

Preventing Asthma through Housing Interventions: How Supportive is the US Policy Environment?

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ABSTRACT *This paper investigates whether the policy environment in the United States is supportive of addressing the asthma epidemic through housing plans and policies. Asthma is increasing at an alarming rate worldwide and is linked to allergens in the housing environment such as ground-level ozone, excessive moisture and dust, rodents and pests, and environmental tobacco smoke. The study finds basic laws and regulations are in place regulating outdoor air quality and calling for the maintenance of public and rental housing in good condition, but there is still a need for specific standards to be adopted into law, for better enforcement of existing laws, and for increased funding. Because asthma prevention programs are relatively new, the paper reviews the US experience with lead-based paint hazard control programs to identify the components of effective strategies. These include explicit health objectives in housing plans and policies, promotion by both health and housing officials, advocacy by citizens' groups and tenants' associations, adequate funding for implementation, and focus on multiple health outcomes.*

KEY WORDS: Housing, environmental health, planning

Introduction

The influence of the housing environment on health has long been recognized, from the effects of household crowding and poor hygiene and sanitation on infectious diseases, to the link between lead-based paint and dust in housing to lead poisoning in children, and to the effect of poorly maintained housing structures on injuries. Yet health and housing professionals seldom work together to address common problems with critical health implications. The experience of combating lead poisoning through housing interventions is an important exception, and one that shows environmental approaches carried out jointly by health and housing professionals can be effective. The mounting scientific evidence linking asthma both to outdoor and indoor environments suggests similar approaches are likely to make a difference for people suffering from asthma.

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This paper investigates whether the policy environment in the US today is supportive of addressing asthma prevention through housing plans and policies. Asthma affects approximately 150 million people worldwide and 17 million in the USA (Institute of Medicine, 2000) and is increasing at alarming rates. From 1980 to 1994, the prevalence of self-reported asthma in the US increased 75 per cent (US CDC, 1998b). Nationally, asthma is the ninth leading cause of hospitalization (US CDC, 1998a).

Both the quality of housing structures and the immediate housing environment influence the prevalence of asthma. Hazardous concentrations of ground-level ozone in housing environments are strongly linked to asthma (Friedman *et al.*, 2001; McConnell *et al.*, 2002). Growing evidence suggests indoor environments are also an important contributor to the asthma epidemic. A recent estimate suggests people in industrial countries spend about 90 per cent of their time indoors; for certain subpopulations such as infants, the elderly and those with chronic illnesses, the proportion of time spent indoors is even higher (American Lung Association *et al.*, 1994). Damp, moldy housing, defects in housing structures, poor ventilation, fumes from home building materials and floor covering, have all been implicated in the increasing prevalence of asthma. Indoor air contaminants have also been linked to numerous other adverse health outcomes, including eye, throat, and skin irritations, cancer and various infections. In addition, the quality of indoor environments influences the likelihood of injuries and house fires.

This paper argues that incorporating health objectives in housing plans and policies will help prevent asthma while strengthening efforts to uphold minimum housing quality standards. Such a strategy makes sense politically: asthma and other housing-related health concerns such as lead poisoning, falls and other injuries and house fires, are highly visible. Asthma in particular is characterized by its devastating effect on quality-of-life. Comparatively few people die of asthma-related symptoms but many more suffer from the chronic wheezing, shortness of breath, coughing, chest tightness and other respiratory conditions characteristic of the disease. In the US between 1980 and 1993, 3850 persons aged 0–24 died of asthma-related symptoms. During that same period, however, annual hospitalization rates for persons 0–24 years of age were nearly 22 per 10 000 (US CDC, 1998a). Asthma prevention through environmental intervention also makes sense from an economic perspective. It is estimated that the treatment of asthma cases costs the US about \$14.5 billion annually (IOM, 2000).

