						
Project overview	X	X				
Set home priorities and make plan	X	X				
Revisit household priorities		X	X	X	X	X
Assessments						
Home environmental assessment	X					
Screen for urgent issues[a]	X				X	
Dust sampling (allergens)	X					
Deep dust assessment[b]		X	X	X	X	X
Dust mite control reassessment		X[c]	X	X	X	
Roach assessment: traps	X	X		(X)[d]		(X)[d]
Tobacco reassessment			X	(X)	(X)	(X)
Pet reassessment				X	(X)	(X)
Rodent reassessment			X	(X)	(X)	(X)
Moisture reassessment			X	X		X
Vacuuming and cleaning technique reassessment			X[e]	X	X	X
Toxins reassessment				X		
Education and action						
Asthma basics	X			X		
Dust mites	X	X	X		X	
Discuss household action plan items		X	X	X	X	X
Household cleaning			X	X	X	(X)
Household toxins			X	(X)	X	(X)
Moisture control		X[f]	X[g]	(X)[h]	(X)	(X)
Pets			X	(X)[i]		(X)[i]
Tobacco		X[j]	(X)[k]	(X)	(X)	(X)
Roaches	X	X		X	(X)	
Rodents			X		(X)	
Outdoor air			X			
Referrals						
Skin testing	X[l]	(X)[l]				
Tobacco cessation		X[m]	(X)[m]	(X)[m]	(X)[m]	(X)[m]

[a]Pesticide (canceled/suspended), car exhaust (attached garage and idle >15 sec), flammable products near heat/fire, hazardous products within reach of children, hazardous products in rusting, leaking or open container, use of wood stove, use cooking source to heat house, unvented gas/kerosene heater, smell heating fuel (gas or oil), wet carpet present, roaches present, rodents present. [b]Three-spot vacuuming test. [c]Check if allergy-control covers are installed. [d]Households with "severe" roach problem may need additional assessments. [e]Review frequency and check technique. [f]Brief introduction, how to use relative humidity meter. [g]Overview (sources, general control measures). [h]Only for high-moisture homes. [i]Only for homes with pets. [j]General information for all households with/without tobacco problem. [k]Brief reminder for homes with tobacco problem. [l]Arrange if not yet completed (appointment for skin testing will have been made at intake interview). [m]If issue and caretaker or smoker desires to quit and participate in a smoking cessation class.

appointed time was giving them a calendar to post in the kitchen and circling the visit date. While participants occasionally were not home for a scheduled visit, this was not a major problem and overbooking the CHES schedules was not necessary. The Vietnamese CHES and his clients were comfortable with unscheduled drop-in visits, but this was not acceptable to other participants.

We developed a computer-based system for tracking home visits, assessment findings, client contact activities, and action plan implementation. The CHES supervisor used the system extensively to prepare visit schedules and develop weekly work plans for each CHES, but the CHES did not regularly use this system because data entry was too time consuming. We are redesigning the system with input from the CHES and will enlist clerical staff to enter encounter form data collected by CHES after each visit.

Each full-time equivalent CHES had a case load of 40–80 clients at any point in time. Carrying a case load at the high end of this range required considerable overtime. A reasonable load is approximately 50 clients. During an average week, each full-time equivalent CHES scheduled 12 visits and completed 10. The initial assessment visit averaged 50 min (range, 30–90 min), and follow-up visits averaged 45 min (range, 20–120 min). We needed additional time for other operational tasks such as travel, assessing client eligibility, scheduling appointments, attending team meetings, training, and picking up supplies. The CHES completed 970 visits over the course of 2 years.

It was important that the CHES performed their work with cultural competence (*82,83*). When possible, we matched the ethnicities of CHES and participants (54% of participants shared ethnicity with their CHES). CHES communicated in the primary language of nearly all of their clients. All staff participated in 6 hr of cultural competency training, which emphasized effective communication with diverse clients. CHES would have liked further training to understand the specific values, beliefs, and concerns of each of the ethnic groups with which they worked. The basic educational materials used by the CHES were available in Spanish, Vietnamese, and English. Adequate materials, especially in Vietnamese, were not available when we began our work. We translated some resources, but culturally appropriate, low-literacy, visually oriented materials are needed.

