The Green Housing Study

Supporting Statement
(Part B)

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B. Collections of Information Employing Statistical Methods

B.1. Respondent Universe and Sampling Methods

The purpose of this study is to provide insight into the potential implications of green renovations for the health of young asthmatics who live multifamily HUD-subsidized housing in the United States and US. territories. According to HUD, 970,532 households live in public housing in the United States(HUD 2009). The number of M2M properties is in flux according to market forces and other factors such as landlord motivations for participation; however, it is estimated that since 1997, 1600 developments (with approximately 100 units each) have been renovated through the M2M Green Initiative **http://www.hud.gov/offices/hsg/omhar/paes/greenini.cfm**. Collecting data from asthmatic children in all housing units being renovated would be too burdensome, expensive, and logistically impractical. We will include a targeted non-probability sample of 832 homes in 13 cities for this study methodology. HUD had selected housing developments for green renovations projects prior to the inception of this proposed study based upon specific requirements (e.g., use of low VOC materials, use of energy efficient appliances). Figure 8 illustrates the sampling process. Since the housing developments were already selected based on grant awards, random assignment of the green intervention was not possible for this study.

The selection of the cities is based upon the following:

1. City must have one or more housing developments which are receiving a HUD-subsidized green-renovation.
    a. These renovations must occur within the timeline of our study period (5 years, although, we will ask OMB for a continuation prior to the expiration of the initial 3-year OMB approval)
    b. Housing developments should have many apartments which will undergo the green renovations. Smaller housing developments would severely hamper recruitment of our targeted sample size in each city. However, we will consider cities which have several housing developments with a smaller number of apartments, given that the housing developments will undergo renovations within 6 months of each other.
    c. Green renovations must meet inclusion criteria: Low VOC materials and Integrated Pest management (IPM).

2. The housing renovations within the city must occur in areas with high prevalence (i.e., greater than the national average, currently 9.1%) of childhood asthma (based upon National Health Interview Survey data, (Akinbami et al. 2009)). This is to enhance the potential pool of study participants. Areas of lower asthma prevalence would severely hamper recruitment of our targeted sample size in each city.

3. Cities are located in different regions of the country and/or represent different types of housing stock.

The design being used allows us to provide insight into the societal benefits of green housing on low income families with asthmatic children. However, it will not be generalizable to

respondents or even geographically or demographically defined subgroups due to the fact that both the applicants of the HUD awards and the households themselves are self-selected. Specifically, the design does not allow generalizations based on city, type of locations (rural, suburban), climactic regions (e.g., desert, arctic), or ethnicities. Furthermore, this study will systematically exclude certain subsets of the population for logistical reasons. Specifically:

i. Public housing is comprised mostly of 3 main ethnicities: white, African-American, and Latino (HUD, 2009).

ii. Our main health endpoint, asthma, is highest among Latinos and African-Americans. While several childhood asthma studies have focused on some minority populations in the United States (African American and Latino), only recently have investigators focused studies of Asian populations. In the Boston Chinatown neighborhood, researchers found a higher prevalence of asthma for children born in the US as compared to those who were foreign-born in an Asian population, enriched with recent Chinese immigrants (Brugge et al., 2007). These results confirm findings in a similar Asian population from the same community (Greenfield et al., 2005).

iii. We do not have the capacity to translate into all languages. However, we determined that it would be beneficial to include Spanish and Chinese translations for the reasons mentioned above. In meetings with stakeholders at our first potential study site, Boston, we found that they have a substantial Chinese population (along with Latino and African-American). The tenants' organization asked if we would recruit the Chinese residents too and if we could translate all of our materials into Chinese. We believe that the tenants' organization's request is reasonable. Furthermore, in other potential study site locations (e.g., Los Angeles, New York, San Francisco), Chinese language translation might also be relevant.

We assume an 80% participation rate for the eligible residents for the collection as a whole (as described in Part B, section 3).

