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A M E R I C A N C O L L E G E O F
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Inner-city Asthma*

The Role of the Community

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Asthma morbidity and mortality are disproportionately high in low-income minority populations. Variations in environmental exposures, stress, and access to appropriate health care all contribute to these disparities. The complex nature of asthma with strong contributions from environmental, psychosocial, and biological factors suggest that community-based approaches focused on the unique needs of high-risk populations may be effective. The few previous randomized trials suggest that case management with professionals and/or community health educators may reduce asthma morbidity. Health-educator programs should be lodged in stable infrastructures with training and funding for community health workers to obtain long-term sustainability. Factors not amenable to individual intervention, however, such as poor condition of homes, outdoor pollution, and lack of access to appropriate care, will require collaborative efforts of community groups, academic professionals, public agencies, and health-care providers.

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Key words: asthma; Chicago; collaboration; community; community health educators; environment; intervention; stress

Abbreviations: CAPP = Community Asthma Prevention Program; NIEHS = National Institute for Environmental Health Sciences

Mortality rates from asthma rose steadily from the mid-1970s through the 1990s, with rates disproportionately high among low-income minority

populations.^{1–4} Various measures of asthma severity are also greater in low-income communities.^{3,5} Differences in asthma prevalence, however, suggest that while rates are somewhat higher in low-income African Americans and Puerto Ricans,^{2,6,7} these differences are far less than differences in mortality and morbidity, implying that health disparities in asthma severity should be amenable to intervention.

Asthma is a complex disease with environmental, psychosocial, and biological components. Factors contributing to asthma symptoms include exposure to air pollutants, pets, dampness, molds, cigarette smoke, infections, indoor and outdoor allergens, poor housing conditions, acute and chronic stress, and lack of appropriate medical care.^{8–18}

ENVIRONMENTAL EXPOSURES

There is an increasing body of literature documenting greater exposure among low-income communities to environmental factors related to

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asthma severity.^{19–20} We have previously reported significant associations of asthma severity with exposure to *Alternaria* and Gram-negative bacteria in East Moline, Illinois.²¹ Housing conditions were related to presence of measured mite allergen and fungi.^{22,23}

Within Chicago, in a study of baseline data from a small intervention trial with 62 inner-city families with asthma, we found that 34% had pets and 42% had smokers in the home. Eighty percent of the homes had cockroach allergen > 8 U/g.²⁴ In a 1994-to-1995 survey of 2,145 Catholic school adolescents, there was a large variation among racial and ethnic groups in reported exposure to asthma triggers (Table 1). Overall, 54% report home exposure to furry pets, 18% to cockroaches, 18% to rodents, 23% to dampness, and 56% to smoking. Use of inhalants was common, with 13 to 24% smoking cigarettes and up to 23% in some groups reporting use of another inhalant (correction fluid, glue, gasoline, paint) in the last year. Within this population of mixed socioeconomic backgrounds, exposure to individual triggers was not always consistent. At home, cockroaches and rodents tended to be higher in nonwhite children, pets were more common among whites, and exposure to dampness, mold, and passive smoke was relatively high for all subgroups studied.

A more recent survey of 263 low-income African-American public housing residents found even higher levels of overall exposures, with one third having plumbing problems, one third with mold or mildew, one half with cockroaches, one fifth with rodents, and more than one third with a smoker in the home. There was substantial variation among the housing developments, with almost three fourths of the residences in one of the developments having cockroaches, an equal number with mold or mildew, and almost 100% with rodents near the building (M. Turyk, PhD; unpublished data; September 2004). Findings in this study underscore the need for interventions targeting buildings in addition to individual units.

