

Conceptual Framework of the Controlling Asthma in American Cities Project

Elizabeth Jane Herman

ABSTRACT *The Controlling Asthma in American Cities Project (CAACP) was designed to improve the control of asthma in inner-city populations of children with a disparate burden of symptoms and adverse outcomes. As with many chronic diseases, asthma is the manifestation of multiple biologic, environmental, and social determinants. In addition to appropriate medical management, individuals with asthma must have logistical, financial, and cultural access to environments that allow avoidance of asthma triggers and encourage good asthma management practices. In recognition of this complexity, the CAACP required the seven project sites to coordinate and synchronize multiple interventions (education, healthcare access, medical management, trigger reduction) at multiple levels (individual, home, school, community, and policy) through the collaboration of relevant groups, institutions, and individuals. This paper describes the “program theory” of the CAACP project—the assumptions about how the project worked, how the components were linked, and what outcomes were anticipated. It relates the subsequent papers in the supplement to the program theory and describes how the papers can inform and guide other community-based interventions, and advance the translation of scientific knowledge to effective interventions in communities of need.*

KEYWORDS *Community health partnerships, Coalitions, Asthma, Inner-city, Program theory, Ecological model of behavior change*

INTRODUCTION

Asthma is a disease that inflicts a great burden in the United States at both the individual and population level. Lifelong symptoms of cough, wheeze, and shortness of breath can cause individuals with untreated or uncontrolled asthma to experience activity limitations, poor sleep, and frequent sick days. In 2004, 6.7% of adults and 8.5% of children (<18 yrs) reported having current asthma.¹ In 2007, 4,210 deaths, 504,000 hospitalizations, and 1,772,200 emergency department visits were attributable to asthma¹ at an estimated direct cost of \$14.7 billion.² Great racial disparities exist in both the prevalence of asthma and its adverse outcomes.¹

As with many other chronic diseases, asthma is the manifestation of multiple biologic, environmental, and social determinants. How the interaction of environmental factors with individual genetic susceptibility influences who will develop

Herman is with the Air Pollution and Respiratory Health Branch, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA, USA.

Correspondence: Elizabeth Jane Herman, MD, MPH, Air Pollution and Respiratory Health Branch, National Center for Environmental Health, Centers for Disease Control and Prevention, 4770 Buford Highway MS F58, Atlanta, GA 30341, USA. (E-mail: ehh9@cdc.gov)

This project was supported through a cooperative agreement with the Centers for Disease Control and Prevention, US Department of Health and Human Services, under program announcement 03030.

asthma is only partially understood.³ Indoor and outdoor allergens and irritants (asthma triggers),⁴ as well as psychosocial stress,^{5,6} contribute to the frequency and severity of symptoms among people with existing asthma. While low socioeconomic status increases the burden of asthma, it is unknown whether this is primarily due to a family's limited access to healthcare, reduced ability to prioritize asthma management activities, increased exposure to environmental triggers, other pathways, or a combination of factors.^{7,8}

Although asthma cannot be prevented (except in limited cases of occupationally induced asthma),⁹ research has improved the understanding of asthma as an inflammatory disease, and produced more effective pharmacologic agents to control the underlying inflammation. Guidelines for optimally assessing, classifying, treating, and managing asthma have been issued,¹⁰ and studies have demonstrated the effectiveness of asthma self-management education¹¹ and environmental trigger reduction^{12,13} in lowering the burden of asthma at the individual level. To benefit from advances in medical management, however, individuals with asthma must also have logistical, financial, and cultural access to a family and community environment that encourages good asthma management, and the support of asthma-friendly institutions and policies.

The complexity of both the determinants of asthma's burden on individuals, and the factors necessary to control symptoms and reduce adverse outcomes demands a comprehensive approach. To reduce the burden of asthma on a large scale, population-based asthma projects must reach and enroll large numbers of people with asthma, especially those who bear the greatest burden of the disease and, at the same time, are often the most difficult to engage. The projects must also ensure that providers who treat large numbers of individuals with asthma have the knowledge, skills, and resources to deliver good quality of care. People with asthma and their families need training and motivation to adhere to effective asthma self-management practices and have access to necessary medication, devices, and follow-up. Appropriate self-management practices should be encouraged and supported at the family, institutional (school or workplace), and community levels. Measures must also be taken at these different levels to reduce the exposure of persons with asthma to environmental triggers.