The design is stratified by city. As discussed below, one pair of housing developments will be chosen in each of 13 cities that meet the criteria delineated in section B1. We will frequency match green intervention and comparison homes by HUD-subsidized housing development, asthma status of children, age group of asthmatic children (7-12 years) and primary language spoken by mother/primary caregiver of the asthmatic child. We are not matching on ethnicity *per se*; however, much of the low-income housing in inner-city communities tend to be segregated to some extent, by race/ethnicity (Acevedo-Garcia and Lochner 2003). We will record race/ethnicity in our questionnaire and adjust accordingly in our analysis. As mentioned earlier, this selection will be limited by the availability of the ongoing HUD renovation efforts. There are no other problems requiring specialized sampling procedures. The data collection plan requires only one series of data collection within a one-year follow-up period.

Sample size overviews: Our calculations estimate that 416 subjects/study arm (i.e., green vs. comparison homes) must be recruited in order to achieve sufficient statistical power to statistically differentiate between the study arms (this paragraph outlines the calculations supporting this estimate, with details in subsequent paragraphs of this section; see also figure below). In order to have sufficient power to detect meaningful differences in both environmental measurements and health outcomes between the arms, we began by calculating sample sizes based on each of these measures.

1. Our sample calculations for environmental measurements (see Table 21) were based on cockroach allergen data in a repeated measures study of the effect of an integrated pest management (IPM) intervention, which indicate that 13 buildings would be necessary in each of the two arms of the study, assuming that 25 subjects could be recruited for each building, yielding 325 subjects/study arm to provide adequate statistical power for environmental measurements.
2. Our sample calculations for health outcomes (see Table 22) were based on asthma in children subjected to a multifactorial intervention (i.e., education, mattress covers, IPM, and HEPA filter units) in a repeated measures study. These data indicate that 274 subjects/study arm would be needed to provide adequate statistical power for asthma outcomes.

Therefore, since we desired sufficient power to detect meaningful differences in both 1) environmental measurements and 2) health outcomes, we selected the larger of the two estimates — 325 subjects/study arm — as the minimum sample size (see Figure 7). In addition, we augmented this number in order to account for an anticipated 20 percent loss to follow-up over a one-year period. After rounding up where necessary, this increased the sample size to 416 subjects/study arm, comprising 32 subjects (one subject per apartment) in each of 13 buildings in each study arm. The total sample size for the study across both study arms is 832 subjects. The details of our sample size calculations are listed below and the equations that were used were from a book on longitudinal data analysis by Diggle, Liang, and Zeger (1994).

Figure 7. Summary of sample size

Sample size calculations for the overall difference between environmental exposures in green vs. comparison homes can be given as a simple test of two proportions and means; however a specific difficulty arises when trying to adjust for temporal and spatial correlations between measurements. A study that had enough measurements to assess spatial and temporal correlation was an integrated pest management (IPM) study conducted in New York City (Chew et al. 2006; Kass et al. 2009). We have used the design effect from this study to estimate the number of clusters (or buildings) needed to detect differences in cockroach allergen because IPM is also one of the main green characteristics in the Green Housing Study. Assumptions from the aforementioned study comparing IPM to non-IPM homes are listed below:

1 13 buildings
2 About half were treatment and the other half comparison
3 3 repeated measures at: baseline (before IPM), 3months later (post-IPM), and 6months later (post-IPM)
4 On average, 25 apartments within each building were measured
5 For the comparison homes, the correlations between baseline and 3-month follow-up cockroach allergen measurements and 3-month and 6 months follow-up measurements were approximately equal to 0.5.

