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Impact of Health Department Worker Safety Training on Health Impacts after Sandy

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List of Abbreviations

ANOVA – Analysis of Variance

BRFSS – Behavioral Risk Factor Surveillance System

CDC – Centers for Disease Control and Prevention

CI – Confidence Interval

COPD – Chronic Obstructive Pulmonary Disease

DOH – Department of Health

DOHMH – New York City Department of Health and Mental Hygiene

IRB – Institutional Review Board

NIEHS – National Institute of Environmental Health Sciences

NIOSH – National Institute for Occupational Health and Safety

NYC – New York City

OR – Odds Ratio

PPE – Personal Protective Equipment

SES – Socioeconomic Status

VIF – Variance Inflation Factor

Abstract

Background and Significance: In New York City (NYC) mold damage and other flood-related contamination has been a significant concern among the public, homeowners, and public health agencies. Following Hurricane Sandy, due to the overwhelming demand for restoration of water damage in homes, lay persons who had no previous experience remediating homes began ad hoc reparations to residential buildings and were exposed to mold, asbestos and other contaminants. The New York City Department of Health and Mental Hygiene (DOHMH) saw the immediate need to educate the "do-it-yourself" public, along with volunteers, in proper safe work practices for handling contaminated debris and using basic personal protective equipment (PPE). Over 70, 1 hour and 3 hour trainings were conducted on behalf of the DOHMH across the City of New York. Little is known about the effectiveness of an environmental and occupational hazards education program for a lay workforce following a disaster. It is essential to the science of public and environmental health to understand how training could serve as a prevention strategy for occupational illness following a disaster.

Specific Aim 1. Characterize the specific distribution and determinants of illness and injury among laypersons and volunteers assisting in the remediation of homes flooded and damaged during Superstorm Sandy.

Specific Aim 2. Evaluate the effectiveness of health department worker safety training to lay persons and volunteers in reducing the incidence of illness and injury due to exposure to environmental hazards.

Methods: A field comprehensive survey of 544 homeowners and volunteers who performed mold remediation activities and participated in NYC Department of Health sponsored worker safety training programs was conducted to determine possible exposures and health effects. In addition, a control group of homeowners and volunteers who performed remediation activities but received no worker safety training were also surveyed and the distribution and determinants of physical and mental health outcomes were compared.

Results: 429 completed surveys were collected and over 61 statistically significant associations between occupational and environmental exposures and symptoms of illness were identified. Prior research on the relationships between the exposure to mold and the development of various symptoms was replicated in our cohort. Although symptom prevalence was moderate, rates of self-reported diagnosed illness in the cohort were low. The illness that affected the highest number of participants was depression (6.5%). There were few significant differences in rates of illness between cases and controls however, safe work practices were slightly better in the trained group.

Conclusions: Attempting to educate, train and provide the best information on how to provide personal protection and how to safely remediate potential hazards can undoubtedly be an effective public health intervention. However, just-in-time training should be supplemented with pre-disaster public information on basic safe work practices and personal protection in widely disseminated form. Ideally, health departments would offer regular training programs that allow for the communication of information and the hands-on practice necessary for more effective learning. When combined, this educational strategy may have the best opportunity to minimize recovery-related environmental exposures among the public following a disaster.

Significant (Key) Findings

Specific Aim 1. Characterize the specific distribution and determinants of illness and injury among laypersons and volunteers assisting in the remediation of homes flooded and damaged during Superstorm Sandy.

Analysis of job tasks allowed investigators to understand where significant occupational exposures may be occurring in this cohort. Removing water damaged insulation was associated with development of a cough, OR 2.74, CI 1.61, 4.66, or nasal congestion OR 1.82, CI 1.08, 3.08. Removing water damaged carpeting was linked to increased complaints of nasal congestion, OR 2.08, CI 1.22, 3.55, severe headache or migraine, OR 2.62, CI 1.38, 4.96, or extreme tiredness OR 1.94, CI 1.11, 3.39. Additionally, individuals who reported removing water damaged wood or plywood building materials from a home were associated with development of a skin rash, sore or irritation that lasted more than 3 days 2.42, CI 1.18, 4.97.

Exposure to household environmental contaminates resulted in some of the strongest associations with illness. Those who indicated that lead or lead paint was in the home were at increased risk of developing a cough, OR 2.81, CI 1.49, 5.27, excessive fatigue, OR 2.14, CI 1.17, 3.92, and a skin rash OR 3.05, CI 1.55, 6.02, compared with homes without knowledge of a lead hazard. Other contaminates related to symptom development included those who reported the use of pesticides in the home from approximately 3 months before Sandy until 6 months after. These respondents were associated with increased risk of the development of a skin rash, sore, or irritation that lasted 3 days or more OR 2.16, CI 1.25, 3.73. Furthermore, in households reporting the presence of raw sewage in their home or residence following Sandy there is an increased likelihood of being diagnosed with asthma, OR 6.42, CI 1.29, 31.85, (n=11), or other respiratory problems, OR 5.11, CI 1.78, 22.16, (n=11).

When evaluating occupants of homes with a known history of mold there was an association with increased likelihood of experiencing wheezing OR 1.94 CI 1.24, 1.38, shortness of breath OR 2.17, CI 1.41, 3.34, nasal congestion OR 2.05, CI 1.38, 3.37, and excessive fatigue OR 3.2, CI 2.09, 4.90. Also, it was determined that in individuals who indicated a history of known mold in the home, they were more likely to seek out professional mental health treatment than in households without previous mold presence, OR 2.19, CI 1.33, 3.63.

Mental health outcomes were determined to be significant in our cohort with depression as the most reported diagnosed illness among respondents. Women were found to seek out mental health treatment more often than men who live in homes with mold contamination, OR 1.79, CI 1.04, 3.10. We have also found that this is the case in the combined cohort, with individuals who indicated a history of known mold in the home, in general, are more likely to seek out professional mental health treatment than those without mold in their homes, OR 2.19, CI 1.33, 3.63. A large association was observed in individuals whose exposures have caused symptoms of wheezing, OR 4.73, CI 2.80, 8.05, eye irritation OR 3.62, CI 2.17, 6.06, or excessive fatigue, OR 4.79, CI 2.84, 8.09 and their increased likelihood to seek out treatment for mental health issues following Sandy. Many of these findings are consistent with prior studies in the published literature and are discussed in the scientific report.

One observation that was determined to be significant in the development of both symptoms and diagnosed illness was related to the use of non-professional community or volunteer organizations to perform remediation activities in the home. Households that used these community groups were at increased risk of developing symptoms of wheezing and diagnosis of respiratory illness following Sandy (OR 2.26, CI 1.32, 3.78 and OR 6.5, CI 1.16, 36.58, n=13).

When considering an individual's self-reported overall health status, individuals who reported higher overall health status prior to Sandy, were associated with several (protective) lower likelihoods of developing symptoms of illness following Sandy. These include wheezing OR 0.68, CI 0.55, 0.84, shortness of breath OR 0.59, CI 0.48, 0.72, eye irritation OR 0.76, CI 0.63, 0.92, nasal congestion OR 0.77, CI 0.63, 0.92, excessive fatigue OR 0.77, CI 0.64, 0.93, and skin irritation OR 0.67, CI 0.52, 0.85. In contrast, level of smoking status results in several increased associations with health outcomes. These include likelihood of reporting wheezing OR 1.50, CI 1.19, 1.89, shortness of breath OR 1.54, CI 1.23, 1.94, or nasal congestion OR 1.32, CI 1.05, 1.64.

Specific Aim 2. Evaluate the effectiveness of health department worker safety training to lay persons and volunteers in reducing the incidence of illness and injury due to exposure to environmental hazards.

The effectiveness of the New York City Department of Health and Mental Hygiene sponsored training programs was evaluated based on the assumption of a lower rate of post-Sandy related illness and injury among cases than controls. In addition, effectiveness could be demonstrated by an increase in compliance with the utilization of appropriate PPE and observance of safe work practices while engaging in remediation activities.

There does not appear to be a clear finding of reduced rates of illness or injury among cases compared with controls. In fact, cases had an increased likelihood of reporting symptoms of nasal congestion compared with controls, OR 1.47, CI 1.09, 2.40. Additionally, if we look at the rates of reported illness among the cohort after Sandy, we find cases reported significantly more diagnosed respiratory illness post-Sandy than controls, 50.0% vs. 22.6%, $p<0.050$.

In terms of job tasks related to home remediation, cases were more likely to assist neighbors, family or friends in the remediation, reconstruction, remodeling or mucking and gutting of homes or businesses impacted by damage from Hurricane Sandy, OR 2.12, CI 1.40, 3.20. Furthermore, cases were more likely to have been a member of a volunteer group or organization that assisted in the remediation, reconstruction, remodeling, or mucking and gutting of homes or businesses impacted by damage from Sandy, OR 3.17, CI 1.81, 5.57. Cases were also more likely to report removing water damaged furniture from homes, OR 1.82, CI 1.03, 3.22.

As related to safe work practices and appropriate use of PPE, controls had a higher rate of reporting using toxic and hazardous chemicals to clean household mold damage. Specifically, nearly 21% of controls reported using a mixture of bleach and ammonia to clean their homes. This was a significantly higher percentage than the 9% of cases that reported using the same mixture ($p<0.015$). Additionally, controls reported using water alone, with no anti-fungal agent added, when performing remediation activities compared with cases (43.5% vs. 30.2%, $p<0.039$). These two examples of safe work practices are not substantial in magnitude or impact but may indicate some retention of training content related to the appropriate use of cleaning agents for mold remediation.

Scientific Report

Background

During response and recovery activities following a hurricane or other natural or manmade disaster, workers and volunteers are exposed to a number of single or complex mixtures of contaminants and environmental hazards including mold, chemical hazards, physical and social stressors. While numerous surveillance, health hazard evaluations, research studies, and guidance documents have been developed following previous hurricanes and public health disasters, including Rita (1997), Floyd (1999), and Katrina (2005), gaps in exposure data and associations with health effects (physical and mental), protective equipment and strategies, and effective training of emergency response personnel and volunteers exist.

