# Building Related Asthma Research in Public Schools (New)

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## B. COLLECTION OF INFORMATION EMPLOYING STATISTICAL METHODS

### 1. Respondent Universe and Sampling Methods

The respondent universe comprises all teachers and staff at three schools in New England. Three schools will be selected based on varying levels of water incursion and damage. If possible, we will match the three schools for size, student grade levels, ventilation system type (presence of air-conditioning and humidification), geographic location (within one district or adjoining districts), and all in areas with similar socioeconomic status.

We expect each school to have approximately 100 teachers and staff, for a total of 300 eligible respondents. Previous NIOSH studies at schools yielded between a 73% and 92% response rate, so we expect to achieve at least a 70% overall response rate.

### 2. Procedures for the Collection of Information

A. NIOSH questionnaire and lung function testing

Prior to data collection, NIOSH will send an announcement to all school personnel informing them of the upcoming survey (see Appendix F).

All current staff in the three schools will be invited to participate in an interviewer-administered questionnaire and spirometry lung function test. The questionnaire will take approximately 45 minutes, with an additional 10-15 minutes for the spirometry lung function test. The questionnaire and spirometry will be done at the school during school hours and will be carried out by trained NIOSH personnel. Persons who are unable to complete the questionnaire during the NIOSH visit will be contacted afterward and given the opportunity to complete the questionnaire by phone. NIOSH will then analyze the results of the questionnaire to identify persons meeting certain criteria to participate in the serial spirometry portion of the study. The criteria are as follows: physician-diagnosed current asthma with a work-related pattern of lower respiratory symptoms; or three or more of five lower respiratory symptoms occurring in the last four weeks and having a work-related pattern. We define a work-related pattern as occurring when symptoms are better when away from the school. Up to 20 people in the water-damaged school will be asked to participate in a serial spirometry study and will be trained in the use of an EasyOne® spirometer and given an instruction sheet. The training protocol, instruction sheet, and consent form are provided in Appendices J and E, respectively. The subjects will carry out five sets of blows a day for three weeks during the school semester and three weeks during the summer vacation. Five sessions with at least three blows per session will be performed daily: 1) upon waking before medication; 2) upon arrival at work, or mid-morning on days not at work; 3) before lunch; 4) before leaving work, or before the evening meal on days not at work; and 5) at bedtime. At each trial, the participants will make entries in a diary programmed into the spirometer that includes: the type of session (arising, awake hours, bedtime), location of testing, respiratory symptoms, medication use, and cigarette smoking.

The participants will cradle their spirometer on a modem every night before bedtime and spirometry results will be automatically downloaded to a NIOSH computer using a dedicated toll-free phone number. The EasyOne® spirometry results will be reviewed by NIOSH staff on a daily basis and participants will be contacted by telephone as needed to provide encouragement and further coaching if compliance or quality of the

spirometry falls. To help ensure compliance, participants that successfully complete the serial spirometry will be compensated for their time.

B. NIOSH environmental assessment

Trained NIOSH investigators will conduct dust sampling and complete the semi-quantitative assessment check sheet (see Appendix G). All rooms in the three schools will be sampled in the surveys. We will choose schools with about 50 rooms, giving a total of about 150 rooms for the three schools.

C. Questionnaire and semi-quantitative assessment to be used by school personnel

During the field surveys, we will have a meeting with facility personnel from the three study schools regarding the semi-quantitative assessment tool. We will discuss the following subjects: 1) how to evaluate building dampness using the NIOSH semi-quantitative assessment tool and a moisture meter; 2) how to make summary semi-quantitative dampness indices per room; 3) how to use room-specific dampness indices to identify damp and dry areas, and categorize rooms based on dampness; 4) how to use the results to motivate remediation. After the meeting, we will evaluate the rooms with the facility personnel. After these evaluations we will meet to discuss the results and work to standardize the scoring techniques. NIOSH staff and facility personnel will then carry out independent room evaluations and again meet to discuss the results, using the semi-quantitative check sheet (see Appendix G). During field surveys we will encourage facilities personnel to apply this semi-quantitative assessment tool during their routine inspections.