Among 290 low-income, predominantly Hispanic women participating in another study in Chicago, visual inspection of the homes similarly revealed high a prevalence of problems, with 53% having mold or moisture, 31% with cockroaches, 20% with rodents, 33% with pets, and 44% with smokers in the home. Infestation was significantly related to poor housing conditions, such as having holes in the wall, leaks, peeling plaster, and mold (Table 2). The stage of migration was also related to selected exposures, with women born in the mainland United States having greater exposure to

Table 1—Percentage of Students in Chicago Asthma Prevalence Study With Exposures at Home and Personal Exposures to Potential Asthma Triggers*

Variables	Missing/Not Sure	Total	White	Black	Puerto Rican	Mexican	Asian	Other	Mixed
Students, No.	0	2,145	862	393	94	386	62	112	236
Exposures at home									
Dog	34	42.1	52.9	27.1†	43.0	35.9†	9.8†	34.7†	48.7
Cat	41	17.9	20.5	16.2	12.8	12.8†	9.8†	19.8	23.0
Bird	41	13.9	14.6	5.4†	24.5†	17.5	13.1	12.5	15.9
Any small mammal (not cat or dog)	0	9.2	13.0	4.8†	8.5	5.7†	1.6	11.6	9.3
Any furry pet	0	54.2	66.0	39.7†	54.3†	46.4†	17.7†	44.6†	62.3
Rats or mice in last year	189	17.8	13.2	19.4	19.5	22.6†	30.4	16.9	22.6†
Cockroaches in last year	214	17.8	3.1	22.8†	30.7	35.5†	44.8†	25.6†	20.7†
Insecticides sprayed in last year	253	42.9	27.2	61.7†	44.8	45.8	54.6†	50.0†	54.0†
Dampness in last year	326	23.3	20.9	27.2	17.5	20.3	34.8	27.6	27.8
Mold or mildew in last year	232	9.3	9.8	9.0	8.6	6.0	17.7†	5.5	12.5
Cigarette smoker in home	33	55.5	55.8	59.8	53.2	47.5†	50.8	53.0	62.9
Personal exposures									
Smoked cigarettes in last year	71	21.2	24.2	13.1†	18.3	24.2	14.8	22.2	21.3
Marijuana in last year	82	10.3	7.8	13.7	7.5	12.6†	5.0	7.5	13.7†
Crack or cocaine in last year	102	2.2	1.6	1.4	1.1	3.0	3.3	2.2	4.9†
Inhalant use in last year‡	125	16.7	17.1	12.8	14.1	18.4	22.8	13.6	20.0
Alcohol in last year	74	27.3	29.4	20.0	24.4	32.4	15.3	24.2	28.3

*White, black, and Asian = indicated only one race category in response. Puerto Rican = indicated only Puerto Rican in response or indicated Puerto Rican and other Hispanic (n = 11); Mexican = indicated only Mexican in response or indicated Mexican and other Hispanic (n = 21); Other = indicated only one race in response: Native American, other Hispanic, other not specified; Mixed = indicated more than one racial group in response; Missing/Not sure = deleted from data set (n = 128).

†p < 0.05 from logistic regression or proportional odds models with indicator variables for each race category, using white race as reference category. Models were adjusted for clustering of students within schools. Percentages are not adjusted for clustering.

‡Inhalant = correction fluid, glue, gasoline, paint.

Table 2—Relationship of Home Environment With Presence of Cockroaches and Rodents: Baseline Data From Peer Education in Pregnancy Study

Housing Conditions (n = 290)	Cockroaches		Rodents	
	%	Odds Ratio	%	Odds Ratio
Holes in wall				
Yes	55.6	4.0*	34.9	2.9*
No	24.0		15.6	
Space between wall and baseboard				
Yes	46.0	2.4*	20.3	1.0
No	26.1		19.9	
Any leaks				
Yes	42.9	2.0*	37.1	3.6*
No	27.1		14.2	
Peeling plaster				
Yes	43.6	2.2*	25.6	1.6
No	26.2		17.6	
Flaking paint				
Yes	45.9	2.3*	27.9	1.8
No	27.2		18.0	
Mold				
Yes	42.9	2.2*	20.2	1.1
No	25.7		19.3	
Pets				
Yes	39.0	1.7*	22.1	1.2
No	26.9		18.7	

*p < 0.05.

passive smoke and pets and lower exposure to mold and moisture than women born elsewhere (Fig 1).