This study begins by describing the specific allergens that have been linked to exposures inside housing units such as water-damaged roofs and walls, poor ventilation, certain home building materials, as well as outdoor exposures due to the siting of the house (air quality, proximity to a bus depot). It then identifies existing policies and laws that address these housing conditions and the agencies responsible for implementation and enforcement, and concludes that for the most part, basic regulations exist. Nonetheless, there is still a need for specific standards to be adopted into law and for better enforcement of existing laws. The paper then reviews efforts to prevent hazards from lead-based paint through interventions in the housing environment, arguing these can provide useful insights for asthma prevention programs; the latter have been implemented more recently. At this point in history, both types of programs face the same set of political and economic constraints. In the case of asthma however, it is harder to screen for environmental exposures. The review identifies five components that increase the likelihood housing plans and policies would meet health objectives: explicit health objectives included in housing plans and policies, promotion by both health and housing officials, advocacy

by citizens' groups and tenants' associations, adequate funding for implementation, and focus on multiple health outcomes.

Background

Asthma: Who, What, Where?

Asthma is a chronic illness that affects over 17 million persons in the US and approximately 150 million persons worldwide (IOM, 2000). It is characterized as a chronic disease because it persists over time in affected individuals, and also because its symptoms are thought to develop slowly due to exposure to certain risk factors (Martinez *et al.*, 1995). Symptoms can be triggered by both non-allergic and allergic reactions to inhaled irritants, such as pollen or fungi, which cause the inflammation in the lungs (Martinez *et al.*, 1995).

In the US, non-whites, particularly blacks, have higher asthma mortality rates than whites. In 1993, black children aged 5–14 were six times more likely to die from asthma-related symptoms (US CDC, 1998b; Weiss & Wagener, 1990). In Chicago, between 1968 and 1991, asthma mortality rates increased by 337 per cent for black inner-city residents while remaining stable for white inner-city residents (Targonski *et al.*, 1994). In Philadelphia, asthma mortality rates were highest in the census tracts with the highest percentages of poor people and minority residents (Lang & Polansky, 1994). Hospitalization rates for asthma are also higher among blacks (Carr *et al.*, 1992; Joseph *et al.*, 1996; Weitzman *et al.*, 1992). Other risk factors for asthma at the individual level include sex, with males being at higher risk in childhood and females at higher risk as adults, genetic and familial factors, respiratory infections, and cigarette smoking (Barbee & Murphy, 1998).

Allergens in the immediate housing environment. Allergens associated with asthma produced near the home can negatively affect residents, either because they enter the home and concentrate there, or because they affect residents as they leave and enter their home, play or walk nearby. The principal source of outdoor air pollution that influences asthma is ground-level ozone (Friedman *et al.*, 2001). Ozone can originate from motor vehicle and power plant emissions that when inhaled can cause mild to severe lung irritations that exacerbate asthma symptoms. A recent article, taking advantage of efforts to reduce downtown traffic congestion in Atlanta during the Olympic Games, investigated the health effects and found significant decreases in asthma rates (Friedman *et al.*, 2001).

The findings of a recent study in southern California suggest that high ozone concentrations not only cause asthma attacks in children who already have it, but also cause asthma to develop in those who do not. The study found that in high ozone communities, children playing multiple team sports were significantly more likely to develop asthma than children with less exposure; this greater likelihood was not found in low ozone communities (McConnell *et al.*, 2002). In the same models, time spent outside was also associated with asthma in high ozone communities but not in communities with low ozone concentrations (McConnell *et al.*, 2002).

Allergens in indoor housing environments. Allergens linked to asthma are also produced in poorly maintained housing. Damp, cold and moldy housing is associated with the

development of asthma and with exacerbating the symptoms of asthma (IOM, 2000; also see scientific literature cited in Krieger & Higgins, 2002). Damp houses provide an environment in which mites, roaches and molds thrive, all of which have been linked with asthma (Miller *et al.*, 1999; Rosenstreich *et al.*, 1997). Dust mites nest in carpets and bedding. The source of the cockroach allergen is thought to be cockroach feces or body parts, or other sources on the body. Animal and rodent allergens are also implicated. Dander is found on cat hair and is extremely mobile and often airborne. Dander may remain in the environment for up to 20 weeks following the removal of the cat (IOM, 2000). Defects in the structure of the house permit entry of cockroaches and rodents. Dead spaces in the walls allow circulation between apartments in multi-unit dwellings; leaking pipes and roofs, and damp basements provide drinking sources.