During the field surveys we will also meet with school nurses from the three study schools regarding using a simple health questionnaire to evaluate employees' health. We will discuss with them on how to administer a questionnaire, and how to compute prevalences of health symptoms and compare the prevalences with dampness index data. School nurses will be encouraged to use a simplified version of the longer NIOSH questionnaire which will contain questions on work history, asthma, cough, chest tightness, shortness of breath, wheeze, nose and sinus symptoms, eye irritation, throat irritation, headache, lack of ability to concentrate, and drowsiness in the past 4 weeks (see Appendix H.3).

D. Power analysis for association between environmental assessment and health outcomes

A power analysis was run for the scores from the semi-quantitative assessment for moisture/mold are positively associated with work-related lower and upper respiratory symptoms in school staff within and across the schools. We used the PASS power and sample size software (Hintze 2006) to estimate the power of a logistic regression of lower respiratory symptoms against the semi-quantitative dampness scores as a continuous variable, using the following assumptions: 1) The response probability at the mean dampness score was 0.123. (This value was calculated using existing data on dampness scores and lower respiratory symptoms from a prior NIOSH study on a water-damaged health care facility.); 2) The odds ratios of interest for the association of symptoms with the scores were 1.5, 2 and 2.5; 3) The alpha level was set at 0.05; 4) The sample size was set at 150 (a sample size of 50 per school)

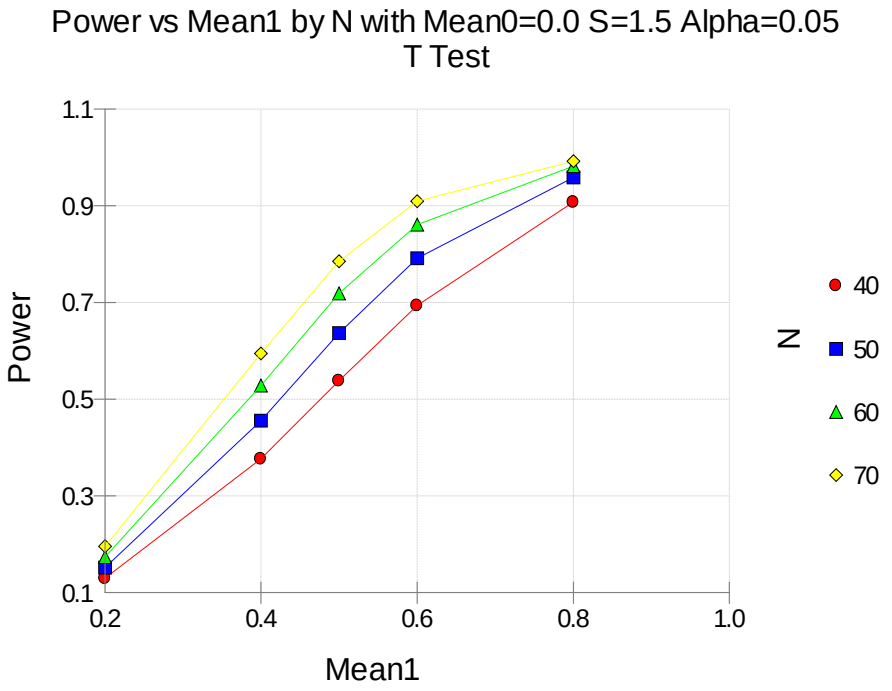
Using these assumptions, there was a power of about 40% to detect an odds ratio of 1.5, 80% power to detect an odds ratio of 2, and 96% power to detect an odds ratio of 2.5.

E. Power analysis to detect differences from intervention

Using the PASS power and sample size software (Hintze 2006), we estimated the power for the difference in the mean number of lower respiratory symptoms from the first survey in 2008 to the last survey in 2010 for occupants of the water-damaged school (School B). We used the one-sample t-test power analysis using the following assumptions:

1) The sample size was set between 40 and 70 participants.
2) The mean number of lower respiratory symptoms (wheeze, chest tightness, shortness of breath, cough, and awakened by breathing difficulty) in the last 12 months before remediation was estimated at 2.2, which was based on a previous evaluation at a water-damaged school. The mean number of lower respiratory symptoms in the last 12 months after remediation was estimated at 1.4, which was found at three schools with very little water damage. The maximum difference before and after remediation was 0.8.
3) The standard deviation was assumed to be 1.5.
4) Alpha was set at 0.05.