The relationship of stress to acute asthma events has been known for > 20 years.²⁵ Several studies

have also noted effects of stressful life events,¹² the mental health of children and their caretakers,¹⁷ community violence,¹⁸ and posttraumatic stress after terrorist attacks¹³ on asthma symptoms. Within the survey of Chicago Catholic school children discussed above, we found surprisingly high rates of stressful events that vary widely among racial and ethnic groups. Although events were somewhat more frequent in African Americans than others, all groups mentioned substantial exposure, with 64% reporting family related events (birth of sibling, breakup with boy/girlfriend, parent divorce/separation, job loss, or serious illness in the family or death in family), 43% reporting school-related events (change of school, suspension or expulsion, or failing a class), and 36% reporting violence-related events (physical fight, arrest or conflict with the police, gang problems, stabbing or shooting of child or family member, or sexual abuse). The number of stressful events in the last year was significantly associated with prevalence of asthma as well as asthma attacks, emergency department visits, and hospitalizations in the last 12 months.²⁶

Overall, our Chicago studies highlight the high levels of exposures to environmental triggers and to stressful events for all groups. The large variation in exposures among different communities, however, underscores the need for interventions tailored to the individual needs of the community served.

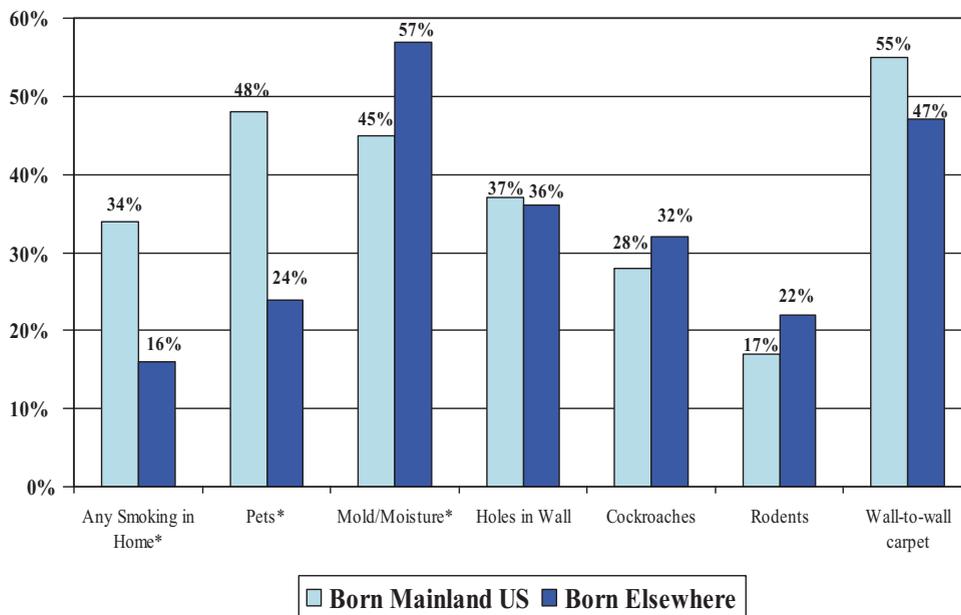


FIGURE 1. Peer Education in Pregnancy Study home environment exposures by place of birth. *p < 0.05 for birthplace differences.

INTERVENTION TRIALS

Most previous intervention trials examining the effects of single allergen reduction on asthma severity have focused on dust mites and have yielded conflicting results. A metaanalysis²⁷ of earlier studies concluded that existing strategies may be ineffective, but the authors included several groups with low mite exposures in their analysis. A large recent randomized placebo-controlled study²⁸ of allergen-impermeable bed covers involving 1,122 adults with asthma found no clinical improvement, even in the mite-sensitive subgroup. In contrast, a study²⁹ of 85 children in Atlanta found a significant correlation of decreases in mite allergen with changes in acute asthma visits among children with mite allergy, although visitation to the home yielded as strong effects overall as active intervention when compared with the group with no home visitation. In another study³⁰ of 47 children, encasing mattresses and pillows resulted in a significant long-term reduction of mite concentrations in mattresses and a decrease in the need for inhaled steroids in children with asthma and mite allergy. Inconsistencies in results in studies so far may result from difference in exposure levels, targeted age groups, intensity of intervention, and other concurrent exposures.