Superstorm Sandy in the City of New York

The storm path of Hurricane Sandy exposed over a million residents of New York and New Jersey to the destructive impacts of wind and water, and claimed at least 97 lives. The storm surge for Hurricane Sandy hit NYC on October 29, 2012. With tropical storm force winds and record storm surge, nearly 9,000 homes in NYC were seriously damaged or destroyed; thousands more developed mold following inundation of seawater or sewage backup. NYC and other coastal urban cities are vulnerable to substantial public health impacts from such natural disasters because of their low elevation above sea level and the high population density. Hurricane Sandy's impact in NYC illustrated this, with substantial overlap between areas with a high density of residential buildings and flooding. Further complications of Hurricane Sandy included loss of electrical power to 800,000 New Yorkers (in some areas for several months) and impaired public transportation, severely limiting timely remediation efforts. Domestic mold contamination was one of the greatest concerns for public health officials and one of the most common and serious complaints of residents in the aftermath of Hurricane Sandy.

Environmental Hazards during Hurricanes

Typically, injury and infectious diseases are the leading causes of morbidity and mortality following disasters. When natural disasters impact an area, there are countless ways toxins and hazardous substances can enter the environment through mechanisms such as spilled fuel, breeched containment vessels, introduction of household and commercial/industrial hazardous waste into flood waters, etc. It is inherently difficult to attempt to trace back each contaminant to its source and often a slurry of contamination can be forced into residential and commercial settings causing various types of damage and exposing recovery and remediation workers to unknown contaminants during post-disaster rehabilitation activities.[1-3]

Vulnerability of Volunteer Workforces

Volunteers and community members are often the first people to offer help and assistance following a disaster, especially in the setting of natural disasters where the needs for assistance outnumber the number and availability of professional responders. This is particularly true in the post-natural disaster environment where well-intended community members want to help their neighbors who are severely affected by the storm. This need to help and offer assistance is seen time and time again through the offering of assistance and help from people far beyond the geographic boundaries of the disaster. Often, community groups will organize themselves in a grass-roots or ad hoc fashion and begin to "deploy" to affected areas to offer assistance. Many times, although well-intended, these convergent volunteers lack the knowledge, skills or experience to work in austere or hazardous conditions, and lack the

appropriate personal protective equipment (PPE) to protect themselves in a contaminated environment.[4-5] This remains true among more established organizations that are well-organized and have a track record of offering humanitarian assistance. This has been demonstrated throughout the literature following all types of disasters including hurricanes Katrina and Rita, and following the World Trade Center attacks in September 2001.[1-7] The resulting volunteer "surge" workforce is now particularly vulnerable to injury and illness in the post-disaster environment and is difficult to manage and account for due to the informal nature of volunteerism.

Scientific knowledge gained from Hurricanes Katrina and Rita

Hurricanes Katrina and Rita caused catastrophic damage to homes in the Gulf Coast during 2005. Following this disaster, several scientific studies examined exposure in homes damaged by these storms and corresponding health effects. The findings from these studies contributed to the understanding about domestic exposure and adverse health outcomes in damaged, but occupied residences following a hurricane.[8] In particular these studies suggest that the severe water damage caused by Hurricanes Katrina and Rita lead to significant presence of environmental contamination.[8-11] An important difference between the impact of hurricanes Katrina and Rita in New Orleans and hurricane Sandy in NYC is that New Orleans residents typically relocated during the storm and did not return to their homes until after remediation was complete (if at all), while a substantial portion of NYC residents remained present in a flood or mold-damaged home or quickly returned to water and/or mold damaged homes.

In addition to the presence of environmental contamination in homes, there have been several studies documenting a variety of occupational safety and health concerns among the volunteer workforce during Hurricane Katrina. One study by Cummings, et al, evaluated the public's proper donning of N95 respirators for the purposes of mold remediation. Their results showed that only 24% of lay persons were able to donn N95 respirators properly, suggesting interventions be designed to increase the safety of this lay workforce.[6] A study by Rando and colleagues following hurricane Katrina in New Orleans, showed that among persons performing "do-it-yourself" type restorations of residential mold contamination, there was an association with moderately adverse effects of respiratory health.[3] Additionally, a study conducted by the University of Northern Colorado on volunteer disaster relief workers following Hurricanes Katrina and Rita, showed an increase in acute stress reactions and mental health outcomes.[7]

Specific Aims

This study had two linked specific aims:

Specific Aim 1. Characterize the specific distribution and determinants of illness and injury among laypersons and volunteers assisting in the remediation of homes flooded and damaged during Superstorm Sandy.

Specific Aim 2. Evaluate the effectiveness of health department worker safety training to lay persons and volunteers in reducing the incidence of illness and injury due to exposure to environmental hazards.

Through these fundamentally linked aims we were able to describe the nature of illness and injury that was reported in this New York City population, as well as the work practice precautions that were taken, and how a "just-in-time" worker safety training program sponsored by the City health department affected health outcomes in this population**.**

Methodology

Study Design

This study was designed by the principal investigator Dr. Michael J. Reilly in collaboration with his co-investigator Dr. David Abramson at New York University and with the assistance of Christopher D'Andrea and Maureen Little at the New York City Department of Health and Mental Hygiene. The survey instrument was developed by Drs. Reilly and Abramson with the assistance of Dr. Jaishree Beedasy at Columbia University. The research methodology described was approved by the Institutional Review Boards at New York Medical College, Columbia University and the New York City Department of Health and Mental Hygiene (NYC DOHMH).

This study is an overall cross-sectional design utilizing a detailed survey instrument to measure period prevalence of disease and disease indicators along with possible exposure variables in a defined population of individuals directly impacted by Hurricane Sandy in the City of New York in the fall of 2012. This study uses a purposeful sampling strategy based upon a sampling frame of 544 eligible individuals who participated in one of 70 "just-in-time" mold and worker safety training programs sponsored by the New York City DOHMH following Hurricane Sandy and who "opted-in" to be contacted for follow-up by the Department of Health. From this frame subjects were contacted and a "case" group was identified comprised of Sandy affected homeowners and volunteers who received training on safe work practices for remediating damaged homes. For the purposes of determining if the worker safety training provided by the health department in minimizing injury or illness following the storm, the "case" group represents those individuals who were "exposed" to the training program and "controls" were not.

Controls were geographically matched to cases to standardize the collective impact of Hurricane Sandy on the study subject. For each completed survey by a respondent in the "case" group, a non-trained "control" was identified by one of two methods. When possible the "nearest neighbor" method was used to select an eligible control based on the address of the respondent. The case's address was geocoded and an open source records search or the purchase of a marketing list would generate a call list of the nearest neighbors to the case for possible recruitment as a control. The second method, which proved more efficient, was the use of Census block groups to obtain marketing call lists matched to the case's address and yield more possible eligible households to serve as a neighborhood-level control. Using the census block group gives us a "whole neighborhood" approach to matching as opposed to a "nearest neighbor". Both still match based on geographic proximity, however the latter method allows for greater success in identifying controls who actually complete a survey.

Recruitment

Initial case recruitment was based on a list of eligible study participants provided by the New York City Department of Health and Mental Hygiene. A member of the research team would make phone calls to eligible subjects and read a standardized recruitment letter approved by the IRB. If a subject consented to participate, consent was obtained via phone through a waiver of written consent, and an appointment was scheduled with the participant to complete the 40-minute phone survey with a trained interviewer. If contact could not be made by phone, subjects were mailed a letter with a self-addressed stamped envelope, a registration form and instructions that included a phone number, website and e-mail address to register and schedule a time for a phone interview. After interviews were scheduled, if the phone number provided by the subject was not answered after six attempts, a home

visit was conducted by a trained member of the field interview team. If contact was made during a home visit, the participant was able to complete the survey at that time or reschedule a telephone-based interview. All participants who completed a survey either by phone or in-person were given a gift card with a $25 incentive.

Controls were recruited by phone exclusively through the purchase of marketing mailing lists. Controls were identified and matched to a Census block group following the completion of a survey by a member of the case group. Calls were made to the Census block group mailing list in a systematic fashion by a professional phone survey company and the first eligible subject on the list to consent to complete the survey became the identified control. Incentives were similarly given to all controls after the completion of a survey.

Sample Size Determination

We determined the sample size to detect differences in the proportion of respondents who reported illness or injury while performing remediation activities in a non-professional role after Hurricane Sandy, comparing individuals who received training by the Department of Health on safe work practices with those who did not receive training. To determine the effect size we assumed that the experience of those exposed to the effects of Sandy in NYC would be similar to that of New Jersey, which based on impact, was determined to be less severe than the illness and injury rates of Katrina and Ike. Our calculation was made based on an effect size of 6%, illness rate of 7%, injury rate of 1% and a case-control ratio of 1:1. This is a similar assumption to a companion study being conducted by the co-investigator called the Sandy Child and Family Healthy Study (S-CAFH), funded by the State of New Jersey Department of Public Health and conducted by Dr. Abramson at Columbia University/NYU. The S-CAFH study is a population-level cohort study which aims to assess the impacts of Superstorm Sandy on households in New Jersey. Early data from this study suggest a 7% rate of illness and 1% injury in the New Jersey area which validates the injury and illness assumptions used here.

When calculated using these parameters, the sample size required in order to reach such an effect size in a two-sided test ensuring at least 80% power with a type I error rate of 5% and equal subjects in treatment and control groups, the minimum number of total surveys needed to be completed is 398 (199 cases and 199 controls). Sample size calculation was done using the SAMPSI function in STATA/IC 14 (StataCorp LP, College Station, TX). This study meets that power requirement with an enrolled cohort of 429 (201 cases and 228 controls).

Survey Methodology

The survey instrument consists of 71 questions designed to capture information from respondents regarding pre- and post-disaster demographics, housing, environmental and occupational exposures, overall hurricane impact, remediation work performed, hazards encountered, use of personal protective equipment, mental and physical health, occupational history, co-morbidities, medical treatment received, and current health status**.**

Various sources were consulted when formulating survey items. In addition to considering the study aims, literature on previous hurricanes and coastal storms was consulted for environmental exposure variables of interest, along with information on mold remediation from the National Institute of Environmental Health Sciences (NIEHS).[1-3, 6-7, 11-15] Health related quality of life factors were assessed using select items from the Medical Outcome Study's Short Form 12 (version 2), which yields the mental

component score and the physical component score for mental and physical health status, respectively. Neighborhood characteristic items were partially drawn from Raudenbush and Sampson's "ecometric" assessments, which have been adapted by the investigators and described previously.[14]

The survey was pilot tested among a convenience sample of NYC residents and public health professionals. Feedback on survey items was reviewed by the study team and the instrument was modified prior to IRB submission. No modification of the final survey instrument was required based on feedback from any of the IRBs.