Design effect due to clustering = 3.62

Equation 1. Sample size for repeated measures – cockroach allergen.

$$m = D * [2(z_{\alpha} + z_{Q})^{2}\{1 + (n-1)\rho\}]/(n\Delta^{2})$$

m = number in each group (e.g., intervention and non-intervention)
n = number of repeated measurements (equals 3 in this scenario)
z_{α} = Z score for alpha = 0.05
z_{Q} = Power, set at 0.80
ρ = correlation among repeated observations
Δ = d/ σ where d is the smallest meaningful difference and σ is the standard deviation
D = Design effect due to clustering of apartments within buildings (This was not in the formula used by Diggle et al. 1994, but was added to adjust for clustering expected in our study)

Note: we also assumed a design effect (e.g., increase (multiplicative) sample needed because of the effects of clustering) equal to 3.62. This is the ratio in clustering sampling variance divided by the simple random variance (of the same size) (i.e., the denominator without clustering taken into account).

When calculating the sample sizes, we used two standardized effect sizes based on the IPM study: 0.37 and 0.30. The effect size of 0.37 is based on the ability to detect a difference of 0.8148 ln units of the *Blatella germanica* cockroach allergen (i.e., Bla g 2) and a standard deviation of ~ 2.2. The effect size of 0.30 is the based on the ability to detect a difference of 0.649 ln units of Bla g 2 and a standard deviation of 2.2. We also assumed an alpha of 0.05 and a power of 80%). The sample size based on changing the expected correlation between repeated measures would result is presented in Table 21.

Assuming a correlation of 0.5 we get the following:

1 With assumption 1, we would need 16 buildings (8 green and 8 comparison) with at least 25 apartments per building
2 With assumption 2, we would need 26 buildings (13 green and 13 comparison) with at least 25 apartments per building.

Table 21. Sample size requirements for number of buildings.

Correlation between repeated measures	Sample size requirements (number of buildings)	
	Assuming Delta=0.377	Assuming Delta=0.30
0.2	6	9
0.3	7	11
0.4	8	12
0.5	8	13
0.6	9	15
0.7	10	16
0.8	11	17

*samples size is for each group (e.g., 8 buildings means 8 comparison and 8 green buildings)

We also estimated the sample size for detecting differences in pesticides and VOCs. To date, there is only one study of an intervention to decrease pesticide exposures that used objective measurements of pesticide levels in residential homes in a non-agricultural environment (Williams et al., 2006). This study was conducted in homes of Latina and African-American women living in low-income housing in New York. In the study, 25 homes underwent IPM as an intervention. The pesticide synergist, piperonyl butoxide, is unique to pyrethoid pesticides and this was an analyte that was measured in the study's air samples. We used their pre- and post piperonyl butoxide concentrations (pre = mean 1.66 ± s.e. 0.71 ng/m^3 vs. post = mean 0.8 ± s.e. 0.22 ng/m^3) for our calculations of sample size which are shown in Table 22.

To date, there is only one study comparing the VOC levels in newly-built green homes and conventionally-built homes; therefore, this was not a renovation like our proposed study. We calculated the sample size based on their measurements of formaldehyde in the two types of homes in their study. This study was conducted in Finland. In the study, 6 apartments in each type of building had air measurements for formaldehyde (green-built: mean = 13 µg/m^3, s.d. = 4 vs. conventionally-built: mean 23 µg/m^3, s.d. = 5). We calculated the sample size necessary to detect a decrease in 50%, 25%, and 15%, of the difference in formaldehyde levels observed in their two study groups (see Table 22).

Devos et al (1990) have suggested that the minimum level of an indoor irritant be set with a safety factor of 40 (Devos, Patte et al. 1990). Given that the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value is 368 µg/m^3, a minimum level of formaldehyde below which no irritant effects are expected is 9.8 µg/m^3 (which is the CDC/ATSDR Minimum Risk Level, http://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=220&tid=39).