In addressing the large number of issues facing inner-city families—heavy exposure to environmental triggers, high prevalence of stressful events, and inadequate access to appropriate health care—it is important to identify and address individual needs of each community. Thus, even if single allergen exposure such as mite allergens were reduced, it is possible that high levels of other exacerbants would render the single interventions ineffective. Previous intervention trials^{31,32} designed to decrease asthma severity in underserved populations have tended to rely on professional case management focused on multifaceted interventions. The strongest results seen so far were in the National Cooperative Inner-city Asthma Study,³³ in which 515 children age 5 to 11 years in active case management by masters-level social workers reported significantly less symptom days in the previous 2 weeks than the control group (3.51 days vs 4.06 days). Recently, the Inner-city Asthma Study (a follow-up to the National Cooperative Inner-city Asthma Study) achieved significant decreases in allergen levels and symptoms with aggressive management, including donation of high-efficiency particulate air vacuum cleaners and air purifiers.³⁴ The above results suggest that modification of the home environment through professional intervention may be effective in reducing asthma morbidity. Case management by professionals, how-

ever, is often expensive, inconsistently received by low-income groups, and not always transferable in a mobile population.

There is increasing focus on the importance of community health educators in identifying and addressing asthma-related issues. Community health educators have worked in a variety of settings addressing a large number of health problems.³⁵ The issues in asthma are complex and may require lower cost interventions tailored to the unique needs of the selected community.^{36,37} The most comprehensive study to date was recently reported by Krieger et al,³⁸ who conducted a randomized controlled trial with 1-year follow-up among 274 low-income households containing children aged 4 to 12 years with asthma. Community health workers provided in-home environmental assessment, education, support for behavior change, and resources. Participants were assigned to either a high-intensity group receiving seven visits or a low-intensity group receiving a single visit and more limited resources. The high-intensity group improved more significantly in quality of life and asthma-related urgent health services use. Asthma symptom days declined more in the high-intensity group, although differences across groups did not reach statistical significance. The authors estimated that the 4-year net cost savings were \$189 to \$721 in the high-intensity group. Several other ongoing trials are evaluating the effect of community-health educators on asthma severity, although results from most of these are not yet available.

COMMUNITY-LEVEL INTERVENTIONS

The complexity of asthma and the many barriers facing low-income minority communities has led to the development of multifaceted interventions that target communities rather than individuals. The nature of the collaborations has varied from groups of professional and public organizations to community-based intervention research in which the agenda is in part determined by community concerns and the program developed by partnerships of community groups, health-care professionals, and academics. Common to all these initiatives is a commitment to intervene at the group or community level, rather than the individual level. The necessity of working through coalitions and community partnerships to obtain lasting change has become manifest in the last 10 to 15 years. The National Institute for Environmental Health Sciences (NIEHS) was one of the first institutes to appreciate the importance of community-driven research. In 1993, the NIEHS developed the Environmental Justice: Partnerships

for Communication, the first of its translational research programs.³⁹ These programs have expanded in the last 10 years to include a wide variety of projects linking research to community issues in a unique and iterative process that includes information exchange among scientists, community groups, academics, and providers through town meetings, workshops, and funded programs.

The evolution of coalitions within the National Heart, Lung, and Blood Institute had a somewhat different course. The National Asthma Education and Prevention Program began in 1989 to develop and apply appropriate guidelines for asthma detection and management. In the course of implementing the program, the National Asthma Education and Prevention Program recognized the importance of working at the local level through community asthma coalitions.⁴⁰ In 1988, they identified 44 such coalitions, mostly with ≤ 25 voluntary members without paid staff. In general, these voluntary coalitions have proved extremely useful for communication and network development.