Given these assumptions, we estimated that we would have at least 90% power to detect a 0.8 difference for sample sizes between 40 and 70 participants.




## 3. Methods to Maximize Response Rates and Deal with Non-Response

To encourage participation in the questionnaire, we will send a notice to all employees prior to our visit explaining the purpose of the study. A copy of the notice is provided in Appendix F.

To maximize response, we will contact employees by either phone or e-mail to remind them to participate in the questionnaire and spirometry lung function test. If employees are absent or unavailable the week we are on-site, we will contact them afterward by e-mail to participate in the questionnaire over the telephone.

Due to the intensive time commitment of the serial spirometry component of the study, we plan to offer remuneration to all participants that successfully complete the

study. We will compensate participants with gift cards to a local merchant for their time and effort.

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

The following procedures will be done as part of this study:

A. Environmental assessment by NIOSH

The unit of assessment is individual rooms in school buildings. The semi-quantitative scoring sheet that will be used is shown in Appendix G. We will evaluate water stains, visible mold, mold smells, and presence of wet building materials with visual and olfactory observation using semi-quantitative scales for intensity and affected area of ceiling, walls, floors, windows, furniture, unit ventilators, and pipes within a room. We will grade each observation on a scale of 0-3 by location. In addition, we will measure moisture content of building materials using a moisture meter. We will examine the distribution of moisture meter measurements within a school and will group rooms by quartiles with a scale of 0-3 (0: lowest 25%; 1: between 25 and 50%; 2: between 50 and 75%; 3: greater than 75%). A score for each room will be calculated as follows. First, for each of the factors, the score of each location within a room will be summed over the seven locations. Second, the totals for the four factors will be summed. We will use these scores for the rooms in the statistical data analysis.

During the field surveys, we will collect one composite dust sample for each classroom by vacuuming the following areas for two minutes each, using a vacuum sampler: one-square meter of floor on each of two corners by the exterior wall; one square meter of floor in the middle of the exterior wall, one square meter by the door, and one square meter under the teacher's desk. We will store collected dust samples in coolers for shipment, homogenize them using a rotating-motion shaker, and sieve (mesh size: 425 μm) samples within two weeks after the samples arrive at NIOSH. The fine dust will be weighed and split into aliquots for analysis of each analyte within a month. Pending analyses, all dust samples will be stored in refrigerators. The dust will be analyzed for phthalates, β-(1, 3)-D-glucan, ergosterol, endotoxin, peptidoglycan, mycobacteria, total culturable fungi, total culturable bacteria, cat allergen, and dust mite allergens. The motivation for measuring cat and dust mite allergens is that they are known risk factors for asthma and rhinitis.

B. NIOSH questionnaire

The NIOSH questionnaire will be interviewer-administered directly into computers. We will use a questionnaire modified from a previous study conducted in an office building with reported lower and upper respiratory symptoms and asthma. It will include sections on demographic information, work-history, atopy, upper and lower respiratory symptoms, physician diagnoses of respiratory conditions, asthma medication use, nasal and sinus medication use, sick leave, job stress/satisfaction, quality of life, and home water-incursion/mold odor (see Appendix H.1). These questions have been used in prior indoor air quality studies as part of the NIOSH Health Hazard Evaluation program (OMB Approval No. 0920-0260, Expires 11/30/2007).

C. Spirometry

During each year of the study, all staff will be asked to take part in a spirometry lung function test. Participants will be sent a letter with the results and interpretation of the tests (see Appendix I). Please refer Appendix J for the spirometry lung function testing protocol. The spirometry lung function test has been done in several previous

NIOSH Health Hazard Evaluations (OMB Approval No. 0920-0260, Expires 11/30/2007).

D. Serial spirometry

NIOSH will analyze the results of the questionnaire to identify persons meeting certain criteria to participate in the serial spirometry portion of the study. The criteria are as follows: physician-diagnosed current asthma with a work-related pattern of lower respiratory symptoms; or three or more of five lower respiratory symptoms occurring in the last four weeks and having a work-related pattern. We define a work-related pattern as occurring when symptoms are better when away from the school. Up to 20 people in the water-damaged school will be asked to participate in a serial spirometry study and will be trained in the use of an EasyOne® spirometer and given an instruction sheet. The training protocol, instruction sheet, and consent form are provided in Appendices J and E, respectively. The subjects will carry out five sets of blows a day for three weeks during the school semester and three weeks during the summer vacation. Five sessions with at least three blows per session will be performed daily: 1) upon waking before medication; 2) upon arrival at work, or mid-morning on days not at work; 3) before lunch; 4) before leaving work, or before the evening meal on days not at work; and 5) at bedtime. At each trial, the participants will make entries in a diary programmed into the spirometer that includes: the type of session (arising, awake hours, bedtime), location of testing, respiratory symptoms, medication use, and cigarette smoking.