Table 22. Calculations of samples sizes for VOCs and pesticides

Analyte	Design Effect	Effect Size (Δ)	Required Sample size (in each group)
Formaldehyde - 15% : 1.5 μg/m^3 - 25% : 3.5 μg/m^3 - 50% : 5 μg/m^3 (based on Tuomainen et al, 2003)	 3.6 3.6 3.6	 0.33 0.77 1.10	 408 75 37
Piperonyl butoxide 0.8 ng/m^3 decrease (based on Williams et al, 2006)	3.6	0.33	418

* α = 0.05, 1-β = 0.80

Summary of sample size for environmental exposures: Of the intervention studies relevant to green housing, the sample size calculations based upon the cockroach allergen intervention study provided the most information to inform our estimates of sample size required for the Green Housing Study. Because Dr. Chew was a co-author on the manuscript and had analyzed the cockroach allergen samples in her laboratory, she had access to the repeated measurements database and this helped to guide our design effect due to clustering of apartments within buildings. The other papers did not have repeated measurements (thus the variance estimates were rather wide) and they also had more restrictive groups (e.g., nonsmoking pregnant women, Finnish families living in newly-constructed apartments) than is planned in the Green Housing Study. Thus, we believe that our estimates are conservative.

Sample size for assessing asthma outcomes: The calculation for assessing differences in health markers were based upon a multi-site asthma intervention study (Morgan et al. 2004). In this study, 407 asthmatic children with the multi-factorial intervention (asthma trigger education, mattress covers, IPM, HEPA filter units) had fewer days (2.62 days ± 0.12) than those (n=414) without the intervention (3.21 days ± 0.13). Table 15 shows sample sizes with different assumptions of effect sizes using equation 2.

Equation 2. Sample size for asthma morbidity outcomes.

$$m = D * [2(z_\alpha + z_Q)^2\{1 + (n-1)\rho\}]/(n\Delta^2)$$

m = number in each group (e.g., intervention and non-intervention)
n = 1 (note: for differences of differences, we assumed a value of 1)
z_α = Z score for alpha = 0.05
z_Q = Power, set at 0.80
ρ = correlation among repeated observations
Δ = d/ σ where d is the smallest meaningful difference and σ is the standard deviation
D = Design effect due to clustering within 13 sites (This was not in the formula used by Diggle et al.1994, but was added to adjust for clustering expected in our study). Based upon the Kwon et al (2003) paper that showed a design effect of 1.5 was helpful for designing cluster studies to assess asthma outcomes in national surveys (e.g., BRFSS and NHANES), we assumed a slightly smaller design effect equal 1.2 due to the expected low average number of children per cluster).

Table 23. Sample size requirements for number of children with asthma.

Effect size (i.e., delta)	Sample size requirements (number of asthmatic children)	
	in Green buildings	in Comparison buildings
0.20	274	274
0.232*	274	274
0.30	206	206
0.35	151	151
0.40	116	116

* Based on observed effect size from Morgan et al (2004) study.

We used Equation 3 to calculate the sample size based on binary outcomes. The assumptions for the equation were based upon an intervention study in Seattle Public housing (Krieger et al., 2005). The Seattle researchers had n= 110 in a high-intensity intervention group and n = 104 in a low-intensity intervention group follow. They assessed the percentage of children in each group with urgent health service use in the past 2 months. Taking the difference between baseline and exit measurements of the two proportions for high-intensity (23.4% - 8.4% = 15% difference) and low-intensity (20.2% - 16.4% = 3.8% difference), we calculated n= 102 in each study group.

Equation 3. Sample size for binary asthma morbidity outcomes.

$$m = [[(z_{\alpha}\{2\bar{p}\bar{q}\,(1 + (n-1)\rho)\}^{\frac{1}{2}} + z_{Q}\{(1 + (n-1)\rho)(p_{A}q_{A} + p_{B}q_{B})\}^{1/2}]^{2}]/nd^{2}$$

m = number in each group (e.g., intervention and non-intervention)
n = 1 (note: for differences of differences, we assumed a value of 1)
z_{α} = Z score for alpha = 0.05
z_{Q} = Power, set at 0.80
ρ = correlation among repeated observations
p_A = proportion of Group A
p_B = proportion of Group B
q_A = 1- proportion of Group A
q_B = 1- proportion of Group B
$\bar{p} = (p_A + p_B)/2$
$\bar{q} = 1 - \bar{p}$

d = is the smallest meaningful difference between proportions
D = Design effect due to clustering (This was not in the formula used by Diggle et al. 1994, but was added to adjust for clustering expected in our study). Based upon the Kwon et al paper (2003) that showed a design effect of 1.5 was helpful for designing cluster studies to assess asthma outcomes in national surveys (e.g., BRFSS and NHANES), we assumed a slightly smaller design effect equal 1.2 due to the expected low number of expected of average children per cluster).