An alternative approach is to fund large focused efforts aimed at populations rather than individuals. Three large sets of multifaceted interventions are currently in progress. The first initiative, Allies Against Asthma, funded by the Robert Wood Johnson Foundation, includes coalitions in seven cities: Allies Against Pediatric Asthma in Puerto Rico; Consortium for Infant and Child Health in Hampton Roads, VA; the DC Asthma Coalition; Fight Asthma Milwaukee Allies; The King County Asthma Forum in Washington; The Long Beach Alliance for Children With Asthma in California; and The Philadelphia Allies Against Asthma Coalition. The second initiative, Controlling Asthma in American Cities, is funded by the Centers for Disease Control and Prevention and includes coalitions in Philadelphia, New York City, Minneapolis, St. Louis, Richmond, Berkeley, and Chicago. The third initiative, funded by the Merck Childhood Asthma Network, includes coalitions from Chicago, New York City, Philadelphia, Los Angeles, and Puerto Rico. In all of these programs, coalitions of community organizations, academics, schools, and/or health-care providers are working to establish better linkages among institutions and individuals caring for children with asthma. Each group is approaching the problem somewhat differently, but activities include provider education, increased public awareness, training of community health educators, integration of institutional infrastructures, development of educational materials, enhanced community-wide education, and enhanced referral systems. Evaluation of the programs will be complex. Appropriate controls for community-level interventions are not clear, especially at a time when

measures of asthma severity such as hospitalization rates are changing throughout the country. The benefits of increased education and improving linkages among large institutions caring for children with asthma may not be obvious for several years. Separating effects of individual and joint interventions will provide additional challenges. Nevertheless, the magnitude of the problem and the complexity of issues facing low-income communities demand that we expand our approaches to deal with asthma in a cohesive and innovative manner. The evolution of the Community Asthma Prevention Program (CAPP) in Chicago highlights some of the issues facing our cities and the importance of community-driven projects in addressing those issues.

THE CHICAGO CAPP

The Chicago CAPP was described previously.⁴¹ It was developed in the mid 1990s in response to needs in the low-income communities with high asthma morbidity and mortality rates. The initial pilot trial was lodged in the population served by Erie Family Health Center and Head Start programs on the west side of Chicago.²⁴ It focused on effects of community health educators working with families of children with asthma on modification of their home environment. During this trial, it became apparent that inner-city families had a wide variety of issues impacting on the disease, including lack of knowledge, especially culturally appropriate educational material; lack of coherent infrastructures within the institutions (*eg*, schools, health-care centers, social service agencies) serving the children; family psychosocial issues; environmental exposures; lack of resources; and lack of access to appropriate health care. As the program expanded, services were extended into public housing projects, schools, social service agencies, and health-care systems, and eventually these activities were linked with referrals to three asthma vans delivering free medical care to indigent children enrolled in Chicago schools.

Central to the program is the work of community health educators. Community health educators have unique skills in identifying issues within families, working with them to overcome barriers and build on strengths within the community, finding local resources, obtaining cooperation and acceptance from the family, and working with other groups in building more cohesive infrastructures and changing policies at the local and state level. Our community health-educator program, in addition, enhances skills and job opportunities for the educators themselves. Several of the educators have moved on to more

advanced health-care positions. As a direct result of our program, we have worked with other groups in Chicago to establish a degree program within Daley College that allows community health educators to take courses toward a certificate that can be applied to college credit in a flexible and community-oriented approach.