Another important CHES activity was provision of instrumental, informational and emotional support. Social support can be a powerful motivator and reinforcer of behavioral change (*84,85*). CHES had a caring, empathetic attitude and genuine interest in the well-being of their participants. They helped clients initiate cleaning and make minor repairs. They referred caretakers to the Asthma and Allergy Foundation's dedicated help line for additional advice and to local asthma support groups. CHES served as role models for clients, demonstrating the skills for making a healthier home. Many participants had issues that took precedence over asthma, such as inadequate income, risk of eviction, unemployment, child behavior problems, teen suicide, drug addiction, and inability to pay utility bills. The CHES and their coordinator identified appropriate community resources [using the local "Where to Turn" manual (*86*) and a network of contacts] and linked participants with them. Other assistance included finding free furniture (some homes had no beds), collecting funds to assist clients in the purchase of asthma medication, enrollment in a program to receive Christmas gifts, and weatherization program assistance. The need for these support activities could become overwhelming, and it was important to provide CHES with support and counseling in setting boundaries on the roles they played in participants' lives. At times, sustained assistance and case management beyond the scope of CHES skills was necessary. In the future, a public health nurse will provide these services.

The stresses of setting boundaries with clients and being confronted with their difficult life circumstances were only some of the challenges faced by the CHES. Another challenge was changes in roles and responsibilities because we modified protocols based on field experience. A third was that some of the CHES felt too constrained when following project protocols that allowed limited

flexibility in working with their clients. A fourth was the daily logistical hassles such as spending much time traveling heavily trafficked roads, carrying cumbersome vacuums and other equipment, working evenings and weekends, and arriving for home visits only to find the client not in. Finally, family issues such as difficulties in arranging childcare when working evenings and weekends played a role. These issues contributed to high staff turnover during the first 2 years of the project. However, once the project matured during the third year, staff stabilized and we completed the project with CHES who were skilled at their work and committed to SKCHH. The difficulties faced by the CHES underscore the need for debriefing them when experiences become overwhelming, providing emotional support, offering incentives such as attendance at conferences, and assuring periods of less intensive activity.

Community Volunteers

We originally intended to use community volunteers from the MHE program to implement the low-intensity intervention. The MHE program provides trained volunteers who visit homes to educate residents about improving indoor environmental quality. Volunteers receive a 40-hr training covering indoor pollution, communication and community outreach skills, and cultural diversity. They use the Home Environmental Assessment List (HEAL) (*63*) to identify pollutants and develop an action plan that prioritizes problems and low-cost or no-cost solutions that reduce exposures. The initial visit is followed up with a telephone call to assess progress.

A special recruitment and training prepared 20 volunteers for participation in SKCHH. We focused recruitment efforts on reaching people who lived in the communities to be served or who had worked with low-income community members.

The volunteer component faced a number of challenges and ultimately was ineffective. This result was surprising because the MHE program routinely employs volunteers successfully. Multiple factors may have contributed to this outcome. First, an 8-month delay occurred between completion of the training and commencement of interventions. In this time, volunteers had limited contact with the program. When home visits by volunteers did begin, project staff supported volunteers consistent with past MHE practice, but this was insufficient for the specific needs of the SKCHH project volunteers. A new project coordinator assumed this responsibility and devoted considerable time to calling active volunteers every 7–14 days to answer questions, providing support, and requesting submission of visit reports. Second, despite the recruiting efforts, volunteers were generally not from the participants' communities. This led to reluctance of volunteers to work in inner-city neighborhoods and limitations on the cultural competence of the volunteers. Third, scheduling home visits was difficult for the volunteers, who often were not available at the times preferred by participants and had limited ability to adjust their schedules. Fourth, volunteers had difficulty in adhering to protocols, fully completing home assessments, keeping to timelines, and returning visit reports. Because of these difficulties, the CHES assumed responsibility for providing services to the low-intensity group.

Participant Recruitment and Retention

To obtain participants, we collected lists of potential participants from community and public health clinics, hospitals, and emergency departments; publicized the project through local media and at community events; and received referrals from public schools, government and community agencies, public housing, churches, sororities, and other community organizations. The most efficient approach was identifying potential participants through their sources of medical care. All these sources yielded 1,111 potentially eligible children, whose asthma diagnosis we verified through chart review. We reached 709 (64%) of their caretakers and were unable to contact the remaining 402 households because of disconnected or incorrect phone numbers, or no response after six phone calls and one mailing. Of the households we reached, 355 (50%) were eligible; the remainder either refused the eligibility interview (90) or were not eligible (258). Of the eligible households, we randomly assigned 138 (39%) to the high-intensity group and 136 (38%) to the low-intensity group; 67 (19%) declined participation, and 14 (4%) did not enroll because of logistical difficulties.

Of the original participants, 226 (82%) completed the 1-year program . The difficulties in maintaining contact with participants in health-related outreach and research projects have been well described (*87*). The most common reason for dropping out of our project was being too busy. A small number of participants (12) seemed motivated to join in order to obtain the supplies and dropped out after receiving the vacuum. CHES followed a protocol to maximize retention, which included up to seven phone calls, a postcard, a letter, two home visits, three attempts to reach an alternate personal contact, contacting workplace and source of medical care, and consulting residence directories. Recruitment and retention may have been facilitated by offering cash incentives ($45 for completion of baseline data collection and $65 for completing the project), as well as providing resources such as the vacuum and bedding encasements.