Poor ventilation, another housing-related factor, influences asthma in a number of ways. It increases interior moisture and thereby helps create an environment in which dust mites thrive (see citations in Kreiger & Higgins, 2002). It also may increase exposure to smoke, thereby exacerbating the effect on asthma of environmental tobacco smoke (ETS), smoke which non-smokers are exposed to while indoors (IOM, 2000; Sears, 1997). Ventilation systems influence health by changing the rates of pollutant removal and dilution with outdoor air. Existing studies suggest that “large increases in ventilation rates would be most effective in reducing exposures to ETS, cat allergens, infectious droplet nuclei, and some volatile organic compounds” (IOM, 2000, p. 357).

Indoor biochemical pollutants from a variety of sources can concentrate in buildings, causing a common array of symptoms among workers referred to as the ‘sick building syndrome’. Some of these gaseous pollutants are associated with asthma. The syndrome most often occurs in new, remodeled and poorly maintained buildings (Aicher, 1998). There is concern in some circles that energy conservation measures such as new types of insulation and construction materials could be increasing indoor air pollution; decreased ventilation and installed ventilation systems that are difficult to manage effectively may also play a role (Greenberg, 1986, p. 255).

The US Policy Environment

A review of the policy environment in the US for addressing asthma through interventions in the built environment indicates that to a large extent, basic laws and regulations are in place regulating outdoor air quality and calling for the maintenance of public and rental housing in good condition. Relevant laws and regulations may originate at the federal, state or local level. At all levels, the review presented here indicates enforcement remains a challenge; standards specifying hazardous levels of indoor exposures need to be adopted into law at the state and local levels to support enforcement efforts. Furthermore, in cases where the needed remediation is expensive and technically complex, subsidies to help landlords come into compliance may be necessary.

Relevant regulations and agencies responsible for enforcement. Table 1 identifies the regulations governing the housing conditions and aspects of the immediate housing environment that have been linked to asthma, and the agencies responsible for enforcement.

Table 1. Regulations governing the housing conditions that have been linked to asthma, the allergens involved, and the agencies responsible for enforcement

Allergen	Housing-related exposure	Relevant policy or regulation	Agency responsible for enforcement
<i>Dust mites</i>	water-damaged roofs and walls; damp basements; leaking pipes; poor ventilation; old, dirty carpeting	housing codes; regulations governing landlord-tenant relations	county or city code enforcement officers
<i>Environmental tobacco smoke (ETS)</i>	poor ventilation	as above	as above
<i>Cockroach parts; mouse allergens</i>	defects in the house structure that permit entry; dead spaces in walls; dampness;	as above	as above
<i>Cat dander</i>	old carpeting; contaminated air	as above	as above
<i>Volatile organic compounds (VOCs) (formaldehyde)</i>	inadequate air exchange rates; fumes from building materials and some furnishings, carpets	building codes	code enforcement officers
<i>Ground-level ozone</i>	motor vehicle emissions; power plant emissions; gasoline vapors	Clean Air Act; zoning regulations; policies and plans governing transportation	EPA code enforcement officers; Metropolitan Planning Organizations and transportation planners

Federal level. The Federal Clean Air Act Amendments of 1990, Section 176c are the main policies affecting outdoor air exposures linked to asthma. They require the President and the Environmental Protection Agency (EPA) to review health standards associated with outdoor air exposure every five years, and make adjustments based on new scientific findings (US EPA, 1990).