The Controlling Asthma in American Cities Project

In 2001, community-based collaborative groups in seven cities (Chicago, Minneapolis/St. Paul, New York, Oakland, Philadelphia, Richmond, St. Louis) received funding from the Controlling Asthma in American Cities Project (CAACP) to develop comprehensive, culturally appropriate community asthma control plans targeting children (0–18 years) in inner-city areas with large, unmet asthma control needs. In 2003, these sites were awarded funds to implement their plans over a 5-year period.

The CAACP design reflected the belief that “it takes a community” to address the multiple social, environmental, and medical interventions necessary to control asthma, particularly in populations with a disparate burden of asthma symptoms and adverse outcomes. Funded by the National Asthma Program of the National Center for Environmental Health, Centers for Disease Control and Prevention (CDC), the project required the coordination and synchronization of multiple interventions (education, healthcare access, medical management, trigger reduction) at multiple levels (individual, home, school, community, policy). The project design required the collaboration of relevant groups, institutions, and individuals through formal asthma coalitions.

The CAACP drew heavily upon previous community-level, disease-specific projects,^{14,15} particularly the design and experience of the Allies Against Asthma (Allies) Initiative, which was planned and implemented between January 2000 and July 2006¹⁶ with funding from the Robert Wood Johnson Foundation and direction and technical assistance from the University of Michigan School of Public Health. Allies supported the development of seven community-based coalitions of professional and grassroots leaders to improve asthma care and coordination, and used standardized tools to evaluate coalition functioning and progression through previously described stages of coalition development.^{16,17} Building on the Allies' experience, CDC encouraged the CAACP sites to invest in coalition development, conduct regular self-assessments of coalition functioning, and use findings to improve coalition performance.

CAACP project guidance gave the sites maximum flexibility for selecting interventions and evaluating coalition functioning, processes, and outcomes. The funding mechanism did not permit research or a requirement that the sites use a common set of evaluation measures and methods, but the funding terms required each site to conduct a comprehensive evaluation of their entire project, using CDC's Framework for Program Evaluation in Public Health¹⁸ as a guide. CDC anticipated that all sites, in addition to evaluating the coalitions and tracking the implementation and outcomes of individual interventions, would measure changes in hospitalization rates and other population-based indicators (emergency department utilization, school absenteeism, or asthma-prescription-fill data) appropriate to their settings and resources.

The CAACP Program Theory

Program theory is the articulation of assumptions about how a project works, how the components are linked, what contextual factors mediate the project's effectiveness, and what outcomes are anticipated.^{19,20} An overview of the CAACP's program theory is summarized in a conceptual model (Figure 1) that is adapted from a framework developed by Chen.²¹ As indicated in Figure 1, the CAACP's core purpose was to transform a population of children with uncontrolled asthma into a population of children with well controlled asthma. The services that, based on the literature and on preceding projects, were assumed essential to drive improved outcomes were (1) reduction of asthma triggers; (2) access to quality healthcare; (3) support in relevant institutional settings (schools and daycare facilities); (4) acquisition of asthma self-management skills, including access to appropriate medications and devices; and (5) assistance with competing needs and concerns such as unemployment, substance abuse, housing problems, or other family illnesses. The achievement of better asthma control would ultimately be reflected in the more distal outcomes of better healthcare utilization, better academic performance, improved school or daycare attendance, increased tolerance for physical activity, and better asthma-related quality of life.

A major assumption of the CAACP program theory was that successfully functioning, community-based asthma coalitions would greatly facilitate delivery of the services in the shaded box of Figure 1, and ultimately the achievement of the desired distal outcomes. The expectation, as summarized in the Community Asthma Coalition box (Figure 1) and expanded in Figure 2, was that the coalitions would progress through a formative period with inputs from interested community and professional members, external funding, local expertise and resources, paid staff, and technical assistance. During that period, the coalitions would execute the