Statistical Analysis

Descriptive statistics are reported for various data points using standard measures of central tendency, numerator distributions and classic tests of hypotheses that have been previously described.[13,16-17] This includes t-tests, ANOVA, and period prevalence. Analytical statistical testing was performed using independent variables in related groups used to predict outcomes. Predictor variables were divided into six categories based on their similarity and relevance for describing an effect. These categories include: Socioeconomic variables; Household variables; Storm impact variables; Occupational exposure variables; Job-related training; Job-related exposures; and Pre-storm health. Health outcome variables were divided into four categories to simplify analysis:

1. Diagnosis of Illness
2. Symptoms of Illness
3. Overall Health Status
4. Mental Health Outcomes

Multivariate regression was performed to determine the relative importance of the grouped independent (predictor) variables on the health outcome variables based on the *a priori* hypothesis of a relationship between certain variables. This was done systematically for each outcome category independently. Statistically significant variables were considered those with a P-value <0.05. A backwards elimination method was used to remove variables from the final model that were not statistically significant. This method has been previously described.[3, 6, 16]

Tests of collinearity/multicollinearity were performed using two methods. The variance inflation factor (VIF) was calculated along with the formal detection tolerance. Collinearity or multicollinearity was determined using a VIF>5 or a tolerance <0.20. The square-root of the VIF was used to describe the effect of collinearity on the standard error. When collinearity was identified, the specific variable was excluded from the model for that regression series.

Individual tests of statistical association were performed using simple, ordinal and interval logistic regression. All variables found to be significantly associated in the multivariate regression models were entered into a logistic regression to determine a maximum likelihood ratio which is reported as an odds ratio (OR) with corresponding 95% confidence intervals (CI). Variables determined to be statistically insignificant (p-value <0.05 or odds ratios with confidence intervals including 1.00), were eliminated from the final analysis.

During the data analysis process certain variables were amenable to simplification as binary or interval variables. Analysis of certain binomial variables (i.e., Male vs. Female, Yes vs. No) were often cluttered with observations that were "Don't know" or "Refused" or "Unknown". Since the magnitude of these additional responses was often insignificant to the analysis, dummy variables were created to allow for

ease of interpretation. When this was performed the "noise" observations were included in the dispositive response. For example, a "Yes or No" response was converted to a "Yes or Not Yes" dummy variable for analysis. This results in a conservative approach in measuring likelihood which acknowledges the inclusion of a few non-responsive observations without overestimation of a likelihood ratio or decreased power from a dropped observation. This approach has been previously described.[19-21]

Data were compiled and basic illustrative tables and figures were created using Microsoft Excel 2010 and Word 2010 (Microsoft, Inc., Redmond, WA). Statistical analysis was conducted using STATA/IC 14 (StataCorp LP, College Station, TX).

Results

Survey Response

Included in the original participant list provided by the NYC DOHMH was contact information for 544 participants that attended sponsored trainings. 283 (52%) of these were excluded due to lack of contact, refusal to participate, unable to consent, returned mailings or subjects who moved from their stated residence. 261 (48%) consented to participate in the study and were scheduled for an interview. An additional 60 (11%) of the participants were excluded because they cancelled their appointments with the interviewers or were unable to be reached after their scheduled appointments. 201 (37%) of the original eligible participants completed surveys and comprised the "trained" case group. 255 "untrained" controls consented to participate. 27 (11%) of the enrolled participants cancelled, were unable to be contacted, or were found to be ineligible and 228 (89%) eventually completed surveys with an interviewer.

Cohort Demographics

In Table 1 below a summary of the socioeconomic status (SES) of the entire study cohort is shown stratified into case and control groups and compared with the demographics of New York City as a whole. When compared to the SES data available from the City of New York, the CDC's Behavioral Risk Factor Surveillance System (BRFSS) Survey and the US Census Bureau, the cohort of homeowners affected by Hurricane Sandy in this study vary in certain categories.[22-25] Statistically significant differences exist between cases and control as they relate to age and ethnicity. T-statistics and p-values were calculated to evaluate differences in the means between both groups. The mean age of a New Yorker is 35.6 years old compared with 57.2 years old for cases and 61.0 years old for controls ($t = 2.63$, $p<0.009$), although it is important to point out that the mean population age for NYC includes persons younger than 18 years of age who were not eligible for our study. Additionally, the population of the City of New York self-identify as 28.6% Hispanic or Latino compared with 16.2% of cases and 8.1% of controls ($t = 2.58$, $p<0.010$).

In addition to socioeconomic status and general demographics certain health status indicators from the survey were able to be compared with disease prevalence among all New York City residents. Table 2 describes three such indicators. The first indicator is the self-reported prevalence of certain chronic diseases and conditions within the cohort. The second indicator is the self-determined assessment of an individual's overall health status after Hurricane Sandy. The third indicator is self-reported smoking status prior to Sandy. Each factor is listed as a rate and a statistical comparison is performed between the rates of the case and control groups. T-statistics and p-values are reported for individual-level variables, ordered variables are reported as Pearson's chi-squared statistic. Background rates of disease, when available, are also listed as reference for the City of New York or New York State.

Although not all categories of illness were able to be compared with rates from the general population, the data used to generate the reported rates was compiled through the New York City DOH Community Health Survey and the Centers for Disease Control and Prevention (CDC), Behavioral Risk Factor Surveillance System (BRFSS), 2011. [22-25]

Table 1: Comparison of Socioeconomic Variables Compared with the Population of the City of New York. [22-25] **T-statistic and p-value represent case and control mean comparison.** * Indicates statistically significant difference.

Variable		City of New York	Total Cohort	Trained (case)	Not Trained (control)	T-test	p-value
Age		35.6 (years)	59.2 (years)	57.2 (years)	61.0 (years)	2.63	p<0.009*
Gender						-1.00	p<0.317
	Male	47.5%	38.8% (166)	41.3% (83)	36.6% (83)		
	Female	52.5%	61.2% (262)	58.7% (118)	63.4% (144)		
Race						0.56	p<0.573
	White	44.0%	65.6% (281)	62.7% (126)	68.3% (155)		
	Black	25.5%	16.4% (70)	17.4% (35)	15.4% (35)		
	Asian/Pacific Islander	12.8%	4.0% (17)	4.5% (9)	3.5% (8)		
	Native American	0.7%	0.2% (1)	0.005% (1)	0		
	Other	17.0%	13.8% (59)	14.9% (30)	12.8% (29)		
Ethnicity						2.58	p<0.010*
	Hispanic or Latino	28.6%	11.9% (50)	16.2% (32)	8.1% (18)		
	Non-Hispanic or Latino	71.4%	88.1% (371)	83.8% (166)	91.9% (205)		
Marital Status						-1.74	p<0.083
	Single, Never Married	44.2%	20.3% (87)	20.9% (42)	19.8% (45)		
	Living with Partner		6.1% (26)	9.0% (18)	3.5% (8)		
	Married	39.4%	49.8% (213)	49.3% (99)	50.2% (114)		
	Separated	3.1%	3.0% (13)	4.0% (8)	2.2% (5)		
	Divorced	7.5%	7.5% (32)	7.0% (14)	7.9% (18)		
	Widowed	5.6%	12.6% (54)	9.0% (18)	15.9% (36)		
	Unknown		0.7% (3)	1.0% (2)	0.004% (1)		
Years of Education						1.20	p<0.232
	Less than High School		6.3% (27)	7.5% (15)	5.3% (12)		
	High School/GED	High School or Higher - 80.1%	32.2% (138)	22.9% (46)	40.5% (92)		
	Technical or Vocational School		4.9% (21)	3.5% (7)	6.2% (14)		
	Associate's Degree		15.4% (66)	18.4% (37)	12.8% (29)		
	Bachelor's Degree	Bachelor's or Higher - 35.0%	20.8% (89)	25.4% (51)	16.7% (38)		
	Master's Degree or Doctoral		18.9% (81)	19.9% (40)	18.1% (41)		
	Unknown		1.4% (6)	2.5% (5)	0.004% (1)		
Annual Household Income						0.65	p<0.516
	Less than $10K	Under $20K	8.2% (35)	8.5% (17)	7.9% (18)		
	$10K - $20K	36.6%	7.7% (33)	8.5% (17)	7.1% (16)		
	$20K - $30K	13.0%	10.8% (46)	10.5% (21)	11.0% (25)		
	$30K - $40K	10.2%	7.7% (33)	7.0% (14)	8.4% (19)		
	$40K - $50K	8.5%	6.5% (28)	7.0% (14)	6.2% (14)		
	$50K - $65K	$50K - $75K	11.0% (47)	12.9% (26)	9.3% (21)		
	$65K - $75K	12.9%	7.0% (30)	5.5% (11)	8.4% (19)		
	$75K - $100K	7.1%	10.8% (46)	12.4% (25)	9.3% (21)		
	Greater than $100K	11.8%	12.4% (53)	11.9% (24)	12.8% (29)		
	Unknown		18.0% (77)	15.9% (32)	19.8% (45)		
Language						0.24	p<0.809
	English	51.2%	92.1% (394)	90.1% (181)	93.8% (213)		
	Spanish	Non-English	3.5% (15)	7.0% (14)	0.4% (1)		
	Other	48.8%	4.4% (19)	3.0% (6)	5.7% (13)		

Two illnesses are noted in the first indicator of self-reported disease diagnosis to have a statistically significant difference between the case and control groups, hypertension and diabetes, which were both more prevalent among controls. Additionally, the second variable of overall health status is significantly different in the case and control groups, with cases reporting higher overall health prior to Sandy than

controls. All other values reported were determined not to have a significant difference between cases and controls.