Conducting Home Environmental Assessments

The CHES conducted a comprehensive home environmental assessment at their first visit. They repeated portions of this assessment at subsequent visits to assess progress in resolving problems or development of new concerns. If households moved (3% of SKCHH participants did so), the CHES performed a complete assessment of the new home. To conduct the assessment, the CHES administered a questionnaire, joined participants in conducting a visual inspection of the home, and made environmental measurements. Dharmage et al. (*88*) have shown that interview and inspection provide valid measures of home environmental conditions. We collected data using the Healthy Homes Baseline Questionnaire and the Home Environmental Assessment List – II (HEAL-II), both of which are available on the SKCHH website. We adapted the latter from the HEAL developed by the MHE program. Areas covered in the assessment included

- knowledge of asthma triggers and prior asthma education
- assessment of asthma severity and medications used
- access to medical care for asthma
- tobacco smoke exposure
- exposure to allergen sources (mites, cockroaches, rodents, dust, pets)
- dust control behaviors (track-in, vacuuming/cleaning, use of allergen-control bedding encasements)
- mold and moisture problems and contributing structural factors (condensation, water infiltration and damage, sources of leaks, ventilation [windows and fans, appliances], weatherization, heating, insulation, vapor barriers)
- structural conditions (carpeting, building age, condition of paint, structural deficits, recent remodeling)
- additional factors contributing to exposure (food debris and storage, trash, clutter, heating system filters and ducts, heating and cooking sources, location of garage)
- use and storage of hazardous and toxic products
- additional indoor air contaminants (asbestos, combustion products)
- tap and washing machine water temperature
- exposure to take-home hazards from work

We encouraged participants to obtain free skin-prick allergy testing to determine the specific exposures most relevant for their

children. Ten allergens (dust mite [Der p1 and Der f1], regional mold mix, cat, dog, cockroach [American and German], alder, birch, grass mix) and histamine and saline controls were applied intradermally with bifurcated needles using standard procedures (*89*). We made arrangements with three clinical sites in the target area to provide this service on weekday afternoons and Saturday mornings. We also held an allergy testing fair that included food, games, door prizes, and a raffle. Despite these efforts, only 23% of children received the test. Lack of easy transportation and competing demands were the major obstacles. Having the child's health provider order the test and increasing client appreciation of its benefits may have increased testing. Future efforts may require taxi vouchers or collecting blood samples for radioallergosorbent allergy testing during a regular clinic visit rather than relying on skin prick tests.

We collected additional environmental exposure data as part of our research and evaluation protocol. Briefly, CHES collected floor dust from the child's bedroom that was sieved and weighed prior to analysis for cat, dog, cockroach, and dust mite antigen and viable mold counts. A forthcoming article will document these methods in more detail.

The Action Plan

The CHES developed a Home Action Plan with each client. A computerized system generated a draft action plan by linking each assessment finding with protocol-derived action steps for the residents and CHES. The following section summarizes these protocols. Because the protocols specified a wide range of actions and because clients' interests varied, the CHES and client together prioritized the action steps to prepare a final individualized action plan. A standard form logged actions taken by the CHES and clients after each visit for entry into the data system, which then generated an updated action plan for the next visit. As actions were accomplished, the CHES and participants moved on to address other items.

A key component of our intervention, therefore, was promoting participant actions to improve control of asthma. Social cognitive theory (*90–92*) and the transtheoretical stages of change model (*93–95*) suggest the value of an individualized, stage-specific approach that sets manageable priorities, of providing clients with feedback on their implementation of action plans, and of CHES serving as role models who demonstrate actions to reduce exposures (e.g., vacuuming and cleaning mold). CHES used several techniques to encourage participant actions: simplification to adapt to the participant's lifestyle; monitoring and reinforcement; individualizing, reviewing, and adjusting plans as needed; encouraging family involvement; being attentive to client concerns and fears; and giving participants simple, brief, written materials that reinforced the actions recommended and skills taught (*96–101*).

Reducing Specific Exposures

Table 3 summarizes the protocols used by the CHES, and details are available at our website. Recent reviews summarize the justification for including these interventions (*8,9,16,49,102–104*), and Table 3 cites additional supporting literature.

Table 3. Exposure reduction protocols used in Seattle–King County Healthy Homes project.