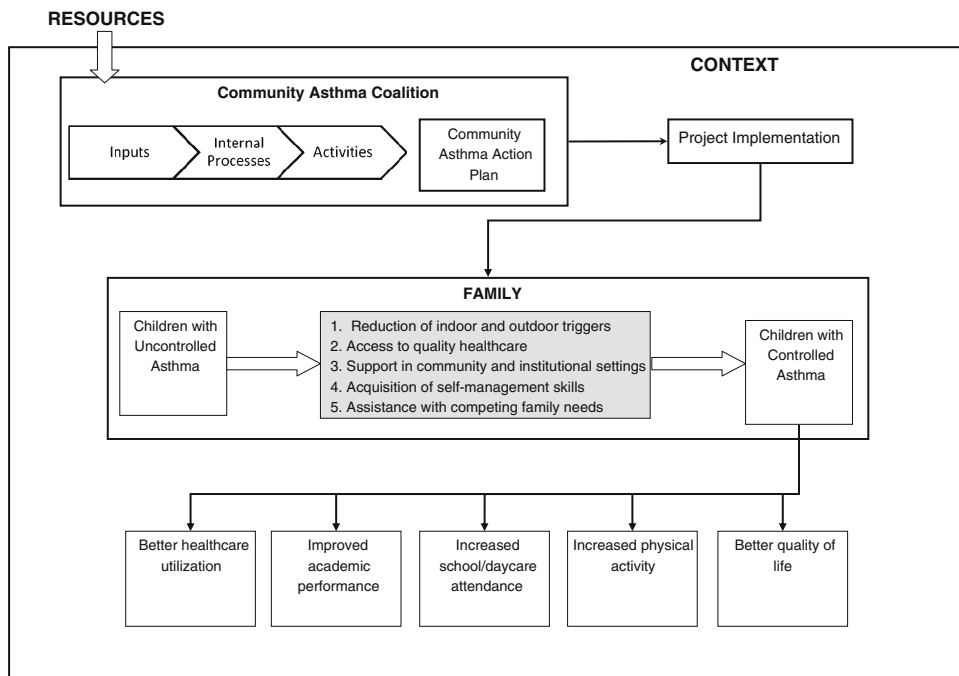


FIGURE 1. Program theory of the CAACP.

important internal processes of recruiting key members, identifying strong leadership, defining operating procedures and ways of working together, and ensuring benefits to its members that would keep them engaged and productive. During a two-year planning period, coalitions were expected to assess community needs and resources, solicit community input, network with relevant change leaders and non-member organizations and plan the type and sequence of interventions to be implemented. The anticipated outputs from the formative and planning periods included a comprehensive, culturally appropriate community asthma action plan that would be widely supported by the community, change leaders, policy makers, and healthcare payers. The interventions specified in that plan were expected to be coordinated and synergistic; have good reach and coverage; have a system for monitoring, evaluation, feedback, and modification; be effective in achieving the desired outcomes; and eventually be institutionalized and sustained through community ownership and supportive policies.

CDC encouraged the sites to develop their community asthma action plans using an ecological model of behavior change that encompasses multiple levels of influence on health behavior.²² Each CAACP site, in addition to targeting children with asthma and their families (intrapersonal level), was expected to implement interventions involving healthcare providers and other individuals who interact with children and families with asthma (interpersonal level), faith- and community-based organizations (community level), healthcare payers and systems (institutional level), and the achievement of a physically and psychosocially asthma-friendly environment (policy level). Figure 3 lists the types of asthma interventions that might be appropriate to these levels, and the asthma services (shaded box in Figure 1) to which they map. The program theory acknowledged that these interventions would be implemented in, with, and through the local social, cultural, and political context as well as in the context of other non-CAACP asthma initiatives.