B.2. Procedures for the Collection of Information

The characteristics of study participants that will be included are: 1) Children age 7-12 years with asthma (note: The child must have been diagnosed with asthma by a physician and have had asthma-related symptoms (wheezing, slow play or night awakening) during the past 6 months), and 2) mothers/ primary caregivers of enrolled children. Also, the mother/ primary caregiver must speak English, Spanish, or Chinese to be included in the study and the enrolled participants must live in the home (from which environmental samples will be collected) on average 7 days per week.

Upon notification from HUD that a participating housing complex is about to begin rehabilitation, CDC will contact local academic institutions and departments of health in order to mobilize the Green Housing Study in that location. We envision that together with HUD and local academic investigators at the selected sites, CDC will convene town meetings at each participating complex to describe the study to residents, answer questions, and invite their participation. Depending upon the number of residents who initially volunteer at the town hall, we will convene additional town hall meetings to augment participation. Residents who express interest in the study can contact the site projector coordinator either at the town hall meetings or by telephone. Subsequently, the trained staff will schedule a home visit with the residents. For quality control purposes, teams of two trained staff will visit the home to collect questionnaire data via an in-person interview and perform environmental sampling. The environmental sampling technician will review the questionnaire information that the other technician obtained during the interview with the study participant. Also, the database entry screen will have validation checks (e.g., number of reported asthma symptoms cannot equal a negative number)

Statistical analysis: The main variable of interest is the type of home (green vs. comparison); however, there may be different permutations within green housing. For example, HUD has two levels of green which are based upon the acceptance of HUD-approved recommendations: Level 1) landlord agrees to implement at least 75% of the dollar amount of green repairs and improvements; and Level 2) landlord agrees to implement at least 50% of the dollar amount. While discretizing the green rehabilitation into Level 1 and Level 2 categories could simplify our analysis, we acknowledge that the two different levels do not necessarily capture green materials or practices that are potentially related to health. For example, a green home could have low VOC paint, or low VOC carpet, or replace the kitchen cabinets with low VOC materials, or have some combination of these activities.

Allergens in the homes: Variables related to indoor allergens in the homes may take the form of continuous measures of specific allergens or of indicator variables for the presence or absence of certain allergens or combinations of allergens. Allergen concentrations will be reported as μg of allergen per g of collected dust and μg of allergen per unit area vacuumed.

VOCs and pesticides in the homes: Variables related to VOCs (whether total or speciated) and pesticides (pythrethroids, propoxur, and piperonyl butoxide) in the homes may take the form of continuous measures or indicator variables for the presence or absence of certain chemicals or combinations of chemicals. Concentrations will be reported as ppm (and also $\mu g/m^3$) in the case of the VOCs and μg/g in the case of the pesticides.

Conditions of the home environments: Factors that may influence the presence and levels of allergens, VOCs, and pesticides include: the presence of carpets; pests; housing type and age,

average winter temperature and relative humidity, air exchange rates.

Wheeze /asthma severity: This information may be used in the form of categorical and continuous variables (number of emergency room visits for asthma, use of asthma medications, lost school days). Nights awakened by asthma, and spirometry measurement such as FEV1 and $FEF_{25-75\%}$).

Additional environmental and host factors for disposition to wheeze/asthma: Other risk factors for the main outcomes of interest include: environmental tobacco smoke; acute respiratory illnesses; gender; socioeconomic status of primary caregiver; degree of acculturation (operationalized); and deficiencies in access to and quality of health care. Many of these factors allow for a variety of formulations. Environmental tobacco smoke, for example, may be analyzed as an indicator variable for the presence or absence of smoking in the home, as count data for the number of smokers in the home, or as a continuous variable for the number of cigarettes smoked per day in the home. The choice of formulation of risk factors will be driven by the aim of clarifying the main relationships of interest, for example the role of allergens in the development of early allergic sensitization and asthmatic airways disorders.