Exposure	Action	
	Resident	CHES
Asthma triggers		
Moisture and mold (*107*)	Use ventilation properly (kitchen, bath, crawl space), avoid fish tanks, clean with 5% bleach/detergent solution, heat all rooms and closets, open windows often, repair leaks, maintain humidity below 50%, reduce household plants if present in large quantity (*131*), remove carpeting, place vapor barrier between concrete floors and carpet, remove mold damaged carpet, furniture and other items	Educate on moisture sources/barriers, provide cleaning materials, replace moldy shower curtain, inspect and clean ventilation fans, plug holes between crawl space and home with steel wool and foam
Dust	Vacuuming and dusting (*124–126,132*), use double-layer vacuum bags and/or low-emission vacuum (*133*), use high-quality door mats and remove shoes (*134*)	Educate and provide with low-emission vacuum with dirt finder, double-layer microfiltration vacuum bags, clean green cleaning kit (vinegar, baking soda, oil soap, etc.), mop and bucket, gloves, door mat, furnace filters, lint-free dusting rags
Mites (*74*)	Vacuuming, cleaning and dusting, wash bedding weekly in ≥130°F water (pillows monthly), remove or wash stuffed animals, replace (or vacuum) upholstered furniture, carpet and drape removal, maintain humidity below 50% (*13,119,135,136*)	Educate, provide and install allergy-control bedding encasements on pillows and mattresses (*13,136–140*)
Roaches (*110,141*)	Food clean up and storage, clean up clutter, remove garbage from home daily, cleaning, eliminate sources of standing water (e.g., leaks, refrigerator drip pans), cleaning before and after eradication	Educate, integrated pest management methods (provide food storage containers, caulk or steel wool and foam to seal small defects; Abamectin gel bait[a] (*142*); vacuuming and intensive cleaning posteradication)
Rodents	As per roaches and clean up outdoor rodent hiding places and attractants	Seal small defects, screens on exhaust vents, glue boards and snap traps
Tobacco smoke	Quit smoking or smoke outside using smoking jacket, launder clothes exposed to smoke, avoid smoking in the car	Assess stage of change (*93*), brief nonconfrontational counseling (*143*), refer to the Free and Clear smoking cessation program[b] (telephone counseling and nicotine replacement)
Wood smoke	Use alternative heat source or maintain stove and flue	Educate and refer to weatherization program for replacement with natural gas
Pets (*114*)	Remove from home or keep outside bedroom, vacuuming, carpet removal, bedding covers (*23*)	Educate
NO_x	Ventilate kitchen, assure furnace properly vented	Educate on combustion sources
Toxics		
Toxic or hazardous chemicals	Store safely, dispose of properly and switch to less toxic alternative	Educate about safer use, storage, and disposal and encourage use of alternatives, provide safer cleaning alternatives in "clean green" cleaning kit
Pesticides	Use integrated pest management alternatives	Educate about integrated pest management alternatives
CO	Identify combustion sources vented to living area	Educate[c]
Lead	Vacuuming and cleaning (*126,144*), and reducing track-in of exterior dust	If lead risk present, refer child to primary medical provider for lead testing
Asbestos		Identify materials potentially containing asbestos; refer to certified remediation team (*145*)

[a]Whitmire Micro-Gen Research Laboratories, St. Louis, MO. [b]Group Health Cooperative of Puget Sound, Seattle, WA. [c]For households with combustion appliances/furnaces.

The experience of implementing SKCHH and new findings in the research literature have shown us ways to improve our protocols. A major lesson learned was that the "best practices" as described in the literature and guidelines may not be feasible to implement in low-income households similar to those that participated in our project. A project that emphasizes actions that are easy to adopt, that uses simple protocols, and that encourages participants to take on a limited number of actions may increase chances of success. We summarize what we have learned in the following paragraphs.

Mites. Providing allergy-control bedding covers was not sufficient; participants often needed assistance in placing them on the mattress. Less expensive vinyl covers ripped easily, and we recommend the more durable woven fabric type. We measured the temperature of hot water in homes and found that it was below the 130°F needed for killing mites in 74%. We considered adding eucalyptus oil to cooler wash water (*105*), but it is expensive and leaves a residual odor. Drying bedding at 130°F for at least 20 min also kills mites and is an alternative (*106,107*). Many (82%) children had stuffed toys, but few participants (26%) washed them regularly. Freezing toys and small items for at least 24 hr kills mites and may be easier than washing. We elected not to use acaricides because evidence of their effectiveness is inconclusive (*74*) and not to use tannic acid because of its unacceptability to participants (it may stain fabrics).

Mold. Not all homes with visible mold were able to eliminate it through cleaning with bleach solution, yet replacement of contaminated building material was beyond the scope of this project. Although we recommended the use of a high-efficiency particulate air (HEPA) filter if a child was sensitized to molds and ongoing exposure was present, most participants could not afford one (*108,109*). We will include provision of air filters for such situations in future work.