The participants will cradle their spirometer on a modem every night before bedtime and spirometry results will be automatically downloaded to a NIOSH computer using a dedicated toll-free phone number. The EasyOne® spirometry results will be reviewed by NIOSH staff on a daily basis and participants will be contacted by telephone as needed to provide encouragement and further coaching if compliance or quality of the spirometry falls. To help ensure compliance, participants that successfully complete the serial spirometry will be compensated for their time by receiving an honorarium. Participants will be sent a letter with the results and interpretation of the tests (see Appendix I). Please refer to Appendix J for the serial spirometry protocol and instruction sheet. This method has been used in previous NIOSH Health Hazard Evaluations (OMB Approval No. 0920-0260, Expires 11/30/2007).

E. Questionnaire and semi-quantitative assessment to be used by school personnel

During the field surveys, we will have a meeting with facility personnel from the three study schools regarding the semi-quantitative assessment tool. We will discuss the following subjects: 1) how to evaluate building dampness using the NIOSH semi-quantitative assessment tool and a moisture meter; 2) how to make summary semi-quantitative dampness indices per room; 3) how to use room-specific dampness indices to identify damp and dry areas, and categorize rooms based on dampness; 4) how to use the results to motivate remediation. After the meeting, we will evaluate the rooms with the facility personnel. After these evaluations we will meet to discuss the results and work to standardize the scoring techniques. NIOSH staff and facility personnel will then carry out independent room evaluations and again meet to discuss the results. During field surveys we will encourage facilities personnel to apply this semi-quantitative assessment tool during their routine inspections. A copy of this tool is included in Appendix G.

School nurses will be trained on using a simplified version of the research questionnaire which will contain questions on work history, cough, chest tightness, shortness of breath, wheeze, nose and sinus symptoms, eye irritation, throat irritation,

headache, lack of ability to concentrate, and drowsiness in the past 4 weeks (see Appendix H.3). These questions will be a subset of the longer NIOSH questionnaire.

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

The following individuals will be involved in the design, collection and analysis of the data obtained in this study:

Ju-Hyeong Park, Sc.D., M.P.H, C.I.H - Project Officer/Industrial Hygienist, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-5967, gzp8@cdc.gov will be involved in the design, collection and analysis of data.

Jean Cox-Ganser, Ph.D. – Senior Scientist/Advisor, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-5818, jjc8@cdc.gov will be involved in the design, collection and analysis of data.

Sandra White, M.S. – Project Manager/Programmer, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-6094, sqg8@cdc.gov will be involved in the design, collection and analysis of data.

Yulia Iossifova, M.D., Ph.D. – EIS Officer, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-5778, eya3@cdc.gov will be involved in the collection and analysis of data.

Kathleen Kreiss, M.D. – Senior Scientist/Advisor, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-5800, kxk2@cdc.gov will be involved in the design and analysis of data.

Richard Kanwal, M.D. – Medical Officer, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-5932, rnk0@cdc.gov will be involved in the collection of data.

Nancy Sahakian, M.D. – Medical Officer, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-6383, nks6@cdc.gov will be involved in the collection of data.

Kathleen Fedan, B.S. – Statistician, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-6289, kbk1@cdc.gov will be involved in the design and analysis of data.

Brian Tift – Computer Specialist, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-6097, bet5@cdc.gov will be involved in the design, collection, and analysis of data.

Diana Freeland – Health Technician, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-6315, dlf0@cdc.gov will be involved in the collection of data.

James Taylor – Health Technician, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-5736, jet1@cdc.gov will be involved in the collection of data.

David Spainhour – Health Technician, Field Studies Branch, Division of Respiratory Disease Studies, NIOSH, Morgantown WV, 304-285-6311, zwc1@cdc.gov will be involved in the collection of data.