State and local levels. The main state and local regulations that influence the indoor air environment are housing codes, building codes and the laws specifying landlord and tenant responsibilities. Landlord-tenant law, composed mainly of statutory or common law, governs the rental of commercial and residential property; as such, it covers conditions in much of the low-income US housing stock. A number of states base their statutes on either the Uniform Residential Landlord and Tenant Act (URLTA) or the Model Residential Landlord-Tenant Code (Legal Information Institute, 2004). The habitability of a residential rental unit, considered a basic, legal human right in most states, is ensured by warranties that are included in the URLTA (*see* §§ 2.104).

Basic habitability requirements include adequate weatherproofing, available heat, water and electricity, and clean, sanitary and structurally safe premises; in addition, windows and doors must function properly, thus allowing ventilation control. Through its housing codes, each state specifies which aspects it will address. Florida statutes, for example, require a landlord to comply with local Property Maintenance Codes (State of Florida, 2000). The components that are relevant to asthma are mainly those related to pest infestations such as cockroaches and rodents, and those related to excess moisture problems and ventilation. The latter include that the roof must not leak, that the walls must be weather-tight, that windows and doors must be weather- and water-tight, that window panes cannot have cracks or holes, and that inside floors, walls and ceilings must be kept in sound condition and good repair.

In addition, at the local level zoning ordinances influence outdoor air exposures near homes by restricting land uses in residential areas; for example, code enforcement managers can pursue the owners of illegal businesses such as auto repair, sanding, or bodywork that are in residential zones and that would produce irritants to asthma sufferers (Code enforcement manager, 2000). Local zoning ordinances and policies also affect how supportive the built environment is of physical activity near homes which in turn reduces symptoms in asthma sufferers (Lang, 2004). These include policies and ordinances affecting the siting of schools and parks, sidewalk and greenway construction, pedestrian and bicycle safety, and the proximity of desirable destinations (Frank & Engelke, 2001; Sallis *et al.*, 1998). State transportation planners also play a role. They work with the environmental agency to write the state implementation plan for meeting national ambient air quality standards. This often involves planning for better accommodation of all transportation modes and not just motor vehicles. This plan is put through public hearings and approved by the state legislature.

Experience to Date

Programs addressing asthma through the built environment are relatively new. It is therefore instructive to look at the experience of the longstanding lead poisoning prevention programs in the US. At this point in time, dust and soil contaminated with lead from all sources (currently peeling paint, historic use of leaded gasoline and emissions by

lead industries), are found in the home; strategies focused in and near homes therefore make sense (Morrison, 1998, p. 17). Asthma like lead poisoning is strongly linked to substandard housing environments. It also disproportionately affects inner-city residents, particularly children, as does lead poisoning in the US today. The successes and remaining challenges of lead poisoning prevention programs are therefore useful indicators of the extent to which the US policy environment is supportive of housing interventions with health objectives.

Knowledge of lead-based paint as a major source of childhood lead poisoning predated any large-scale preventive action in the US by at least four decades because of political and economic pressures (Rabin, 1989). In France, the use of lead paints on both the exterior and interior of buildings was prohibited as early as 1920 (Fee, 1990, p. 574). Much of the problem could have been avoided had other countries followed their lead. In the US, first approaches to childhood lead paint poisoning, called the "silent epidemic of American cities" (Fee, 1990, p. 570), started in the 1930s with a health education perspective which essentially blamed the victims, young children and their parents, for the problem (Rabin, 1989). Recognizing the limits of this approach, between the 1930s and 1960s Baltimore pioneered lead poisoning prevention programs involving free diagnostic testing, housing inspection, paint labeling, lead abatement as well as health education (Fee, 1990). By the 1970s other states implemented a number of prevention-oriented programs of action.

The fact that screening of large populations was possible for lead was instrumental in helping gain the public's attention, in showing that many children and many different places were involved, and that the environment was the culprit (Berney, 1993). In 1970, the Lead Paint Poisoning Prevention Act was passed and opened the way for massive screening programs. Five years later, the Environmental Protection Agency (EPA) began to regulate lead in gasoline and catalytic converters were introduced that required the use of unleaded gasoline. In 1978, lead-based paint was banned from homes and children's toys. As a result there has been a dramatic reduction of blood lead levels in children; the proportion of children under 6 years with elevated blood lead levels dropped from 88 per cent in the late 1970s to 6 per cent in the early 1990s (Federal Interagency Forum on Child and Family Statistics, 1998). However, inner-city children living in older, substandard housing, particularly buildings that are privately owned, continue to be exposed to multiple sources and risks of lead poisoning.