Tobacco smoke. Despite making available free telephonic smoking cessation counseling and nicotine replacement patches, only 20% of smoking caretakers quit. We found that motivating smoking household members to smoke outside the home was useful: among smokers who did not go outside to smoke prior to intervention, a quarter did so after education by the CHES. We also recommended use of a HEPA filter (although we were unable to offer one) if tobacco smoke was present in the house (*109*), and we will provide HEPA filters in future work.

Cockroaches. Education regarding cockroaches and asthma emerged as an especially important topic. Participants frequently were unaware of the relationship of roaches to asthma (*69*) and did not often realize that they could be present without being visible. In fact, some participants who reported no roaches were offended when the CHES placed roach traps in the participants' homes. We would modify some aspects of our eradication protocol. Authorities recommend a repeated application of gel bait 1–2 weeks after the initial application, and we will revise our protocol accordingly (*110*). One challenge we faced was that some homes required an intensive amount of work to eliminate clutter and food sources before eradication and to clean comprehensively after eradication for removal of remaining allergen. Assistance for participants from professional house cleaners for some homes would have been beneficial. Other issues were the limited effectiveness of eliminating roaches in homes contained in multiunit structures without treating the entire building and difficulties in addressing some of the underlying structural conditions that allowed entry of roaches. Solutions to these issues require additional resources and cooperation from landlords.

Pets. Because removal of pets from the home is difficult, we have considered other alternatives in addition to the ones listed in Table 3. Cat and dog allergens accumulate in clothing and fabric, and washing them may be of some benefit (*111*). Although some studies have suggested that washing cats twice weekly may reduce exposure to allergen (*112*), we rejected pet washing because experts (*113,114*) and our participants felt that this was not an effective, practical approach. The role of HEPA filters remains controversial (*8,115,116*).

Hazardous household chemicals. Given our focus on reducing asthma morbidity, the intervention for household chemical products was directed primarily at respiratory irritants. However, we took advantage of the opportunity to educate household members about other product hazards that could affect children. We identified products of concern by category (e.g., pesticides), by federally mandated label warnings (*117,118*) (e.g., corrosive products), or by the presence of certain ingredients (e.g., chlorine bleach, solvents) and placed them on one of two priority lists. High-priority products included canceled or suspended pesticides, pesticides in U.S. Environmental Protection Agency hazard category I or II, pesticide dusts, products containing chlorine bleach or ammonia, and solvent-based products used once per week or more. CHES helped participants eliminate these products from homes or minimize exposure. Lower-priority items included corrosive products, other pesticides, solvent products used less than once per week, other volatile organic compounds, and other potential asthma triggers such as air fresheners and fragrances. For these products, CHES suggested alternatives where possible. For all products, CHES looked for unsafe storage, suggested proper disposal, and recommended safer alternatives.

Combustion products. Most (70%) homes relied upon electricity for heat and cooking; exposure to NO_2 and CO was therefore not an issue for most participants. In the homes with hydrocarbon energy sources, CHES counseled participants on maintaining adequate ventilation while cooking and on the value of regular furnace maintenance. We plan to add assessment of CO levels in such homes.

Addressing Underlying Conditions

Exposure is affected by underlying housing conditions. For example, excessive indoor moisture increases exposure to mites and molds, whereas poor ventilation can exacerbate exposure to tobacco smoke, combustion products, irritants, and moisture. Structural deficits allow entry of pests and water. As shown in Table 3, our protocols spoke to these conditions to varying degrees, and we now describe lessons learned as we addressed them.

Moisture. Moisture problems were present in 77% of homes. We collected evidence of excessive moisture by asking questions about humidifier use, fog on glass surfaces, presence of vapor barriers and vents in crawl spaces, and by direct inspection for mold, leaks, wet carpeting, and water damage. We also attempted to assess relative humidity by asking participants to record daily maximum and minimum relative humidity over 2-week periods in a diary using a digital hygrometer, but the very low completion rate (36%) invalidated the diary as a useful tool.

We partially addressed excessive moisture by the protocols described in Table 3. However, we did not usually accomplish some of these interventions (e.g., installation of ventilation fans, installation of vapor barriers and ventilation of moist crawl spaces), given the resource constraints of this project. Controlling indoor relative humidity to less than 50% is effective in reducing mite and possibly mold exposure (*108,119*), but doing so by simple ventilation may not be practical in Seattle and other coastal areas where high relative humidity is common year-round (in Seattle, seasonal humidity ranges from 49–53% in the summer to 74–78% in the winter) (*120*). More expensive options such as dehumidifiers may be efficacious (*121*), but their feasibility and effectiveness have been questioned (*122*). Our project was limited in its ability to correct structural deficits permitting water

intrusion, which we noted in over 20% of the homes. Remediation of mold-contaminated wallboard or carpet was also beyond project resources, and participants did not have the means to do so independently. Healthy Homes demonstration and education projects funded by the Department of Housing and Urban Development are currently assessing the benefits of more aggressive structural remediation interventions. We have recently received such a grant to conduct remediation of 70 homes at an average cost of $3,000.