Table 2: Health Status Indicators Compared with New York City Population

Self-reported Disease Diagnosis	City of New York	Total Cohort	Trained (case)	Not Trained (control)	T-test	p-value
Has a doctor of health professional ever told you that you had…						
Hypertension or High Blood Pressure	28.5%	42.9% (184)	37.3% (75)	47.8% (109)	-2.20	p<0.028*
Diabetes	10.6%	15.2% (65)	11.0% (22)	18.9% (43)	-2.29	p<0.023*
Asthma or a Lung Condition	11.7%	21.0% (90)	20.4% (41)	21.5% (49)	-0.28	p<0.782
Cancer	†	11.2% (48)	12.4% (25)	10.1% (23)	0.77	p<0.442
Heart Condition	†	14.7% (63)	14.4% (29)	14.9% (34)	-0.14	p<0.888
Physical Disability	†	17.3% (74)	15.9% (32)	18.4% (42)	-0.68	p<0.495
Pneumonia	†	11.7% (50)	12.9% (26)	10.5% (24)	0.77	p<0.439
Depression	14.6%	16.1% (69)	16.4% (33)	15.8% (36)	0.18	p<0.860
Chronic Obstructive Pulmonary Disease (COPD)	5.7% (NY State)	7.9% (34)	5.5% (11)	10.1% (23)	-1.77	p<0.078
Problems with your Immune System	†	5.8% (25)	5.0% (10)	6.6% (15)	-0.71	p<0.480

Self-reported Overall Health Status	City of New York	Total Cohort	Trained (case)	Not Trained (control)	$chi^2(3)$	p-value
In general, would you say your health is…					12.58	p<0.006*
Excellent	18.1%	16.9% (72)	17.5% (35)	16.4% (37)		
Very Good	24.9%	23.7% (101)	22.0% (44)	25.2% (57)		
Good	33.8%	33.6% (143)	41.0% (82)	27.0% (61)		
Fair or Poor	23.1%	25.8% (110)	19.5% (39)	31.4% (71)		

Self-reported Smoking Status	City of New York	Total Cohort	Trained (case)	Not Trained (control)	$chi^2(3)$	p-value
Describe your tobacco smoking habits prior to Sandy…					7.06	p<0.070
Never	83.8%	77.1% (316)	81.7% (156)	73.1% (160)		
Occasionally	6.7%	8.1% (33)	4.7% (9)	11.0% (24)		
5 to 15 Cigarettes per day	5.6%	8.8% (36)	8.9% (17)	8.7% (19)		
>15 Cigarettes per day	3.9%	6.1% (25)	4.7% (9)	7.1% (16)		

† - Statistic unavailable

* - Indicates a statistically significant difference in case vs. control groups

Measures of Health Outcomes

Outcome variables as described in the previous section were divided into four groups: 1. Diagnosis of Illness; 2. Symptoms of Illness; 3. Overall Health Status; and 4. Mental Health. Multivariate regression models were created based on a clustering of related predictor variables. Predictor variables were divided into seven categories based on their similarity and relevance for describing an effect. These categories include: Socioeconomic variables; Household variables; Storm impact variables; Occupational exposure variables; Job-related training; Job-related exposures; and Pre-storm health. Each outcome was entered into the model and regressed with each predictor group. Predictor variables and groups are listed in Table 3.

1. Self-reported, Post-Sandy Symptoms of Illness

Subjects were interviewed and asked about a series of symptoms associated with exposure to mold and other environmental contaminants. Participants indicated when they believed the symptoms began, if they were a problem before Sandy, and if they had these symptoms at all in the past month. Symptoms that were evaluated in this study included:

- Cough
- Wheezing or tightness in the chest
- Shortness of breath
- Watery, burning, or itchy eyes
- Stuffy, itchy, or runny nose
- Severe headaches or migraines
- Excessive fatigue or extreme tiredness
- Skin rash, sore, or irritation that lasted more than three days

Table 3: List of Grouped Predictor Variables Used in Analysis

Socioeconomic	Household	Job-related Training	Health Status-related
Age	Rent vs. Own Home	Did Employer Provide Training in:	General Health Status before Sandy
Gender	Length of Time at Residence	Wearing Goggles	Smoking Status before Sandy
Marital Status	Home Evacuated Prior to Sandy	Wearing Gloves	Household Secondhand Smoke before Sandy
Race	Number of Persons in Household	Wearing Protective Clothing	
Ethnicity	Number and Type of Pets in Household Before Sandy	Wearing Respirators	
Primary Language Spoken	Number and Type of Pets in Household After Sandy	Working with Hazardous Chemicals	
Household Income	Known Household Use of Pesticides	Proper Hand Washing Technique	
Highest Level of Education	Known Lead Ever Present in Home	Mold Remediation	
	Known Asbestos Ever Present in Home	Working with Lead Paint	
	Known Mold Ever Present in Home	Working with Asbestos	
	Type of Heating System		
	Presence and Type of Air Conditioner		
	Age of Home		

Storm Impact	Occupational Exposure	Potential Employment-related Exposure
Severity of Damage to Home	Subject Performed Remediation Work Themselves	Employment Status
Loss of Heat	Subject Hired a Contractor	Number of Jobs
Loss of Hot Water	Subject Used a Community or Volunteer Group	Hours per Week
Loss of Electricity	Nature, Type and Frequency of Glove Use	Were any of the Following Conditions Present in the Workplace
Damage from Wind	Nature, Type and Frequency of Mask Use	Dampness
Damage from Flooding	Nature, Type and Frequency of Goggle Use	Visible Mold or Mildew
Level and Location of Flooding in Home	Specific Types of Cleaning Agents Used by Subject	Water Stains
Signs of Flood Damage in Home	Type and Duration of Remediation Work Performed	Condensation
Dampness	Did Subject Volunteer with a Group that Helped with Remediation	Water Damage
Visible Mold or Mildew	Did Subject Assist with the Remediation of a Home not their Own	Humidity
Water Stains		Musty Odor
Condensation		
Water Damage		
Humidity		
Musty Odor		
Presence of Raw Sewage		
If Subject Lived in or Returned to Home during Remediation		

Overall there were 61 statistically significant associations between a predictor variable and the development of symptoms of illness following Sandy. Each category contained predictor variables that were significantly associated with a symptom of illness. Significant findings are described below.

Within the socioeconomic category, gender was associated with increased risk of eye irritation OR 2.16, CI 1.38, 3.37, headaches OR 2.09, CI 1.24, 3.53, or fatigue among women OR 1.68, CI 1.09, 2.59. Primary language spoken and household income were also determined to be significant, however both were negatively associated (protective) for excessive fatigue or extreme tiredness. For those participants who spoke languages other than English or Spanish OR 0.39, CI 0.18, 0.82, and for subjects with higher household incomes OR 0.39, CI 0.18, 0.82, the odds of having these symptoms were lower. The finding

of English-speaking individuals being at potentially high risk for illness is consistent with previously published studies of post-flood respiratory illness among Hispanic and Latino populations. [21]

Within the category containing household-level variables we see several associations between home exposures and health effects. First, the age of the home was protective for several different health outcomes. Homes built after 1970 experienced lower rates of wheezing OR 0.70, CI 0.54, 0.90, shortness of breath OR 0.74, CI 0.58, 0.93, or nasal congestion OR 0.72, CI 0.53, 0.89, than homes built prior to 1970. The type of heating system was also associated with increased risk of symptoms. Households with steam or radiant heating systems are more likely to report a cough than electric or forced hot air systems OR 1.18, CI 1.01, 1.38. Homes with heating systems other than steam or hot air have a higher likelihood of individuals reporting watery, burning, or itchy eyes OR 1.31, CI 1.11, 1.53. Homes with heating systems other than steam, forced hot air or electric are associated with developing excessive fatigue or extreme tiredness OR 1.74, CI 1.06, 2.85, or wheezing following Sandy OR 1.98, CI 1.18, 3.36.

The presence of contaminates in the home environment were strongly associated with potentially adverse health outcomes. The known presence of lead in the home is associated with cough OR 2.81, CI 1.49, 5.27, excessive fatigue OR 2.14, CI 1.17, 3.92, or skin rash following Sandy OR 3.05, CI 1.55, 6.02. The known presence of mold problems in the home is associated with increased likelihood of wheezing OR 1.94 CI 1.24, 1.38, shortness of breath OR 2.17, CI 1.41, 3.34, nasal congestion OR 2.05, CI 1.38, 3.37, or excessive fatigue OR 3.2, CI 2.09, 4.90. Finally, the reported use of pesticides in the home from approximately 3 months before Sandy until 6 months after Sandy was associated with a skin rash, sore, or irritation that lasted 3 days or more OR 2.16, CI 1.25, 3.73.

The group of storm impact variables also yielded associations that were determined to be significant. Households that reported losing heat during or following Sandy have increased likelihoods of developing a cough OR 2.27, CI 1.38, 3.73, or extreme tiredness OR 2.47, CI 1.38, 4.43. Homes that claim damage from the wind have increased odds of developing a skin rash OR 2.30, CI 1.31, 4.01, or excessive fatigue OR 2.11, CI 1.39, 3.20. Individuals whose homes were impacted by flooding on the ground floor are associated with an increased likelihood of cough OR 1.89, CI 1.21, 2.94, wheezing OR 2.03, CI 1.20, 3.44, or development of a headache or migraine in the months following Sandy, OR 2.04, CI 1.18, 3.53. Also, individuals who reported flooding in the basement were more likely to develop a skin rash lasting more than 3 days OR 2.50, CI 1.08, 5.78.

In addition to direct flooding, damage caused by residual moisture in homes was also associated with symptoms. In homes where residents reported the presence of condensation in the interior of the home several types of symptoms were more common, including wheezing OR 2.42, CI 1.45, 4.06, shortness of breath OR 1.93, CI 1.19, 3.15, headaches or migraines OR 1.97, CI 1.16, 3.34, watery, burning or itchy eyes OR 2.14, CI 1.33, 3.45, or nasal congestion OR 1.84, CI 1.18, 2.89. Additionally, individuals who reported a distinct musty odor of mold or mildew showed an increased likelihood of developing a cough OR 1.97, CI 1.23, 3.18.

Occupational exposure variables of interest included homeowners who used a community or volunteer group to help remediate their home. These households reported an increased rate of wheezing when compared to those who did not use volunteer organizations for remediation services, OR 2.26, CI 1.32, 3.78. Using certain cleaning solutions during remediation work was also associated with adverse health outcomes. Using products containing ammonia was associated with an increased likelihood of developing shortness of breath OR 1.97, CI 1.06, 3.66, or excessive fatigue, OR 2.56, CI 1.39, 4.72.

Certain exposures related to specific remediation job tasks also resulted in higher likelihoods of symptom manifestation. Removing water damaged insulation was associated with development of a cough OR 2.74, CI 1.61, 4.66, or nasal congestion OR 1.82, CI 1.08, 3.08. Removing water damaged carpeting was linked to increased complaints of nasal congestion OR 2.08, CI 1.22, 3.55, severe headache or migraine OR 2.62, CI 1.38, 4.96, or extreme tiredness OR 1.94, CI 1.11, 3.39. Lastly, individuals who reported removing water damaged wood or plywood building materials from a home were associated with development of a skin rash, sore or irritation that lasted more than 3 days 2.42, CI 1.18, 4.97.