Descriptive statistics: Study participants will be characterized with regard to demographic variables such as age, gender, and race; clinical variables such as symptom/medication use frequency, healthcare utilization, allergy sensitivity and pulmonary function, and environmental variables such as indoor allergens (cockroach, mouse, cat, and dust mite). Categorical variables will be summarized by frequencies, while continuous variables will be summarized by mean, standard deviation, median, and range. Levels of mold, indoor allergens, pesticides, and VOCs will be log-transformed to compute geometric means and geometric standard deviations. Where appropriate, other transformations or non-parametric analysis methods will be used.

Regression models: In general, for the regression analyses, primary interest lies in the coefficients for the binary "exposure" variable (green vs. comparison). The regressions will also include background variables such as pesticide, VOC, and allergen levels; these variables are included to adjust for differences between households, and we are particularly interested in the coefficients. We will also include interactions between exposure and the background variables. Significant coefficients for these interactions are important because they imply that the exposure has a larger effect under some conditions in comparison to others. In addition, it will be important to consider nonlinear models to allow, for example, for a threshold of allergen exposure.

In the case of dichotomous outcomes, multiple logistic regression will be used to calculate odds ratios (in the case of rare events such as overnight hospitalizations due to asthma attacks). When rare events exceed 10%, then risk ratios will be calculated from the logistic regression (J. Zhang & Yu, 1998). Hierarchical linear modeling will be used for evaluating effects of individual apartment, neighborhood and regional factors on levels of environmental agents. The main outcomes are allergen, VOC, and pesticide levels in the home; however, several factors should be adjusted in the analysis, including but not limited to smoking in the home, proximity to major roadways, and region of the country. For example, researchers in Baltimore found a low prevalence of both cockroach exposure and sensitization among children in high SES African American families (Sarpong, Hamilton, Eggleston, & Adkinson, 1996). This observation highlights a possible mechanism through which factors operating at the social/environmental

level (e.g., deteriorated built environment) might contribute to asthma among disadvantaged urban children, i.e., via increased exposure to indoor allergens (Rauh et al., 2002). Conceivably, the greenest of homes could still have poor indoor air quality due to some of the aforementioned factors.

The analytical plan for specific hypotheses are:

Hypothesis 1: Green housing will lead to 1) lower levels of environmental contaminants compared with those of comparison housing, and 2) lower levels of related biomarkers in the residents of green vs. comparison housing. (Note: Hypotheses are abbreviated here for brevity. For complete wording of hypotheses see Part A)

The longitudinal study here outlined will permit estimation of:

Geometric mean (GM) and standard deviation (GSD) for each of the environmental analytes (e.g., pesticides, VOCs, mold, and indoor allergens) by rehabilitation type (green vs. comparison).

Geometric mean (GM) and standard deviation (GSD) for each of the biomarkers for pesticides and VOCs by rehabilitation type (green vs. comparison).

Correlations between environmental measurements and biomarkers (stratified by several characteristics including but not limited to age and gender).

Proportion of green vs. comparison homes that have pesticides that are currently banned for residential use by EPA.

Hypothesis 2: If irritants and allergens are lower in green vs. comparison housing, children with asthma (ages 7-12) living in green housing should experience fewer and less severe asthma exacerbations. (Note: Hypothesis is abbreviated here for brevity. For complete wording of hypothesis see Part A)

The longitudinal study here outlined will permit estimation of:

Odds ratios (OR) or Rate Ratios (RR) for exposures to environmental agents and cumulative incidence of wheeze and/or other asthma-related morbidity measurements (among children ages 7-12 with asthma).