Dust and housecleaning. CHES found that conveying basic information about housecleaning and its benefits for a child with asthma was valuable, and most participants became more effective cleaners (the proportion vacuuming at least weekly increased from 62% to 78% in the high-intensity group). It was important to help participants distinguish between aspects of household appearance relevant to asthma control (e.g., clutter, dust, mold) and those of a more cosmetic nature (e.g., stains). Providing simple tips such as cleaning on a schedule, giving oneself a reward for cleaning, and doing a little bit each day seemed helpful, as did provision of vacuums and cleaning supplies.

Household clutter was a significant problem in 42% of homes, and participants had widely varying tolerances for its extent. They had limited understanding of how clutter contributed to increasing levels of allergens by impeding implementation of other cleaning strategies, such as vacuuming, dusting, and removal of food debris. CHES had to work alongside a limited number of participants to help them attain a reasonable level of cleanliness in their home so that they could implement action plan items related to cleaning. Providing professional housecleaning services for participants with large cleaning needs or those whose homes harbor roaches may be useful. Visual information such as a video of housecleaning or before-and-after pictures demonstrating successfully cleaned homes may also be helpful.

Carpets are an important reservoir of dust and allergens (*123*). While most (85%) homes had carpets, few (7%) participants were able to remove them because they were renters or could not afford to install alternative flooring. As a partial solution, vacuuming may be moderately effective in reducing dust and allergen exposure (*124–126*). We enhanced the effectiveness of vacuuming by providing participants with low-emission, power-head vacuums equipped with a dirt detector and gave them feedback regarding effectiveness of vacuuming through the "three-spot" vacuum test (*127*). The test uses a vacuum with a dirt detection system that allows the deep carpet dust to be estimated. The detector used in this project has a red light that changes to green when nearly all the dust is out. The three-spot test measures the time in seconds to get green lights on three spots three feet apart. Ten seconds or less is considered a clean carpet (<10 g/m^2 of deep dust). The three-spot test appears to be useful in assessing the effectiveness of efforts to reduce dust levels in carpets and may reinforce good cleaning habits by demonstrating progress in removing dust from carpets. Details of the test are available at our website. About 10% of vacuums we provided required repairs after use. Many of the repairs were related to motors jammed with vacuumed material. In the future, we will use a vacuum in which vacuumed material is deposited directly into the bag, rather than passing through the motor.

Removing shoes and leaving them at the door was difficult for many households, as homes lacked space for shoe storage. We are exploring the provision of shoe storage bags or shelving and inexpensive house slippers.

Ventilation. We assessed ventilation by observing the presence and use of exhaust fans and operable windows in kitchen and bath, and testing the function of the fan by observing whether it generated sufficient suction to hold a piece of two-ply tissue paper against the grille. While those participants who had working fans used them, project resources did not permit installation of fans in homes without them or repair of nonworking units. We are currently working with subsidized weatherization programs for help in repairing and installing ventilation fans. While we recommended opening windows to increase ventilation, participants felt unsafe with open windows and did not follow this advice. We will begin to provide window locks.

Landlord–tenant relations. Remediation of underlying conditions sometimes required involvement of a landlord because 86% of participants were renters. In some cases, tenants were afraid to approach the landlord because of fear of retaliation in the context of a very tight housing market. In other cases, CHES assisted tenants approach their landlords by helping draft letters and speaking directly to the landlords as needed. In the few cases in which the landlord was not responsive, we referred participants to the Seattle Tenants Union for additional assistance.

Because many participants lived in public housing or were on the waiting list, we worked closely with the Seattle Housing Authority (SHA). Participants on the waiting list were moved to the top and offered housing that met Healthy Homes criteria. For participants already living in SHA units, SHA immediately repaired unhealthy conditions upon contact by the project coordinator and gave priority to eradication of roaches in participants' homes. If the only solution was a move to a different unit, SHA moved the client.

Participant Feedback

We collected data from participants regarding their perceptions of the program as part of an exit interview conducted 1 year after enrollment by an interviewer with no prior contact with the participant. Questions included close-ended items covering the usefulness of the information provided, supplies received, and the action plan on a 4-point response scale (extremely useful, very useful, somewhat useful, not useful) and satisfaction with CHES worker (excellent, very good, good, fair, poor). Additional questions asked the participant how much of the action plan they carried out (all, most, some, none) and the reasons why participants had not completed parts of the plan (the questions included six specific items such as "not enough time or being too busy," "cost too much," "didn't think the actions would be helpful," as well as an open-ended probe asking about "other things that got in your way"). A set of open-ended questions asked the respondent to describe the most important actions he or she took a result of the project, things most liked about the project, things to improve the project, things liked best about the CHES worker, and things the CHES could do to improve the service received.