Our programs require an extensive infrastructure for training, supervision, and continued staff development. The initial training involves 1 to 2 weeks of half-day sessions. These sessions are also open at times to other community members and have served to increase general asthma knowledge in the area. Over the years, we have trained hundreds of residents in these sessions, residents who in turn return to their communities with increased understanding of the disease. After the initial training, in part based on the skills and performance of the participants as well as references and previous experience, and in part on availability of funding, we hire educators for the specific projects. We feel that it is important that the educators, when at all possible, come from and live in the communities being served. Training focused on the needs of the project then continues for the duration: initially in project-related sessions, then usually weekly meetings with supervisors from their agencies, and enhanced by less frequent meetings with project directors, nurses, physicians, and social service support. This intense infrastructure we feel is important because of the complexity of issues that arise, especially during home visits with families under stress from a variety of sources.

The community health educators provide education programs in the community, at health fairs, and at clinical and social service sites. They also work with families in a series of home visits designed to increase asthma knowledge and to identify and modify asthma triggers. General intervention strategies include dust control; decreased exposure to pets; frequent washing of bedding in hot water; elimination of carpets, if possible; decreasing humidity and molds; removal of feather pillows and stuffed toys; covering mattresses and upholstered furniture; use of integrated pest management for pest control; and decreasing exposure to active smoke and passive smoke. Follow-up visits review and reinforce education and assist families in overcoming barriers to change. Throughout our programs, we emphasize low-cost realistic recommendations that can be transported by families when they move. Key to these programs has been the development of culturally sensitive, age-appropriate educational material. Our group, in collaboration with Chicago Public School nurses and the Chicago Asthma Consortium, developed asthma manuals for all principals and nurses within the Chicago Public Schools, as well as

educational brochures in Spanish and English that were distributed to 80,000 families. In addition, with funding from the Otho S.A. Sprague Institute, we developed a series of educational asthma games in Spanish and English for children and adults for use in group settings, such as clinic waiting rooms, health fairs, and parent workshops.

Initially, our program was based at a community health center and Head Start programs in Chicago. Over time, however, we realized the importance of incorporating other agencies, schools, and health centers. This in part evolved from a need for stable and diverse infrastructures—not amenable to perturbations in funding—and in part from a need to establish more coherent linkages among institutions serving the children. When we began working with the schools, for instance, the need for appropriate health-care referrals for students with both established and newly recognized asthma became apparent. We were fortunate to collaborate with the Mobile C.A.R.E. Foundation that now has asthma physicians and staff in three vans providing free asthma care to students in 48 schools in the city. Over the last few years, we have screened approximately 50,000 students in the public and Catholic schools. The 15% of children with diagnosed asthma and an equal number of others with symptoms who desire further evaluation are referred to Mobile C.A.R.E. Foundation vans. We have worked with programs within the public schools (Parents as Teachers First, and subsequently the Early Childhood Program) to train educators within the schools to educate families and children with asthma.

Several years ago, in response to concerns of public housing residents, we screened residents of public housing developments on the south side of Chicago for asthma prevalence and for factors in the homes that could be exacerbating the disease. Subsequently, The Safer Pest Control Project, in collaboration with our group and many of our partners, obtained NIEHS funding for randomized controlled trial of 145 families in which community health educators work with public housing residents on modification of the home environment of families with asthma. As an outgrowth of that project, and again in response to community concerns, Dr. Samuel Dorevitch at University of Illinois at Chicago obtained an NIEHS K08 Training Award to examine the effects of public housing demolitions on particulates and respiratory function.

An important series of questions that still remain relate to the primary prevention of asthma in children at risk for the disease. In the Peer Education in Pregnancy Study, we are working with 351 families recruited when women at risk for having children with asthma were pregnant. This project is a ran-

domized controlled trial examining the effect of aggressive modification of the home environment in pregnancy and early in life on the subsequent development of asthma. Baseline data from that study has shown a high prevalence of asthma triggers in the home as well as psychosocial and medical issues needing to be addressed. In 1-year alone, 130 referrals were made for dental and health-care providers, mental health counseling, legal assistance, help obtaining employment, transportation, food assistance, housing, furniture, finding child care, help with parenting, domestic violence, and car seats.