An individual's previous job-related training was important to consider in order to determine if the subject had any additional worker safety training other than what was provided for in the DOH-sponsored trainings. Individuals who reported previous job-related training in working with asbestos were associated with an increased risk of reporting a cough OR 2.71, CI 1.02, 7.23. Likewise, previous training from an employer on mold remediation was associated with symptoms of excessive fatigue OR 3.05, CI 1.40, 6.63, or a skin rash that lasts more than 3 days OR 2.61, CI 1.02, 6.71.

Many individuals continued to work following Sandy which gave them an opportunity to not only escape a possibly contaminated residence, but for possibility of secondary exposures to indoor air quality contaminates outside their Sandy-affected homes. Individuals who reported employment during the 6 months following Sandy showed a negative (protective) association with wheezing 0.34, CI 0.21, 0.56, and eye irritation OR 0.61, CI 0.40, 0.94. Persons who reported noticing dampness at work were at increased risk for eye irritation OR 2.38, CI 1.11, 5.09. Those who noticed a musty odor of mold or mildew were associated with wheezing OR 2.62, CI 1.16, 5.92, and individuals who reported visible water stains at work were at increased risk for nasal congestion OR 2.23, CI 1.12, 4.44 or developing watery, burning, or itchy eyes following Sandy, OR 2.76, CI 1.35, 5.62.

The final category of predictive factors evaluated were pre-Sandy health status and smoking history. Both variables were significantly associated with post-Sandy health outcomes. For individuals who reported higher overall health status prior to Sandy, this was associated with several (protective) lower likelihoods of developing symptoms of illness following Sandy. These include wheezing OR 0.68, CI 0.55, 0.84, shortness of breath OR 0.59, CI 0.48, 0.72, eye irritation OR 0.76, CI 0.63, 0.92, nasal congestion OR 0.77, CI 0.63, 0.92, excessive fatigue OR 0.77, CI 0.64, 0.93, and skin irritation OR 0.67, CI 0.52, 0.85. In contrast, level of smoking status results in several increased associations with health outcomes. These include likelihood of reporting wheezing OR 1.50, CI 1.19, 1.89, shortness of breath OR 1.54, CI 1.23, 1.94, or nasal congestion OR 1.32, CI 1.05, 1.64.

2. Diagnosis of Illness

Two evaluations of the determinants of post-Sandy diagnosed illness were performed in this cohort. First, all individuals who reported any symptom of an illness were entered into a multivariate regression and compared with those individuals who indicated they were newly diagnosed with a disease following Sandy. Rates of new disease following Sandy are reported in Table 4. Due to the limited number of new cases occurring in this cohort few significant findings were found. However, individuals who complained of nasal congestion were more likely to be diagnosed with a respiratory problem, OR 5.83, CI 1.14, 29.84, (n=14) or pneumonia after Sandy, OR 5.12, CI 1.37, 19.08, (n=14). Additionally, of all the study subjects who were diagnosed with asthma following Sandy (n=16), reported experiencing wheezing after the storm.

A separate multivariate regression was performed on individuals reporting a new diagnosis of illness post-Sandy and the predictor variables in Table 3. This analysis was complicated by a lack of observations which fell well below our required effect size for sufficient power. Several variables were significant in the multivariate regression model for a predictor category but were determined to be statistically insignificant upon individual comparison using logistic regression. There were however several associations that were significant but due to low numbers of observations are not generalizable.

Some examples include individuals who noticed the presence of raw sewage in their home or residence have an increased likelihood of being diagnosed with asthma, OR 6.42, CI 1.29, 31.85, (n=11), or are more likely to develop other respiratory problems following Sandy, OR 5.11, CI 1.78, 22.16, (n=11). All persons diagnosed with asthma following Sandy reported using commercial mold or mildew cleaners in their homes (n=12). Persons reporting pesticide use in their residence were more likely to have a new diagnosis of asthma following Sandy, OR 4.82, CI 1.55, 15.06, (n=10).

Table 4: Rates of Self-reported Diagnosed Illness after Sandy

Self-reported Disease Diagnosis	Total Cohort	Trained (case)	Not Trained (control)	T-test	p-value
Were you diagnosed with this condition AFTER Sandy?					
Hypertension or High Blood Pressure	14.1% (26)	13.3% (10)	14.7% (16)	-0.26	p<0.798
Diabetes	24.6% (16)	18.2% (4)	27.9% (12)	-0.85	p<0.397
Asthma or a Lung Condition	17.8% (16)	22.0% (9)	14.3% (7)	0.94	p<0.349
Other Respiratory Problems	32.7% (16)	50.0% (9)	22.6% (7)	2.01	p<0.050*
Cancer	26.1% (12)	30.4% (7)	21.7% (5)	0.66	p<0.513
Heart Condition	17.5% (11)	20.7% (6)	14.7% (5)	0.62	p<0.541
Physical Disability	18.9% (14)	21.9% (7)	16.7% (7)	0.56	p<0.577
Pneumonia	36.0% (18)	26.9% (7)	45.8% (11)	-1.39	p<0.171
Depression	40.6% (28)	36.4% (12)	44.4% (16)	-0.68	p<0.502
Chronic Obstructive Pulmonary Disease (COPD)	8.8% (3)	9.1% (1)	8.7% (2)	0.04	p<0.971
Problems with your Immune System	36.0% (9)	40.0% (4)	33.3% (5)	0.33	p<0.747
Percentages reflect the proportion of those that were diagnosed AFTER Hurricane Sandy compared with those diagnosed before Sandy					
* Indicates a statistically significant difference in case vs. control groups					

3. Mental Health Outcomes

Mental health outcomes included in this analysis consist of two end points. Self-reported diagnosis of depression or seeking professional treatment for emotional, psychological, or behavioral problems after Sandy. Both survey items were included as outcomes in the multivariate regression of predictor variables listed in Table 3. Significant findings related to mental health outcomes included, women were more likely than men to seek out treatment for mental health issues following Sandy OR 1.79, CI 1.04, 3.10. Those individuals who were diagnosed with depression were more likely to hire professional contractors to perform remediation, OR 6.07, CI 1.47, 25.09, (n=16).

Individuals who indicated a history of known mold in the home were also more likely to seek out professional mental health treatment, OR 2.19, CI 1.33, 3.63. Additionally, persons who had symptoms of wheezing, watery, burning or itchy eyes or excessive fatigue were more likely to seek out treatment for mental health issues, OR 4.79, CI 2.84, 8.09.

4. Overall Health Status

Post-Sandy self-reported health status was measured as an endpoint in the multivariate analysis and only found to be significantly associated with two predictors. Those individuals who rated their health status high pre-Sandy were more likely to report high overall health status after Sandy, OR 5.40, CI 3.02, 9.65. In addition, high post-Sandy health status was negatively associated with cigarette smoking, OR

0.57, CI 0.39, 0.84. These findings are consistent with previous studies that have evaluated the association of indoor air quality contaminates and self-reported health status. [26]

Effectiveness of "Just-in-Time" Worker Safety Trainings

There were few statistically significant differences between the trained vs. untrained groups. In terms of significant rates of illness or symptoms of illness among groups, the only significant health disparity between cases and controls was an increased likelihood among cases to report symptoms of nasal congestion compared with controls, OR 1.47, CI 1.09, 2.40. Also, if we look at the rates of reported illness among the cohort after Sandy, we only see one category where cases may have an increased rate of illness over controls. Other respiratory problems seem to be reported more often by the case group than controls, 50.0% (9) vs. 22.6% (7), p<0.050.

In terms of job tasks related to home remediation, cases were more likely to assist neighbors, family or friends in the remediation, reconstruction, remodeling or mucking and gutting of homes or businesses impacted by damage from Hurricane Sandy, OR 2.12, CI 1.40, 3.20. Furthermore, cases were more likely to have been a member of a volunteer group or organization that assisted in the remediation, reconstruction, remodeling, or mucking and gutting of homes or businesses impacted by damage from Sandy, OR 3.17, CI 1.81, 5.57. Cases were also more likely to report removing water damaged furniture from homes, OR 1.82, CI 1.03, 3.22.

As related to safe work practices and appropriate use of PPE, cases were negatively associated with the use of mixed beach and ammonia as a cleaning agent during clean-up activities when compared with controls, OR 0.40, CI 0.18, 0.85.

The rates of PPE usage in this cohort as a whole are consistent with previous studies on mask and glove use by non-professional residents performing remediation work following Hurricane Katrina. 68.8% of respondents reported always using gloves after Sandy vs. 66% following Katrina; 39.8% reported always wearing a mask following Sandy vs. 45% after Katrina; and 26.8% reported always wearing goggles following Sandy vs. 10% after Katrina. The compliance with eye protection is slightly higher among the Sandy cohort, however our case group reported a lower rate of always using goggles compared with the controls 23.0% vs. 32.6% respectively, although this was not determined to be a statistically significant finding, p<0.332.[6]

Overall, cases reported greater pre-Sandy health status than controls, OR 1.26, CI 1.05, 1.50; And cases were more likely to self-identify as Hispanic or Latino than controls, OR 2.20, CI 1.19, 4.05.

Discussion

There are several interesting aspects of this research that deserve exploration.

In spite of recent research, the health consequences of mold exposure following extensive flooding remain unclear. [27-29] A unique aspect of Hurricane Sandy shown in this study is the impact of the storm on the middle class. Unlike Hurricane Katrina which disproportionally affected families in a lower socioeconomic demographic, numerous families impacted by Sandy were able to return to their homes and in many cases begin remediation and reparation once the storm passed. This resilient population worked immediately and worked tirelessly into the beginning of a Northeast winter to remove potentially contaminated and water damaged materials from their homes and small businesses and

attempt to return things to normal. When their friends, families or neighbors needed assistance, they willingly assisted, possibly putting their health at risk by doing so. The resiliency of a population and the willingness to help others is not unique to Sandy. This mass altruism of neighbor helping neighbor is described as a strength, and an important aspect of the "non-traditional" first response to a disaster by untrained and well-intentioned civilians. [4-5]

In the weeks and months that followed, anecdotal reports of a new illness began circulating among the survivors of Hurricane Sandy who had reported water damage and mold growth in their homes. This condition became known as the "Sandy Cough". A persistent non-productive cough sometimes associated with symptoms of a stuffy, itchy or runny nose and sore throat. This was not the first time the public health community has heard of such a syndrome. Similar reports were common following Hurricane Katrina in New Orleans of a syndrome called the "Katrina Cough".[3] Little evidence is reported in the epidemiologic literature following Katrina that suggests there were any meaningful increases in respiratory illness among healthy persons in the general population beyond reports of these symptoms.[3, 6, 27, 29-30] This was corroborated by the local health authority following Katrina and this was a similar finding of among local health departments in New York following Sandy.