Caretakers in the high-intensity group generally gave positive feedback: 93% said that the information they received was extremely useful or very useful. Most considered the supplies provided to be extremely useful or very useful (97% for the vacuum cleaner, 96% for the mattress cover, 93% for the door mat, and 89% for the cleaning kit). Of those who remembered receiving an action plan (78% of caretakers), 88% thought it was extremely useful or very useful, and 77% were able to carry out all or most of the action plan. Among those who did not carry out all of the action plan items, the main barriers were "not enough time or being too busy" (55%) and "cost too much money to do" (44%).

The actions the caretakers described as most important for controlling their child's asthma were cleaning, dusting, and vacuuming more often and more thoroughly; covering bedding with allergy-control encasements; washing or changing bedding more regularly; cleaning mold; keeping the child away from tobacco smoke; and getting rid of stuffed animals.

The aspects of the project the caretakers liked most included the information and education provided, supplies (especially the

vacuum cleaner and allergy-control encasements), home visits, and help from CHES. Most (84%) of the caretakers described their experience working with the CHES workers as excellent or very good. When asked about things that could improve the project, the most frequent response was reducing the length or repetitiveness of the evaluation questionnaires. Some caretakers would have preferred fewer visits, but a few others would have liked more. A few would have liked the project to have the school involved.

Conclusions

We have described the organization and implementation of the SKCHH project. It is a promising approach to address the disparities in exposures to indoor asthma triggers and in asthma morbidity seen among low-income households. The SKCHH project members worked with 274 low-income families to identify and take actions to control indoor health hazards. We developed protocols to address major indoor environmental quality problems associated with asthma that low-income and ethnically diverse caretakers of children with asthma can implement with assistance from community health workers. Project participants were enthusiastic about SKCHH, felt they derived important benefits and would like to see the project made available more widely. Before doing so, we need evidence of the effectiveness of this and other Healthy Homes projects (e.g., Boston and Cambridge, Massachusetts; Detroit, Michigan; Cleveland, Ohio; Philadelphia, Pennsylvania; and San Diego and San Francisco, California) that have employed similar approaches to improving indoor environmental quality. We are currently completing collection of exit data from participating homes and will publish the exposure and health outcomes of SKCHH in the near future. Other Healthy Homes projects will also be reporting on their evaluations in coming years. Until these evaluations are complete, it seems reasonable to use existing evidence to guide education and actions to improve home environmental quality, as summarized in Table 3 and elsewhere (*8,9, 16,64,66–68,103,104*).

We limited our protocols to asthma triggers, dust control, and elimination of hazardous chemical products and did not address other indoor hazards. We plan to add additional protocols to address injury hazards. Lead and radon are not major issues in the Seattle area, so we did not emphasize them. However, dust control is an important tool for prevention of lead and pesticide exposure (*128*), and our current protocols would be expected to reduce these exposures if present in house dust. We are planning to add more explicit linkages with health care providers, who have expressed an interest in receiving information about the homes of their patients and the changes they are making as a result of SKCHH, and would like assistance with improving medication use and self-management of asthma. Participants indicated a desire for more education regarding asthma medications and help in communicating with medical providers. Community health workers are well suited to meet these needs. While the SKCHH project members worked with children with asthma and their caretakers, our protocols should be useful for adults with asthma as well. We expect that the SKCHH approach could also be used among higher-income homes, where many of the barriers to implementing action plans would be absent.

The SKCHH project was designed as a culturally competent approach for addressing indoor environmental conditions in low-income, ethnically diverse homes. Our work illustrates the gaps between literature-based recommended practices and what is practical in these homes. Many recommended resources (e.g., allergy-control bedding encasements or HEPA filters) are not affordable. Some recommended behavioral changes are impractical (e.g., pet washing, washing in hot water), and others are difficult to sustain given other pressing demands (e.g., regular vacuuming). Continued support from community health workers, health care providers, and others may help. Continuously collecting feedback from caretakers and field staff on how well protocols are working is essential. Protocols should be viewed as guidelines that can be adapted to fit the values, beliefs, and resources of diverse communities.