A truly preventive approach to the problem of lead-based paint hazard reduction in low-income private housing has been elusive both due to the high costs of removing lead from the housing environment and to resistance from landlords. An early and innovative attempt in Baltimore to screen for lead-based paint and require its removal as a preventive measure was abandoned after the costs of the personnel needed to inspect a large number of homes and ensure landlords complied with the removal of all lead-based paint were found to be prohibitive (Berney, 1993, p. 8; Fee, 1990, p. 597). The main issue is how to assign responsibility for the large economic costs of a truly preventive approach to lead-based paint hazard reduction in home environments; removing sources of lead in the environment is technically difficult and politically controversial. In Duval County, one of only two counties with a lead poisoning prevention program in Florida, staff report that the lack of a public ordinance mandating that the landlord be responsible for paying the costs of lead abatement, remains a major obstacle in their work (Brown, 2001). They recall only one case where a tenant tried to force a landlord to abate and they settled out of court.

Studies have shown that the cost to society of the damage done by lead poisoning far outweighs the costs of lead-based paint removal, suggesting a role for government (Berney, p. 8). The federal grant program started in the early 1990s was an important catalyst in putting lead-based paint initiatives on the agenda of state and local governments (Morrison, 1998). The 1991 Department of Veterans' Affairs, Housing and Urban Development, and Independent Agencies Appropriation Act (Public Law 102–139) led to the creation of the US Department of Housing and Urban Development (US HUD) Lead-Based Paint (LBP) Hazard Control Grant Program. The grant fund was strengthened in 1992 by Title X of the Housing and Community Development Act. This Act stipulated that lead-based paint hazards must be disclosed to buyers and renters, although no testing or removal of the paint is required (Morrison, 1998, p. 17).

Projects funded under the LBP Hazard Control Grant Program have used a variety of implementation and funding mechanisms to overcome political and economic pressures. The program requires a close working relationship between local public health and housing agencies which has created expertise at the state and local government level to address lead-based-paint-related hazards and which can be built upon for other housing-related health issues (Morrison, 1998, p. 17). Many projects have also partnered with neighborhood associations and community-based groups. Some have been implemented as part of neighborhood revitalization programs and others as part of city and nonprofit agency housing rehabilitation efforts. Several of the Healthy Homes projects supplemented their funding from the Housing and Urban Development Department (HUD) with federal home loan programs, energy assistance grants and other sources (Krieger & Higgins, 2002, *Healthy Homes* section).

Among the issues faced by area-based LBP hazard control programs that take a truly preventive approach is that economic and political pressures may cause families to move from one hazardous living unit or area to another (Fee, 1990, p. 597). HUD requires that homes abated under the lead paint grant program remain available to low-income families for at least 3 years (Jacobs, 2004). Some recent programs included assisting families at risk with relocation among other activities (Morrison, 1998, p. 18). The Healthy Homes project in Seattle built protective clauses into the design of the project.

A truly preventive approach to the asthma epidemic has yet to take shape. Much of the emphasis has been on individual case management; the latter can make an enormous difference to the health and well-being of those who suffer from asthma. But the US health care system is not oriented towards caring for people with chronic diseases. Medical professionals doubt individual case management will ever be the norm for asthma patients; with as many as 20 per cent of children in some areas needing care, health systems work against proper management of asthma symptoms for all who need it (Shell, 2000, part 3, p. 4 of 5).

However, as reviewed earlier, there is a growing awareness of the influence of the environment in and near homes on asthma, and progress has been made in regulating the outdoor pollutants associated with it. A number of projects addressing asthma through environmental interventions are beginning to be implemented. They confront similar political and economic constraints as do lead-based paint hazard control programs. At the state and local levels, codes and regulations are in place stipulating it is the landlord's responsibility to maintain housing structures in good condition and free of pest infestation, but compliance is often elusive (Kreiger & Higgins, 2002; Meyer, 1998). Some landlords are simply unwilling; others may not have the resources.