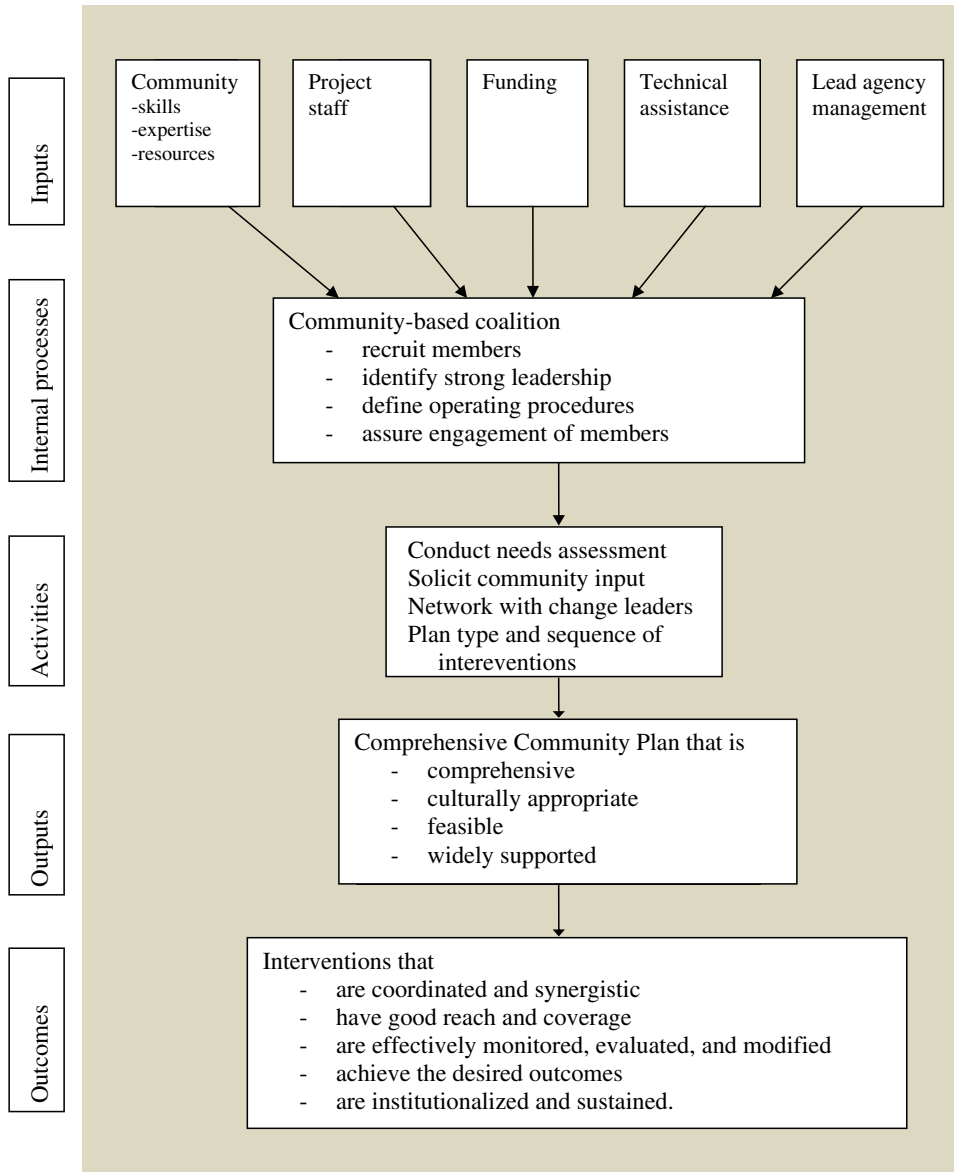


FIGURE 2. Expansion of CAACP program theory related to community asthma coalitions.

The parts of this program theory were envisioned to interact in a dynamic and iterative way that cannot be captured in two-dimensional figures. The coalitions were expected to evolve as tasks changed from planning to implementation, new members joined, and opportunities for funding or collaboration arose. Monitoring and evaluation results would lead to changes in the community action plan and its interventions. As interventions were implemented and linkages created, the relationships between institutions were likely to change. Institutionalizing new interventions or services and asthma-friendly policies and procedures would also result in change within member organizations. Just as the local political, social, and cultural context would influence efforts to implement and coordinate the interventions, it was anticipated that the planning and implementation of the project would lead to