Strategies for improving indoor environmental quality must go beyond asking household members to take individual actions. Structural changes are needed to reduce exposure sources, yet are often not completed given the cost to the households or lack of landlord interest (e.g., installation of ventilation systems, removal of water-damaged carpet or wallboard, or replacement of windows). Our local public housing authority, although able to make improvements in the units it manages, lacks resources to do so in the homes of Section 8 tenants. Financially strapped, small-scale landlords may need assistance in making remediations to assure that their units are code compliant and healthy. Updating and enforcement of housing codes are needed, as are policies that assure access to housing units that meet basic guidelines for healthy living conditions. Project staff successfully worked with the local public housing agency to increase its awareness of the impact of housing conditions on asthma and to arrange for tenants with asthma to move to more suitable units (e.g., second-floor units with less dampness). However, a single research project could not achieve the goal of addressing the impact of housing quality on asthma. The complexity of this issue suggests that further progress will depend on organizing effective advocacy efforts and increasing funding for programs such as the above-mentioned Housing and Urban Development Healthy Homes initiative.

Policy changes to assure health insurance coverage of durable medical equipment (e.g., bedding encasements) and home visitation services are needed in order to make progress, and we are beginning advocacy efforts to address them. If evaluations of our and other Healthy Homes projects demonstrate potential for cost savings through decreased health services utilization, insurers may be more likely to cover these services and the costs of remediation.

The community health workers were critical to the implementation of SKCHH. Using full-time, salaried CHES enabled us to develop a knowledgeable cadre of workers who understood and followed project protocols and were able to work well with their clients. The CHES also faced many challenges as they implemented the project. It is important that prospective community health workers have a clear understanding of the nature of the type of work before accepting the position. We observed several characteristics that contributed to CHES success (*129*). They included being outgoing and skilled at establishing rapport with diverse participants, being nonjudgmental in their relationships with their clients, having an ability to adapt to changing job requirements, being able to set priorities independently in the context of a carefully defined weekly work plan, having flexibility to work evenings and weekends, being able to learn new skills and information and transmit them to their clients, understanding and being comfortable with their clients and communities, being good communicators, being caring and respectful, connecting well with clients in their cultural context, knowing their communities and being involved in them as volunteers and members of social networks, having good organizational skills and paying attention to details (e.g., reporting and documentation, scheduling), being motivated to help others, being reliable with good follow-through and self-management, and having lots of energy, enthusiasm, patience and perseverance. These attributes of successful community health workers are similar to those described by other projects (*76,77,130*).

Providing a supportive work environment is critical for ensuring their success. Their supervisor must be able to observe their work closely, review challenging clients, offer advice and resources, provide a detailed

weekly work plan, arrange a consistent work schedule, assure that the pace of work is reasonable, allow for administrative and "catch-up" time, and provide emotional support. Emotional support can also come from peer support groups and networks. Providing opportunities for enhancing skills and sharing knowledge through peer networks and more formal conferences is valuable. Involving CHES in program design and evaluation not only increases their morale and skill but also yields a better program. Adequate training and ongoing opportunities for feedback and continuing education add to job satisfaction.

We considered alternatives to using community health workers, and tried some of them. We were not successful in using volunteers; this approach may have required more resources for volunteer recruitment and support than were available to this project. An uncontrolled postparticipation evaluation of 36 MHE program clients showed that self-reported knowledge of indoor environmental issues increased and that most participants made at least one behavior change (*63*). A "natural helper" or peer educator model (*75*) based upon volunteers from the participants' communities is another possible alternative. Additional, more rigorous evaluation of these programs, and comparison with staff-model programs, would be helpful. We considered using group classes and support groups, but community partners indicated attendance would be low, the format would not permit attention to the specific issues of each participant, and the approach would not allow direct observation of the home. One promising approach that we did not test was training other home visitors (e.g., public health nurses, social workers, environmental health inspectors) in Healthy Homes protocols so that they could integrate these protocols into their work.

The SKCHH project was designed and implemented with the participation of parents of children with asthma, community-based organizations, community health workers, public health staff, and university faculty. Guided by principles of community–researcher collaboration, they worked together and developed a project that was more suited to community desires, more effective, and more likely to be sustained than if traditional approaches to research had been employed. An important goal of community-based participatory research is to provide tangible benefits to community members. Participants valued the knowledge, support, and resources received from the project. Project staff hired from the community gained jobs along with specialized skills and knowledge. We have shared the knowledge resulting from the project with the participants and the broader community. We sent a summary of project findings to all participants and discussed them in more detail with the Parent Advisory Group. Our experience has informed the activities of the King County Asthma Forum, the local asthma coalition, and the asthma-related activities of the King County Health Action Plan, a local partnership of health care institutions, insurers, foundations, public health, and consumer organizations. Both the Forum and Action Plan have provided support to sustain SKCHH activities.

In conclusion, we have presented one of the first descriptions of the implementation of a Healthy Homes project. We hope that the lessons we have learned will be of use to others who are developing similar projects in their communities. The cumulative potential of all these efforts is great for addressing the growing burden of asthma, especially among low-income and ethnically diverse communities.

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