Missing data: We anticipate the inevitable occurrence of missing data, including dropouts. First, if the missingness of the data is sufficiently small and the associations of interest are sufficiently large, the simple device of imputing upper and lower bound data, if possible, will suffice. That is, a small amount of missing data and a large effect size will allow a unique inference to stand no matter whether the missing data are imputed at their minimum or maximum possible values and used as such. This is consistent with the most conservative approaches adopted in clinical trials wherein subjects lost to follow-up are assumed to have died or to have otherwise suffered the worst possible endpoint. In general however, we must anticipate that we may be facing larger missingness and/or smaller effect sizes and/or impractical upper and lower bounds, such that primary inference changes between the extremes. In this case we will use the multiple imputation procedure of Rubin (Rubin, 1985) to address the problem. In this

technique, a fair amount of effort is devoted to the construction of an imputation model or set of models to provide best estimates of missing endpoints. These best estimates may include the best case or worst case scenarios; the point is that they should most fairly represent data that are missing given the observable information at hand. The imputation models may need to assume data missing at random or they may need further specification to allow for non-ignorable missingness. Each analysis be developed using the best imputation model for missing data for that analysis, using available observed covariates and non-missing endpoints.

B.3. Methods to Maximize Response Rates and Deal with Nonresponse

Two large-scale housing intervention studies in low-income neighborhoods that had a 1-year follow-up have reported response rates of 92-93% (Morgan et al. 2004; Persky et al. 2009). We anticipate that once enrolled into the Green Housing study, participants will have at least an 80% response rate for completion of the 1-yr study.

We have two strategies to maximize response rates of the enrolled participants: 1) Study participants (mothers/ primary caregivers of children enrolled in study) will receive compensation for their participation as they complete the required study activities throughout the 1-year duration. (see section A.9 INCENTIVES FOR RESPONDENTS for details) and 2)We will also give study results to the participants. Other investigators have found that study participants often wish to know their results (Brody et al. 2007). By offering an in-person discussion of their results during their last home visit, we hope to maximize the chance for completion of their 1-yr follow-up. If we experience a loss-to-follow-up greater than 80%, our contingency plan is to meet with HUD partners to possibly add another study site.

We have the following instructions for trying to contact difficult-to-reach participants: 1) At least 10 attempts will be made and documented in an effort to reach the participant; 2) Calls and visits to the participants will be made at various times of days (mainly between 10am- 8pm) and on different days of the week at a time convenient to the study participant; 3) When leaving a message, the trained technician will leave his/her name, the name of his/her institution, the reason for the call (i.e., housing study, and the call-back number; and 4) The technician will try calling “alternate contacts” to reach the study participants.

B.4. Tests of Procedures or Methods to be Undertaken

The Green Housing Study questionnaires were primarily based on questions from national health and housing surveys and different epidemiologic studies (e.g., The Inner-City Asthma Study, ICAS) that were conducted in different parts of the country among similar low-income, inner city children with asthma. The national surveys include the following:

1. The National Children’s Study (NCS)
2. The National Health and Nutrition Examination Survey (NHANES)
3. The National Health Interview Survey (NHIS)
4. The Behavioral Risk Factor Surveillance System (BRFSS)
5. The Current Population Survey (CPS)
6. The American Healthy Homes Survey (AHHS)
7. The American Housing Survey (AHS)

Results from the research studies have been extensively published in peer-reviewed environmental health journals that provided scientific basis for home-based asthma intervention studies (Wilson et al. 2009). Some questions from these studies were included verbatim in the Green Housing Study baseline questionnaire, some were modified to fit our study framework, and some additional questions were added (Table 24). CDC epidemiologists modified some of the existing questions and developed new questions in consultation with academic peers and subject matter experts.

Table 24. Examples of questions used in the Green Housing Study and their provenance.