Policy	Institutional	Community	Interpersonal	Intrapersonal
<ul style="list-style-type: none"> Improving reimbursement policies for asthma self-management training, asthma medication and devices, and routine asthma check-ups (2,4)* Promoting anti-idling laws for school buses (1) Encouraging enforcement of self-carry laws for asthma medications (3) Addressing local outdoor air pollution issues (1) 	<ul style="list-style-type: none"> Providing asthma resource nurses and asthma case management in the schools (3) Asthma friendly cleaning and trigger reduction practices in schools and daycare facilities (1,3) Improved asthma training in healthcare professional school (2) Improved healthcare systems for managing children with asthma (2,3) 	<ul style="list-style-type: none"> Partnering with community-based organizations to provide or refer to asthma services (3,5) Mobilizing social service and mental health support (5) Increasing community awareness and capacity to address asthma (3) Creating linkages between groups to provide comprehensive services (1-5) 	<ul style="list-style-type: none"> Training healthcare professionals who treat children with asthma (2) Training pharmacists who dispense asthma medications (2,3) Training others who interact with children with asthma (coaches, teachers, daycare providers) (3) 	<ul style="list-style-type: none"> Self-management training for children with asthma and their families (4) Household trigger reduction education and remediation (1)

FIGURE 3. Level and range of possible asthma interventions following the ecological model of behavior change. *Numbers in parentheses indicate the services (shaded box in Figure 1) to which the interventions map.

increased awareness, more supportive policies, and other improvements in the political, social, and cultural context of asthma.

Thus the program theory of the CAACP assumed a complex, continuously changing dynamic. The design, which maximized flexibility and autonomy for the sites, defied concise project description, site comparisons, or a simple definition of success. Moreover, the incorporation of ongoing evaluation, feedback, and modification ensured the evolution of interventions and measures over time.

Use of Program Theory to Understand Program Implementation and Evaluation

CDC used a multi-faceted approach to its evaluation of the CAACP. At a basic level, the CDC leads sought to assure that the interventions implemented by the sites reduced the burden of asthma suffered by participating children, and that the coalitions functioned effectively. More broadly, the project was intended to contribute to the knowledge base about project implementation, particularly the implementation and evaluation of complex community-level projects. The articles in this special journal supplement represent a sample of the CAACP accomplishments and map to different parts of, and different assumptions underlying, the program theory.

Two papers in this supplement focus on the community-based asthma coalitions. The paper by Davis and Herman²³ draws on the experiences of the CAACP coalitions to outline the decisions that must be made, either implicitly or explicitly, when developing a community asthma action plan. It was written as a resource to inform the decision making of government agencies, community groups, program managers and funders of complex community-based interventions. The paper on the added value of coalition by Herman et al.²⁴ tests the assumption that implementing projects through coalitions yields benefits beyond what can be achieved by single organizations or through other methods of collaboration. It focuses on the dynamic aspect of the program theory by documenting increased linkages among health systems, community-based organizations, schools, and other institutions; changes within institutions; achievement of policy changes; and

empowerment of community members to sustain interventions and influence their local social, political, and cultural contexts.

The papers on interventions demonstrate the successes and failures of project implementation and of reaching the targeted “children with uncontrolled asthma” across sites. Given the age of the target population, all sites conducted interventions in the schools, three of which appear in this supplement. The paper from Oakland by Shrimali et al.²⁵ describes changes in asthma medication use following a program offered in middle schools. Two case studies from the St. Louis site describe innovative approaches to increasing the number of asthma action plans submitted to school nurses²⁶ and to integrating asthma education into the routine school curriculum.²⁷ All sites brought asthma self-management training and indoor-trigger reduction directly into the home, thus directly providing two of the necessary services listed in the program theory (Figure 1). The cross-site paper by Brown et al.²⁸ contrasts different approaches to designing these home-based interventions as well as strategies for recruiting participants for, staffing, and sustaining them.

The CAACP sites struggled with engaging physicians and other healthcare providers in interventions to ensure optimal quality of care for children with asthma. Although all started with off-site group trainings, they had to expand their strategies to reach providers unable or unwilling to attend training sessions. The Richmond site took their quality improvement intervention directly to pediatric practices, using problem-based learning within an academic detailing model.²⁹ Richmond’s experience, as described Ragazzi et al., emphasizes the importance of flexibility and adaptability in reaching out to providers and designing practice-based interventions.