As found with area-based LBP hazard control programs and federal environmental regulations in general (Downing & Kimball, 1983, p. 249), detecting where violations are occurring is an ongoing problem for enforcement. Similarly, identifying and resolving housing code violations remains an issue. Several asthma prevention programs found tenants with asthma held back from reporting their landlords out of fear their rents would increase to cover the costs of upgrading the indoor environment (Lachapelle, 1998).

Efforts to bring landlords into compliance are further constrained by the fact that there are no standards at the federal level for how much mold is permissible in homes. The most common root cause of mold, uncontrolled bulk moisture, is addressed in housing codes, but indoor air quality and mold generally are not addressed. The New York City Department of Health issued guidelines for assessing and remediating mold problems in indoor environments (New York City Department of Health, 2002). The California legislature went further and passed the Toxic Mold Protection Act of 2001, which calls for setting standards for permissible levels of mold exposure and requires disclosure of a mold condition to potential buyers, tenants, renters, landlords or occupants (California, 2001). Other jurisdictions have to rely on more general stipulations in health or housing codes, making it more difficult to hold landlords accountable for remediating mold problems.

Similarly, in most states and municipalities, there are no legal requirements to maintain ventilation rates at or above the minimum levels stipulated by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE). There are little scientific data on the relationship between building ventilation rates and the health and well-being of residents so these are based mainly on professional judgment and laboratory studies (IOM, 2000, p. 332).

The experience of a project in New York with resistance from landlords underscores the problem. It was not until after the tenant took her landlord, the New York City Department of Housing, to court four times that the water leakage in her bathroom ceiling was fixed. She had suffered repeated asthma attacks because of the leakage (Meyer, 1998). Resistance on the part of landlords also reduced the effectiveness of the Healthy Homes project in Seattle:

We found structural deficits permitting water intrusion in over 20% of the low-income homes included in our Healthy Homes project. Remediation is often not completed given the lack of landlord interest or resources to make the improvements (e.g. installation of ventilation systems, removal of water-damaged carpet or wallboard, or replacement of windows). (Krieger & Higgins, 2002, *Healthy Homes* section)

In the absence of broad-based support for better enforcement of housing codes, most Healthy Homes projects restricted their scope “to educating household members, asking them to take individual actions and assisting them with minor repairs” (Krieger & Higgins, 2002, *Healthy Homes* section).

In some cases, organized efforts on the part of tenants have proven to be effective in overcoming landlord resistance. An asthma initiative in East Harlem, largely implemented through the home health agency of the Little Sisters of the Assumption Family Health Service, repeatedly reported encountering landlords who were not willing to repair serious leaks from plumbing or roofing problems and landlords who did not provide adequate

cockroach extermination services. They report addressing the landlord's resistance through negotiation and organization, with the family's consent (Lachapelle, 1998).

This is not an easy step, because tenants often fear they will be threatened with eviction if they complain. In one instance, the landlord was initially very defensive and blamed the tenants for all the problems, most of which were there before they moved in. Once the landlord saw the family's efforts to organize other tenants to improve the building, however, he visited the apartment and personally directed the repairs needed. (p. 2 of 2)

In many cases, the costs of the structural repairs needed to solve mold and dampness or ventilation problems remain a major constraint to prevention through environmental intervention. Repairs may include "removing and replacing extensive mold or water-damaged material, installing continuously operating whole-house exhaust ventilation systems, repairing plumbing leaks, and removing carpeting" (Krieger & Higgins, 2002, *Healthy Homes* section). These are beyond the means of the low-income residents who typically occupy public and rental housing. When the needed remediation is technically complex or particularly expensive as is the case with lead abatement, subsidies may be necessary to help landlords come into compliance.