Questions	Questionnaire Type	Question	Name of the study	Reference article
Included verbatim	Baseline (Home characteristics)	In the last 3 days: today or yesterday or the day before yesterday, have you either breathed fumes from **gasoline** or had it on your skin?	NHANES	n/a
	Baseline (Child with asthma age 7-12)	Is [Child's name] currently covered by any kind of health insurance or some other health care plan?	NCS	n/a
	Illness checklist	Did you receive Tamiflu® or oseltamivir [*o sel TAM i veer*] or an inhaled medicine called Relenza® or zanamivir [*za NA mi veer*] to treat this illness?	BRFSS	n/a
Included with minor modifications	6 and 12 month follow-up (Child with asthma age 7-12) * note: the mother or primary caregiver answers this question, not the child.	Green Housing Study version: In the last 3 months, did [Child's name] receive Tamiflu® or oseltamivir [*o sel TAM i veer*] or an inhaled medicine called Relenza® or zanamivir [*za NA mi veer*] to treat this illness? BRFSS version: Last month, did you receive Tamiflu® or oseltamivir [*o sel TAM i veer*] or an inhaled medicine called Relenza® or zanamivir [*za NA mi veer*] to treat this illness?	BRFSS And also recent H1N1 flu pandemic surveillance	Cauchemez S, Donnelly CA, Reed C, Ghani AC, Fraser C, Kent CK, Finelli L, Ferguson NM. Household transmission of 2009 pandemic influenza A (H1N1) virus in the United States. N Engl J Med. 2009 Dec 31;361(27):2619-27.

After development of initial draft, the baseline questionnaire was distributed among CDC, NIH, EPA, and HUD colleagues and five non-federal academic peers (Drs. Gary Adamkiewicz, Brett Singer, Mark Mendell, Doug Brugge, and Tiina Reponen) for face and content validation. Based on repeated feedback received from peers, the questionnaire underwent multiple revisions before a final draft was prepared. Cognitive interviews with nine or fewer college-educated CDC colleagues were conducted in a controlled environment. The questionnaire underwent a final revision based on the responses from participants. Some of the results from this pilot testing are shown below.

Each of the questionnaires was pilot-tested at CDC on nine or fewer (in some cases not all 9 were available to participate) predominantly college-educated CDC employee-volunteers during non-work hours. The pilot tests were administered by two Green Housing Study researchers. The results of our pilot testing are shown in Table 25. Based upon pilot testing, the questionnaires were revised to increase ease of understanding and speed of response. We conservatively estimated the response times for our study participants (low-income mothers/primary caregivers living in multifamily, urban housing) based on the average response times recorded during our pilot tests.

Table 25. Pilot test of each questionnaire and estimated response time for study participants

Form name	Average response time (minutes)	Minimum response time (minutes)	Maximum response time (minutes)	Estimated response time for study participants

Screening questionnaire	4:52	2:16	7:57	10
Baseline Questionnaire (Home Characteristics)	6:03	4:37	7:15	15
Baseline Questionnaire (Part 2: Home Characteristics)	2:56	2:26	3:31	5
Baseline Questionnaire (Mother/primary caregiver)	0:58	0:50	1:15	5
Baseline Questionnaire (for Children with asthma 7-12 years)	6:38	6:20	6:50	15
3 and 9-month Phone contact	2:30	2:15	2:45	5
6 and 12-month Follow-up Questionnaire (for environment)	3:52	3:10	4:20	10
6 and 12-month Follow-up Questionnaire (for children with asthma 7-12)	3:07	3:00	3:15	10
Time/Activity form (for Mothers/primary caregivers of enrolled children)	1:45	1:40	2:00	5
Time/Activity form (for Children with asthma 7-12 yrs)	0:40	0:35	0:50	5
Illness Checklist	1:05	0:45	1:25	5

B.5. Individuals Consulted on Statistical Aspects and Individuals Collecting and/or Analyzing Data

Individuals Consulted on Statistical Aspects of the Design

Curtis Blanton, MS	CDC/NCEH	(770) 488-7114
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Contractors Responsible for Collecting Information for the Agency

Contractor Name: TBD

Contractor Address: TBD

Contractors Responsible for Analyzing Information for the Agency

Not applicable. CDC will analyze data.

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