The evaluation of project implementation was not limited to specific interventions and their direct impact on individuals. An equally important part of the CAACP program theory was the project’s effect on policies and procedures within the participating organizations, changes in the asthma culture within the community, and continuation of successful interventions and linkages created during the funding period. The set of papers under the heading *Creating Community Linkages*, describes some of these more abstract achievements. The paper on Asthma Friendly Pharmacies by Berry et al.³⁰ describes success in institutionalizing communication between pharmacists, patients, and primary care providers. Nesvold and Brust³¹ demonstrate a model of cooperation that benefited health plans, healthcare providers, and patients in the Minneapolis/St. Paul metropolitan area. The paper on asthma interventions in the daycare setting by Findley et al.³² demonstrates the effectiveness of reinforcing asthma messages by exposing children and caregivers to multiple levels of intervention including training daycare staff, providing self-management training for parents of children with asthma, improving the medical management of providers, and implementing community-based interventions to increase awareness and interest.

Each of the papers in the final group demonstrates an innovative approach, supplementary to measuring hospitalization and emergency department utilization, to measuring the project’s impact at a population level. The paper by Davis et al.³³ uses prescription-fill data from a commercial pharmacy database in Chicago to trace improvements in asthma medication prescription/use in the intervention zip codes. Bryant-Stephens’ paper on a community street-corner survey demonstrates an affordable approach to identifying trends in awareness and knowledge among community members.³⁴ The paper on the added value of coalitions²⁴ summarizes project-related outcomes ranging from the professional development of individual coalition members, to changes within institutions, to increased linkages among institutions within and outside of the coalition, to policy changes related to asthma.

CONCLUSION

The design of the Controlling Asthma in American Cities Project was complex. Its flexibility and accommodation to local context produced countless permutations of interventions, implementation methods, and evaluation strategies. A single outcome is incapable of measuring the project's success. Each paper in this supplement addresses an aspect of the CAACP program theory. The many complementary stories offered in the following pages aim to inform and guide other community-based asthma control efforts and advance the translation of scientific knowledge to effective interventions in communities of need.

ACKNOWLEDGEMENTS

The author thanks Maureen Wilce, Amanda Savage Brown, and Sheri Disler for their thoughtful reviews of the manuscript and Krista Valenzuela for her assistance with the figures and references. The findings and conclusions in this paper are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention.

REFERENCES

1. Moorman JE, Rudd RA, Johnson CA et al. National surveillance for asthma—United States, 1980–2004. *MMWR Surveill Summ.* 2007; 56(8): 1–54.
2. 2007 NHLBI Morbidity and Mortality Chart Book. National Institutes of Health; National Heart, Lung, and Blood Institute; 7 A.D. Jun 1.
3. London SJ, Romieu I. Gene by environment interaction in asthma. *Annu Rev Public Health.* 2009; 30: 55–80.
4. Phipatanakul W. Environmental factors and childhood asthma. *Pediatr Ann.* 2006; 35(9): 646–656.
5. Chen E, Miller GE. Stress and inflammation in exacerbations of asthma. *Brain Behav Immun.* 2007; 21(8): 993–999.
6. Weil CM, Wade SL, Bauman LJ, Lynn H, Mitchell H, Lavigne J. The relationship between psychosocial factors and asthma morbidity in inner-city children with asthma. *Pediatrics.* 1999; 104(6): 1274–1280.
7. Drake KA, Galanter JM, Burchard EG. Race, ethnicity and social class and the complex etiologies of asthma. *Pharmacogenomics.* 2008; 9(4): 453–462.
8. Gupta RS, Springston EE, Weiss KB. Eliminating asthma disparities: is there evidence of progress? *Curr Opin Pulm Med.* 2009; 15(1): 72–78.
9. Quint J, Beckett WS, Campleman SL et al. Primary prevention of occupational asthma: identifying and controlling exposures to asthma-causing agents. *Am J Ind Med.* 2008; 51(7): 477–491.
10. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma—Summary Report 2007. *J Allergy Clin Immunol.* 2007; 120(5 Suppl): S94–S138.
11. Coffman JM, Cabana MD, Halpin HA, Yelin EH. Effects of asthma education on children's use of acute care services: a meta-analysis. *Pediatrics.* 2008; 121(3): 575–586.
12. Kattan M, Stearns SC, Crain EF et al. Cost-effectiveness of a home-based environmental intervention for inner-city children with asthma. *J Allergy Clin Immunol.* 2005; 116(5): 1058–1063.
13. Krieger JW, Takaro TK, Song L, Weaver M. The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. *Am J Public Health.* 2005; 95(4): 652–659.