There are differences between the lead poisoning and asthma epidemics that have implications for prevention programs. Unlike lead poisoning, screening for asthma-related exposures is not widely available or straightforward. "Past lead exposure produces a long-lasting body burden that can be measured precisely even at low levels" and standards for permissible levels exist (Schell & Stark, 1999, p. 154). In the case of asthma, individuals cannot be screened for past exposure to outdoor air pollutants because "oxides of nitrogen and sulfur or ozone . . . do not leave measurable 'body burdens'" (Schell & Stark, 1999, p. 154). Skin testing can be used to screen for a limited number of exposures; in particular, it can be used to estimate whether an individual's asthma is related to exposure to house dust mite and cockroach allergens (Huss *et al.*, 2001; Li *et al.*, 2000).

Testing the housing environment for asthma triggers, for example, collecting samples and testing for mold spores, is complicated and expensive and therefore also does not lend itself to widespread screening efforts (Affordable Comfort, Inc., 2004). Building ventilation rates are usually poorly controlled and difficult to measure (IOM, 2000, p. 332). At this time, data on housing quality in general are not widely available at the local level. The US Census Bureau collects housing quality data for larger metropolitan areas every six years through the American Housing Survey but smaller area data are not available in most places. Generating support for asthma prevention through interventions in the housing environment will be more difficult in the absence of local prevalence data linked to housing conditions.

Beyond Regulation: Health Objectives in Housing Plans and Policies

The analysis of current lead-based paint hazard control and asthma prevention programs suggests if health objectives are to be met through interventions in the home environment, strategies are needed that both support and complement existing laws and regulations. Such strategies could be incorporated into housing plans such as the Consolidated Plans HUD requires of participating jurisdictions. These plans "indicate how Community Development

Block Grant (CDBG) and other housing funds are to be expended over a several-year period” (Jacobs, 2004). Many of the environmental interventions with health effects are eligible expenses under the CDBG program; local jurisdictions must make the decision to include them (Jacobs, 2004). The analysis presented here identifies five components that should be included to increase the likelihood that housing plans and policies will meet health objectives: explicit health objectives, promotion by both health and housing officials, advocacy by citizens’ groups and tenants’ associations, adequate funding for implementation and focus on multiple health outcomes.

Making the health connection in housing plans and policies can strengthen efforts to implement and enforce existing policies and regulations, especially in areas with a cumulative burden of multiple sources of exposure. The finding that children playing sports and living in areas chronically experiencing high ozone levels are three to four times more likely to develop asthma than other children, can help support efforts to enforce the Clean Air Act and bring cities into compliance. Natural allies in such strategies are those promoting increased physical activity to help prevent obesity, cardiovascular disease and diabetes. It is counterproductive to encourage physical activity in high ozone areas, when this places people at significantly increased risk of asthma.

Making the health connection can also strengthen efforts to maintain minimum housing standards. The scientific evidence exists linking indoor environmental exposures such as cockroach feces and body parts, mildew, mold, and dust mites to the development of asthma and the exacerbation of its symptoms. These in turn can be traced to damp, poorly ventilated houses and ones with structural defects. Regulations exist specifying the landlord’s responsibility for structural repairs to stop leakage in roofs, walls and windows. Landlords are also responsible for cockroach extermination, for maintaining proper ventilation and for keeping heating and cooling systems in working order. Linking landlord–tenant regulations to a highly visible health condition such as asthma could strengthen support for landlord education programs and enforcement efforts at the local level.

Furthermore, specifying the connection between asthma and the extent to which the home environment offers opportunities for physical activity lends support to the growing movement seeking to increase physical activity levels through changes in the built environment. Aspects of the home environment that promote physical activity include location near a park or walking trail, location within walking distance of schools or other desirable locations, the safety and security of neighboring streets.

In order for explicit health objectives to be adopted in housing plans and policies and to ensure their effective implementation, greater interaction is needed between housing and planning officials and public health departments. Both are needed to collect relevant data and support efforts to specify standards for acceptable levels of indoor exposures. It is critical that standards be set “at a level that is high enough to protect occupants’ (especially children’s) safety and health, but does not discourage compliance or worse, encourage significant abandonment of properties” (US HUD, 1999b, p. 75).