As is well known and described in the literature, fungal exposure associations with disease are typically dose and route dependent and often specific to the immune status of the subject being exposed. [27, 30] Findings of association between exposures to fungal species, including molds, and respiratory or other illness are not common among healthy individuals. [3, 6, 27, 29-30] There do however seem to be associations between exposure to fungal species and certain vulnerable populations.[26-27, 29] Asthmatics, those with chronic illness, people with allergies, children, and the immunocompromised are most susceptible to respiratory symptoms and illness than healthy individuals.[3, 6, 27, 29-30] There have even been studies that report low incidences of illness in severely immunocompromised people performing mold remediation after Katrina.[29] This underscored the variability of responses among exposed individuals exposed to molds.

The results of this investigation are in congruence with previous studies on the symptom prevalence associated with exposure to molds and the lack of an appreciable increase in diagnosed illness as a result of the exposures. There are however several instances where an increased risk of developing symptoms or diagnosed illness were identified in this cohort.

One of the initial findings was that gender disparities exist among exposed persons in this group. Multivariate and logistic regression identified women as more often associated with an increased risk of eye irritation, OR 2.16, CI 1.38, 3.37, severe headaches or migraines, OR 2.09, CI 1.24, 3.53, and excessive fatigue or tiredness, OR 1.68, CI 1.09, 2.59. There were no significant differences between men and women related to how often they performed remediation work ($p>0.416$). Additionally, there were no significant differences in how often women and men wore masks or goggles ($p>0.582$ and $p>0.113$) but there was a difference suggesting women used gloves more often than men ($p<0.038$). A previous study suggests that women exposed to known mold in the home are more likely to experience symptoms of depression than men.[28] This was another finding demonstrated here as women were found to be more likely than men to seek out mental health treatment following Sandy, OR 1.79, CI 1.04, 3.10.

In this study some of the strongest associations were made between the known presence of environmental contaminates in the home and health outcomes which has been supported by previous studies.[1-3, 15] Respondents were asked if they knew there was a presence of lead in the home prior to

Sandy. Those who indicated that lead or lead paint was in the home were at increased risk of developing a cough, OR 2.81, CI 1.49, 5.27, excessive fatigue, OR 2.14, CI 1.17, 3.92, and a skin rash OR 3.05, CI 1.55, 6.02, compared with homes without knowledge of a lead hazard. Other contaminates related to symptom development included those who reported the use of pesticides in the home from approximately 3 months before Sandy until 6 months after. These respondents were associated with increased risk of the development of a skin rash, sore, or irritation that lasted 3 days or more OR 2.16, CI 1.25, 3.73. Furthermore, in households reporting the presence of raw sewage in their home or residence following Sandy there is an increased likelihood of being diagnosed with asthma, OR 6.42, CI 1.29, 31.85, (n=11), or other respiratory problems, OR 5.11, CI 1.78, 22.16, (n=11). However in light of these findings it is important to point out that these findings, although significant, are based on a low number of respondents.

An obvious finding considering the focus of the study was in homes with a known history of mold. In these homes there was an association with increased likelihood of experiencing wheezing OR 1.94 CI 1.24, 1.38, shortness of breath OR 2.17, CI 1.41, 3.34, nasal congestion OR 2.05, CI 1.38, 3.37, and excessive fatigue OR 3.2, CI 2.09, 4.90. Also, it was determined that in individuals who indicated a history of known mold in the home, they were more likely to seek out professional mental health treatment than in households without previous mold presence, OR 2.19, CI 1.33, 3.63. These findings are consistent with multiple other studies of residential mold exposure and findings following Hurricane Katrina. [3, 6, 21, 26-28, 30-32]

Mental health outcomes were determined to be significant in our cohort, which is consistent with literature on findings post-Katrina, and in other assessments of mold-related health effects. [12, 28] We previously mentioned that women were found to seek out mental health treatment more often than men who live in homes with mold contamination, OR 1.79, CI 1.04, 3.10.[28] We have also found that this is the case in the combined cohort, with individuals who indicated a history of known mold in the home, in general, are more likely to seek out professional mental health treatment than those without mold in their homes, OR 2.19, CI 1.33, 3.63. A large association was observed in individuals whose exposures have caused symptoms of wheezing, OR 4.73, CI 2.80, 8.05, eye irritation OR 3.62, CI 2.17, 6.06, or excessive fatigue, OR 4.79, CI 2.84, 8.09 and their increased likelihood to seek out treatment for mental health issues following Sandy. This is similar to findings elsewhere that have pointed out that mold exposure combined with an underlying chronic illness was also often related to the occurrence of depression.[28] In this analysis, individuals who were diagnosed with depression were more likely to hire professional contractors to perform remediation, OR 6.07, CI 1.47, 25.09, (n=16). In a previous study, Shenassa and colleagues describe the importance of an individual's perception of their control over their home regarding mold exposure and suggested that this feeling of control can mediate the effects of depression in this population.[28]

One observation that was determined to be significant in the development of both symptoms and diagnosed illness was related to the use of non-professional community or volunteer organizations to perform remediation activities in the home. Households that used these community groups were at increased risk of developing symptoms of wheezing and diagnosis of respiratory illness following Sandy (OR 2.26, CI 1.32, 3.78 and OR 6.5, CI 1.16, 36.58, n=13). This finding is not particularly well understood. There is a paucity of literature describing similar findings in other natural disasters, however it is possible that organizations that are primarily composed of non-professional workers who are performing tasks that require technical training and in many areas professional licensure, may be less effective in ensuring removal of all traces of contaminated materials from the home. A further explanation may be the presence of several people from a volunteer or community group in the home could result in an increased likelihood of the homeowner remaining present to supervise while the

remediation is ongoing. If the homeowner is not wearing appropriate PPE, even though there is a perceived lower risk because they are not performing the work themselves, this could result in a scenario where a secondary exposure to debris, aerosols and particulate matter could induce symptoms of illness. Additionally, these findings could suggest that individuals who are more susceptible to respiratory illness in some manner are more likely to use community and volunteer groups to assist with remediation activities.

As previously mentioned, the effectiveness of the New York City Department of Health and Mental Hygiene sponsored training programs was evaluated based on the assumption of a lower rate of post-Sandy related illness and injury among cases than controls. In addition, effectiveness could be demonstrated by an increase in compliance with the utilization of appropriate PPE and observance of safe work practices while engaging in remediation activities. There does not appear to be a clear finding of reduced rates of illness or injury among cases compared with controls. In fact, cases were determined to have a higher likelihood of nasal congestion and respiratory illness than controls. It is possible that this is the result of a larger proportion of the case group performing remediation activities than the controls, and consequently having higher exposure risk than the comparison group. This theory would be supported by the increased likelihood of cases to volunteer with community groups and assist neighbors with remediation activities outside their own homes compared with controls. Additionally, cases were found to be significantly more likely to both perform remediation work themselves and more likely to remove water damaged furniture than controls which represents an additional opportunity for exposure. Nevertheless, controls were not found to have increased risk of the development of symptoms or illness compared with cases. In addition, this theory might be refuted by the evidence that suggests there were no significant differences between cases and controls as it relates to the proper use or compliance with PPE including masks and respirators or eye protection, however cases were found to be more consistent with the use of gloves during remediation work.

Although there is no appreciable reduction in injury or illness rates in the trained group, there are some safe work practices that are better among cases than controls. First, controls had a higher rate of reporting using toxic and hazardous chemicals to clean household mold damage. Specifically, nearly 21% of controls reported using a mixture of bleach and ammonia to clean their homes. This was a significantly higher percentage than the 14% of cases that reported using the same mixture ($p<0.015$). Additionally, controls reported using water alone, with no anti-fungal agent added, when performing remediation activities compared with cases (43.5% vs. 30.2%, $p<0.039$). These two examples of safe work practices may indicate some retention of training content related to the appropriate use of cleaning agents for mold remediation.

Limitations

There are several limitations to the methods and findings of this study that should be discussed. There may be the presence of a healthy worker effect in case population. Cases reported higher overall health status prior to Sandy than controls. This was associated with several lower likelihoods of developing symptoms of illness following Sandy. Additionally, controls have higher rates of pre-Sandy chronic illnesses such as hypertension and diabetes which may have limited their ability to perform remediation work. We also found that individuals who reported employment during the 6 months following Sandy showed a negative (protective) association with both wheezing 0.34, CI 0.21, 0.56, and eye irritation OR 0.61, CI 0.40, 0.94 which are strongly associated with the development of mold-related illness.[3, 21, 27, 30, 32] There may also be an element of exposure confounding in individuals who report signs of mold present in the workplace or who work in an industry that requires the individual to work with known hazardous materials. For example, individuals who reported previous job-related training in working with asbestos

were associated with an increased risk of reporting a cough OR 2.71, CI 1.02, 7.23. Likewise, previous training from an employer on mold remediation was associated with symptoms of excessive fatigue OR 3.05, CI 1.40, 6.63, or a skin rash that lasts more than 3 days OR 2.61, CI 1.02, 6.71. These findings may be the result of occupational exposures rather than home remediation-related exposures.

Persons who reported noticing dampness at their workplace were at increased risk for reporting eye irritation OR 2.38, CI 1.11, 5.09. Those who noticed a musty odor of mold or mildew were associated with wheezing OR 2.62, CI 1.16, 5.92, and individuals who reported visible water stains at work were at increased risk for nasal congestion OR 2.23, CI 1.12, 4.44 or developing watery, burning, or itchy eyes following Sandy, OR 2.76, CI 1.35, 5.62. These findings are consistent with prior evidence suggesting link between mold odor and level of mold spores present in the environment and should be considered in confounding the associations with home remediation.[31-32]

Methodologically, there are inherent difficulties in designing an environmental study evaluating exposures a year after the event occurs. From the time funding was awarded, surveys were designed, personnel trained and the team deployed to begin data collection, study subjects were recalling experiences from two years in the past. This introduces a systematic recall bias which may have resulted in misclassification. Study power may also be a concern in this analysis. Although we succeeded in recruiting sufficient numbers of participants to achieve our effect size, the process of multivariate regression and the skip-patterns present in the survey instrument reduced the number of respondents to some survey questions to as few as 9 individuals. Even statistically significant findings with insufficient study power limit the external validity of our results to our defined study population. Finally, multicollinearity is a concern when using multivariate regression. To ensure this was not an issue in our analysis we controlled for and eliminated variables in the multivariate regression models that were determined through VIF or tolerance to be collinear.