14. Goodman RM, Liburd LC, Green-Phillips A. The formation of a complex community program for diabetes control: lessons learned from a case study of Project DIRECT. *J Public Health Manag Pract.* 2001; 7(3): 19–29.
15. Rosenthal J, Morrow AL, Butterfoss FD, Stallings V. Design and baseline results of an immunization community intervention trial in Norfolk, Virginia. *Pediatr Ann.* 1998; 27(7): 418–423.
16. Clark NM, Doctor LJ, Friedman AR et al. Community coalitions to control chronic disease: allies against asthma as a model and case study. *Health Promot Pract.* 2006; 7(2 Suppl): 14S–22S.
17. Butterfoss FD, Goodman RM, Wandersman A. Community coalitions for prevention and health promotion. *Health Educ Res.* 1993; 8(3): 315–330.
18. Framework for program evaluation in public health. *MMWR Recomm Rep.* 1999 September 17; 48(RR-11): 1–40.
19. Chen HT. *Theory-driven evaluations.* Newbury Park: Sage; 1990.
20. Weiss C. Nothing as practical as good theory. In: Connell TP, Kubisch AC, Schorr LB, Weiss C, eds. *New approaches to evaluating community initiatives.* Washington: Aspen Institute; 1995:65-92.
21. Chen H. *Figure 2.2 conceptual framework of program theory (Comprehensive Form). Practical program evaluation.* Thousand Oaks: Sage Publications Inc.; 2005:31.
22. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q.* 1988; 15(4): 351–377.
23. Davis A, Herman EJ. Considerations and challenges for planning a public health approach to asthma. *J Urban Health.* 2010 [This issue; needs rest of citation].
24. Herman EJ, Keller A, Davis A et al. A model driven approach to assessing the added value of community coalitions. *J Urban Health.* 2010 [This issue; needs rest of citation].
25. Shrimali BP, Hasenbush A, Davis A, Tager IB, Magzamen S. Medication use patterns among urban youth participating in school-based asthma education. *J Urban Health.* 2010. doi:10.1007/s11524-010-9475-z.
26. Richmond CM, Hobson A, Pike EV, Kleiss J, Wottowa J, Sterling S. Breathe your best for school success. *J Urban Health.* 2010. doi:10.1007/s11524-010-9478-9.
27. Pike EV, Richmond CM, Hobson A, Kleiss J, Wottowa J, Sterling DA. Development and evaluation of an integrated asthma awareness curriculum for the elementary school classroom. *J Urban Health.* 2010. doi:10.1007/s11524-010-9477-x.
28. Savage Brown A, Disler S, Burns L et al. Family and home asthma services across the Controlling Asthma in American Cities Project. *J Urban Health.* 2010. doi:10.1007/s11524-010-9472-2.
29. Ragazzi H, Keller A, Ehrensberger R, Irani AM. Evaluation of a practice-based intervention to improve the management of pediatric asthma. *J Urban Health.* 2010. doi:10.1007/s11524-010-9471-3.
30. Berry T, Prosser T, Wilson K, Castro M. Asthma friendly pharmacies: a model to improve communication and collaboration among pharmacists, patients and health care providers. *J Urban Health.* 2010 [This issue; needs rest of citation].
31. Heins Nesvold J, Carlson A, Brust J. Building a partnership with health plans: the Minneapolis and St. Paul Controlling Asthma in American Cities experience. *J Urban Health.* 2010 [This issue; needs rest of citation].
32. Findley SE, Thomas G, Madera-Reese R et al. A community-based strategy for improving asthma management and outcomes for preschoolers. *J Urban Health.* 2010. doi:10.1007/s11524-010-9479-8.
33. Davis S, Krishnan J, Lee K, Perskey VW, Naureckas E. Effect of a community-wide asthma intervention on appropriate use of inhaled corticosteroids. *J Urban Health.* 2010. doi:10.1007/s11524-010-9476-y.
34. Bryant-Stevens T, Kurian C, Chen Z. Brief report of a low-cost street corner methodology to assess inner-city residents' awareness and knowledge about asthma. *J Urban Health.* 2010 [This issue; needs rest of citation].