Recently, the necessity for more coherent integration of institutions serving children with asthma has become clear. With funding from the Centers for Disease Control and Prevention and Merck Childhood Asthma Network, we are participating in two large collective efforts aimed at reducing asthma morbidity. For the first initiative, we are targeting children in an area of the city containing one of six of Chicago Public Schools. This is a collaboration of the Chicago Public Schools; the Chicago Housing Authority; local and state public health departments; the University of Illinois at Chicago; the University of Chicago; the Chicago Asthma Consortium; the American Lung Association Metropolitan Chicago; community groups such as the Grand Boulevard Federation and Health Care Alternatives Systems; and local hospitals and health-care providers, such as Mobile C.A.R.E. Foundation and Access Community Health Network. As part of this effort, we are screening children in schools in the targeted area, and linking them with health-care providers, social services, and community educators hired at four sites. We are training school nurses and health-care providers and working with the American Lung Association Metropolitan Chicago to establish asthma training programs for families and staff within the schools. The second initiative is similar. It targets a smaller African-American, inner-city community on the south side of Chicago with similar multifaceted interventions. The ultimate goal of these programs is to institutionalize coordinated systems able to identify and serve children and their families in a more cohesive and comprehensive fashion.

As these programs have evolved, it has become obvious that barriers exist to asthma management that cannot be addressed within existing structures without major policy change. Collaborations within Chicago have been effective in altering state and local school medication policies so that children with documented asthma can carry their inhalers. Integrated pest management is now mandatory in all Illinois schools and Chicago Public Housing and is included on all Chicago Public

Schools contracts for pest control. Demolition procedures for Chicago Public Housing buildings have been changed to minimize dust and rodent exposure. There are, however, many issues remaining to be addressed. Elimination of indoor exposures to asthma triggers requires better understanding of renovation, construction, and maintenance of healthy homes and schools, enforcement of appropriate building codes, and examination of policies regarding inspection and enforcement of subsidized housing in the inner city. Similarly, decreasing outdoor exposure to pollution requires changes in regulations for diesel fuel and power plant emissions currently undergoing review at the local and national levels. In addition, systems need to be established for the identification and remediation of acute events that have the potential of affecting asthma, such as the current renovation of the Dan Ryan Expressway in Chicago.

Community involvement has been key to all aspects of our activities in Chicago. It is the concern of the community that first alerted us to problems with the medication policy in schools, access to spacers and inhalers, environmental problems in public housing, demolition procedures, and impact of the Dan Ryan Expressway renovation. It is through community action that appropriate committees and task forces have been developed to address these problems, and it is through the continued work of our community health educators that issues in individual homes are identified and addressed, and that culturally specific educational programs have evolved.

FUTURE DIRECTIONS

Despite the increasing experience with asthma interventions, many issues relating to community roles have not yet been addressed. There are still relatively few randomized trials examining the effectiveness of programs that target global reduction in asthma triggers, and even fewer trials examining the effectiveness of community health educators. Evidence to date suggests that reduction in triggers probably decreases asthma symptoms and that community health educators may be particularly suited to such programs, but the level of intensity needed, the importance of addressing multiple vs single triggers, and the usefulness of including general asthma education in overall interventions need to be examined. The multifaceted nature of asthma suggests that interventions at the individual level may not be sufficient. Maintenance of healthy homes, minimizing exposure to outdoor pollution, addressing psychosocial stresses, and expanding access to

appropriate health-care services require partnerships among community groups, academic professionals, public agencies, and health-care providers. In many cases, broad provider/community education programs need to be linked to policy changes at the city, state, and federal levels. The process must be iterative, with communication at all levels and with a community role that is multifaceted. For change to be sustainable at the local level, it will require the development of infrastructures in stable and flexible institutions. This in turn will require training, credentialing, and funding for community workers, as well as the integration of these workers with professionals in other organizations at the local and national levels. The challenges in overcoming the toll this disease is assuming in our society are substantial. The solutions that evolve to meet those challenges should ultimately serve as models to understand and address overall health disparities in underserved populations.

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