Public health practitioners have particular expertise in running public education campaigns and screening programs. These help raise awareness and generate the complaints needed to initiate enforcement efforts. However, meeting health objectives through housing plans and policies is not only about changing the built environment. It is also about promoting behavior change on the part of landlords, code enforcers,

residents and builders. In the absence of building and housing codes that incorporate appropriate standards, public health and planning professionals, builders, owners and tenants will need to “inform themselves about hazardous products such as asbestos and formaldehydes, identify building materials and floor coverings with low emission rates, and ensure proper ventilation” (Greenberg, 1986, p. 257). Some local governments are already offering training sessions for landlords and tenants, raising awareness of their respective rights and responsibilities; health issues could be incorporated into such sessions.

Public health specialists bring to the table experience with social marketing, encouraging behavior change and monitoring health outcomes. Planners and housing officials are experienced in collaborating with professionals in other fields to address problems that are rooted in more than one sector, and have experience with education and organizing as well. They have valuable experience working with various city officials and agencies, and with a variety of non-governmental, local organizations.

Active citizens’ groups or other non-governmental organizations can be critical to ensuring health objectives are addressed and met. These include tenants’ associations, environmental justice groups and churches. Such groups may be more effective than government in facilitating successful informal negotiations between landlords and tenants. In cases where negotiations fail, they can provide needed support to tenants, including assistance in finding alternate living arrangements. They can advocate for the equitable distribution of resources such as parks, trails and sidewalks, and the reform of transportation systems to better support walking and public transit.

Federal grant programs have been important catalysts in the movement towards housing environment interventions to address both lead-based paint hazards and asthma. State and local resources will need to be tapped to increase the coverage of these interventions. Potential exists to incorporate health objectives into the variety of sources of financing for public and private housing. “Public housing and rental subsidies, community development block grants, job development programs, economic development programs, insurance underwriting standards, and mortgage loans sometimes include requirements for inspections, repairs, or other measures to ensure certain structural or environmental problems are addressed” (US HUD, 1999b, p. 39). Health maintenance organizations and several pharmaceutical companies are also potential sources that have been tapped for at least one healthy homes project (US HUD, 1999b, p. 50).

Although for the sake of clarity this paper has focused on asthma prevention and lead-based paint hazard control, there are other housing-related health problems such as falls and other injuries, other respiratory conditions, and house fires that can be addressed in housing policies and plans. For example, housing inspections can cover not only excess moisture, dust, rodents and pests and lead exposures, but also ventilation and toxics, injury and fire hazards, the presence of environmental tobacco smoke (ETS) and education in relation to these exposures (US HUD, 1999b). They can also include the housing inspector’s assessment of the quality of the immediate surroundings such as the existence of open or green spaces in the immediate housing environment, the safety of neighboring streets, the proximity of a park or schools (see for example WHO, 2004). Where projects can address multiple housing-related health problems at the same time, experience shows costs are less than they would be if interventions were implemented one at a time (US HUD, 1999b, p. 4).

Conclusion

This paper shows that in the United States regulations exist protecting residents of public and rental housing from unacceptable levels of outdoor pollution and from structural problems associated with asthma triggers in the home. However, enforcement of these and funding for interventions remain significant challenges. Furthermore, the analysis of current policy and program experience suggests if health objectives are to be met through interventions in the home environment, strategies are needed that both support and complement existing laws and regulations. Critical among these is a broad-based approach that creates synergies and builds on existing strengths in the housing and public health arenas. Public health with its emphasis on increasing levels of physical activity in the population at large is a natural ally in efforts to reduce ground-level ozone and increase the extent to which housing environments encourage rather than constrain walking and biking. They are also natural allies in efforts to hold landlords accountable for upholding housing quality standards. The approach identified here calls on the fields of housing and public health to look to their broader missions and collaborate in addressing today's critical health problems.

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