Conclusions

The local health department has an important role both before and during a disaster to anticipate and mitigate the potential increases in injury and illness among the affected population. In hurricanes, coastal storms, and flooding incidents that cause significant water damage to residential areas, it is clear that environmental contaminates, including mold, will be a hazard requiring attention. Understanding the most susceptible populations to environmental hazards and attempting to educate, train and provide the best information on how to provide personal protection and how to safely remediate potential hazards can undoubtedly be an effective public health intervention if the training programs can reach the right audiences at the right time. Just-in-time training programs such as the ones developed by the School of Public Health at Hunter College and the University of Medicine and Dentistry of New Jersey, School of Public Health for the NYC Department of Health and Mental Hygiene can be helpful and delivered in a rapid manner to affected populations. However, just-in-time training should be supplemented with pre-disaster, pre-flood or pre-storm public information on basic safe work practices and personal protection in an easy to read and understandable format. Ideally, health departments would offer regular training programs for the community that allow for the communication of information and the hands-on practice necessary for more effective learning to occur. When combined, this educational strategy may have the best opportunity to minimize recovery-related environmental exposures among the public following a disaster.

Translation of Research

The findings of this research study have begun to be translated to different audiences of public health professionals, commissioners of health, healthcare coalitions, physicians and other healthcare professionals, public health students and public health academics and scholars. The mechanisms of dissemination include scientific meetings, grantee meetings, journal manuscript submission, and poster presentations. Our local public health partner, the New York City Department of Health and Mental Hygiene, has planned a dissemination and rollout meeting for all ASPR and CDC grantees conducting research with the City of New York in early February of 2016. This meeting with further focus on our important study findings and highlight them for possible implementation within the largest public health department in the Country.

The findings of this research that are most important for translation include the congruence of findings from Hurricane Sandy that are consistent with environmental and occupational health research from previous hurricanes such as Katrina and Rita. The ability to replicate findings in a study that were observed by researchers 10 years prior in a geographically different area, among a socioeconomic and demographically different population, but that show many of the same associations between exposure and disease and with similar magnitudes is rare. This indicates that the lessons to be learned from this research should be used as a benchmark for the design of effective public health prevention strategies that can be used to mitigate these predictable health effects in future populations exposed to the effects of hurricanes, floods and coastal storms.

Our partnerships on this research project are a major strength and contribute to the ability to translate our findings with others. Our co-investigator is based at New York University and is conducting his own assessment of the health impacts of Sandy on residents of New Jersey with the New Jersey State Department of Health. He intends to use data from our New York City research and compare it with the findings from New Jersey to both strengthen associations and external validity and also identify disparities that could exist and need to be remedied within the region prior to the next hurricane or coastal storm. Additionally, our close relationship with Columbia University has allowed us to collaborate on an ASPR Sandy Supplemental Grant which will sample from our study subjects and further investigate the impact and importance of mold exposure on their manifestation of symptoms and illnesses after Sandy. This allows our research to continue on and will add additional metagenomic data to our dataset with which to further understand environmental exposures following hurricanes and coastal storms.

We have begun and will continue for some time to submit varying aspects of our research findings for presentation at conferences and symposia and for publication in the peer reviewed literature. We have begun to do this already and look forward to being able to present our entire research findings at major conferences and in the literature within the next year. As the principal investigator I would welcome the opportunity to return to the CDC to speak about the important findings of our study.

Public Health Relevance and Impact

The findings of this study will, in many ways, be implemented not only by our local public health partner but potentially by health departments of all sizes throughout the country when designing public health interventions to mitigate environmental and occupational exposures following a natural disaster.

There are few opportunities to conduct research that is not only scholarly but directly informs public health practice designed to impact acute illness and injury. This research will give validity to the content of future pre-event and just-in-time training programs that address the exposure to environmental contaminants following a disaster or in the remediation of mold in all applications.

The finding that the training programs utilized in this study did little to minimize rates of illness among trained persons in our cohort does not render the training materials ineffective. It allows us to provide our public health partner, and the academic partners at the Schools of Public Health that helped create this training program, with an evidence-based roadmap to revise and enhance future curricula. Additionally, future public information materials that can be disseminated prior to a disaster can incorporate information from this study to target specific vulnerable populations and environmental health hazards of interest. Both of these tools allow the public health educator to easily adapt scientific findings into educational materials that will be relevant not only for hurricanes but for all natural disasters.

Our findings also suggest that community groups and volunteer organizations that provide assistance with remediation of contaminated homes may wish to evaluate their training programs and work practices to ensure their services are effective in eliminating environmental hazards from homes. Understanding that homes in which volunteer groups conducted remediation efforts experienced higher rates of illness might indicate a previously undetected problem with the quality of these services. If we can increase awareness among these organizations that this is a concern, then possibly we may be able to minimize excess illness in future responses to disasters.

When considering the impact of this research on the public, it is important to note that the subject of “Sandy Cough” and the perception and anecdotal reports of a wide-spread and pervasive illness is a serious and politically sensitive topic in the New York and New Jersey area. There is a perception among many in the New York City area that the health consequences of disasters are not adequately addressed by the government or public health agencies. Given the issues surrounding the exposure of residents to toxic dust from the World Trade Center attacks, the increased morbidity and mortality and the ultimate lack of specificity of exposures, public trust is low as it relates to syndromes like “Sandy Cough” and often there is a perception that the public is being misled by public health authorities. This study confirms the existence of a cough and shows the analogy of this symptom to a similar phenomenon in New Orleans following Katrina. The scientific confirmation of symptoms without a “smoking gun” cause or better understanding as to why or how this condition occurs could be potentially frustrating to the general public. This underscores the importance of risk communication as a public health professional and how being able to explain scientific concepts such as an immunologically-mediated hypersensitivity to mold or other determinants of indoor air quality, is an essential skill in the appropriate dissemination of these research findings to the public or through the media.

An additional area of public health relevance is in the use of our study and data as hypothesis-generating research. Future studies of occupational and environmental exposures following hurricanes and coastal storms may reference this study when designing their investigation. Being able to inform future research by pointing out new or unique findings is significantly impactful in contributing to environmental health science.

Publications, Presentations and Media Coverage

Oral Presentations

1. Environmental Health Effects of Hurricane Sandy on Non-traditional Responders, 4th Annual National Healthcare Preparedness Coalition Meeting, San Diego, CA – 12/2/15
2. Impact of Health Department Worker Safety Training on Health Impacts After Sandy, Preparedness and Response Research from Hurricane Sandy Grantee Meeting, New York University, New York, NY – 8/11/15
3. Impact of Health Department Worker Safety Training on Health Impacts After Sandy, Preparedness and Response Research from Hurricane Sandy Grantee Meeting, Centers for Disease Control and Prevention (CDC), Atlanta, GA – 3/26/15
4. Occupational Health Issues among Non-traditional Response Workers Following Hurricane Sandy, American Public Health Association (APHA) Annual Meeting, Philadelphia, PA – 11/19/14
5. Occupational Health Issues among Non-traditional Response Workers Following Hurricane Sandy in New York City, 12th Asia Pacific Conference on Disaster Medicine, Tokyo, Japan – 9/17/14

Poster Presentations

1. Impact of Health Department Worker Safety Training on Health Impacts After Sandy, Preparedness and Response Research from Hurricane Sandy Grantee Meeting, New York University, New York, NY – 8/11/15
2. Protecting Non-Traditional Responders in Resilient Communities from Health Impacts Following Hurricane Sandy, Public Health Preparedness Summit, Atlanta, GA – 4/16/15
3. Impact of Health Department Worker Safety Training on Health Impacts After Sandy, Preparedness and Response Research from Hurricane Sandy Grantee Meeting, Centers for Disease Control and Prevention (CDC), Atlanta, GA – 3/26/15
4. Protecting Non-traditional Responders in Resilient Communities from Health Impacts Following Hurricane Sandy, 12th Asia Pacific Conference on Disaster Medicine, Tokyo, Japan – 9/17/14

Journal Articles

1. Reilly MJ and Abramson D. Distribution and determinants of environmental-related illness among non-traditional responders to Hurricane Sandy. *Disaster Med Public Health Prep*. 2015. In submission.

2. Reilly MJ and Abramson D. Impact of Worker Safety Training for Non-traditional Responders on Occupational-related Illness after Hurricane Sandy in the City of New York. *Environmental Health Perspectives*. 2015. In submission.

Media Coverage

Knott A. A problem in our own backyard. In: Chironian. Valhalla, NY: New York Medical College; 2013(Fall/Winter):2-5.

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Program Director/Principal Investigator (Last, First, Middle): Reilly, Michael J.

Inclusion Enrollment Report

This report format should NOT be used for data collection from study participants.

Study Title: Impact of Health Department Worker Safety Training on Health Impacts after Sandy

Total Enrollment: 428 **Protocol Number:**

Grant Number: 1U01OH010625-01

PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race				
Ethnic Category	**Females**	**Males**	**Sex/Gender Unknown or Not Reported**	**Total**
Hispanic or Latino	34	16	0	50 **
Not Hispanic or Latino	219	146	0	365
Unknown (individuals not reporting ethnicity)	9	4	0	13
Ethnic Category: Total of All Subjects*	262	166		428 *
Racial Categories				
American Indian/Alaska Native	1	0	0	1
Asian	9	8	0	17
Native Hawaiian or Other Pacific Islander	0	0	0	
Black or African American	48	22	0	70
White	162	119	0	281
More Than One Race	2	1	0	3
Unknown or Not Reported	41	15	0	56
Racial Categories: Total of All Subjects*	263	165		428 *

PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)				
Racial Categories	**Females**	**Males**	**Sex/Gender Unknown or Not Reported**	**Total**
American Indian or Alaska Native	0	0		
Asian	0	2	0	2
Native Hawaiian or Other Pacific Islander	1	0	0	1
Black or African American	3	1		4
White	12	6		18
More Than One Race	0	0	0	
Unknown or Not Reported	18	7		25
Racial Categories: Total of Hispanics or Latinos**	34	16		50 **

* These totals must agree.
** These totals must agree.

Materials Available for Other Investigators

1. Manuscript reprints from published articles may be obtained by contacting the principal investigator directly.

2. The survey instrument utilized in this study is available as a PDF file and can be shared by contacting the principal directly.

3. De-identified survey data from this study may be available for students or public health researchers with a current approval from an accredited Institutional Review Board (IRB), after consultation with and approval from the Office of Human Subjects Protection at New York Medical College. Any potential investigator with interest in the dataset should contact the principal investigator directly for information related to release of any study data.

4. The power point slides from the original 1 and 3 hour mold hazard safety awareness training sessions can be obtained by contacting the principal investigator directly.

NEW YORK MEDICAL COLLEGE

RESTRICTED FUNDS
ADMINISTRATION BUILDING, 40 SUNSHINE COTTAGE ROAD VALHALLA, NEW YORK 10595
TEL 914-594-4467 FAX 914-594-4476

January 4, 2016

Centers for Disease Control & Prevention (CDC)
Attn: Brownie Anderson-Rana
Grants Management Specialist
Procurement and Grants Office (PGO)
OD, Environmental, Occupational Health, and Injury Prevention Branch
2960 Brandywine Road, MS E-01, Atlanta, GA 30341

Grant Award No.: 1U01OH010625-01
Project Period: 09/30/2013 – 09/29/2015
Quarter Ended: 09/29/15
NYMC Account No.: 41-259-1

Dear Ms. Anderson-Rana:

Please find enclosed, the quarterly Federal Financial Report (Standard Form 425) for the above referenced grant period.

Should you have any questions pertaining to this report, or should you need further assistance or additional information, please contact me at the above address.

Sincerely,

Ahmet Iris
Manager, Restricted Funds

AI/ca
Enclosures
File

Submit form | Clear Form

FEDERAL FINANCIAL REPORT

(Follow form instructions)

1. Federal Agency and Organizational Element to Which Report is Submitted	2. Federal Grant or Other Identifying Number Assigned by Federal Agency (To report multiple grants, use FFR Attachment)	Page	of
National Institute of Occupational Safety and Health	1U01OH01625-01	1	1 pages

3. Recipient Organization (Name and complete address including Zip code)

NEW YORK MEDICAL COLLEGE: 40 Sunshine Cottage Road, Valhalla, NY 10595

4a. DUNS Number	4b. EIN	5. Recipient Account Number or Identifying Number (To report multiple grants, use FFR Attachment)	6. Report Type	7. Basis of Accounting
618500128	113099420A1	41 259-1	☒ Quarterly ☐ Semi-Annual ☐ Annual ☐ Final	☐ Cash ☒ Accrual

8. Project/Grant Period From: (Month, Day, Year)	To: (Month, Day, Year)	9. Reporting Period End Date (Month, Day, Year)
September 30, 2013	September 29, 2015	September 29, 2015

10. Transactions	Cumulative
(Use lines a-c for single or multiple grant reporting)	
Federal Cash (To report multiple grants, also use FFR Attachment): N/A	
a. Cash Receipts	$386,834.73
b. Cash Disbursements	$386,834.73
c. Cash on Hand (line a minus b)	$0.00
(Use lines d-o for single grant reporting)	
Federal Expenditures and Unobligated Balance:	
d. Total Federal funds authorized	$564,136.00
e. Federal share of expenditures	$564,136.00
f. Federal share of unliquidated obligations	$0.00
g. Total Federal share (sum of lines e and f)	$564,136.00
h. Unobligated balance of Federal funds (line d minus g)	$0.00
Recipient Share:	
i. Total recipient share required	$0.00
j. Recipient share of expenditures	$0.00
k. Remaining recipient share to be provided (line i minus j)	$0.00
Program Income:	
l. Total Federal program income earned	$0.00
m. Program income expended in accordance with the deduction alternative	$0.00
n. Program income expended in accordance with the addition alternative	$0.00
o. Unexpended program income (line l minus line m or line n)	$0.00

11. Indirect Expense	a. Type	b. Rate	c. Period From	Period To	d. Base	e. Amount Charged	f. Federal Share
	Predetermined	0.61	9/30/13	9/29/15	$135,577.64	$82,702.36	$82,702.36
					$0.00	$0.00	$0.00
				g. Totals:	$135,577.64	$82,702.36	$82,702.36

12. *Remarks: Attach any explanations deemed necessary or information required by Federal sponsoring agency in compliance with governing legislation:*

13. Certification: By signing this report, I certify that it is true, complete, and accurate to the best of my knowledge. I am aware that any false, fictitious, or fraudulent information may subject me to criminal, civil, or administrative penalities. (U.S. Code, Title 18, Section 1001)

a. Typed or Printed Name and Title of Authorized Certifying Official	c. Telephone (Area code, number and extension)
Ahmet Iris, Manager of Restricted Funds	914-594-4459
	d. Email address: Ahmet_Iris@nymc.edu
b. Signature of Authorized Certifying Official: Ahmet T. Iris	e. Date Report Submitted (Month, Day, Year): January 4, 2016
	14. Agency use only:

Standard Form 425
OMB Approval Number: 0348-0061
Expiration Date: 10/31/2011

Description	Month to date	Year to date	Ytd encumbrnce	Annual budget	Annual var
Run date: 12/29/2015 @ 16:30	New York Med	al College			
Bus date: 12/29/2015	REVENUE/EX	NSE WITH ENCUM	RANCE		GRVEXE.L02
Setup by: COLIN AHYOUNG					
----------| Selec	ge |----------	----------	---		
ID type.....: B - Grants Repor	stem				
Report Name....: RVEXE - REVENUE/	WITH ENCUMBRANC				
Account Mask...: B41 25-91 XXX.XX					
Date.....: 09/29/2015					
Adj period.....: No					
Include Attrs..: | | | |	| | | |	| | |			
Exclude Attrs..: | | | |	| | | |	| | |			
Reclass.....: No					
Show pennies...: Yes					
Report zero....: No					
Run date: 12/29/2015 @ 16:30	New York Med	al College		S	..: B41 25-9
Bus date: 12/29/2015	REVENUE/EX	NSE WITH ENCUM	RANCE		GRVEXE.L02
			F	scal year thru	od ending 12
41 25-91 IMPACT OF HEALTH DEPARTMENT					
Description	Month to date	Year to date	Ytd encumbrnce	Annual budget	Annual var
432.00 REVENUE-APPROPRIATIONS REC	0.00	385,752.73	0.00	561,054.00	175,301.27
Total Revenue	0.00	385,752.73	0.00	561,054.00	175,301.27
500.00 SALARIES-GENERAL	0.00	0.00	0.00	66,990.00	66,990.00
502.00 SALARIES-CST	0.00	14,129.78	0.00	0.00	(14,129.78)
503.00 SALARIES-EXEMPT-1	0.00	8,823.74	0.00	0.00	(8,823.74)
504.00 SALARIES-EXEMPT	0.00	3,232.61	0.00	0.00	(3,232.61)
505.00 SALARIES-FACULTY	0.00	47,203.19	0.00	0.00	(47,203.19)
550.00 FRINGE BENEFITS	0.00	12,684.03	0.00	18,087.00	5,402.97
609.00 CONSULTANT & OTHER PROF FEES	0.00	7,631.50	0.00	12,900.00	5,268.50
653.01 TRAVEL-DOMESTIC	0.00	8,504.50	0.00	7,700.00	(804.50)
653.12 AUTO MILEAGE	0.00	150.99	0.00	0.00	(150.99)
655.02 SUBCONTRACT (NO OVERHEAD)	0.00	342,774.00	0.00	342,774.00	0.00
655.11 SUBCONTRACT (OVERHEAD)	0.00	25,000.00	0.00	25,000.00	0.00
758.00 SUPPLIES	0.00	4,899.49	0.00	4,900.02	0.53
800.03 NON-CAPITAL EQUIPMENT	0.00	1,723.79	0.00	0.00	(1,723.79)
908.51 OTHER EXPENSE	0.00	1,594.02	0.00	0.62	(1,593.40)
909.00 OVERHEAD	0.00	82,702.36	0.00	82,702.36	0.00
Total Expenditure	0.00	561,054.00	0.00	561,054.00	0.00

Description	Month to date	Year to date	Ytd encumbrnce	Annual budget	Annual var
Run date: 12/29/2015 @ 16:54	New York Med	al College			
Bus date: 12/29/2015	REVENUE/EX	NSE WITH ENCUM	RANCE		GRVEXE.L02
Setup by: COLIN AHYOUNG					
----------| Selec	ge |----------	----------	---		
ID type.....: B - Grants Repor	stem				
Report Name....: RVEXE - REVENUE/	WITH ENCUMBRANC				
Account Mask...: B41 26-81 XXX.XX					
Date.....: 09/29/2015					
Adj period.....: No					
Include Attrs..: | | | |	| | | |	| | |			
Exclude Attrs..: | | | |	| | | |	| | |			
Reclass.....: No					
Show pennies...: Yes					
Report zero....: No					
Run date: 12/29/2015 @ 16:54	New York Med	al College		S	..: B41 26-8
Bus date: 12/29/2015	REVENUE/EX	NSE WITH ENCUM	RANCE		GRVEXE.L02
			F	scal year thru	od ending 12
41 26-81 IMPACT OF HEALTH DEPARTMENT					
Description	Month to date	Year to date	Ytd encumbrnce	Annual budget	Annual var
432.00 REVENUE-APPROPRIATIONS REC	0.00	3,082.00	0.00	3,082.00	0.00
Total Revenue	0.00	3,082.00	0.00	3,082.00	0.00
653.01 TRAVEL-DOMESTIC	0.00	3,021.71	0.00	3,082.00	60.29
908.51 OTHER EXPENSE	0.00	60.29	0.00	0.00	(60.29)
Total Expenditure	0.00	3,082.00	0.00	3,082.00	0.00

Equipment Inventory Report

This is to indicate that there was no equipment purchased with funds from this grant.

Form Approved Through 10/31/2018
OMB No. 0925-0002

Department of Health and Human Services

Final Invention Statement and Certification

(For Grant or Award)

DHHS Grant or Award No.
1U01OH010625-1

A. We hereby certify that, to the best of our knowledge and belief, all inventions are listed below which were conceived and/or first actually reduced to practice during the course of work under the above-referenced DHHS grant or award for the period

9/30/2013 *original effective date* through 9/29/2015 *date of termination*.

B. Inventions (Note: If no inventions have been made under the grant or award, insert the word *"NONE"* under

NAME OF INVENTOR	TITLE OF INVENTION	DATE REPORTED TO DHHS
NONE	NONE	NONE
(Use continuation sheet if necessary)		

C. Signature — This block ***must*** be signed by an official authorized to sign on behalf of the institution.

Title
Asst. Dean for Research Administration

Typed Name
Charles B. Hathaway, PhD

Signature 

Date
7Jan2015

Name and Mailing Address of Institution
New York Medical College
Administration Building
40 Sunshine Cottage Road
Valhalla, NY 10595